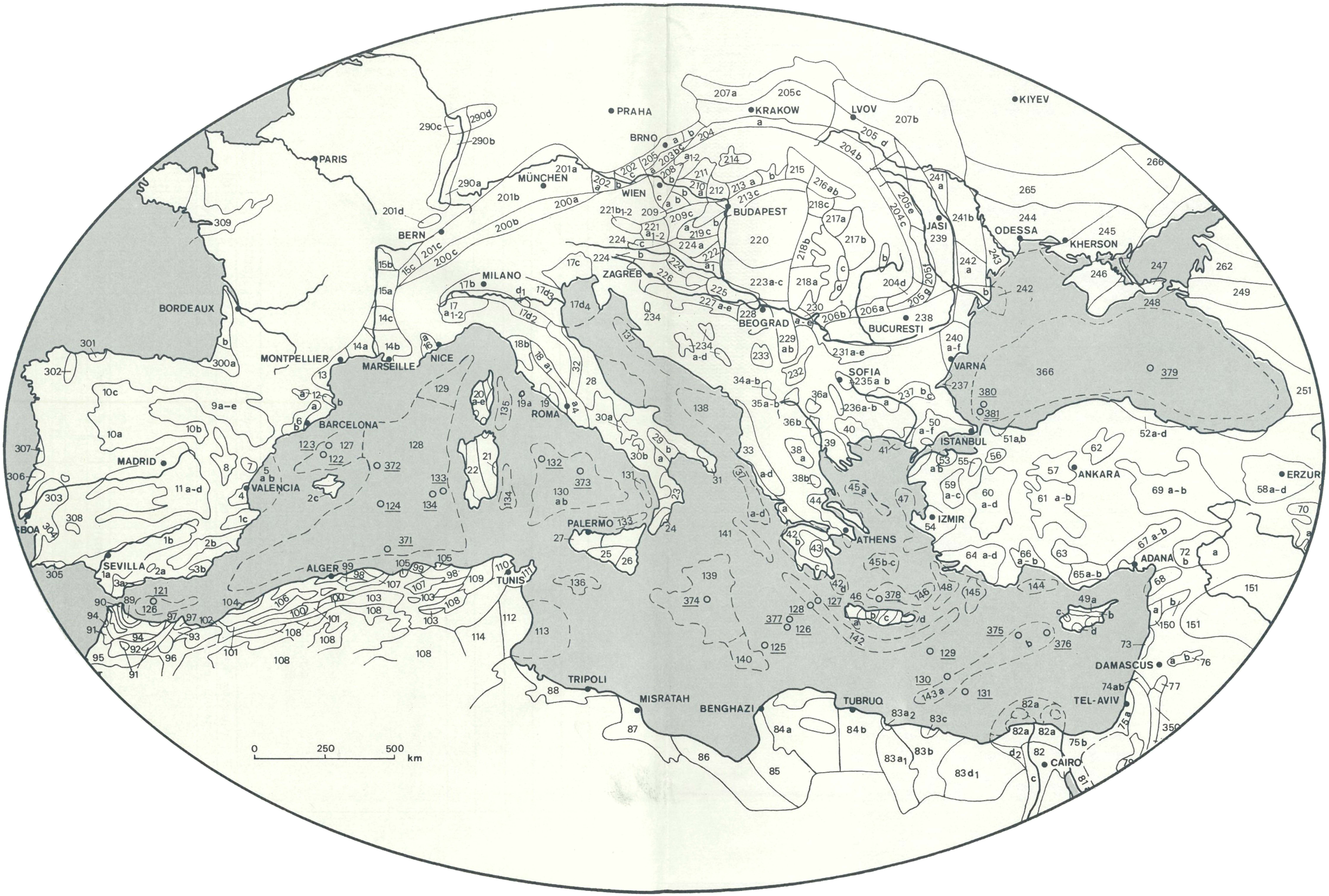

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BARCELONA
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# NEOGENE

OF THE

# MEDITERRANEAN TETHYS AND PARATETHYS

STRATIGRAPHIC CORRELATION TABLES

AND

SEDIMENT DISTRIBUTION MAPS

IUGS
UNESCO
IGCP
No. 25

**Participants of the Final Meeting of IGCP-Project No. 25 – "Tethys – Paratethys Neogene" – in the courtyard of the Castle in Smolenice near Bratislava, Czechoslovakia (September, 1983).**

Left to right: first row: J. E. Meulenkamp (Utrecht), P. Mein (Lyon), R. Tsuchi (Shizuoka), T. Baldi (Budapest), M. Baldi-Beke (Budapest), D. Ray (Calcutta), E. Kojumdgieva (Sofia), E. Luczkowska (Krakow), J. Senes (Bratislava), L. A. Nevesskaja (Moscow), P. Stevanovic (Beograd), E. Georgiades-Dikeoulia (Athens). Second row: L. v. Banda (Hannover), M. Dermitzakis (Athens), I. Cicha (Praha), Fl. Marinescu (Bucuresti), F. Rögl (Vienna), J. P. Suc (Montpellier), F. F. Steininger (Vienna), M. T. Alberdi (Madrid), E. Aguirre (Madrid), G. Hamor (Budapest), G. Demarq (Lyon), E. F. P. Rose (London). Not on the picture: J. Gasparik (Bratislava), M. Kovac (Bratislava), J. Pavlovic (Bratislava), D. Vass (Bratislava), I. Krystek (Brno), L. Berczi (Budapest), J. Halmai (Budapest), A. Jambor (Budapest), M. Boccaletti (Firenze), A. M. Borsetti (Bologna), R. Gelati (Milano), A. Slatzka (Krakow).

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# NEOGENE

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# MEDITERRANEAN TETHYS AND PARATETHYS

STRATIGRAPHIC CORRELATION TABLES

AND

SEDIMENT DISTRIBUTION MAPS

Volume 1

Edited by

FRITZ F. STEININGER

JAN SENES

KARL KLEEMANN

FRED RÖGL

This work was sponsored and presents the results of the
International Geological Correlation Program
Project Number 25 :
**"Stratigraphic Correlation Tethys – Paratethys Neogene"**
**1974–1983**

Project leader :
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Institute for Geology, Slovakian Academy of Science
Bratislava, Czechoslovakia

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# CONTENTS

# PREFACE

The two volumes of the edition "Neogene of the Mediterranean Tethys and Paratethys. Stratigraphic Correlation Tables and Sediment Distribution Maps" are one of the results of the International Stratigraphic Correlation Program, Project No. 25 : "Stratigraphic Correlation Tethys – Paratethys Neogene" organized under the direction of Jan Senes between 1973 and 1983.

This IGCP-Project was endorsed to support the work of the Regional Committee on Mediterranean Neogene Stratigraphy (RCMNS) and followed two main lines:

(1) to help to establish a succession of well-defined Chronostratigraphic Stages for the Mediterranean Tethys the Central Paratethys and the Eastern Paratethys and to bring foreward a better correlation of these Chronostratigraphic Units to each other and to biochronologies, magnetostratigraphy and the radiometric scale.

(2) the compilation of the Stratigraphic Correlation Tables for the Mediterranean Tethys and the Paratethys Neogene Sedimentation Areas.

These Stratigraphic Correlation Tables and the Sediment Distribution Maps cover the area from the Iberian Peninsula in the west to southern Ural–Kazakhstan–Uzbekistan–Turkmeniya in the east, and from Kazan (UdSSR) approximately 56° north latitude to northern Africa and the northern Red Sea in the south. Since the Correlation Tables and the Sediment Distribution Maps should contribute to a better understanding of the evolution of the Neogene of the Mediterranean Neogene Tethys sensu lato the Atlantic entrance areas, crucial North European areas and areas from the Near- and Middle-East: the Indo-Pacific connection to the Mediterranean were also included. A total of 250 Neogene circum-Mediterranean sedimentation areas from 28 countries are treated on 531 Correlation Tables by 232 authors in these two volumes. The distribution of these areas and their numbering is shown on Map 1 in the book-pocket of Volume 1 which also contains the sediment distribution maps (Maps 2 – 10) constructed for nine different time slices through the Neogene showing a generalized distribution of sediments according to their overall facies evolution. Volume 1 is devoted to the stratigraphy used in this edition and to the text and the detailed area maps accompanying the graphical Correlation Tables, the Sediment Distribution Maps, References, Contributors and Indexes. Volume 2 contains the backbone of this edition: the graphical Correlation Tables.

The main aim of this edition is to come up with a more updated inventory of our knowledge on the Neogene circum-Mediterranean sedimentation areas and to provide better data for the future solution of major paleogeographic, geodynamic and industrial key problems in this crucial area. One of the many possible applications of the Correlation Tables is given as an example in this edition: the Neogene Sediment Distribution Maps. Further national and international projects like the IUGS-RDP-Project "Neogene Paleogeographic Map Series of Central and Eastern Europe" hopefully will demonstrate the value of this edition and its necessary continuation in the future for Neogene sientific and industrial research.

The editors

# INTRODUCTION

As a result of plate tectonics a major change affecting the distribution of continents and oceans of the Tethys Area has occurred since the beginning of the Cenozoic. The former Mesozoic Tethys, which existed between the Northern Hemisphere continents and those making up Gondwanaland, started to split into smaller fragments creating new "geosynclines" and seaways. Consequently, as early as in the Palaeogene, the Tethys was divided into two marine realms, separated by the Alpine orogenic belts. The most distinct isolation of these two separated marine realms came into existence at the beginning of the Neogene. The southern marine realm, the Mediterranean Tethys, had direct connection with the Atlantic and Indo-Pacific, whilst the northern realm, the Paratethys, became isolated from time to time from the Mediterranean Tethys respectively the Indo-Pacific and thus also from the world oceans.

These two distinct marine sedimentation areas – the Mediterranean Tethys and the Paratethys – with a rapidly changing facies distribution during Neogene times in the wider area of Europe, Northern Africa and Western Asia were already well known in the course of the last century. The stratigraphic correlation of the different sedimentary basins, the reasons for the changing facies distribution and the connection between these regions in time and space has remained problematic since that time. The aim of the Stratigraphic Correlation Tables was to provide a better data base for the solution of these and other crucial problems within the Neogene of the wider Mediterranean realm.

The **organization** of the Stratigraphic Correlation Tables within IGCP-Project No. 25 was started in 1974 using similar tables and sediment distribution maps from the Central Paratethys as a model. During several meetings a first draft and examples for the graphical tables, the legend to these tables, the text and the form of references, the outline and the numbering system of the sedimentation areas and the state of the art of the correlation of the Chronostratigraphic Stage systems for the Mediterranean, the Central Paratethys and the Eastern Paratethys were elaborated and sent to the national representatives of the project. After several changes and corrections the final model for the tables, the legend and the form of the text with references as well as the configuration and numbering of the sedimentation areas on the map were accepted in 1976 by all national members of the project. Over these national representatives, specialists for specific areas were invited to contribute and construct area by area the specific Correlation Tables. Since several countries of the wider circum-Mediterranean area were unable to participate in the project we are grateful to the following colleagues who volunteered to prepare the Correlation Tables for these otherwise lacking sedimentation areas: F. Baroz, S. Basha, L. Benda, G. Bizon, P. F. Burrollet, I. Cicha, I. El Heiny, A. V. Krasheninnikov, J. Meulenkamp, J. Prazak, O. Spajic and G. Suter.

In 1978 a first version of the Correlation Tables could be presented and distributed for critical reevaluation to the national representatives. At this stage 26 countries participated in the project, and 400 tables had been elaborated by 190 authors. During the RCMNS-Congress in Athens in 1979 a first version of twelve "Sediment Distribution Maps" was presented by F. F. Steininger and F. Rögl.

In January 1980 all originals of the first version of the Correlation Tables were returned to the national representatives with the aim to complete the tables and the text, to add the latest results and to unify the entire material for printing. A deadline of November 1980 was set; the last material, however, was not returned until the end of 1983. Some colleagues have taken the opportunity to correct and unify the material, others not, therefore some tables still represent the state of 1978. The editors did not correct or redraft the tables; the authors themselves are responsible for form and content of tables and text. We also did not succeed in receiving all the addresses of the authors from the national representatives. This second revision was the basis for the compilation of nine final Sediment Distribution Maps presented in the present edition. 28 countries participated officially in this last stage of the project, and the edition deals with 250 Neogene sedimentation areas presented on 531 Correlation Tables by 232 authors. The editing of this heterogeneous material took from 1983 to 1984.

The **compilation** of this edition was done under the following aspects: the sedimentation areas were defined and outlined by the national representatives and their co-workers. Numbers from 1 – 199 were reserved for Mediterranean Tethys Areas; 200 – 239 for Western and Central Paratethys Areas; 240 – 289 for Eastern Paratethys Areas; 290 – 310 for Atlantic and Northern Neogene Areas; 350 – 400 for Indo-Pacific, Near, Middle and Far East Areas. The main numbering follows the overall region (e. g. Mediterranean, Western and Central Paratethys etc.); within this region the numbers are arranged by countries and within the countries they more or less follow geologic-tectonic units. Correlation tables could not be constructed for all numbers of the large regions; within these regions certain numbers therefore remain for future use.

For each sedimentation area a Stratigraphic Correlation Table was requested and if necessary the area was divided into smaller units and a Correlation Table was prepared for each subunit of an area. These subunits bear the number of the area and a subnumber. For areas divided in this way supplementory detailed area maps are provided in the text part of the first volume (see also: List of Detailed Area Maps in the Index of this volume). The authors were asked to prepare a graphical Correlation Table and an explanatory text, with the references cited in the tables and in the text. For this purpose and to unify the work, blank Correlation Table forms were distributed, although not all authors followed the instructions.

The progress in the **correlation** of the Chronostratigraphic Stages within the large area covered by the project was one of the most difficult problems to handle. During preparation of the Correlation Tables (1974 to 1983) a first proposal for a correlation of the regional Chronostratigraphic Stages was circulated using standardized forms of Correlation Tables in early 1977, a second version in late 1978; the problems themselves are discussed in Chapter I of this volume. Since several authors did not change their tables during the second phase of the project according to the proposed correlation scheme, two different versions are contained in this edition.

This edition of the "Neogene of the Mediterranean Tethys and Paratethys. Stratigraphic Correlation Tables and Sediment Distribution Maps" would not have been possible without the help of UNESCO's International Correlation Program and the ever–flexible assistance of E. von Braun, IGCP-Secretary General as well as the late A. Martinsson, Chairman of the IUGS-Commission on Stratigraphy and M. G. Basset, the Secretary General of this commission. M. Stachowitsch, Vienna, read parts of the manuscript.

# I. MEDITERRANEAN TETHYS AND PARATETHYS NEOGENE STAGES AND THEIR CURRENT CORRELATIONS.

Figures 1 – 8

Jan SENES & Fritz F. STEININGER

The wider area of the Mediterranean, Central- and Eastern-Europe was divided as early as the Oligocene into two distinct marine realms: the Mediterranean Neogene Tethys and the Paratethys. The differentiated geodynamic evolution of this area gave rise to an immense variety of ever-changing facies belts and biogeographic and paleogeographic features. These facts are expressed by the difference in the stratigraphic nomenclature and the time scope of the Regional Chronostratigraphic Stage Concepts in usage within these areas. Three Regional Chronostratigraphic Stage Concepts for the Neogene of the Mediterranean Tethys, the Central Paratethys and the Eastern Paratethys were defined at the VI$^{th}$ Congress of the Regional Committee on the Mediterranean Neogene Stratigraphy in Bratislava in 1975 (BERGGREN & al., 1976). Numerous classical stages of European, West Asian and North African Neogene originated in these areas (e. g. Langhian, Serravallian, Tortonian, Sahelian, Messinian, Piacenzian etc. in the Mediterranean Tethys; Helvetian, Vindobonian, Sarmatian, Pannonian, Pontian etc. in the Paratethys); their correlation, however, in most cases remained inadequate and one of the aims of IGCP-Project No. 25 was to help to establish, define and correlate these Regional Chronostratigraphic Stages (see also Preface and Introduction).

One of the major problems during the compilation of the Stratigraphic Correlation Tables for the Mediterranean Tethys and Paratethys Neogene sedimentation areas was to keep pace with the progress made in correlation of these different stage concepts. A first version of such a tentative correlation was distributed to the collaborators in February 1977 (Fig. 1), and the first version of the Correlation Tables was compiled according to this stratigraphic concept. After the distribution of the first version of the Correlation Tables for final corrections, an improved version of a tentative correlation of the stage concepts for the Mediterranean, the Central Paratethys and the Eastern Paratethys was circulated in October 1978 (Fig. 2). All contributors were asked to correct their Correlation Tables in respect to this new correlation version; some followed this advice, others did not improve the correlation of their tables. Since 1978 several improvements, respectively different versions for the correlation between the stage concepts on the one side and biochronology, magnetostratigraphy and radiochronology on the other side were published. Some of these later correlation schemes up to 1985 are given in Figures 3 – 8.

**Figure 3**: Calibration and Correlation of Mediterranean, Paratethys and Continental Stages (PAPP, 1981). During the VII$^{th}$ Congress of the Regional Committee on the Mediterranean Neogene Stratigraphy in Athens in 1979, the late A. Papp discussed an updated version, which was accepted as the recommended correlation scheme by RCMNS.

**Figure 4**: Correlation chart of Neogene biostratigraphic and chronostratigraphic units for the Mediterranean, the Central and the Eastern Paratethys (STEININGER & RÖGL, 1984; see also RÖGL & STEININGER, 1983). Improvements involve a better correlation of the "European Land Mammal Zones" and the Late Miocene and Pliocene of the Central and Eastern Paratethys.

**Figure 5**: Regional Neogene Correlation (BERGGREN, 1984). This correlation summarized the current knowledge on the Neogene in a worldwide sense.

**Figure 6**: Tentative correlation of biochronologies and the Mediterranean Neogene Stages (after "Compilation Charts Neogene Faunal and Floral Changes", SUC (ed.), 1984). During the RCMNS Interim Colloquium "Mediterranean Neogene Continental Paleoenvironments and Climatic Evolution" a series of compilation charts concerned with the succession of mammal associations, relative humidity and temperature changes were published and a tentative correlation of the marine zones and stages according to MEULENKAMP with the continental zones of MEIN respectively AGUILAR & MICHAUX was given. The correlation version shown here in Figure 6 reproduces only the stratigraphic backbone of these climatic charts.

**Figure 7**: Correlation scheme of Regional Stages of Eastern Paratethys, Western (= Central) Paratethys and Mediterranean Tethys (NEVESSKAJA & al. 1984). The most important differences concern the restriction of the Caucasian to the Late Egerian, respectively to the Aquitanian, the correlation of the Tarchanian and the Karpatian, and the position of the Pontian within the Messinian. These new correlations are mainly based on biostratigraphic results and have not been used in the construction of the sediment distribution maps.

**Figure 8**: Neogene geochronology (BERGGREN, KENT & VAN COUVERING, 1985). This latest attempt presents a revised Neogene geochronology based on a best fit to selected high temperature radiometric dates on a number of identified magnetic polarity chrons (within the late Cretaceous, Paleogene and Neogene). This geochronology minimizes apparent accelerations in seafloor spreading. An assessment of first order correlations of calcareous plankton biostratigraphic datum events to magnetic polarity stratigraphy yields the following estimated magnetobiochronology of major chronostratigraphic boundaries: Oligocene/Miocene (mid–anomaly 6C): 23.7 Ma; Miocene/Pliocene (slightly younger than Gilbert/Chron 5 boundary): 5.3 Ma; Pliocene/Pleistocene (slightly younger than Olduvai Event): 1.6 Ma.

The changes to the marine time scale are relatively minor in terms of recent and current usage except in the interval of the middle Miocene, where new DSDP data reveal that previous correlations of magnetic anomalies 5 and 5A to magnetic polarity chrons 9 and 11, respectively, are incorrect. Our revised magnetobiostratigraphic correlations result in a 1.5–2 Ma shift towards a younger magnetobiochronologic age estimate in the middle Miocene. Radiometric dates, correlated to the bio- and magnetostratigraphy in the continental section, generally support the revised marine magnetobiochronology presented here. Major changes, however, are made in marine – non-marine correlations in the Miocene in Eurasia; these indicate African–Eurasian migrations through the Persian Gulf as early as 20 Ma. The 12.5 Ma estimate of the Hipparion datum is supported by recent taxonomic revisions of the hipparions and magnetobiostratigraphic correlations which show that primitive hipparions first arrived in Eurasia and North Africa at ca. 12.5 Ma, with a second wave in the tropics (i. e., India and central Africa) at ca. 10 Ma.

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SUC J P (editor) 1984 Compilation Charts Neogene Faunal and Floral Changes. – Paleobiol. Cont., 14/2, 485–493, Montpellier.

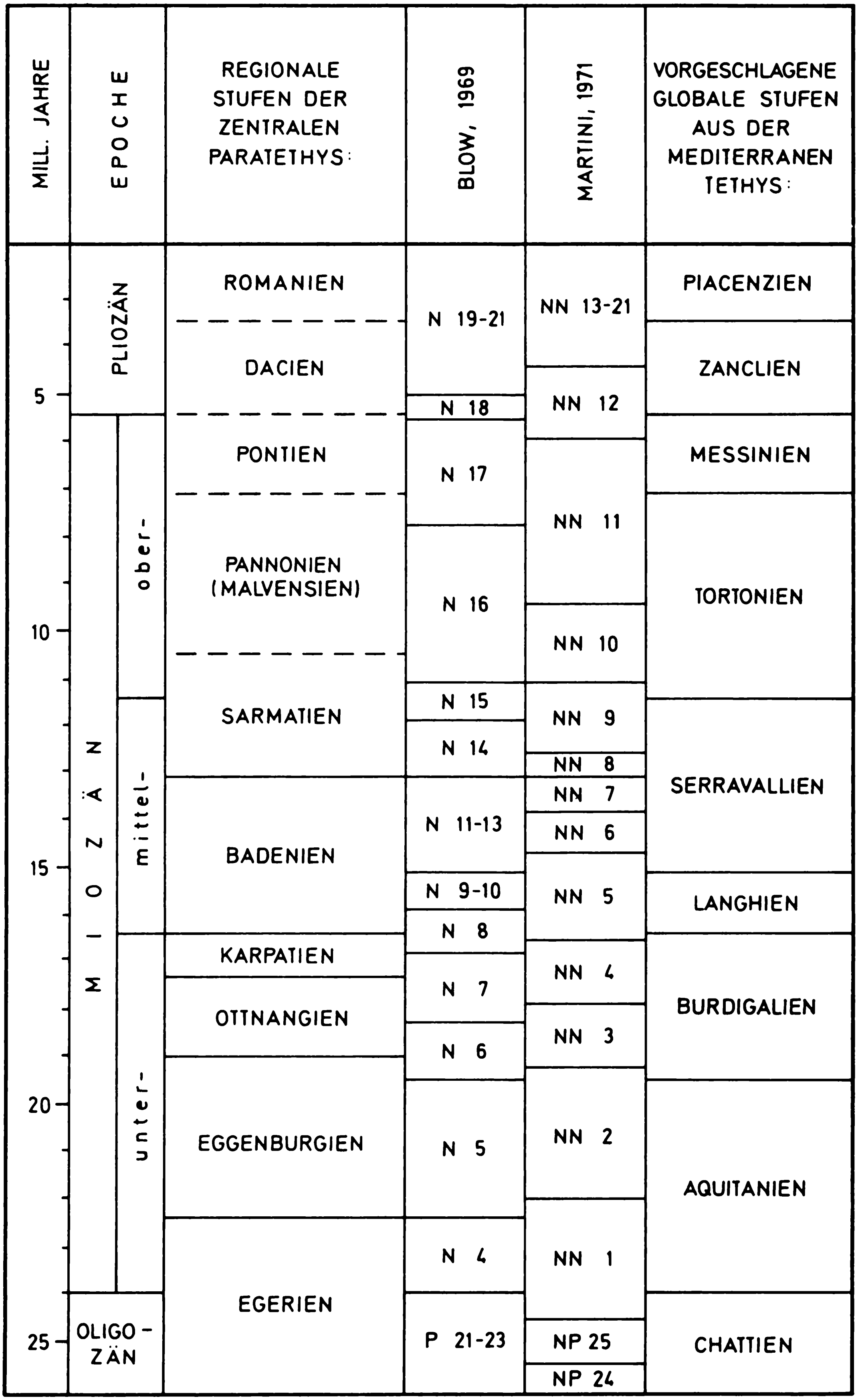



Fig. 1: Tentative correlation of Mediterranean and Central Paratethys Neogene Stages. First version for Correlation Tables, February 1977.

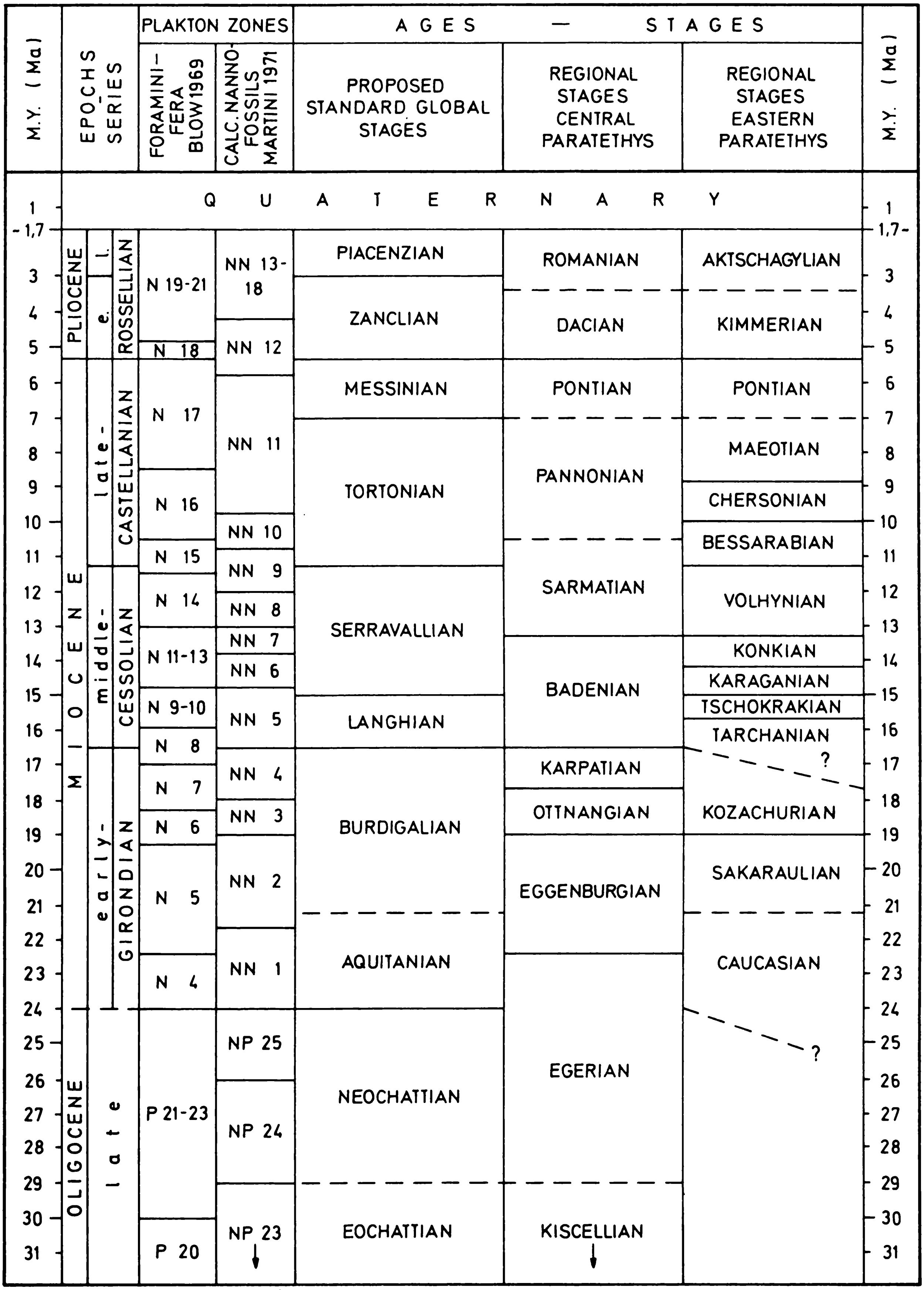



Fig. 2: Tentative correlation of Mediterranean-, Central Paratethys- and Eastern Paratethys - Neogene Stages. Second version for Correlation Tables, October 1978.

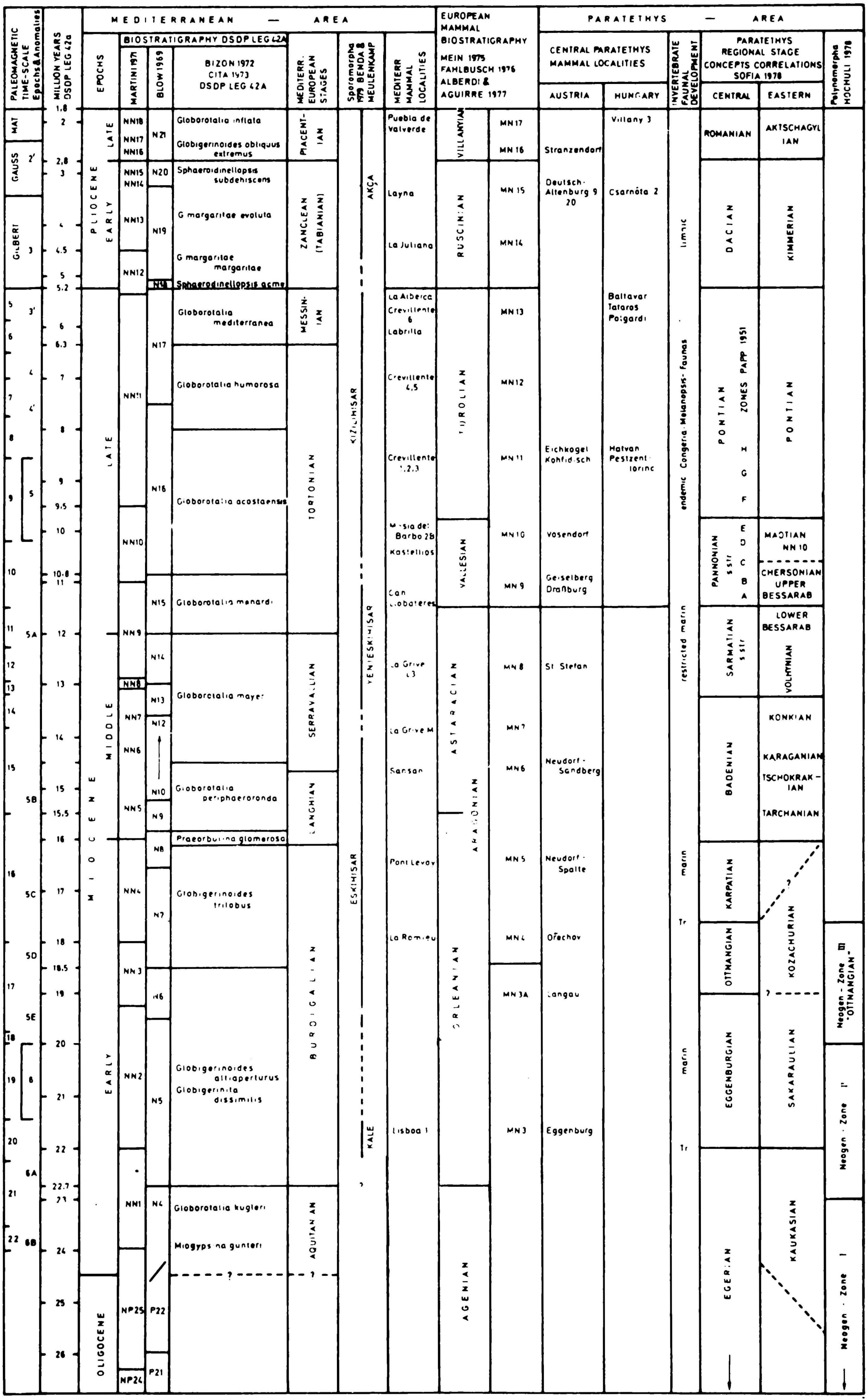



Fig. 3: Calibration and Correlation of Mediterranean, Paratethys and Continental Stages (PAPP, 1981).

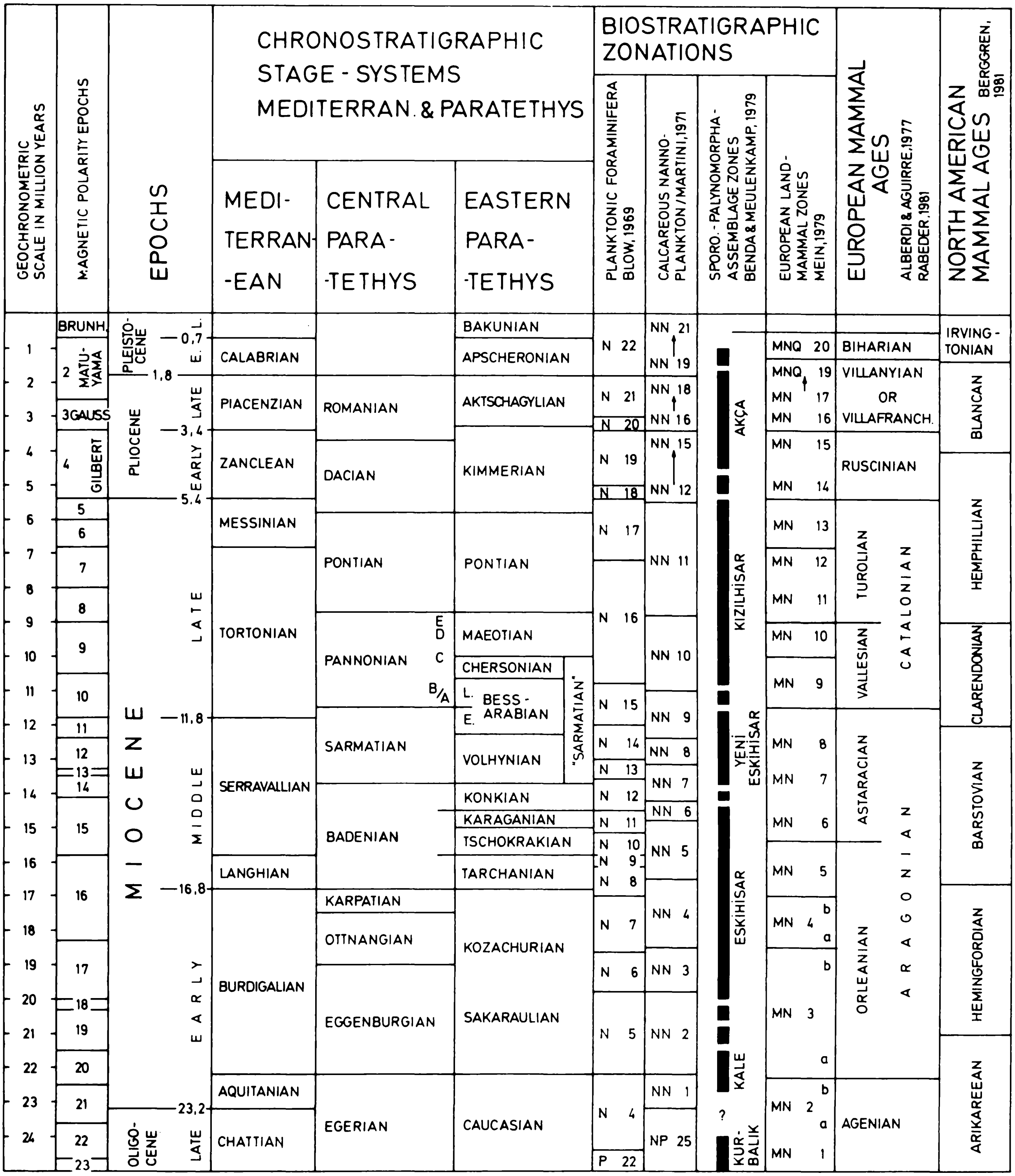



Fig. 4: Correlation chart of Neogene biostratigraphic and chronostratigraphic units for the Mediterranean, the Central and the Eastern Paratethys (STEININGER & RÖGL, 1984; see also RÖGL & STEININGER, 1983).

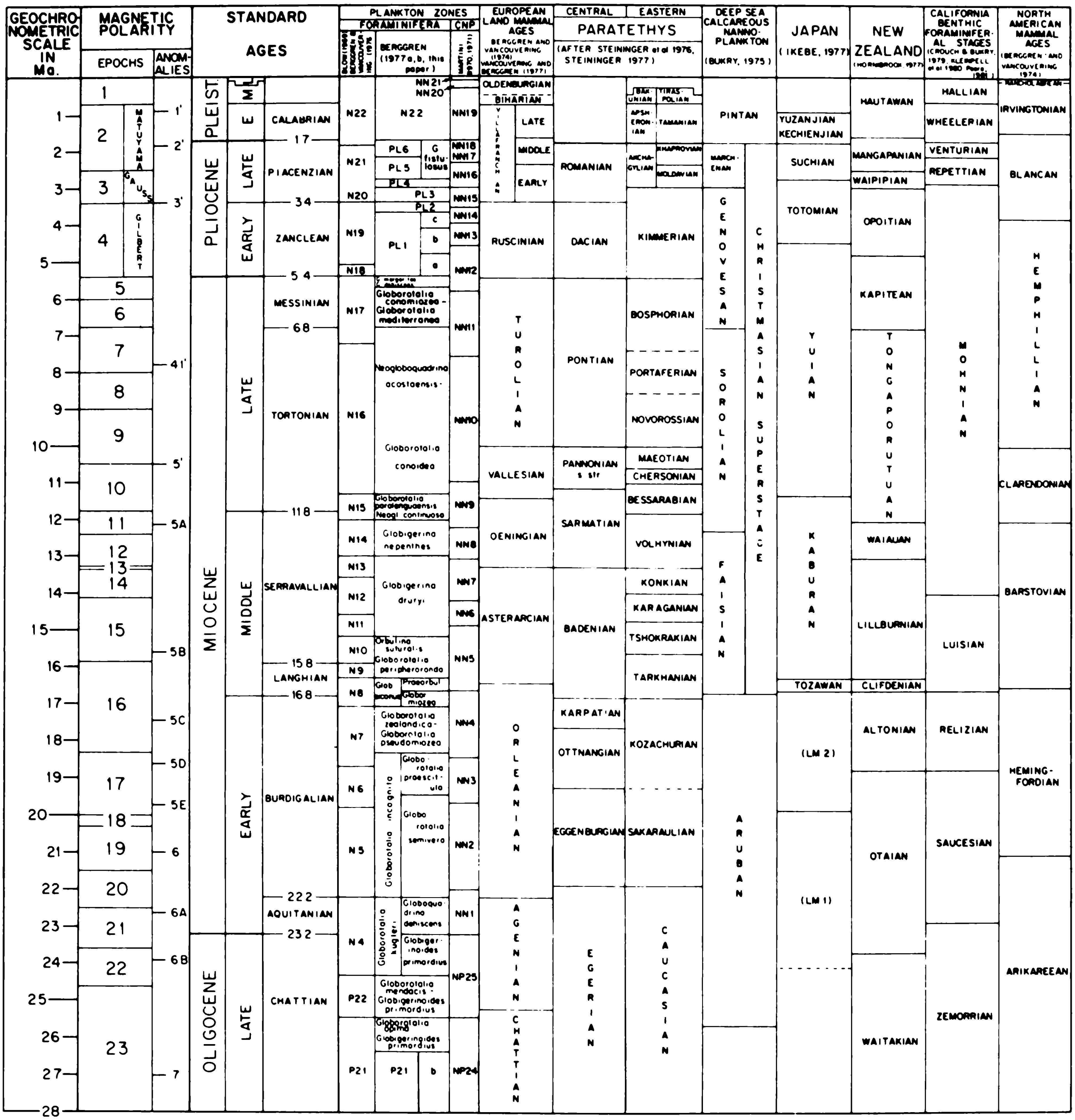



Fig. 5: Regional Neogene Correlation (BERGGREN, 1984).

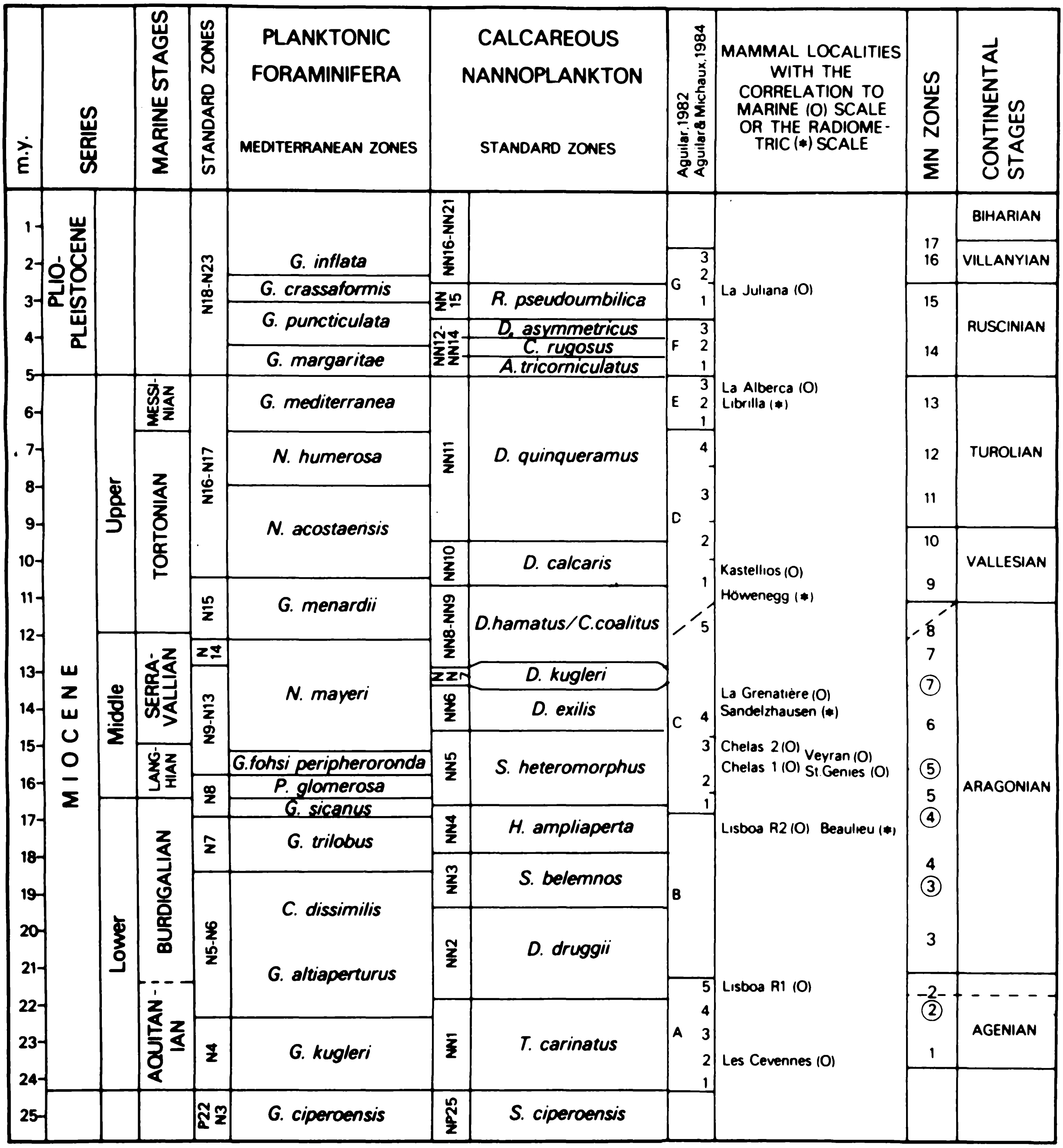



Fig. 6: Tentative correlation of biochronologies and the Mediterranean Neogene Stages (after "Compilation charts Neogene Faunal and Floral Changes", SUC (ed.), 1984.

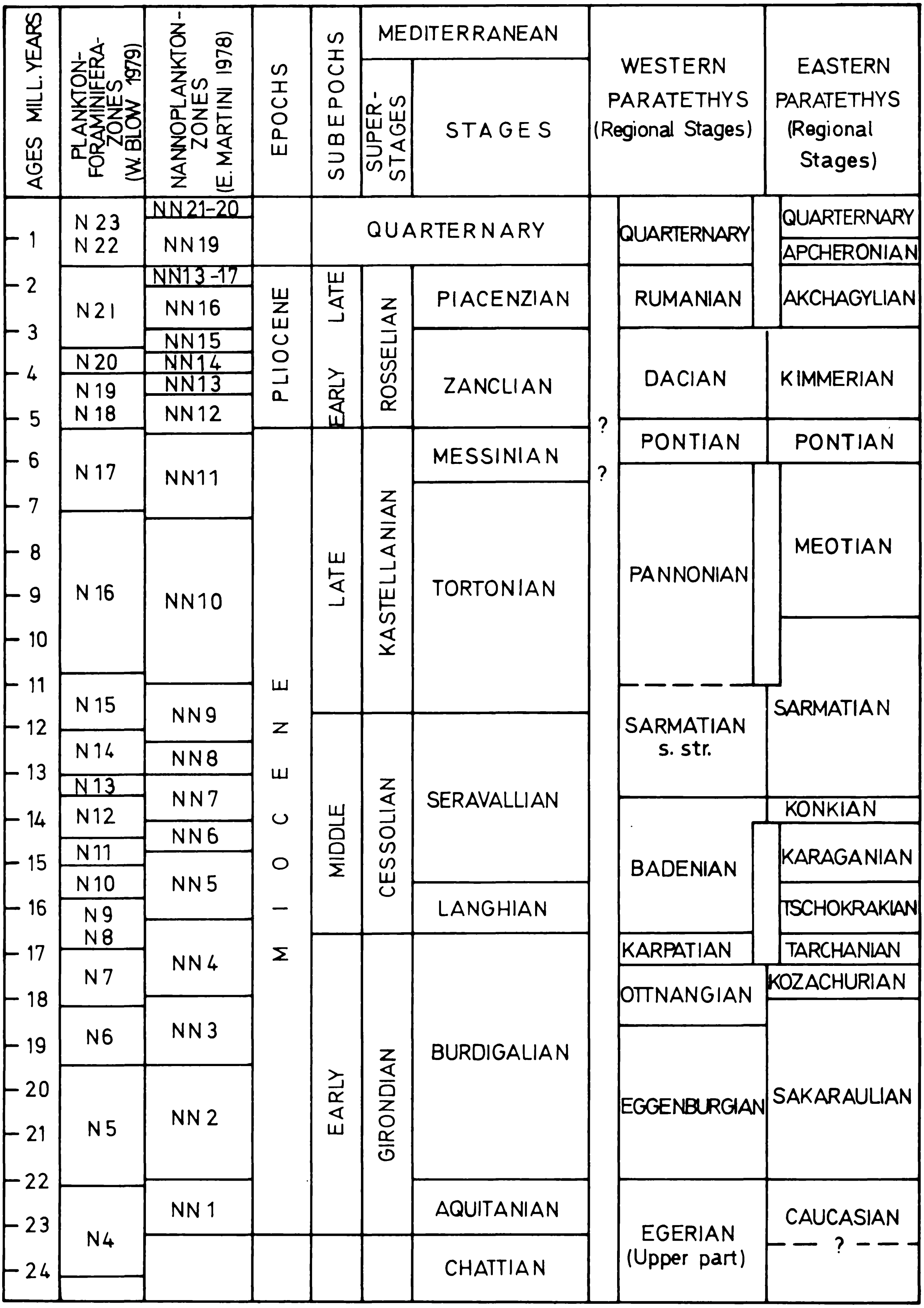



Fig. 7: Correlation scheme of Regional Stages of Eastern Paratethys, Western (= Central) Paratethys and Mediterranean Tethys (NEVESSKAJA & al., 1984).

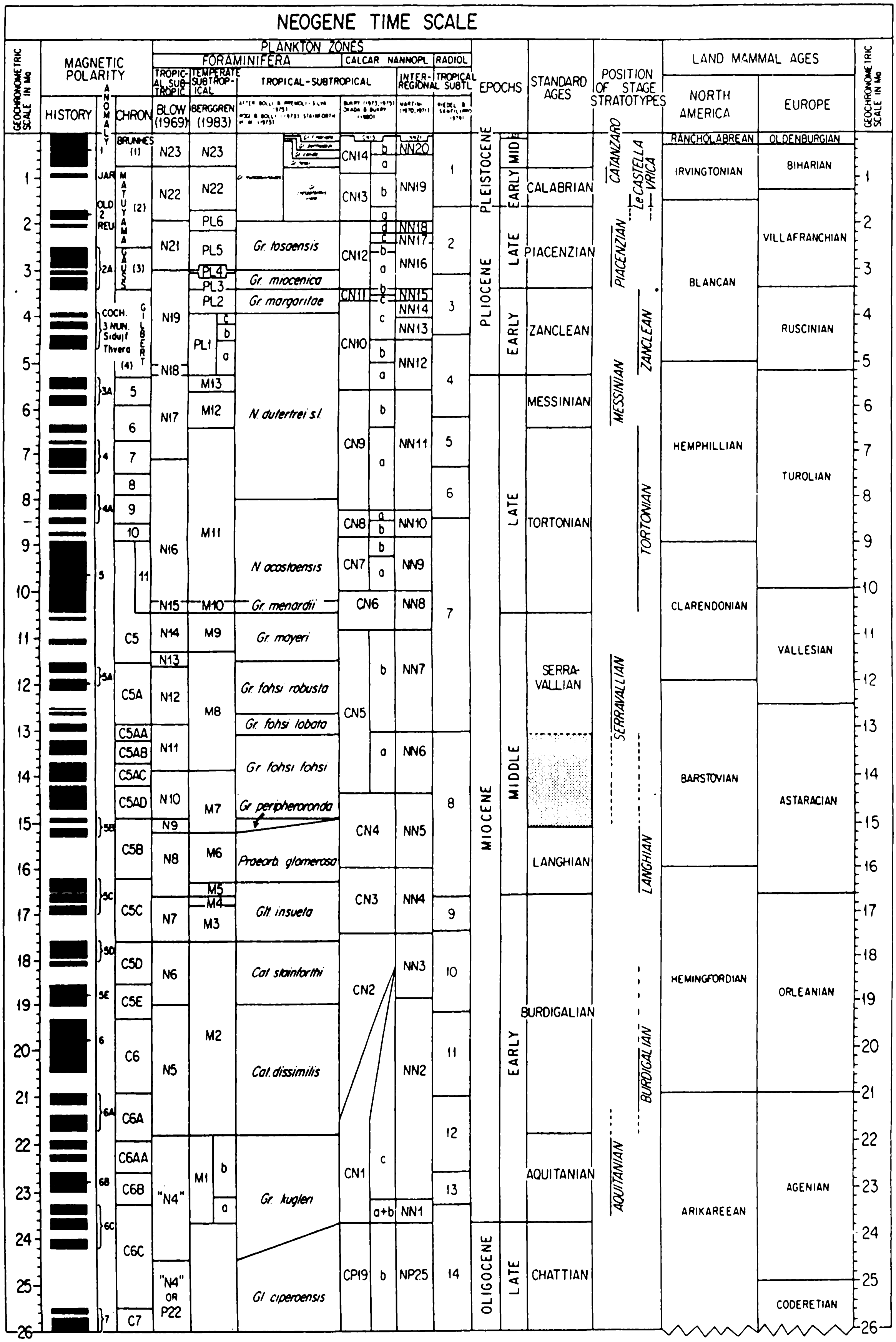


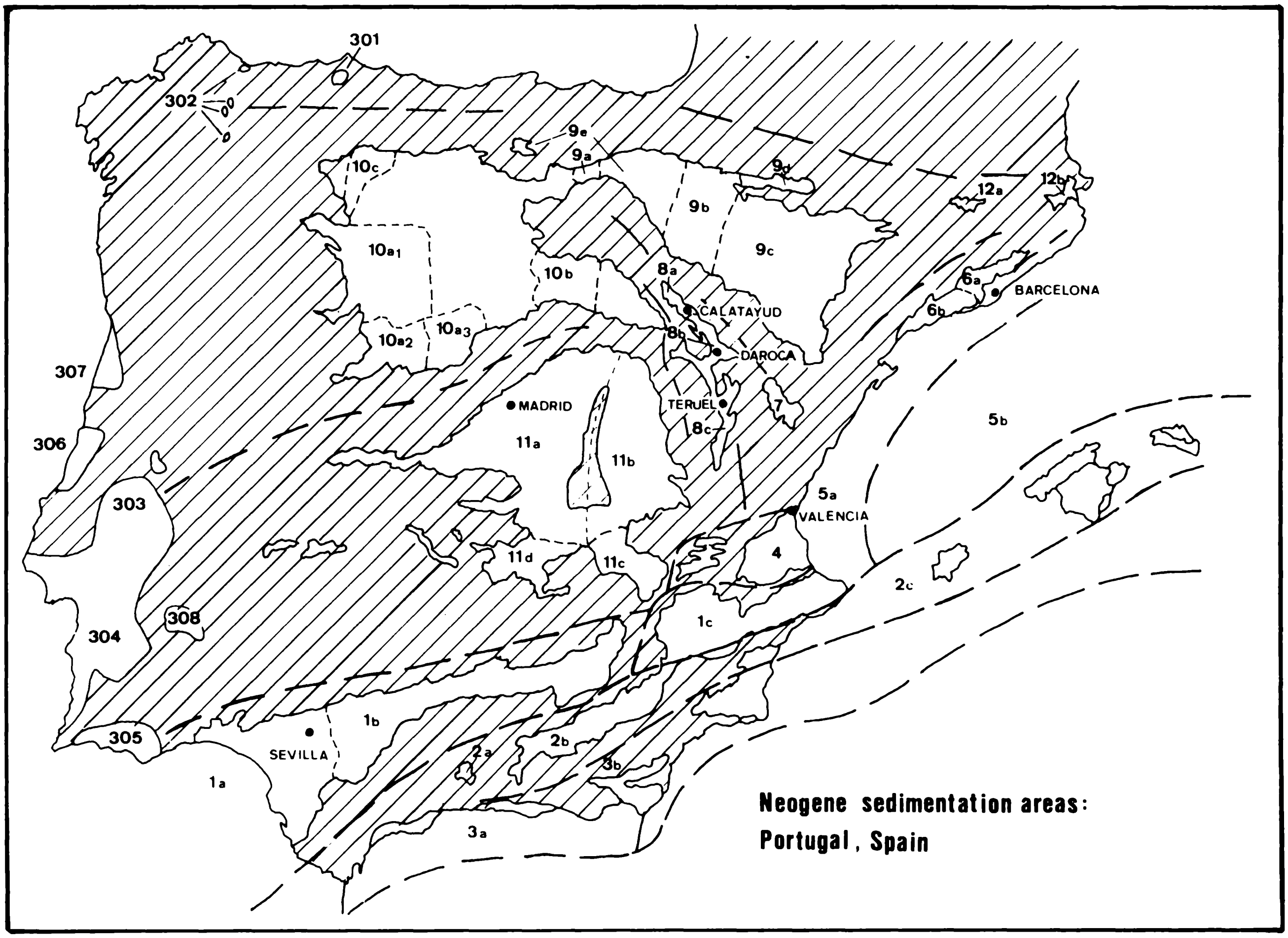

Fig. 8: Neogene geochronology (BERGGREN, KENT & VAN COUVERING, 1985).

# II. STRATIGRAPHIC CORRELATION TABLES

Text and Detailed Area Maps (for graphic Tables see volume 2 of this edition)

Index Map: Sedimentation Areas of the Mediterranean Tethys and Paratethys Neogene
(MAP 1, in book-pocket)

## PORTUGAL (PL) AND SPAIN (E)




### SPAIN (E)

**Area No. 301: ASTURIAN DEPRESSION, E**
Author: M. HOYOS

The continental Neogene series of Grado (Asturias), dated to the Upper Miocene-Pliocene for the presence of *Rhinocerus* sp. and *Libralces* sp. (1), is at present in revision, which is located according the bibliography.

Reference:
LLOPIS & MARTINEZ 1959.

**Area No. 302: GALLEGAS DEPRESSION, NW SPAIN**
Author: J.M. BRELL

In this area the Miocene forms a long negative sequence. The lower Miocene is constitued by orthochemical materials (limestones, dolomites or marls with palygorskite). The medium Miocene is constitued by lacustrine kaolinitic clays with lignites and the upper Miocene, by detritical sediments.

The study of clays mineralogy, shows the transition from biostasic conditions, leading to strong chemical weathering during the lower part of Miocene, to the tipical rexistasic conditions along the upper Miocene.

In the medium Miocene a first period of weak epirogenic activity have allowed the presence of terrigenous sediments. A more strong second epirogenic stage caused the starting of the conglomeratic materials in the Miocene-Pliocene transition.

References:
1. BIROT & SOLE 1954 2. BRELL 1975 3. BRELL & DOVAL 1974 4. MEDUS 1965 5. NONN 1965 6. SLUITER & PANNEKOEK 1964 7. VIDAL BOX 1941.

**Area No. 1 a: GUADALQUIVIR DEPRESSION, E**
Author: C. ZAZO

The Guadalquivir structural depression is installed during the later Miocene, on the basement Paleozoic and Mesozoic, between the Iberic plateau to the N and the internal zone of the Betic sequence to the S.

The Miocene transgression, upper Tortonian, reaches the plateau border and a marked subsidence remains till the last Messinian. The sedimentation of Tortonian-Messinian materials is disturbed by the arrival to the basin of "Olistostroma de Carmona", of mainly triasical matrix although it includes ages of the Jurassic-middle Miocene, the above said overthrust drags in its movement the "Alvarizas", which "would float" over it behaving as a para-autochthonous formation. The northern boundary of the "Olistostroma" coincides with the line of the swamp Guadalquivir-Carmona.

During the Pliocene, the subsidence diminishes and is even nule and in the formation of the Basin an epoch of filling begins. The regression is maintained during all the Pliocene.

An angular discordance can be seen near Moguer separates middle Pliocene from the, likely, Upper Pliocene, represented by the "red sands" which don't presents any characteristic fauna; it is a marine formation but with a clear continental influence which at the W of Huelva is tectonical. It is probable that part of this formation could also have a Lower Quaternary.

Inside the Guadalquivir Basin is where we have establiched the type column.

In the Bay of Cadiz and to the south of the same one discordance between Miocene and Pliocene (5). The Upper Pliocene is represented by a facies marine-brackish, in the Bay.

In any case the Upper Pliocene from the south of Cadiz up to Tarifa, is redued to a narrow parallel litoral band.

The "red sands", they can be seen in Conil, rest on the Upper Pliocene, with *Globorotalia inflata;* and that's the reason why this formation is diachronical; belonging, at least, in the south of Cadiz to the Quaternary.

From the tectonic point of view the area is completed in the following way: mio-pliocene distension phase, followed by a last pliocene compression phase.

References:
1. LEVUA & al. 1976 2. PERCONIG 1961 3. VIGUIER 1974 4. ZAZO & al. 1977 5. BENKHELIL 1976.

Area No. 1 c: **BETIC DEPRESSIONS (IBERIC–BETIC BASIN), E**

Authors: J. P. CALVO SORANDO, J. USERA, N. LOPEZ & E. ELIZAGA

Sediments older than Burdigalian have not been recognized in this zone. The marine sediments deposits that take place during the Burdigalian-Langhian are essentialy limestones-bioclastic with a event continental detritic in its lower part (7). This deposits arrange on mesozoic-paleogene paleorelief previously folding.

Over this Burdigalian-Langhian ages, in discordance (7, 8), there settle conglomerates, sandstones and clays of continental character filling unevenly small depression that later were covert with the progress of the transgression for deeps marines deposits, i. e. limestones with abundant planktonic fauna and flora (1,6). At the end of Serravalian-Lower Tortonian the regression gives place to deposits shallowest progressively (2) remaining this zone emerged definitively towards the middle Tortonian (3).

At this moment take place the continental depression formation where a strong thickness of continental sediment it deposited locally (4). The age of this continental formation has been established on the basis micromammalian fauna between the Upper Vallesian and Upper Turolian (MN 10 to MN 13 Mein's). The sedimentation is essentially of lacustrine character with a basal period sandstones-gypsum and limestones, sometimes with diatoms, in the upper period. The presence of the lamproitic volcanism dating the upper part of this formation at 5,4 m. y. (5). Over this formation, possibly lower Pliocene, appearance detritical facies of fluviatic character.

The Pliocene sediments are, at present, not well known in this area. Exclusive, to top of Pliocene has been signaled (9) a detritical formation whose placement and fauna can belong at this epoch, with certain security.

References:
1. USERA & al. 1979 2. CALVO SORANDO 1978 3. GARRIDO MEGIAS & al. 1980 4. CALVO SORANDO & al. 1978 5. BELLON & al. 1980 6. USERA 1974 7. JEREZ MIR 1973 8. BRINKMANN & GALLWITZ 1933 9. ROBLES & al. 1974.

Area No. 1 b, c; 2 b; 3 b: **BETIC RANGES, E**

Authors: A. G. MEGIAS, W. MARTINEZ & R. SOLER

The Mio-Pliocene sediments of the Betic Ranges have been divided in six "tectosedimentary units" (T. S. U.) (MEGIAS 1973) bounded at its top and base by main "sedimentary ruptures" that can be detected, defined and correlated in every Neogene basin of the chain, on and offshore (MEGIAS & al. 1980). These discontinuities or ruptures of the sedimentary process implies a modification of the tectonic process. A "tectosedimentary unit" can be bounded by disconformities in the margins of the basin or by their correlative conformities or paraconformities in the depocenters (different aspects of the same "sedimentary rupture" according to its position in the basin). As far as chronology is concerned, a T. S. U. in each vertical column represents the addition of the time covered by sediments plus the time of no deposition and/or erosion; each T. S. U. defines a constant and well defined interval of time. Therefore a T. S. U. is a tridimensional sedimentary body genetically independent either in the time and in the space, and the changes of environments and facies inside each T. S. U. and relationships among different T. S. U. can be clearly established everywhere.

The Neogene of the Betic Ranges is described through the main three onshore basins: areas 1b–1c, 2b and 3b (fig. 1).

a) **Northern Subbetic Basin.** Areas 1b and 1c (figures 4 and 5). This basin is limited by a southern active margin (Subbetic northern front) and by a northern pasive margin (Prebetic and Meseta craton).
b) **Southern Subbetic Basin.** Area 2b (figures 4 and 6). This basin is limited by a northern active margin (Subbetic southern front) and by a pasive margin (Inner Betic Zone).
c) **Almeria – Murcia Basin.** Area 3 b (figure 7)
Main example of a Neogene basin with only Inner Betic Zone substratum: reduced Lower Neogene (Aquitanian – Langhian) and well developed Upper Neogene (Serravalian-Pliocene). Figure 8 shows the relationships among T. S. U. – 4, 5 and 6 between onshore and offshore.

References:
BIZON & al. 1975 2. BOULIN & al. 1973 3. BOURGOIS 1973 4. BOURGOIS & al. 1973 5. BOURGOIS & al.

Fig. 1: Neogene Basins in Spain, see p. 13

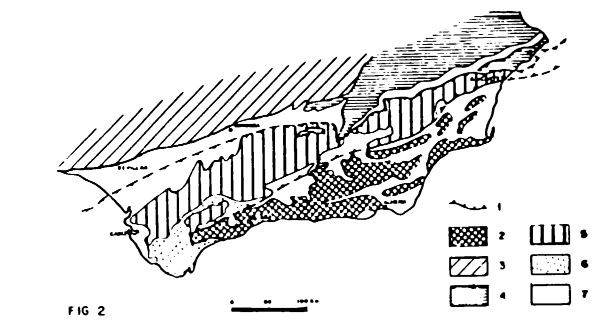



Fig. 2: Schematic map for tectonic domains (Spanish Betic Ranges) (1): Southern and Northern Subbetic Fronts. (2): Betic Internal Zones. (3): Paleozoic of the Meseta Craton. (4): Prebetic External Zone. (5): Subbetic External Zone. (6): Miocene tectosedimentary complex of 'Campo de Gibraltar'. (7): Neogene.

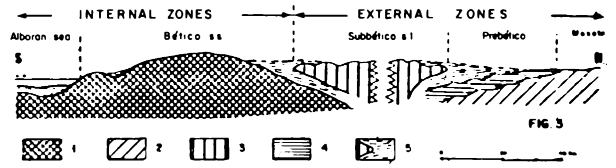



Fig. 3: Schematic cross-section (Betic Ranges).
(1): Betic (Internal) Complex. (2): Paleozoic of the Meseta Craton. (3): Subbetic Complex s. l. (4): Prebetic Zone or Mesozoic-Tertiary sedimentary cover of the Meseta. (5): Miocene pre-, syn-, and post "mise en place" of the Subbetic Complex.

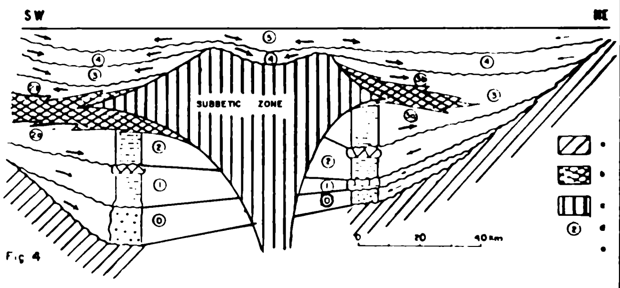
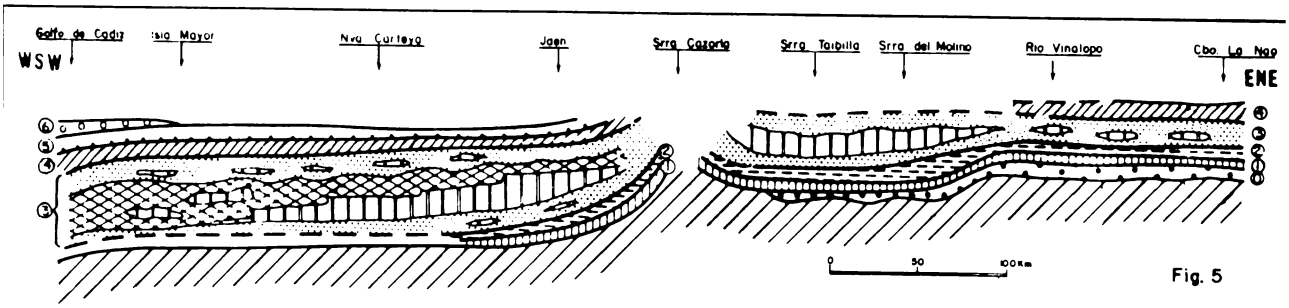



Fig. 4: Tectosedimentary NE–SW model of the Subbetic in Neogene times.
(a): Neogene subcrop (South Internal Zones and North Prebetic-Meseta Zone). (b): Frontal tectosedimentary complex (olistholites, olisthostroma, debris and mass flow . . . ). (c): Subbetic. (d): UTS numeral. (d): Source area for normal detritic and delapsional bodies.



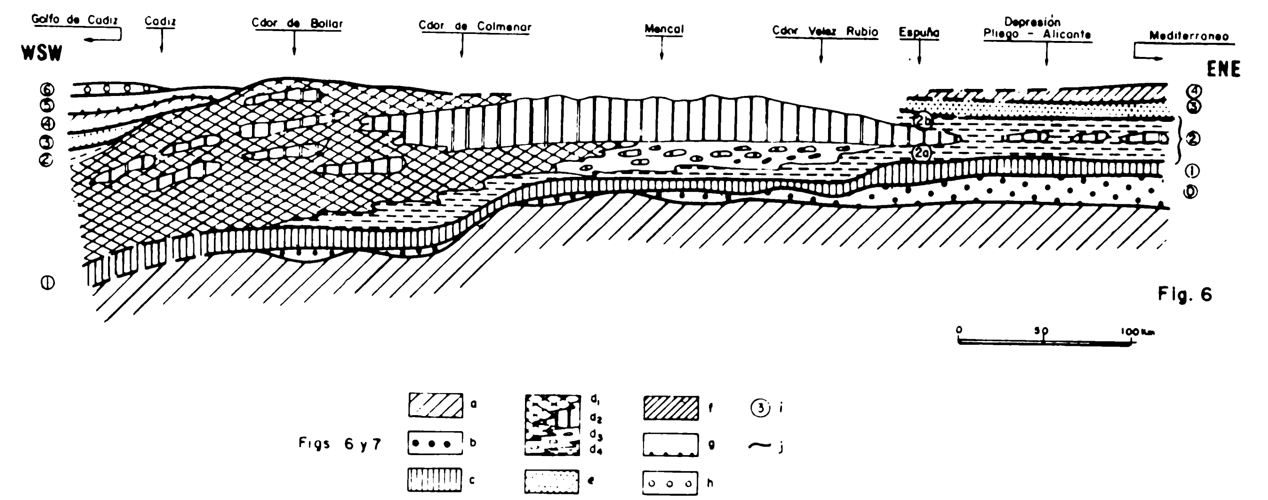




Fig. 5 and 6: Tectosedimentary model of the Subbetic North and South margins in Neogene times. (a): Neogene subcrop (as in fig. 3). (b): Uppermost Oligocene-Aquitanian 1. (c): Aquitanian 2 – Burdigalian 1. (d): Burdigalian 2 – Langhian 1. ($d_1$): tectosedimentary complex = olisthostroma = "clays with blocks". ($d_2$): Main Subbetic Tectonic Units. ($d_3$): Pelagic Shales with subbetic olistholites. ($d_4$): Pelagic Shales. (e): Langhian 2 – Serravalian – Tortonian 1 (with similar subdivision as above). (f): Tortonian 2 – Messinian 1. (g): Messinian 2 – Pliocene 1. (h): Pliocene 2 – Quaternary. (i): U. T. S. numeral. (j): Sedimentary rupture.

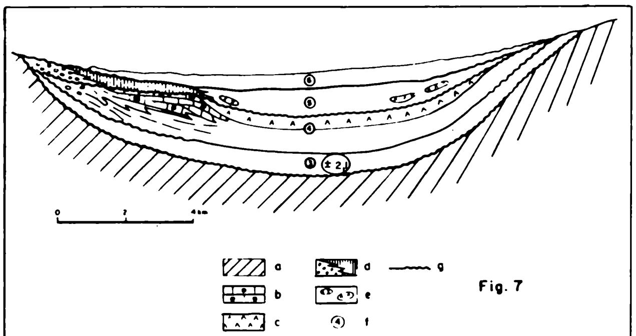


Fig. 7

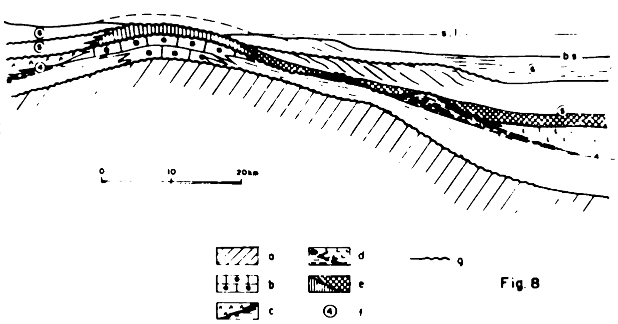


Fig. 8

Fig. 7: Tectosedimentary model for the Almeria Murcia Basin type in Upper Neogene times.
(a): Subcrop of UTS-3. (b): Reef. (c): Messinian 1 gypsum. (d): Terminal complex and equivalent detritic deposits. (e): Reefal and evaporitic messinian olistholites. (f): UTS numeral. (8): Sedimentary rupture.

Fig. 8: Tectosedimentary model in Upper Neogene times (On/Offshore).
(a): Subcrop of UTS-4. (b): Reef. (c): Tortonian shales, "laminites" and evaporites of the onshore Messinian 1. (d): Facies offshore as above. (e): Terminal complex and evaporites of the Messinian 2. (f): UTS numeral. (g): Sedimentary rupture.

1972 b 6. BOURGOIS & al. 1972 a 7. DABRIO & al. (in print) 8. DECIMA & WEZEL 1973 9. DIDON 1977 10. ESTEBAN 1979 11. GEEL 1977 12. LACCARINO & al. 1975 13. JEREZ MIR 1973 14. JEREZ MIR & al. 1977 15. LERET 1977 16. MAC GILLAVRY & al. 1964 17. MARTINA & al. 1979 18. MEGIAS 1973 19. MEGIAS 1977 20. MONTADERT & al. 1978 21. MONTENAT 1973 22. PERCÓNIG 1960–62 23. PEYRE 1974 24. RODA 1965 25. SOEDIONO 1971 26. VERA 1970 27. VÖLK 1966.

## Area No. 2 a: RONDA BASIN, E
Author: F. SERRANO

In the Ronda region, during the Upper Oligocene and Aquitanian, the bassin was clearly unstable tectonic which made possible the formation of facies sediments, flysch. The absence of significative fauna has not made the datation of the material very precise. This tectonic unstableness is evidence of a stage of strong folding that occurred during the lower and middle Miocene (?), followed by a general regression that makes the region emerge. During the Tortonian, the sea invades the area, being submerged partially although very little.

This situation continues until the Messinian, being followed by a new regression that leaves the materials definitely submerged. The deposited materials during this cycle have been widely classified by means of planctonic foraminifera.

References:
1. BERTRAND & KILIAN 1889 2. CHAUVE 1968 3. DURR 1967 4. GONZALES DONOSO & SERRANO 1977 5. MAUTHE 1971 6. ORUETA DE 1917.

## Area No. 2 b1–4: GRANADA BASIN, E
Author: J.M. GONZALES DONOSO

Granada's depression is a Neogene basin with very varied sediments, both horizontal and vertical, controlled tectonically.

One can divide it in various sectors and this, in turn, in subsections, each one with its own characteristics. The most representative points are the columns: first, 2aa, the synthesis of the NE and SE sections (the S° Nevada border); the others are the W (2ad) sections, the central subsections of the central section (2ab) and the N subsection of the central section (2ac).

The Miocene materials could be divided in three formations, separated by generalized angular discordances. The formations, in turn, could be divided in members by means of discordances and/or local erosives phases, or by means of general lithologic changes. Because of the great lithological heterogeneity, as for now, there has not been established a formal lithostratigraphic nomenclature for distinguishing members and formations (it would lead to the use of too many local names and, in many cases, it would be difficult to meet all the requisites of a formal definition).

The lower formation ("Tramo de Murchas) a marine one, has an age base of lower Burdigalian, the rest could approach the Serravalian, but there are no paleontological criteria, as for now, for determining its exact superior boundary.

The middle formation ("Tramo inferior miocenica") presents a marine base of age Serravalian and a top, also marine, of lower Tortonian age (not basal). Between them one finds a package of materials mainly continentals. The whole formation could be divided in a minimum of fine members.

The upper formation ("Tramo superior miocenico") presents a marine base, of middle -upper-? Tortonian, at different altitudes, depending on the sections and subsections, the marine habitat evolves toward one restricted circulation and, finally, in some sections there appears lacustrine terms. The more recent marine terms, dated by means of planctonic foraminifera, indicate an upper Tortonian age (not terminal) as the oldest although one cannot exclude that they reached the lower Messinian. The superior continental terms, which contain mammals and pollen, have been dated as Messinian.

Aside from this three formations, there exists another on Sierra Nevada's border, that of Pinos Genil, without autochthonous fauna, separated from the others by an erosive phase. Its age could go from the Messinian to the Pliocene and the deposits are evidently continental, fluviatile s. l., fundamentally alluvial.

In the rest of Granada's Depression there appears different continental terms, also fluviatile s. l., whose total systematization has not been made yet. Given its stratigraphic position (over the lacustrine terms of the Messinian) one can give them ages beween the Pliocene and the Quaternary.

References:
1. AGUIRRE 1975 2. DABRIO & al. 1972 3. D'ONOFRIO & al. 1975 4. GONZALEZ DONOSO 1968 5. GONZALEZ DONOSO 1970 6. GONZALEZ DONOSO (in print) 7. ORTEGA HEURTAS & al. 1974 8. SOLE DE PORTA & DE PORTA 1977 9. VERA & GONZALEZ DONOSO 1964.

Area No. 2 c: **BALEARIC DEPRESSION, E**
Authors: A. BARON & L. POMAR

References:
1. BARON 1976 2. COLOM 1967 3. COLOM & BARON (in prep.) 4. BIZON & al. 1973 5. ESTEBAN & al. (in print) 6. OBRADOR 1973.

Area No. 3 a: **MALAGA COASTAL AREA, E**
Authors: F. CARRASCO & P. RODRIGUEZ

The Neogene materials from the Malaga coast could be distributed into three independent formations, of ages between the Upper Tortonian and the Piacenzian.

Velez's formation was found at the Velez River mouth, beneath quaternary sediments and dissonant over the paleozoic substrate. It is formed by limes and blue argil whose age goes between the Upper Tortonian and the lower Messinian.

Malaga's formation, which primarily shows in "hoya de Malaga", has sediments belonging to the Zanclean, from the $MPl_2$ zone to the $MPl_3$, in discordance over preorogenic material, almost always paleozoic. The sedimentary cycle, begins in a transgressive stage, with a conglomerate deposit in the basins border followed by lime, sometimes with a little gypsum. In the basin's center there are great deposits of blue argil.

After that there is a regression with the appearance of lime and sand in the upper part of the series.

Over this materials, in discordance, there appears Pliocene?, Quaternary, continental materials.

The Atalaya formation, a small emergence of phosillike sand, belonging to the Piacenzian, $MPl_6$ zone, rest in discordance over azoic preorogenic sandstones.

This three formations are found to be independent the intermediate material between them has not been found.

References:
1. AZEMA 1961 2. BERTRAND & KILIAN 1889 3. BLUMENTHAL 1949 4. BUNTFUSS 1970 5. CARRASCO & al. (in print) 6. CITA 1975 7. DIDON 1969 8. D'ONOFRIO & al. 1975 9. GONZALEZ DONOSO & PORTA 1977 10. MICHEL-LEVY & BERGERON 1889 11. ORUETA DE 1917.

Area No. 3 b1: **BETIC DEPRESSIONS, ALMERIAN CORRIDOR, E**
Author: C. J. DABRIO

The Vera Basin shows clearly different types of neogenic materials: an old Neogene (early and middle Miocene) outcropping only in the borders of the Basin, without mesometamorphic debris and strongly tectonized and a young Neogene (late Miocene and Pliocene) forming the main filling of the Basin, with metamorphic debris (Nevadofilabride) and only slightly deformed.

All these units use to be discordant around the borders of the Basin and conformable at the inner areas.

Two volcanic episods: one at the end of late Miocene ("veritic" lavas, a kind of lamproites) and other Pliocenic (?) very altered rhyodacits. The rest of Basins of "Almerian Corridor" are very similar to this, but often show evaporites (for instance Sorbas Basin, a few kilometers westward).

References:
1. DABRIO 1975 2. DRONKERK & PAGNIER 1977 3. FUSTER & al. 1967 4. MONTENAT 1975 5. MONTENAT & BIZON 1976 a 6. MONTENAT & BIZON 1976 b 7. SEVERAL AUTHORS 1977 8. VÖLK 1966.

Area No. 4: **VALENCIAN DEPRESSION, E**
Authors: J. USERA, J. P. CALVO & F. ROBLES

After the main fold of the Iberic range (Upper Stampian–Chattian), a lacustrine regime is installed in the inner zones (mammals bed of Bunol (1 & 5) and simultaneously a transgression is initiated in the South of the area which originates the marine detritical materials of the most depressed zones at the E (3 & 8). During the Langhian the detritical sedimentation is maintained in the Southern marine areas, with calcarenites and sandy marnes. At the later Langhian and during the Serravalian, the advance of the transgression produces the deposition of marls and abundant planctonic fauna and flora (11). The continental equivalence has not been well characterized, but it can correspond with the lacustrine limestone of Fuencaliente dated as Vallesian (4 & 6) and possibly with the lacustrine deposits that are superposed to the lignites Burdigalian de Bunol (5, 1 & 10). During the Tortonian, in the marine environment two different zones paleogeographical are found: In the South the regression begins with the deposition of sandy marls which culminate with the formation of molasses of the lower Tortonian age, which erosionate the underlying unity and mark the last marine sedimentation. In the North of the area, the marine observable series belongs to the lower and middle Tortonian (12) and is formed in its main part by sandy marls. Above the marine materials a thick continental series of uncertain age in the basis is found, with lacustrine characteristics (river Jucar Formation) or fluviatil with lacustrine events (Venta del Moro – Villatoya Formation), in which trough mammals the Upper Turolian has been dated (Fuente Podrida, Venta del Moro) (9 & 2) as well as the Middle Pliocene (7). The Upper boundary has not been dated.

References:
1. ADROVER 1968 2. AGUIRRE & al. 1973 3. CALVO & al. 1974 4. CROUZEL & VIALLARD 1968 5. CRUSAFONT & TRUYOLS 1957 6. GOLPE-POSSE 1971 7. LOPEZ (pers. com.) 8. QUESADA & al. 1967 9. ROBLES 1974 10. ROBLES & al. 1974 11. USERA 1974 12. USERA 1975.

## Area No. 5 a, b: VALEANCIA PLATFORM - NORTH BALEARIC THROUGH (SPANISH MEDITERRANEAN)

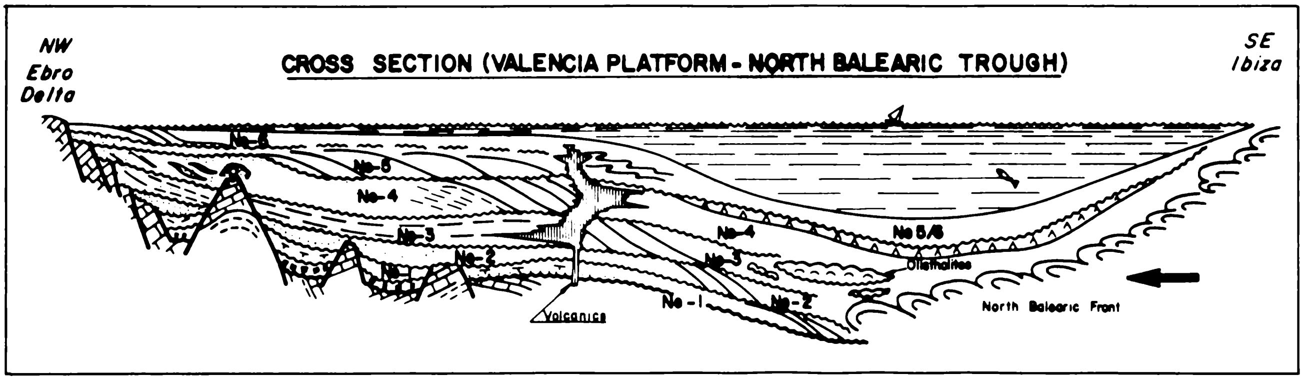
Authors: W. MARTINEZ, R. SOLER & A. G. MEGIAS

Oil exploration wells, subsurface geology and geophysical studies of the Tertiary basin between the east coast of Spain and the Balearic Islands allow us to present a regional tectosedimentary model. The Mio-Pliocene sediments have been divided in six "tectosedimentary units" (T. S. U.) bounded at its top and base by main "sedimentary ruptures" (modifications of the sedimentary process: marginal disconformities or their correlative conformities or paraconformities in the depocentres), which corresponde with main regional seismic markers. Correlation, changes of environments and facies inside each T. S. U., and relationships among different T. S. U. 's are stablished with this methodology complemented with micropaleontological analysis.

The Miocene T. S. U. are extensive (onlaping) over the northwestern land. Migration toward the north-west of the paleo-slopes, separating coastal and platform environments from deep distal fans, is an evident fact. This extension is the countereffect of the south-eastern tectonic Betic overthrusts and related delapsional processes, affecting the Miocene synchronic sedimentary deposition. The messinian evaporites mark the end of these particular dynamic phases.

The Pliocene and Quaternary sequences indicate a less extensive area of deposition, in approximative coincidence with the actual shoreline.

References:
1. GARCIA SINERIZ & al. 1979 2. MARTINEZ & ESTEBAN (in print) 3. MARTINEZ & al. 1978 4. MARTINEZ & al. 1980 5. MEGIAS, LERET & al. 1980 6. SOLER & al. 1980.




## Area No. 6 a: VALEES, and 6 b: PENEDES, E

Authors: V. SANTAFE & M. L. CASANOVAS

The presence of a series of dislocations in the Lower Astracian and Vallesian, as well as the suppositions of others – covered by Quaternary –, reduces the thickness of the different strata in relation to the data given by the first authors.

As a whole it deals with a sedimentary cycle which in the Valees begins in the Lower Burdigalian, with a basal zone of evaporites and limes. In the upper part we find limolites with plenty of conglomerate beds. Lately a transgression Helvetian–Tortonian has been produced in which the marine materials, of little thickness; would lean on the continental Burdigalian in cartographic discordance. In a regime of continuity there would come the Upper terrestrial, fluviatil and lacustrine Astaracian with the shape of limolites with a 10 % of alternated conglomerates. In the Vallesian the same type of sedimentation would continue changing slightly the climatic conditions at the end of the cycle.

In the Penedes, the sedimentary cycle is alike, although it begins a bit later, the Helvetian–Tortonian transgressions are more numerous and the Astaracian–Vallesian sediments are richer in conglomerates (20 %). The sedimentary cycle ends in this area in the Turolian. Laterally the cliff formations of Sant Pau d'Ordal.

References:
1. CASANOVAS & al. 1972 2. CRUSAFONT 1959 3. CRUSAFONT & TRUYOLS 1947 4. CRUSAFONT, VILLALTA & TRUYOLS 1955 5. CRUSAFONT & GOLPE 1972 6. CRUSAFONT & GOLPE 1974 7. GOLPE 1971 8. Inst. Geol. Min. Espana 1975 9. SANTAFE (in print) 10. SANTAFE 1977 11. ROSELL & al. 1973 12. THALER 1965 13. TRUYOLS & CRUSAFONT 1951 14. VILLALTA & ROSELL 1966 15. VILLALTA & al. 1968.

## Area No. 7: SARRION DEPRESSIONS, E

Authors: N. LOPEZ & M. HOYOS

The Neogene is found in discordance over the Mesozoic, beginning by fluviatil clay-sandy facies mixed with lacustrines. The conjunct is found plied with the axis of pliying E–W and dislocated. Over the Miocene a detritical subhorizontal series of Sarrion is situated in angular discordance, which fossilizes a karst over the Mesozoic which has been dated as Middle Pliocene.

The age of the Neogene series has been precised by faunas of micro- and macromammals: the beds of Rubielos de Mora 1 and 2 belong the Lower Aragonian (biozone MN 3 and 4 respectively). The base of this series has not been dated up to now. The age of the Sarrion series is precised by the age of the karst which fossilizes. The bed of Sarrion is found in the biozone MN 15.

The bibliographical references are referred to the paleontology and stratigraphy of each bed.

References:

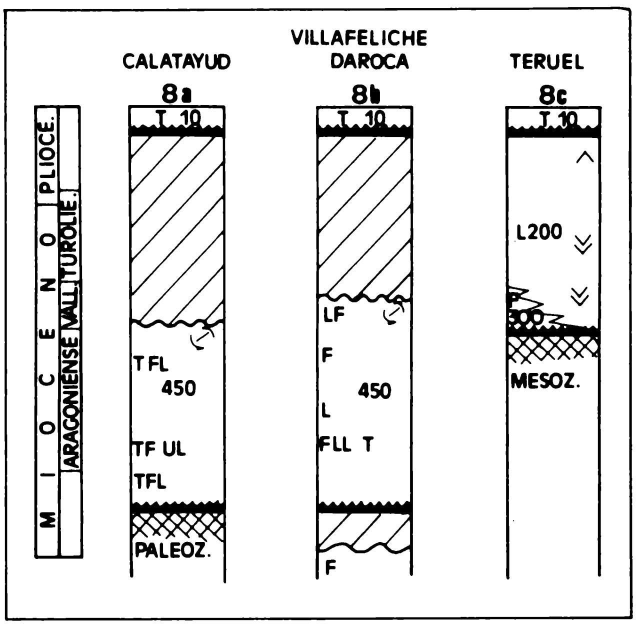
1. ADROVER & al. 1974 2. DE BRUIJN & MOLTZER 1974 3. CRUSAFONT & al. 1966 4. LOPEZ MARTINEZ 1977.

Area No. 8: **IBERIC DEPRESSION, E**
Authors: M. HOYOS & N. LOPEZ

The Neogene of Calatayud-Teruel is placed discordantly on the Paleozoic to the E and W; on the Mesozoic to the N and to the S being found; on very located points, detritical sublying materials attributed to the Oligocene (Villafeliche). The distribution presents very quick changes of facies, mainly in Calatayud-Daroca. In the area of Calatayud a progressive movement is observed of the lacustrine facies towards the E, due to the uprising of the W border. The filling of the basin is quicker towards the N while in Teruel there is more subsidency and more homogeneous facies continuing the sedimentation till the Middle Pliocene.

These materials have been very well dated by the micromammals fauna, being placed in these bases the type fauna of ages of mammals used in all the Mediterranean Basin: Aragonian and Turolian. The more important beds are Ateca (MN 3) and Armantes 7 (MN 6) in Calatayud; Villafeliche 2 (MN 4), Las Planas (MN 5) and Manchones (MN 6) in Daroca; Nombrevilla (MN 9) in Daroca and Masia del Barbo (MN 10), Los Mansuetos (MN 12), El Arquillo (MN 13) and Escorihuela (MN 16) in Teruel.

The references 1, 2 and 5 are referred to the Paleontology and Stratigraphy respectively from Calatayud, Daroca and Teruel. The papers 3 and 4 refer to the general Geology and Tectonic.




Reference:

1. DE BRUIJN 1967 2. FREUDENTHAL 1963 3. AGUIRRE & al. 1974 4. MOISSENET 1977 5. VAN DER WEERD 1976.

Area No. 9 a–e: **EBRO DEPRESSION, E**
Author: O. RIBA

Area No. 9 a: Ebro depression, Bureba – Rioja Alta
1: Molasa de Najera Fm. 2: Molasa de Haro Fm. 3. Conglomerados de Santurdejo 4: Yesos de Cerezo de Rio Tiron Fm. 5: Margas de Altable 6: Cgl. de Silanes 7: Calizas de los Paramos.

Area No. 9 b: Ebro depression, Rioja – Baja, Navarra
1: Yesos de Losarcos Fm. 2: Anguiano Fm. 3: Najera Fm. 4: Haro Fm. 5: Conglomerados de Anguiano 6: Yesos de Monteagudo 7: Conglomerados de Yerga.

Area No. 9 c: Ebro depression, Aragon
1: Calizas de Menquinenza Fm. 2: Calizas de Alcubierre Fm. 3: Caspe Fm. 4: Molasa de Sarinena Fm. 5: Yesos de los Monegros Fm.

Area No. 9 d: Ebro depression, Jaca basin
1 and 2: Conglomerados de Oroel and San Juan de la Pena Fm. 3: Molasa de Sarinena y Bernies Fm. 4: Conglomerados de Riglos 5: Conglomerados de S. Pelayo y de la Pena Izaga.

Area No. 9 e: Ebro depression, Miranda – Trevino basin
1: Calizas de Moriana Fm. 2: Molasa de S. Martin de Zar Fm. 3: Molasa de Fontecha Fm. 4: Conglomerados de Pobes 5: Calizas de Trevino 6: Calizas de Nograro 7: Conglomerados de Caicedo 8: Calizas de Oron 9: Conglomerados de las Tetas de Encio 10: Conglomerados de San Miguel.

The Miocene of the Ebro Basin is totally of continental origin and the facies were developed in an internal basin without connection to the sea (endorheic). The deposits show a gradual transition from evaporites (halite, and mostly gypsum or anhydrite, and very seldom glauberite) in the center of the basin, to lagoonal clay and silt, to fluviatile molasses (red and yellow) to pedmont alluvial fans in the margins. The source areas are the Pyrenees in the north and the Iberian Range, in the south.

Several sub-areas are differentiated (see above).

The endorheism is of tectonic origin, favoured by a strong subsidence, resulting in very thick continental deposits. The sedimentation is active throughouth the Pontian (Messinian). At this time, the erosion took place and the basin was progressively denudated by an external drainage system, which was maintained to present.

The diastrophism and sedimentation were operating at the same time and the syntectonic angular unconformities as well as progressive unconformities (cumulative wedging), comprising thick conglomeratic bodies, were often developed mostly in the northern margin of the basin (see O. RIBA 1976: Syntectonic unconformities on the Alto Cardener, Spanish Pyrenees: a genetic interpretation. Sed. Geol. 15, 213–33; and Tectogenese et sedimentation: deux modeles de discordances syntectoniques pyreneennes, Bull. B. R. G. M., 4, 383–401).

The stratigraphy has been traditionally established on the basis of terrestrial vertebrate biozones (according to the correlation made by J. M. GOLPE POSSE). Much recent effort has been placed in the biozonation with characees and ostracods, mostly by J. RAMIREZ DEL POZO, in areas of the Pyrennees of Aragon, and Rioja, Bureba and Miranda Basin. Despite better understanding some controversy still exists concerning this zonation. The framework of absolute radiometric dates is still missing and the paleomagnetic stratigraphy has not been developed.

There is no volcanic activity during the Miocene.

Reference:

1. CRUSAFONT, RIBA & VILLENA 1966 2. CRUSAFONT, TRUYOLS & RIBA 1966 3. GOLPE (unpubl.) 4. GROSS 1968 5. GROSS 1966 6. INST. GEOL. MIN. ESPANA 1970 7. INST. GEOL. MIN. ESPANA 1971 a 8. INST. GEOL. MIN. ESPANA 1971 b 9. LLAMAS 1959 10. PUIGDEFABREGAS 1975 11. QUIRANTES 1969 12. RAMIREZ DEL POZO & al. 1977 13. RAMIREZ DEL POZO 1977 14. RAMIREZ DEL POZO (pers. com.) 15. REILLE 1971 16. RIBA 1954 17. RIBA 1955 18. RIBA 1956 19. RIBA 1957 a 20. RIBA 1961 21. RIBA & al. (1968 a unpubl.) 22. RIBA & al. (1968 b unpubl.) 23. RIBA, VILLENA & MALDONADO 1971 24. RIBA 1971 25. RIBA, MALDONADO & 1971 26. RIBA & al. 1972 27. RIBA & al. 1973 28. RIBA & al. 1975 29. RUIZ DE GAONA & al. 1946 30. SOLE SABARIS & RIBA 1971 31. VALLE DEL & al. 1973 32. VILLALTA 1966 33. VILLALTA & CABRERA 1977 34. CRUSAFONT & VILLALTA 1957.

**Area No. 10 a1–3: DUERO BASIN W, SW, S AND CENTRAL, E**

Author: E. JIMENEZ FUENTES

References:

1. ALCALA 1972 2. CORROCHANO 1977 3. CRUSAFONT 1952 4. CRUSAFONT & al. 1968 5. GARCIA ABBAD & REY SALGADO 1973 6. GARCIA & ALBERDI 1968 7. HERNANDEZ PACHECO 1930 8. JIMENEZ 1971 9. JIMENEZ 1973 10. JIMENEZ & GARCIA MARCOS 1977 a 11. JIMENEZ & GARCIA MARCOS 1977 b 12. JIMENEZ & GARCIA MARCOS 1977 c 13. NICOLAU & JIMENEZ 1972 14. PLANS 1970 15. ROYO GOMEZ 1922 16. ROYO GOMEZ 1929.

**Area No. 10 b: DUERO BASIN, E, E**

Authors: A. GARCIA DEL CURA & S. ORDONEZ

This zone presents a lot of lageral changes of facies of which the graphic column are a simplification. Possibly the better known formations: "Calizas de Paramos" and "Calizas terminales" are markedly heterochronic. They also present great textural variations generally as a reflection of the variations of the environment sedimentation s. s.

The carbonatic sedimentation is clearly expansive, the "Formacion Arcilla de la tierra de Campos" appears only in the regions nearer to the centre of the Basin (W).

The "Caliza de los Paramos" appears with some deformations of ample expansion (7) but we believe that its extent does not allow to speak of tectonical movements s. s.

References:

1. ALBERDI 1974 a 2. ALBERDI 1974 b 3. CRUSAFONT & CELORRIO 1959 4. GARCIA DEL CURA 1974 a 5. GARCIA DEL CURA 1974 b 6. HERNANDEZ PACHECO 1915 7. ROYO GOMEZ 1926 a.

**Area No. 10 c: DUERO BASIN, E**

Author: L. C. PEREZ GARCIA

On the NW of the Duero (not Bierzo) you can find as a sample of continuous sedimentary from the Palaeogene to the later Miocene, the one of aluvial fans of warm season climate (wet season and dry season).

The means of transport have been mainly water and you can find three facies in them:

Proximal facies. –

In the intramontainous canyon the feeding of the aluvial fans s. s. is characterized by a high granulometry (centil 1 m) and longitudinals point bar.

Middle facies. –

Braited regime with some bigger channels of distribution and a bigger amount of deposits.

Distal facies. –

Braited regime sometimes meander-like.

In the Neogene, these deposits can be assimilated to a series of red detritical in MILLOT (1964) terminology.

It is impossible to date directly these limnic littoral deposits.

Reference:

1. PEREZ GARCIA 1977.

**Area No. 11 a: TAJO-GUADIANA BASIN (FOSA DE MADRID), E**

Authors: C. MARTIN ESCORZA & M. A. BUSTILLO

The Madrid fosse dues its origin to the tectonical processes of the movements of the deep basement (3) which have influenced in some aspect of its sedimentation (6, 16, 17).

The Miocene filling of this tectonic fosse is of continental character. The composition of the detritical marginal facies is very influenced by the basis areas being differentiated 4 types which pass by indentation to a central evaporitical facies (5). The Central System is the matrix area which plaid the most important role, existing in the west part, in the transition from the marginal facies to the evaporitical ones, a transition facies with plenty of neoformed clays, limestones, dolomites and chert which is interpreted as a consequence of the basic chemical lagunal precipitation and diageneses (16, 14, 7). Of the existence a mineralogist sequende in the Saline Unity, it can be inferred the existence of one metamorphic processes at low temperature (12).

The lateral changes of facies detected not only in the surface (5, 8, 14, 15, 19) but by the data obtained in the perforations (15) are very rude in the main part of the cases, because they are conditioned by the tectonic. The disposition of the basement according to main or small block (8) allows through his more moveable boundaries a peculiar dynamic (3) which provoques the isolation of small basing inside the general scheme of sedimentation and the local appearance of small emerged zones which function individually.

In its west boundary its relation with the Paleogene is done by progressive or angular discordances (14, 17).

In spite of the fact that some beds of vertebrates exist, the definition of chronostratigraphic inities is not factible because of the imprecision of the data we have been given up to now.

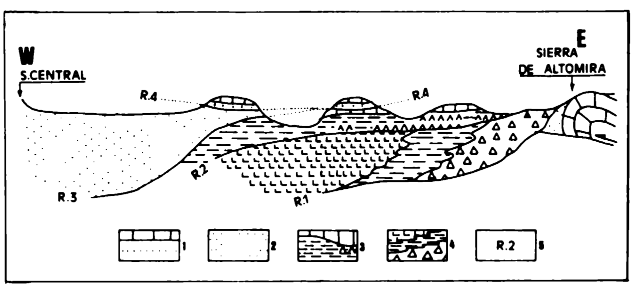
Locally, the thickness can be bigger.

References:
1. AGUIRRE & al. 1976 2. ALIA & al. 1973 3. ALIA 1960 4. ASENSIO AMOR & GONZALEZ MARTIN 1977 5. BENAYAS & al. 1960 6. BUSTILLO REVUELTA 1979 7. BUSTILLO REVUELTA 1976 8. CADAVID 1977 9. CARRO & CAPOTE 1968 10. CAPOTE & CARRO 1968 11. CUTANDA PERALES 1969 12. GARCIA DEL CURA, ORDONEZ & LOPEZ AGUAYO 1979 13. GAVALA LABORDE 1965 14. HUERTAS & al. 1971 15. LLAMAS & LOPEZ VERA 1975 16. MARTIN ES–CORZA 1980 17. MARTIN ESCORZA 1976 18. MARTIN ESCORZA & HERNANDEZ ENRILE 1972 19. MAZO & ALBERDI 1974 20. PEREZ GONZALEZ & al. 1971 21. PEREZ MATEOS & VOUDOUR 1972 22. RIBA 1957 b 23. RIBA, AREVALO & DE LEIVA 1969 24. ROYO GOMEZ 1923 25. VOUDOUR 1974 26. ALONSO & al.

## Area No. 11 a: MADRID BASIN, E

Authors: A. G. MEGIAS, S. ORDONEZ & J. P. CALVO

The Continental Neogene sedimentary filling of the intracratonic Madrid Basin has been divided in four "tecto-sedimentary units" (T. S. U.) by means of the sedimentary main ruptures that bound the top and base of each T. S. U. This dynamic methodology, successfully aplied in marine deposits (MEGIAS, 1973; MEGIAS et al. 1980), seems to be very useful in continental environments. Inerrruptions of the sedimentary process and their relationships with tectonic events, are in fact the real guidelines for the disection of the independent sedimentary units.




Chronostratigraphy is provisionally proposed by correlation with the marine T. S. U. of the Betic Ranges. Additionally the "Hispanotherium" faune (ANTUNES, 1979), NN. 5 Mein's zone (1974), is included in the Langhian time.

T. S. U. –1:

Coarse detritic deposits with a gypsum breccia bed in the northern part of the area. Sandy channels interbedded with carbonates and nodular gypsum – bearing shales in the NE of the basin. Evaporite deposits (anhydrite, magnesite, halite, glauconite, thenardite, polyhalite, bloehdite) and clays (illite, muscovite, kaolinite, montmorrilonite, chlorite) in the center of the basin. Coarse detritic deposits coming from metamorphic rocks in the south-western side.

Rupture in the top of this unit is marked by an unconformity.

T. S. U. –2:

Conglomeratic and sandy channel deposits with gypsum or carbonate beds in the northeastern side. Biotite-sands and green shales with carbonate and cherty beds in central parts of the basin, which laterally change to detrital gypsum facies with mud pebbles and slumping structures. These deposits are interbedded with brown-grey gypsum and shales. In the eastern side are observed gypsum deposits interbedded with shales and carbonates.

Rupture with the overlying units is marked by an erosive or karstified surface.

T. S. U. –3:

Feldspathic sands with interbedded chertified limestone beds and dolomites. These deposits are situated in the central and northern side of the basin.

Rupture in the top of this unit is marked by an erosive surface.

T. S. U. –4:

Fluviatil facies with channels (conglomerates, sands and fluviatil carbonates). Lacustrine carbonates overlie frequently these detritic formation.

References:
1. AGUIRRE & al. 1976 2. ANTUNES 1979 3. BENAYAS & al. 1960 4. CAPOTE & CARRO 1968 5. GARCIA DEL CURA 1979 6. GARCIA DEL CURA & al. 1979 7. MEGIAS 1973 8. MEGIAS & al. 1980 a 9. MEGIAS & al. 1980 b 10. MARTIN ESCORZA 1976 11. ROYO GOMEZ 1926 a 12. VAUDOUR 1979.

## Area No. 11 b: TAJO-GUADIANA BASIN, E ALTOMIRA, E

Authors: M. DIAZ MOLINA & N. LOPEZ MARTINEZ

The Paleogene-Neogene boundary is produced in a lithostratigraphic unit with a sedimentary continuity. This unit has been named "Upper Detritical Unit", that has been dated between the Arvenian (p. p.) and the Aragonian.

All the sedimentation of both the Upper Detritical Unit can be assimilated to alluvial fan and lacustrine environments (mostly playa-lakes).

There are two main orogenic movements, referred to as Castillian (PEREZ GONZALEZ & al., 1971) and Neocastillian (AGUIRRE & al., 1976) phases. The former is intra-Arvernian in age, the latter is post-Agenian in age.

The age of the "Paramos limestones" is still uncertain.

References:

1. AGUIRRE & al. 1976 2. CRUSAFONT & AGUIRRE 1973 3. DIAZ MOLINA & LOPEZ MARTINEZ 1979 4. PEREZ GONZALES & al. 1971.

Area No. 11 c: **TAJO-GUADIANA BASIN**, JUCAR, E

Authors: J. A. SANTOS & N. LOPEZ

The Neogene (Mio-Pliocene) basin has a marked tectonic character, it consists of two blocks which have acted independently after the middle Miocene and have been reactivated in the Quaternary-Upper Pliocene (4).

The materials filling the basin are termed Lower Complex, and can be divided in the following unit (4, 5 and 8):

– Carboneras Unit: formed by well stratified calcareous layers of up to 1 m, dated Chattian–Aquitanian by rest of gastropoda, ostracoda and algae, the unit is laying on triassic materials (2).

– Puntal Blanco Unit: Sediment deposit of big angulate blocks conglomerate facies, evolving to an alluvial deposit fan. The age of the basal discordance (on Mesozoic) of this unit is uncertain, but by regional data it seems to correspond to the Tortonian which indicate the beginning of a regressive period with a continental sedimentation regime.

– Alcala de Jucar Unit: Formed by a 150 m thick, layer of micrite, biomicrite and biopelmicrite with characeas, gastropoda and ostracoda. It consist in a base of alternance of carbonates and organic matter rich layers, followed by alternance of carbonates and marls levels. Several deposits of Vertebrates (2, 3, 7 and 8) allow us to classify this series as Upper Turolian–Lower Villafranquian.

– Fuentealbilla Unit: Basically detritical, with some sandy limestones interlayered and showing a clear soil formation process. This unit is interlayered inside the Alcala Unit; with a progressive discordance as basal contact (paraconformity, erosive discordance and/or angular discordance, depending on zones) (8).

– Yesares Unit: I represents a lateral facies change of the Alcala Unit (W of Valdeganga (8)). Its lithology consists in well stratified gypsum marls, with some clay level, and lenticular gypsum deposits.

The Upper Complex, situated over the previous units, consists of two detritical facies delimited by two perfectly defined discordances, which indicate an important change in the sedimentation process (4, 5, 6, 7 and 8).

The Mio-Pliocene boundary of this basin cannot be defined unambiguously but it can roughly be situated in the middle of the Jucar's canyon slope (3) (near Alcala).

The existence of older deposits (La Gineta), in an higher topographical position, could be explained by the relative blocks displacement (4 and 5), which permit the existence of erosion and/or the lack of sediments in this zone. Therefore it is not necessary to evoke the correlation between the detritical facies of the Upper Complex and the marls and limestones of Valdeganga, that other authors do, to explain this phenomenon (3).

There exist a deposit in Casas del Rincon (2), which actually is under study, where (initially considered) Lower Quaternary fauna is presented, therefore the discordance between the upper and lower complexes can be provisionaly situated almost in the Neogene–Quaternary boundary.

References:

1. AGUIRRE & al. 1976 2. BASCONES & MARTIN 1977 3. MEIN & al. 1978 4. ORDÓNEZ & al. 1975 5. ORDONEZ & al. 1976 6. ROBLES & al. 1974 7. SANTOS 1975 8. SANTOS 1980 9. SANTOS (in prep.) 10. SANCHEZ CELA & al. 1972.

Area No. 11 d: **TAJO-GUADIANA BASIN, UPPER GUADIANA VALLEY, E**

Author: E. MOLINA

The lower levels of Tertiary appearing in this zone are the Miocene limestones. The volcanic breccia is a mixture of schists, shales, quartzites and basic volcanic rocks (olivine, orthopyroxene very common).

The new limestone formation has a lacustrine – palustrine facies with some volcanic episodes and abundant mammalian fauna: *Hipparion, Anancus,* etc. (Ref. 2, 4, 6).

After tectonic, erosive and weathering processes have taken part. It is the moment of formation of **Terra Rossa** and the 1st calcareous crusts, respectively. At the end, the **Paramo** surface is built up. The age of 4,7 m. y. ± 0,7 (Ref. 1) is referred to the top of this surface.

New tectonic phases and the **Rana**'s deposition cut this generalized surface (Ref. 6, 7).

Just after Rana's deposition, a new volcanic periode (lavas, ashes, etc.) of 3,2 ± 0,2 m. y. age (Ref. 1).

Development of a new surface with a new calcareous crust, being the pre-terrasses surface (Ref. 6).

References:

1. AGUIRRE & al. 1976 2. ALBERDI 1974 a 3. GOMEZ DE LLARENA 1916 4. HERNANDEZ PACHECO 1921 5. HERNANDEZ PACHECO 1932 6. MOLINA 1975 7. MOLINA 1976 8. ROYO GOMEZ 1926 b.

Area No. 12 a: **PYRENEAN DEPRESSION, CERDANA, E**

Author: R. JULIA

From the Seo de Urgell to Puigcerda different Neogene casks can be recognized which have not had an homogeneous sedimentological evolution. The Neogene deposits indicated in the column correspond to the filling of the Cerdana cask. You can distinguish two sections one lower lacustrine and another upper fluvial. The contrast between both unities is erosional and slightly angular. The geochronological criteria are based in the remains of Vertebrates found in the lignite of the lower section and in criterions of the lithofacies for the upper section.

References:

1. SOLE SABARIS 1947 2. MARGALEF 1957.

**Area No. 12b: PYRENEAN DEPRESSION (AMPURDAN)**
Authors: R. JULIA & J. MARTINELL

The tectonical depression of the Ampurdan is formed by the Fallines fosse in its west border and by the Riumors fosse in its eastern border. Both fosses are separated by the Colomers - Vilopriu horst where the eocenical materials appear, affected by the Neogene volcanism. The sedimentary evolution of both fosses is not homogeneous, so that while the in the eastern one a transgressive and regressive cycle of the marine Pliocene is registered in the western one a detritical continental sedimentation is preponderate.

The column represents the filling of the Riumors fosse in which the marine Pliocene and the dadations of the volcanics washings allow us to locate the place of the sedimentary chronostratigraphic block.

References:
1. SOLE SABARIS 1962 2. DONVILLE 1973 3. MARTINELL 1976 4. JULIA 1977.

## FRANCE (F)

**Area No. 13: LANGUEDOC – ROUSSILLON, F**
Author: G. DEMARCQ

Aux environs de Montpellier, un golfe marin local permet des l'Aquitanien des depots marins littoraux et saumatres: conglomerat bordier a *Ostrea aginensis*, calcaire brechique, lamachelle a huitres, marnes bleues de Fontcaude a faune saumatre, puis marine (au sommet chlamys tournali), sables marneux littoraux a dents de silaciens, intercalations de niveaux a rongeurs (La Paillade, Caunelles).

Le burdigalien est beaucoup plus etendu et ses facies marins largement transgressifs: calcaire grossier bioclatique clair ("calcaire moellon"), molasses de facies divers, avec faune marine littorale. Le sommet est souvent marneux ou sablo-marneux avec des correlations continentales directes, grace a des faunes de rongeurs (ex: Leucate).

Le Miocene moyen directement transgressif par endroit surtout a l'Ouest, montre des facies varies a faunes marines littorales: marnes bleues, marnes sableuses saumatres, lamallechelles, calcaire molassique, il est incomplet.

Le Tortonien, localise au SW est saumatre et lacustre avec des Mammiferes a Montredon.

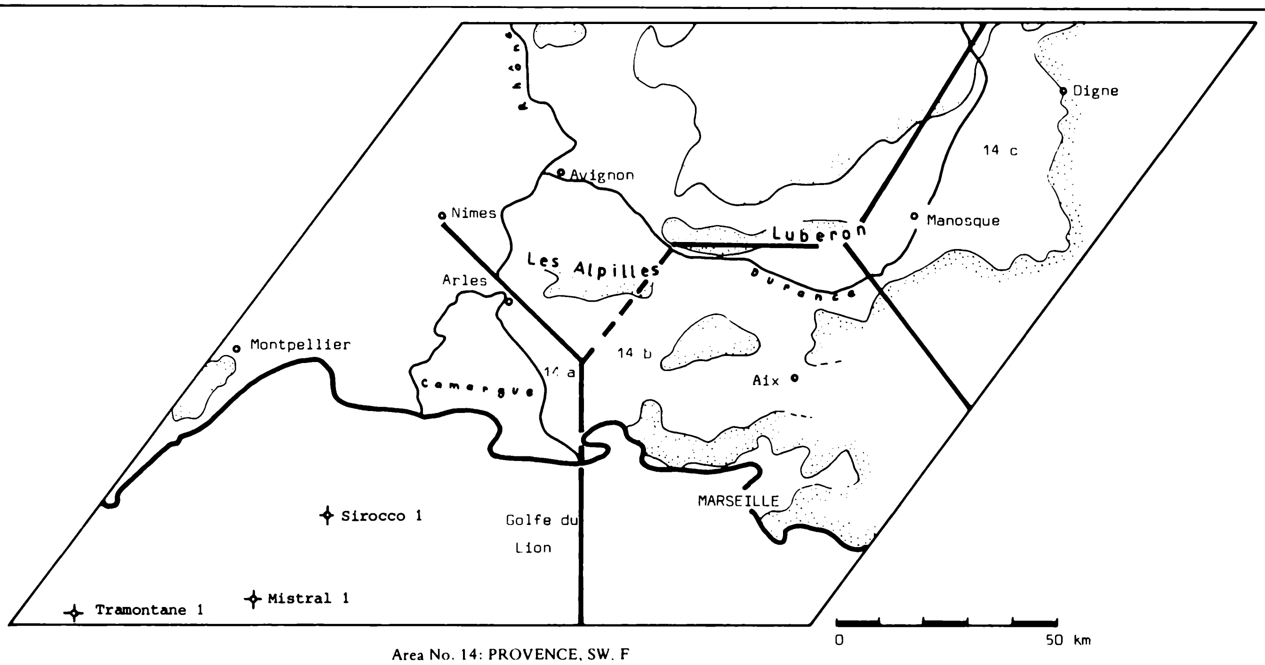
Au Pliocene, les marnes de Cellcneuve et surtout les sables de Montpellier represent des facies continentaux ou parfois saumatres avec riches faunes de macro- et micromammiferes. Le Pliocene n'est franchement marin qu'a l'Est de Montpellier (Pichegu, bordure de la Carmargue) surtout qu'au SW dans le Languedoc (golfe de Perpignan, vallee du Tet) argiles marno-sableuses a faunes de vasieres littorales.

References:
1. AGUILAR 1974 2. AGUILAR 1979 3. CHEVALIER 1961 4. DEMANGEON 1959 5. MAGNE 1976.

**Area No. 14 a: CARMARGUE – GOLFE DU LION, PROVENCE, F**
Authors: R. ANGLADA, F. CATZIGRAS, E. COLOMB & H. MERCIER

La Camargue est recouverte par des depots quaternaires et le Golfe du Lion n'est connu que par des campagnes geophysiques et 4 sondages off shore.

La connaissance du Neogene de ces Bassins est donc fragmentaire mais l'on sait que l'uniformite de surface cache une heterogeneite structurale ou les incidences tecto-




Area No. 14: PROVENCE, SW. F

niques de la phase antemiocene (responsables des hauts fonds et des variations de facies pendant le Miocene) sont souvent masquees par l'intense erosion fini-miocene et les reprises tectoniques pliocenes.

Par ailleurs, l'analyse des documents geologiques est ancienne et, le Neogene ne constituant pas un objectif petrolier prioritaire, certaines informations sont douteuses.

En resume, la transgression "neogene", probablement liee a la dislocation et la derive du continent pyreneo-corso-sarde, debute des l'Oligocene superieur. L'Aquitanien presente des facies tres varies: epaisses formations laguno-lacustres avec depot d'evaporites, facies carbonates a grands Foraminiferes et marnes silteuses avec indices de pelagisme (N 4).

Le Burdigalien, generalement transgressif est de ce fait plus marin que l'Aquitanien quand il lui est superpose. Le Miocene moyen, parfois epais de plus de 1000 metres est, au moins a la base, bien date par les Foraminiferes pelagiques. Le Miocene superieur off shore n'a pu etre caracterise car les facies deviennent tres littoraux des la base du Tortonien et que la serie est tronquee par une erosion messinienne considerable.

Le Pliocene, parfois epais de plus de 2000 metres est souvent lie a l'erosion du reseau hydrographique antepliocene. Le Pliocene inferieur (zone a *Gl. margaritae)* constitue par des marnes gris bleu, homogenes represente la facies le plus profond. Le Pliocene moyen (zone a *Gl. crassaformis)* annonce les facies regressifs bien connus dans les coupes a terre. Le Pliocene superieur est generalement erode ou ne s'est pas depose sous la Camargue et il est tres littoral en off shore.

References:

1. BALLESIO 1971 2. CRAVATTE & al. 1974 3. DEMARCQ 1971 4. POGGI 1968 5. REUNION . . . 1978 6. DOCUMENTS SONDAGES (non publ.).

**Area No. 14 b: DE LA BASSE DURANCE A LA MER, PROVENCE, F**

Authors: R. ANGLADA, F. CATZIGRAS, E. COLOMB & M. MERCIER

De la Basse Durance a la Mer et de la rive gauche du Rhone jusqu'a l'Est du meridien Aix-Marseille, le Neogene presente de nombreux facies variant tres rapidement dans l'espace et dans le temps.

La mer transgresse, avant l'Aquitanien stratotypique, dans les points bas de la plate-forme oligocene: zones deltaique et fluviolacustre. L' amplitude de la transgression reste faible pendant tout l'Aquitanien qui est represente, a l'affleurement par une gamme tres variee de formations fossiliferes: circalittoral, infralittoral, recifal, lagunaire, lacustre, fluviatile, continental.

La transgression du Burdigalien tres rapide a l'echelle regionale parait synchrone en Aquitaine, en Provence et en de nombreux points du Bassin mediterraneen.

Elle est suivie d'une forte erosion qui laisse rarement subsister les marnes a *Globigerinoides sicanus* (N 8) du sommet de l'etage: Pont Gaye.

Cette erosion annonce les facies helvetiens caracterises par une sedimentation marine detritique qui debute de plus en plus tot au fur a mesure que l'on se dirige vers le Nord–Est (zones d'apport).

Le Tortonien marin discordant sur l' "Helvetien" devient rapidement fluviatile, lacustre ou continental. Les formations correspondant a des depots non marins prennent localement le nom de "facies pontiques" ou sarmato-pontiques".

Le Messinien se traduit par une reprise vigoureuse de l'erosion et un enfoncement du reseau hydrographique fini-miocene qui explique la localisation des sediments deposes lors de l'ingression pliocene.

La regression pliocene avec des facies littoraux puis subaeriens est tronquee par des terrasses quaternaires. En Basse Provence occidentale le volcanisme essentiellement basique est d'age Burdigalien.

Toute la serie est impliquee dans l'orogenese alpine: chevauchements (Luberon–Costes) apparaissant lors du depot des formations post-tortoniennes et interessant la serie miocene jusqu'au Burdigalien qui peut etre affecte de pendages inverses, inversion de relief: Burdigalien surplombant le miocene moyen, Aquitanien inferieur surmontant le Burdigalien.

References:

1. ALVINERIE & al. 1977 2. ANGLADA & al. 1972 3. ANGLADA & CATZIGRAS 1975 4. ANGLADA & al. 1978 5. ANGLADA 1980 6. BAUDRON & al. 1965 7. CATZIGRAS & al 1979 8. CATZIGRAS & al. 1980 9. COLOMB 1965 10. COLOMB & al. 1979 11. COMITE FRANCAIS DE STRATIGRAPHIE 1980 12. DEYDIER 1902 13. HUGUENEY & TRUC 1976 14. MAUREL-FERRANDINI 1977 15. MEIN 1975.

**Area No. 14 c: GOLFE DURANCIEN, PROVENCE, F**

Authors: R. ANGLADA, F. CATZIGRAS, E. COLOMB & H. MERCIER

Dans la vallee de la Moyenne Durance, le Neogene est individualise dans ce qu'on appelle le golfe durancien, qui est divise en deux domaines: au Sud, un domaine provencal de plate forme, au Nord, un domaine alpin caracterise par une subsidence permanente.

Dans le domaine provencal le Burdigalien est directement transgressif sur l'Oligocene superieur lacustre: dans le domaine alpin, le substratum est plus detritique (molasse rouge superieure) mais on note des formations lacustres aquitaniennes (vallee du Vancon).

Les facies marins (Burdigalien a Tortonien moyen) sont d'autant plus puissants que l'on se rapproche du fond du golfe (vallee du Vancon) et de la bordure occidentale des Chaines Subalpines Meridionales (chevauchement de la Robine, au Nord de Digne). Ils sont toujours littoraux et ne semblent guere depasser le Tortonien moyen qui est regressif dans toute la Provence.

A partir de la regression, une premiere unite conglomeratique du Complexe de Digne Valensole se met en place resultant du demantelement de la chaine alpine au cours de l'orogenese fini-miocene.

Cet ensemble est relaye dans le domaine alpin par une deuxieme unite conglomeratique tandis que dans le domaine provencal s'intercale le Plaisancien marin.

References:
1. CORNET 1966 2. DESTOMBES 1962 3. GIGOT & al. 1976 4. GUBLER & al. 1975 5. LAPPARENT DE 1938 6. MERCIER 1978.

**Area No. 15 a: MOYENNE VALLEE DU RHONE (VALREAS–FAUCON), F**
Author: G. DEMARCQ

Apres de petits bassins lacustres apars au Stampien, la transgression est aussi tardive que brutale au Burdigalien, dont cette region est le stratotype selon Deperet. Alors, avec des variations de facies et d'epaisseur importantes, s'etalent divers types de molasses, soit detritique, soit marneuse, soit bioclastique, ces dernieres richement fossilifères. Il s'en suit des sediments plus transgressifs encore, sables, molasses zoogenes, marnes, deja moins habites, correspondants au Langhian actuel: on voit alors que l'Helvetien s. s. est a chaval sur les deux. La masse du Miocene moyen est occupee, avec des facies monotones epais et detritiques, par des sables molassiques d'origine alpine: subsidence, conglomerats intercalaires sub-alpins, transgressions locales. Au Miocene superieur, la sedimentation reste marine un moment (marnes et sables tortoniens) puis devient lacustre et palustre, avec lignite et intercalations fluvialiles, enfin conglomeratique et sub-serienne: cette regression correspond au Vallesien et au Turolien. Elle annonce la phase tectonique rhodanienne, qui s' accompagne d'une forte erosion hydrographique: dans la "ria" correspondante l'ingression pliocene depose alors des sediments continentaux, puis marine (Plaisancien) enfin lacustres et fluviatiles: on se lie alors au cycle de la terrasse villafranchienne.

References:
1. DEMARCQ 1973 2. DEMARCQ 1962 3. CARBONNEL 1969 4. MONGEREAU 1970 5. POUYET 1973 6. MEIN 1971 7. BALLESIO 1972.

**Area No. 15 b: LYON – BAS DAUPHINE – VERCORS, F**
Author: G. DEMARCQ

Apres d'epais sediments marno-evaporitiques en graben durant l'Oligocene, la transgression ne se marque, au Burdigalien, que dans le sillon peri-alpin ou elle est molassique et glyptogenetique. Elle gagne ensuite vers le NW, au Langhien puis au Serravallien (L + S = "Helvetien" s. l. des auteurs) le Bas-Dauphine puis le Lyonnais sous forme de sables marneux puis molassiques steriles. Un important atterrissage conglomeratique vers l'E marque la presence d'un fleuve alpin ancetre de l'Isere. A lyon meme la transgression tardive aborde le cristallin du Massif Central (biotopes saxicoles). Vers le NE les sables de Chimilin du Serravallien superieur livrent quelques fossiles marins; au milieu (Bas-Dauphine) les sables de Tersanne fossiliferes annoncent la dessalure au debut du Tortonien. L'ensemble du bassin devient alors lacustre (marnes sableuses a lignite) puis fluviatile (conglomerats polygeniques). Apres l'emersion fin Miocene, accompagnee cote subalpin par la phase orogenique rhodanienne, le creusement de la ria pliocene remonte jusqu' a 20 km au S de Lyon (paleophone), remplie au flaisancien par des marnes marines puis des sables fluviatiles enfin des conglomerats qui achevent le cycle au Villafranchien.

References:
1. DEMARCQ 1973 2. DEMARCQ 1969 3. CARBONNEL 1969 4. LATREILLE 1969 5. POUYET 1973 6. BALLESIO 1972 7. MEON-VILAIN 1970.

**Area No. 15 c: LYON – DOMBES – BRESSE, F**
Author: G. DEMARCQ

Apres d'epais sediments marno-evaporitiques en graben durant l'Oligocene (Bresse, bassin independant du Bas-Dauphine) la transgression tardive ne depasse Lyon qu' au Serravallien, puis seulement a la limite Serravallien–Tortonien encore plus au N. La mentation s'acheve par des marnes sableuses fluvio-lacustres a pollens, micromammmiferes et mollusques d'eau douce. Le cycle pliocene, ravinant plus ou moins le Miocene, repete oes facies fluvio-lacustres, qui s'achevent pas des conglomerats se liant finalement a la terrasse villafranchienne.

References:
1. DEMARCQ 1973 2. DEMARCQ 1962 3. CARBONNEL 1969 4. LATREILLE 1969 5. MEIN 1975 b 6. BALLESIO 1972 7. MEON-VILAIN 1970.

**Area No. 16: LIGURIAN BASIN BORDER, F**
Author: F. IRR

Added symbols: H hyperhaline, ꟸ Algae.

The Miocene basins of Vence and of Roquebrune–Cap Martin are not interconnected. Owing to their littoral facies, stratigraphic correlations between these two basins are yet to be established; in the Vence basin, only the lower part of the series is dated on the basis of planctonic Foraminifera (Aquitanian by *Globigerinoides primordius* and Burdigalian by *Globigerinoides trilobus);* in the Roquebrune–Cap Martin basin, only the upper part has been precisely dated on the basis of Foraminifera (Tortonian by *Globorotalia menardii).*

Radiometric dating of the andesitic tuffs was established by the K-Ar method.

After the important movements at the end of the Miocene, a discordance is reported at the Upper Pliocene; but in actual fact the tectonic movements had been continuous throughout the entire Pliocene period.

The following have not been shown on the stratigraphic table:

– the continental Miocene formations of the subalpine border situated west of the Vence basin.

– the thick detritic series (Upper Oligocene to Aquitanian) detected first by coring and then by deep-diving submersible at a depth of 2000 m off the Maures (BELLAICHE, G. et al. 1976, see below ref. 2; Groupe Estocade 1978; Messinian subaerial erosion of the Stoechades and Saint-Tropez Canyons – a submersible study. Marine Geology, 27, p. 247–269).

References:
1. ANGLADA & al. 1967 2. BELLAICHE & al. 1976 3. BELLON & BROUSSE 1971 4. GIAMMARINO & TEDESCHI 1975 5. GINSBURG 1960 6. GOHAU & VESLIN 1960 7. IAWORSKY & CURTI 1960 8. IRR 1973 9. IRR 1975 10. IRR & DARDEAU 1976 11. LE CALVEZ & VERNET 1966.

Area No. 300 a: **AQUITAINE (= SUD DES LANDES) MERIDIONALE, F**
Author: G. DEMARCQ

Par rapport a l'Aquitaine septentrionale les differences portent sur les points suivants:

– Les formations d'Escornebeou ont ete recemment etudiees en detail sur le plan biostratigraphique pour tous les groupes: en particulier les macrofaunes et microfaunes et la polynologie indiquent un age oligocene superieur terminal: zone NP 25 a *Sphenolithus aperoensis* pour le nannoplancton, base de la zone N3 de Blow pour les foraminiferes.

– La continuite marine semble assuree entre ces formations d'Escornebeou et la base du Mïocene, marquee entre autres par l'apparition des *Glolugerinoides,* base de la zone N4 de Blow.

– Le miocene inferieur montre des facies marins continus, moins littoraux et plus marneux qu'en Aquitaine septentrionale. Jean FIC (SW des Landes) le Burdigalien superieur date par foraminiferes est present.

– Les marnes de Saubrigues, avec faune de vasiere littorale a herbier, d'age miocene moyen (ou Burdigalien superieur, mais non pas du Tortonien) achevent la serie.

– Les sables de Landes (Pliocene superieur et Pleistocene) montrent des developements de zones palustres a lignites avec macro et micro flores.

References:
1. ALVINERIE & al. 1964 2. DEPERET 1893 3. PUJOL 1970 4. CARALP & DEMARCQ (in prep.) 5. CARALP & al. 1966 6. CARALP & al. 1964 7. POIGNANT 1967 8. VIGNEAUX & al. 1964 9. VIGNEAUX & MARKS 1967 10. GROUPE FRANCAIS 1974.

Area No. 300 b: **AQUITAINE SEPTENTRIONALE (= BORDELAIS), F**
Author: G. DEMARCQ

En dehors des stratotypes aquitanien et burdigalien, les affleurements du Miocene inferieur sont extremement rares, d'extension geographique reduite et difficiles a correler. Des gisements classique proches de Bordeaux sont disparus mais plusieurs forages recents completent les affleurements epars.

L'Aquitanien est transgressif sur des calcaires et marnes lacustres de l'Oligocene superieur (calcaires de l'Agenais). Le Burdigalien est transgressif sur un horizon limite de calcaire lacustre situe au toit de l'Aquitanien, plus developpe vers l'interieur (Est et disparaissant vite vers l'Atlantique (Ouest).

L'Aquitanien stratotypique que renferme des alternances de sables littoraux coquillers et de marnes saumatres verdatres abondantes surtout a la base mais aussi lateralement. L'une des coupes type est celle du moulin de Bernachon et du moulin de l'Eglise.

Le Burdigalien co-stratotypique est represente surtout par des faluns (sables fins saumatres tres coquilliers): gisements du Coquillat a Leognan; de Pont-Pourquey, de Saucats.

Dans l'ensemble la transgression du Miocene inferieur ne penetre que de quelques dizaines de kilometres. La sedimentation est plus epaisse et plus homogene a l'W (faluns = sables calcaires jaunes tres fossiliferes, plus ou moins glauconieux et argileux; plus mince et plus heterogene a l'E (lithofacies varies tres littoraux, saumatres ou lacustres).

En forage of Shore (une quarantaine), la destruction entre Aquitanien et Burdigalien apparait moins fondee que dans les environs de Bordeaux.

De plus la totalite du temps "Miocene inferieur" n'est probablement pas integralement materialisee par les sediments. Tout se passe comme si les donnees etaient plus unifiees dans un regime marin moins littoral et plus ouvert, mais pas forcement continu.

Le "Sablomacien" etage local, correspond a une nouvelle transgression temporaire, ravinant le Burdigalien, il est marque par des sables greseux bioclastiques plus ou moins fossiliferes correspondant sans doute a und episode plutot basal du Miocene moyen.

Ensuite il a emersion et les sables des Landes fluviatiles (pliocene superieur-pleistocene) recouvrent legerement sur quelques metres la topographie plane du Bordelais.

References:
1. ALVINERIE & al. 1964 2. DEPERET 1893 3. PUJOL 1970 4. CARALP & DEMARCQ (in prep.) 5. CARALP & al. 1966 6. CARALP & al. 1964 7. POIGNANT 1967 8. VIGNEAUX & al. 1964 9. VIGNEAUX & MARKS 1967.

Area No. 309: **BASSINS DE LA LOIRE ET DE BRETAGNE, F**
Author: G. DEMARCQ

Dans la zone de moyenne Loire, la partie meridionale du bassin de Paris devient subsidente apres la transgression du Stampien. Au dessus des calcaires lacustres de Beauce (Chattien–Aquitanien) les marnes sableuses du Gatinais (Aquitanien ?), plus les sables argilo-marneux de Blessis (Burdigalien infe. ?) puis les sables argileux de Sologne (Burdigalien sup. ?) annoncent l'arrivee d'une transgression atlantique au Miocene moyen.

Ce sont les faluns d'Anjou, qui remontent a l'E jusqu'a Blois dont les facies littoraux zoogenes et fossiliferes sont tres varies, tres meles et peu epais. On reconnait en Anjou comme en Bretagne deux facies, le pont levien cotier forme de sables grossiers a coquilles roulees (faluns de Pontlevoy, d'Anjou, de Touraine et du Blessis) et le facies savigneen sublittoral forme de debris calcaires a Bryozoaires, Algues et Polypiers (Savigne en Anjou, Bretagne). Ces facies avaient ete denommes "Falunien" par d'ORBIGNY et consideres comme "Vindobonien" par DEPERET; la presence d'un hipparion au sommet le ferrait s'achever au debut du Miocene superieur.

Une nouvelle sedimentation reprend au Pliocene: c'est le Redonien (du nom latin de Rennes) de facies egalement tres varies mais rarement fossiliferes et toujours detritiques: sables gris glauconneux avec ou sans fossiles roules, argiles noires a pollen, sables fins a diatomees, sables rouges.

Paleographiquement, la transgression du Miocene moyen interesse surtout la moyenne vallee de la Loire dont elle prefigure le trace hydrographique et s'etale largement dans la basse Loire. Celle du Pliocene n'interesse que la basse Loire mais recouvre entierement la basse Bretagne (bassin de Rennes) et jusqu'au Cotentin.

References:

1. DURAND 1960 2. BREBION & al. 1958.

Area No. 20: **CORSICA, F**
Author: F. ORSZAG-SPERBER

In Corsica, since the Brudigalian, the sedimentation begins after the thrusting of the Alpine Corsica (2).

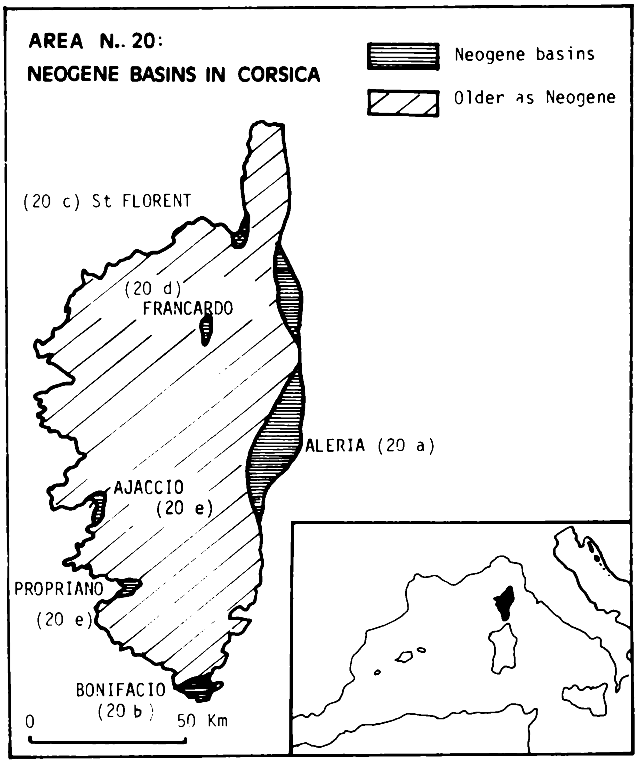
The Neogene Corsican sedimentary basins did not evolve in the same way: it is only the Eastern one which contains the most complete sequence (6). Three regressive periods (at the Langhian, Serravallian and Messinian stages) can be observed, throughout the Western Mediterranean basin.

The sediments of these basins during the Miocene show a variety of paleoenvironments (reefal environments, deeper sedimentation, or continental and brakish deposits), and the Pliocene is marine.

Tectonic activity, mainly in extension, syn- and post-sedimentary deposition have been observed.

References:

1. ALESANDRI & al. 1977 2. DURAND-DELGA & al. 1978 3. MAGNE & al. 1977 4. ORSZAG-SPERBER 1975 5. ORSZAG-SPERBER 1978 6. ORSZAG-SPERBER 1979 7. ORSZAG-SPERBER & FREYTET 1972 8. ORSZAG-SPERBER & PILOT 1976.




CORSICA (20) - Localisation of Neogene basins

## ITALY (I)

Area No. 17 a: **PIEMONT BASIN, I**
Author: R. GELATI

GL = *Globigerinoides* GN = *Globigerina nepenthes* PG = *Praeorbulina glomerosa* OU = *Orbulina universa* GP = *Globorotalia praemenardii* GM = *Globorotalia menardii*

References:

1. CITA & al. 1965 2. CITA & BLOW 1969 3. BONI & CASNEDI 1970 4. GELATI 1968 5. GELATI 1977 6. GELATI & al. 1978 7. NAKAGAWA & al. 1974 8. ROBBA 1968 9. ROBBA 1972 10. SACCO 1889–1890 11. STURANI & SAMPO 1973 12. BELLINZONA & al. 1971.

Area No. 17 b: **PO BASIN N, I**
Author: R. GELATI

References:

1. CITA 1957 2. DESIO 1973 3. LONGO 1968 4. VENZO 1934 5. BONI & al. 1970 6. CARRARO & al. 1969 7. RÖGL & al. 1975 8. RIZZINI & DONDI 1978.

Area No. 17 c: **VENETO AND FRIULI, I**
Author: S. IACCARINO

References:

1. DESIO 1973 2. MASSARI 1975 3. VENZO 1977 4. RAFFI & RIO 1978.

Area No. 17 d1: **SALSOMAGGIORE AREA, I**
Author: R. GELATI

References:

1. ARRIGONI & al. 1965 2. DESIO 1973 3. MEDIOLI & ZANZUCCHI 1963 4. MEDIOLI & al. 1964 5. GIAMMETTI & al. 1968 6. IACCARINO & PAPANI 1980.

Area No. 17 d2: **EMILIA WESTERN APENNINE, I**
Author: S. IACCARINO

References:

1. BARBIERI 1967 2. IACCARINO 1967 3. BONI & al. 1971 4. DESIO 1973 5. ARRIGONI & al. 1965 6. PELOSIO 1967.

**Area No. 17 d3: ROMAGNA APENNINE, I**
Author: S. IACCARINO

References:
1. CATI 1974 2. CATI & al. 1968 3. COLALONGO & al. 1974 4. CREMONINI & ELMI 1971 5. LIPPARINI 1966 6. LIPPARINI 1969 7. DESIO 1973 8. RICCI LUCCHI 1968.

**Area No. 19: PONTINE DEPRESSION, I**
Authors: M. B. CITA & R. GELATI

Reference:
Note Illustrative Carta Geologica d'Italia Foglio 136 – Foglio 142 Serv. Geol. Ital. 1970.

**Area No. 19 a: PIANOSA ISLAND, TYRRHENIAN SEA, I**
Author: M. B. CITA

References:
1. DALLAN NARDI 1967 2. BARBERI & al. 1969.

**Area No. 20: CORSICA, F AND 21, 22: SARDINIA, I**
Author: R. GELATI

GM = *Globorotalia margaritae*, GS = *Globigerinoides bisphaericus*

References:
1. ASSORGIA & al. 1977, 2. BELLON 1976 3. COULON & al. 1974 4. COULON 1977 5. DI PAOLA & al. 1975 6. SAVELLI 1975 7. CHERCHI 1971 8. ORSZAG-SPERBER 1971 9. ORSZAG-SPERBER 1974 10. PECORINI & POMESANO CHERCHI 11. DIENI & OMENETTO 1960 12. FERRO 1963 13. OTTMANN 1953 14. OTTMANN 1956 15. OTTMANN 1958 16. ZINONI 1958 17. BECCALUVA & al. 1977.

**Area No. 22: SARDINIA, GRABEN OF CAMPIDANO, I**
Author: R. GELATI

Regional Biozones (CHERCHI, 1971)
A – *Globigerina ciperoensis angulisuturalis* B – *Globigerinita dissimilis* (1 – *Globigerinoides primordius;* 2 – *G. altiaperturus/trilobus*) C – *Globigerinoides trilobus* (3 – *Globoquadrina dehiscens;* 4 – *Globigerinoides bisphericus;* 5 – *Praeorbulina glomerosa*) D – *Orbulina* s. l. (6 – *O. suturalis;* 7 – *O. universa;* 8 – *Globigerinoides obliquus obliquus*) E – *Globorotalia acostaensis acostaensis* (9 – *G. continuosa;* 10 – *G. obliquus extremus;* 11 – *G. suterae*) F – *G. conomiozea* (12 – *G. mediterranea*) G – *G. margaritae.*

Il bacino e ininterrotto dal Golfo di Cagliari all'Asinara. Le lave alcaline, per lo piu basaltiche, sono plio-quaternarie; la loro eta varia da 5,5 – 2 m. a. circa.

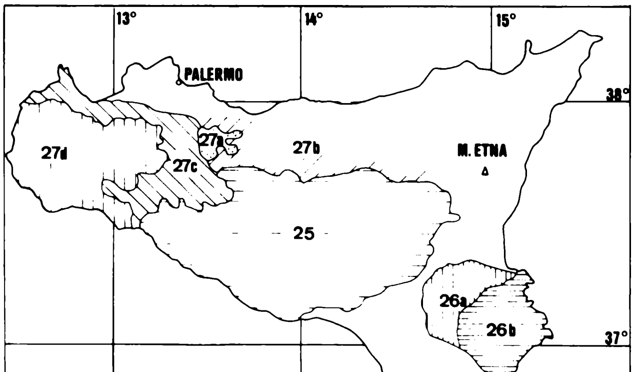
Il graben del Campidano (dal Golfo di Cagliari a quello di Oristano) e successivo al Miocene e sblocca tettonicamente il bacino miocenico; il graben e riferibile al Pliocene sup., contemporaneo cioe alla Formaz. di Samassi che ne costituisce la colmata e precedente alle colate basaltiche di 3 m. a.

**Area No. 23: CALABRIA, CROTONE BASIN, I**
Authors: L. PAGGI & M. B. CITA

References:
1. RODA 1965 2. DESIO 1973 3. CECCHI & MARTINA 1976 4. SELLI & al. 1977.

**Area No. 24: CALABRIA PUNTA STILO, I**
Authors: M. B. CITA & MALINVERNO

References:
1. PATA 1955 2. DESIO 1973.



NEOGENE SEDIMENTATION AREAS: SICILY, I

**Area No. 25, 26, 27: SICILY, I**
Author: A. D. GRANDE

In Sicily the outcropping Neogene terrains are chiefly sedimentary and more or less detrital; excluding the Peloritani Range, where they are allochthonous, in the remaining part is possible to distinguish three groups of lithostratigraphic sequences which are clearer in Upper Miocene. The first group includes the series of Caltanissetta (25), Castelvetrano (27) and Ciminna (27 a) basins and is lithologically very uniform in its Upper Miocene-Pliocene units; the second one belong the Sicani–Trapanese Mountains series (27 c), characterized by a mainly carbonatic facies of Lower Miocene age, and the mostly pelitic-arenaceous or marly series of the Madonie–Nebrodi Mountains; the third group is found in the iblean area, showing an eastern carbonatic marine littoral series and a western marly or calcareous or evaporitic series. All the lithostratigraphic units are interested by either tensional or compressive tectonic phases with an age mainly between Middle–Upper Miocene and Holocene.

Reference:
1. ACCORDI 1962 2. BOMMARITO 1981 3. CAMPISI 1968 4. CATALANO & al. 1976 5. CATALANO & SPROVIERI 1971 6. CITA 1959 7. CITA & DECIMA 1975 8. ROMANO & al. 1979 9. DECIMA 1979 10. DE-

CIMA & WEZEL 1971 11. DESIO 1973 12. DI GRANDE 1969 13. DI GRANDE 1972 14. DI GRANDE & al. 1978 15. DI GRANDE & ROMEO 1981 16. GRASSO & al. 1978 17. OGNIBEN 1954 18. OGNIBEN 1960 19. OGNIBEN 1975 20. RIGO & BARBIERI 1958 21. RODA 1967 22. RUGGIERI & TORRE 1973 23. SCHMIDT DI FRIEDBERG 1964–65 24. VEZZANI 1973.

**Area No. 28: MARCHES ABRUZZES BASINS, I**
Author: R. GELATI

References:
1. CRESCENTI & al. 1969 2. CRESCENTI 1966 3. DESIO 1973 4. RICCI LUCCHI 1975 5. SELLI 1954 6. CARLONI & al. 1971 7. GIROTTI 1969 8. GUERRERA 1977.

**Area No. 29: BRADANICA FOREDEEP, I**
Author: R. GELATI

References:
1. ENI 1972 2. CENTAMORE & al. 1971 3. DESIO 1973 4. MONGELLI & RICCHETTI 1970.

**Area No. 30: INTRA–APENNINIC BASINS, I**
Author: R. GELATI

References:
1. SELLI 1957 2. DESIO 1973 3. COCCO 1971 4. CESTARI & al. 1975.

**Area No. 31: SALENTO BASIN, I**
Author: R. GELATI

References:
1. DESIO 1973 2. ROSSI 1969.

**Area No. 32: UMBRIA BASIN, I**
Author: R. GELATI

References:
1. ACCORDI & MORETTI 1967 2. JACOBACCI & al. 1970 3. PERNO 1969 4. RICCHI LUCCHI 1975 5. GUERRERA 1977.

## G R E E C E (GR)

**Area No. 33 b–d: IONIAN ZONE, GR**
Authors: J. J. BIZON & G. BIZON

Unstability of Epirus is clearly reflected in the Oligocene and Neogene sedimentation.

During the middle Oligocene, uplift of the internal Ionian zone (b).

– Major tectonic phase with overthrusting at the end of the Burdigalian in the middle Ionian Zone (c) (Zalagon: Trias on Burdigalian).

From Langhian to late Miocene, marine sedimentation is restricted to the actual coast of Epirus. High tectonic activity during all this period (Trias on Tortonian at Parga).

– Sandy conglomeratic facies (Arkhangelos formation) probably belongs to the Plio–Pleistocene. In Arkhangelos 1, Triassic limestone was recovered under 600 m. of this formation.

Local Biozones
A = *G. ampliapertura*, B = *G. opima*, C = *G. ciperoensis*, D = *G. kugleri/primordius*, E = *G. dissimilis/altiaperturus*, F = *G. trilobus*, G = *P. glomerosa*, H = *G. peripheroronda*, I = *G. mayeri*, J = *G. menardii*, K = *G. acostaensis*, L = *G. humerosa/mediterranea*.

References:
1. AUBOUIN 1959 2. BIZON 1967 3. BIZON & BIZON 1968 4. BORNOVAS 1960 5. IFP – IGRS 1966 6. MULDER DE 1975 7. RENZ 1955 8. SAVOYAT 1977 9. ZACHOS & al. 1963.

**Area No. 37 a: CORFU, GR**
Authors: G. BIZON & J. J. BIZON

In the North West part of Corfu, Oligocene strongly folded deposits are overthrusted by Eocene, Jurassic or Triassic limestones (Pantokrator mountain).

Late Miocene marls and breccia with gypsum strongly folded, overthrusted by triassic limestone and breccia.

Brakish shallow water clays with Ostracoda and plant remains near the boundary Miocene–Pliocene.

High tectonic instability after the early Pliocene transgression. Withdrawal of the sea during the Middle Pliocene – in the central part of Corfu, marine middle Pliocene overthrusted by triassic breccia.

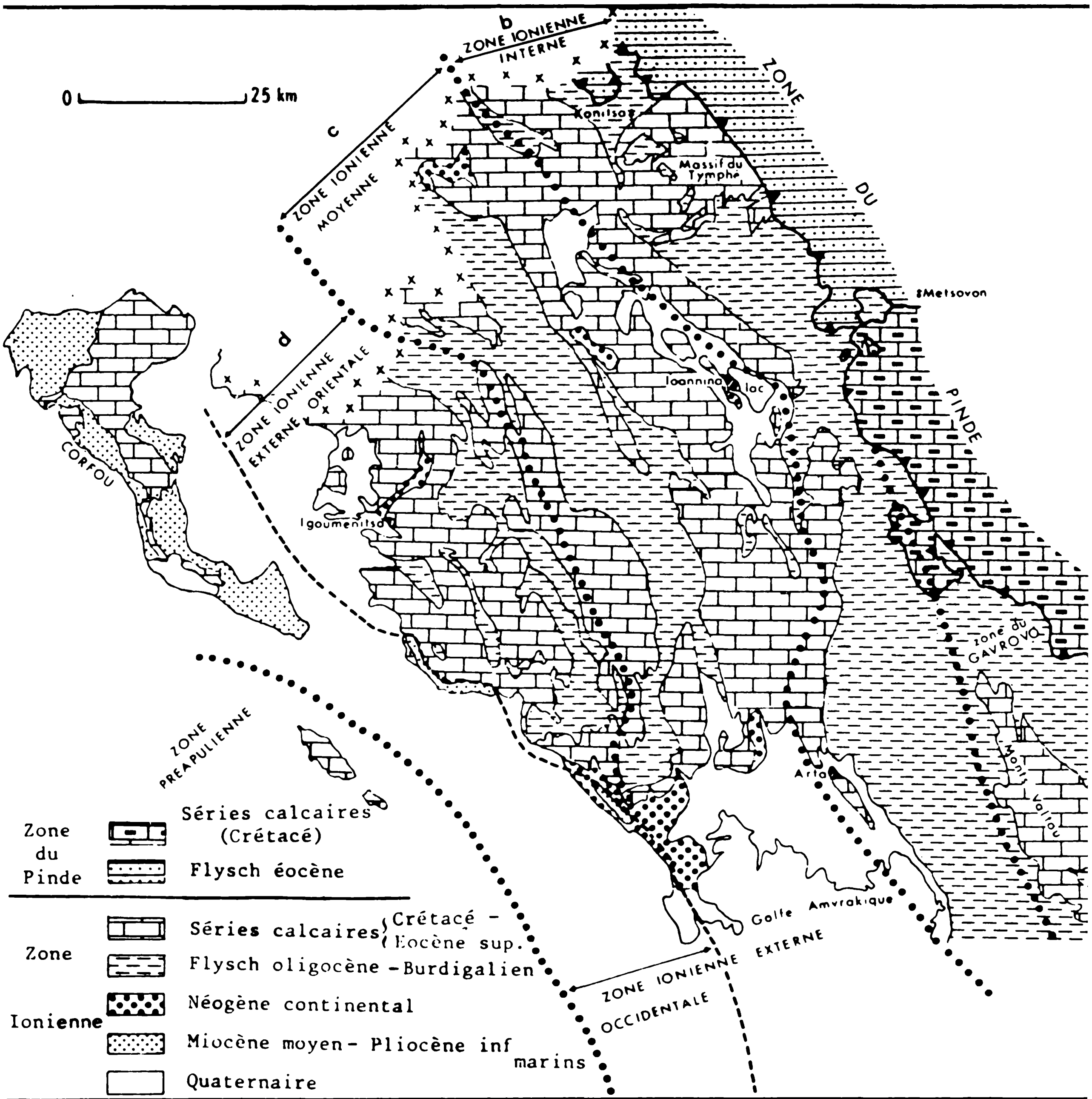
Clays and sandy conglomeratic beds poorly fossiliferous in the Northern part of Corfu (Pliocene–Pleistocene ?).

Local biozones:
B = *G. opima*, C = *G. ciperoensis*, D = *G. kugleri/G. primordius*, K = *G. acostaensis*, L = *G. humerosa/G. mediterranea*, M = *Sphaeroidinellopsis acme + G. margaritae*, N = *G. puncticulata*, O = *G. crassaformis*.

References:
1. BIZON 1967 2. HEIMANN & al. 1975 3. HEIMANN 1977 4. IFP – IGRS 1966 5. MARANGOUDAKIS 1967 6. MULDER DE 1975 7. PINEL 1965 8. RENZ 1955 9. VAN DER VLERK & POSTUMA 1967 10. VISMARA SCHILLING & al. 1976.

**Area No. 37 b: LEFKAS, GR**
Authors: G. BIZON & J. J. BIZON

Lefkas East belongs to the External Ionian Zone. Sediments are strongly folded with a main tectonic phase in the late Burdigalian.




Detailled situation of Neogene areas No. 33 b, c, d

In Lefkas West, late Burdigalian is transgressive on Eocene. Late Miocene is overthrusted by Triassic – early ,iassic limestones.

egional Biozones (see Corfu)

eferences:
. BIZON 1967 2. BORNOVAS 1964 3. IFP – IGRS 966.

rea No. 37 c: KEFALLINIA, GR
uthors: G. BIZON & J. J. BIZON

In northern part of Kefallinia, late Oligocene–Aquitaian is transgressive on early Eocene. 5 km to the North (Kondogourata) late Burdigalian is transgressive on late Paleocene with a hiatus of Eocene, Oligocene and early Burdigalian.

Serravallian seems to be partly missing.

Tortonain and Messinian marls and conglomerates are overlain by gypsum with a brackish environment.

Marine marls and sands in Pliocene and Pleistocene.

Tectonic

Tangential movements in early Serravalian (Overthrust of Eocene limestone), and in early Pliocene.

Strong vertical movements in Pliocene – Pleistocene. Regional Biozones (see Zakinthos)

References:
1. BIZON 1967 2. BRAUNE 1973 3. DREMEL 1968 4. HEIMANN 1977 5. JENKINS 1972 6. SOREL 1976.

**Area No. 37 d1: ZAKINTHOS, GR**
Authors: G. BIZON & J. J. BIZON

Eocene, Oligocene and Miocene sediments are transgressive on the western late Cretaceous, shallow water limestones of Zakinthos. Early Oligocene with algae and Nummulites, Late Oligocene strongly faulted, eroded, very thin or absent (breccia and reefal limestones with *Lepidocyclina, Miogypsinoides* and *Miogypsina).* These sediments are overlain by marly intercalations (N 4–5). Occurrence of Middle Burdigalian is doubtful.

From late Burdigalian to Serravallian, marly sediments with some conglomeratic beds. Clastic marly deposits from early Tortonian to Messinian. Evaporites in late Messinian (30 meters in subsurface). Brakish deposits in some places. Early Pliocene transgression -- Marls and sandy marls in Pliocene. Pleistocene with marls, sand and calcarenitic beds.

**Tectonic**

In South-East of Zakinthos, Skopos overthrust from late Miocene to early Pliocene – *Sphaeroidinellopsis acme* marls very strongly folded in front of Skopos.

Important vertical movements from Pleistocene to Recent.

Regional biozones:
D = *G. kugleri/G. primordius,* E = *G. altiaperturus/G. dissimilis* F = *G. trilobus,* G = *Praeorbulina glomerosa,* H = *Orbulina suturalis/G. fohsi peripheroronda,* I = *G. mayeri,* J = *G. menardii,* K = *G. acostaensis,* L = *G. humerosa/G. mediterranea,* M = *Sphaeroidinellopsis acme* + *G. margaritae,* N = *G. puncticulata,* O = *G. crassaformis,* P = *G. inflata.*

References:
1. BIZON 1967 2. BIZON & al. 1969 3. BIZON & MIRKOU 1969 4. BIZON & MULLER 1977 5. DERMITZAKIS 1978 6. IFP – IGRS 1966 7. HEIMANN 1977 8. HORSTMANN 1967 9. MIRKOU 1974 10. SOREL 1976.

**Area No. 37 d2: IONIAN BASIN (ZAKHYNTHOS), GR**
Authors: M. DERMITZAKIS & D. PAPANIKOLAOU

The lower part of the Miocene sequence of southwestern Zakynthos consists of marls and marly limestones, with intercalations of generally positively graded detrital limestones, illsorted limestone conglomerates and breccio-conglomerates. The marls and marly limestones were deposited in relatively deep water. Their planktonic foraminiferal assemblages can be correlated with the interval of zones $N_4$ (Aquitanian) to $N_{15}$ (Serravallian), which indicates that the calcareous successions are of Early and Middle Miocene age.

The coarse intercalations reflect deposition by mass transport of a very proximal character. The faunas of these beds display a mixture of Cretaceous, Eocene, Oligocene and Lower Miocene larger foraminifera.

The upper part of the Miocene sequence is predominantly composed of clays and sands of Late Miocene (Tortonian–Messinian) age. Evaporites occur in the upper-most part of these terrigenous-clastic successions.

The change from calcareous mud into terrigenous-clastic sedimentation took place approximately at the transition from the Middle to the Late Miocene. It was the result of a major tectonic event, resulting in a fundamental change of the paleogeographic configuration.

In the Early and Middle Miocene differential vertical movements caused a fairly constant rejuvenation of the relief. These movements triggered the removal of coarse material from the basin margin and its downslope transport by gravity-induced currents to deeper parts of the basin. The basin margin was located to the west; the present Vrachionas mountains formed a shoal and were in part even subject to erosion.

In the Late Miocene Zakynthos was incorporated in an overall submergence and large amounts of terrigeneous-clastic sediments were supplied from more distant course areas. The evaporites of the uppermost part of the terrigeneous-clastic successions reflect the effect of the Messinian salinity crisis, which was connected with a lowering of the sea level.

Generally, the Lower Pliocene sediments conformably overlie the Upper Pliocene sequende. The occurrence of an angular unconformity between Lower Pliocene calcarenites and marls and Upper Miocene sands and clays near Vrachionas mountains, however, points to local tilting and erosion prior to the Early Pliocene flooding.

References:
1. DERMITZAKIS 1978 2. MIRKOU 1974.

**Area No. 38 a1: GREVENA, GR**
Authors: G. BIZON & J. J. BIZON

Very thick sedimentary sequence from late Oligocene to late Burdigalian with fluviatile to marine environments.

Regional Biozones:
C = *G. ciperoensis,* E = *G. altiaperturus/G. dissimilis,* F = *G. trilobus.*

References:
1. IFP – IGRS 1961–1967 2. BRUNN 1956 3. DESPRAIRIES & al. 1977.

**Area No. 38 a2: MESOHELLENIC BASIN, GR**
Authors: D. PAPANIKOLAOU & M. DERMITZAKIS

Deposition of clastic sediments within the mesohellenic basin during Oligocene times in transgression over the Pindos zone and the Pindos ophiolite nappe to the west and the Pelagonian metamorphic rocks to the east. Cycles of coarse-grained. Sediments alternate with cycles of fine-grained sediments and cyclothems. The deposition continuous throughout lower and middle Miocene times with internal unconformities and creation of paleoreliefs covered by younger cycles. During middle to late (?) Miocene the deposition of the Ondrias formation marks the end of essentially marine, sedimentation in the basin trough a very shallow platform characterized by lithothamnium limestones and lumachells of *Ostrea.* Since then vertical movements of several hundreds of meters have uplifted parts of the basin delimited by very active transcurrent faults. Fluviatil and terrestrial sediments are locally developed over the Pliocene landscape.

References:
1. BRUNN 1956 2. DESPRAIRIES 1979 3. GEORGIADES-DIKEOULIA & al. 1977 4. PAPANIKOLAOU & SIDERIS 1977 5. SOLIMAN & ZYGOJANNIS 1977.

**Area No. 39: THESSALONIKI – CHALKIDIKI MARGINAL BASIN, GR**
Author: M. DERMITZAKIS

The cycle starts with the Upper Lutetian and ends with the Lower Oligocene Deposition of melasse type sediments prevail. Deformation is even less pronounced than in the former cycles. Upthrusting occurs at the margins of the Serbo–Macedonian Massif.

The Neogene–Quaternary cycle begins with the subsidence of basin regions without relations to the former orogenic structural pattern. The continental fluviatile and lacustrine sedimentation in these basins only in places is interrupted by brackish or marin ingressions.

References:
1. ARAMBOURG & PIVETEAU 1929 2. FREYBERG VON 1955 3. SONDAAR 1968 4. SAKELLARIOU & SYMEONIDIS 1970 5. KOCKE & MOLLAT 1977.

**Area No. 40: STRIMON BASIN, GR**
Authors: M. DERMITZAKIS & E. LEKKAS

The lower part of the Neogene sequence is composed of non-marine, fluviatile and lacustrine clastic sediments ("Basalschichten" of GRAMANN and KOCKEL, 1969, Lefkon Formation + Ano Metochi Formation of ARMOUR-BROWN et al., 1979) throughout the Strimon Basin. According to the latter authors the fluvio-lacustrine successions reflect the sedimentary expression of block-faulting along SW–NE trending faults. Coarse granite breccias intercalated in the uppermost part suggest mass transport triggered by movements along fault escarpments bordering the basin in the Serrai area at the time.

Micromammals recovered from the lower part of the Lefkon Formation near Serrai indicate a Vallesian Age (MN 10/11) while those from the upper part of the Lefkon suggest a Late Turolian Age (MN 13/14), sporomorphs belong to the Kizilhisar association. These data suggest that the Lefkon Formation is of Late Miocene age.

The upper part of the unit contains fresh-water limestones with a maximum thickness for individual bodies of some tens of metres, lacustrine clayey beds with micromammals suggesting a Late Turolian Age and brackish sediments with ostracodes indicative of the Pontian. The evaporites reflect the sedimentary expression of the Messinian salinity crisis; in off-shore drillings near the island of Tasos the evaporite sequence has a thickness of about 700 metres, including some 400 metres of salt (LALECHOS and SAVOYAT, 1979).

The evaporite-travertine-clay units is in exposures along the Orphanian Gulf conformably onerlain by a clastic sequence, consisting in its basal part of open marine, partly laminated sandy or silty clays with nannoplankton associations indicative of the lowermost Pliocene *Ceratolithus acutus* Zone. Upwards, the number of conglomeratic interbeds increases rapidly and the upper part of the sequence shows irregular alterations of conglomerates, sands and clays deposited in a coastral area with an intricate pattern of lacustrine, fluviatile and marine environments.

References:
1. ARMOUR-BROWN & al. 1979 2. GRAMANN & KOCKEL 1969 3. LALECHOS & SAVOYAT 1979 4. OPPENHEIM 1920 5. PAPP 1948 6. SAKELLARIOU-MANE 1966.

**Area No. 41: THRACIAN MARGINAL BASIN, GR**
Author: M. DERMITZAKIS

The Tertiary sediments of Thracian marginal basin appear at the Northeastern part of the basin at the east side of Rhodope area. They form the west extension of the tertiary basin Ergene.

The sediments are divided in three formations
a) Marls, partly toffitic and sandstones and conglomerates
b) Marls and sandstones. At the upper part of the formation there are banks of Nummulitic limestones.
c) Sequences of conglomerates and sandstones that change laterally in marly layers.

The south part of the basin includes the areas of Alexandroupolis, Ferres and Provatona and the north part the areas of Soufli, Didymoticho and Andrianoupolis. At the south part the sedimentary sequence starts with Middle Eocene to Pliocene–Pleistocene. The sediments of the northern part represented the ages of Roupelian, Tortonian and Pontian.

References:
1. KOPP 1965 2. LÜTTIG & THENIUS 1961 3. MITZOPOULOS 1961 4. MITZOPOULOS & TRIKKALINOS 1937.

**Area No. 42 a: SW AKARNANIA MARGINAL BASIN, GR**
Author: M. DERMITZAKIS

At the lower Aquitanian in the basin of SW Akarnania starts a tectonic phase which gives at the central district of the basin that belongs at the Ionian zone, a new form.

The outer part of the Ionian zone (except its outer margin) it is not influenced by this tectonic phase. During Aquitanian at the outer Ionian zone we have the upper flysch. At the eastern part the basal flysch belongs to the lower Aquitanian. At the western part is younger and is placed at the *G. dissimilis* zone.

The end of the flysch sedimentation at the western part of the basin is younger than that of the central part of the basin.

At the same time we have at the Pre-apulian and Apulian zones the neritic calcitic sedimentation with small thickness. Deposits. During Burdigalian at the western part of the basin we have calcite-sandstone deposits and at the eastern parts we have sediment of littoral phase.

After Burdigalian we have clastic deposits in accordance until Pliocene. The inner Ionian zone is filled with mollasic sediments.

Reference:
IFP & IGM 1966.

Area No. 42 b: **PYRGOS, GR**
Author: J. E. MEULENKAMP

In surface outcrops the Middle Pleistocene–Pleistocene sequence unconformably overlies Mesozoic–Paleogene rocks. The Late Cenozoic sequence starts with lacustrine, locally brackish sediments, which are succeeded upwards by marine clays, silty clays, siltstones and sands. The latter were deposited in near-shore to lagoonal environments.

At a few spots clays, lignites and sands are exposed which are probably of Early Miocene age. Middle Miocene sediments were encountered in a drilling performed near Sosti.

References:
1. HAGEMAN 1977 2. HAGEMAN 1979.

Area No. 42 c: **S PELOPONNESIAN MARGINAL BASIN, GR**
Authors: M. DERMITZAKIS & E. LEKKAS

The neogene formations of the basin consist mainly of marls and marly sandstone with sandstone intercalations which in various locations become calcite–sandstone.

Also conglomerates of limited thickness increases from the center to the edges of the basin.

References:
1. SYMEONIDIS & ANAPLIOTIS 1969 2. ALEXOULIS-LIVADITIS 1972.

Area No. 42 d: **KYTHIRA, GR**
Author: J. E. MEULENKAMP

Late Miocene (Tortonian) fluviolacustrine, brackish and shallow marine conglomerates, sands and clays with locally lignite intercalations were deposited on the Mesozoic–Paleogene basement. The Upper Miocene clastics are unconformably overlain by marls and bioclastic limestones of late Early–Late Pliocene age. Tilting and erosion of part of the Upper Miocene (Tortonian) sequence occurred in the Messinian–late Early Pliocene time-span.

References:
1. FREYBERG 1967 2. CHRISTODOULOU 1966 3. THEODOROPOULOS 1973 4. MEULENKAMP & al. 1978.

Area No. 43: **MEGALONOLIS (PELOPONNISOS) INTERMONTANE BASIN, GR**
Authors: M. DERMITZAKIS & E. LEKKAS

The Neogene of the basin fo Megalopolis filling of the basin comprizes limnic and fluviatile sediments. The sequence commences with the Upper Pliocene limnic Makrision Stage, consisting of marls with intercalated lignite seams of small thickness. The predominantly fluviatile sediments of the Trilofon Stage belong to the Upper Pliocene as well.

References:
1. LUTTIQ & MARINOS 1962 2. VINKEN 1965.

Area No. 44: **ATTIKA–EUBOEA–LAMIA, GR**
Authors: M. DERMITZAKIS & D. PAPANIKOLAOU

Deposition of continental Miocene pre-Pikermian age, molasse of Raphina. They consist of travertines clays, gray marls, sometimes with fossiliferous lignites (Planorbis etc.) yellow sandstones and conglomerates with rounded pebbles overlay unconformably the Mesozoic deposits. They follow unconformably the yellowish and red colour loams of Pikermi, with the fossiliferous beds of Pikermian fauna. With the low angular discordance exposed marine fossiliferous sands, conglomerates, travertine limestones of Pliocene age.

References:
1. CHRISTODOULOU 1961 2. CHARALAMBAKIS 1952 3. GUERNET & SAUVAGE 1969 4. MITZOPOULOS 1948 5. PAPP & al. 1979 6. SYMEONIDIS & al. 1979.

Area No. 45 a: **NORTHERN SPORADES (SKYROS), GR**
Authors: M. DERMITZAKIS & D. PAPANIKOLAOU

The Neogene deposits are overlay in discordance with fossiliferous formations from marls, sandstones, conglomerates, and clays. In these deposits mollusc associations have described as also diatoms.

References:
1. GUERNET 1971 2. MELENTIS 1973.

Area No. 45 b: **MILOS, GR**
Author: J. E. MEULENKAMP

The (Late Tortonian?) – Messinian sequence is transgressive on the metamorphic basement. The lower part of the sequence consists of coral–pelecypod limestones with intercalations of reddish conglomerates; the upper part displays lacustrine–brackish–lagoonal conglomerates, limestones and clays with some gypsum lenses. The Upper Miocene sequence is overlain by open marine clays of Early Pliocene age, which pass upwards into marine marls with volcanic interbeds. The latter type of sediment succession probably continued until the Pleistocene. The Pleistocene is characterized by sandy marls, diatomites and thick successions of volcanic rocks.

The Neogene of the island of Milos is not representative for the Cyclades area. For instance, marine Upper Oligocene–Lower Miocene sediments have been reported from the islands of Naxos and Paros. Late Neogene sediments on the latter islands consist of non-marine clastics, which are of Middle–Late Miocene and possibly partly of Pliocene age.

References:

1. FITIKAS & MARINELLI 1977 2. MEULENKAMP 1978.

**Area No. 45 c: CYCLADES (PAROS), GR**
Authors: D. PAPANIKOLAOU & M. DERMITZAKIS

Deposition of clastic sediments during Burdigalian times within a molassic basin developed over the "sub-pelagonian zone" which was tectonised already in Eocene times. The molassic sediments lie transgressively over the ophiolites or over the Cretaceous limestones. Thrusting and folding of the molassic sediments together with their Mesozoic basement rocks takes place during Serravallian–Tortonian times. This major episode ends before the beginning of the development of the Neogene basin of the southern Cyclades (e. g. Milos) during Messinian times. The transgressive travertines in the central Cyclades belong to this younger cycle of sedimentation.

References:

1. ANGELIER & al. 1978 2. DERMITZAKIS & PAPANIKOLAOU 1980 3. JANSEN 1973 4. PAPANIKOLAOU 1980 5. ROESLER 1978.

**Area No. 46 a: CRETE: KHANIA, GR**
Author: J. E. MEULENKAMP

Limestone breccias were deposited in Middle Miocene time. The breccias are conformably overlain by lacustrine and shallow marine clastics of Late Serravallian Age in the south; in central and northern Khania they are unconformably overlain by Tortonian conglomerates, sands and clays. The Tortonian sequence is succeeded by alternations of homogeneous and laminated marls with gypsum intercalations of (Early) Messinian Age. The Upper Messinian consists of red conglomerates, sands, siltstones and clays with gypsum interbeds, deposited in fluvio-lacustrine and lagoonal environments. The latter sediments are overlain by open marine marls of Early Pliocene age. The marls pass upwards into sands, reflecting the overall regression which took place in the course of the Early Pliocene.

**Area No. 46 b: CRETE, RETHYMON, GR**
Author: J. E. MEULENKAMP

Remnants of Middle Miocene limestone breccias are found in the south. Late Middle Miocene (Late Serravallian ?) fluvio-lacustrine sequences unconformably overlie the pre-Neogene basement in various parts of the area. These non-marine clastics are conformably overlain by Tortonian sands and silty clays, which, in turn, are succeeded by bioclastic limestones and alternations of homogeneous and laminated marls of Early Messinian Age. Uplift and erosion took place in Late Messinian time. The Pliocene succession starts with marl-breccias, which contain components of marly limestones of the lowermost Pliocene; the limestone breccias reflect tectonic instability shortly after the Early Pliocene flooding. The higher part of the Pliocene sequence sonsists of marls with diatomite intercalations. An overall regression occurred in the course of the Middle Pliocene.

**Area No. 46 c: CRETE: IRAKLION, GR**
Author: J. E. MEULENKAMP

Neogene sedimentation started with the accumulation of fluvio-lacustrine successions in Middle Miocene time. In the Late Serravallian some parts of the area submerged; a conspicuous rejuvenation of the relief in other parts resulted in gravity-sliding of large masses of limestone breccias and pre-Neogene limestone slabs. Conglomerates, sandstones and clays with lignite intercalations were deposited in fluvio-lacustrine, brackish and marine, generally nearshore environments in Tortonian time. Bioclastic limestones and alternations of homogeneous and laminated marls with evaporite intercalations characterize the Lower Messinian. Upper Messinian clastic deposits occur at a few places only. The Early Pliocene flooding caused accumulation of marly limestones; part of these lowermost Pliocene deposits, however, were eroded and became incorporated in marl breccias as the result of Early Pliocene differential movements. An overall regression started in some parts of Iraklion in the late Early Pliocene, but marine sedimentation continued at some places until the Late Pliocene.

**Area No. 46 d: CRETE: IERAPETRA, GR**
Author: J. E. MEULENKAMP

Neogene sedimentation started in Middle Miocene time. The Middle Miocene successions consist predominantly of fluviatile-lacustrine conglomerates, sands and clays, open marine, partly turbiditic sequences and of terrestrial-shallow marine limestone breccias and breccioconglomerates. The latter coarse clastics often reflect deposition by gravity-induced currents. The breccias and breccioconglomerates were deposited in Late Serravallian time as the result of a pronounced rejuvenation of the relief by differential, vertical movements. These movements also triggered the decollement of large slabs of pre-Neogene limestones and their subsequent downslope transport. Turbiditic terrigeneous-clastic sedimentation prevailed in Tortonian time; calcareous successions, including evaporites were deposited in the Late Tortonian–Early Messinian. Uplift and erosion of part of the older Neogene cover occurred in some parts of the area prior to Late Messinian, local subsicence, which resulted in the deposition of a thin cover of mainly brackish sediments. A renewed accentuation of the relief, shortly after the Early Pliocene flooding caused downslope transport of the lowermost Pliocene marly limestones, along with older Neogene sediments, including evaporites. An overall regression started in the Middle Pliocene.

References for 46 a–d:

1. FREUDENTHAL 1969 2. MEULENKAMP 1969 3. SISSINGH 1972 4. SCHMIDT 1973 5. GRADSTEIN 1974 6. ZACHARIASSE 1975 7. BRUIJN DE & al.

1971 8. MEULENKAMP & al. 1975 9. MEULENKAMP & al. 1978 10. DERMITZAKIS 1969 11. FORTUIN 1977 12. BENDA & al. 1974 13. DROOGER & MEULENKAMP 1973 14. MEULENKAMP 1979.

Area No. 47: E AEGEAN ISLANDS (CHIOS), GR
Authors: M. DERMITZAKIS & D. PAPANIKOLAOU

During Lower Miocene were deposited in a lake or fluviatile environment the Thymiana schichten with sandstone, calcarenites, dolomites and marls. They are follow by Zyfia schichten with sands and conglomerates of fluviatil origin and the possible age is Badenien. Then are overlay the Keramaria schichten of terrestrial or limnic environment with clays, marls, sands and vertebrates fossils. The deposits of Nenita schichten are follow with limestones, marls, clays, etc. There are vertebrates, Sporomorphs associations and mollusc assemblages of lake environment. The possible age of this formation is Upper Miocene–Lower Pliocene.

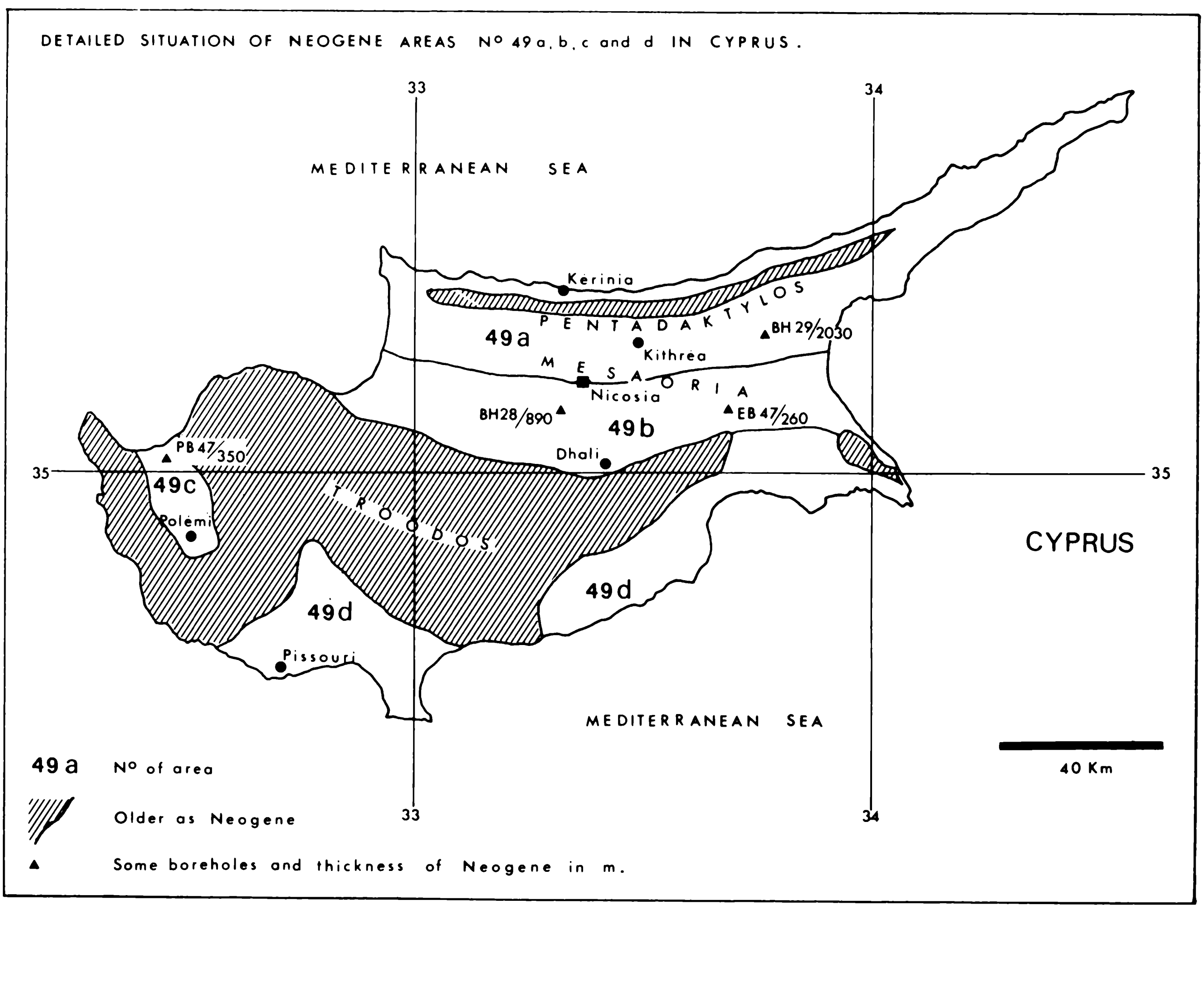
References:
1. BESENECKER 1973 2. KREATSAS 1963 3. PARASKEVAIDIS 1940 4. TOBIEN 1968 5. TOBIEN 1969.

Area No. 48: RHODOS, GR
Author: J. E. MEULENKAMP

In contrast to earlier ideas, (at least part of) the Istrios Formation of southern Rhodos should be placed in the Miocene (Serravallian? – Tortonian, WILLMANN, 1980). Part of the formation may belong to the Pliocene. In the course of the Pliocene the Rhodos area became subject to an overall subsidence, which resulted in the deposition of fluviatile and fluviolacustrine successions. Differential vertical movements caused the break-up of the comprehensive sedimentation realm in the course of the Late Pliocene. Then fluvio-lacustrine sediments, passing laterally into brackish–lagoonal–shallow marine successions were deposited in the north; lacustrine marls and limestones with lignite intercalations accumulated in the south. Open marine sediments of the uppermost Pliocene and the Pleistocene are found in coastal strips in the north and in the southeast.

References:
1. MUTTI & al. 1980 2. MEULENKAMP & al. 1972 3. SISSINGH 1972 4. BROEKMAN 1974 5. BENDA & al. 1977 6. WILLMANN 1980.

## CYPRUS (CY)



**Area No. 49 a–c: CYPRUS, CY**
Authors: F. BAROZ & G. BIZON

Cyprus has been an active margin from the Cretaceous to the Present. This unstability is clearly reflected in the neogene sedimentation. The main outcrops are located in the Mesaoria where two areas are to be distinguished. The northern one (49 a) shows the succession of two typical cycles. The older, composed by terrigenous turbidites, is limited at its base (Upper Eocene–Oligocene) and at its top (Messinian) by angular disconformities indicating two main orogenic phases. The southern one (49 b) and the Polemi basin (49 c) exhibit, over the Troodos lavas basement, an autochthonous pelagic sedimentation with local calciturbidites and redeposited marls and chalks. This series, sometimes condensed, which has been disturbed by synsedimentary faults and slumps, started during the Maastrichtian, and ended with the Messinian salinity crisis and the first emersion of the Troodos. No modern data are available in the basins of the southern shore (49 d).

Local biozones:
A = *G. ampliapertura*, B = *G. opima*, C = *G. ciperoensis*, D = *G. primordius*, E = *G. dissimilis*, F = *G. tirlobus*, G = *P. glomerosa*, H = *G. peripheroronda*, I = *G. mayeri*, J = *G. menardii*, K = *G. acostaensis*, L = *G. humerosa*, M = *G. margaritae*, N = *G. puncticulata*, O = *G. crassaformis*, P = *G. inflata*.

References:
1. BAROZ & BIZON 1974 2. BAROZ, BERNOULLI & al. 1978 3. BAROZ 1977 4. WEILER 1969 5. MOORE 1960 6. BAROZ & BIZON 1977 7. MANTIS 1970 8. ADAMS 1976 9. PANTAZIS 1967 10. TURNER 1968 11. BAROZ, BIZON & al. 1978.

## TURKEY (TR)

**Area No. 50–72: TURKEY, TR**

We compiled Neogene Stratigraphical Columns from different authors. As can be seen Turkey is a big country, and the correlation of the whole Neogene Basin of Turkey is not yet possible. While we met some perfect individual works, on the other hand some works were insufficient. These we made the best of and saught to compile them in the column. It must be mentioned, however, that the correctness of each column depends eventually on its original author.

Because of these difficulties and also because of lack of time, we will give a global explication of these columns.

The most suitable way of doing this is to present the summary of the work "Explanatory Notes for the Paleogeogrpaphic Atlas of Turkey from the Oligocene to the Pleistocene" written by G. LÜTTIG and P. STEFFENS (1976).

We hope that is sufficient for the time being, and that it will be improved in the course of time, as we get more work done on the Neogene of Turkey.

1) **LATE OLIGOCENE**: The uplift of Asia Minor and Thrace persisted during the late Oligocene and resulted in an isolated sea, the Paratethys, in the northern continental area of Anatolia. By this time, the sea had retreated from Thrace, from the Adana Basin, and from the southeastern foreland of the Taurus ranges.

Nonmarine sediments (Red-Bed-Molasse) accumulated in a coherent syncline formed out of the isolated intramontane basins in central Anatolia. Near the end of the Oligocene, the eastern part of Anatolia was reached by the sea which was advancing from central Iran. Brief advances into the molasse trough of central Anatolia coupled with an arid climate resulted in the deposition of halite and gypsum before the marine environment finally prevailed in Aquitanian time.

2) **EARLY MIOCENE**: An early Miocene transgression, which there were already signs of in the late Chattian, covered vast regions of eastern Anatolia, the Taurus ranges, and the Arabian Shield and formed a connection between the Mediterranean Basin and the Persian Gulf. The transgression reached a maximum and nonmarine deposition a minimum during the late Burdigalian.

3) **MIDDLE MIOCENE**: As early as in Langhian time, the regression of the sea from eastern Anatolia resulted in deposition of lagoonal sediments and evaporite. Subsequently, nonmarine molasse-type strata accumulated in this region. The regression did not start before the late Langhian in the western Taurus ranges and on the Arabian Shield.

Uplift in the western Anatolia resulted in the subsidence of intramontane basins in which fluviatil and limnic sediments were deposited. At the same time there was a considerable increase in volcanic activity.

In Thrace, there is good evidence that a Karaganian–Konkian Paratethys transgression advanced from the Black Sea to the northern part of the Aegean Sea. Here there may also have been briefly a connection with the Tethys via the Cyclades.

4) **LATE MIOCENE**: Late Miocene marine sediments are limited to the Adana Basin where gypsum and halite were deposited during the Messinian. In the north, part of the brackish Paratethys extended from the Black Sea via Thrace and the Canakkale Bogazi (Dardanelles) into the Aegean Sea during the Chersonian and Pontian s. str. The resultant deposits can be traced as far as Athens area. The subsidence of zones of the continental platform that began in the middle Miocene continued. In addition, limnic and fluviatil molasse-type sediments accumulated in intramontane basins which began to subside in eastern Anatolia and the Pontic region. The deposits contain mammalian remains of Vallesian and Turolian age. Volcanic activity increased over its middle Miocene level.

5) **PLIOCENE**: After an almost complete withdrawal of the Tethys sea from Asia Minor in the late Miocene, another transgression occurred during the late Pliocene. In the southeast it covered the Orontes–Aafrine Depression and parts of the Adana Basin. In the west, subsidence of parts of the Aegean continental block resulted in invasions of the sea along the present-day western coastline of Turkey as far as to the island of Cos. At the same time, a small trench extending into the Saros Körfezi (Gulf of

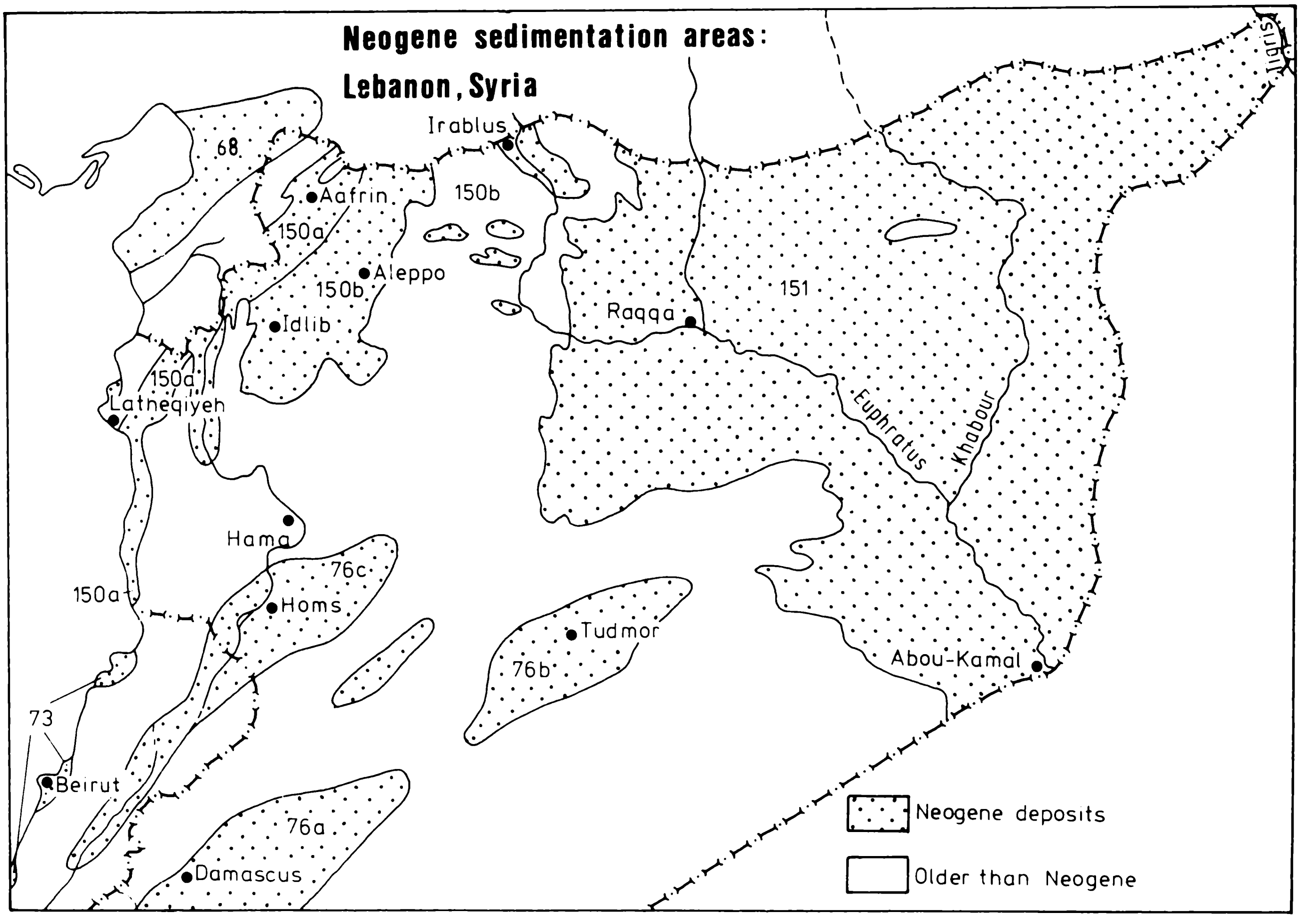
Saros) formed between the Peloponnesus and the Cyclades.

In areas of nonmarine deposition, limnic deposits dominated in the west and fluviatil sediments in Thrace, in part of the Pontic region, and in the southeast. In eastern Anatolia, large quantities of basaltic lava were extruded.

References:

AKDENIZ & al. (in prep) AKKUS 1965 AKKUS 1971 ALTINLI 1975 ARPAT 1964 ARPAT 1965 BECKER-PLATEN 1970 BEER 1960 BENDA & al. 1978 BINGÖL 1975 BINGÖL & al. 1975 DEMIRTASLI & al. 1975 DORUK 1975 DOUST & ARIKAN 1974 ERDOGAN 1966 EROSKAY 1965 GAYLE 1959 GÖKCEN (unpubl.) GRACIANSKY 1968 GÜN 1971 GÜN 1975 GÜN & al. 1976 IZDAR & KÖKTÜRK 1974 KALAFATCIOGLU 1973 KALAFATCIOGLU & UYSALLI 1964 KARAMANDERESI 1971 KESKIN 1974 KOCYIGIT 1978 KURTMAN & AKKUS 1974 ORAL 1972 OROMBELLI & al. 1967 ÖNGÜR 1972 ÖRCEN 1976 ÖZBEY 1966 ÖZSAYAR 1974 ÖZSAYAR 1977 ÖZTÜMER & al. 1974 PISONI 1965 POISSON & POIGNANT 1974 SIREL 1975 SUNGURLU 1967 SENOL 1972 TANER 1972 TANER 1974 TANER (unpubl.) TEKKAYA & al. 1975 TERNEK 1949 TUNA 1973 ÜNAL & HAVUR 1970 YALCINLAR 1958 YILMAZ 1975 WRIGHT 1960.

## LEBANON (RL) AND SYRIA (SYR)




Area No. 73, 76, 150, 151: LEBANON (RL) AND SYRIA (SYR)

Author: V. A. KRASHENINNIKOV

The Neogene of Area No. 73 (the Mediterranean coast of Lebanon), Area No. 150 a and b (Syria – the Mediterranean coast, Nahr el-Kabir depression, Idlib foredeep, Aleppo plateau) ist represented by marine facies; the Messinian stage is characterized also by brackish and evaporitic hypersaline facies. The Neogene of Area No. 151

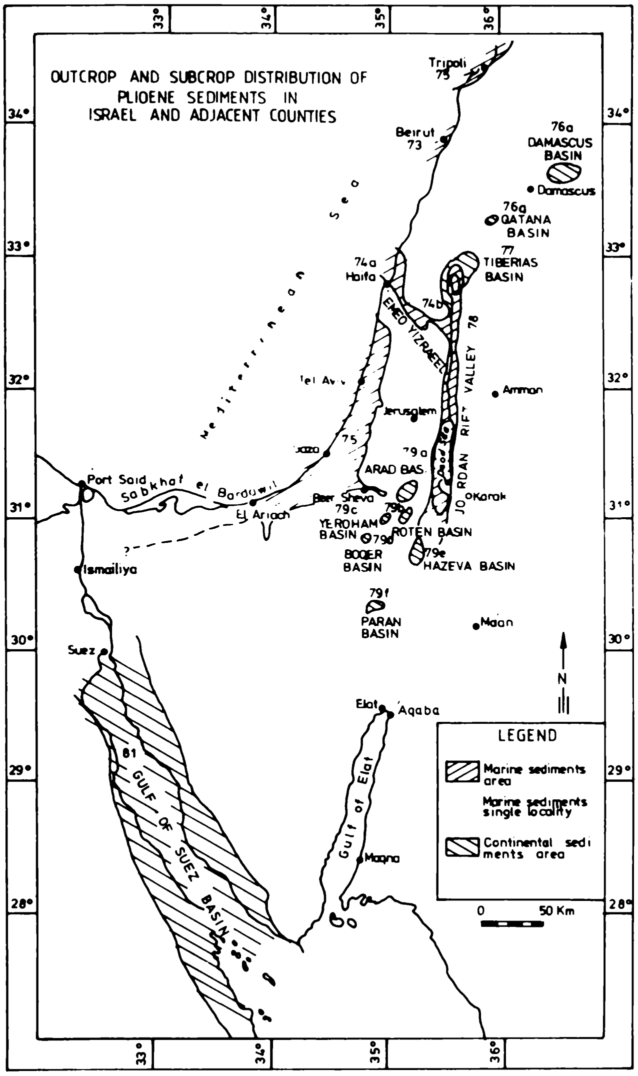
(the semiclosed Mesopotamian basin, Syria) is composed by alternation of marine, brackish, fresh-water and terrestrial sediments. The Neogene of Area No. 76 (Qatana and Ad-Daw depressions, Syria; Homs and Bekaa depression on the territory of Syria and Lebanon) includes terrestrial and fresh-water (fluviatile, limnic) deposits.

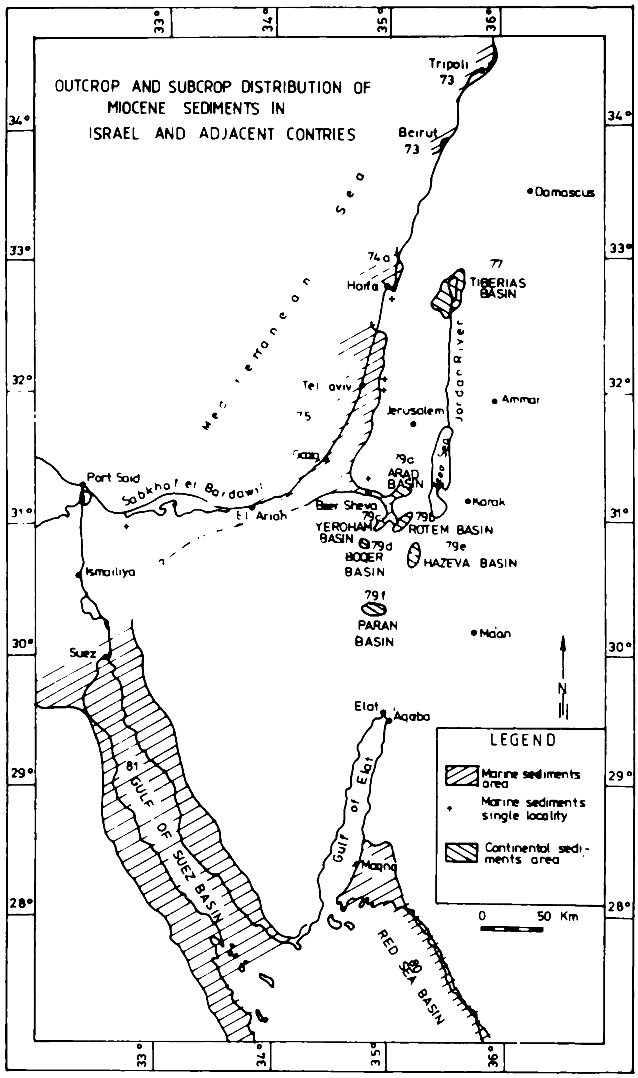
Therefore comparison of Neogene deposits of the Mediterranean, Mesopotamian basin and intramountain depressions of Southern Syria is connected with great difficulties. At the present time this correlation can be made in a general way as well as the age determination of local stratigraphical subdivisions of Neogene of the Mesopotamian and South Syrian depressions.

References:

1. DUBERTRET 1960 2. KRASHENINNIKOV 1966 3. KRASHENINNIKOV 1971 4. PONIKAROV & al. 1967 5. PONIKAROV & al. 1969.

## ISRAEL (IL)




### Area No. 75 a: TEL AVIV – EL ARISH (IL & ET)

Author: G. M. MARTINOTTI

1) This correlation table is a compilation of data from the publications listed below. New ideas about the local stratigraphy, which are as yet unpublished or insufficiently documented, are not considered here.

2) The "N" biozones are according to BLOW, 1969.

3) The stages column is not to scale.

4) Column Facies: R – Reef complex, S – Sabkha

References:

1. ALMAGOR & GARFUNKEL 1979 2. BUCHBINDER 1976 3. BUCHBINDER 1977 4. BUCHBINDER 1979 5. DERIN & REISS 1973 6. EHRLICH & MOSHKOVITZ 1978 7. GARFUNKEL & al. 1979 8. GVIRTZMAN 1970

GVIRTZMAN & BUCHBINDER 1978 10. MARTINOTTI 1973 11. MARTINOTTI 1981 a 12. MARTINOTTI 1981 b 13. MARTINOTTI 1981 c 14. MARTINOTTI & al. 1978 15. MOSHKOVITZ & EHRLICH 1980 16. MOSHKOVITZ & MARTINOTTI 1979 17. NEEV 1979 18. NEEV & al. 1976 19. NEEV & al. 1978 20. REISS 1965 21. REISS 1968.

Area No. 77: **TIBERIAS BASIN, IL**
Author: G. GVIRTZMAN

Column Facies: H Hyperhaline
Column Volcanism: T Tuff

References:
1. HOROWITZ 1979 2. FREUND & al. 1965 3. GVIRTZMAN 1970 4. PICARD 1965 5. REPENNING & FEJFAR 1982 6. ROSENFELD & al. 1981 7. SHANAR & al. 1966 8. SCHULMAN 1959 9. SCHULMAN 1962 10. SCHULMAN & BARTOV 1978 11. SIEDNER & HOROWITZ 1974 12. STEINITZ & al. 1977 13. TCHERNOV 1981.

Area No. 78: **JORDAN RIFF VALLEY, IL**
Author: G. GVIRTZMAN

Column Facies: H Hyperhaline

References:
1. BARTOV & al. 1980 2. BEGIN 1975 3. GVIRTZMAN 1970 4. HOROWITZ 1979 5. NEEV & EMERY 1967 6. SCHULMAN & BARTOV 1978 7. STEINITZ 1979 8. STEINITZ & al. 1977 9. ZAK 1967.

Area No. 79 c: **YEROHAM BASIN, IL**
Author: G. GVIRTZMAN

References:
1. GARFUNKEL & HOROWITZ 1966 2. GOLDSMITH & al. 1982 3. GVIRTZMAN 1970 4. GVIRTZMAN & BUCHBINDER 1969 5. HARASH 1967 6. NEEV 1960 7. REISS & GVIRTZMAN 1966 8. SAVAGE & TCHERNOV 1968 9. SHAHAR 1973.

Area No. 79 e: **HAZEVA BASIN, IL**
Author: G. GVIRTZMAN

References:
1. BENTOR & VROMAN 1957 2. BENTOR & al. 1959 3. GARFUNKEL & MOROWITZ 1966 4. RODED 1982 5. SNEH 1967 6. SNEH 1981.

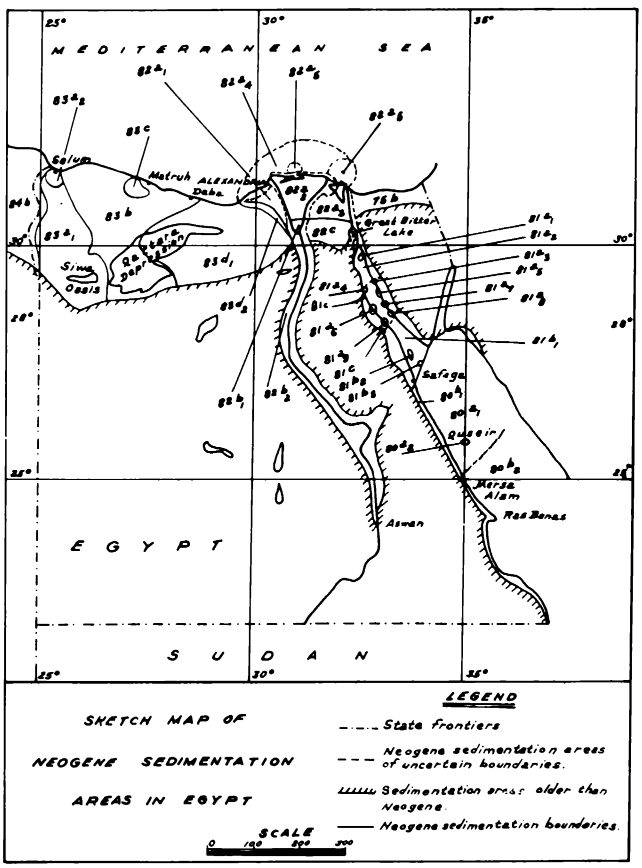
## EGYPT (ET)

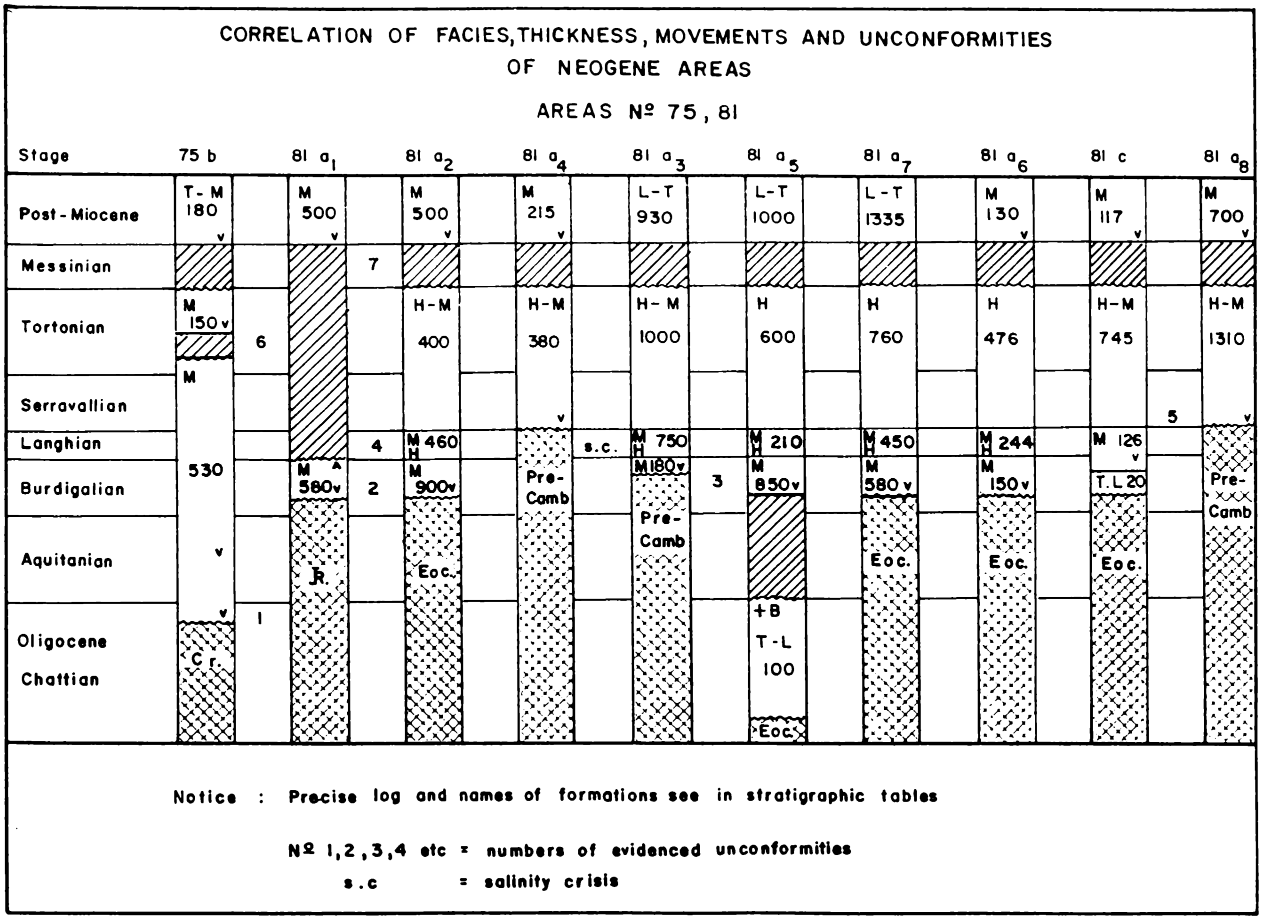
Area No. 75 b: **ARISH AREA (N SINAI), ET**
Author: I. EL-HEINY

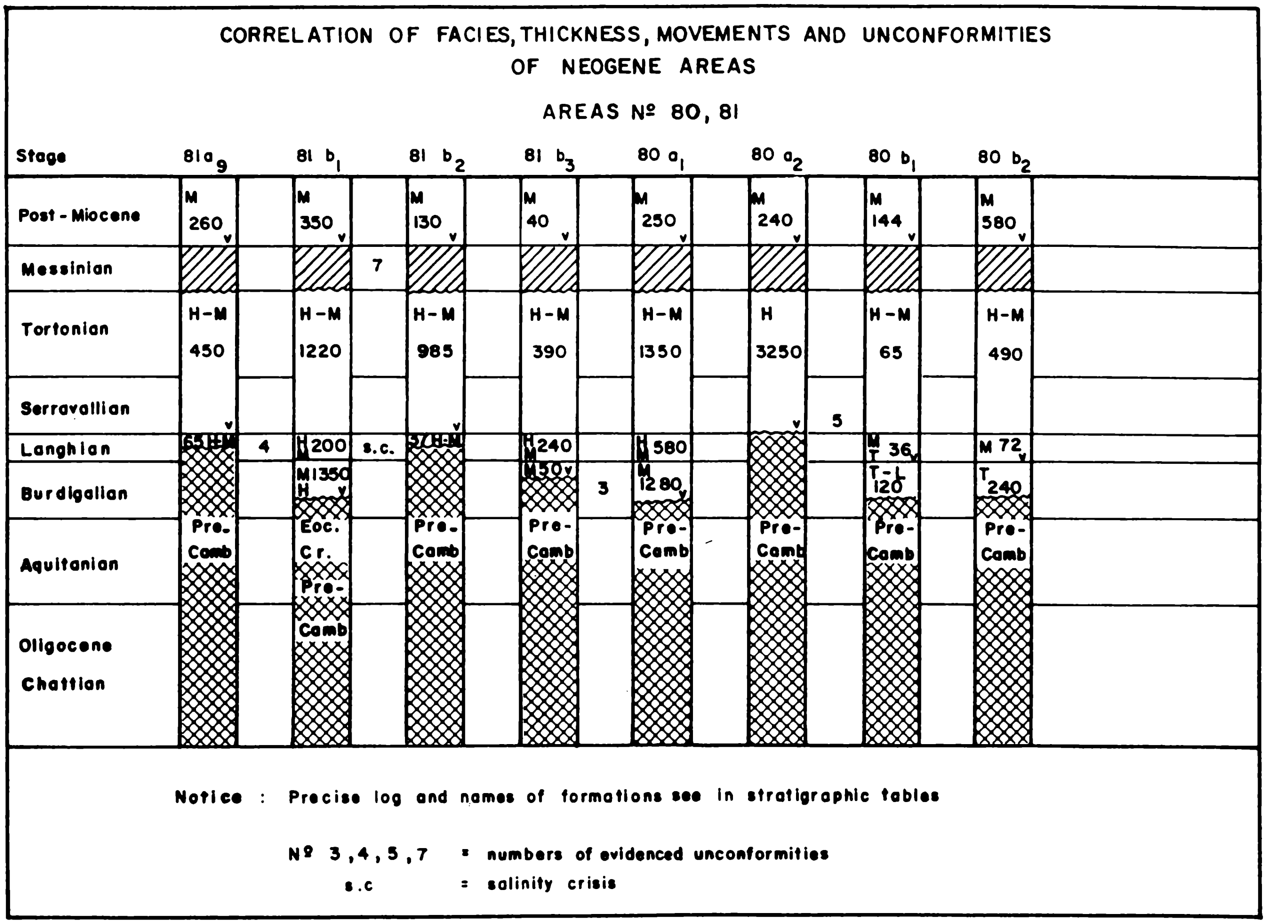
References:
1. DERIN & REISS 1973 2. EHRLICH & MOSHKOVITZ 1978 3. GVIRTZMAN & BUCHBINDER 1978.

Area No. 80 and 81: **N RED SEA AND GULF OF SUEZ BASINS, ET**
Author: I. EL-HEINY

These two basins consist of differentially subsiding fault blocks and are characterized by thickness and facies variations. The sedimentological and tectonical characters of the Gulf as well as the opposite position of the high fault blocks (Areas No. 81 $a_3$, 81 $a_4$ and 81 $a_8$ and 81 $a_9$) permit to subdivide the Gulf into three sub-basins. The norhtern sub-basin is characterized by NW trending major faults crossing older NE major faults and by poor development of sands and salts. In the central and southern sub-basins the NE trending major faults vanish and NW trending major faults predominate while sands and huge salts are dominant. The southern sub-basin is characterized by the development of early Miocene evaporite deposits within the Nukhul Fm. The reduced thickness of pre-Miocene and Miocene deposits in the southern part of the Gulf (Areas No. 81 $b_2$, 81 $b_3$) also indicates its relative high position throughout its geologic history. In early Miocene time the southern part of the Gulf has acted as a submarine high which has favoured the deposition of euxi-




CORRELATION OF FACIES, THICKNESS, MOVEMENTS AND UNCONFORMITIES
OF NEOGENE AREAS
AREAS Nº 75, 81
Stage
75 b
81 a1
81 a2
81 a4
81 a3
81 a5
81 a7
81 a6
81 c
81 a8
Post-Miocene
Messinian
Tortonian
Serravallian
Langhian
Burdigalian
Aquitanian
Oligocene
Chattian
T-M 180
M 500
M 500
M 215
L-T 930
L-T 1000
L-T 1335
M 130
M 117
M 700
7
M 150
6
H-M 400
H-M 380
H-M 1000
H 600
H 760
H 476
H-M 745
H-M 1310
M
5
4
M H 460
s.c.
M H 750
M H 210
M H 450
M H 244
M 126
530
M 580
2
M 900
Pre-Camb
M 180
3
M 850
M 580
M 150
T.L 20
Pre-Camb
Pre-Camb
Eoc.
Eoc.
Eoc.
Eoc.
J.R.
1
+B
T-L
100
Cr.
Eoc.
Notice : Precise log and names of formations see in stratigraphic tables
Nº 1, 2, 3, 4 etc = numbers of evidenced unconformities
s.c = salinity crisis


CORRELATION OF FACIES, THICKNESS, MOVEMENTS AND UNCONFORMITIES
OF NEOGENE AREAS
AREAS Nº 80, 81
Stage
81a9
81 b1
81 b2
81 b3
80 a1
80 a2
80 b1
80 b2
Post-Miocene
Messinian
Tortonian
Serravallian
Langhian
Burdigalian
Aquitanian
Oligocene
Chattian
M 260
M 350
M 130
M 40
M 250
M 240
M 144
M 580
7
H-M 450
H-M 1220
H-M 985
H-M 390
H-M 1350
H 3250
H-M 65
H-M 490
5
65 H-M
4
H 200
s.c.
57 H-M
H 240
H 580
M T 36
M 72
M 1350
H
M 50
3
M 1280
T-L 120
T 240
Pre-Camb
Eoc.
Cr.
Pre-Camb
Pre-Camb
Pre-Camb
Pre-Camb
Pre-Camb
Pre-Camb
Pre-Camb
Notice : Precise log and names of formations see in stratigraphic tables
Nº 3, 4, 5, 7 = numbers of evidenced unconformities
s.c = salinity crisis

nic black shales within the Rudeis Fm. in the northern Red Sea basin (Area No. 80 $a_1$).

The early Miocene transgression in the Gulf of Suez and the northern Red Sea was from the northern Levantine basin and began with the unconformable deposition of the Nukul Fm. overlain conformably by the Rudeis Fm. In the northern parts of the Gulf (Area No. 81 $a_1$, 81 $a_2$) the Rudeis Fm. is divided into the following informal members mentioned from the older to the younger: Mheiherrat, Hawara. Asl and Mreir. On the western coast of the Gulf (Area No. 81 $a_6$) the Rudeis Fm. could be divided into the following informal members mentioned from the older to the younger: Bakr, Yusr, Safra and Ayrun.

The Nukhul and Rudeis Formations recorded in the offshore area of the northern Red Sea (Area No. 81 $a_1$) pinch out at the basin peripheries (Area No. 80 $b_1$ & 80 $b_2$) where marine middle Miocene (Gebel El Rusas Fm.) onlap continental early Miocene deposits (Nakheil Fm.).

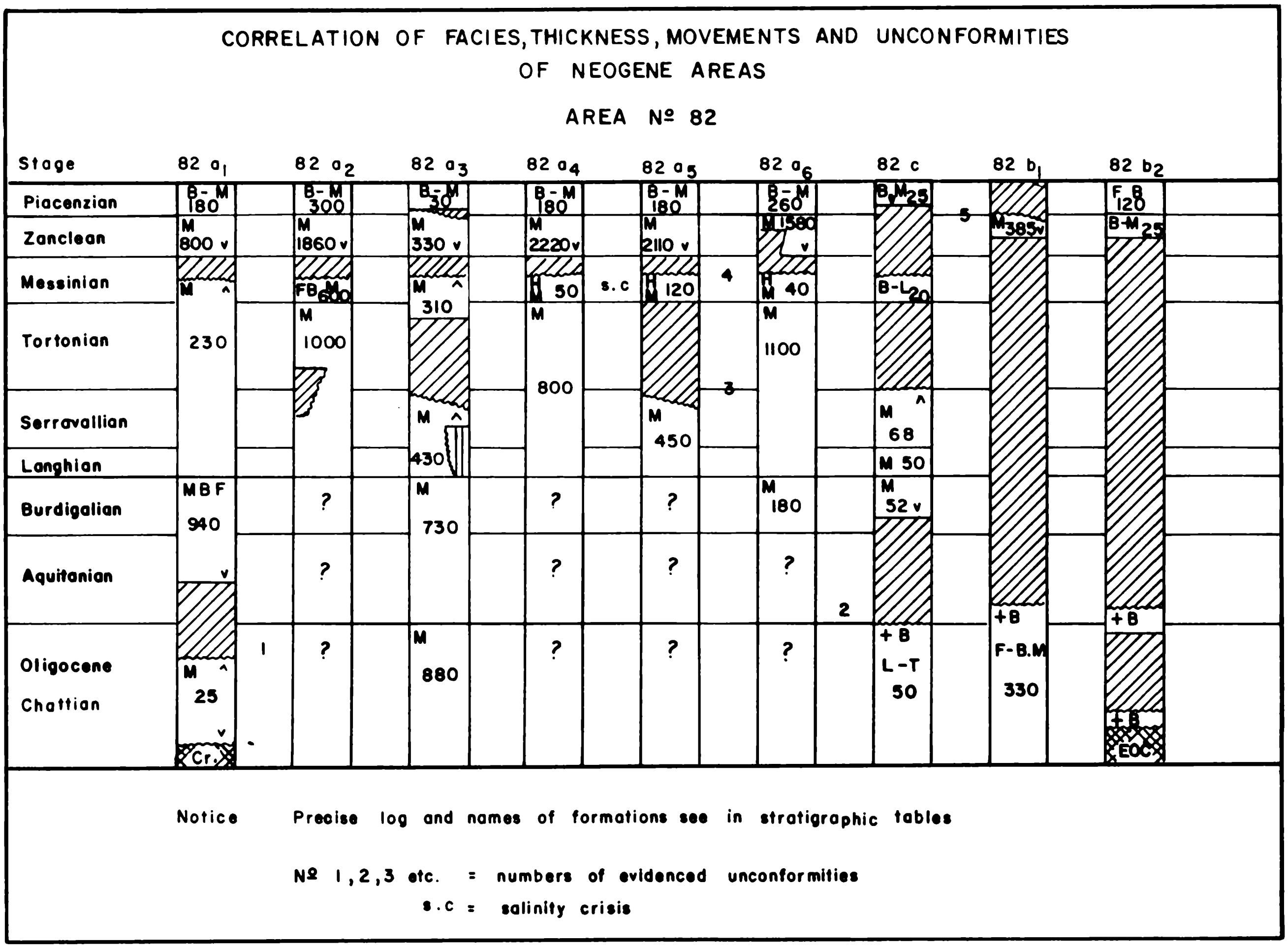
The Langhian deposits in the Gulf of Suez and the northern offshore Red Sea is divided into the Kareem Fm. overlain by the Belayim Fm. The Kareem Fm. consists of minor evaporites (Rahmi Mb) overlain by foraminiferal shales (Shagar Mb). The Belayim Fm. consists mainly of evaporites intercalated with foraminiferal sandy shale. The formation is divided into the following members mentioned from the older to the younger: Baba Mb. (Evaporites), Sidri Mb. (Clastics), Feiran Mb. (Evaporites), Hammam Faraoun Mb. (Clastics).

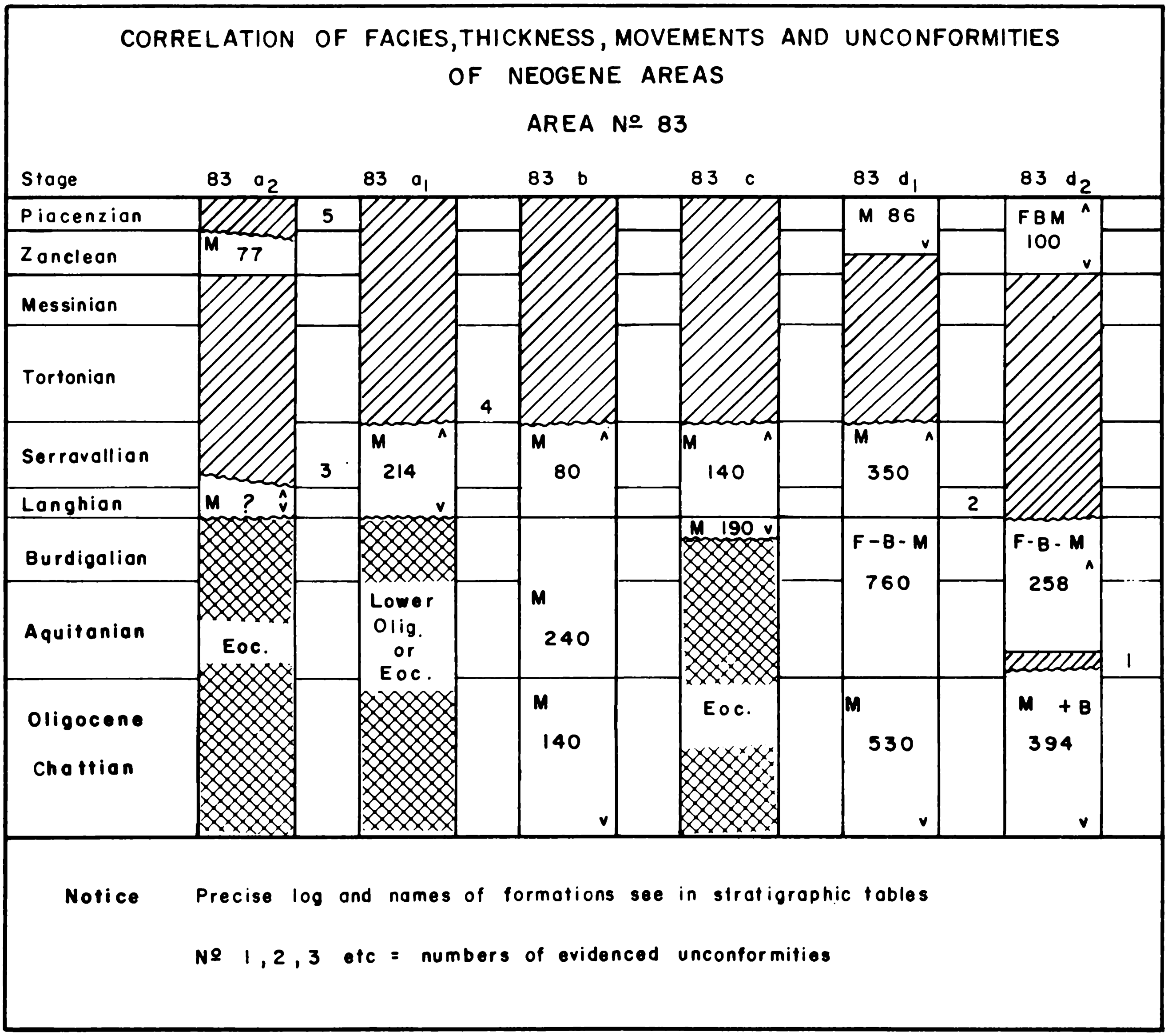
In the northern part of the Gulf (Area No. 81 $a_1$) the positive tectonic movement took place during late Burdigalian time barred the Gulf and resulted in evaporite deposition in the Gulf and the northern Red Sea. The high geothermal gradient in these two basins during Miocene time may have enhanced evaporite deposition.

The middle to late Miocene deposits (South Gharib and Zeit Formations) consist of salt and anhydrite intercalated with faunistically barren shales and sands. The salt deposits thicken in the southern parts of the Gulf and in the northern Red Sea on the expense of anhydrite and thin or vanish in the northern parts of the Gulf where anhydrite predominates. All the high fault blocks in the Gulf and the northern Red Sea were submerged before deposition of these evaporite formations.

The post-Miocene section in these two basins is either unfossiliferous or with undiagnostic fossils. The Pliocene -Pleistocene boundary could not be determined. The thickness values provided by the tables represent the deposits of the Pliocene Quaternary time.

References:
1. EL-HEINY 1979 2. EL-HEINY (in print a) 3. EL-HEINY (in print b) 4. EL-HEINY & MARTINI (in print) 5. SAID 1971 6. SOUAYA 1963 a 7. STRATIGRAPHIC SUB-COMMITTEE 1976.






Area No. 82: NILE DELTA BASIN, ET
Author: I. EL-HEINY

This basin is divided according to its stratigraphic and sedimentologic characteristics into a number of sedimentation areas namely:

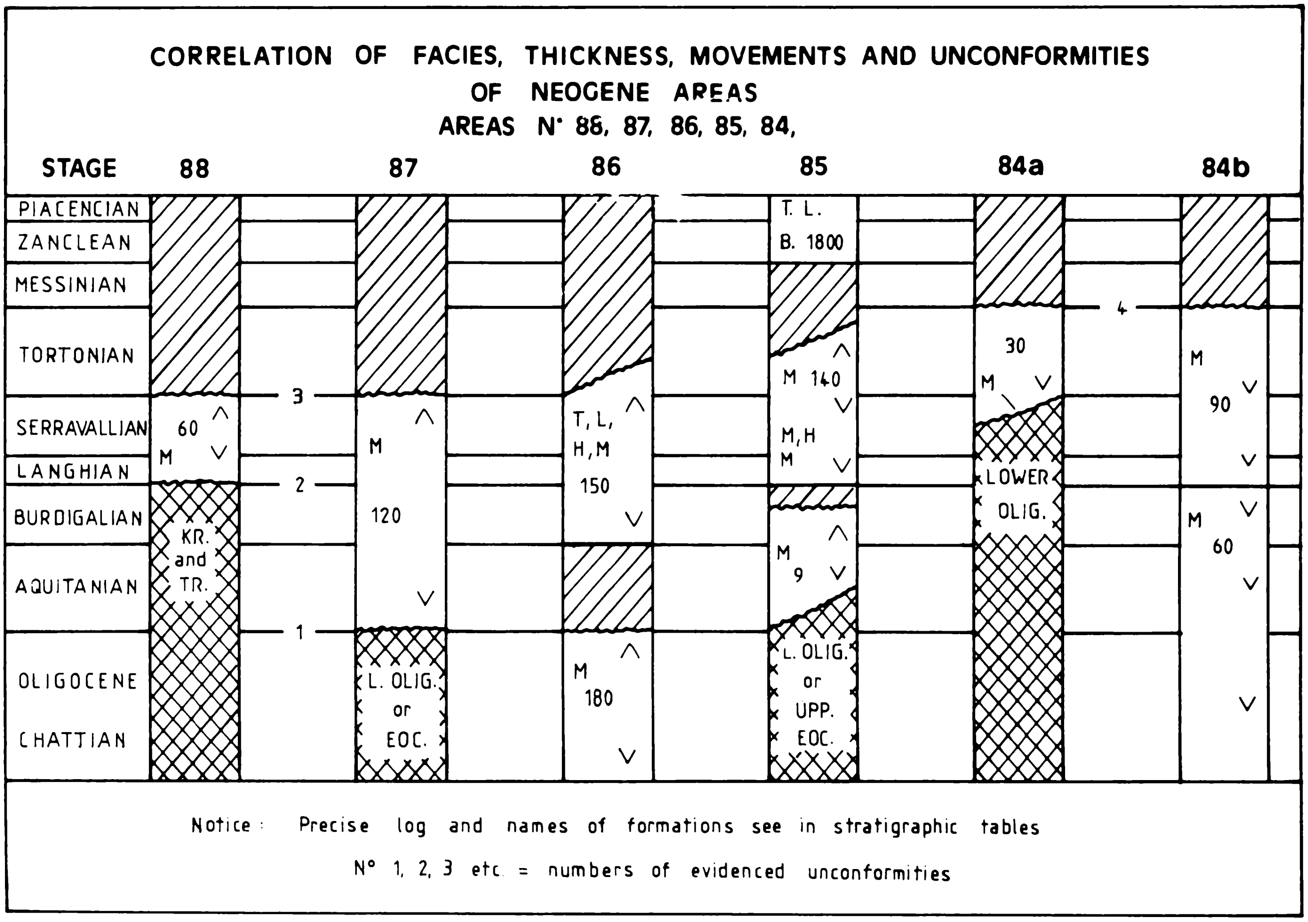
1) Nile Delta proper which include the shelf and slope deposits (Areas No. 82 $a_1$–82 $a_6$) to the north and the south delta fault block (Area No. 82 $b_1$).
2) East Cairo (Area No. 82$_c$) which includes the marginal facies deposits equivalent to the deeper facies deposits of the Nile Delta proper.
3) Nile Valley estuary (Area No. 82 $b_2$).

References:
1. EL-HEINY 1979 2. EL-HEINY (in print b) 3. MENEISY & KREUZER 1974 4. RIZZINI & al. 1978 5. SAID 1971 6. SAID 1973 7. SOUAYA 1963b 8. STRATIGRAPHIC SUB-COMMITTEE 1976 9. VASS 1975.

Area No. 83: LIBYAN PLATEAU, W DESERT OF EGYPT, ET
Author: I. EL-HEINY

References:
1. BECKMANN & al. 1969 2. EL-HEINY 1979 3. EL-HEINY (in print b) 4. GINDY & EL-ASKARI 1969 5. MANSOUR & al. 1969 6. OMARA & OUDA 1969 7. SAID 1973 8. STRATIGRAPHIC SUB-COMMITTEE 1976.

## LIBYA (LAR)




Area No. 84–88: **LIBYA, LAR**
Author: I. EL-HEINY

The Miocene was a time of transgression following a brief emergence at the end of Oligocene in the areas No. 88, 87, 86, 85 and 84 a.

The Sirte basin (Area No. 86) consists of differentially subsiding fault blocks. Great lithofacies and thickness varations should be excepected. Subsurface data from the Sirte basin are unavailable.

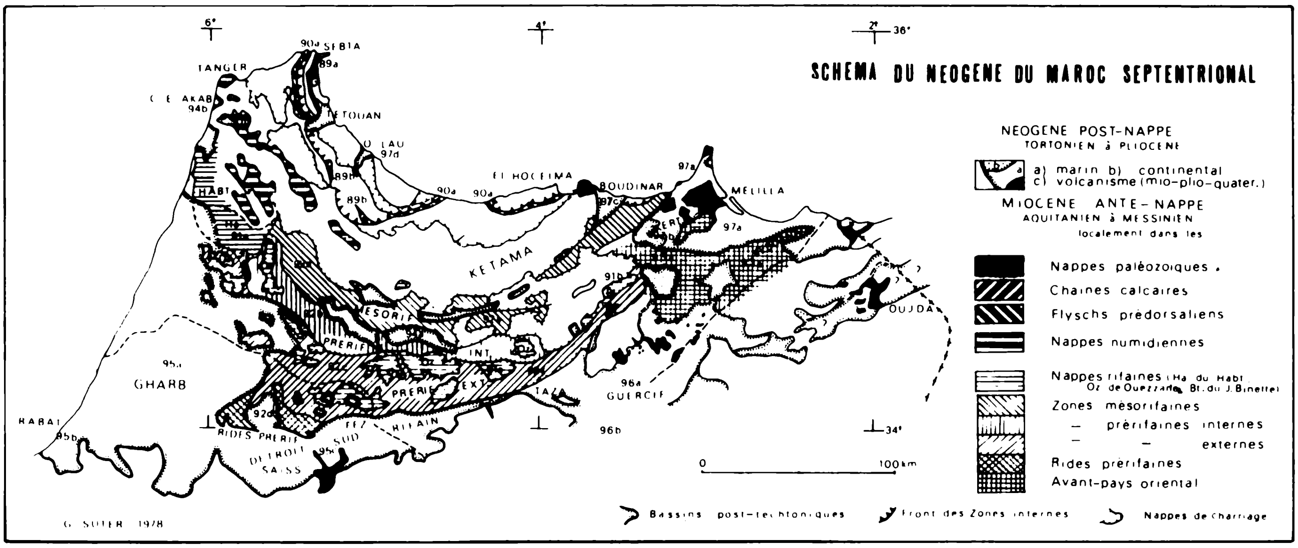
The recent work referred to by references No. 6, 7, 11 and 13 provided valuable data about the biostratigraphy of areas No. 85, 84 a–b. Reference No. 3 refers to the geological development of the Sirte basin.

References:
1. BARR & WALKER 1973 2. BARR & WEEGAR 1972 3. BERGGREN 1969 4. BUROLLET 1960 5. CONANT & GOUDARZI 1967 6. DEFTAR & ISSAWI 1977 7. FRANCIS & ISSAWI 1977 8. HECHT & al. 1963 9. KLEINSMIEDE & VAN DEN BERG 1968 10. KLITZCH 1968 11. MAZHAR & ISSAWI 1977 12. PIETERSZ 1968 13. SWEDAN & ISSAWI 1977.

## MOROCCO (MA)

Area No. 89–97: **MOROCCO, MA**
Authors: G. SUTER, W. WILDI, D. LEBLANC, W. WERNLI, C. GENDROT, M. GUILLEMIN, J. P. HOUZAY

Zones internes:
89 a: Nappes paleozoiques (= Ghomarides).
89 b: Chaines calcaires.
Nappes des "Flyschs":
90 a: Zone des Flyschs predorsaliens.
90 b: Nappes des Gres numidiens.
Zones externes:
91 a: Nappes du Habt, de Ouezzane
92 a: Zones mesorifaines
92 b: Prerif interne
92 c: Prerif externe
92 d: Rides prerifaines
Avant pays oriental:
93 a (voir 97 a–b).




## MIOCENE POST-NAPPE 94–97

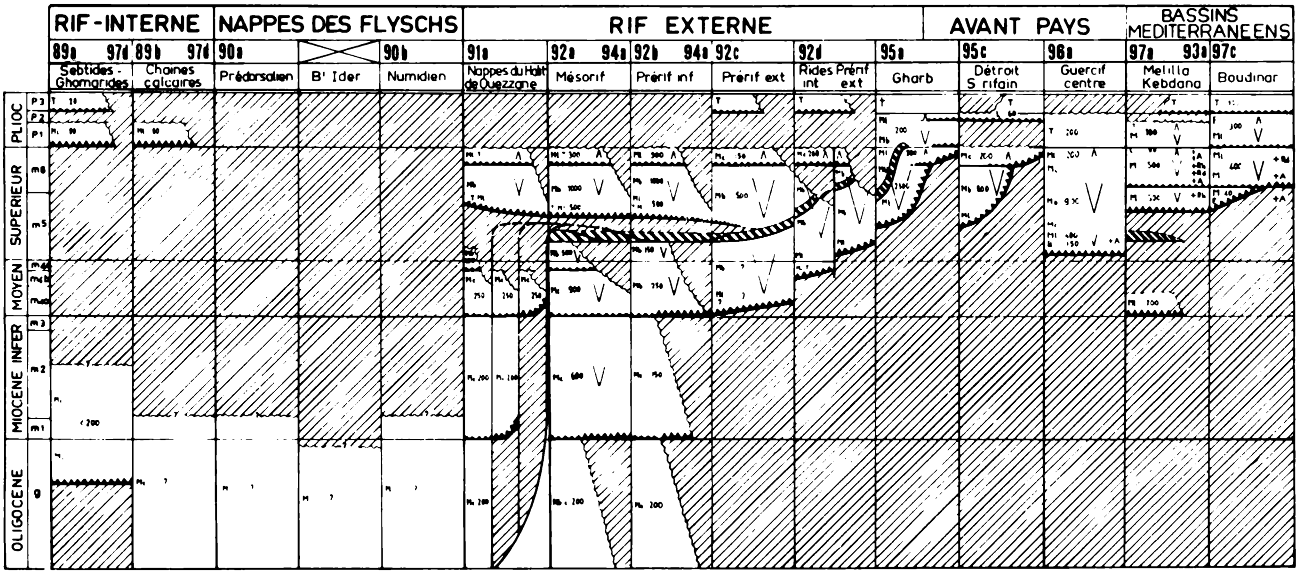
Synclinaux internes:
94 a: (Taounate)
94 b: Charf el Akab
Gharb et Detroit Sud-rifain:
95 a: Gharb centre
95 b: Gharb, bordure Sud
95 c: Detroit Sud-rifain (Saiss)
96 a: Guercif centre (sondage Grf 1)
96 b: Guercif sud
Bassins mediterraneens:
97 a: Melilla–Nord Kebdana (+ 93 a)
97 b: Kert (+ 93 a)
97 c: Boudinar

References:

1. ANDRIEUX 1971 2. ARAMBOURG & CHOUBERT 1965 3. BARBIERI & al. 1976 4. BELLON 1976 5. BELLON & HERNANDEZ 1976 6. BOSSIO & al. 1976 7. CAIRE & al. 1975 8. CAIRE & al. 1974 9. CHARLOT & al. 1967 10. CHEVALIER 1962 11. CHEVALIER 1961 12. CHOUBERT & al. 1968 13. CHOUBERT 1965 14. CHOUBERT & ARAMBOURG 1965 15. CHOUBERT & al. 1964 16. COLLETTA 1977 17. DAGUIN 1927 18. DIDON & al. 1973 19. DUDRESNAY & SUTER 1975 20. ENNADIFI 1960 21. FEINBERG 1978 22. FEINBERG 1976 23. FEINBERG & LORENZ 1971 24. FEINBERG & LORENZ 1973 25. FEINBERG & LORENZ 1970 26. GUILLEMIN 1976 27. HAMEL 1968 28. HERNANDEZ 1975 29. HOUZAY 1975 30. HOUZAY & al. 1975 31. JAEGER & al. 1973 32. KORNPROBST 1974 33. LEBLANC 1975 34. LORENZ 1972 35. MEDIONI & WERNLI 1978 36. SUTER (in print) 37. SUTER & FLECHTER 1966 38. SUTER 1965 39. WERNLI (in print a) 40. WERNLI 1977 41. WILDI & WERNLI 1977 42. WILDI & al 1977 43. WERNLI 1979 44. WERNLI 1980 45. WERNLI (in print b) 46. ARIAS & al. 1978.

| Stand. STAGES | M. Y. | Zones Blow (1969) | MAROC Indices | biozonation | | étages | | | Correlation |
|---|---|---|---|---|---|---|---|---|---|
| | | 22 | | G. truncatulinoides | | | | QUAT. | |
| PIAC. | | 21 | p3 | G. inflata | | | sup. | PLIOCENE | Corrélation arbitraire |
| ZANCL. | | 20 | P2 | G. crassaformis | | | m. | PLIOCENE | |
| ZANCL. | | 19 | p1b | G. puncticulata | | | inf. | PLIOCENE | |
| ZANCL. | 5 | 18 | p1a | G. margaritae | | | inf. | PLIOCENE | |
| MESSIN. | | 17 | m6b | G. primitiva | G. dutertrei | "Messin." | superieur | MIOCENE | |
| MESSIN. | | 17 | m6a | G. dutertrei G. humerosa | G. dutertrei | "Messin." | superieur | MIOCENE | |
| TORTONIAN | 10 | 16 | m5b | G. miotumida G. saphoae | G. menardii | "Tortonien" | superieur | MIOCENE | |
| TORTONIAN | | 15 | m5a | G. nepenthes | G. menardii | "Tortonien" | superieur | MIOCENE | |
| SERRAVAL. | | 14 | m4c | G. praemenardii | Orbulines s.l. | | moyen | MIOCENE | Corrélation indirecte |
| SERRAVAL. | | 13 | m4b | G. miozea rifensis | Orbulines s.l. | | moyen | MIOCENE | |
| SERRAVAL. / LAN. | 15 | 11, 10, 9 | m4a | Orbulines seules | Orbulines s.l. | | moyen | MIOCENE | |
| BURDIGAL. | | 8 | m3 | G. sicanus | | | inferieur | MIOCENE | |
| BURDIGAL. | | 7, 6 | m2b | G. dehiscens | | | inferieur | MIOCENE | |
| AQUITANIAN | 20 | 5 | m2a | G. trilobus trilobus | | | inferieur | MIOCENE | |
| AQUITANIAN | | 4 | m1 | G. primordius | | | inferieur | MIOCENE | |
| CHATTIAN | 25 | 22 (3) | g3 | G. ciperoensis | | | sup. | OLIGOCENE | Corrélation directe |
| CHATTIAN | 30 | 21 (2) | g2 | G. opima opima | | | moyen | OLIGOCENE | |

Stratigraphie du Neogene etablie au Maroc par R. WERNLI (1978) (egalement utilisee pour l'Algerie) Addendum R. WERNLI (1980): la base m6b (F. A. D. primitiva) est post F. A. D. conomiozea F. A. D conomiozea = 6,6 ±05 a Melilla: ARIAS et al. (197 ).




## ALGERIA (DZ)

Area No. 98–108: **ALGERIA, DZ**
Author: G. SUTER

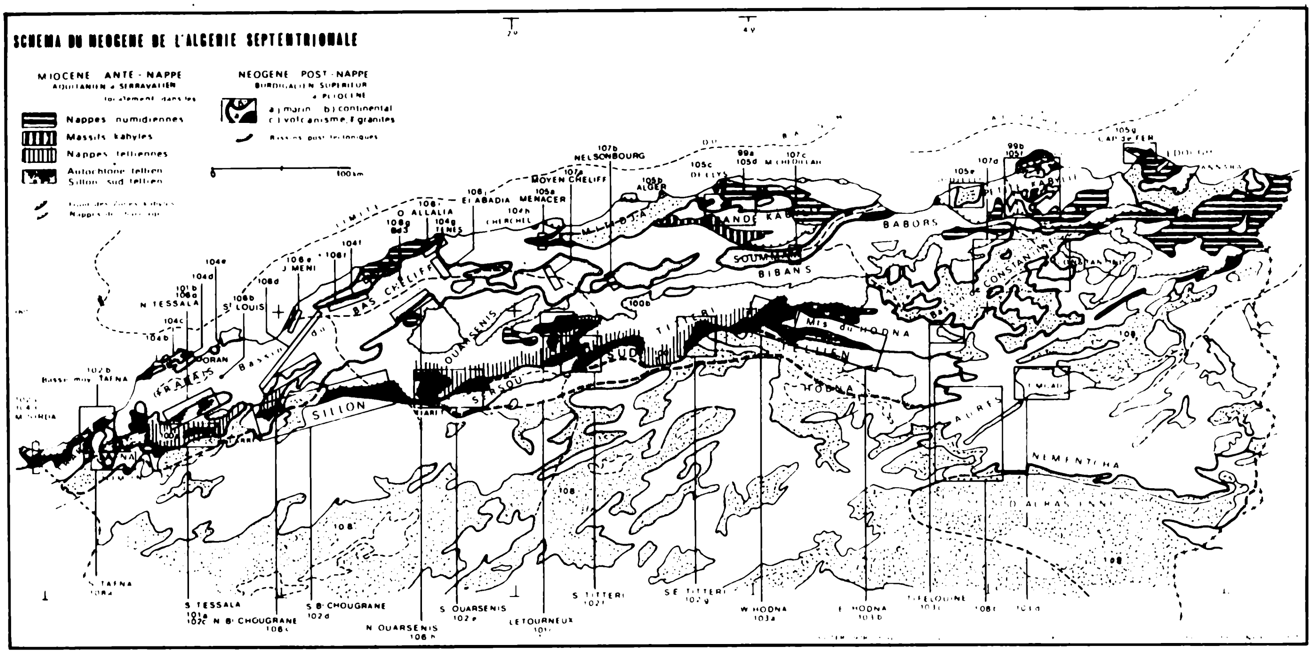
**MIOCENE ANTE-NAPPE 98–101**
Nappes des Gres numidiens 98
Oligo-miocene Kabyle:
99 a: Nord-Ouest de la Grande Kabylie (Guennana, ex Hausonvilliers)
99 b: Petite Kabylie (Collo, El Milia)
Nappes telliennes:
100 a: (Unite Oligo-miocene)
100 b: (Nappe sous numide du Bou Maiz)
Autochtone tellien:
101 a: Bordure S des Tessala (+ 102 c)
101 b: Bordure N des Tessala (+ 106 a)
101 c: Bordure S E de l'Ouarsenis (Letourneux).

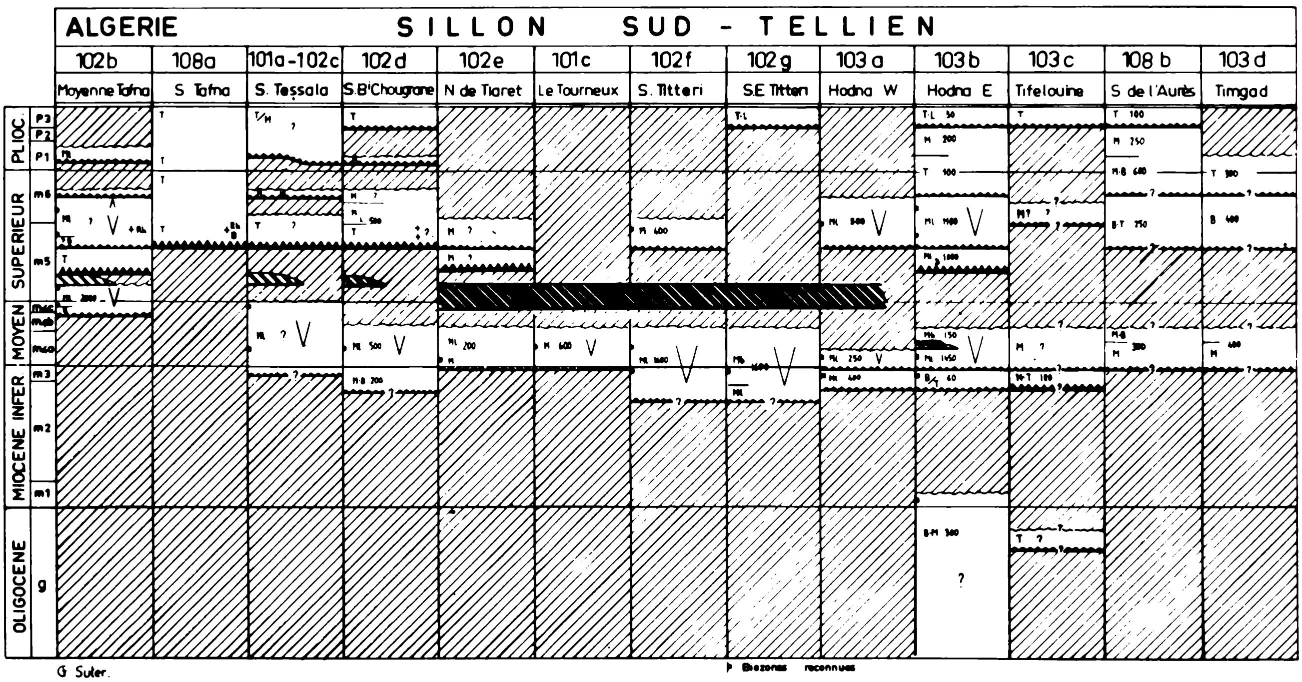
**MIOCENE ANTE-NAPPE et MIOCENE POST-NAPPE** en continuite 102–103
Sillon Sud-tellien:
102 a: M'sirda (Bab el Assa) (+ 104 a)
102 b: Bordures E et SE des Traras, Basse et moyenne Tafna, Sebaa Chioukh
102 c: Bordure S des tessala: voir 101 a
102 d: Bordure S des Beni Chougrane
102 e: Bordure S de l'Ouarsenis (N de Tiaret)
102 f: S du Titteri (Draa el Asnam et sondage Grn 1)
102 g: SE du Titteri (Sondage Rl 1)
103 a: Bassin du Hodna: regions W et NW
103 b: Bassin du Hodna: region E
103 c: Hodna oriental (Col de Tifelouine)
103 d: Bassin de Timgad.

**MIOCENE POST-NAPPE et PLIOCENE** marins 104–107
Bassins littoraux:
104 a: M'sirda: voir 102 a
104 b: S du Cap Sigale
104 c: Les Andalouses, Oued Hammadi
104 d: Mers el Kebir, Murdjadjo
104 e: a l'E d'Oran
104 f: Dahra
104 g: Tenes
104 h: Cherchel
105 a: Mitidja occidentale (Menacer ex Marceau)
105 b: Region d'Alger
105 c: Dellys
105 e: Djidjelli
105 g: du Cap de fer
Bassins intra-tellien
du Bas Cheliff:
106 a: Bordure N des Tessala: voir 101 b
106 b: Plateau de Saint Louis
106 c: Bordure N des Beni Chougrane (J. Touaka)
106 d: Coupe synthetique du bassin du Bas Cheliff (entre le Bas Cheliff et les Beni Chougrane)
106 e: Bas Cheliff (J. Meni)
106 f: Bordure S du Dahra (Oued Djelloul et sondage Az 6)
106 g: Zone axiale du Bas Cheliff (sondage Bd 3)
106 h: Bordure NW de l'Ouarsenis (entre le Chabet Teffoune et l'Oued Riou)
106 i: Oued Allalia
106 j: El Abadia (ex Carnot)
du Moyen Cheliff: 107 a: J. Gontas
de Nelsonbourg: 107 b
de la Soummam: 107 c: (M'chedillah ex Maillot)
de Constantine: 107 d

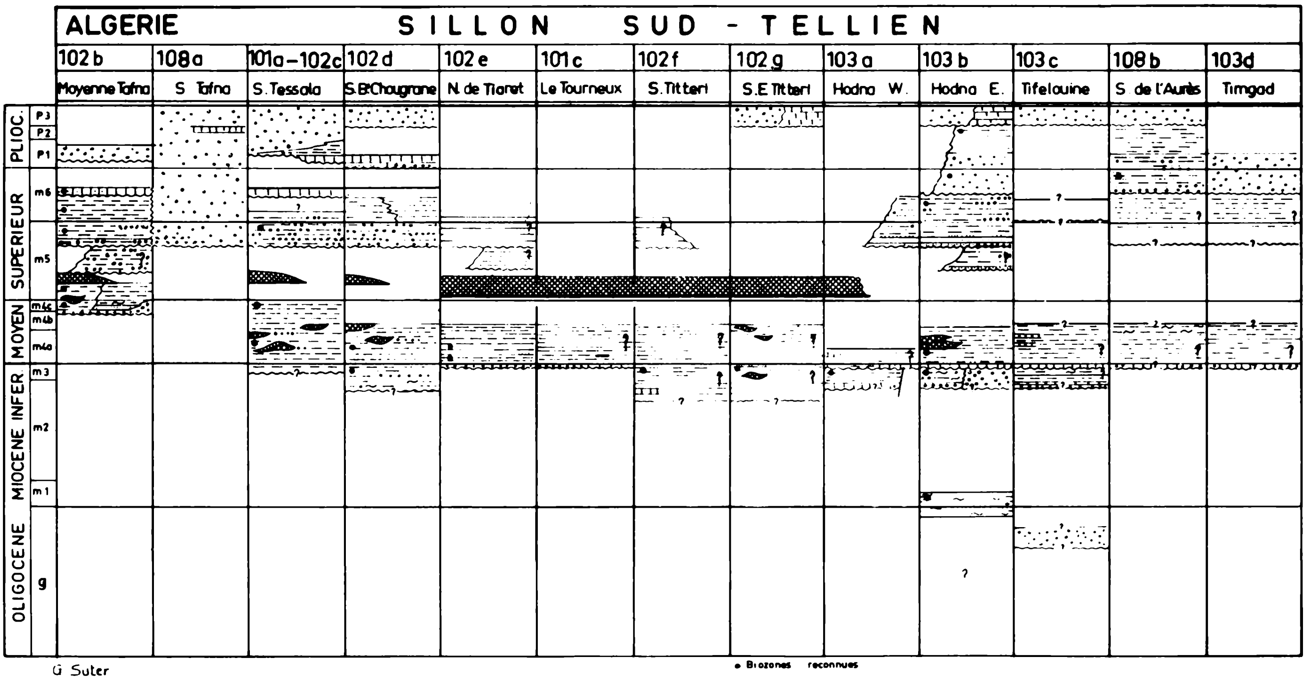
**MIOCENE SUPERIEUR et PLIOCENE** continentaux 108

108 a: Tafna Sud
108 b: Bordure W et SW de l'Aures.




References:
1. ADDADI-DELMOTTE 1968 2. ADDADI & al. 1968 3. ARAMBOURG 1968 4. ARAMBOURG 1959 5. ARAMBOURG 1956 6. ARAMBOURG 1927 7. AUCLAIR & BIEHLER 1967 8. AYME 1956 9. AYME & al. 1954 10. BELLON 1976 11. BERTRANEU 1955 12. BERTRANEU & MAGNE 1952 13. BIJU-DUVAL· 1974 14. BLONDEAU & al. 1968 15. BOUILLIN 1977 16. BOUILLIN 1975 17. BOUILLIN & RAOULT 1971 18. CAIRE 1957 19. CAIRE & MATTAUER 1953 20. CASSAN 1968 a 21. CASSAN 1968 b 22. CITA & al. 1968 23. COLOM & MURAOUR 1956 24. COURME RAULT 1974 25. COUTELLE & YASSINI 1974 26. DAME & MAGNE 1956 27. DELMOTTE 1967 28. DELTEIL 1974 29. DELTEIL & POLVECHE 1968 30. DURAND DELGA 1955 31. DURAND DELGA 1952 32. FENET 1975 33. FENET & IRR 1973 34. FENET & MAGNE 1973 35. FICHEUR 1891 36. GELARD & BIZON 1975 37. GELARD & al. 1973 38. GLACON & GUIRAUD 1970 39. GLACON 1952 40. GUARDIA 1975 41. GUARDIA & al. 1974 42. GUIRAUD 1973 43. HILLY 1957 44. HILLY & MAGNE 1956 45. HILLY & MAGNE 1953 46. IFP-CNEXO 1974 47. KIEKEN 1974–75 48. KIEKEN & MAGNE 1956 49. KIEKEN & al. 1956 50. LAFITTE 1939 51. LEIKINE 1968 52. LEPVRIER & MAGNE 1975 53. LEPVRIER & WELDE 1976 54. LAVAL 1974 55. MAGNE & RAYMOND 1974 56. MAGNE & RAY-


ALGERIE
SILLON SUD - TELLIEN
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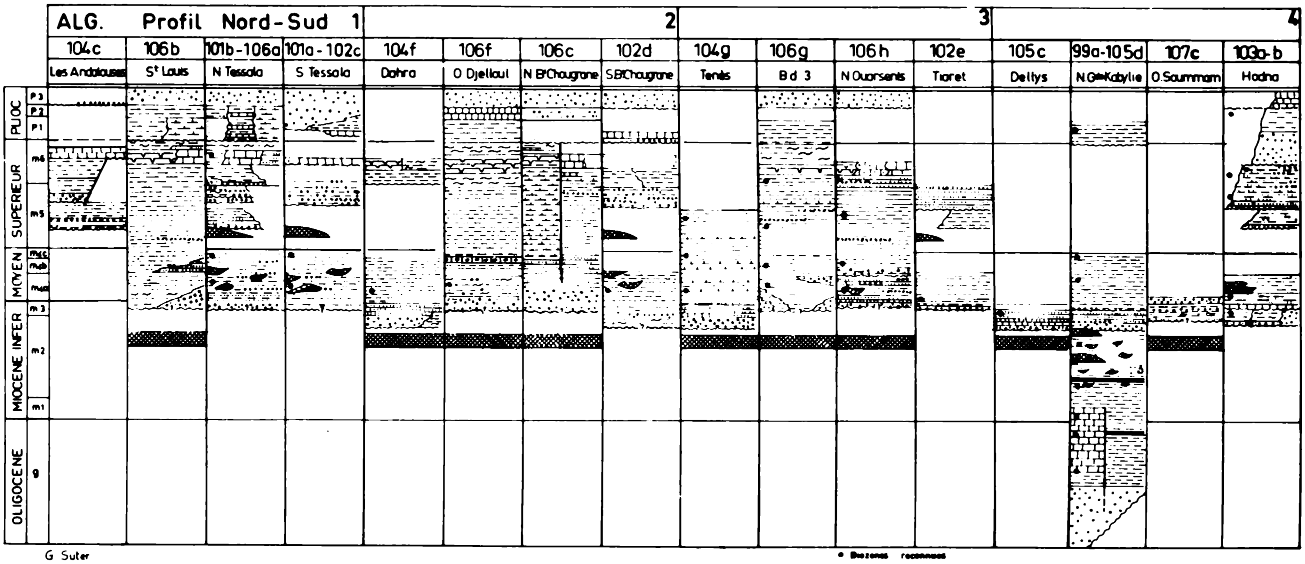
S Tafna
S.Tessala
S.B^t Chougrane
N. de Tiaret
Le Tourneux
S.Titteri
S.E Titteri
Hodna W.
Hodna E.
Tifelouine
S de l'Aurès
Timgad
PLIOC. P3 P2 P1
SUPERIEUR m6 m5
MOYEN m4c m4b m4a
MIOCENE INFER m3 m2 m1
OLIGOCENE g
G Suter
• Biozones reconnues


ALG. Profil Nord-Sud 1
2
3
4
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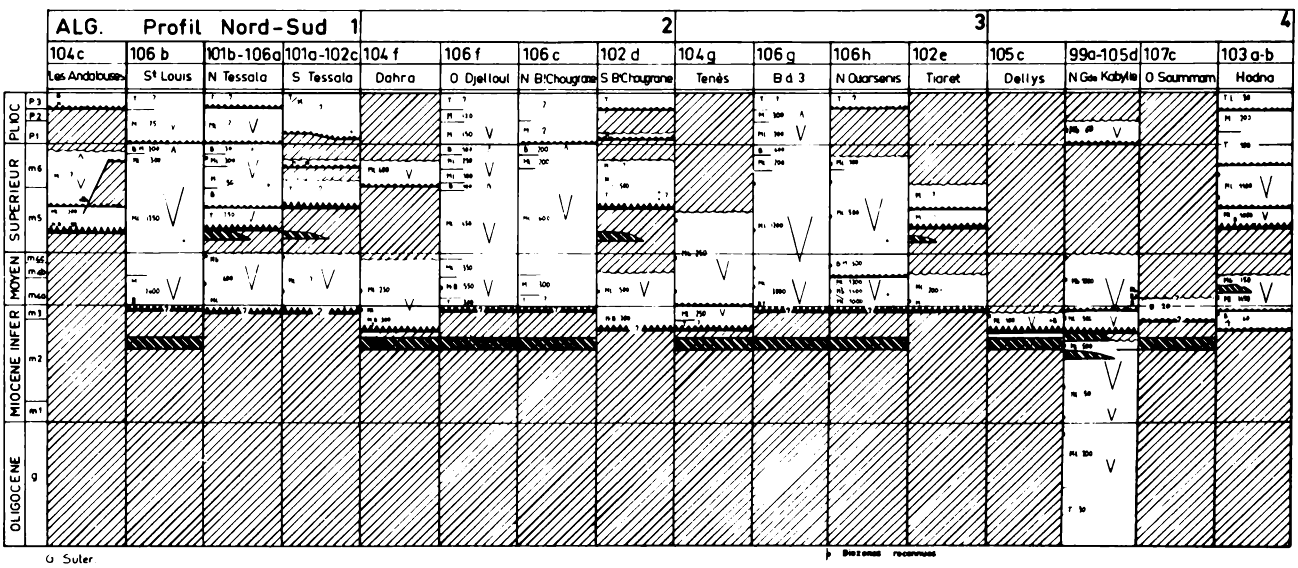
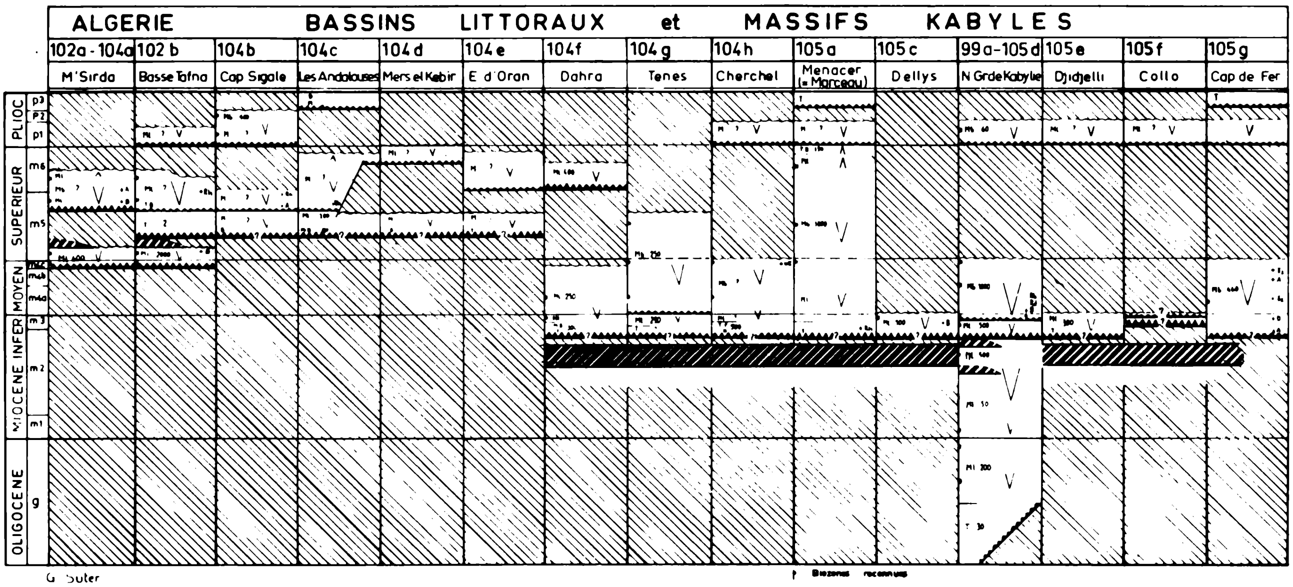
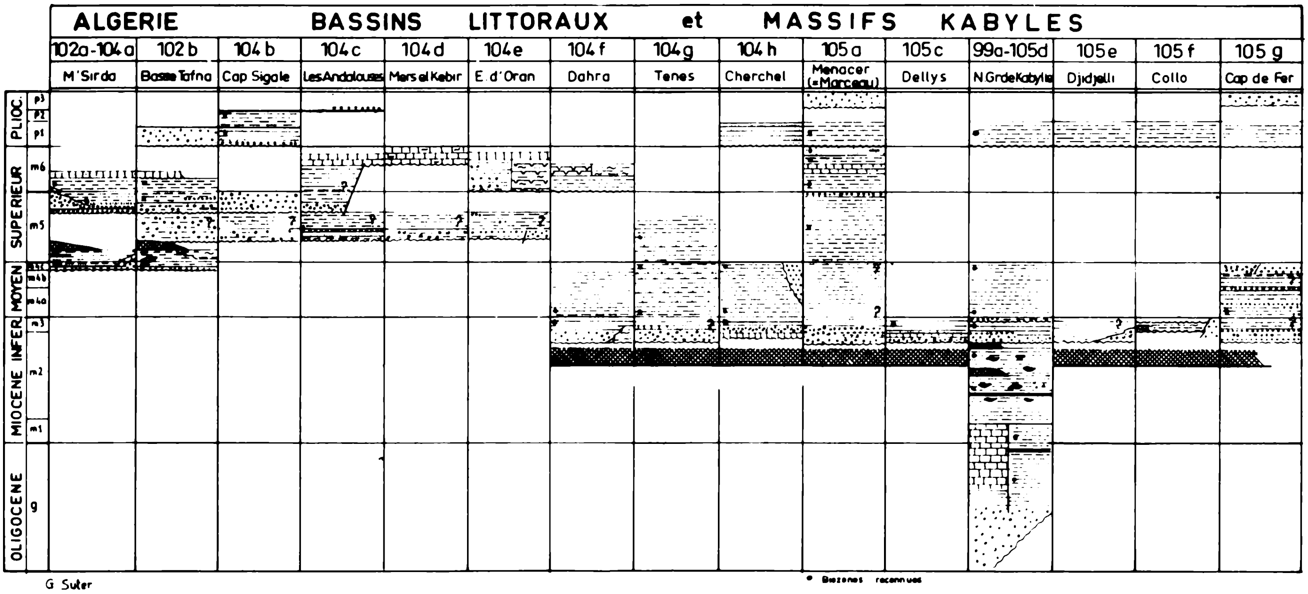
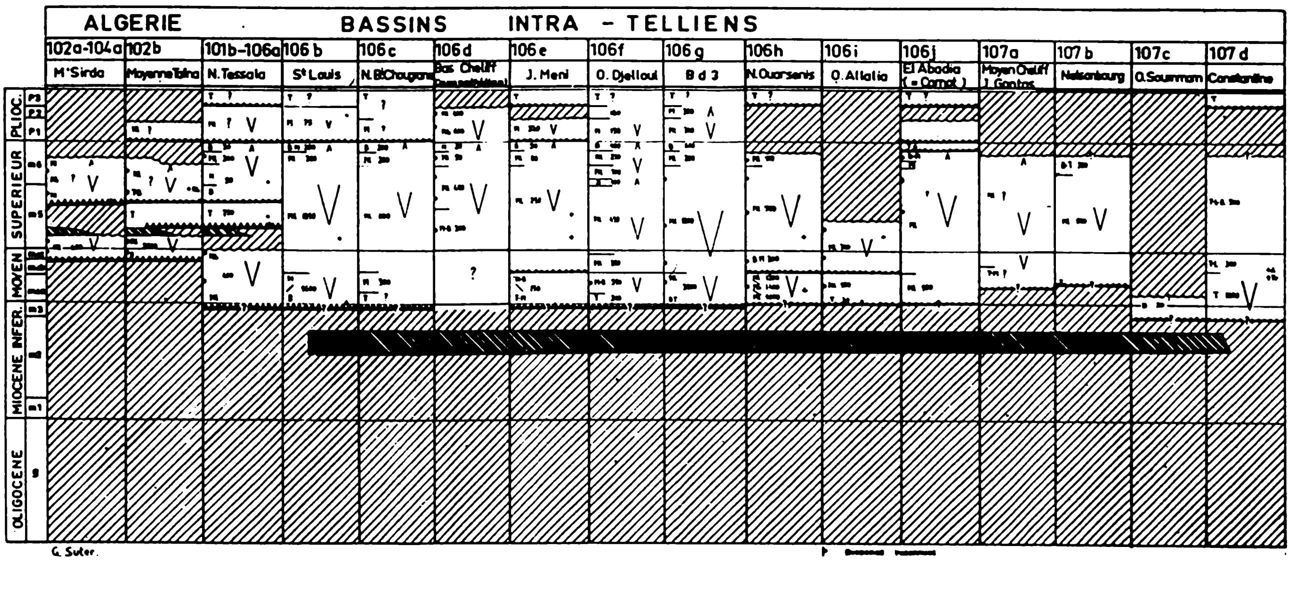
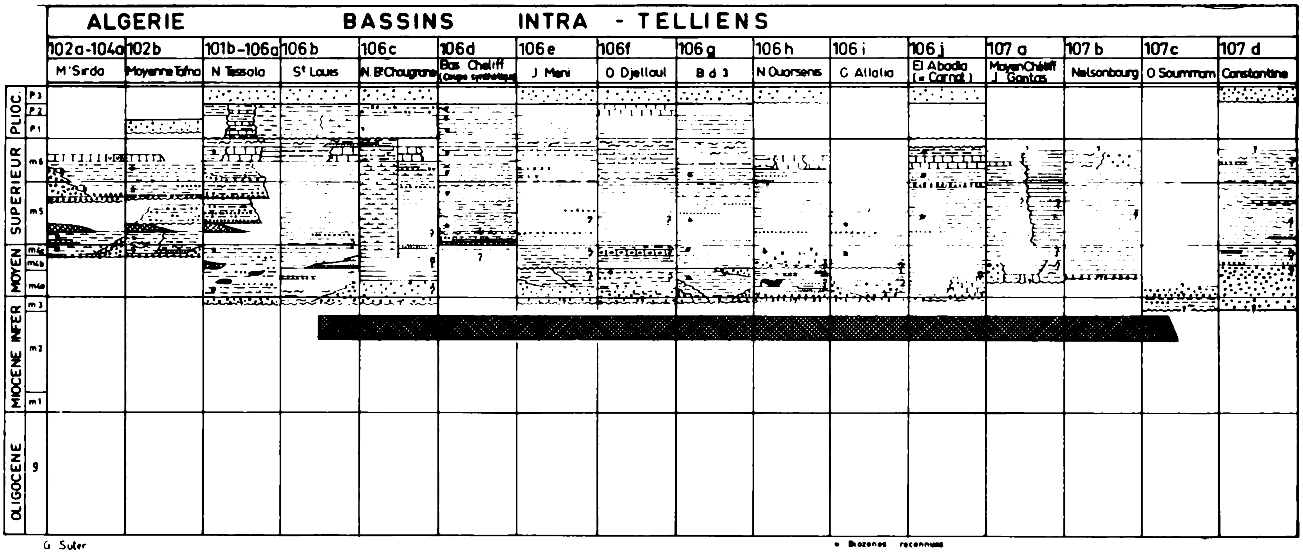
Les Andalouses
S^t Louis
N Tessala
S Tessala
Dahra
O Djelloul
N B^t Chougrane
S B^t Chougrane
Tenès
B d 3
N Ouarsenis
Tiaret
Dellys
N G^de Kabylie
O.Soummam
Hodna
PLIOC P3 P2 P1
SUPERIEUR m6 m5
MOYEN m4c m4b m4a
MIOCENE INFER m3 m2 m1
OLIGOCENE g
G Suter
• Biozones reconnues


ALG. Profil Nord-Sud 1
2
3
4
104c 106 b 101b-106a 101a-102c 104 f 106 f 106 c 102 d 104g 106g 106h 102e 105c 99a-105d 107c 103 a-b
Les Andalouses
S^t Louis
N Tessala
S Tessala
Dahra
O Djelloul
N B^t Chougrane
S B^t Chougrane
Tenès
B d 3
N Ouarsenis
Tiaret
Dellys
N G^de Kabylie
O Soummam
Hodna
PLIOC P3 P2 P1
SUPERIEUR m6 m5
MOYEN m4c m4b m4a
MIOCENE INFER m3 m2 m1
OLIGOCENE g
G Suter
Biozones reconnues


ALGERIE BASSINS LITTORAUX et MASSIFS KABYLES
102a-104a M'Sirda
102 b Basse Tafna
104b Cap Sigale
104c Les Andalouses
104d Mers el Kebir
104e E. d'Oran
104f Dahra
104g Tenes
104h Cherchel
105a Menacer (=Marceau)
105c Dellys
99a-105d N Grde Kabylie
105e Djidjelli
105f Collo
105g Cap de Fer
PLIOC. p3 p2 p1
SUPERIEUR m6 m5
MOYEN m4b m4a
MIOCENE INFER. m3 m2 m1
OLIGOCENE g
G. Suter
Biozones reconnues


ALGERIE BASSINS LITTORAUX et MASSIFS KABYLES
102a-104a M'Sirda
102 b Basse Tafna
104 b Cap Sigale
104c Les Andalouses
104d Mers el Kebir
104e E. d'Oran
104 f Dahra
104g Tenes
104 h Cherchel
105 a Menacer (=Marceau)
105c Dellys
99a-105d N Grde Kabylie
105e Djidjelli
105 f Collo
105 g Cap de Fer
PLIOC. p3 p2 p1
SUPERIEUR m6 m5
MOYEN m4b m4a
MIOCENE INFER. m3 m2 m1
OLIGOCENE g
G. Suter
Biozones reconnues


ALGERIE BASSINS INTRA - TELLIENS
102a-104a M'Sirda
102b Moyenne Tafna
101b-106a N. Tessala
106 b St Louis
106c N. Bl Chougrane
106d Bas Cheliff
106e J. Meni
106f O. Djelloul
106 g B d 3
106h N. Ouarsenis
106i O. Allalia
106j El Abadia (=Carnot)
107a Moyen Cheliff J. Gontas
107 b Nelsonbourg
107c O. Soummam
107 d Constantine
PLIOC. p3 p2 p1
SUPERIEUR m6 m5
MOYEN
MIOCENE INFER. m3 m2 m1
OLIGOCENE g
G. Suter.




MOND 1971 57. MAGNE & RAULT 1970 58. MAGNE & TEMPERE 1953 59. MATTAUER 1958 60. MAZZOLA 1971 61. MURAOUR 1949 62. PERRODON 1957 63. POLVECHE 1960 64. RAYMOND 1976 65. RAOULT 1974 66. SADRAN 1956 67. SISSINGH 1972 68. TEFIANI 1970 69. THOMAS 1977 70. TENAILLE & BURGER 1953 71. TJALSMA & WONDERS 1971 72. VILA & al. 1968 73. YASSINI 1974 74. CHABBAR AMEUR & al. 1976.

## TUNISIA (TN)

Area No. 109–114: TUNISIA, TN
Author: P. F. BUROLLET

Area No. 109: Khoumirie–Mogods, TN
- Raf–Raf
- Hakima Nappes
- Couches de Babouch
- Gres Numidiens

Area No. 110: Bizerte, TN
- Porto Farina sstones
- Raf–Raf shale
- Segui Form.
- Oued bel Khedim Form.
- Kechabta Form.
- Oued el Melah shale
- Hakima Form
- Mellaha evaporites
- Sandstone, clay and sandy limestone with glauconite
- Numidian Flysch/Allochtonous

Area No. 111: Cap Bon, TN
- Porto Farina sstone
- Raf–Raf shale
- Segui continental beds
- Saouaf Form.
- Gray shale interbedded with sandstone, gypsum oyster beds and brown coal seams
- Beglia sandstone
- crossbedded coarse grained sandstone
- Mahmoud shale
- Ain Brab Form.
- Bioclastic limestone, conglomerate, Pectinidae, Echinids
- Ain el Hammam
- Oum Douil Group
- Cap Bon Group
- *Ggs. primordius* Zone
- offshore E of Cap Bon
- Marine shale facies
- *G. ciperoensis* Fortuna sandstone
- *Ggs. anguisuturalis* Zone
- Coarn grained sstone in the upper part
- Interbedded sstone and shale in the lower part

Area No. 112: Tunisie orientale – Sahel, TN
- Porto Farina sstone
- Raf–Raf shale
- Segui continent. Beds
- Saouaf Form.
- shale, brown coal, sandstone, gypsum, oyster beds
- Beglia sandstone
- Oum Douil Group
- Mahmoud shale
- Ain Grab Form.
- bioclastic limestone, conglomeratic in places
- Cap Bon Group
- Messiouta Red Beds
- Fortuna sandstone
- *Ggs. angulisuturalis* Zone

Area No. 113: Plateau sous-marin de Kerkennah – Golfe de Gabes, TN
- Calcareous sstone and sandy marl

May be very thick in the Linosa and Malta troughs
Oued bel Khedim
Aouaf Form.
Melqart Form., shale and bioclastic limestone with Corals.
Few gypsum and sand
Oum Douil Group
Beglia Form., sandstone, some interbedded shale/ Mahmoud shale
Group Cap Bon
*Praeorbulina, Gl. sicanus*
Upper member
Upper Tetatna Form., *Ggs. trilobus*
Middle Ketatna Form., *Ggs. primordius, Lepidocyclines*
Lower Ketatna Form. / including Lower Oligocene / *Nummulites*
Ketatna Formation

**Area 114: Sud Ouest Tunesia – Chott Jerid, TN**
Segui Form.
brownish to yellow sands, conglomerates, some sandy clay
Saouaf Form., Shale, Oystro, Gypsum
Beglia sandstone
crossbedded
Vertebrates with *Hipparion*
Sehib Form., Red beds

References:
1. ROUVIER 1977 2. BUROLLET 1951 3. BIELY & al. 1971 4. ARNOULD 1951 5. BUROLLET 1956 6. VERHOEVE 1973 7. BIELY & al. 1972 8. SALAJ & STRANIK 1971 9. ROBINSON & WIMAN 1976 10. HOOYBERGHS 1973 11. RAAF DE 1952 12. DEMARCQ & al. 1976 13. COMTE & DUFAURE 1973 14. FOURNIE 1978 15. BISMUTH 1973 16. DOMERGUE & al. 1952.

## MALTA (M)

**Area No. 136: MALTESE ISLANDS, M**
Author: E. P. F. ROSE

Both the islands of Malta and Gozo expose two lower carbonate formations separated from two upper carbonate formations by a distinctive Blue Clay Formation. Recent maps show the distribution of these formations (BP Exploration Co., 1957) and of their members (PEDLEY, HOUSE & WAUGH, 1976; PEDLEY, 1978). The strata are cut by normal faults (PEDLEY & al., 1976), and arguably by a sequence of subsidence structures (PEDLEY, 1974), but otherwise have a slight regional dip to the northeast unaffected by major tectonism, or by volcanism.

The succession is richly fossiliferous, the macrofossils including locally abundant molluscs (ROMAN & ROGER, 1939), echinoids (ROSE, 1975), and fish debris (MENESINI, 1974). An extensive literature on Maltese geology and palaeontology extends back over 200 years. The most recent published reviews are by FELIX (1973) (fully comprehensive); PEDLEY & al. (1976) (outline stratigraphy and structure); ZAMMIT-MAEMPEL (1977) (simplified but well-illustrated) and PEDLEY, HOUSE & WAUGH (1978). PEDLEY & WAUGH (1976) and BOSENCE, PEDLEY & ROSE (1980) have provided field guides to key localities. ROSE (1978) has outlined British I.G.C.P. work on Malta.

The lower carbonates have been interpreted as a transgressive sequence spanning the Paleogene-Neogene boundary, the boundary being marked by a widespread hardground and probable non-sequence (BENNETT, 1979). The underlying lower Coralline Limestone has not been precisely dated. EAMES & al. (1962) have ascribed it to the Miocene (Aquitanian), but FELIX (1973) and GIANNELLI & SALVATORINI (1972) agree in dating the exposed strata as Oligocene, probably Chattian. Similar lithologies have been recorded in a borehole down to 600 m (EAMES & al., 1962) and beds of Cretaceous age at 3000 m (PEDLEY & al., 1976). The *Globigerina* Limestone extending above the hardground has been dated as of Miocene Aquitanian--Langhian (N5 to N9 zone) age by FELIX (1973), and late Oligocene/Aquitanian–Langhian (pre-N4 to N9 zone) age by GIANNELLI & SALVATORINI (1972). Breaks in sedimentation are controversially recognised at phosphorite conglomerate horizons (FELIX, 1973; GIANNELLI & SALVATORINI, 1972; 1975), and at a widespread hardground of terminal Lower *Globigerina* Limestone age which is associated with occasional neptunean dykes (BENNETT, 1980).

The Blue Clay Formation has been correlated with foraminiferal zones N9 (top) to N14 (Langhian–Serravallian) by FELIX (1973), and with Serravallian nannoplankton zones NN6 to NN7 by HOJJATZADEH (1978). In contrast, GIANNELLI & SALVATORINI (1975) recognise an N9 (top) to N16 (Langhian–Tortonian) range on the basis of foraminifera; a widespread N13 to lower N15 hiatus at a glauconite horizon high in the formation; and (1972) a K-Ar based minimum age of 12.5 m. years (supposed Upper Tortonian) for the glauconite.

For the upper carbonates, FELIX (1973) ascribed a Serravallian (N15) age to much of the Greensand, and Tortonian (N16) age to the basal overlying Upper Coralline Limestone. GIANNELLI & SALVATORINI (1975), however, claim an entirely Messinian (N17) range for these two formations; a widespread if variable pre-Upper Coralline Limestone hiatus marked by partial absence of zones N16 and N17 (base); and (1972) a K-Ar date of 8.2–10.4 m. years for glauconite from the Greensand.

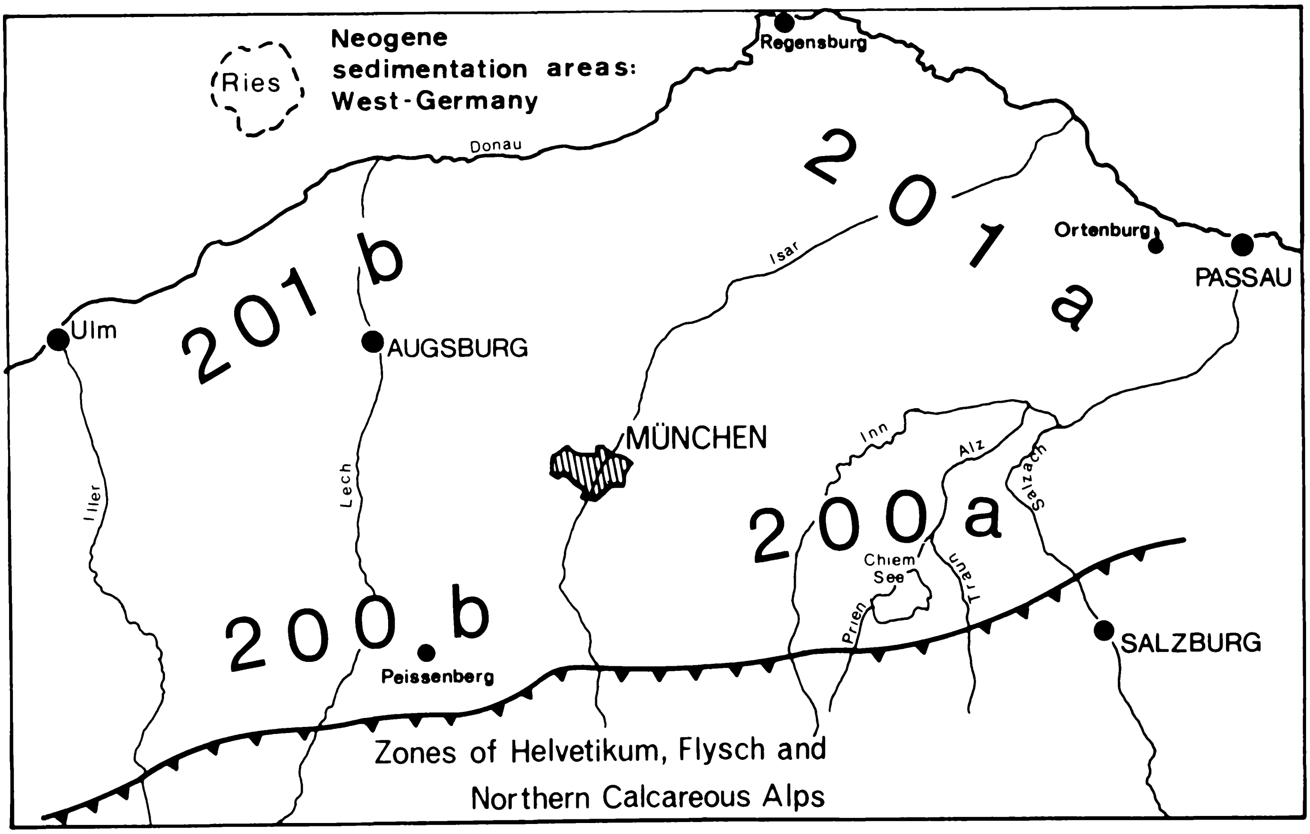
Palaeoenvironmental studies based on foraminifera (FELIX, 1973), sedimentary facies (PEDLEY, 1978; BENNETT, 1980) and echinoids (CHALLIS, 1979; 1980) agree in interpreting the depositional history of the Maltese Neogene as a continuously marine shelf which subsided (differentially and intermittently) from shallow water in Lower Coralline Limestone times to a water depth of some

150–200 m during deposition of the Blue Clay, the Greensand and Upper Coralline Limestone indicating a return to general shallow water conditions.

PEDLEY & al. (1978) accept that Malta was part of a mid-Tertiary carbonate platform extending from southern Sicily to North Africa, with Malta situated toward the leading edge of the African plate. In North Africa, closest similarity in faunas and carbonate facies is with Cyrenaican Libya (ROSE, 1974; ZERT, 1974) (area 84 a above) rather than Tunisia (WIMAN, 1978). In Sicily, similarities exist in the Ragusa platform area (EAMES & al., 1962) to the SE and the Sicani mountains (MASCLE, 1979( to the SW. Precise correlation is as yet controversial. However, the Malta escarpment to the east of the islands, separating western from eastern Mediterranean basins, appears to have existed even in Miocene time (CITA & al., 1979).

References:
1. BENNETT 1979 2. BENNETT 1980 3. BOSENCE & al. 1980 4. BP EXPLORATION CO. LTD. 1957 5. CHALLIS 1979 6. CHALLIS 1980 7. CITA & al. 1979 8. EAMES & al. 1962 9. FELIX 1973 10. GIANNELLI & SALVATORINI 1972 11. GIANNELLI & SALVATORINI 1975 12. HOJJATZADEH 1978 13. MASCLE 1979 14. MENESINI 1974 15. PEDLEY 1974 16. PEDLEY 1978 17. PEDLEY & al. 1976 18. PEDLEY & al. 1978 19. PEDLEY & WAUGH 1976 20. ROMAN & ROGER 1939 21. ROSE 1974 22. ROSE 1975 23. ROSE 1978 (see also 1979 & 1980 reports) 24. WIMAN 1978 25. ZAMMIT-MAEMPEL 1977 26. ZERT 1974.

## WEST GERMANY (D)




Area No. 200 a b, 201 a b: **SUBALPINE UND NIEDERBAYRISCHE MOLASSE, D**
Authors: H. HAGN, E. MARTINI, D. HERM, V. FAHLBUSCH, H. GALL, P. JUNG

References:
1. BERZ & JOOS 1927 2. CICHA & al. 1972 3. CICHA & al. 1971 4. DEHM 1955 5. GALL 1971 a 6. GALL 1971 b 7. GALL 1975 8. GALL & al. 1978 9. GANSS 1977 10. GEISSLER 1975 11. HAGN 1955 12. HAGN & HÖLZL 1952 13. HAGN & al. 1962 14. KIDERLEN 1931 15. MALL 1968 16. MOOS 1925 17. MÜLLER 1972 18. MÜLLER 1975 19. NEUMAIER & al. 1957 20. OSCHMANN 1963 21. SCHETELIG 1962 22. SCHLICKUM & STRAUCH 1968 23. WINKLER 1966 24. ZÖBELEIN 1957.

**Area No. 290 a–d: RHEINGRABEN, MAINZ, HANAU, WETTERAU, D**
Author: E. MARTINI

References:
1. BOENIGK & al. 1977 2. DOEBL 1961 3. DOEBL 1967 4. GOLWER 1968 5. SCHRICKE 1975 6. STEPHAN-HARTL 1972 7. WEILER 1963 8. WENZ 1921 9. ROTHAUSEN 1969 10. LAUER & al. 1967.

## SWITZERLAND (CH)

**Area No. 200 c 1: SUBALPINE MOLASSE – WESTSCHWEIZ, CH**
Authors: U. BÜCHI & S. SCHLANKE (1977) and H. NAEF

References:
1. BÜCHI & SCHLANKE 1977 2. NAEF 1984 3. MATTER & al. 1980.

**Area No. 200 c 2: SUBALPINE MOLASSE – THUNERSEE REGION, CH**
Author: A. BREITSCHMID

References:
1. HAUS 1951 2. ENGESSER, MAYO, WEIDMANN 1984.

**Area No. 200 b: SUBALPINE MOLASSE – OSTSCHWEIZ, CH**
Authors: U. BÜCHI & S. SCHLANKE (1977), H. BÜRGISSER & al. (1981).

References:
1. BÜCHI & SCHLANKE 1977 2. BÜRGISSER & al. 1981.

**Area No. 201 c 1: MITTELLÄNDISCHE MOLASSE – WESTSCHWEIZ, CH**
Authors: U. BÜCHI & S. SCHLANKE (1977)

References:
1. BÜCHI & SCHLANKE 1977 2. MATTER & al. 1980.

**Area No. 201 c 2: MITTELLÄNDISCHE MOLASSE – ZENTRALSCHWEIZ, CH**
Authors: A. MATTER, U. BÜCHI & S. SCHLANKE (1977), H. NAEF (1984)

References:
1. BERGER 1983 2. MATTER & al. 1980 3. KELLER 1972 4. ENGESSER, MATTER & WEIDMANN 1981.

**Area No. 201 b: MITTELLÄNDISCHE MOLASSE – OSTSCHWEIZ, CH**
Authors: S. SCHLANKE, U. BÜCHI & S. SCHLANKE (1977), H. NAEF (1984).

References:
1. NAEF 1984 2. BÜCHI & SCHLANKE 1977 3. BÜRGISSER & al. 1983.

**Area No. 201 d 1: INTRAJURASSIC BASINS, LAUFEN BASIN AND PLATEAU JURA, CH**
Authors: A. MATTER, H. NAEF (1984).

Reference:
1. NAEF 1984

**Area No. 201 d 2: INTRAJURASSIC BASIN, DELEMONT BASIN (DELSBERG BECKEN), CH**
Authors: A. MATTER, H. NAEF (1984)

References:
1. MAYO 1980 2. ENGESSER & al. 1981 3. WEIDMANN & ENGESSER 1984.

**Area No. 201 d 3: INTRAJURASSIC BASINS, TAVANNES, ST. IMIER ETC., CH**
Authors: A. MATTER, M. ANTENEN, H. NAEF (1984)

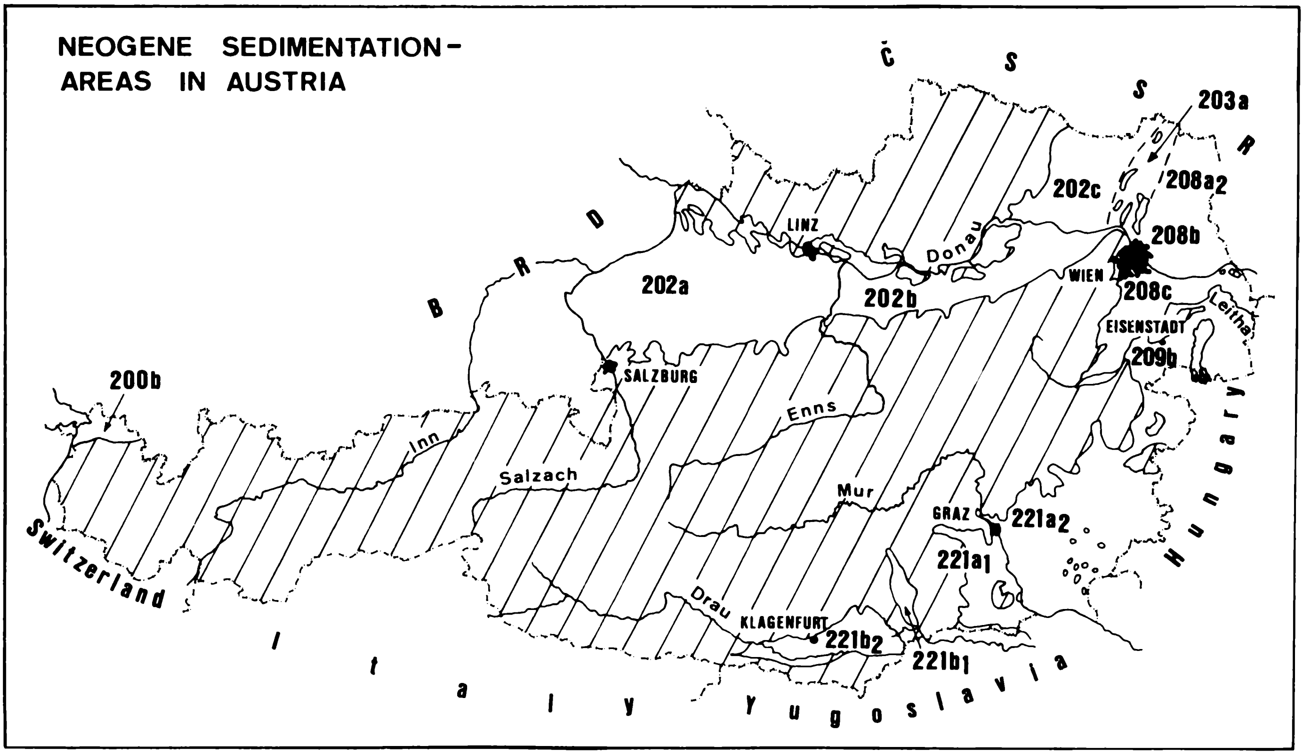
References:
1. DE BEAUMONT & al. 1984 2. NAEF 1984

## AUSTRIA (A)

**Area No. 200 b: ALLGÄUER MOLASSE EINSCHLIESSLICH VORARLBERG, A**
Author: F. F. STEININGER

Gegen Osten werden die limnisch-fluviatilen Schichtserien des Egerien, Eggenburgien und Ottnangien zunehmend durch brackische bis marine Serien vertreten. Gegen Westen ist eine durchgehende marine Verbindung nur im oberen Eggenburgien und tieferen Ottnangien fossil zu belegen. Gegen Norden rasche Abnahme der Schüttfächer, die ab der Oberen Meeresmolasse in Vorarlberg als eigener Schüttungsfächer (Bodenseeschüttung) neben der Hörnli-Schüttung in Erscheinung treten.

References:
1. BÜCHI 1967 2. BÜCHI & al. 1965 3. BÜCHI & SCHLANKE 1977 4. FUCHS 1976 5. FUCHS 1980 a 6. FÜCHTBAUER 1964 7. HOCHULI 1978 8. HOCH-




ULI, 1982 9. LEMCKE 1977 10. LEMCKE & al. 1953 11. LEMCKE & VOLLMAYR 1970 12. MÜLLER 1982 13. RÖGL 1982 14. RÖGL & STEININGER 1983 15. SCHIEMENZ 1960 16. STEININGER, RESCH & al. 1982 17. STEININGER, RÖGL & al. 1982 18. ZÖBELEIN 1957.

Area No. 202 a: **MOLASSEZONE VOM INN BIS ZUM SÜD-SPORN DER BÖHMISCHEN MASSE, A**
Author: F. F. STEININGER

References:
1. BRIX & al. 1977 2. Chronostratigraphie & Neostratotypen 1–6 3. FUCHS 1964 4. FUCHS 1976 5. FUCHS 1980 a 6. HOCHULI 1978 7. KOLLMANN 1977 8. KOLLMANN & MALZER 1980 9. RÖGL & al. 1979 10. RÖGL & STEININGER 1982 11. STEININGER & al. 1976.

Area No. 202 b: **MOLASSEZONE VOM SÜD-SPORN DER BÖHMISCHEN MASSE UND S DER DONAU, A**
Author: F. F. STEININGER

References:
1. BRIX & al. 1977 2. Chronostratigraphie und Neostratotypen 1–6 3. FUCHS 1976 4. FUCHS 1972 5. FUCHS 1980 a 6. HOCHULI 1978 7. KRÖLL 1980 b 8. RÖGL & STEININGER 1983 9. RÖTZEL (1983 in print) 10. STEININGER & al. 1976 11. THENIUS 1974.

Area No. 202 c: **MOLASSEZONE NÖRDLICH DER DONAU, A**
Author: F. F. STEININGER

References:
1. BRIX & al. 1977 2. Chronostratigraphie & Neostratotypen 1–6 3. FINK 1976 4. FUCHS & al. 1980 5. FUCHS 1976 6. FUCHS 1980 a 7. HOCHULI 1978 8. KRÖLL 1980 9. RABEDER 1981 10. RÖGL & STEININGER 1983 11. STEININGER & al. 1976 12. THENIUS 1974 13. THENIUS 1976.

Area No. 203 a: **WASCHBERGZONE IN ÖSTERREICH, A**
Author: A. PAPP

References:
1. BRIX & al. 1977 2. Chronostratigraphie und Neostratotypen 1–6 3. FUCHS 1980 4. FUCHS 1976 5. FUCHS 1980 a 6. GRILL 1968 7. PAPP, KRÖLL & al. 1978 8. RÖGL & STEININGER 1983 9. STEININGER & al. 1976 10. THENIUS 1974.

Area No. 208 a2, b, c, 209 b: **WIENER BECKEN UND RANDBUCHTEN, A**
Author: A. PAPP

References:
1. Chronostratigraphie & Neostratotypen 1–6 2. FUCHS 1980 b 3. KRÖLL 1980 a 4. RÖGL & STEININGER 1983 5. ROYDEN & al. 1982 6. ROYDEN & al. 1983 7. STEININGER & al. 1976.

Area No. 221 a 1, a 2: **STEIRISCHES BECKEN, A**
Author: A. PAPP

References:
1. Chronostratigraphie & Neostratotypen 1–6 2. FUCHS

1980 b 3. KOLLMANN 1970 4. KOLLMANN 1980 5. MOTTL 1970 6. RABEDER & STEININGER 1975 7. RÖGL & STEININGER 1983 8. STEININGER & al. 1976.

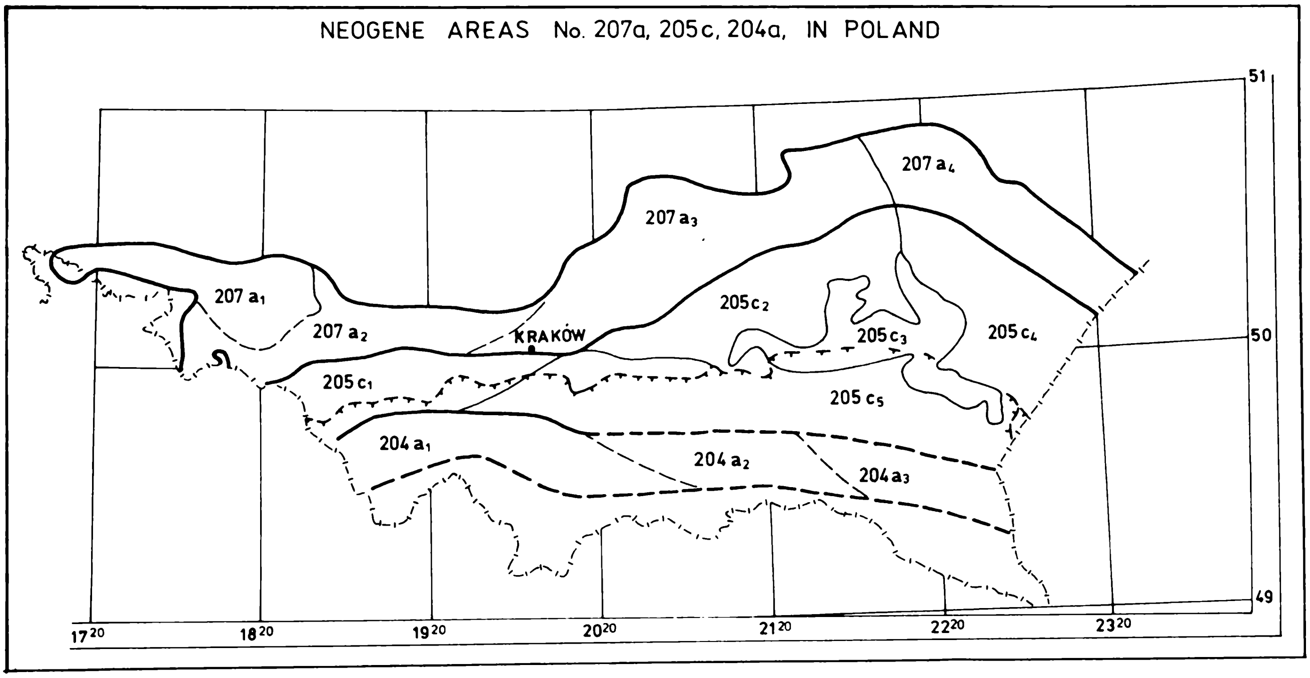
Area No. 221 b1: **LAVANTTAL, KÄRNTEN, A**
Author: A. PAPP

References:
1. BECK-MANNAGETTA 1959 2. FUCHS 1980 b 3. KOLLMANN 1965 4. LIPPOLT & al. 1975 5. MOTTL 1957 6. SCHMID 1974 7. THIEDIG 1970.

Area No. 221 b2: **KLAGENFURTER BECKEN, A**
Author: A. PAPP

References:
1. BAUER 1970 2. BAUER 1973 3. FUCHS 1980 b 4. KAHLER 1953 5. VAN HUSEN 1976.

## POLAND (PL)




**Area No. 204 a, 205 c, 207 a: POLAND (PL)**
Author: T.M. KUCINSKI

In the Polish and Ukrainian Carpathians Early Miocene microfauna and nannoflora are found. However these faunas are confused and the zonation is incomparable with the Tethyan one (10, 11) because of submarine slides and erosion. The first appearance of *Globigerinoides trilobus* in the *G. primordius* Zone (8, 11) belongs to the lowermost Lower Miocene. On the contrary presence of *Globigerina angulisuturalis* (9, 26) indicates a Late Oligocene age. An extend and lithology of Krosno Formation (upper part) in the East-Carpathians are given on the paleogeographical map (22).

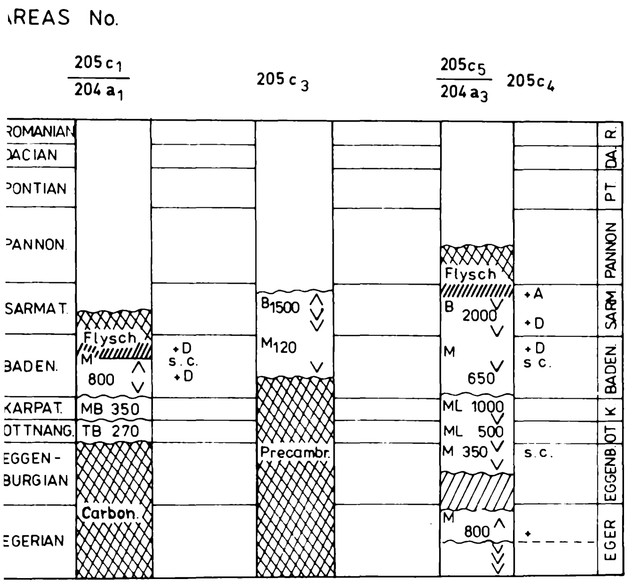
In the Polish part of the Carpathian Foredeep several sedimentary areas can be distinguished (4). However these outlines are revised and supplemented by the Sub-Carpathian area. Paleogeographical maps are published (33) of deposits of several stages based on provisional stratigraphic scheme.

In Poland the Carpathian Foredeep is combined of two basins: southern one called inner and younger one called outer basin (33). The axis of the inner basin was gradually displaced to the north during Middle Badenian and Early Sarmatian.

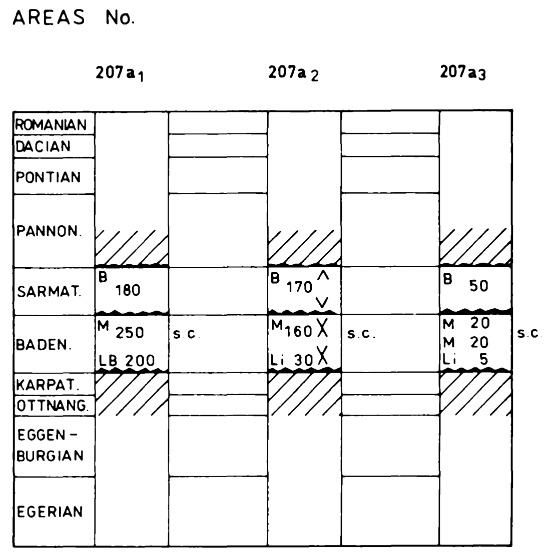
Stebnik and Balich Formations of the inner basin can be correlated with Sucha and Bielsko Formations, occurring beneath West-Carpathians. Only Moravian deposits in the western part of the outer basin (Area 205 $c_1$) are present. These sediments are overlied by deposits of Kosovian age towards the north-west. In the central part of the Carpathian Foredeep the "Rzeszow Island" of Upper Wielician age is found (Area 205 $c_3$). It is overlied by the deposits of Kosovian and Volhynian age.

The best known stratigraphical conditions are of Badenian and Sarmatian Stages. Nevertheless there are two different stratigraphical divisions. One point of view (25): Lower boundary of Bochenian Substage can be placed between the Lagenidae and Sandschaler Zone. Consequently Lagenidae Zone can be a time equivalent of Opolian Substage, however Bochenian Substage is equivalent of Sandschaler Zone and Tarnovian Substage is equivalent of *Bulimina–Bolivina* Zone. Moreover the deposits of Tarnovian Substage in Poland can be correlated with Kosovian Sub-

ORRELATION OF FACIES, THICKNESS, VOLCANISM, MOVEMENTS
ND UNCONFORMITIES OF ADJACENT NEOGENE AREAS




CORRELATION OF FACIES, THICKNESS, VOLCANISM, MOVEMENTS
AND UNCONFORMITIES OF ADJACENT NEOGENE AREAS




STRATIGRAPHIC CORRELATION OF THE MIOCENE IN THE WEST CARPATHIANS FOREDEEP (T. M. KUCINSKI, 1981)

| EPOCH | STAGE | | CHRONOSTRATIGR. 1969 | BIOSTRATIGRAPHY VIENNA BASIN | LITHOSTRATIGR. | CHRONOSTRATIGR. 1974 | BIOSTRATIGRAPHY |
|---|---|---|---|---|---|---|---|
| Middle MIOCENE | CESSOLIAN | SERRAVALLIAN | LOWER SARMATIAN | ELPHIDIUM CIBICIDES ZONE | KRAKOWIEC FM | EARLY SARMATIAN | ANOMALINOIDES DIVIDENS |
| | | | UPPER BADENIAN /TARNOVIAN/ | BULIMINA BOLIVINA ZONE | TARNOV FM | LATE BADENIAN /KOSOVIAN/ | VELAPERTINA INDIGENA |
| | | | MIDDLE BADENIAN /BOCHENIAN/ | SANDSCHALER ZONE | BOCHNIA FM | MIDDLE BADENIAN /WIELICIAN/ | GLOBIGERINA DECORAPERTA |
| | | LANG | LOWER BADENIAN /OPOLIAN/ | LAGENIDAE ZONE | SKAWINA FM | EARLY BADENIAN /MORAVIAN/ | ORBULINA SUTURALIS |
| Early MIOCENE | GIRONDIAN | BURDIGALIAN | KARPATIAN | UVIGERINA GRACILIFORMIS | BIELSKO FM | KARPATIAN | GLOBIGERINOIDES SICANUS |
| | | | OTTNANGIAN | | SUCHA FM | OTTNANGIAN | GLOBOQUADRINA DEHISCENS |
| | | | | | | | |
| | | AQUIT. | | | | | |

stage s. str. of Ukraine, however without the Verbovec Member equivalent of Chodenice Member in Poland. A second point of view (31): Lower boundary of Wielician should be placed between the lower and Upper Lagenidae Zone. On the contrary the upper boundary of Wielician may be situated on the top of evaporites (lower Sandschaler Zone) (see Correlation Table).

Correlation of the Middle Badenian with the deposits of the same age of the Tethys areas is based on the radiometric data and the Pectinids and Pteropods range examinations. Langhian–Serravalian boundary was estimated as 15 m. y. (VASS 1978); the middle part of Chodenice Member as 14 m. y. (NAESER 1979).

Consequently Langhian–Serravalian boundary can be correlated with the bottom of Bochnia evaporitic Formation, underlaid with *Uvigerina brunnensis* and *Pseudotriplasia* horizon.

Explanations of two synthetic sections

Western section (Area 204 $a_1$, 205 $c_1$): Beneath the West-Carpathian overthrust the Ottnangian (?), Karpatian and Moravian deposits occur in drillings (24, 39). Moreover the Moravian sediments overlie the Sub-Silesian unit and appear partly as an imbricated thrust folding on the Carpathian border.

Autochthonous Karpatian and Badenian marine, brackish and continental sediments extend in Upper Silesia to Paczkow and Kedzierzyn Graben (12).

Eastern section (Area 204 $a_3$, 205 $c_5$ $c_3$ $c_4$): The Carpathian overthrust (Skole unit) with folded Krosno Formation is connected with the Stebnik unit. The sequence of the Stebnik unit (Modrych Member of the Vorotyshche Formation, Stebnik Fm., Balich Fm. and Przemysl Fm.) is thrusted over the autochthonous Badenian and Sarmatian deposits of the outer zone of the Foredeep. The deposits of the Stebnik unit are well preserved only southern of Przemysl.

Moreover the Badenian and lowermost Lower Sarmatian sediments overlie the folded Skole unit (Embayement of Rzeszow). Autochthonous sediments of Badenian age in the area of the "Rzeszow Island" consist only of deposits of Kosovian age. Volhynian sediments attain of considerable thickness are related to the inversion of relief.

Lower Badenian transgression into the southern slopes of the Holy Cross Mts. (Area 207 $a_3$) is described by A. RADWANSKI (37) and the stratigraphical conditions are examined by E. LUCZKOWSKA (27, 28).

References:

1. ANDREEWA-GRIGOROVICH 1977 2. ALEXANDROWICZ 1970 a 3. ALEXANDROWICZ 1970 b 4. ALEXANDROWICZ 1971 5. ALEXANDROWICZ 1974 6. AREN 1962 7. BIELECKA 1967 8. BIZON & MÜLLER 1979 9. BLAICHER & NOWAK 1963 10. BORSETTI & al. 1979 11. DOSIN & GRUZMAN 1977 12. DYJOR & al. 1978 13. GARLICKI 1973 14. KIRCHNER & al. 1974 15. KOWALEWSKI 1930 16. KOWALEWSKI 1966 17. KRACH 1947 18. KRACH 1956 19. KRACH 1967 20. KRACH & al. 1971 21. KRACH & al. 1974 22. KSIAZKIEWICZ & al. 1962 23. KUCINSKI 1969 24. KUCINSKI & al. 1975 25. KUCINSKI 1977 26. LAMB & STAINFORTH 1976 27. LUCZKOWSKA 1964 28. LUCZKOWSKA 1970 29. LUCZKOWSKA 1978 a 30. LUCZKOWSKA 1978 b 31. LUCZKOWSKA 1979 32. NEY 1965 33. NEY & al. 1974 34. ODRZYWOLSKA-BIENKOWA 1977 35. PISHVANOVA & GRUZMAN 1978 36. RADWANSKI 1967 37. RADWANSKI 1969 38. STREPKA 1977 39. SLACZKA 1977 40. VIALOV 1965 41. BIEDA & al. 1963.

## C S S R (CS)

### Area No. 203 b: POUZDRANY UNIT, CS

Author: I. CICHA

The Pouzdrany tectonic unit comprises an about 40 km long and some km wide belt of upper Eocene to Neogene sediments overthrust upon the Neogene filling of the Subcarpathian Miocene Foredeep (Area No. 205 a) chiefly after the time section of the Eggenburgian. This is, evidently, an equivalent of the Subalpine Molasse. In its autochthonous position, the Pouzdrany Unit has been nowhere cored yet.

References:

1. CICHA & al. 1964 b 2. CICHA & al. 1971.

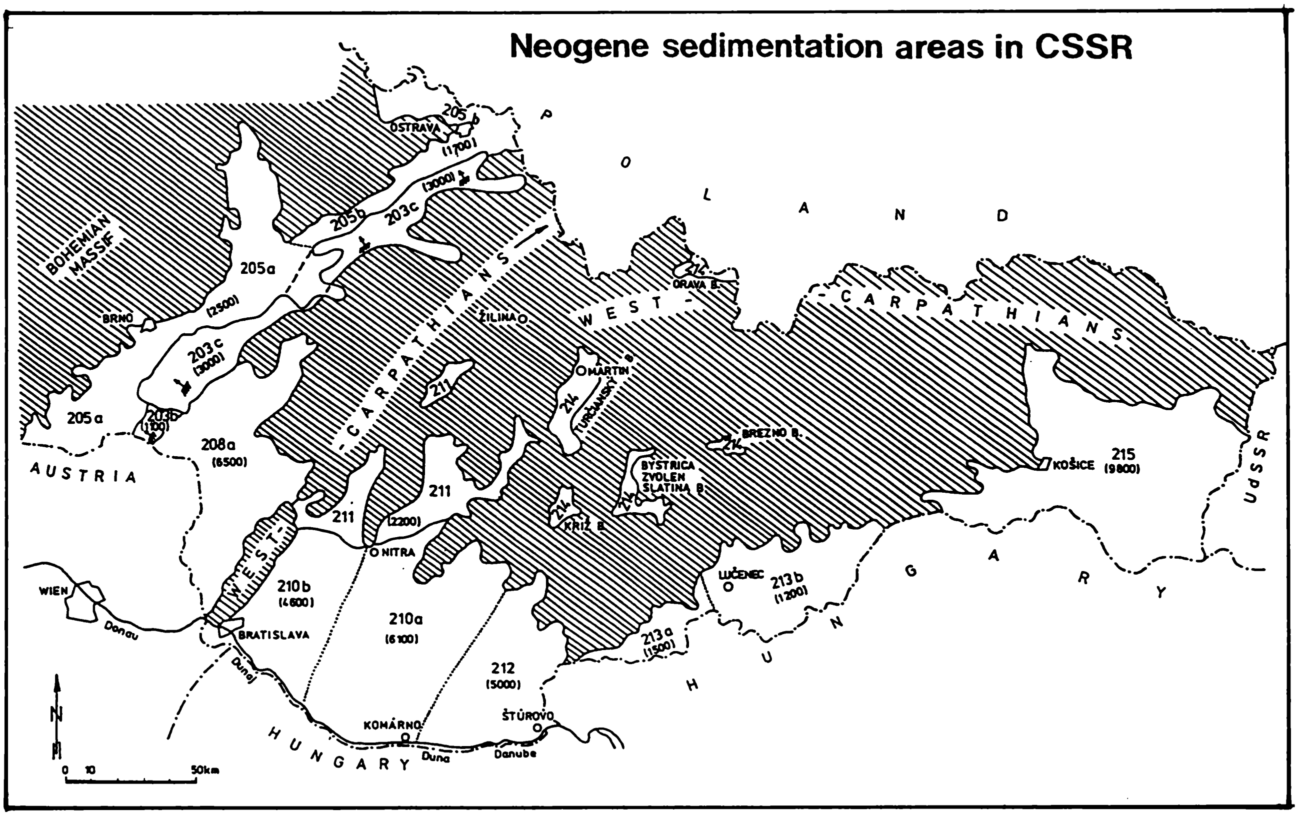
### Area No. 203 c: ZDANICE–SUBSILESIAN UNIT, CS

Author: I. CICHA

This tectonic unit is divided into the Zdanice and Subsilesian segments, respectively. It is overthrust onto the Pouzdrany Unit (Area No. 203 b) and onto the Neogene of the Subcarpathian Miocene Foredeep (Area No. 205 a, b). In both segments of this unit the contents is stratigraphically represented by the Jurassic, by the upper Cretaceous, by the whole Paleogene, including Menilit Beds, as well as by the Egerian, represented first of all by the so called Zdanice–Hustopece group, in some places of flyschoid character. Into the Zdanice unit reached the Eggenburgian (Luzice Fm.) transgression from the area of the Vienna Basin (Area No. 208 a) or from the Foredeep (Area No. 205 a), further from the Karpatian and lower Badenian. The chief phase of the overthrust occurred after the Eggenburgian, after the Karpatian and in the broader area of Ostrava (the N part of the Area), after the lower Badenian. The Miocene strata are component of the nappe structure.

References:

1. CICHA & al. 1964 a 2. CICHA & al. 1968 3. CICHA & al. 1971.




Area No. 205 a: **SUBCARPATHIAN MIOCENE FOREDEEP S, CS**
Authors: I. CICHA & I. KRYSTEK

The Subcarpathian Miocene Foredeep in Moravia (Czechoslovakia) has a complex tectonic structure and consists of a number of partial sedimentation areas. It lies before the front, and partially, in the substrata of outer nappes of the West Carpathians. The Neogene transgresses in this southern part of the Foredeep onto the Variscians of the Bohemian Massif. In southern regions of this area, the Neogene transgression reached only partially into the region of overthrust outer units of the West Carpathians. The broadest space distribution had the Foredeep in the Karpatian, when it reached up to the recently exposed margins of the Bohemian Massif; its accretion, paleogeographically prevailingly to the NW direction (i. e. farthest into the Bohemian Massif), occurred in the Badenian. For cubic volume and the sediment accumulation rates of some lithostratigraphic units see table in the end of this set of the West Carpathian Neogene.

References:
1. BUDAY & al. 1965 2. CICHA & al. 1957 3. CICHA & SENES 1968.

Area No. 205 b: **SUBCARPATHIAN MIOCENE FOREDEEP N, CS**
Authors: I. CICHA & I. KRYSTEK

The Northern part of the Subcarpathian Miocene Foredeep in Moravia (Czechoslovakia) lying to the North of the Uppermoravian depression is the continuation of its southern part (Area 205 a). The Eggenburgian is known only from the most northern area of the vicinity of Ostrava, however, up to now, we did not succeed in the reconstruction of the course of the original sedimentation area. This part of the Foredeep had a considerable space distribution under the outer flysch (Cretaceous and Paleogene) nappe of the West Carpathians in the time of the Karpatian. In the lower Badenian, the sea reached up to the most northern Opava area and into the Mountains Nizke Jeseniky, and had connection not only with the southern part of the Foredeep, but also with the Vienna Basin and with the Intracarpathian Depression. In con-trast, sediments of the middle and upper Badenian are known only in the most northern parts of this area, from the vicinity of Opava and to the west of Ostrava and paleogeographically they represented only the most western branch of the sea from the Polish area of the Subcarpathian Miocene Foredeep. The connection towards the south and with the Vienna Basin already ceased. The shifting of the outer flysch nappe of the West Carpathians onto the Neogene (at the eastern margin of this part of the Foredeep) occurred between the Karpatian and the lower Badenian and then in the middle, eventually in the upper Badenian. For cubic volume and sediment accumulation rates of some lithostratigraphic units see the table at the end of this set of West Carpathian Neogene.

References:
1. CICHA 1959 2. CICHA Mikro- 3. JURKOVA & NOVOTNA 1974 4. ROTH & al 1963.

Area No. 208 a: **VIENNA BASIN N, CS**
Authors: R. JIRICEK & I. CICHA

In the table are given the maximum thicknesses of the individual lithostratigraphic units which are consideralby dissimilar in the tectonically strongly divided Vienna Basin. Paleogeographically, the basin spread from the Eggenburgian to the Badenian with a prevailingly West–East axis and had junction with the megasynclinal of Brozov and of Central Slovakia (see Area No. 211). The recent extension of the basin has formed gradually from the middle and upper Badenian. For cubic volúme and sediment accumulation rates of lithostratigraphic units see table in the end of this set of West Carpathian Neogene.

References:

1. BUDAY 1961 2. BUDAY & al. 1965 3. CICHA & ZAPLETALOVA 1958 4. GRILL 1943 5. JIRICEK 1972 6. JIRICEK 1978 7. PAPP 1951 8. PAPP 1954 9. POKORNY 1944 10. SPICKA 1966 11. SPICKA 1969 12. CHRONOSTRATIGRAPHIE UND NEOSTRATOTYPEN I–VI.

**Area No. 210 a: S SLOVAKIAN DANUBE BASIN, CENTRAL, CS**

Author: R. JIRICEK

In the table are given the maximum thicknesses of lithostratigraphic units (in the middle and upper Badenian, including thicknesses of volcanites and their agglomerates). In the central part of the South Slovakian Danube Basin there occurred a subsidence of crystalline and Mesozoic substrata beginning probably only from the middle Badenian; culminated in the Pannonian, Pontian and in the Pliocene. For cubic volume and sediment accumulation rates of the lithostratigraphic units (or Regional Stages) see the table in the end of this set from the West Carpathian Neogene.

References:

1. ADAM & DLABAC 1969 2. BUDAY & al. 1965 3. JIRICEK 1972 4. JIRICEK 1969 5. CHRONOSTRATIGRAPHIE UND NEOSTRATOTYPEN IV.

**Area No. 210 b: S SLOVAKIAN DANUBE BASIN, W, CS**

Author: R. JIRICEK

In the table are given the maximum thicknesses of lithostratigraphic units. Similarly as in the central part, also in the W part of the Basin occurred a subsidence only in the Badenian. Stratigraphy of the central and western part of this deep area is known first of all on the basis of deep drillings. Northwards, this area passes into the megasynclinal of Brezov (Area No. 211 with a typical development of the lower Miocene) where the Badenian and all younger sediments are wedgeing out. For cubic volume and sediment accumulation rates of the lithostratigraphic units (or Regional Stages) see in the table at the end of this set of West Carpathian Neogene.

References:

1. ADAM & DLABAC 1969 2. BUDAY & al. 1965 3. JIRICEK 1978 4. POKORNY 1946 5. CHRONOSTRATIGRAPHIE UND NEOSTRATOTYPEN IV.

**Area No. 211: NITRA AND VAH VALLEY BASINS, MEGASYNCLINAL OF BREZOV, MIDDLE SLOVAKIA, CS**

Authors: J. GASPARIK, E. BRESTENSKA & R. JIRICEK

Paleogeographically, the sediments of the lower Miocene of this area belong to the megasynclinal of Brezov and Central Slovakia. Westwards, they had direct connection with the Vienna Basin. Marine sediments of the middle Miocene (Badenian and Sarmatian) reach into this area from the South from the South Slovakian Danube Basin (Area 210 a and 210 b). Limnic and continental sediments of the middle and upper Miocene constitute in this area from the viewpoint of paleogeography a component of the Central and North Slovakian Freshwater Basin (Area No. 214).

References:

1. BUDAY 1957 2. BUDAY & al. 1965 3. BUDAY & CICHA 1956 4. CICHA 1957 5. CECHOVIC 1959 6. GASPARIK 1969 7. GASPARIKOVA 1970 8. JIRICEK 1978 9. LEHOTAYOVA 1959 10. SENES 1959 11. SENES 1960.

**Area No. 212: S SLOVAKIAN DANUBE BASIN, E, CS**

Author: J. SENES

In the table are given the maximum thicknesses of lithostratigraphic units. The East part of the South Slovakian Danube Basin with Mesozoic substratum belonged in the Oligocene and in the Egerian to the North–Hungarian and South–Slovakian sedimentation area. From the area of Southern Slovakia (see Area No. 213 a) the transgression reached also into the lower Badenian and widened later in the middle Badenian onto the whole area of the South Slovakian Danube Basin (see Areas No. 210 a, b). For cubic volume and sediment accumulation rates of the lithostratigraphic units (or Regional Stages) see the table in the end of this set of the West Carpathian Neogene.

References:

1. BUDAY & al. 1965 2. CICHA & al. 1964 3. JIRICEK 1972 4. SENES & al. 1975 5. SENES 1949 6. SENES 1963 7. SENES 1958 8. CHRONOSTRATIGRAPHIE UND NEOSTRATOTYPEN IV–VI 9. EXCURSION "A" 1975.

**Area No. 213 a: S SLOVAKIAN IPEL BASIN, CS**

Author: D. VASS

In the table are given maximum thicknesses of lithostratigraphic units (or Regional Stages). The basin represents the north part of an extensive Neogene basin, in North Hungaria. The basin was in the Oligocene and in the Egerian, later also in the Badenian, connected with the eastern part of the South Slovakian Danube Basin (Area No. 212) and from the Oligocene to the Eggenburgian and then also in the Ottnangian connected to the East with the South Slovakian Rimava Basin (Area No. 213 b). For cubic volume and sediment accumulation rates of the lithostratigraphic units (or Regional Stages) see table in the end of this set of West Carpathian Neogene.

References:
1. BUDAY & al. 1965 2. BYSTRICKA & LEHOTAYOVA 1974 3. CECHOVIC & VASS 1962 4. KANTOROVA & al. 1968 5. MARKOVA & al. 1972 6. SENES 1952 7. VASS & al. 1971 8. CHRONOSTRATIGRAPHIE UND NEOSTRATOTYPEN I, II, III, V.

Area No. 213 b: S SLOVAKIAN RIMAVA BASIN, CS
Author: D. VASS

The Rimava Basin, similarly as the South Slovakian Danube Basin (Area No. 213 a), is only the northern part of a more extensive North-Hungarian Oligocene depression. Classical is the development of Oligocene and chiefly of the Egerian. The Miocene is developed only in the form of relicts in the SW part of the Basin. The northern part of the basin is marginated by Pliocene sediments of limnic origin, in the southern part of the basin by volcanites, represented by basalts of the latest Pliocene. For cubic volume and sediment accumulation rates of the lithostratigraphic unit see table in the end of this set of the West Carpathian Neogene.

References:
1. BUDAY & al. 1965 2. FEJFAR 1964 3. FUSAN & al. 1962 4. ONDREJICKOVA 1972 5. PAPP 1960 6. VASS & al. 1971 7. CHRONOSTRATIGRAPHIE UND NEOSTRATOTYPEN II, III, V.

Area No. 214: CENTRAL AND N SLOVAKIAN FRESHWATER BASINS, CS
Authors: J. GASPARIK & E. BRESTENSKA

The Central and North Slovakian Freshwater Basins (first of all the Basins of Novaky–Handlova–Kriz, the Turciansky Basin, the Bystrica–Zvolen–Slatina Basin etc.) have formed beginning from the upper Badenian on the Central Carpathian Paleogene, Mesozoic and Paleozoic and in the areas of the broadening of the Brezova and of the Central Slovakian megasynclinal (partially on sediments of the lower Miocene – see also Area No. 211). From the marine and brackish developments of the middle and upper Miocene of the South Slovakian Basins they were isolated by syngenetic and volcanic complexes of Central Slovakia (Kremnica–Stiavnica and Krupina Mts.).

Area No. 215: E SLOVAKIAN BASIN, CS
Authors: J. CVERCKO, J. MAGYAR & R. RUDINEC

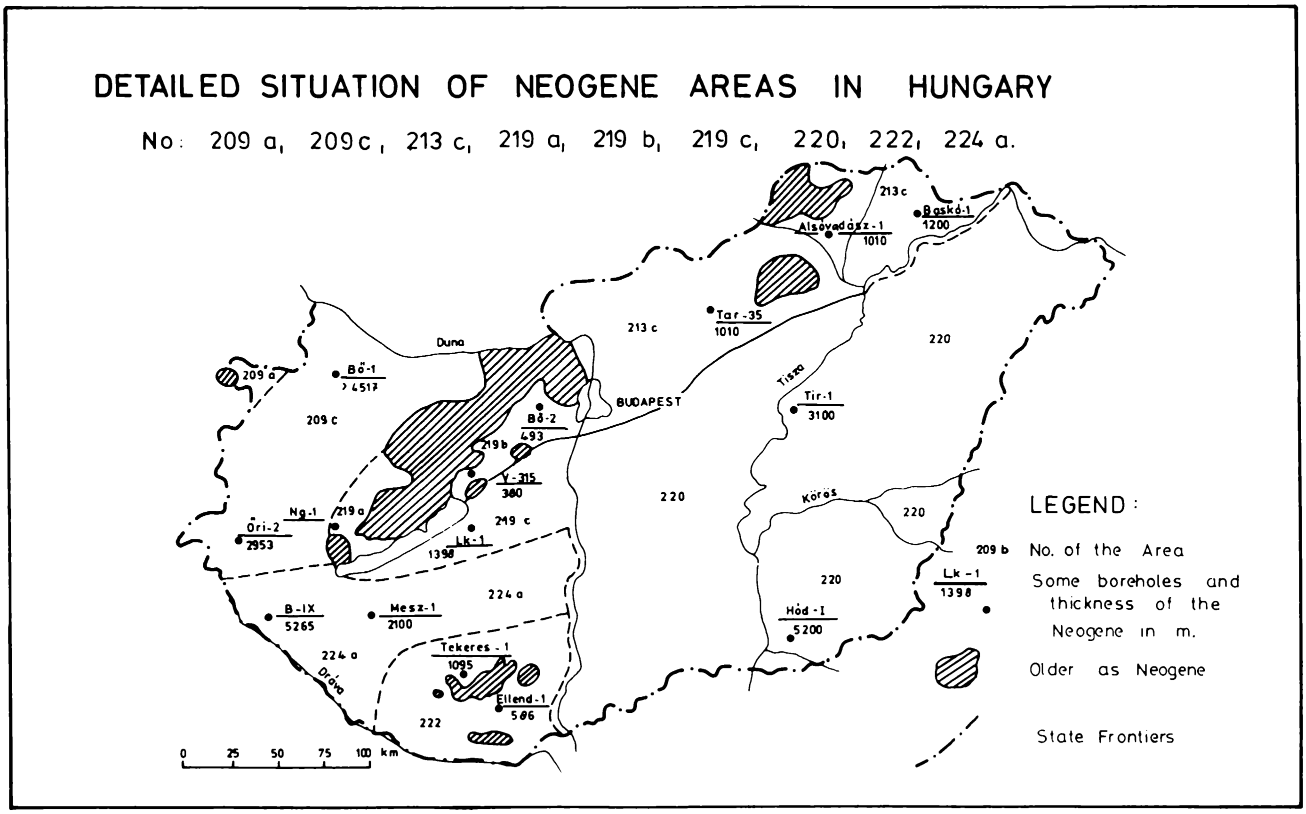
The East Slovakian Basin was the most active subsidence area of the West Carpathians in the Miocene and Pliocene. The subsidence lasts up today. From the paleogeographic point of view we see the migration of sedimentation areas in the individual sections of time in the Miocene and Pliocene from the North to the South. The present configuration of the East Slovakian Basin started probably only from the upper Badenian and the formation of morphology of this depression over an extraordinarily thin crust (MOHO in the depth of only 24 km) last up today. The geothermic gradient of the whole area is extraordinarily high. The total thickness of the Neogene is nearly 10 thousand meters and detailed stratigraphy is known first of all on the basis of deep drillings. Considerable facial changes and the stratigraphical position of many volcanites have been established only in the last massive overthrust of the East Slovakian flysh nappes to the north is not older than about 10 m. y. Curiosity of the East Slovakian Basin are the orogenic movements between the middle and upper Badenian and not between the lower and middle Badenian as in other areas of the West Carpathians. For cubic volume and sediment accumulation rates of the lithostratigraphic units see table in the end of this set of the West Carpathian Neogene.

References:
1. BUDAY 1959 2. BUDAY & al. 1965 3. BRODNAN & al. 1959 4. CECHOVIC 1953 5. CVERCKO & al. 1963 6. CVERCKO & al. 1968 7. CVERCKO & RUDINEC 1971 8. DURICA 1976 9. JANACEK 1959 10. JANACEK & al. 1975 11. JIRICEK 1972 12. KOCAK & CVERCKO 1964 13 RUDINEC & CVERCKO 1971 14. RUDINEC 1977 15. VASS 1977.

## HUNGARY (H)

Area No. 209 a, 209 c, 213 c, 219 a, 219 b, 222, 224 a: HUNGARY, H
Authors: G. HAMOR & A. JAMBOR

References:
1. ANDREANSZKY 1959 2. BALOGH & RAKOVITS 1976 3. BARTHA 1966 4. BARTHA 1971 5. BARTKO 1967 6. BALDI 1969 7. BALDI 1973 8. BALDI & RADOCZ 1971 9. BODA 1959 10. BODA 1971 11. BODZAY 1968 12. BOGSCH 1936 13. BOGSCH 1943 14. BOHNNE HAVAS 1964 15. BONA & KERNERNE SÜMEGI 1966 16. BÖCKH 1873 17. CSEPREGHYNE MEZNERICS 1950 18. CSEPREGHYNE MEZNERICS 1956 19. CSEPREGHYNE MEZNERICS & SENES 1957 20. CSEPREGHYNE MEZNERICS 1960 21. DANK 1965 22. ERHARDT 1965 23. GREGUSS 1954 24. GYARMATI 1977 25. HAJOS 1966 26. HAJOS 1968 27. HAMOR 1964 28. HAMOR 1970 29. HAMOR 1973 30. HAMOR 1974 31. HAMOR 1975 32. HAMOR 1977 a 33. HAMOR 1977 b 34. HAMOR & al. 1978 35. HAMOR & JAMBOR 1971 36. JASKO 1966 37. JAMBOR 1975 38. JAMBOR & KORPASNE HODI 1973 39. KLEB 1971 40. KORECZNE LAKY 1968 41. KÖRÖSSY 1965 42. KÖRÖSSY 1971 43. KRETZOI 1951 44. MAJZON 1937 45. NAGY 1969 46. NAGY–NE 1958 47. NAGY-MAROSI 1977 48. NOSZKY 1940 49. PAL-




FALVY 1964 50. KBGA 11. Congr. 51. RADOCZ 1960 52. RADOCZ 1968 53. RAVASZNE BARANYAI 1973 54. SÜMEGHY 1939 55. STRAUSZ 1927 56. STRAUSZ 1941 57. STRAUSZ 1928 58. SZELES 1962 59. SZELES 1964 60. SZELES 1965 61. SZELES 1971 62. TASNADI KUBACSKA 1976 63. VASS 1975 b 64. VENDL 1929 65. VENDL 1930 66. VITALIS 1911 67. VITALIS 1951 68. VÖLGYI 1956 69. VÖLGYI 1965.

**Area No. 220: GRÉAT PLAIN BASIN, H**
Authors: A. SOMFAI & K. SZENTGYÖRGYI

References:
1. BARTHA & al. 1971 2. BERCZI 1971 3. DANK 1963 4. JUHASZ 1971 5. KÖVARY 1967 6. KÖVARY 1968 7. KÖVARY 1973 8. PANTO 1965 9. SZELES 1970 10. SZENTGYÖRGYI 1978 11. SZEPESHAZI 1971 12. KOVACS 1975 13. VÖLGYI 1959.

## RUMANIA (R)

**Area No. 204 c, d: E CARPATHIAN FLYSCHZONE, R**
Author: M. SANDULESCU

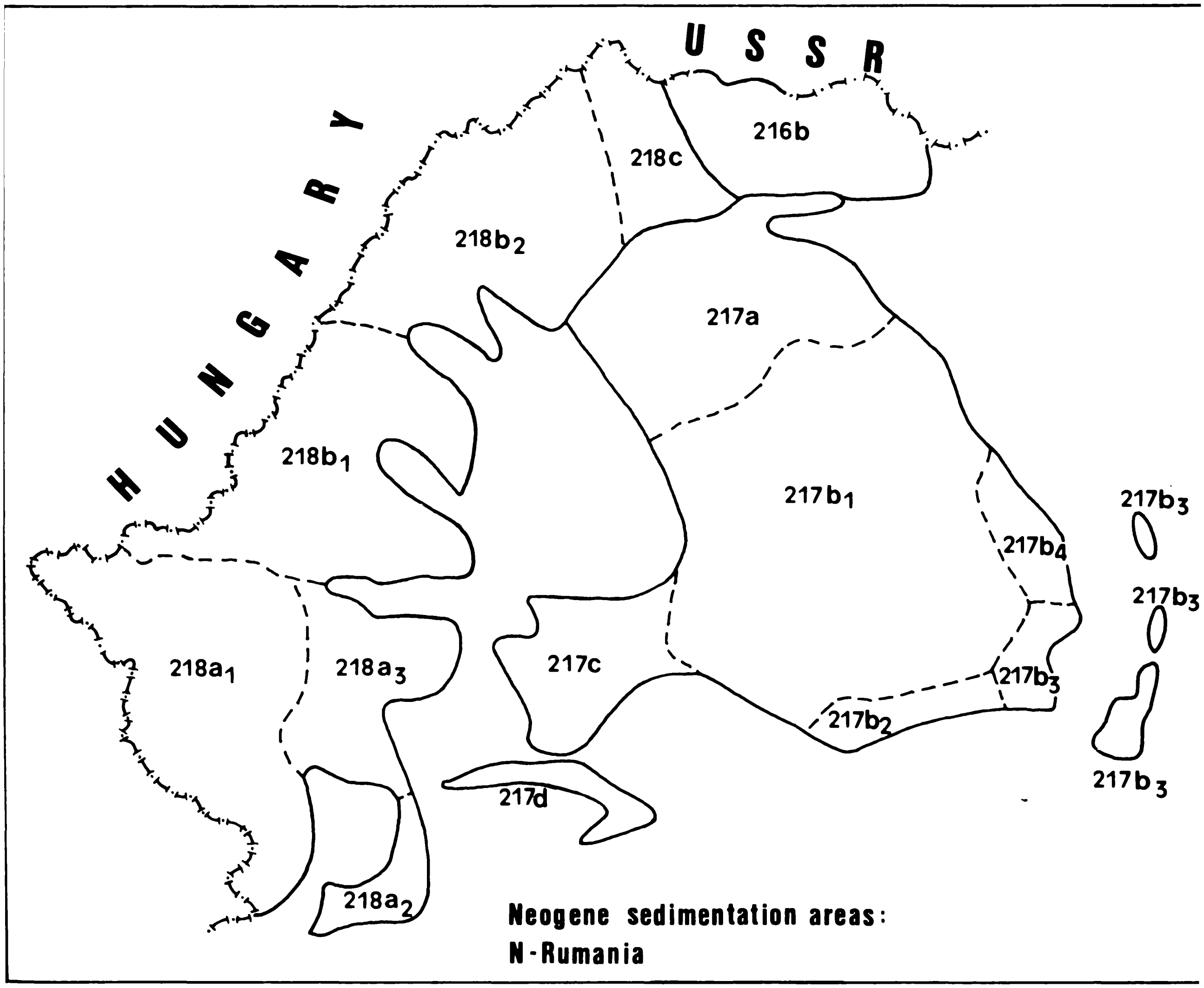
References:
1. BALTES & al. 1975 2. BOMBITA & al. 1975 3. DUMITRESCU 1963 4. DUMITRESCU & SANDULESCU 1974 5. MICU 1976 6. MIRAUTA & MIRAUTA 1964 7. POPESCU 1975 8. POPESCU 1953.

**Area No. 205 e, f, g: SUBCARPATHIAN FOLDED NEOGENE FOREDEEP, R**
Authors: M. SANDULESCU & I. PAPAIANOPOL

References:
1. ANDREESCU & PAPAIANOPOL 1970 2. ANDREESCU 1972 a 3. ANDREESCU 1972 b 4. DUMITRESCU 1952 5. GHENEA & GHENEA 1970 6. GHEORGHIAN & POPESCU 1975 7. HANGANU 1966 8. IONESI & IONESI 1972 9. JOJA 1952 10. KREJCI GRAF & WENZ 1931 11. LUBENESCU & al. 1974 12. MACAROVICI 1961 13. MACAROVICI & al. 1967 14. MARUNTEANU 1974 15. MIRAUTA 1969 16. MOTAS 1952 17. MOTAS 1956 18. MOTAS 1960 19. MOTAS & PAPAIANOPOL 1972 20. NICOLESCU 1964 21. OLTEANU 1958 22. PANA 1966 23. SAULEA 1956 24. SANDULESCU 1962 25. SANDULESCU & al. 1977 26. SANDULESCU & al. 1978.

**Area No. 206: S SUBCARPATHIAN FOREDEEP, GETIC DEPRESSION, R**
Authors: F. MARINESCU, B. POPESCU & M. GHEORGHIAN

References:
1. HRISTESCU 1944 2. MARINESCU & MARINESCU




1962 3. MARINESCU 1972 b 4. MARINESCU 1978 5. MOTAS & MOISESCU 1975 6. MURGEANU 1948 7. POPESCU & al. 1976 8. POPESCU 1959 9. STANCU & POPESCU 1976 10. TUDOR 1955.

Area No. 216 b: MARAMURES BASIN, R
Authors: F. MARINESCU & M. GHEORGHIAN

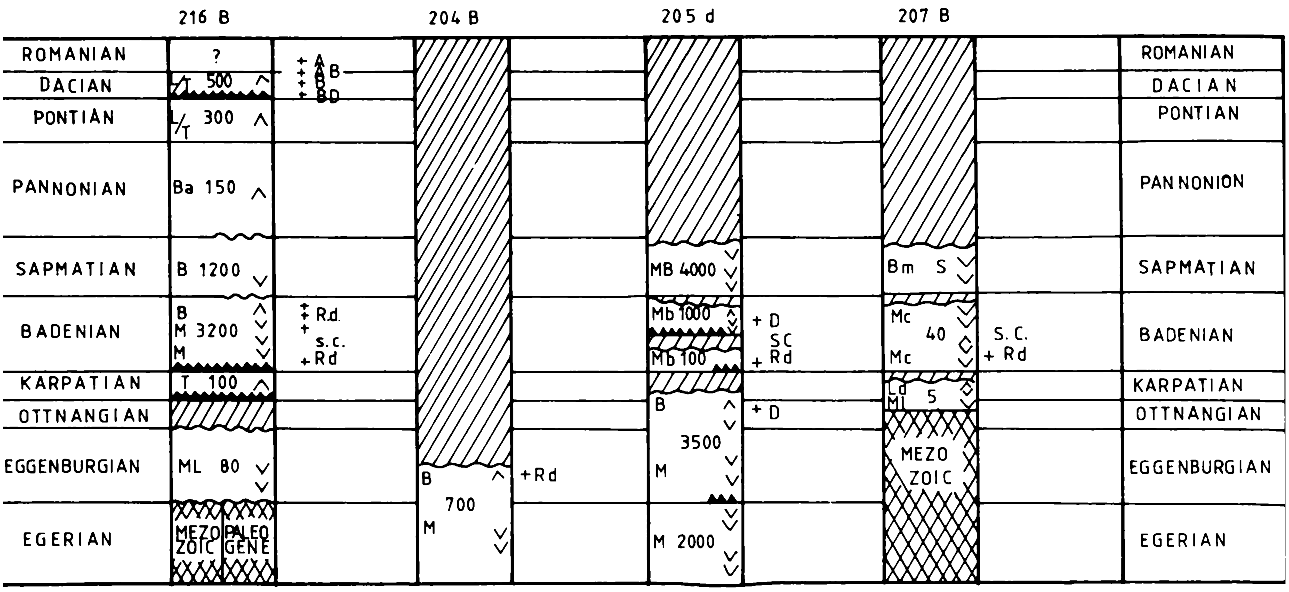
References:
1. BORCOS & al. 1973 2. EDELSTEIN & al. 1973 3. GHEORGHIAN & al. 1975 4. IVA MARIANA -- inedits 5. PATRULIUS & al. 1960 6. TUDOR & MOISESCU 1956.

Area No. 217: TRANSYLVANIAN BASIN, R
Authors: M. GHEORGHIAN, F. MARINESCU, G. POPESCU, V. MOISESCU

References:
1. CODARCEA & STANCU 1968 2. CIOFLICA & POPOESCU 1966 3. CIOFLICA & al. 1968 4. DUMITRESCU 1957 5. DUMITRICA & al. 1975 6. GEORGESCU & al. 1970 7. GHEORGHIAN & al. 1971 8. GHEORGHIAN 1975 9. GHEORGHIAN 1971 10. GHEORGHIAN 1974 11. GHEORGHIAN 1975 12. GHEORGHIAN & al. 1975 13. HOFMANN 1887 14. KOCH 1900 15. MARINESCU & PELTZ 1967 16. MARINESCU & POPESCU 1968 17. MIHAILA & al. 1962 18. MOISESCU 1975 19. PATRULIUS & al. 1968 20. POPESCU 1970 21. POPESCU 1975 22. POPESCU 1978 23. RADO & al. (1978 in print) 24. RUSU 1977 25. SAVU & al. 1979 26. SAVU (in print) 27. VANCEA 1960 28. VOICU & al. 1976.

Area No. 218: E INTRA-CARPATHIAN DEPRESSION, R
Authors: F. MARINESCU, G. POPESCU, P. DUMITRICA, A. RUSU, M. GHEORGHIAN

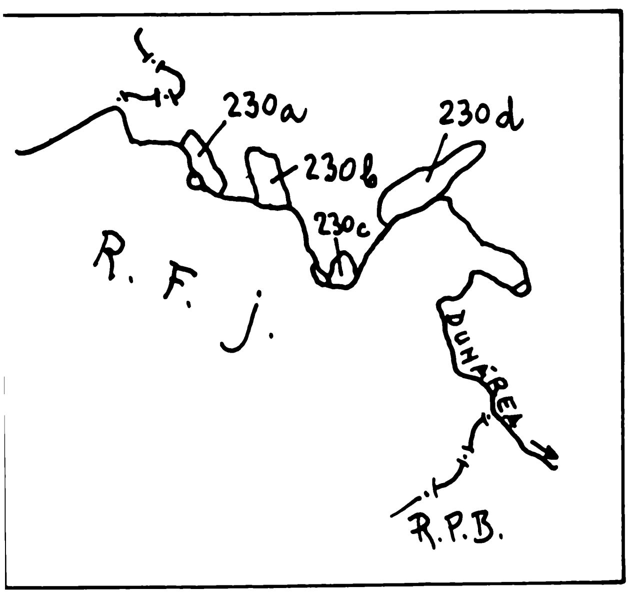
References:
1. BLEAHU & al. 1976 a 2. BORCOS & al. 1972 3. CHIVU & al. 1966 4. CLICHICI 1973 5. FERU & al. 1980 6. ILIESCU & al. 1968 7. IONESI & SAGATOVICI 1969 8. IONESI & SAGATOVICI 1970 9. ISTOCESCU 1971 10. MARINESCU 1964 11. MARINESCU & MIHAILA 1971 12. MARINESCU 1972 a 13. MARINESCU & ISTOCESCU 1972 14. MARINESCU & POPESCU 1978 15. MARINESCU & al. 1977 16. MARINESCU & al. 1978




17. MARINESCU – unpubl. 18. NICORICI 1972 19. ORASANU & al. 1971 20. PAPAIANOPOL & al. 1977 21. RUSU & al. 1978 22. SAGATOVICI 1968 23. SAGATOVICI & NICORICI 1973 24. STANCU – unpubl.

**Area No. 230 b–e: DANUBIAN CORRIDOR, R**
Authors: M. GHEORGHIAN, F. MARINESCU, E. POPESCU

References:
1. BLEAHU & al. 1976 2. MACOVEI 1909 3. MARINESCU & MARINESCU 1963 4. STANCU & al. 1971.




**Area No. 238: DACIC BASIN, R**
Authors: F. MARINESCU, E. POPESCU, M. GHEORGHIAN, I. PAPAIANOPOL & I. MOTAS

References:
1. DUMITRICA & al. 1975 2. GHEORGHIAN & al. 1975 3. HANGANU 1977 4. NEGOITA & al. 1969 5. NEGOITA & al. 1971 6. PANA & KRUCK 1972 7. PARASCHIV 1975 8. STOICOV 1970 9. TATARIM & al. 1977.

**Area No. 239: W PART OF E EUROPEAN PLATEAU AND BIRLAD DEPRESSION, R**
Authors: I. MOTAS & I. PAPAIANOPOL

References:
1. ATANASIU & MACAROVICI 1950 2. GHENEA 1968 3. JEANRENAUD 1971 4. MACAROVICI 1964.

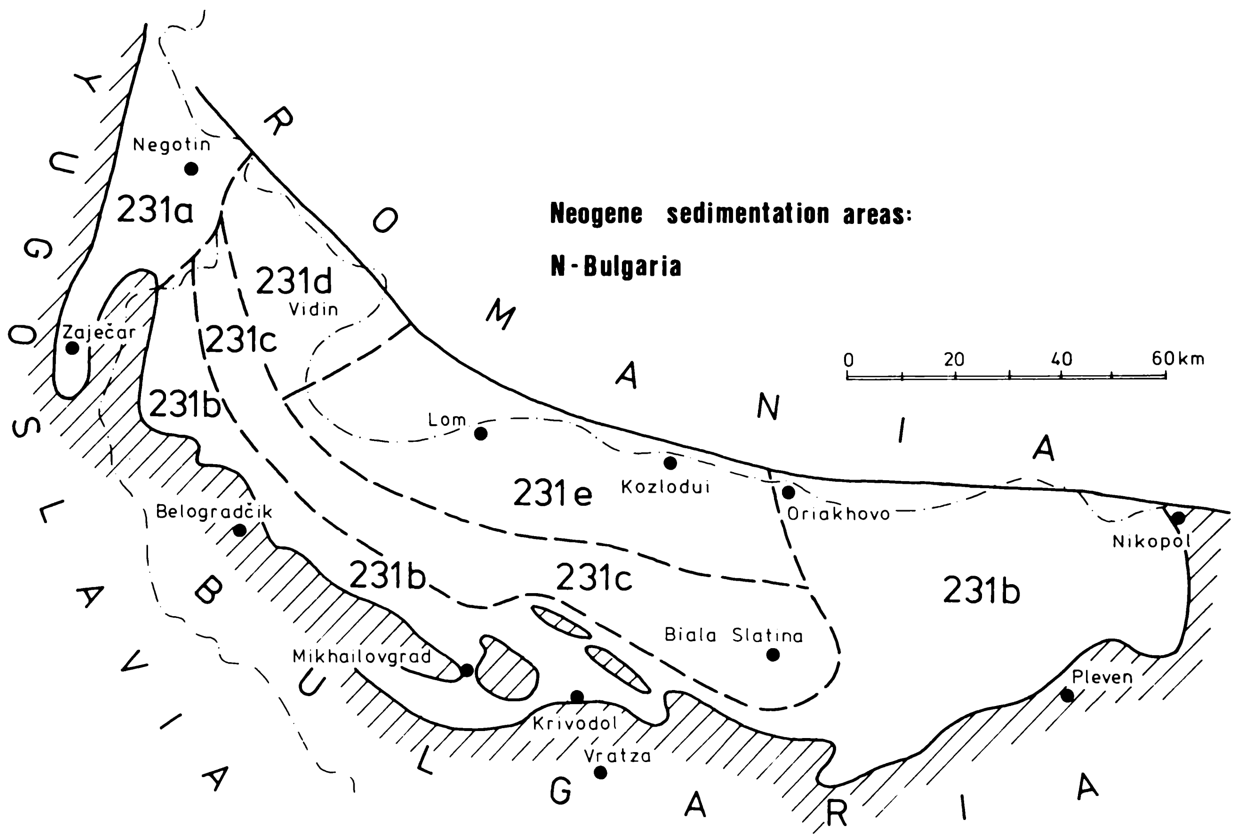
**Area No. 240 a: S DOBROGEA AND VARNA GULF, R**
Author: F. MARINESCU & M. GHEORGHIAN

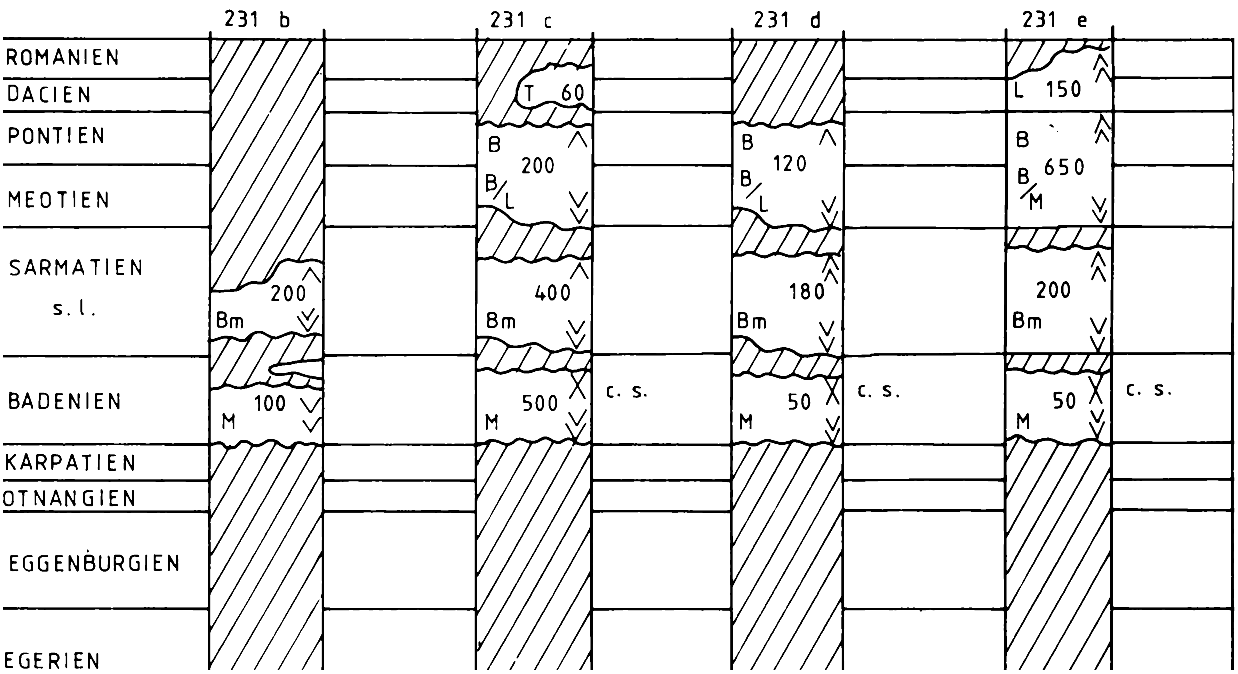
References:
1. CHIRIAC 1970 2. IONESI & IONESI 1971 3. IONESI 1974 4. RADO & PANA 1975 5. TATARIM & al. 1977.

**Area No. 242 b: DANUBIAN DELTA, R**
Authors: F. MARINESCU & M. GHEORGHIAN

References:
1. LITEANU & PRICAJAN 1963 2. LITEANU & al. 1967.

# BULGARIA (BG)


Neogene sedimentation areas:
N-Bulgaria
ROMANIA
YUGOSLAVIA
BULGARIA
0 20 40 60km
Negotin
231a
231d
Vidin
Zaječar
231c
231b
Lom
231e
Kozlodui
Oriakhovo
Nikopol
Belogradčik
231b
231c
231b
Biala Slatina
Mikhailovgrad
Pleven
Krivodol
Vratza


231 b
231 c
231 d
231 e
ROMANIEN
DACIEN
PONTIEN
MEOTIEN
SARMATIEN s.l.
BADENIEN
KARPATIEN
OTNANGIEN
EGGENBURGIEN
EGERIEN
T 60
L 150
B 200 B/L
B 120 B/L
B 650 B/M
200 Bm
400 Bm
180 Bm
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100 M
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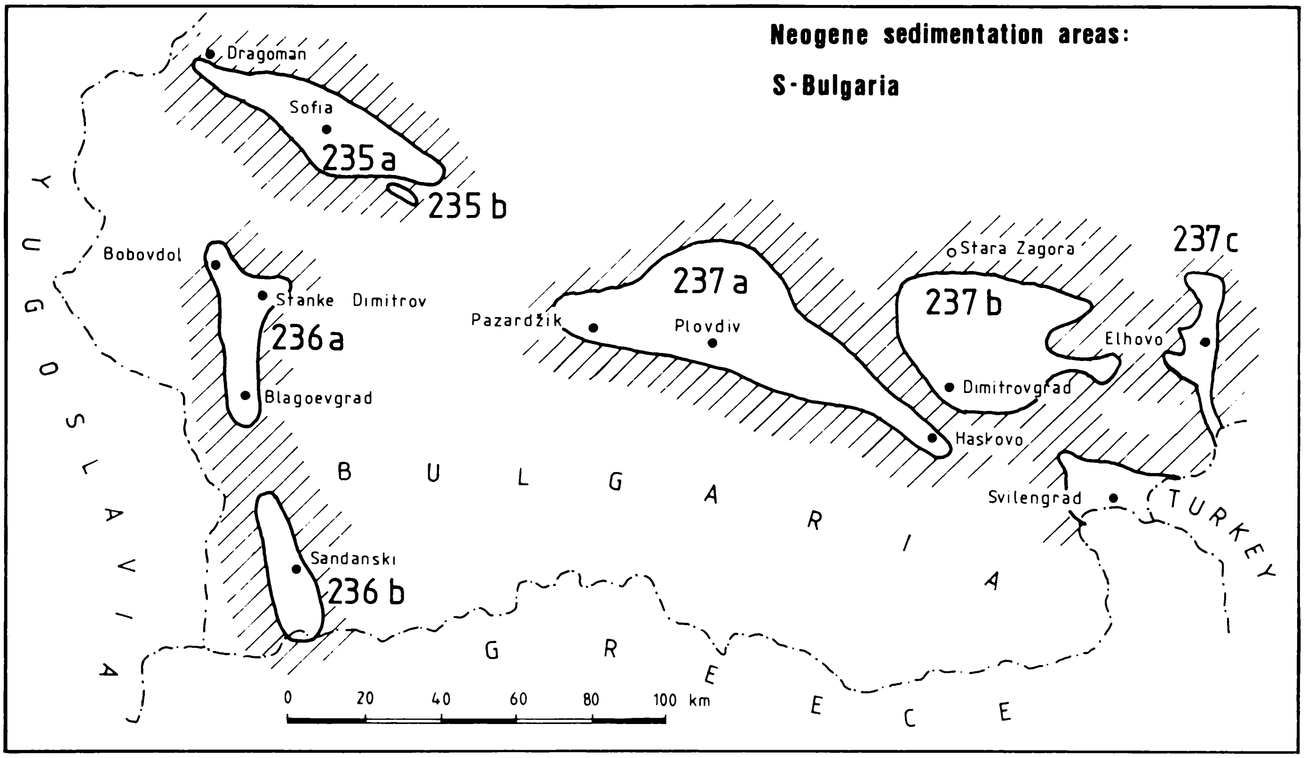



**Area No. 231 b–e: GOLFE DE LOM, BG**
Author: E. KOJUMDGIEVA

L'evolution paleogeographique du golfe de Lom (partie sud-ouest du bassin Dacique) comporte trois grandes etapes. Au cours de la premiere (Badenien–Volhynien) on distingue 3 grandes regions: une depression preorogene (aire 231 c) aux depots assez epais, bordee du sud et de l'est par la region bordiere (aire 231 b) – region stable aux depots peu epais, et du nord par la region elevee de Vidin (aire 231 d) et la future depression de Lom (aire 231 e), lesquelles pendant ce temps etaient relativement elevees et ou se formąient des argiles peu epais et (au Badenien Moyen) – du gypse. Au cours du Bessarabien Inferieur la situation change – la mer quite la region bordiere, dans la depression preorogene la sedimentation continue, mais les depots sont grossiers et peu epais et dans la depression de Lom (aire 231 e) deja formee se deposent des argiles epaisses. La situation reste approximativement la meme du Bessarabien Superieur jusque le Portaferrien, malgre la regression complete au Chersonien Superieur. Pendant la troisieme etape (Bosphorien – Romanien) on n'observe une sedimentation continue que dans la partie centrale de la depression de Lom, ou se forment des depots lacustres et terrestres a lignites. Les depots continentaux des environs de Biala Slatina (aire 231 c) contiennent une riche faune de Vertebres rusciniens.

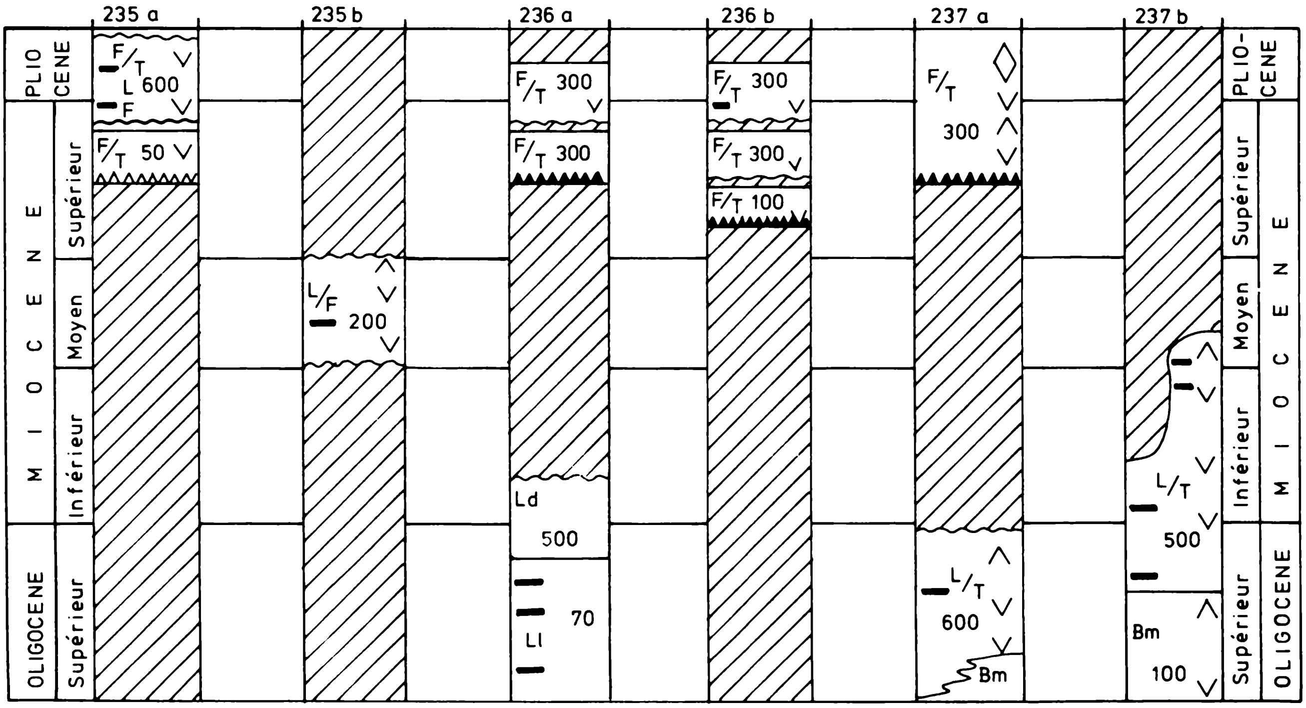
References:
1. KOJUMDGIEVA 1974 2. KOJUMDGIEVA & al. 1978 3. KOJUMDGIEVA & al. (1981 in print) 4. NIKOLOV 1965 5. POPOV & al. 1964 6. POPOV 1971 7. TRACHLIEV & al. 1963.

**Area No. 235 a–b, 236 a–b, 237 a–c: BASSINS CONTINENTAUX EN BULGARIE MERIDIONALE, BG**
Author: E. KOJUMDGIEVA

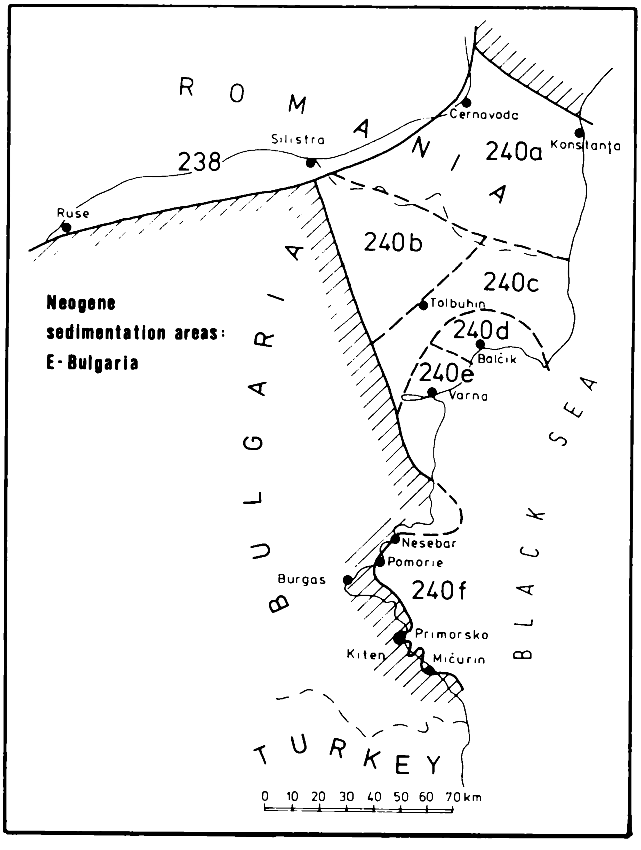
Le Neogene en Bulgarie Meridionale est object des etudes en cours et une grande partie des donnees n'est pas encore publiee. Son evolution comporte 2 grandes etapes. La premiere est la phase finale du cycle oligocene. Dans les bassins de Plovdiv et de Zagore (aires 237 a, b) au Kiscellien (dans le dernier aussi au debut de l'Egerien) existait un bassin a salinite reduite, relie a la Paratethys Orientale. Pendant l'Oligocene Superieur la sedimentation marine est remplacee par une sedimentation continentale – proluviale, fluviale, lacustre, a lignites. Dans le bassin de Zagore (aire 237 b) cette sedimentation continue jusque le Miocene Moyen. Dans le bassin de Bobovdol–Pernik, inclus plus tard dans le graben de Blagoevgrad (aire 236 a) la formation huillere d'age Oligocene Moyen–Superieur est surmontee par des argiles lacustres d'age probablement Miocene Inferieur (d'apres Macroflore).

Les sediments du petit bassin de Cukurovo (aire 235 b) sont d'age Miocene Moyen (d'apres Macroflore).

La deuxieme etape (Miocene Superieur–Pliocene) comprend 3 cycles de sediments fluvio-proluviaux, rarement lacustres. Le premier cycle n'est constate que dans le graben de Sandanski (aire 236 b) et contient des Vertebres vallesiens. Le deuxieme (aires 236 a, b, 237 a) contient des Vertebres pikermiens (turoliens) et une Flore miocene. A la base du troisieme cycle (aires 235 a, 236 a, b, 237 a) on trouve des Vertebres du Pikermien terminal (MN-13) et une Flore du type intermediaire (mio–pliocene), et dans ses parties superieures – des Vertebres rusciniens. Dans le bassin de Sofia (aire 235 a), entre ces deux niveaux on trouve des Mollusques du Pontien Moyen.



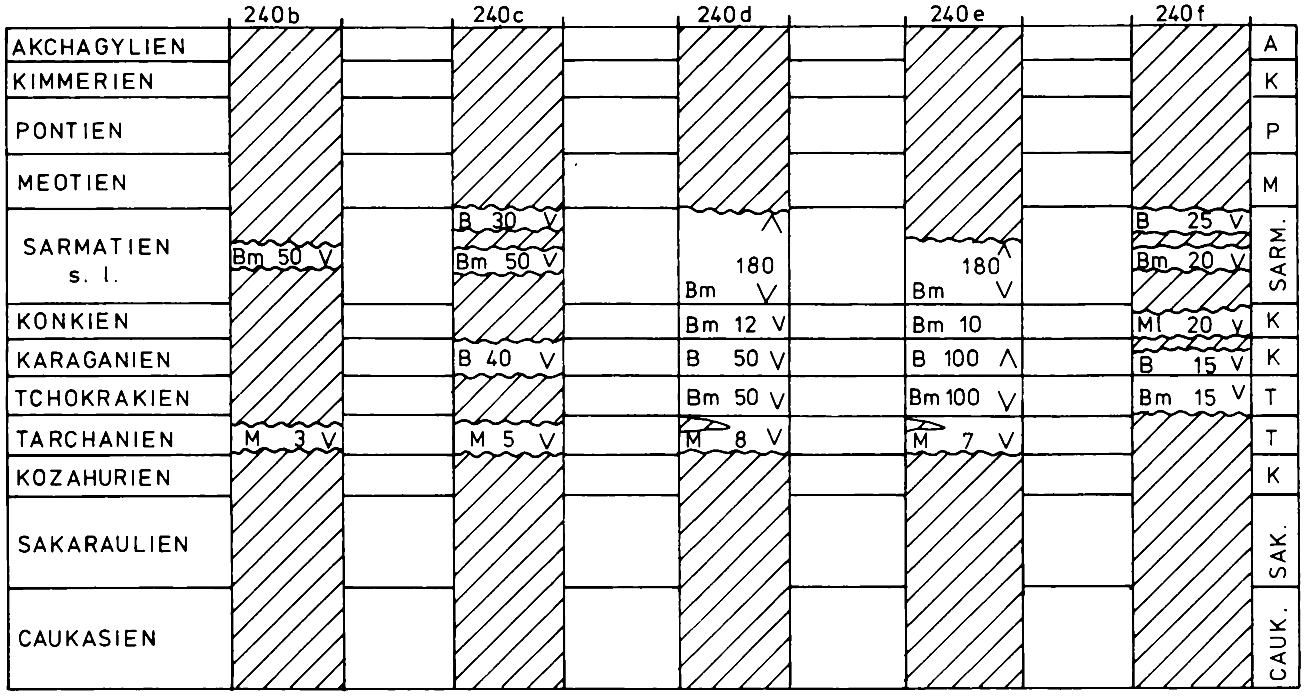

References:
1. Not published 2. BAKALOV 1977 3. BAKALOV & NIKOLOV 1962 4. CERNJAVSKA 1977 5. DRAGOMANOV & al. 1981 6. KAMENOV & KOHEN 1952 7. KOJUMDGIEVA & DRAGOMANOV 1979 8. KOJUMDGIEVA & NIKOLOV 1975 9. KOJUMDGIEVA & al. 1984 10. PALAMAREV 1964 11. PALAMAREV 1981 12. PANOV 1962 13. SAPUNDGIEVA & KOJUMDGIEVA 1973 14. ZACHARIEVA-KOVACHEVA 1951.




Area No. 240 b–f: **GOLFES MIOCENES EN BULGARIE ORIENTALE**
Author: E. KOJUMDGIEVA

On peut distinguer en Bulgarie due Nord–Est au Miocene 4 regions structuro–paleogeographiques et le Miocene en Bulgarie du Sud–Est (golfe de Burgas) forme une cinquieme. Le detroit suddobrojeen (aire 240 b) est une region elevee, qui n'a ete recouverte par la mer qu'au Tarchanien et au Bessarabien Superieur, formant un detroit reliant les bassins Precarpatique et Ponto–Caspien. La region bordiere de la depression (aire 240 c) est une bande relativement stable et elevee, recouverte sporadiquement par les eaux de la Paratethys Orientale au cours du Miocene Moyen et le Sarmatien. La situation est semblable dans le golfe de Burgas (aire 240 f), mais la les affleurements du Miocene sont tres petits. La region de Varna (aire 240 e) correspond a la partie meridionale de la depression de Varna–Balcik, comblee par des depots grossiers d'age miocene moyen – volhynien (et un peu de depots bessarabiens). La region de Balcik correspond a la partie septentrionale de la depression de Varna–Balcik. Au cours du Miocene Moyen et du Volhynien ici ce forment des depots argileux peu epais, relativement profonds, au Bessarabien – des depots argileux epais, et vers sa fin et au Chersonien – des depots argileux et calcaires.

References:
1. not published 2. GOTCHEV 1953 3. KOJUMDGIEVA 1969 4. KOJUMDGIEVA & POPOV 1968 5. KOJUMDGIEVA & DIKOVA 1978 6. STANCHEVA 1976 7. STRACHIMIROV 1971.




## YUGOSLAVIA (YU)

**Area No. 17 d4: NORTHERN APENNINE FOREDEEP YU**

Authors: A. BISTRICIC & K. JENKO

At the time of the most pronounced subsidence of miocene sediments in the Po Basin, its northeastern rim border underwent uplifting which continued to the total emergence of that part of Basin. This continental phase was accompanied by an intense erosion so that oligocene and miocene sediments became either completely eroded, or only some eroded oligocene and miocene strata remained to the time when pliocene transgression occurred. This uplifting is in our part of the Adriatic reflected in thinning out and reduction of pliocene sediments. In the area of "Istrian semi-platform", where continental phase commenced as early as during the Eocene, pliocene sediments are deposited on the sediments of Eocene and Mesozoic age.

References:

1. BAUMAN 1970 2. BAUMAN & ROTH 1969 3. BISTRICIC 1975 4. CATI & BORSETTI 1968 5. CRESCENTI 1966 6. DONDI & PAPPETTI 1968 7. JENKO & al. (in print) 8. PRPIC & al. 1972 9. LORENZ 1968 10. MULDINI-MAMUZIC 1971 11. D'ONOFRIO 1968 12. TONCIC-GREGL 1974 13. TURK 1971.

**Area No. 33 a: TETHYS AREA OF ALBANIA AND CRNA GORA (MONTENEGRO), YU**

Author: O. SPAJIC

In this region, the only place where Neogene marine sediments have been discovered was on the surface within a small area, near Ulcinj. The total thickness of the sediments amounts to about 100 m.

Based on Mollusca macrofauna and Foraminifera microfauna, in whose association the benthos forms are predominant (an assemblage comparable to zone 15, after BLOW), these sediments have been defined as certainly belonging to the Middle Miocene.

By deep well drilling along the shoreline of the Skadar Lake (Skadarsko Jezero), southwest of the above-mentioned locality, a complex of sediments, more than 100 m thick, was discovered, and egualised as Lower Pliocene on the basis of its Mollusca macrofauna.

References:

1. BESIC 1975 2. DZODZO 1965 3. LUKOVIC & PETKOVIC 1952 4. SPAJIC 1955 5. SPAJIC (in print) 6. ZUBER 1930.

**Area No. 34: KOSOVO AND METHODIA BASINS, YU**

Author: M. ATANACKOVIC

The basins were formed in the Upper Miocene as a typical dissymetric tectonic graben. Deposition of the Upper Miocene sediments, equivalent to the Pannonian, took place in the shallow-water lacustrine conditions. Towards the end of the Pannonian begins the phase of coal and equivalent deposits sedimentation. While in the final phase of sedimentation coal deposits are overlaid by clays, in the remaining parts of the basin clays, sands and gravels are deposited. Sedimentation ends in the Upper Pontian and the erosion phase is still going on. The tectonics of basin deposits is of a faulting type.


Reference:
1. ATANACKOVIC 1959.

Area No. 35 a: **SKOPJE BASIN (NEREZI)**, YU
Author: V. TEMKOVA

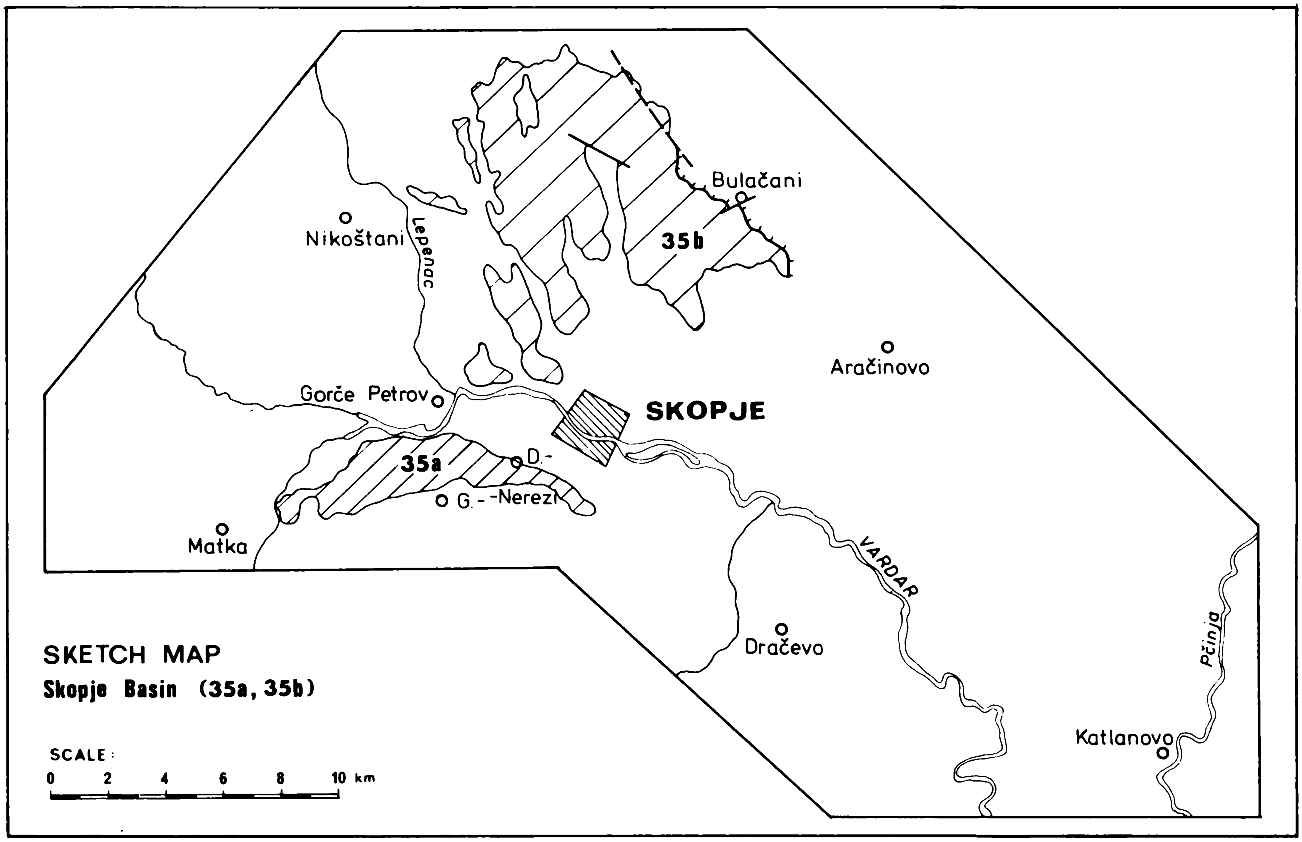
Within the area of Skopje Neogene, Miocene sediments have been discovered in the vicinity of Nerezi. The sedimentary complex of Miocene starts with conglomerates, which are being replaced by sandy clays. fine sands and marly clays with coal seams.

In the productive series, remains of *Mastodon angustidens* cf. *subtapiroidea* SCHLES. were found, and thus, this part of the Neogene complex may be identified with Miocene.

The roof of the marly coal series consists of sandy clays and sands, being replaced by loose sandstones in places. This final part of the profile, probably corresponds to Pliocene.

References:
1. IZMAJLOV 1953 2. KARAJOVANOVIK 1976 3. KOLEKTIVNA RABOTA 1964 4. LASKAREV 1937 5. PAVLOVIC 1931 6. PETKOVIC 1936.

Area No. 35 b: **SKOPJE BASIN (BULACANI)**, YU
Author: V. TEMKOVA




The Neogene sediments in this part of the Skopje Basin are represented by Miocene and Pliocene.

The Miocene sediments, there, have overlain the Oligocene, and they are represented by mainly clayey deposits with scarce intercalations of sand and gravel.

The Pliocene sediments are represented by grey and green clays with carbonate concretions. In places, these clays are replaced by sandy clays with intercalated coarse grained sands. Large pebbles of quartz, quartzite and schist have been noticed in the sandy intercalations.

The Oligocene sediments in the base of the Neogene complex are disturbed to a considerable degree. The deposits of Miocene and Pliocene are undisturbed, lying horizontally or subhorizontally.

References:
1. CIPAN & al. 1974 2. IZMAJLOV 1953 3. KARAJOVANOVIK 1976.

**Area No. 36 a: OVCE POLE BASIN, YU**
Author: V. TEMKOVA

The Ovce Pole basin represents a depression, that is connected with the Skopje and Tikves depression. In the west part of this basin, the complete Paleogene series has been drilled through (Well TV-1), and Neogene sediments were encountered down to a depth of 545 m.

The Neogene sediments in this area are overlying the already known Paleogene complex of Ovce Pole. They are represented by continental-lacustrine deposits, composed of gravel, sand and sandy clay.

From the stratigraphic point of view, these elements are not entirely defined because of missing paleontological data.

References:
1. CIPAN & al. 1974 2. CIRIC 1957 3. KARAJOVANOVIK 1976 4. MAKSIMOVIC & SIKOSEK 1954 5. NANIC & BULIC 1972.

**Area No. 36 b: TIKVES BASIN, YU**
Author: V. TEMKOVA

Within the Neogene complex of the Tikves basin, in superposition, the following may be singled out:

a) Variegated sands and clays with sand intercalations.

b) A productive series with marlstones included. This part of the complex includes 1–5 coal seams varying in thickness. The marlstones of the productive series contain fauna, micro- and macroflora.

c) The roof of the productive part of this sedimentary complex consists of sands, clays, poorly cemented sandstones, and loose sands. In the terminal parts, there are platlike travertine limestones varying in thickness. This part of the sedimentary series ends with thin layers of diatomaceous earth.

d) Platelike tuffaceous andesite deposits from the final element of Neogene sedimentation in this basin. In places, the thickness of these deposits ranges between 200 and 300 m, and pebbles of andesite and the bordering rocks are included in the composition of this part of the complex.

Structurally, the Tikves basin is a complex depression, with Paleogene sediments predominant in its filling. The

Neogene sediments occur only within a small area and they are reduced in thickness.

References:

1. CIPAN 1956 2. CIPAN & al. 1974 3. IZMAJLOV 1955 4. JENKO 1955.

## Area No. 137: DUGI OTOK BASIN, YU

Authors: A. BISTICIC & K. JENKO

The basin of Dugi Otok (North-Dalmatian Miocene basin – TURK 1971) was formed at the time of the uplifting of the Istrian semiplatform and the Central Adriatic shelf, as a consequence of Pyrenean and Sava orogenic activity. In the course of Lower Miocene, the intensity of subsidence in the basin was of a degree allowing the accumulation of very thick sediments (about 1.000 m). The Aquitanian sediments in the northwestern part of the central part of the basin are thicker than the simultaneous deposits in the southeastern part but, in the course of Burdigalian and Langhinian (Langhinian in the sense of differentiation after CRESCENTI 1966, CATI–BORSETTI 1968), maximum thicknesses developed in the southeastern part of the basin. Due to strong subsidence in the western part of the basin, there was an increase in sedimentation speed with a tendency of basin axis migration in eastward direction during the Burdigalian.

No Oligocene deposits have been established in the southeastern part of the basin. The Aquitanian sediments are unconformably overlying the Middle Eocene. Throughout the entire region of the Dugi Otok basin, a distinct unconformity is to be noticed between Eocene and younger sediments of Paleogene and Lower Miocene.

Lower and Upper Oligocene sediments have been established in the area of the northeastern marginal part of the basin. Miocene deposits have not been noticed, as they are wedging out abruptly ahead of the northeastern edge of the basin. By identifying the stratigraphic units in the wells, and observing the seismic events in the area, it has been established that the Lower Oligocene deposits, in direction from the northeastern marginal part of the basin towards southwest, are faulted and display a tendency of wedging out. The Miocene deposits are also wedging out to the northwest, towards the Istrian semiplatform.

Aquitanian deposits in the northwest of the middle part of the basin are overlying the Upper Oligocene sediments. This gives the impression of quite a gradual transition between the Oligocene and the Aquitanian deposits – both from the faunistic and the lithologic points of view. In the other part of the basin, however, a distinctly pronounced unconformity is to be noticed between the Aquitanian and the older sediments.

On the southwestern margin of the basin, i. e. along the rim of the Central Adriatic shelf, there is a reduction of Miocene sediments. The Aquitanian sediments are of a reduced thickness (ca. 50 m), occurring in the facies of biomicrite limestones with microfossil association of shallow-sea foraminifera varieties; *Lepidocyclinae, Miogypsinae,* and some rare types of *Rotalia* sp. and *Globigerina* sp. It has not been possible precisely to establish which part of the Aquitanian these deposits belong to. It could be presumed, anyhow, on the basis of faunistic elements, that they belong to the Aquitanian. Serravalian deposits are unconformably overlying the Aquitanian (classification after CRESCENTI M. 1966, CATI–BORSETTI 1968 – Helvetian). It could be presumed that the above unconformity, as to the time of its occurrence, corresponds to the boundary between Egerian and Eggenburgian in the Paratethys. As yet, however, it has not been definitely established whether the above unconformity is of a regional significance in that area. In the region of the Dugi Otok basin, we have at disposal by far too few reference points, to obtain such results as could be used as a basis for the successful solution of this problem. Hence in the Correlation table of unconformities, this unconformity has been denoted by a question mark.

Throughout the area of the Dugi Otok basin, two regional unconformities may easily be observed, i. e. that between Serravalian and Lower Pliocene, and that between Lower Pliocene and Pleistocene.

Within the area of the Dugi Otok basin, regional biostratigraphic zones have been singled out (by a differentiation of marine sediments on the basis of planktonic foraminifera) according to the classification after BAUMANN P. – M. ROTH (for Oligocene), CRESCENTI 1966, CATI-BORSETTI 1968 (for Miocene), and DONDI-POPETTI 1968 (for Pliocene).

No essential differences considering the microfaunistic associations of planktonic foraminifera have been established in comparing the Upper Oligocene and Aquitanian deposits of the Dugi Otok basin with the Egerian deposits of the Paratethys.

It may also be noticed that the Langhinian sediments correspond to those of Lower Badenian, and the sediments of Serravalian to the Middle and Upper Badenian deposits.

In the Langhinian also, zones of *Praeorbulina* and *Orbulina suturalis* may be singled out in the same way as in the Lower Badenian sediments of the Paratethys.

The Burdigalian microfaunistic associations are rather difficult to compare with microfaunistic associations of simultaneous deposits of the Paratethys, as in the Dugi Otok basin they occur in bathymetrically deeper environments.

A microfauna-based comparison of Pliocene sediments of the Dugi Otok basin with those of the Paratethys is not possible, as the Pliocene deposits of the Dugi Otok basin are of a marine facies, and those of the Paratethys, of a brackish and fresh-water facies.

References:

1. BAUMANN 1970 2. BAUMANN & ROTH 1969 3. BISTRICIC 1975 4. CATI & BORSETTI 1968 5. CRESCENTI 1966 6. DONDI & PAPPETTI 1968 7. JENKO & al. 1976 8. PRPIC & al. 1972 9. LORENZ 1968 10. MULDINI-MAMUZIC 1971 11. D'ONOFRIO 1968 12. TONCIC-GREGL, 1974 13. TURK 1971.

## Area No. 206 b1: SUBCARPATHIAN FOREDEEP GETIC DEPRESSION WEST, KLADOVSKI KLJUC, YU

Authors: D. MARINOVIC, P. JANKOVIC & V. MARKOVIC

The represented column characterizes the western starting point of the Getic depression and is an adequate object for correlation with the Pannonian basin.

The oldest Neogene sediments are represented exclusively by clastics with characteristics of Lower Miocene limnic-continental deposits, and they have been filling the local depressions.

The Badenian has been transgressing through different horizons over the well-developed relief base. Generally speaking, it is completely developed, i. e. as conglomerate-sandy and sandy-marly layers.

The beginning of the Sarmatian is characterized by a relatively rapid fresh water influence. The Volhynian consists mainly of coarse clastics with clayey-marly and sandy-marly intercalations, including the standard fauna of Lower Sarmatian.

The Bessarabian is represented by marly deposits with *Cryptomactra pesanseris* or a sandy "Fabreona" facies, and it is characterized by a relatively poor Foraminifera association, typical of shallow-water and marginal areas of the basin with *Protelphidium granosum* and *Miliolida*.

Decrease of the water cover in the Upper Sarmatian resulted in a tendency of water withdrawal, so that the sandy uppermost Sarmatian, with *Mactra* and *Rotalia*-Ostracoda microfacies, becomes predominant.

The transgressive trend of the Meotian is evident. Most frequently, the younger horizons have been disguising i. e. covering the "Dosinian" horizon. The predominant sandy-marly deposits of the Upper Meotian with *Congeria novorosica, C. panticapea* and specific Ostracoda associations are showing a tendency of thickness increase in northeastward direction.

Unlike the sediments of the *C. novorosica* substage, better known from well data, the Upper Pontian deposits are easier accessible for study on outcrops, since they are only partly and unconformably covered by the considerably younger Tertiary deposits. The regressive Pontian of the Carpathian foredeep represents a reliable marker horizon for the purpose of determining synchronous deposits in the Pannonian basin.

References:

1. BOSKOV-STAJNER & MARINOVIC 1971 2. EBERZIN & STEVANOVIC 1949 3. PAVLOVIC 1937 4. PETKOVIC 1948 5. POPOVIC 1958 6. STEVANOVIC 1949 b 7. STEVANOVIC 1949 a 8. STEVANOVIC 1949 c 9. STEVANOVIC 1951 a 10. STEVANOVIC 1958 11. STEVANOVIC 1960 12. STEVANOVIC 1967.

## Area No. 223 a: BACKA BASIN, YU

Author: D. MARINOVIC

The column is characteristic of eastern and southern parts of the Backa area. The extreme south end of Backa is characterized by a reduction and wedging-out of the Postpontian Pliocene, whereas the northern and northwestern parts of Backa are characterized by a total reduction in the thickness of deposits. This refers especially to the absence of Miocene or a part of Lower Pliocene, so that the medium thickness amounts to several hundred metres only, contrary to the more complete development represented in the subject column, with an approximate thickness of 1000 m of Neogene sediments.

The carbonateless sediments of older Miocene deposits of an isolated continental–lacustrine character, are of variable thickness and restricted extension.

The marine Miocene had transgressed either over the older base or over the continental–lacustrine deposits, and was followed by volcanic activity. There is an evident fresh-water influence from the Upper Badenian through the Lower Sarmatian, with regressive movements at a reduced sedimentation intensity.

At the end of Lower Sarmatian, there was – within a confined area – either a partial desiccation or shallow-water sedimentation, having characterized the alternation of fossil associations.

The development of brackish or caspi-brackish associations is in connection with transgressive movements in the Lower Pliocene, and later on to the consequences of increasing fresh-water influence and shallow-water tendency up to a complete transformation into the fresh-water regime of the Middle and Upper Pliocene. The regional correlation zones of the Pliocene epoch are marked by the indexes X, P, $L_O$, L', R, D and PS.

Analyses of radiometric methods have not been carried out, and thus, we cannot accept the column subdivisions in the standard classification.

References:

1. BOSKOV-STAJNER & MARINOVIC 1971 2. FILJAK & al. 1969 3. MARINOVIC & KEMENCI 1969 4. MARINOVIC 1962 5. MARINOVIC & KUKIN 1971 6. PANTIC & al. (1977 in print) 7. STEVANOVIC 1952 8. STEVANOVIC 1960.

## Area No. 223 b: N BANAT BASIN, YU

Author: D. MARINOVIC

The Neogene deposits in the northern part of the Banat area characterize the development of the deepest depressions within the Pannonian Basin, with particularly thick Pliocene and Quaternary deposits.

The Middle Miocene marine sediments are only in some exceptional cases preceded by continental–limnic deposits, and this in strictly limited areas.

Over the basic, generally coarse clastics, under conditions of a considerably well-developed shore-line, shallow-sea and littoral types of Badenian facies have developed and are passing through a mixed development into the facies of the central areas.

The regressive tendencies in the upper part of the Badenian, manifested by an increasing fresh-water influence in the water basins, were being continued in the course of Lower Sarmatian, causing the absence of a part of Sarmatian and a part of Pannonian deposits in some places.

During the Pannonian, there was again a subsidence of the main depressions, intensely to be continued throughout the Lower Pliocene. Here, the development of marly caspi-brackish deposits, with endemic fauna, has been marked – for the purpose of comparison – by the indexes P, X of reference points. This has proved especially useful in the middle part of the column of Pontian sediments abounding in sandstones of quick sedimentation characteristics, developed between the reference point levels marked by L and L', these, again, being specially important as reservoir rocks for gaseous and liquid hydrocarbons – not only in the Banat area, but in the Pannonian Basin in general.

An outstanding feature of this area is the great thickness of the younger deposits of Pliocene (Postpontian). These are lacustrine—fresh-water, or later on, marshy—fluvial and continental deposits, defining the filling of isolated depressions, with a tendency of continuous desiccation of residual water.

Within the Yugoslav part of Banat, the equivalents of the Middle and the Upper Pliocene have been treated as *Paludina* strata, their division into three parts – according to the evolutionary development of genus *Viviparus* – having recently again been confirmed.

The northern part of Banat and the major part of the Hungarian Alföld, precisely, are the areas where Miocene and Pliocene deposits are to be located with a greater certainty. This is the reason why, having no radiometric analyses at disposal, the question of a boundary between Miocene and Pliocene and that of a correlation with the Mediterranean basin development have remained open.

According to our present knowledge, the lower boundary of Pontian is to be considered as the starting point of Pliocene.

References:
1. ASKIN 1967 2. GROUP OF AUTHORS (in print) 3. BOSKOV-STAJNER & MARINOVIC 1971 4. JANKOVIC 1974 5. JANKOVIC & al. 1974 6. LASKAREV 1950 7. MARINOVIC 1962 8. NIKOLIC & SIMIC 1959 9. STEVANOVIC 1959.

### Area No. 223 c: S BANAT BASIN, YU

Author: D. MARINOVIC

The represented column may be considered as characteristic of the depressions in the southeastern part of the Pannonian Basin, with a more intense Miocene development, unlike the development of thick Pliocene deposits in the northern part of Banat.

The older Miocene deposits have unconformably overlaid the heterogeneous geologic basement. These are carbonateless continental–limnic structures, whose volcanic component is indicated by dacite and dacite—andesite effusions.

The Middle Miocene marine transgression starts with the Badenian. Besides shallow-sea-littoral development, there is also a basin and mixed type development, where the lagoon environments are also characterized by anhydrite deposition.

In the central parts of the main Miocene depression of southern Banat, the Sarmatian has been developed to a high degree, representing a subject of further studies in the future. The intense fresh-water influence in the Upper Miocene resulted in a transition of Sarmatian into Pannonian deposits.

The marginal Pannonian sediments may, for instance, be compared to synchronous deposits of the Vienna Basin, whereas in the main depression zone, the Sarmatian is directly underlying the typical "Banatica Layers" of the Pannonian Basin. In the hanging-wall, the layers have evoluted into the central "abichiformis" caspi-brackish facies of the Upper Pannonian and Pontian.

Differently than in the northern part of Banat, the Lower Pontian is almost exclusively marly, the Upper Pontian manifesting a stronger fresh-water influence only in its higher horizons, being generally sandy, regressive, and thus, considerably reduced.

The fresh-water Middle and Upper Pliocene have retained, in parts distant from the border, elements for classification by the evolutionary development of genus *Viviparus*, with the exception of the marginal zones, where these deposits are clearly reduced or altogether missing.

Having no radiometric analysis data at our disposal, we have refrained from the proposed "standard classification" before completely defining the Pontian stage in relation to the presumed boundary of the Pliocene.

References:
1. BOSKOV-STAJNER & MARINOVIC 1971 2. JANKOVIC 1970 3. KLEMENCIC 1963 4. MARINOVIC 1959 5. MARINOVIC 1961 6. MARINOVIC 1962 7. MARINOVIC & KEMENCI 1969 8. NIKOLIC 1966 9. PAVLOVIC 1959 10. POPOVIC 1967 11. STEVANOVIC 1960.

### Area No. 224 a1: DRAVA BASIN, YU

Authors: J. VELIC & A. SOKAC

By the total thickness of its younger Tertiary sediments, amounting to a maximum of 7000 m, the Drava depression is to be considered as the deepest in Yugoslavia. Fresh-water sediments of the Ottnangian and possibly of the Lower Carpathian have transgressively overlain the eroded Tertiary basement, built of crystalline rocks, then the Paleozoic (magmatic, metamorphic and partly sedimentary) rocks, as well as the Mesozoic sediments, mainly represented by limestones. Above the basal conglomerates, there are prevailingly sandstones, marls and limestones. It could be presumed that, in the deepest parts of the depression, the lower part of these sediments belongs to the Egerian–Eggenburgian, although no deep drilling operations have been carried out so far, and hence, no exact or entirely reliable data are available to prove this supposition. The maximum thickness of this member amounts to 2000 m.

Conformably upon these, Carpathian sediments were being deposited, gradually adopting a marine character in the uppermost part.

Distinctly under the influence of the younger Styrian orogenic phase, there is a transgression of the marine Badenian sediments after a shorter hiatus. Here, in addition to basal conglomerate and breccia, sandstone, marl, calcareous marl and limestone are also occurring; in shallower environments, there are sandstone, breccia, conglomerate and Lithothamnian limestone, and in deeper environments marl and clay. It is characteristic than, in the uppermost part, limestone and calcareous marl are predominant. The total thickness of the Badenian reaches a maximum of 1200 m.

Brackish sediments of the Sarmatian are following there-upon, sometimes characterized by a tendency to unconformity, and in direction toward the Pannonian more and more distinctly regressive characteristics are becoming manifest. Within the range of presumed greatest thickness,

i. e. 400 m, there is an alternation of marl, laminated bituminous marl, sandstone and some diatomite here and there. Toward the central, deeper parts of the depression, sand and sandstone layers of increasing thickness get included into the sequence. The uppermost part of the Sarmatian is missing.

The Pannonian deposits of fresh-water to brackish type, reaching to 900 m in thickness, are, in places, lying unconformably upon the Sarmatian. There are mainly represents by marly limestone and marl, and proceeding father, to deeper parts of the explored area, similarly to the situation established in Sarmatian sediments, an increasing participation of sands and sandstone becomes evident.

In accordance with its Mollusca fauna content, the lower part has been named Croatica beds, and the upper part the Banatica beds.

Conformably, the Pontian sediments are following. Their older part belongs to the Abichi beds, built of sandstone, marl and sand, and the younger to Rhomboidea beds, where sand and clay are predominant, including lignite and peat intercalations. The water salinity is varying from brackish to brackish–fresh water. The thickness of the Pontian is presumed to reach 2500 m.

Within the range of Pretortonian (? Egerian–Eggenburgian, Ottnangian and Carpathian) and Badenian layers, the existence of intercalated lava and effusive has been established, i. e. basalt, basalt–andesite and andesite. Their development is due to repeated volcanic activity, and as established by recent subsurface mapping, they reached as far as right under the Sarmatian.

In addition to the designation of deposits in biostratigraphic terms, the table gives also terms for designation of lithostratigraphic units – here, formations. Their comparison with the regional chronostratigraphic stages is only approximative.

References:

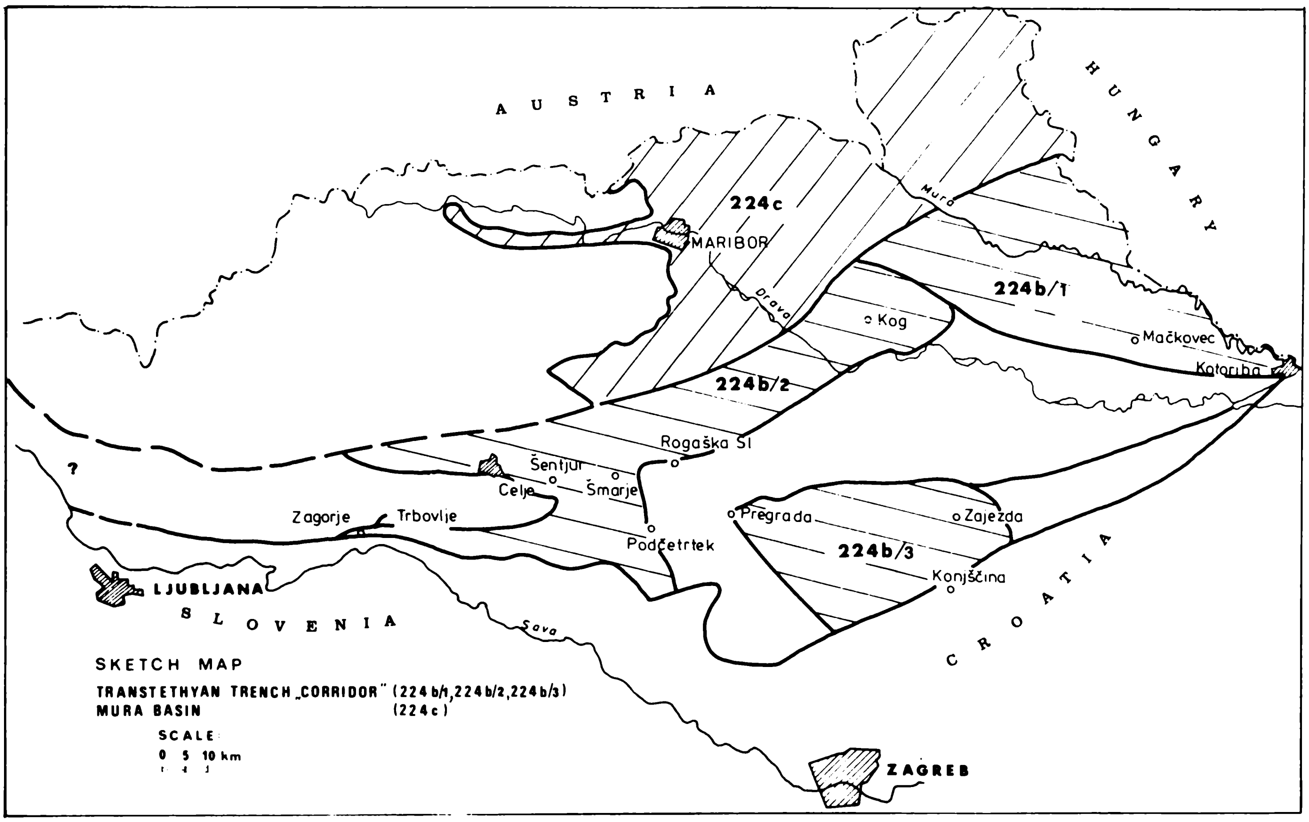
1. BOSKOV-STAJNER 1962 2. BOSKOV-STAJNER 1963 3. BOSKOV-STAJNER & MARINOVIC 1971 4. BOSKOV-STAJNER & al. 1969 5. BOSKOV-STAJNER & RESCEC 1962 6. BOSKOV-STAJNER & al. 1966 7. BRUSINA 1897 8. HAUER 1867–71 9. KRANJEC 1975 10. KRANJEC & al. 1976 a 11. KRANJEC & al. 1976 b 12. MOOS 1944 13. OZEGOVIC 1944 b 14. PLETIKAPIC & al. 1964 15. SIMON 1973 16. TAJDER 1944 17. TAJDER 1956.

**Area No. 224 b1: TRANSTETHYAN TRENCH "CORRIDOR", YU**

Authors: A. BISTRICIC & K. JENKO

The Area No. 224 b1 gives stratigraphic presentation of the northeast and central part of the presumed "Transtethian Trench Corridor". Researches of the petroleum-geologic nature performed by the company INA –NAFTAPLIN in the area of the Mura depression have made it possible to obtain fresh data on the basis of which new body of knowledge of the geologic structure and evolution of this area has been gained.

The oldest rocks drilled are from the Mesozoic era. Overlying them discordantly and transgressively are the Neogene, Egerian and Eggenburgian deposits. The discordance between the Mesozoic and Neogene can be observed on the whole of the 224 b area. The data obtained by drilling proved that during the Egerian period there was a strong volcanic activity and thus the drilled effusives of



some wells exceed 1000 m in thickness. This labile area is a part of the space area between the Alps and the Dinarides, and it is presumable that during the Egerian period there was a corridor in the said area that connected Tethys and Paratethys through northern Italy.

SW of Area No. 224 b1 above the silicified effusives lie the partly silicified and reduced marine sediments of the lower Egerian. They developed in the facies of arenaceous marls and lithothamnium limestones and are confirmed by the characteristic microfauna; *Globorotalia opima opima* BOLLI, *Globigerina praebulloides praebulloides* BLOW, *G. officinalis* SUBOTINA and others; as well as in the lithothamnian limestone; *Miogypsina (Myogypsinoides) formosensis* YABE et HANZAWA; *Lepidocyclina* sp. (? *dilatata*). Planktonic foraminiferous association corresponds to the associations of the *Globorotalia opima – Globigerinoides* zone distinguished in the lower Egerian of the Central Paratethys. It can also be observed that this microfaunistic association does not essentially differentiates from the microfaunistic associations of the upper Oligocene and lower Aquitanian off shore wells of the Adriatic subbottom. There is a break in sedimentation of the southwest area after the lower Egerian period and accordingly the Badenian deposits discordantly overlie the lower Egerian.

In the N part (in the area of the Ormoz–Selnica ridge) Egerian developed in various facies; calcite sericite shale; recrystallized granular calcilutite, arenaceous marl and a thin inclusion of lithothamnian limestone (Z. MALJAK, 1976). Foraminifer association is not typical. In the lower part the foraminifera *Cyclamina acutidorsata* HANTKEN and *Bathysiphon* sp. have been encountered, and also planktonic microfauna of lower Egerian in the arenaceous marl. in poor amount though. The limestone breccias (cca 350) have been drilled in the bottom, having no faunistic elements and which we think belong to Miocene. On the lower Egerian there are discordantly lying Eggenburgian deposits. The discordance of Egerian with younger sediments becomes apparent or may be perceived in the whole of the research area No. 224 b1. The Eggenburgian is demonstrated by the microfauna of the *Bathysiphon–Ciclamina* type and developed in coarse "Schlier" facies; shale, marl, sandstone. The schlieric facies continues also through Ottnangian, but the faunistic composition changes gradually, and so in the upper parts the microfauna *Elphidia* and *Cibicides* prevails. Since the deposits of Eggenburgian and Ottnangian are rather poor and lithologically very similar it has not been possible to draw a line between them. By the end of Ottnangian ensues regression. In exploration wells of the NW part of Area No. 224 b1 the discordant relationship of Ottnangian and Badenian is observed. In the area, however, that is more towards NE in the well Zebanec–1 between the Eggenburgian and Pannonian layers a complex of hard arenaceous marls (cca 600 m) was drilled wherein no microfauna was detected. The question remains open as to the stratigraphic position of Ottnangian and Carpathian. The number of exploration points is far too small to make possible a successful solution to the said problem. On the whole of No. 224 b1 area the Carpathian sediments have been nowhere faunistically proved. The data obtained from exploration wells demostrate that the said area underwent influence of the Styrian orogenesis, and the hiatus between the Ottnangian and Pannonian recorded in many exploration wells confirms that the effect of the late Styrian orogene phase has been great in this area.

In the SE part of the observed area the Neogene sedimentation cycle begins with the Eggenburgian deposits overlying discordantly Mesozoic. Facially they differ from the Eggenburgian development in the N part of the treated area. The breccias have been established in the bottom, then the fine-grained conglomerates, argillaceous-arenaceous sediment with carbon inclusion as well as the lithothamnian limestone in the roof. In the clastic deposits of the said sediment complex a large number of mollusc fragments, of solitary and colonial coralinacee as well as the benthonic foraminifera has been observed. It is not to exclude that the marine deposits – lithothamnian limestone – appertain to Ottnangian. After Eggenburgian, respectively Ottnangian, in the southeastern part of the treated area the uplifting happens, followed by strong erosion, so that on the said sediments discordantly lie brachial deposits of the Pannonian.

The deposits of the lower Badenian have been established in the area between the Ormoz–Selnice ridge (N) and the zone of the volcanic activity (S–SW) in the direction of which they show sudden tendency towards wedging out. They appear in marine clastic development in the facies of calcarenite subgrauwacke, lithothamnian limestones and some marl. Between the lower and upper Badenian lithothamnian limestone has been established with the microfauna corresponding to the zone *Spiroplectamina carinata* known in the Viennese valley. There is a regression at the end of Badenian and so the upper Badenian is not fully developed.

Sarmatian deposits are of small thickness and lie discordantly and transgressively on the Badenian sediments. They appear in brachial development in the facies of arenaceous marls and sandstone. It was not possible to differentiate Sarmatian deposits from the Pliocene on the basis of stratigraphic elements, therefore in this part of the profile the lithological formations and units have been used, excepted as per their lithostratigraphic characteristics of the rocks and the results obtained through electric logging correlation (SIMON J., 1966, SILOBAD M. & PRISC S., 1966).

References:
1. BISTRICIC 1977 2. CICHA & al. 1964 a 3. CICHA & al. 1967 4. BALDI & SENES 1975 5. BIZON & BIZON 1972 6. GELATI & NICORA 1969 7. PAPP & al. 1973 8. PAPP & al. 1974 9. KISOVAR & al. (in print) 10. SILOBAD & PRISC 1966 11. SIMON 1966 12. STEININGER, SENES & al. 1971.

## Area No. 224 b2: TRANSTETHYAN TRENCH "CORRIDOR", YU

Author: L. RIJAVEC

Deposits of the Egerian lie transgressively on the Paleozoic and Mesozoic or on the Oligocene marly clay in the western part of the Transtethyan Trench "Corridor". These deposits are known as the Govsko deposits in the Lasko–Zagorje sinclinorium. There are two regions with different facies divided by the Sostanj fault.

In the southern part there are mainly sands and sandstone with shale inclusions: Foraminifera association is not characteristic. In the lower part one can find Foraminifera *Tritaxia (Clavulinoides) szaboi, Planularia kubynyi,* while *Almaena* ex. gr. *osnabrugensis* is present throughout the Egerian profile.

In the northern part, explored by the Tekocevo-1 well, where sedimentation with andesite tuffs begins, there are limestone lenses with foraminifera *Lepidocyclina morgani* and *Miogypsinoides formosensis*. Tuff is overlaid by sandy marl in which there is a thin andesite tuff inclusion. Above it there is sandy marl with thin intercalations of sandstone. Foraminifera association with *Tritaxia (Clavulinoides) szaboi, Planularia* sp. and *Almaena* ex gr. *osnabrugensis* was found in the lower part of the marl layers.

After Egerian sedimentation follows a long interruption in sedimentation. Part of the Eggenburgian deposits is probably missing. the profile begins again with the Ottnangian and Carpathian sedimentation, which are wedging out westwards. There is an erosional unconformity over the Carpathian. The Badenian is in a transgressive relationship with older deposits. It is uncompletely developed and divided into three biozones: *Orbulina suturalis, Spiroplectamina carinata* and *Bolivina dilatata*.

The Badenian is completely marine. In the Upper Badenian the sea retreats eastwards. This regression is indicated by sands, and is a result of uplifting in the Upper Badenian.

On the marine Badenian deposits one notices erosional unconformity again indicating a new sedimentation cycle with sedimentation of the Sarmatian deposits which are of a transgressive character. They are developed as a conglomerate, sand, sandstone, marl (both clayey and sandy) and marly limestone. Three biozones, important for the central Paratethys, have been found in these deposits. Brackish development of deposits can be determined on the basis of microfauna.

In most cases between the Sarmatian and the Pannonian one can notice a short interruption in sedimentation.

The Lendava formation begins with the Upper Pannonian transgression. Towards the end of the Lendava formation brackish deposits stop and sedimentation of freshwater deposits of the Mura formation begins.

References:
1. BALDI & SENES 1975 2. BUSER (in print) 3. CICHA & al. 1967 4. KUSCER 1967 5. NOSAN 1973 6. PAPP, CICHA & al. 1978 7. PAPP & al. 1974 8. PAPP, RÖGL, SENES & al. 1973 9. PLENICAR 1954 10. RIJAVEC 1965 11. RIJAVEC 1976 12. SIMON 1966.

**Area No. 224 b3: TRANSTETHYAN TRENCH "CORRIDOR, YU**
Author: L. SIKIC

The paralic sedimentation in the Egerian is characterized by an alternation of marine and brackish layers with foraminiferes and fresh-water coal layers (Pregrada, Zajezda). The quick changes in the sedimentation regimes are explained by basin oscillations, reflecting the Sava orogenic phase. A stratigraphic gap has been proved in this area, reaching from the Upper Egerian to the Lower Badenian. Sedimentation had started in the Lower Badenian and continued up to the Upper Pontian.

The microfossils mentioned in the column are index fossils, being representatives of the microfossil associations in the Upper Egerian and Badenian, and should not understood as names of biozones.

Radiometric analyses have not been carried out.

References:
1. ANIC 1952 2. ANIC 1958 3. ANIC 1960 4. MUTIC 1970 5. SOKAC 1961 6. SOKAC 1969 7. SIKIC & JOVIC 1969 8. SIMUNIC & al. 1976 9. SIMUNIC & PIKIJA (in print) 10. TAKSIC 1965.

**Area No. 224 c: MURA BASIN, YU**
Authors: L. RIJAVEC, A. BISTRICIC & K. JENKO

In the Mura basin, the Miocene sequence of sedimentation starts with Ottnangian deposits, mainly in transgression upon a metamorphic basement of Paleozoic, very rarely of Mesozoic origin.

The first sedimentary cycle starts with Ottnangian, and Carpathian deposits. It has developed in of schlieric facies with dacite and andesite tuffs and tuffites. On the basis of these, we may conclude upon a distinct older and a younger Styria orogenic phase.

In the lower part of the profile, there are no fossil remains except scarce Ostracoda, indicating the fluviatile-limnic character of the sediments. The upper part of the profile is of a marine character, what is confirmed by rich foraminiferous fauna, proving the Carpathian origin of the deposits. The marl contains characteristic varieties of Foraminifera, such as *Uvigerina bononiensis primiformos, Uvigerina graciliformis*, and in the uppermost part there are also plankton species of *Globigerinoides bispharicus*. The first sedimentary cycle is represented by the "Urban" and "Kungota" formations.

There is an erosional unconformity above the Carpathian. In some places, a transgressive relationship is noticed between the Badenian and the older deposits (western "Slovenian Gorice" hills). The Badenian deposits are developed as conglomerate, sand, sandstone, marl, and sometimes as clayey or sandy lithothamnian limestone. On the basis of fauna and lithology, we may conclude upon a marine, littoral, and neritic environment of sedimentation. In the Badenian, the existence of the three biozones, already known from the Vienna basin, has been established. An important formation of the Badenian deposits is the "Spielfeld" formation.

In the upper part of the Badenian, the sea has been withdrawing more and more to the east. The regression may be traced according to the sediments, mostly developed as sand with very scarce, thin intercalations of clayey or sandy marl. The regression results from epirogenic movements in the Upper Badenian. There, the second sedimentary cycle in the Mura basin comes to an end.

There is again an erosional unconformity following over the Badenian marine deposits. This unconformity is followed by a third sedimentation cycle, characterized by Sarmatian deposits of a transgressive character. They have been sedimented in the western part of the "Slovenian Gorice" hills, even directly upon the Lower Badenian deposits. They are developed mostly as conglomerates, clayey marl, sand, sandstone and marly limestone. It has been possible to single out three biozones in the Sarmatian deposits. On the basis of Foraminifera and Ostracoda fauna, it may be concluded upon a brackish development of the sediments.

In some places, the Sarmatian deposits are characterized by an uninterrupted continuation of the series into Pannonian deposits, but there are also some areas in which the lowest part of the Pannonian is missing. In places where the sedimentation has not been interrupted, again a regression is to be noticed. There is a transgression again, in the so-called "Lendava" formation. In the lower part, it chiefly consists of marl sediments containing Ostracoda fauna, while its upper part is composed exclusively of sandstones. The "Lendava" formation with Ostracoda proves a brackish development of the sediments. Basalts are important in the "Lendava" formation. There is a further continuation of sedimentation into the "Mura" formation, which consists of clay, coal, sandstone and gravel. Thus the third sedimentary cycle, locally interrupted by a small, apparent unconformity in the Lower Pannonian, comes to an end.

It is to be underlined that the sedimentation of Miocene and Pliocene deposits was depending on the structure of the basement. The best-pronounced structure within the Mura basin is that of Murska Sobota, consisting of the Radgona–Maribor depression and the Kapela block. The latter has no younger Miocene deposits. There, the sedimentation started only with the Ottnangian deposits in a direct transgression on the metamorphic basement.

At the end of Ottnangian, this area underwent a regression; hence, the Miocene sediments are altogether missing along the rims of the Mursko–Sobotski massif, and the Pannonian deposits have been sedimented directly upon the crystalline basement.

No radiometric analyses have been carried out for the Mura basin.

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1. BISTRICIC (in print) 2. CICHA, SENES, TEJKAL & al. 1967 3. MULDINI-MAMUZIC & RIJAVEC 1974 4. PAPP & al. 1978 5. PAPP & al. 1974 6. PAPP & al. 1973 7. PLENICAR 1970 8. RIJAVEC 1970 9. RIJAVEC 1976 10. SPAJIC & RIJAVEC 1973 11. SIMON 1966 12. WINKLER 1913 13. WINKLER 1957.

## Area No. 225: SLAVONIA–SYRMIAN BASIN, YU

Authors: D. MARINOVIC & P. JANKOVIC

The Srem basin holds an area between the Danube and the lowest course of the Sava river. There, the mountain of Fruska Gora may be singled out by its morphpologic structure, being composed of older formations, while Tertiary sediments are represented in the lower parts of the massif.

The western parts of the Tertiary basin, associated to the East–Slavonian depressions, are more completely developed than the eastern and southern parts displaying features of the marginal zones.

The continental-limnic structures of Lower Miocene have been filling-in the local depressions by alternating corase and clayey deposits, partly with coal layers, followed by dacitic volcanic activity.

The marine transgression of Middle Miocene covers quite an extensive area; it is characterized by a differentiation of littoral and basin types of facies with volcanic activity, which completely disappears in the Sarmatian.

Marly-sandy deposits are predominant in the Sarmatian. A regression intensifies fresh-water influence in the marine regime, bringing about – in the Upper Miocene – a transformation to the Pannonian lacustrine-brackish regime, known as having been a subject of continuous studies of the types of facies within that area ever since the seventies of the past century.

The transgressive movements in the Lower Pliocene caused a noticeable development of the Lower Pontian, amounting to an approximate thickness of 1000 m, with simultaneous local unconformities in the position of deposits in relation to the older geologic base.

The end of the Pontian stage is characterized by the basins becoming shallower, what is followed by the sedimentation of sandy deposits with a tendency of complete fresh-water transformation, causing a heterogeneity of the various facies following the regression of water.

For the above-mentioned reasons, the limnic and continental sediments of Middle and Upper Pliocene (*Paludina* layers) are developed only within a considerably reduced area.

Having no radiometric analyses data at our disposal, we are inclined to reservation as to a fixed boundary between different epochs, achieving this by lowering the boundary nearer to the base of the Pontian stage.

References:

1. CICULIC 1961 2. HOERNES 1874 3. JANKOVIC & STANKOVIC 1970 4. KUKIN 1957 5. MARINOVIC 1962 6. PANTIC & al. (in print) 7. STEVANOVIC 1951a 8. STEVANOVIC 1952 9. VESELINOVIC-CICULIC 1968.

## Area No. 226: SAVA BASIN, YU

Authors: L. SIKIC, K. JENKO & K. SIKIC

There was, upon the basement rocks (Paleozoic – Medvednica, Mesozoic – Papuk), a transgressive sedimentation of fresh-water deposits of Upper Ottnangian, possibly of Lower Carpathian origin. They are concordantly overlain by marine deposits of the Carpathian. The absence of brackish faunistic elements is explained by a sudden invasion of sea into this area, thus, having preserved the chronological continuity of fresh-water and marine deposits in spite of the change in the sedimentation regime. The Lower Badenian sediments, throughout this area, show well pronounced transgressive characteristics as a result of tectonic movements of the younger Styrian phase. Volcanic activity was present in the Carpathian and in the Lower Badenian, with rhyolite and dacite rocks.

The deposits of the Upper Badenian, the Lower Pannonian, and the Upper Pontian, in the marginal parts of the basin, show ingressive characteristics. The deposits of Sarmatian, Upper Pannonian, and Lower Pontian, throughout this area, are manifesting a conformable relationship with their foot-walls.

The above-mentioned microfossils in the column are characteristic of the associations of Miocene deposits in this area, and thus, should not be understood as names of biozones.

No radiometric analyses have been carried out.

References:

1. BLASKOVIC & al. 1975 2. BOSKOV-STAJNER 1961 3. BOSKOV-STAJNER 1963 4. BRUSINA 1902 5. JENKO 1944 6. JURILJ 1957 7. KOCHANSKY 1944 8. KOCHANSKY-DEVIDE 1965 9. KRANJEC 1964 10. KRANJEC & al. 1973 11. KRANJEC & BLASKOVIC 1976 12. MOOS 1944 13. MUTIC 1969 14. MUTIC 1973 15. NEUMAYER & PAUL 1875 16. OZEGOVIC 1944 a 17. OZEGOVIC 1953 18. PILAR 1883 19. SOKAC 1966 20. SOKAC 1966 21. SOKAC 1972 22. SIKIC, K. & BASCH 1975 23. SIKIC, L. 1967 24. SIKIC, L. 1968 SIKIC, L. 1975 26. SPARICA & CRNKO 1973 27. SPARICA & al. (in print) 28. TAKSIC 1953.

**Area No. 227 a: INTRADINARIDIAN MARGINAL ZONE TUZLA BASIN, E BOSNIA, YU**
Author: M. ATANACKOVIC

The basin has a complex structure and evolution. It was formed near the end of the Oligocene. During the Egerian and the Eggenburgian, freshwater lacustrine series were deposited. In the Ottnangian and the Carpathian the regime of salt laces began with the sedimentation of the salt formation and its equivalents. Marine transgression began with the Badenian. Transition from the lacustrine to marine regime was gradual. Subsidence of the basin lasted from the Egerian up to the end of the Pontian. From the Pontian, the erosional phase began. Folding of all series was accomplished after the Pontian (the Rhodanian phase).

The regional biozones NN 5 and NN 6 are singled out only for the Badenian and are correlated with the Central Paratethys.

The main papers in the bibliography are listed under the numbres 2 and 6.

References:

1. JERKOVIC & al. 1976 2. KRANJEC 1969 3. SOKLIC & EREMIJA 1977 a 4. STEVANOVIC 1977 5. STEVANOVIC & EREMIJA 1977 6. STEVANOVIC & EREMIJA 1960.

**Area No. 227 b: INTRADINARIDIAN MARGINAL ZONE MAJEVICA MOUNTAIN, NE BOSNIA, YU**
Author: M. ATANACKOVIC

In the first phase of sedimentation (the Eggenburgian and the Ottnangian) lakes with sediments of coal-bearing formations were formed in some regions of the area.

Towards the end of this phase sedimentation conditions differentiate: some lakes were transformed into isolated lagoons and sediments with thin layers of gypsum and other salts and layers of andesite-dacite tuffs were accumulated, while in others pyroclastic facies or limestones and marls with rare traces of salt were deposited. Before the Badenian marine transgression a short erosion phase occurred in some basins. Sedimentation conditions during the Badenian are rather differentiated. Differential movement of individual blocks appears throughout the whole of the Neogene with an overall tendency of subsiding up to the end of the Pannonian. In the course of the Pontian uplifting of the central parts of the area starts to prevail followed by subsidence of its peripheral parts. Folding of all series took place after the Pontian (Rhodanian phase).

The main papers in the bibliography are listed under the numbers 1, 2 and 3.

References:

1. CICIC 1964 2. CICIC 1968 3. JOVANOVIC & JOVANOVIC 1966 4. PANTIC 1961 5. PANTIC & al. 1964 6. SOKLIC & EREMIJA 1977 b 7. STEVANOVIC & EREMIJA 1977 8. STEVANOVIC 1977.

**Area No. 227 c: INTRADINARIDIAN MARGINAL ZONE NW BOSNIA, YU**
Author: A. ATANACKOVIC

Lake basin system was formed towards the end of the Eggenburgian and lasted until the end of the Carpathian. Heterogeneous lacustrine and proluvial layers with rare traces of coal and thinner horizons of tuffs and tuffogene rocks were deposited. The marine regime begins with the Badenian. Relationship between the lacustrine and marine facies is in some basins concordant while in some others it is discordant. Marine sedimentation area differentiates distinctly from the typical marine to the almost lagoon regimes. Difference of sedimentation conditions lasts up to the end of the Pontian. Subsidence of the region dominates from the beginning of the lake phase and particularly from the Badenian to the Pontian. In the Pontian, larger part of the area uplifts and only some parts continue to subside. Proved is the presence only of the Lower and Middle Dacian. The main folding and faulting of the series took place after the Pontian (the Rhodanian phase).

Regional biozones NN5 and NN6 in the Badenian are correlated with the central Paratethys.

The main papers in the bibliography are listed under the numbers 1, 2, 5, 6 and 7.

References:

1. ATANACKOVIC 1977 2. EREMIJA 1969 3. JERKOVIC & al. (in print) 4. JOVANOVIC 1972 5. SOKLIC & EREMIJA 1977 c 6. SOKLIC 1977 7. STEVANOVIC 1977 8. STEVANOVIC & EREMIJA 1977.

**Area No. 227 d: INTRADINARIDIAN MARGINAL ZONE, W, YU**
Authors: K. SIKIC & L. SIKIC

The basic, transgressive, fresh-water and brackish deposits of Upper Ottnangian origin, possibly Lower Carpathian, are equivalents of the fresh-water and marine deposits in the Sava basin. In the course of Upper Helvetian, in the Banija region, tectonic movements were manifested within the final part of the older Styrian phase, having brought about a continental uplifting. The deposits of Lower Badenian are transgressive in the entire area. From the Lower Badenian to the Lower Pontian, inclusively, tectonic movements were manifested by ingressions in the marginal parts of the basin. The tectonic movements in the older Valachian phase caused a continental uplifting at the end of the Pontian. By tectonic activity at the end of Dacian (Postdacian movements) a new subsidence of this area was caused, as well as a sedimentation of fluviatil-lacustrine and proluvial deposits of molasse foredeep type. These sediments had developed during the Romanian, with a possible continuation into Pleistocene.

No radiometric analyses have carried out.

References:

1. EREMIJA 1959 2. PILAR 1874 3. SOKAC 1961 4. SOKAC 1963 5. SIKIC (in print) 6. SIKIC 1962 7. TIETZE 1872.

### Area No. 227 e: INTRADINARIDIAN MARGINAL ZONE W SERBIA, YU

Authors: M. PETROVIC & M. EREMIJA

In the Jadar Koceljevo region, Tertiary deposits have been transgressively overlying a mainly Triassic–Cretaceous basement.

On the basis of fossil content, the pre-Badenian and the Badenian, as well as the Lower and the Middle Sarmatian and the Pannonian have been defined.

Two horizons have singled out within the pre-Badenian, i. e. the Lower pre-Badenian and the Carpathian.

The Lower pre-Badenian lies transgressively over the Triassic and Cretaceous deposits, being remarkably heterogeneous from the petrologic point of view. These deposits are dipping in NNE direction by an angle of 30°.

The Carpathian is more widely spread than its immediately preceding stratigraphic member. The Carpathian has a close communication with the Lower pre-Badenian or is lying transgressively upon the older – mostly marly – basement, the general dip being in NE direction by an angle of about 25°. On the basis of microfauna, the zone of *Globigerinoides bisphaericus* and the microfacies of *Bolivina reticulata* have been singled out.

The Badenian is greater in extension than the pre-Badenian and generally horizontal. According to the Foraminifera content, it has been divided into the lower, Middle and Upper Badenian members.

The clayey facies – i. e. the *Lagenida* zone, and the microfacies of *Globigerinoides*, as well as the facies of marlstones – the microfacies of *Orbulina universa*, correspond to the Lower Badenian.

The Middle Badenian is more heterogeneous by its composition than the Lower Badenian. It is mainly represented by clay-sandlimestone deposits. There, on the basis of microfauna remains, the zone of *Spiroplectamina carinata* and the microfacies of a) *Uvigerina bonaniensis compressa*, $a_1$) *Bulimina elongata*, and $a_2$) *Cibicides ungerianus* have been singled out.

The Upper Badenian shows the greatest variety in its composition. It is represented by lithothamnion limestones, a facies of sands and sandy clay, as well as by sand–sandstone–gravel facies. On the basis of microforaminifers, the above-mentioned sediments have been divided into the following zones: 1) *Bolivina dilatata* and 2) *Rotalia beccarii*, i. e. the microfacies of *Elphidium crispum*.

In general, the Lower Sarmatian is horizontal, represented by clays, gravels and limestones with Mollusca and Foraminifera fauna.

The Middle Sarmatian has been developed in a facies of limestones with *Nubecularia*.

In places, the Pannonian lies transgressively over the Triassic. It is mainly represented by sediments with Mollusca, where a *Melanopsis–Congeria* type is predominant, and with Ostracoda.

References:

1. ANTONOVIC & TODOROVIC 1961 2. EREMIJA 1961 3. EREMIJA 1976 4. GAGIC 1968 5. MARKOVIC & PETROVIC 1975 6. PETROVIC 1969 a 7. PETROVIC 1970 8. PETROVIC 1966 9. PETROVIC 1967 10. PETROVIC 1969 b 11. STEVANOVIC 1949 d 12. STEVANOVIC 1951 c 13. STEVANOVIC & MILOSEVIC 1959.

### Area No. 228: KOLUBARA BASIN, YU

Authors: N. KRSTIC & D. DOLIC

A closed sedimentary cycle is unique for the entire Neogene. The slow overflowing sedimentation (transgression), as a consequence of slight, almost continuously lasting epirogenic movements, has gradually been catching hold of all higher regions and penetrating more and more to the south. Considering the orogenic movements, the II Styria phase is well-pronounces, the Attic phase to a lesser degree, and most of all, the Rhodanian phase, which brought about a withdrawal of the Paratethys from this recess as well as from the entire basin.

Regional microfaunistic biozones (marked by the initials of index fossils) have been singled-out in this region, starting from the Middle Badenian up to the end of the Pontian.

Remains of Mammals, *Dinotherium giganterum*, have been found only in the upper part of the Sarmatian.

For the time being, regarding the Mediterranean s. str., only the Pontian sediments and those of the upper part of Upper Messinian may be correlated.

Reference:

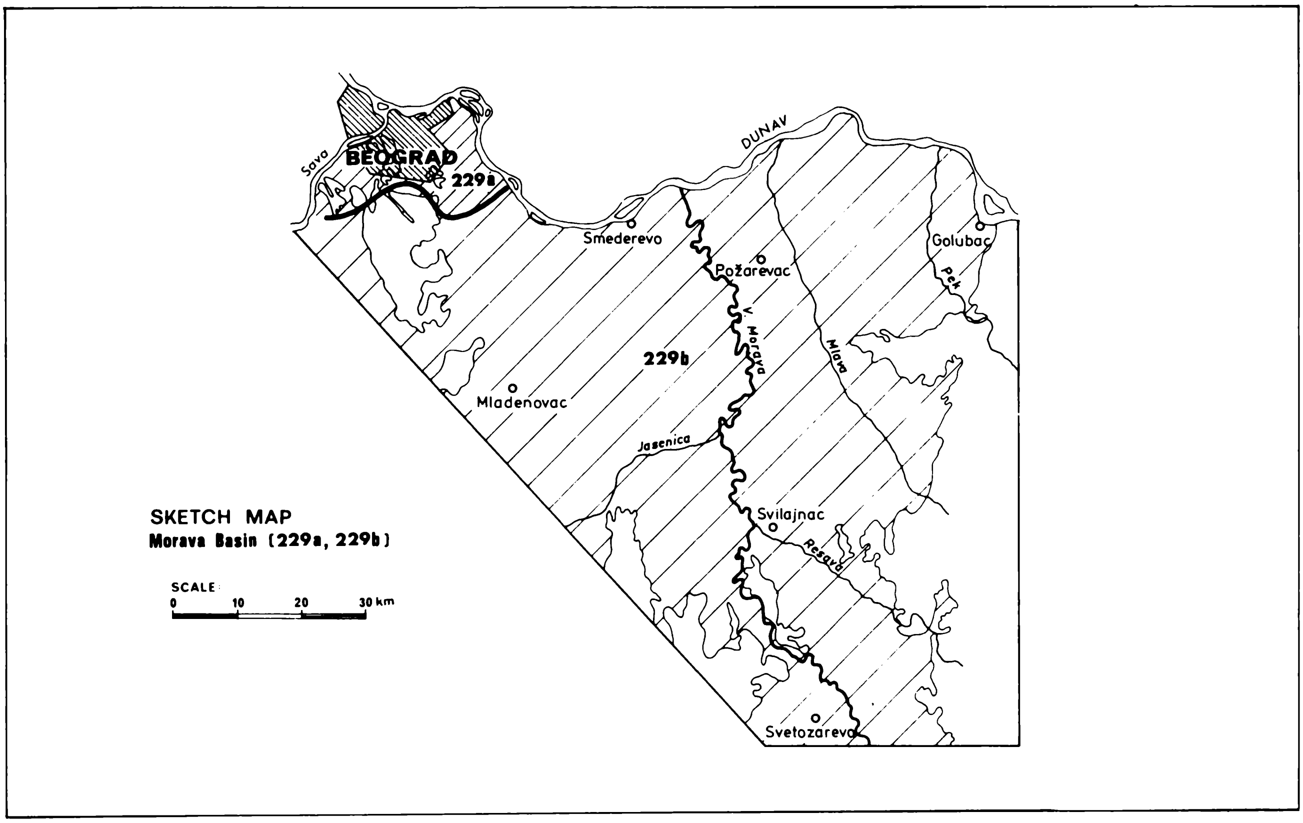
1. DOLIC 1965 2. GAGIC 1962–1977 3. KRSTIC 1973 4. PANTIC 1956 5. PANTIC & al. 1967 6. RAJCEVIC & GAGIC 1973 7. RAJCEVIC 1973 8. STEVANOVIC 1949 e 9. STEVANOVIC 1951 a 10. STEVANOVIC 1953 a 11. STEVANOVIC 1953 b 12. STEVANOVIC & PANTIC 1954 13. STEVANOVIC & MILOSEVIC 1959.

### Area No. 229 a: MORAVA BASIN, BELGRADE, YU

Authors: O. SPAJIC, R. DZODZO & N. KRSTIC

The represented column refers to Neogene development in the area within the very precincts of Beograd city and in that of its wider surroundings.

A unique sedimentary cycle, beginning at the end of Lower Miocene, is characterized by lacustrine development.




The marine transgression at the start of the Badenian stage did not involve all regions simultaneously, and thus, different sediments were being formed, depending on the paleorelief. The analysis of fauna, characterized by Mollusca and Foraminifera, has shown that the entire Badenian stage is represented by sediments of a neritic-littoral type, and that – among the sediments of this stage – several horizons may be singled out according to depth and superposition.

The sedimentary cycle is continued in the Upper Miocene by brackish deposits of the Lower and Middle Sarmatian.

A well-pronounced transgression is indicated by the development of Pannonian sediments, being widely spread throughout this region. Two types of development have been noticed within the Pannonian complex: the "basin type" and the "littoral type" of development.

The sedimentary cycle ends with the Caspi–brackish Pliocene deposits.

Lesser depressions may be observed in the course of Miocene and up to the end of Pliocene, when a very slight uplifting is noticed.

The regional biostratigraphic division, as to the Middle and the Upper Miocene, corresponds in general to the Vienna basin development. In a stratigraphic sense, the Lower Pliocene sediments are divided into two horizons.

References:
1. LUKOVIC 1922 2. DZODZO 1959 3. KRSTIC 1973 4. MILAKOVIC 1956 5. PAVLOVIC 1903 a 6. PETROVIC 1962 7. SPAJIC 1961 8. SPAJIC 1969 9. STEVANOVIC & STANGACILOVIC 1951 10. STEFANOVIC 1951 d 11. STEVANOVIC 1970 12. STEVANOVIC 1971.

Area No. 229 b: **MORAVA BASIN, SMEDEREVSKO–POZAREVACKO PODUNAVLJE, YU**

Authors: D. MARINOVIC & V. SPAJIC

The represented column refers to Neogene development in the lower courses of the Velika Morava and the Mlava rivers, i. e. to the so-called "Smederevo–Pozarevac–Danube area". The well-pronounced structural-tectonic development of the southeastern parts of the Pannonian Basin has imposed upon us the demand of representing the more complete development of the deposits by using data from oil exploration wells. The geologic conditions of the subject area are variable to a considerable degree, the primary difference from the represented generalized column being a partial or a complete reduction of the particular stratigraphic units.

The heterogeneous diversely coloured continental-lacustrine sediments are limited in their extension, but occurring in an intense vertical frequency. Mostly, they are represented by poorly graded coarse of finer clastics, their study being envisaged as a task for the future.

The marine transgression of Middle Miocene was not covering simultaneously the well-developed relief base. In the paleorelief, along the well-developed shorelines and above the ridge, reefy limestones were being developed or coal deposits formed, this being especially characteristic of the Badenian upper horizons.

In the Sarmatian, besides fresh water influence, a transgression tendency is also noticed. Within the contours of local depressions, the rudimentary characteristics of the Sarmatian Sea are noticed through the Bessarabian, differently than in the already singled-out marginal depressions with characteristics of Lower Pannonian types of facies.

The more completely developed Pannonian s. str. resembles the Pannonian development in the Vienna basin, and up to and inclusive of a zone characterized by the presence of *Congeria subglobosa* in its marginal parts, whereas the association of *C. banatica* is found in the inner parts of the basin.

Pliocene is represented by the Pontian stage, where the central parts, for instance, may be identified as the "Abichi" (abichiformis) deposits with *Congeria digitifera* in the horizon of Lower Pontian, while the Upper Pontian is more adequately defined by the *Congeria triangularia* facies, the *Dreissensia auricularis* or the *Prosodacna carbonifera* facies, and other types of facies.

The regression at the end of the Pontian caused the development of brackish-lacustrine deposits with intense fresh-water influence, undergoing a transformation into lacustrine–marshy–continental coal-bearing types of facies, i. e. up to a complete desiccation of the area at the beginning of Middle Pliocene.

References:
1. BOSKOV-STAJNER & MARINOVIC 1971 2. DOLIC 1966 3. JOVANOVIC 1958 4. LASKAREV 1949 5. LASKAREV 1950 b 6. MARINOVIC 1962 7. PROTIC & MIKINCIC 1937 8. MILETIC-SPAJIC 1959 9. MILAKOVIC 1970 10. STEVANOVIC 1951 c 11. STEVANOVIC & PANTIC 1953 12. SPAJIC-MILETIC 1969 13. SPAJIC 1975.

## Area No. 230 a: **DANUBIAN TRENCH "CORRIDOR", YU**

Authors: N. KRSTIC, D. DOLIC & R. DZODZO

The west-east direction of the Transcarpathian trench (corridor), that it has between Golubac and Donji Milanovac, changes to northnorth–east south south-east between Donji Milanovac and Borska Slatina (9, 10). The Prebadenian, Badenian and the fresh-water equivalent of the Sarmatian (7) are developed in the region of Borska Slatina, while only the Badenian prevails in the region of Donji Milanovac. Younger members of the Neogene series have eroded and only the Plio–Pleistocene deluvial-proluvial gravels have been preserved.

The lagenides zone in the region of Donji Milanovac has been determined from the regional micro-faunal biozones.

One cannot carry out any correlation with the Mediterranean Neogene.

References:
1. BOGDANOVIC & RAKIC (in print) 2. CICULIC & DZODZO 1976 3. DOLIC & al. 4. LONCAREVIC & CICULIC 1974 5. MIKINCIC 1932 6. PAVLOVIC 1922 7. POPOVIC 1968 8. STEVANOVIC & PETRONIJEVIC 1951 9. STEVANOVIC 1964 10. STEVANOVIC 1967 11. ZIVKOVIC 1893.

## Area No. 231 a: **TIMOK GRABEN AND BORDER AREA (NEGOTIN), YU**

Authors: D. MARINOVIC & R. DZODZO

Sedimentation characterizes the extreme northwestern part of the pre-Balkan platform, abounding in development reductions. The average thickness of all represented members is about 500 m.

The Neogene begins with continental–fresh-water sediments of quite a restricted extension, which may be coal-bearing in places. There is a gradual southward and westward transgression of the Badenian, so that the older Badenian is not necessarily of a marine or exclusively marine type. Depending on the paleogeographic conditions, there has been a development of distinctly littoral reefy or shallow-water types of basin facies, making possible the defining of biostratigraphic types of horizons.

Through the Lower Sarmatian, the communication with the Pannonian Basin was very good and the sediments were in adequate correlation. The predominant sandstones and limestones with clayey-marly inclusions of Bessarabian display a disappearing tendency in the already rather unsteady conditions. A transgressive position of the Middle Sarmatian has been noticed over the older pre-Tertiary or even the Neogene basement.

In its upper parts, the Bessarabian is regressive in general, represented by "Mactra" layers, the existence of Chersonian being nearly symbolical.

Besides the major part of the Chersonian, a considerable part of the older Meotian has also been missing. The gradual subsidence of the base, during the Meotian stage, did not establish a new communication with the Pannonian basin and the respective types of biofacies were being developed independently.

Anyway, by establishing a uniformity in the basin system, the sandy-marly and sandy-silty sediments of the Lower Pontian represent adequate horizons for the stratigraphic synchronization, since the complete Pontian stage of the eastern and western side of the eastern and western side of the Carpathian has been undergoing a uniform development.

References:
1. BOSKOV-STAJNER & MARINOVIC 1971 2. DZODZO-TOMIC 1970 3. KRSTIC 1969 4. LASKAREV 1934 5. PAVLOVIC 1903 b 6. PAVLOVIC 1923 7. PETKOVIC & MILOJEVIC 1933 8. PETROVIC 1969 c 9. PISCHVANOVA & al. 1969 10. STEVANOVIC 1951 b 11. STEVANOVIC 1951 a 12. STEVANOVIC 1960 13. STEVANOVIC 1964 14. STEVANOVIC 1962.

## Area No. 232: **S MORAVIAN FRESHWATER BASINS AND INTRACARPATHIAN BASINS (NIS BASIN), YU**

Author: M. B. PAVLOVIC

Cycle of sedimentation begins with the Lower Miocene. The basal series, which lies transgressively and discordantly, mainly on the crystallines of the Serbo–Macedonian mass, consists of black sandy argillites sandstones, carbonate shales and bituminuous schists.

The second series is composed of conglomerates, sandstones, carbonate shales, argillites, tuffs, and less frequently sands and sandy clay. This series, too, lies discordantly and transgressively over crystallines, but the hiatus between this and basal series has not been determined. On the basis of flora the stratigraphic age of this series is determined to be the Lower and Middle Miocene.

The third series lies discordantly and transgressively over the crystalline schists and probably also over the two preceding series. Its lithology is heterogeneous: poorly cemented sandstones, gravels, sands, clays and coal. On the basis of flora its age is determined to be the Upper Miocene and Lower Pliocene.

The upper parts of the series show features of the regressive sedimentation.

Reference:

RAKIC & al. 1975.

**Area No. 233 a: W MORAVIAN FRESHWATER BASINS, CACAK–KRALJEVO, YU**

Authors: D. MARINOVIC & R. KEMENCI

The column represents a generalized modification of one of the isolated Inner Dinaric basins. The formation of the basin was predisposed by radial faulting upon the end of the main orogenic activity with still active mafic volcanism.

At the beginning of Neogene, there was a renewal of volcanic activity, i. e. volcanism of acid effusions.

In local depressions, especially along the present southern rim of the basin, the continental-lacustrine deposits (with *Helix, Congeria)* are of a heterogeneous composition, partly carbonate, or with coal and andesite and andesite breccia mass.

The coarse clastics of Lower Miocene with dacite type volcanogenic material also include pelitic coaly deposits with palynological associations of "Normapolites" forms together with the typical paleo-palynological spectrum of Lower Miocene.

The increase of the vitroclastic volcanogenic components corresponds to the development of fine-graned flyschlike sediments with an increased carbonate component. The layers are containing a typical fish association of the Middle Miocene.

The laminated marlstones with the "last" tuffites include a palynological association of the Upper Miocene, lithologically resembling the Sarmatian of "Pannonian" development.

The Pannonian sandy-marly sediments have been defined with certainty and zoning was performed according to the represented column. The series does not include tuffs, but there is coal in a number of strata.

The youngest, prevailingly sandy, Neogene deposits, indicate a completely fresh water influence, and they contain Ostracoda with some coal content, ending by regressive non-typical deposits, most probably of Pontian origin.

References:

1. KEMENCI & MAKSIMCEV 1976 2. LUKOVIC 1950 3. NOVKOVIC 1967 4. NOVKOVIC 1974 5. PANTIC 1958 6. PETRONIJEVIC 1956 7. POPOVIC 1967 8. POPOVIC & NOVKOVIC 1967 9. STANGACILOVIC 1969.

**Area No. 233 b: W MORAVIAN FRESHWATER BASINS AND INTRACARPATHIAN BASINS (DRAGACEVO, KOSJERIC), YU**

Author: Z. PAVLOVIC

Sedimentation in these Neogene basins began in the Lower Miocene and in all probability went on until the beginning of the Middle Miocene, when the most part of the terrain is considered to have been land. Transgression caught hold of this region again at the beginning of the Tortonian. On the basis of faunal data it was found that sedimentation went on even until the Upper Miocene.

Findings of numerous remains of paleoflora, macro- and micro-fauna indicate that sedimentation took place in a sublacustrine environment and that the sediments correspond by their age to the freshwater equivalents of the Lower Miocene, Tortonian, Sarmatian and Pannonian.

Without any stratigraphic data certain gravelly–sandy–clayey sediments, which overlay the Triassic limestone, have been put into the Levantian (Romanian).

All tectonic movements were mainly of a radial character and are mostly attributed to the deepening of the basin in the course of sedimentation, excepting those on the Lower–Middle Miocene boundary which most probably gave the structural form to the existing Neogene basins.

The presence of vulcanites or their products in Neogene sediments has not been noticed.

References:

1. BRKOVIC & al. 1971 2. GAGIC 1966 3. MILOVANOVIC 1966 4. MOJSILOVIC & al. 1971 5. PANTIC & VUJISIC 1958 6. POPOVIC 1966.

**Area No. 234 a: FRESHWATER BASINS, SARAJEVO BASIN, BOSNIA, YU**

Author: M. ATANACKOVIC

The basin was formed near the end of the Upper Oligocene and it presents most deeply subsided tectonic paleodepression in the Dinarides. Sedimentation took place in three cycles, which were not separeted by the erosional phases. The first cycle corresponds to the Egerian (Red series), the second includes the main coal series and the deposits up to the Kosevo series, and the third one comprises the Kosevo series and the deposits which lie across it. Subsidence of the basin had been constant up to the beginning of sedimentation of the Orlacki conglomerates, and then, the uplifting phase began. Tectonics of the basin is complex, with radial and folded structures, which were mostly formed in the Rhodenian phase.

The main papers in the bibliography are listed under the numbers 1, 3 and 4.

References:

1. CICIC & MILOJEVIC 1977 2. KATZER 1918, 1921 3. MILOJEVIC 1964 4. MUFTIC 1965 5. PANTIC 1961.

**Area No. 234 b: FRESHWATER BASINS, LIVNO AND DUVNO BASINS, BOSNIA, YU**

Author: M. ATANACKOVIC

The above two basins had undergone a similar geological evolution and consequently, their series of deposits, practically, correspond to each other. The basins were formed at the end of Lower Miocene as tectonic grabens in the karst region of outer Dinarides. The deposits in these basins were being sedimented in the course of two cycles without a proved unconformity between them. The beginning of the first cycle is indicated by the lower coal-bearing series with hard lignite (Tusnica coal series), ending with layers containing tuff intercalations. The second cycle is the Pannonian–Pliocene one, with soft lignite in its upper part. The basin had been subsiding as far as to the Dacian. The tectonic structure of the basin (faulted syncline) was formed after the deposition of the upper coal-bearing series and its overlying sediments (Rhodanian phase).

The main scientific works and papers in the bibliography are those listed under No. 1, 3, 4.

References:
1. CICIC & MILOJEVIC 1977 2. KATZER 1921 3. MILOJEVIC & SUNARIC 1962 4. MILOJEVIC 1959 5. MUFTIC & LUBURIC 1963 6. PANTIC 1961.

### Area No. 234 c: FRESHWATER BASINS, GACKO BASIN, HERZEGOVINA, YU
Author: M. ATANACKOVIC

The Gacko basin is one of the youngest paleodepressions of the outer Dinarides. It had been developed at the beginning of Upper Miocene, the major part in the Mesozoic limestone–dolomite complex, its features being those of a tectonic graben. The sedimentation of basin deposits was accomplished within one cycle, with several phases of coal deposition (soft lignites). The subsiding of the basin was more distinct after the deposition of the main coal seam. The beginning of the erosion phase could be located somewhere past the Middle Pontian. The series has formed an unfaulted shallow syncline.

The three papers in the bibliography are all of equal significance.

References:
1. CICIC & MILOJEVIC 1977 2. MILOJEVIC 1966 3. MUFTIC 1964.

### Area No. 234 d: FRESHWATER BASINS, PLJEVLJA AREA, MONTENEGRO, YU
Author: M. ATANACKOVIC

Eight fresh-water basins with lacustrine deposits are comprised within the wider area of the Pljevlja town precincts (northern Montenegro), the largest of the basins being those of Pljevlja and Maoca. All these basins are of the same age, in their lacustrine phase having been integral parts of a single system of lakes. They were formed at the end of Lower Miocene by the faulting of older systems and formations, as well as by the action of erosion. The presence of soft lignite has been established in all the basins. In comparison with most of the lacustrine Neogene basins of the Dinarides, the lacustrine phase was relatively short in the abovc basins. The erosion phase began from the end of Middle Miocene. The tectonics of the basin deposits is quite simple, normally characterized by shallow synclines.

The paper listed under No. 1 in the bibliography gives a thorough study of the entire region concerned.

References:
1. ATANACKOVIC 1964 2. PETRONIJEVIC 1957 3. WEYLAND & al. 1958.

## U S S R (SU)

### Area No. 204 b: FLYSCH ZONE IN THE USSR, SU
Authors: G. D. DOSIN & A. D. GRUZMAN

In the upper egerian–eggenburgian drawnwarping and flysch sedimentation continued in the area of Krosno zone of the Ukrainian Carpathians. At the end of Krosno time common uplift of the territory began, and regressive series came in the place of sediments. This regressive series was finished with a patch of gypsums and gypseous clays. The uplift was accompanied by folding and overthrusting.

Zone N 4 (BLOW, 1969) was established in the lower part of middle-Krosno depositions due to the occurrences of *Globigerinoides quadrilobatus primordius*.

References:
1. DOSIN 1964 2. DOSIN & GRUZMAN 1977 3. SHAKIN & SANDLER 1963.

### Area No. 205 d: SUBCARPATHIAN MIOCENE FOREDEEP, SU
Authors: V. BUROV, V. GLUSCHKO & L. PISCHVANOVA

Five main sedimentation periods can be found in the miocene section. The first period is regarded as final regressive stage of paleogene sedimentation which passes into lower miocene (egerian). It is represented by Vorotyshche group – that means: Vorotyshche, Polyanice, Sloboda and Dobrotov suits. The beginning of the period is characterized with fold development in some places, local erosions and accordingly with angular unconformities. And regional sharp change of sedimentation conditions is a result of these movements. The second large period forms a complex of Stebnik and Balitschy deposits and is considerably dislocated in space according to earlier sedimentation area. Thick Nizhankovich conglomerates are situated in its base in the north-west region. Lower badenian, upper badenian and sarmatian (Volynian) cycles of sedimentation can be easily distinguished. These cycles are divided by clear breaks. Folding traces can be found before lower badenian, but the most considerable movements with fold and cover formation took place just between lower–upper

Badenian and between Volhynian and Bessarabian time.

It is necessary to name the new generalizing works from a very large cycle of publications on Praecarpathian Miocene.

References:
1. BUROV & al. 1975 2. VJALOV 1965.

**Area No. 207 b: MIOCENE OF THE PODOLIAN MASSIF, SU**

Authors: V. BUROV, V. GLUSCHKO & L. PISCHVANOVA

The first sedimentation cycle begins with marine littoral sands with *Rzehakia* lying transgressively on the rocks of different age. Regressive part of the cycle is well developed as freshwater lake deposits. Lower Badenian and upper Badenian periods are devided by sandy interbed with a mass of *Ervilia* shells and tirass gypsum. It testifies to sharp changes of paleogeographical conditions. The Sarmatian occurs transgressively and in some places cuts off Buglov beds compelety.

References:
1. VJALOV 1970 2. VJALOV & GORECKIJ 1965 3. VJALOV & al. 1977 4. KURDIN 1966 5. MASLOV & UTROBIN 1958.

**Area No. 216 a: ZAKARPATIA BASIN, SU**

Author: M. PETRASHKEVICH

1. Maximum values are given in the "Thickness" column. Practically their thickness is fluctuating within the limits:

| | | |
|---|---|---|
| Burkalo Mb | | 0 – 80 m |
| Tereshul Mb | | 0 – 100 m |
| Novoselitsa Mb | | 30 – 700 m |
| Tereblia Mb | | 80 – 750 m |
| Solotvino Mb | | 100 – 800 m |
| Teresva Mb | up to | 900 m (?) |
| Baskhev Mb | | 30 – 150 m |
| Dobrobratovo Mb | | 150 – 600 m |
| Lukovo Mb | | 25 – 450 m |
| Isa Mb | | 30 – 100 m |
| Koshelevc Mb | | 80 – 350 m |
| Ilnitsa Mb | up to | 500 m |
| Hutin Mb | | 500 m |

2. The so-called "Negrovskaya" suite (6, 5) singled out by some researchers includes different strata, but it does not have any paleontological evidences of its belonging to lower miocene (14). That is why this suite cannot be taken into account while inter-regional sedimentation correlation.

3. Fauna is not found in the Tereshul conglomerate. This conglomerate is compared with Carpathian only presumably.

4. Novoselitsa suite consists of thick series of rhyolite-dacite tuffs and tuffites (with subordinate marls, argillites and locally developed conglomerates), this series is singled out as *Candorbulina universa* JEDL. zone. Also *Novoselitsa* suite consists of weak bench of tuffs, tuffites, marls and argillites with foraminifera characteristic for zone of *Uvigerina asperula* CZJZ. and *Spiroplectammina carinata* (ORB.) This zone coincides with strata with *Pseudomussium corneum* SOW. var. *denudatum* REUSS. (12).

5. Tereblia (salt-bearing) suit includes lower clayey (50 – 250 m) and upper argillo-halogen (100 – 500 m) members.

Red algal limestone, being exposed along the Peryavitsa (12) stream, possibly corresponds to lower Tereblia member and partly even to *Uvigerina asperula* and *Spiroplectammina carinata* zone.

References:
1. BUROV & SHEREMETA 1959 2. BUROV & al. 1966 3. VENGLINSKIJ 1961 4. VENGLINSKIJ 1962 5. VENGLINSKIJ 1975 6. VJALOV & al. 1961 7. VJALOV & al. 1962 8. GORECKIJ & al. 1958 9. GRISHKEVICH 1956 10. ILNICKAJA 1960 11. ORSHINSKAJA & PETRASHKEVICH 1971 12. PETRASHKEVICH 1965 a 13. PETRASHKEVICH 1965 b 14. PETRASHKEVICH & GURIDOV 1961 17. PETRASHKEVICH & PISHVANOVA 1967 18. PISHVANOVA 1961 19. PISHVANOVA 1965 20. SHEREMETA 1966.

NOTE

In the column "References" the first underlined numbers refer to the geological development of the whole section:

Area No. 241 a, b: **1**, **2**, **5**, **6**; Area No. 243: **1**, **2**, **3**, **4**; Area No. 244: **2**, **3**; Area No. 245: **2**, **3**; Area No. 246: **2**, **3**; Area No. 247: **4**, **5**; Area No. 253: all numbers; Area No. 254: **1**, **5**, **7**, **8**; Area No. 256 a: **4**; Area No. 256 b: **5**; Area No. 257: **5**; Area No. 258: **5**; Area No. 259: **5**; Area No. 260: **4**; Area No. 261: **5**; Area No. 262: **1**; Area No. 267: **5**; Area No. 268: **4**; Area No. 269: **4**; Area No. 270: **1**, **2**, **3**, **4**, **5**; Area No. 271: **1**, **2**; Area No. 272: **2**, **5**, **6**; Area No. 273: **1**, **3**, **4**, **5**; Area No. 274: **1**, **2**, **6**; Area No. 275: **2**, **5**, **6**; Area No. 277: **2**, **7**; Area No. 278 a: **5**, **6**, **7**; Area No. 280 a, b: **3**, **7**, **13**; Area No. 281: **1**, **4**; Area No. 282: **1**, **4**; Area No. 283 a: **1**, **4**, **5**, **8**; Area No. 283 b: **1**, **3**.

**Area No. 241 a, b: MOLDAVIAN PLATFORM, SU**

Author: V. ROSHKA

References:
1. DIDKOVSKIJ 1958 2. ROSHKA 1964 3. ROSHKA 1969 4. SINEGUB 1969 5. STRATIGRAPHY OF USSR 1940 6. EBERZIN 1948.

**Area No. 242 a: DANUBIAN REGION OF THE SCYTHIAN PLATFORM, SU**

Author: V. ROSHKA

References: 1. ROSHKA 1969 2. SINEGUB 1969 3. SLJUSARJ 1961.

**Area No. 243: NEAR BLACK SEA DEPRESSION W, DANUBE-DNIESTR INTERFLUVE, SU**

Author: V. ROSHKA

References:
1. NOSOVSKY 1971 2. ROSHKA 1969 3. ROSHKA 1973 4. MACAROVICI 1939.

**Area No. 244: NEAR BLACK SEA DEPRESSION W, DNIESTR–DNIEPR INTERFLUVE, SU**
Authors: M. NOSOVSKY & V. SEMENENKO

References:
1. KULITCHENKO & NOSOVSKY 1975 a 2. MOLJAVKO 1958 3. MOLJAVKO 1960 4. SEMENENKO 1975.

**Area No. 245: NEAR BLACK SEA DEPRESSION E, SU**
Authors: M. NOSOVSKY & V. SEMENENKO

**Area No. 246: STEPPE CRIMEA, SU**
Authors: M. NOSOVSKY & V. SEMENENKO

References:
1. KULITCHENKO & NOSOVSKY 1975 a 2. MOLJAVKO 1958 3. MOLJAVKO 1960 4. SEMENENKO 1975.

**Area No. 247: KERCH PENINSULA, SU**
Authors: M. NOSOVSKY & V. M. SEMENENKO

References:
1. ZHIZHTCHENKO 1940 2. KOLESNIKOV 1940 a 3. KULITCHENKO & NOSOVSKY 1975 b 5. MOLJAVKO 1960 6. NOSOVSKY & al. 1976 7. SEMENENKO 1975 8. EBERZIN 1940.

**Area No. 248: TAMAN PENINSULA, SU**
Authors: A. BOGDANOVICH & V. BURJAK

References:
1. BURJAK 1965 2. BURJAK 1968 3. BURJAK 1969 4. ZHIZHTCHENKO 1940 5. ZHIZHTCHENKO & REZNIKOV 1968 6. ZHIZHTCHENKO & al. 1968 7. KOLESNIKOV 1940 a 8. EBERZIN 1940 9. GUBKIN & VARENCOV 1934.

**Area No. 249: W PART OF S CISCAUCASIA, SU**
Authors: A. BOGDANOVICH & V. BURJAK

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1. BURJAK 1965 2. BURJAK 1968 3. BURJAK 1969 4. ZHIZHTCHENKO 1940 5. ZHIZHTCHENKO & REZNIKOV 1968 6. ZHIZHTCHENKO & al. 1968 7. KOLESNIKOV 1940 a 8. EBERZIN 1940 9. BOGDANOVICH 1965 10. GROSSGEIM 1960.

**Area No. 250: CENTRAL PART OF S CISCAUCASIA, SU**
Authors: A. BOGDANOVICH & V. BURJAK

References:
1. VJALOV & BOGDANOVICH 1976 2. ZHIZHTCHENKO 1940 3. ZHIZHTCHENKO & REZNIKOV 1968 4. ZHIZHTCHENKO & al. 1968 5. KOLESNIKOV 1940 a 6. GROSSGEIM 1960 7. MERKLIN & al. 1964.

**Area No. 251: RIONI DEPRESSION, W GEORGIA, SU**
Author: D. BULEJSHVILI

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1. BULESHVILI 1964 2. ZHIZHTCHENKO 1940 3. KOLESNIKOV 1940 a 4. TCHELIDZE 1964 5. TCHIKOVANI 1964 6. EBERZIN 1940 7. EBERZIN 1971.

**Area No. 252: UPPER PART OF KURA DEPRESSION, E GEORGIA, SU**
Author: B. BULEJSHVILI

References:
1. BULEJSHVILI 1964 2. ZHIZHTCHENKO 1940 3. KOLESNIKOV 1940 a 4. KURCHKALIJA 1974 5. TCHELIDZE 1964 6. TCHIKOVANI 1964 7. EBERZIN 1940 8. EBERZIN 1971.

**Area No. 253: SEVAN, SHIRAK AND MIDDLE ARAKS DEPRESSIONS AND EREVAN SYNCLINORIUM, SU**
Author: A. GABRIJELJAN

References:
1. ARZUMANJAN & VEGUNI 1970 2. GABRIELJAN 1964 a 3. GABRIELJAN 1964 b.

**Area No. 254: NACHITCHEVAN DEPRESSION, SU**
Author: A. AZIZBEKOVA

References:
1. AZIZBEKOV, S. 2. AZIZBEKOVA 1966 3. AZIZBEKOVA 1968 4. AZIZBEKOVA 1970 5. AZIZBEKOVA 1972 6. AZIZBEKOVA 1974 7. ALIZADE & al. 1980 8. ALIZADE & ASADULLAJEV 1972.

**Area No. 255: E PART OF S CISCAUCASIA, SU**
Authors: A. BOGDANOVICH & V. BURJAK

References:
1. ZHIZHTCHENKO 1940 2. ZHIZHTCHENKO & REZNIKOV 1968 3. ZHIZHTCHENKO & al. 1968 4. KOLESNIKOV 1940 a 5. KOLESNIKOV 1940 b 6. PROKOPOV 1937 7. SOMOV 1963.

**Area No. 256 a: MIDDLE PART OF KURA DEPRESSION W, SU**
Authors: A. ALI-ZADE, D. AGALAROVA, J. ALESKEROV, O. RYBINA & A. VOROSHILOVA

References:
1. ALI-ZADE 1964 2. ALI-ZADE 1974 3. ALIZADE 1954 4. ALIZADE & ASADULIAJEV 1972 5. ZHIZHTCHENKO 1940 6. KOLESNIKOV 1940 a 7. KO-

LESNIKOV 1940 b 8. CHALILOV & KUZNECOVA 1964.

**Area No. 256 b: MIDDLE PART OF KURA DEPRESSION E, SU**
Authors: A. ALI-ZADE, D. AGALAROVA, J. ALESKEROV, O. RYBINA & A. VOROSHILOVA

References:
1. ALI-ZADE 1960 2. ALI-ZADE 1969 3. ALI-ZADE 1974 4. ALIZADE 1954 5. ALIZADE & ASADULLAJEV 1972 6. ZHIZHTCHENKO 1940 7. KOLESNIKOV 1940 a 8. KOLESNIKOV 1940 b.

**Area No. 257: KUSSARA–DIVICHIN SYNCLINORIUM, SU**
Authors: A. ALI-ZADE, D. AGALAROVA, J. ALESKEROV, O. RYBINA & A. VOROSHILOVA

References:
1. ALI-ZADE 1960 2. ALI-ZADE 1969 3. ALI-ZADE 1974 4. ALIZADE 1954 5. ALIZADE & ASADULLAJEV 1972 6. ZHIZHTCHENKO 1940 7. KOLESNIKOV 1940 a 8. KOLESNIKOV 1940 b.

**Area No. 258: SHEMAKHO–KOBISTAN SYNCLINORIUM, SU**
Authors: A. ALI-ZADE, D. AGALAROVA, J. ALESKEROV, O. RYBINA & A. VOROSHILOVA

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**Area No. 259: LOWER KURA DEPRESSION, SU**
Authors: A. ALI-ZADE, D. AGALAROVA, J. ALESKEROV, O. RYBINA & A. VOROSHILOVA

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1. ALI-ZADE 1960 2. ALI-ZADE 1969 3. ALI-ZADE 1974 4. ALIZADE 1954 5. ALIZADE & ASADULLAJEV 1972 6. ZHIZHTCHENKO 1940 7. KOLESNIKOV 1940 a 8. KOLESNIKOV 1940 b.

**Area No. 260: TALYSH, SU**
Authors: A. ALI-ZADE, D. AGALAROVA, J. ALESKEROV, O. RYBINA & A. VOROSHILOVA

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1. ALI-ZADE 1969 2. ALI-ZADE 1974 3. ALIZADE 1954 4. ALIZADE & ASADULLAJEV 1972 5. ZHIZHTCHENKO 1940 6. KOLESNIKOV 1940 a 7. KOLESNIKOV 1940 b 8. SULTANOV 1953.

**Area No. 261: APSHERON TROUGH, SU**
Authors: A. ALI-ZADE, D. AGALAROVA, J. ALESKEROV, O. RYBINA & A. VOROSHILOVA

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1. ALI-ZADE 1960 2. ALI-ZADE 1969 3. ALI-ZADE 1974 4. ALIZADE 1954 5. ALIZADE & ASADULLAJEV 1972 6. ZHIZHTCHENKO 1970 7. KOLESNIKOV 1940 a 8. KOLESNIKOV 1940 b 9. SULTANOV 1953.

**Area No. 262: W PART OF N CISCAUCASIA, SU**
Authors: A. BOGDANOVICH & V. BURJAK

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1. BURJAK 1965 2. ZHIZHTCHENKO 1940 3. ZHIZHTCHENKO & REZNIKOV 1968 4. ZHIZHTCHENKO & al. 1968 5. KOLESNIKOV 1940 a 6. EBERZIN 1940.

**Area No. 263: CENTRAL PART OF N CISCAUCASIA, SU**
Authors: A. BOGDANOVICH & V. BURJAK

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1. BOGDANOVICH & al. 1981 2. ZHIZHTCHENKO 1940 3. ZHIZHTCHENKO & REZNIKOV 1968 4. ZHIZHTCHENKO & al. 1968 5. KOLESNIKOV 1940 a.

**Area No. 264: E PART OF N CISCAUCASIA, SU**
Authors: A. BOGDANOVICH & V. BURJAK

References:
1. ZHIZHTCHENKO 1940 2. ZHIZHTCHENKO & REZNIKOV 1968 3. ZHIZHTCHENKO & al. 1968 4. KOLESNIKOV 1940 a 5. KOLESNIKOV 1940 b.

**Area No. 265: S PART OF UKRAJNIAN SHIELD, SU**
Authors: M. NOSOVSKY & V. SEMENENKO

References:
1. ZHIZHTCHENKO 1940 2. KOLESNIKOV 1940 a 3. DIDKOVSKY & NOSOVSKY 1975 4. MOLJAVKO 1960 5. NOSOVSKY 1971 6. NOSOVSKY 1974 7. SEMENENKO 1975 8. EBERZIN 1940.

**Area No. 266: THE DONBAS, SU**
Authors: G. MOLJAVKO, V. KULITCHENKO, E. SAVRONJ & V. ZOSIMOVITCH

References:
1. ZHIZHTCHENKO 1940 2. KOLESNIKOV 1940 a 3. SAVRONJ 1975 4. SAVRONJ & SATANOVSJKA 1975 5. EBERZIN 1940.

**Area No. 267: NE PART NEAR SEA OF AZOV AND THE LOWER DON, SU**
Author: G. RODZJANKO

References:
1. ZHIZHTCHENKO 1940 2. KOLESNIKOV 1940 a 3.

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Area No. 268: **THE MANYCHS, SU**
Author: G. RODZJANKO

References:
1. ZHIZHTCHENKO 1940 2. KOLESNIKOV 1940 a 3. NIKITINA 1958 4. RODZJANKO 1970 5. RODZJANKO 1976.

Area No. 269: **ERGENI, SU**
Author: G. RODZJANKO

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1. ZHIZHTCHENKO 1940 2. KOLESNIKOV 1940 a 3. NIKITINA 1958 4. RODZJANKO 1970 5. RODZJANKO 1972.

Area No. 270: **OKA–DON LOWLAND, SU**
Author: J. IOSSIPHOVA

References:
1. GRISHTCHENKO 1966 2. GRISHTCHENKO 1971 3. IOSSIPHOVA 1971 4. IOSSIPHOVA 1977 a 5. KRASNENKOV & AGADZHANJAN 1976 7. NIKITIN 1957 8. YAKUBOVSKAYA 1977.

Area No. 271: **VOLGA–KNOPER INTERFLUVE, SU**
Author: G. RODZJANKO

References:
1. RODZJANKO 1970 2. RODZJANKO 1976.

Area No. 272: **MIDDLE POVOLZHJE, S OF SAMARSKAYA LUKA, SU**
Authors: W. YAKHEEMOVICH & N. ZHIDOVINOV

References:
1. ZHIDOVINOV & KURLAJEV 1966 2. ZHIDOVINOV & KURLAJEV 1971 3. ZHIDOVINOV & al. 1966 4. ZHUTEYEV 1955 5. KIRSANOV 1971 6. MOSKVITIN & MOROZOV 1967.

Area No. 273: **MIDDLE POVOLZHJE, N OF SAMARSKAYA LUKA, SU**
Authors: W. YAKHEEMOVICH & G. GORETZKYI

References:
1. GORECKIJ 1964 2. KIRSANOV 1955 3. KIRSANOV 1959 4. KIRSANOV 1971 5. MOSKVITIN & MOROZOV 1967.

Area No. 274: **SOUTHERN CISURALIA, SU**
Author: W. YAKHEEMOVICH

References:
1. YACHIMOVITCH 1958 2. YACHIMOVITCH 1964 a 3. YACHIMOVITCH 1964 b 4. YACHIMOVITCH & ANDRIANOVA 1959 5. YACHIMOVITCH & al. 1965 6. YACHIMOVITCH & al. 1970 7. YACHIMOVITCH & al. 1965.

Area No. 275: **NEAR CASPIAN SEA LOWLAND W, SU**
Authors: N. ZHIDOVINOV & I. BERTELJC-USPENSKAJA

References:
1. ZHIDOVINOV & KURLAYEV 1966 2. ZHIDOVINOV & KURLAYEV 1971 3. ZHIDOVINOV & al. 1966 4. ZHUTEYEV 1965 5. KIRSANOV 1971 6. MOSKVITIN & MOROZOV 1967.

Area No. 276: **NEAR CASPIAN SEA LOWLAND E, SU**
Author: I. BERTELJC-USPENSKAJA

References:
1. BERTELJC-USPENSKAJA 1964 2. BERTELJC-USPENSKAJA 1971 3. VASILJEV & al. 1970 4. VOLTCHEGIRSKIJ & ZHURAVLJEV 1970 5. FEDOROV 1970.

Area No. 277: **MANGYSHLAK, SU**
Author: Y. TCHELJCOV

References:
1. VOLTCHEGIRSKIJ 1970 2. ILJINA & UTKIN 1963 3. ZHIZHTCHENKO 1940 4. KLEYNER & TCHELJCOV 1970 5. KOLESNIKOV 1940 a 6. KOLESNIKOV 1940 b 7. LIVEROVSKAYA 1960 8. MERKLIN & al. 1960 9. TCHELJCOV 1970 10. TCHELJCOV & SALJMAN 1962.

Area No. 278 a: **SOUTHERN USTJURT, SU**
Author: Y. TCHELJCOV

References:
1. GARECKIJ & PLESHTCHEYEV 1970 2. ZHIZHTCHENKO 1940 3. KLEYNER 1970 4. KOLESNIKOV 1940 a 5. KRAVTCHENKO & al. 1964 6. TCHELJCOV & al. 1967 7. EBERZIN 1960.

Area No. 278 b: **NORTHERN USTJURT, SU**
Author: Y. TCHELJCOV & S. HONDKARIAN

References:
1. GARECKIJ & al. 1958 2. GARECKIJ & PLESHTCHEYEV 1970 3. GARECKIJ & al. 1972 4. ZHIZHTCHENKO 1940 5. KIRJUZHIN & PLESHTCHEYEV 1964 6. KLEYNER 1970 7. KOLESNIKOV 1940 a 8. RAZMYSLOVA 1962 9. STAROSTIN 1962.

Area No. 279: **AREA NE OF THE ARAL SEA, SU**
Author: S. HONDKARIAN

References:
1. BRONEVOY & GARECKIJ 1970 2. GARECKIJ & al. 1972 3. ZHIZHTCHENKO 1940.

**Area No. 280: W TURKMENISTAN, SU**
Authors: T. ROZYJEVA & Y. TCHELJCOV

References:
1. ALI-ZADE 1961 2. ALI-ZADE 1967 3. GEOLOGY OF USSR 1972 4. ZHIZHTCHENKO 1940 5. KOLESNIKOV 1940 a 6. KOLESNIKOV 1940 b 7. ROZYJEVA 1971 8. ROZYJEVA & LAPTEVA 1973 9. ROZYJEVA & UZAKOV 1962 10. ROZYJEVA & UZAKOV 1965 11. SUKATCHEVA & al. 1961 12. SYRNEV & al. 1964 13. EBERZIN 1960.

**Area No. 281: AREA S OF THE ARAL SEA, SU**
Authors: I. BELENJKAYA & F. KORSAKOV

References:
1. ALFEROV & al. 2. BELENJKAYA 1976 3. GRAMM 1958 4. KORSAKOV 1976.

**Area No. 282: CENTRAL KIZIL–KUM, SU**
Author: I. BELENJKAYA

References:
1. ALFEROV & al. 2. BELENJKAYA 1976 3. GRAMM 1960 4. KORSAKOV 1976.

**Area No. 283 a: E TURKMENISTAN, N PART, SU**
Author: T. ROZYJEVA

References:
1. GEOLOGY OF USSR 1972 2. IVANOVA 1965 3. IVANOVA & al. 1961 4. KUZJMINA & al. 1970 5. ROZYJEVA 1976 6. ROZYJEVA & LAPTEVA 1973 7. SUDO 1970 8. EBERZIN 1960.

**Area No. 283 b: E TURKMENISTAN, S PART, SU**
Author: T. ROZYJEVA

References:
1. GEOLOGY OF USSR 1972 2. IVANOVA 1965 3. ROZYJEVA 1976 4. ROZYJEVA & LAPTEVA 1973 5. SUDO 1970.

## JORDAN (HKJ) AND SYRIA (SYR)

**Area No. 350, 351, 151: NEOGENE DEPOSITS IN EAST JORDAN AND SYRIA**
Author: S.H. BASHA

The Neogene Period in East Jordan is classified as follows: Recent, Pleistocene, Pliocene, and Miocene Epochs; whereas the Paleogene is classified into Oligocene, Eocene, and Paleocene Epochs.

Consequently, the Oligocene and the Neogene sediments of East Jordan are found either outcropping in limitted areas as in case of Oligocene sediments in the Shaghor and the Wadi Tayyiba sites along the eastern side of the Jordan valley highs or extensively filling low geological features such as the Jordan valley, the Jafr basin, the Azraq Oasis and the Dhahkiyya area. In addition, huge quantities of basalts were flowed out from fractures and cones which resulted from the formation of the Great Rift, and filled – covered low areas and partly intruded in the Neogene sediments. The limits of basalt extension mainly depended on its viscosity and on the configuration of the land. The age of the basalt is ranging from Miocene to Pleistocene (BOOM & SUWAN, 1966), (Fig. 1).

The author has studied the sequences cropping out in the Wadi Tayyiba, the Shaghor, the Shuna, the Lisan marls, Gharandal, the Safi well, and the raised beaches along the eastern side of the Aqaba Gulf. The result of this study is as follows:

1. Wadi Tayyiba section:
   It is illustrated in Are No. 350.
2. Shagor section:
   The sequence is composed of well cemented fresh water carbonates and travertine, of about 50 m thickness. The age is estimated as Upper Pliocene to Lower Pleistocene because no index fossils were recorded.

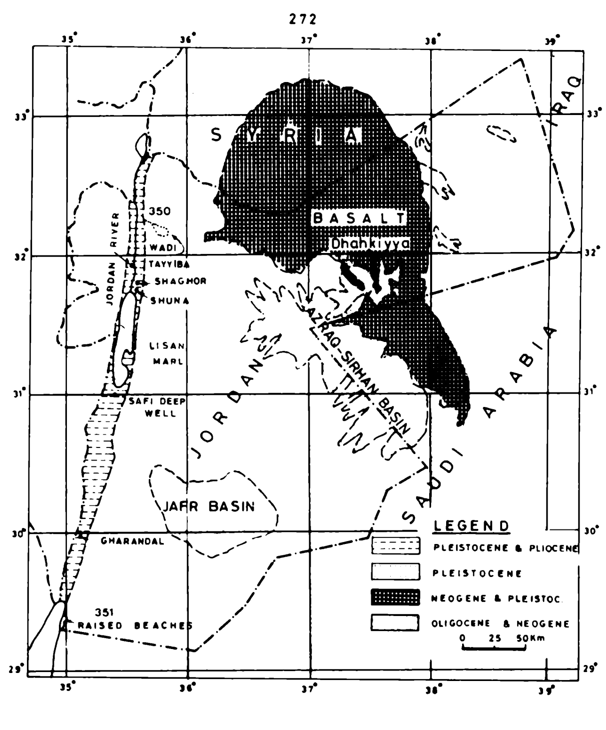



Fig 1 : Locations of Neogene Deposits in Jordan (Basha 1978)

3. **Shuna section:**

The section is composed of glauconitic sandy limestones. The age is estimated Oligocene.

4. **Lisan Marls:**

The Lisan Marls are composed of thick plastic clays at the bottom, followed by alternating sequence of grey and white varved bedded marls, carbonates, and gypsum with native sulpher at certain levels. This sequence was deposited in a brackish to fresh water environments. The age is estimated Upper Pleistocene to Recent.

Fauna: Only fresh to brackish water ostracoeds are found in certain levels of the studied section.

5. **Safi deep well:**

The sequence from ground level up to about 2000 m depth is composed of gravels, alternating with detritus materials, fine sands, plastic clays of alluvial fan and of river origin. No exact age was given for such thick deposits, but it is considered syntectonical to the Great Rift formation from Miocene to Recent.

6. **Gharandal section:**

The studied section is composed of 60 m of alternating marls, coarse conglomerates and gypsum vains. The age is estimated to range from Pliocene to Recent.

7. **Aqaba raised beaches:**

The raised beaches of the eastern side of the Aqaba Gulf are recently reported by the writer. They are composed of coral reef deposits, re-crystalline dolomites in parts aragonitic, and intermixed with detritus materials. This type of rock implies that the reef first deposited in a subtidal environment while later supratidal conditions prevailed.

F a u n a : Similar living foraminifer, ostracoda, and pelecypodes of recent reefs in sub-tropical seas are found as fossils in such beaches such as the following: *Biloculina* spp., *Textularia* spp., *Elphidium* spp., *Peneroplis* spp., and *Quadracythere* sp., *Neonesides* sp., with Gastropods and Lamillibranchs remains (Area No. 351). A Pliocene to Pleistocene age is suggested for such sediments.

8. **Azraq Oasis:**

Sediments of brackish water origin had been penetrated after the syntectonical deposits. This is evidenced by the occurrence of certain ostracodes of the type: *Erpetocypris* sp., *Xestoleberis* sp., and *Cypria* sp. which usually occur in fresh to oligohyaline water environments.

## Neogene deposits of Syria

The Neogene in Syria is classified into the following periods:

| | | |
|---|---|---|
| Top: | Holocene | Recent |
| | Pleistocene | Basalt |
| | Pliocene | Bakhtiari (Upper Fars). |
| | Miocene | Middle and Lower Fars. |
| Bottom: | Oligocene | Midyat (Upper). |

However, Fig. 2 partly shows the general locations of the Neogene deposits in Syria, while Area No. 151 describes the lithological sequences.

References:
1. BENDER 1968 2. VAN DEN BOOM & SUWAN 1966.

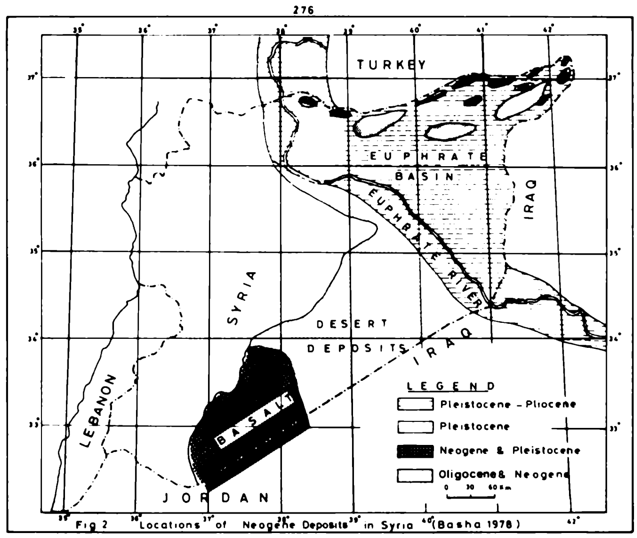



Fig 2 Locations of Neogene Deposits in Syria (Basha 1978)

# I R A Q (IRQ)

Area No. 353-355: **MESOPOTAMIAN-, GULF- AND NE IRAQ BASIN, IRQ**
Authors: I. CICHA & J. PRAZAK

References:
1. AL OMARI & AL SADIQ 1972 2. AL SADIQ 1972 3. BOLTON 1954 4. BUDAY 1973 5. CICHA & al. 1978 6. JAMES & WYND 1965 7. LEXIQUE STRAT. 8. PRAZAK 1976.

# I R A N (IR)

Area No. 356–361: **IRAN, IR**
Author: M. R. CHAHIDA

References No. 1: QUM BASIN, CENTRAL IRAN
ABEDINI 1963–64, BIDDULPH 1891, BLYNFORD 1872, BOBEK 1959, BOZORGNIA 1966, BOZORGNIA & BANAFTI 1964, CHAHIDA & al. 1977, CHAHIDA & PAPP 1977, DIETRICH 1918, FELIZ 1910, FUCHS 1879, FURON 1931, FURON 1936, FURON 1937 a, FURON 1937 b, FURON 1937 c, FURON 1941, FURON & BALAVOINE 1959, FURON & MARIE 1939, FURRER & SODER 1955, GANSSER 1955, GANSSER 1957,

GREWINGK 1881, HEIM 1957, KUEHN 1931, KUEHN 1933, MECQUENEM DE 1908, MECQUENEM DE 1911, MECQUENEM DE 1924, MOSTOFI & GANSSER 1957, NIEDERMAYER VON 1920, NUTTALL 1926, POHLIG 1884, POHLIG 1885, POHLIG 1886 a, POHLIG 1886 b, RIEBEN 1930, RIEBEN 1934, RIEBEN 1942, RIEBEN 1955, RODLER 1885, RODLER & WEITHOFER 1890, STAHL VON 1897, STAHL VON 1907, STAHL VON 1909, THIELE & al. 1968.

References No. 2: PENTACASPIAN AND GORGON–RASHT BASIN, IR
BOZORGNIA & BANAFTI 1964, BELL 1840, BOBEK 1936, BOBEK 1937, FARIDI 1964, FORTESCUE . . . 1924, FORTESCUE . . . 1925, FRASER 1826, GINTL 1876, LIBROVICH 1921, LODOTCHONIKOW 1927, MOSTOFI & PARAN 1964, RAUPACH VON 1952, RODLER 1889, SCHENK 1938, STAHL VON 1933, THOMPSON 1938, THIETZE 1881, ZUBER 1934.

References No. 3: CENTRAL ALBOURZ, IR
ALENBACH 1966, ASSERTO 1965, ASSERTO 1966, BASSIR 1971, BAILEY 1952, BAILEY & al. 1948, DEDUAL 1967, FELLENBACH 1964, GANSSER & HUBER 1962, GLAUS 1965, LORENZ 1964, MEYER 1967, RIVIERE 1930, RIVIERE 1931 a, RIVIERE 1931 b, RIVIERE 1931 c, RIVIERE 1931 d, STEIGER 1966, THIETZE 1881.

References No. 4: FARS GROUP, ZAGROS, IR
DOUGLAS 1927 a, DOUGLAS 1927 b, DOUGLAS 1928, PILGRIM 1924.

References No. 5: ZAGROS IN GENERAL, IR
ANDERSEN 1962, ANON. 1918, ANON. 1937, BAKER & HENSON 1952, BECKE 1835, BELL 1840, BENT 1890, BOBEK 1934, BOBEK 1937, Brit. Petr. Comp. 1956 a, Brit. Petr. Comp. 1956 b, BUSK 1926, BUSK 1940, BUSK & MAYO 1918–19, COX 1936, CURRIE 1921, FURON 1938, GOLDSMID 1873, HEIM 1956, JAMES & WYND 1965, KENT & al. 1951, KREJCI 1927, KRINER-FISCHER 1934, LAW 1957, LEES 1927, LEES 1933 a, LEES 1933 b, LEES 1938, LEES 1950, LEES & RICHARDSON 1940, MINA & al. 1967, MORTON 1959, PILGRIM 1908, RICHARDSON 1924, SAINT-YVES 1927, SLINGER & CRICHTON 1959, STIFTE 1874, STIFTE 1898, THOMAS 1950, THOMAS 1952.

## PAKISTAN (PAK)

### Area No. 362: BALUCHISTAN BASIN, PAK
Author: A. A. KURESHY

The Baluchistan basin extends from 66°E longitude to its border to Iran in the west. The Neogene deposits are characterized by transgression and thick sequence of marine strata was deposited. These deposits are severely effected by Himalayan orogeny in the form of faults and folds. The biostratigraphic zones of these deposits were established on the basis of the planktonic foraminifera, which are quite common in occurrence (KURESHY 1977), and Miocene–Pliocene boundary is also marked on the basis of the planktonic foraminifera (KURESHY 1980).

No radiometric or geomagnetic time scale is determined of these deposits although many good igneous intrusions are characteristic of the Neogene sequence. The geology of the area was described by HUNTING (1960) and SHAH (1977), and depositional history of the basin is discussed by KURESHY (1972).

References:
1. HUNTING SURVEY CORPORATION 1960 2. KURESHY 1972 a 3. KURESHY 1972 b 4. KURESHY 1977 5. KURESHY 1980 6. SHAH 1977.

### Area No. 363: LOWER INDUS BASIN, PAK
Author: A. A. KURESHY

The Lower Indus Basin extends from south of 32° latitude to its border to Baluchistan basin in the west and Indian shield to the east. The Neogene geology of the basin is characterized by marine as well as nonmarine deposits. Marine deposits are confined to the Lower Miocene, which marked the last phase of transgression in the region, and from Middle Miocene to Pleistocene deposits are nonmarine. The stratigraphy and the fauna was described by BLANFORD (1876), SHAH (1977), and foraminifera fauna was described by KURESHY (1970 and 1978).

The Lower Miocene deposits are designated as Gaj Formation belonging to Momani Gr. and characterized by larger and planktonic foraminifera. The nonmarine deposits belong to Siwalik Group, which are characterized by mammalian fossils, which were described by PILGRIM (1910).

References:
1. BLANFORD 1876 2. KURESHY 1970 3. KURESHY 1978 4. PILGRIM 1910 5. SHAH 1977.

### Area No. 364: UPPER INDUS BASIN, PAK
Author: A. A. KURESHY

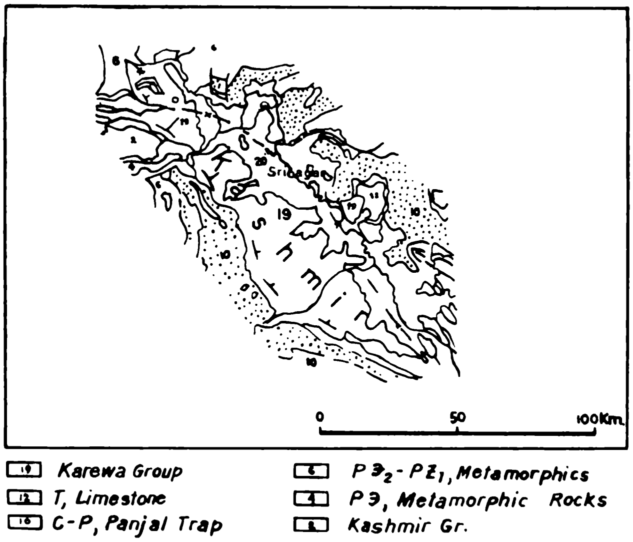
The basin lies north of 32° latitude in the northern part of the country. No marine deposit of Neogene age is exposed in the Upper Indus Basin. Nonmarine deposits are extensively exposed, which are designated to Rawalpindi and Siwalik Groups, and characterized by mammalian fauna. The geology of the basin is described by MIDDLEMISS (1890) and recently by CHEEMA & al. (in SHAH 1977). No radiometric age determination is made, recently magnetic polarity with reference to vertebrate fauna is determined by OPDYKE & al. (1979) and geology and paleontology is described by PILBEAM & al (1977).

The Rawalpindi and Siwalik deposits are of great thickness, composed of detrital material of various dimension. The lithological boundaries are not conspicuous, rather mammalian fauna constitute the chief criteria of age determination and correlation of the strata. These deposits are severely effected by the Himalayan orogeny, which resulted in the development of folds and faults.

References:
1. MIDDLEMISS 1890 2. OPDYKE & al. 1979 3. PILBEAM & al. 1977 4. SHAH 1977.

## INDIA (IND)

Geological map showing Karewa Group (GANSSER, 1964)




Area No. 365: KAREWA GROUP, KASHMIR, IND
Author: D. RAY

In the Indian part of the Tethyan Himalaya, a part of the Neogene Paratethyan sediment is represented by the Karewa Group of Kashmir (Figure 1). LYDEKKER (1978) is credited with the first formal use of the term 'Karewah'. The last letter 'h' of the term has been subsequently dropped in keeping with the phonetic usage. There exists some controversy regarding age of the lower boundary of the Karewa Group. The entire Karewa Group has for long been considered of Pleistocene Epoch but from the review of the recent work, the lower part of the Lower Karewa Formation can be considered to be of Pliocene Epoch. GANSSER (1964) considered the basal 300 m of the Lower Karewa Formation as a separate unit naming it Pre-Karewas of Pleistocene to Pliocene Epoch. From the work of WADIA (1948), BHATT (1975), ROY (1975) and BHATT and CHATTERJEE (1976) this 300 m section has been included within the Lower Karewa Formation.

In the column "Reference" the first five underlined numbers (1, 2, 4, 9 and 12) refer to the geology of the whole area.

References:
1. BHATT 1975 2. BHATT & CHATTERJEE 1976 3. DE TERRA & PATTERSON 1939 4. GANSSER 1964 5. IYENGER & SUBRAMANYAN 1943 6. LYDEKKER 1878 7. NAIR 1960 8. RAO & AWASTHI 1962 9. ROY 1975 10. TRIPATHI & CHANDRA 1962 a 11. VISHNU MITTRE 1964 12. WADIA 1948 13. WODEHOUSE & DE TERRA 1935.

## BLACK SEA

Area No. 366: BLACK SEA BASIN (DSDP SITES 380, 381)
Author: F. F. STEININGER

The stratigraphic correlation of DSDP-Sites 380 and 381 by HSÜ (1978 a, b) was lately revised by KOJUMDGIEVA (1979). These new results also contradict the "Messinian" desiccation phase postulated by HSÜ (1978 c). New paleogeographic interpretations based on this revised stratigraphy have been published lately (KOJUMDGIEVA 1983: RÖGL & STEININGER, 1983).

References:
1. KOJUMDGIEVA 1979 2. JOUSE & MUKHINA 1978 3. HSÜ 1978 a 4. HSÜ 1978 b 5. HSÜ 1978 c 6. KOJUMDGIEVA 1983 7. STEININGER & PAPP 1979 8. RÖGL & STEININGER 1983.

# III. SEDIMENT DISTRIBUTION MAPS FOR SELECTED TIME INTERVALS THROUGH THE NEOGENE

Figures 1–8, Maps 2–10 (see book-pocket)

Fritz F. STEININGER*, Fred RÖGL** and Lydia A. NEVESSKAJA***

## Introdution

We are especially grateful to J. Senes, who initiated a first version of these sediment distribution maps presented at the RCMNS-Congress in Athens, 1979 and the final publication of these maps in this edition. The task of these maps is to demonstrate one aspect of the potential value of the correlation tables as a tool in the scientific and industrial research of the Mediterranean Neogene.

The general idea of constructing sediment distribution maps in form of time slices has been to present the overall paleogeographic evolution of the circum-Mediterranean Neogene. For this purpose 9 crucial time intervals were selected; their position within the Neogene Stage Concepts is given in Figure 1. The scale of the maps as well as the arbitrary basin configuration allow only for a rough draught of the facies distributions. Therefore a distinction was made into five depositional environments only: marine, reduced marine, evaporitic, endemic Paratethys, and continental environments. Uncoloured areas are void of Neogene sediments in the respective time span or information was missing for that particular area.

The sediment distribution within the different Neogene basins was reconstructed area by area from the "Correlation Tables" published in this edition and completed using different sources mentioned in the text below. The maps contain neither information on the tectonic situation of the sediments nor on the tectonic evolution of the basins.

One of the major difficulties in the maps was the graphical illustration of facies changes in time and space. The rapid alternations of marine and evaporitic deposits in the Middle East for instance (map nos. 3–8), the alternations of reduced marine and continental, or evaporitic; endemic Paratethys and continental deposits in the Eastern Paratethys (maps nos.: 4, 6, 7, 8, 10) are therefore shown by parallel strips of the facies concerned.

In general the stratigraphic correlation of the areas corresponds to the correlation tables. In some cases corrections have been necessary due to modification of the first version of the tables of 1978 (see chapter I). In some other areas it was necessary to deviate from the stratigraphic opinion of the authors because of larger discrepancies to the adjacent areas of a basin. The correlation of the different Stage Concepts used is given in Fig. 1; the correlation problems themselves are discussed in chapter I.

## Acknowledgements

The construction of sediment distribution maps would not have been possible without the work of the authors of the correlation tables and the contributors to IGCP-Project No. 25 "Stratigraphic Correlation Tethys – Paratethys Neogene". We are grateful to all of them for the use of their published results.

For valuable discussions on stratigraphic and regional problems, as well as for providing literature and unpublished information we thank personally our colleagues T. Baldi, W. A. Berggren, P. Ctyroky, R. Gelati, E. Kojumdgieva, D. Leflef and P. Stevanovic.

## Regional explanations

In addition to the correlation tables it was necessary to consult regional publications for extent, facies development and stratigraphical range of various formations.

### Eastern Mediterranean:

Libya (Area No. 88): the Jeffara trough was completed after MEGERISI & MAMGAIN (1979).
Egypt completed after EL HEINY (1982).
Albania (Area No. 33 a): completed after SHEHU & al. (1981).
Greece (northern Greece Area No. 39–41): completed according to KARISTINEOS (1984). Figure 2 to 6 according to a written communication of N. KARISTINEOS:
Fig. 2: Area No. 39: Thessaloniki Chalkidiki Marginal Basin: only the Pleistocene is represented by marine sediments. The thickness of sediments in the basin exceeds 4000 meters.
Fig. 3: Area No. 40: Strimon Basin: according to deep bore holes the sediment thickness exceeds 3600 meters.
Figs. 4–6: Area No. 41: Thracian Marginal Basin: sediment thickness ranges up to 4000 meters.
Turkey: (Area No. 66): correlation and sediment distribution according to BIZON & al. (1974).

### Middle East:

Different opinions are published on the stratigraphic ranges and extent of the various formations. The stratigraphy used for these maps was adopted mainly according to BUDAY & TYRACEK (1980). The regional distribution of the Miocene formations in the Persian Gulf area was corrected according to STÖCKLIN (1968).

### Western Paratethys:

Western Germany: Area No. 290 a, b: Rheingraben: ac-

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*** Institute for Paleontology AN SSSR, Profsojuznaja 113, GSP-7 Moscow, 117485 USSR.

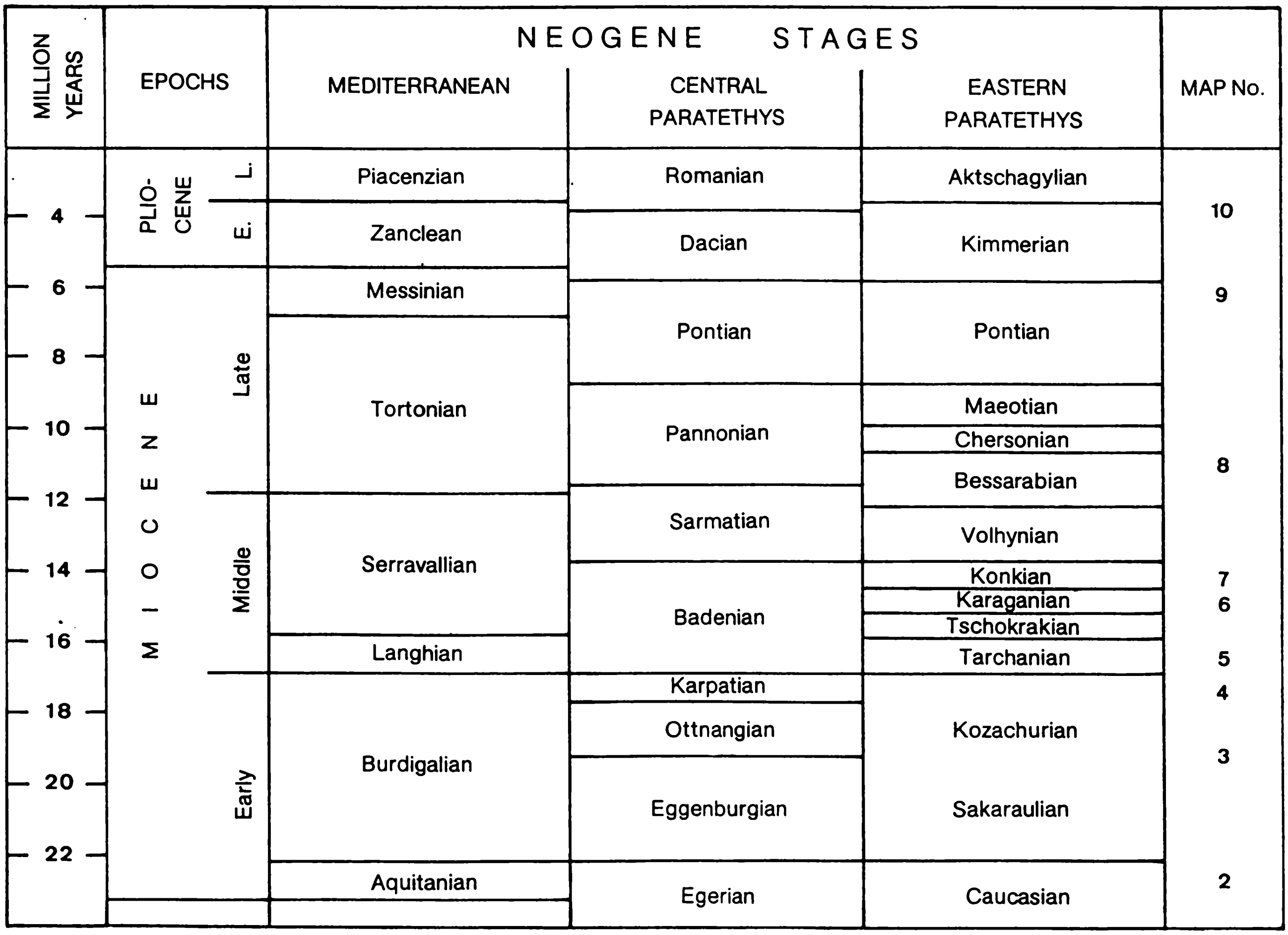


Figure 1: Correlation of Mediterranean and Paratethys Neogene Stages. Map numbers 2 10 indicate the stratigraphic position of the time shown on the sediment distribution maps.

cording to MARTINI (1981) the Hydrobia-beds are correlated with the late Eggenburgian/early Ottnangian.
Area No. 290 c: Mainz Basin: the "Dinotherium-Sande" are miscorrelated and belong to the Late Miocene.
Western Switzerland: Area No. 200 c1 and 201 c1: the correlation tables given in volume 2, p. 336 and p. 339 have been corrected by M. WEIDMANN and are given in this article under Fig. 7 and Fig. 8.
Western Austria: Area No. 200 b: this correlation table combines the formations of the autochthonous (201 b) and the allochthonous (200 b) Molasse-zone.

**Central Paratethys:**
Hungary: the sediment distribution, especially in Area No. 220, is given after JAMBOR (1981).

**Eastern Paratethys:**
Area No. 263: Central Part of N Ciscaucasia: erroneously the sign for a gap in the lithostratigraphy column of the correlation table is given in the Tarchanian.
Area No. 366: Black Sea Basin: according to KOJUMDGIEVA (1979, 1983) the stratigraphic correlation of DSDP (HSÜ, 1978) has been corrected and both versions are given in the correlation tables.

## Remarks on sediment districution maps

In the following remarks we discuss only those areas changed against the interpretation given in the relevant "Correlation Table", i. e. where greater discrepancies in facies interpretation with respect to the surrounding areas exist. The basis for these changes have been publications with a more relevant facies-interpretation for the area under discussion in comparison to the surrounding areas. In cases where such information was not available the interpretation of the "Correlation Table" is shown.

## MAP 2 :

**Aquitanian – Late Egerian – Late Caucasian (24–22 M.Y.)**

Area No. 48: **RHODOS**: according to BÜTTNER & KOWALCZYK (1978) marine Aquitanian exists in Rhodos, which is not shown on the Correlation Table (vol. 2, p. 122).

Area No. 84 and 85: **CYRENAIQUE PLATFORM** and Augila depression, Libya: a marine connection existed south of the continental part of the platform according to MEGERISI & MAMGAIN (1979) (see maps 2 to 5).

**Area No. 138: ADRIATIC–IONIAN BASIN:** according to BISTRICIC and JENKO (1978) a marine sedimentation prevailed in this basin until the Serravallian (see maps 2 to 7).

**Area No. 210: SOUTH SLOVAKIAN DANUBE BASIN:** marine Aquitanian is shown on the paleogeographical maps of GASPARIK (1979).

**Area No. 353: MESOPOTAMIAN BASIN, 354: PERSIAN GULF BASIN, 356: QUM BASIN, CENTRAL IRAN, 359–361: ZAGROS BASIN:** the distribution of the Late Oligocene and Early Miocene in this area is given according to STÖCKLIN (1968, p. 175, fig. 5) (see maps 2 to 4).

MAP 3 :

**Middle Burdigalian – Late Eggenburgian – Late Sakaraulian (20 – 18 M.Y.).**

**Area No. 44: ATTICA–EUBÖA–LAMIA:** continental deposits at Aliveri (Euböa) have been dated as Early Miocene (DE BRUIJN & al., 1980).

**Area No. 204 a: SUBCARPATHIAN FLYSCH ZONE:** Poland: NEY & al. (1974) show an intercalation of the "Grey gipsum Formaion" with marine sediments.

**Area No. 204: SUBCARPATHIAN FLYSCH ZONE, 205 and 206: SUBCARPATHIAN FOREDEEP:** Poland – USSR – Rumania: because of paleogeographic reasons the "Grey gipsum Formation" was correlated in general to Late Eggenburgian/Ottnangian (see also the correlation given for Area No. 205 d – vol. 2, p. 467).

**Area No. 211: NITRA AND VAH VALLEY BASINS, CSSR:** a marine sedimentation is shown according to GASPARIK (1979).

MAP 4 :

**Late Burdigalian – Karpatian – Kozachurian (17,5 – 16,5 M.Y.).**

**Area No. 204: SUBCARPATHIAN FLYSCH ZONE, 205: SUBCARPATHIAN FOREDEEP:** Poland – USSR Rumania: according to Correlation Table 204 b (vol. 2, p. 466) and 205 d (vol. 2, p. 467) no sedimentation occurred in Karpatian time; similar gaps are reported from the neighboring areas and therefore correlated by us within this time slice. The marine transgression in the Rumanian part of the Carpathian arc starts in the Middle Miocene with *Praeorbulina glomerosa* (VOICU, 1984).

MAP 5 :

**Langhian – Early Badenian – Tarchanian (16,5 – 15,5 M.Y)**

**Eastern Paratethys:** the correlation of the Tarchanian is still an open problem (see NEVESSKAJA & al. 1984 and RÖGL & STEININGER 1983). According to NEVESSKAJA & al. (1984) the Tarchanian correlates with the Karpatian and therefore the reduced marine environments of the Kozachurian shown on map 4 would have to be replaced by generally marine environments. The marine facies shown on map 5 would then represent the marine Tshokrakian, correlated to the Early Badenian by NEVESSKAJA & al. (1984).

**Area No. 215: EAST SLOVAKIAN BASIN:** a marine connection existed according to GASPARIK (1979) towards the Carpathian Foredeep in Poland.

**Area No. 227 e: WEST SERBIA:** a reduced marine facies is shown for this area by KRSTIC (1980).

MAP 6 :

**Early Serravallian – Middle Badenian – Karganian (15,0 – 14,5 M.Y.).**

**Central Paratethys:** out of the Middle Badenian the evaporite horizons are shown in this time slice.

**Eastern Paratethys:** within the Karaganian the Spaniodontella- and Barnea-beds represent a time–equivalent to the reduced salinity facies.

**Middle East:** within this time slice a correlation to the Middle Miocene part of the "Lower Fars Formation" is given.

The evaporite basin existing in the Persian Gulf and the marine sedimentation to the North and within the Zagros Basin are taken from BUDAY & TYRACEK (1980).

**Area No. 213 a: SOUTH SLOVAKIAN IPEL BASIN:** in contrast to the Correlation Table (vol. 2, p. 372) GASPARIK (1979) does not show marine sedimentation in this area (see maps 6, 7).

MAP 7 :

**Middle Serravallian – Late Badenian – Konkian (14,5 – 13,5 M.Y.).**

**Central Paratethys:** out of the Late Badenian the marine highstand with pteropod and radiolaria beds is shown in this time slice.

**Area No. 70: ERZURUM KARAYAZI, TURKEY:** according to GELATI (1975) time–equivalent marine *Globigerina* marls are described from the lake Van area.

MAP 8 :

**Late Serravallian – Early Pannonian – Late Bessarabian (12 – 11 M.Y.).**

**Eastern Paratethys:** for this bioprovince the facies distribution in Late Bessarabian/Early Chersonian is documented.

**Area No. 44: ATTICA – EUBÖA – LAMIA:** in the Lamia basin endemic sedimentation with melanopsids dated by micromammals to MN-10 (DE BRUIJN, 1976) prevailed.

**Area No. 366: BLACK SEA BASIN:** the stratigraphy of DSDP-Site 380 was revised by KOJUMDGIEVA (1979, 1983) (see maps 8–10).

**MAP 9 :**

**Early Messinian – Late Pontian (6,5 – 6,0 M.Y.).**

**Eastern Paratethys:** for this time slice the endemic facies of the Novorossian horizon which continues into the Dacian basin and connects across Serbia (Iron Gate) with the Pontian in the Pannonian basin was chosen.

**Area No. 54: IZMIR – URLA:** evaporitic sediments are cited from this area by MEULENKAMP (1977).

**Area No. 138: ADRIATIC – IONIAN BASIN:** evaporites are deposited in the central Adriatic basin (KRSTIC, 1980).

**Area No. 359–361: ZAGROS BASIN:** because of the difficult correlation of the Bakhtyari formation no sediments are displayed in this area.

**MAP 10 :**

**Piacenzian – Rumanian – Akchagylian (3,5 – 2,5 M.Y.).**

Northern Africa (Morocco, Algeria, Tunisia): during the Zanclean wide parts of these areas remained under marine sedimentation. Only since Piacenzian-time has continental deposition developed.

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Fig. 2: Area No. 39: THESSALONIKI CHALKIDIKI MARGINAL BASIN, GR

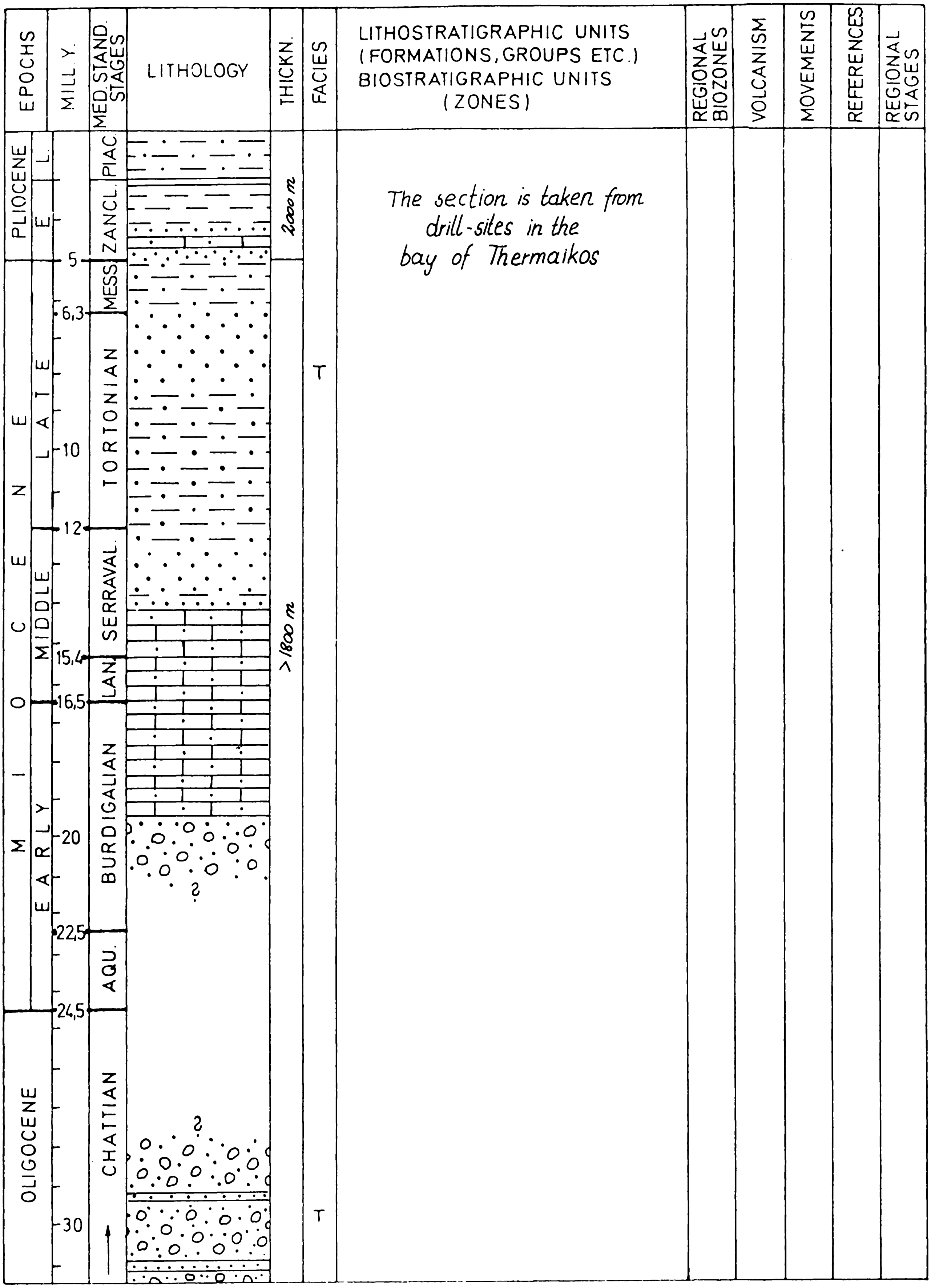


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Fig. 3: Area No. 40: STRIMON BASIN, GR

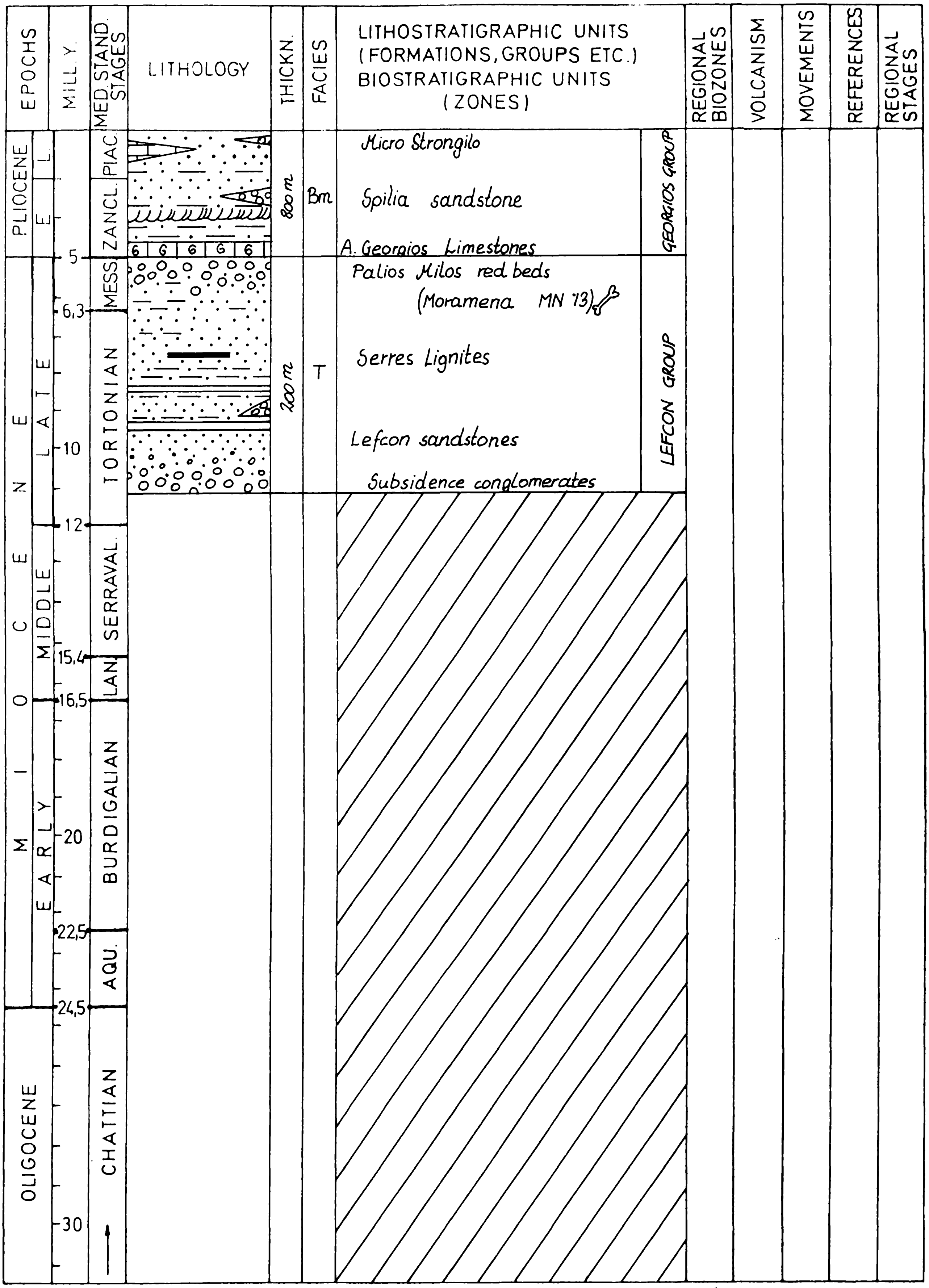


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Fig. 4: Area No. 41: THRACIAN MARGINAL BASIN, NESTOS RIVER DELTA, GR

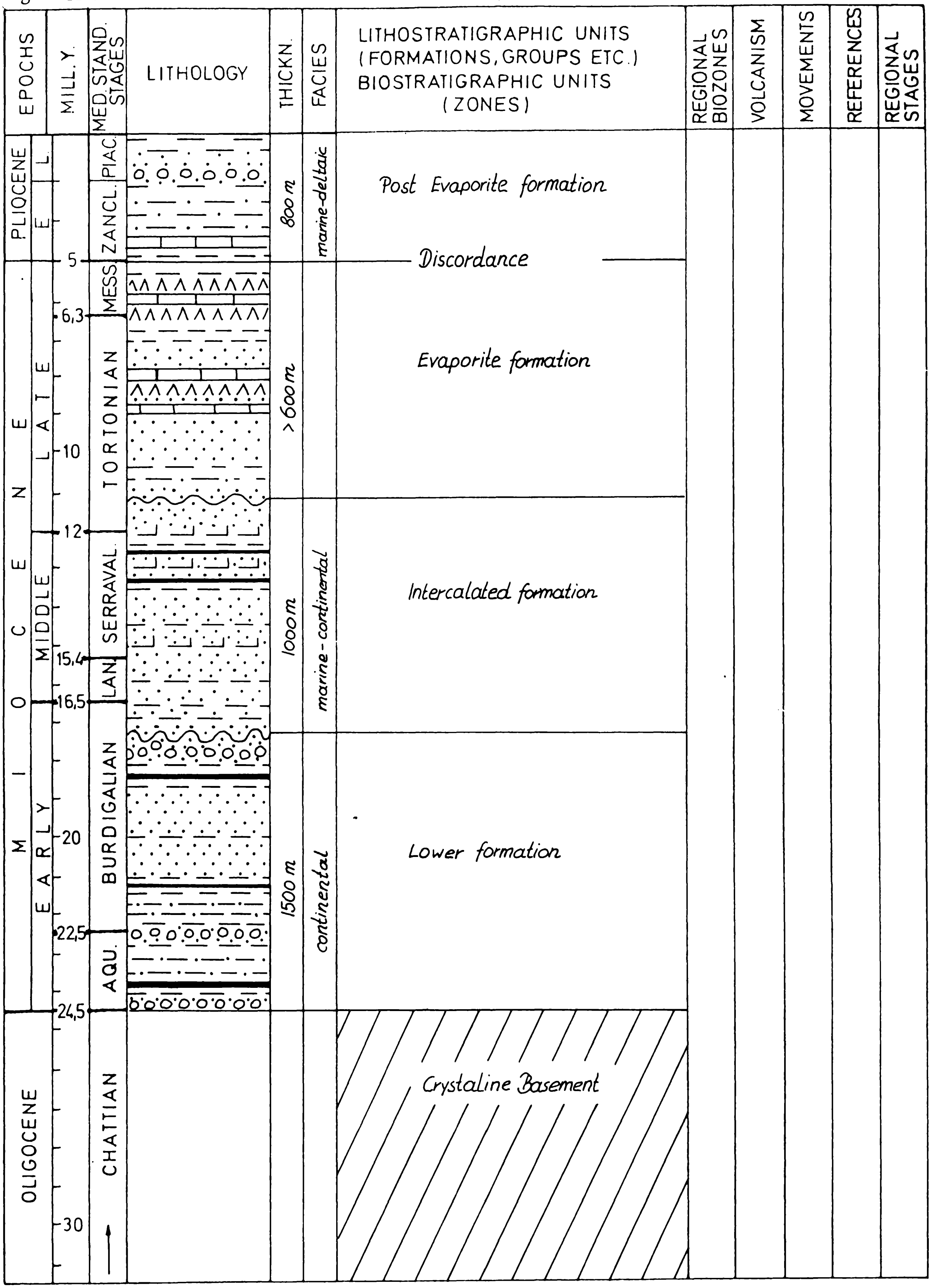


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Fig. 5: Area No. 41: THRACIAN MARGINAL BASIN, XANTHI -KOMOTINI AREA, GR

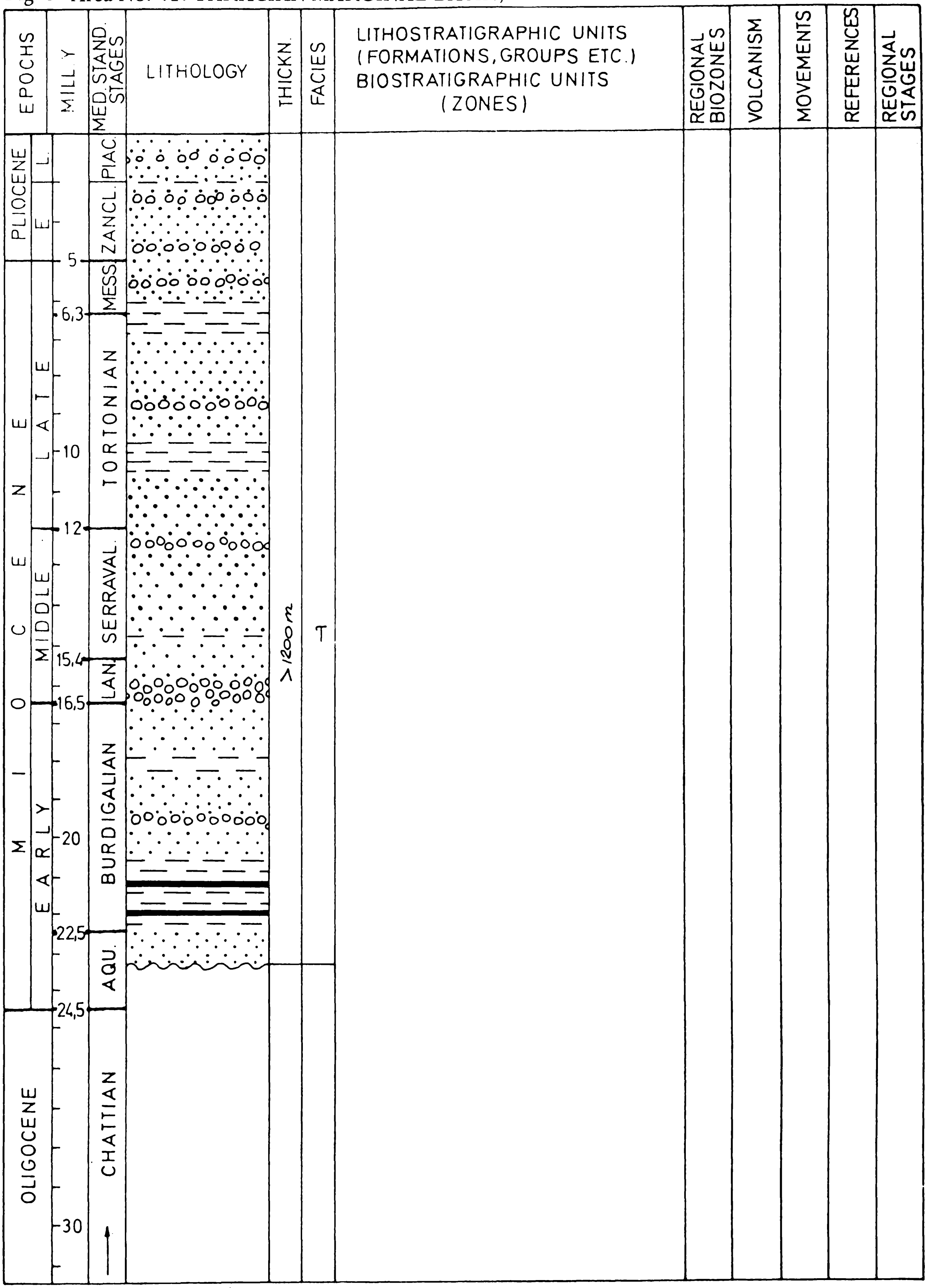


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Fig. 6: Area No. 41: THRACIAN MARGINAL BASIN, EVROS RIVER AREA, GR

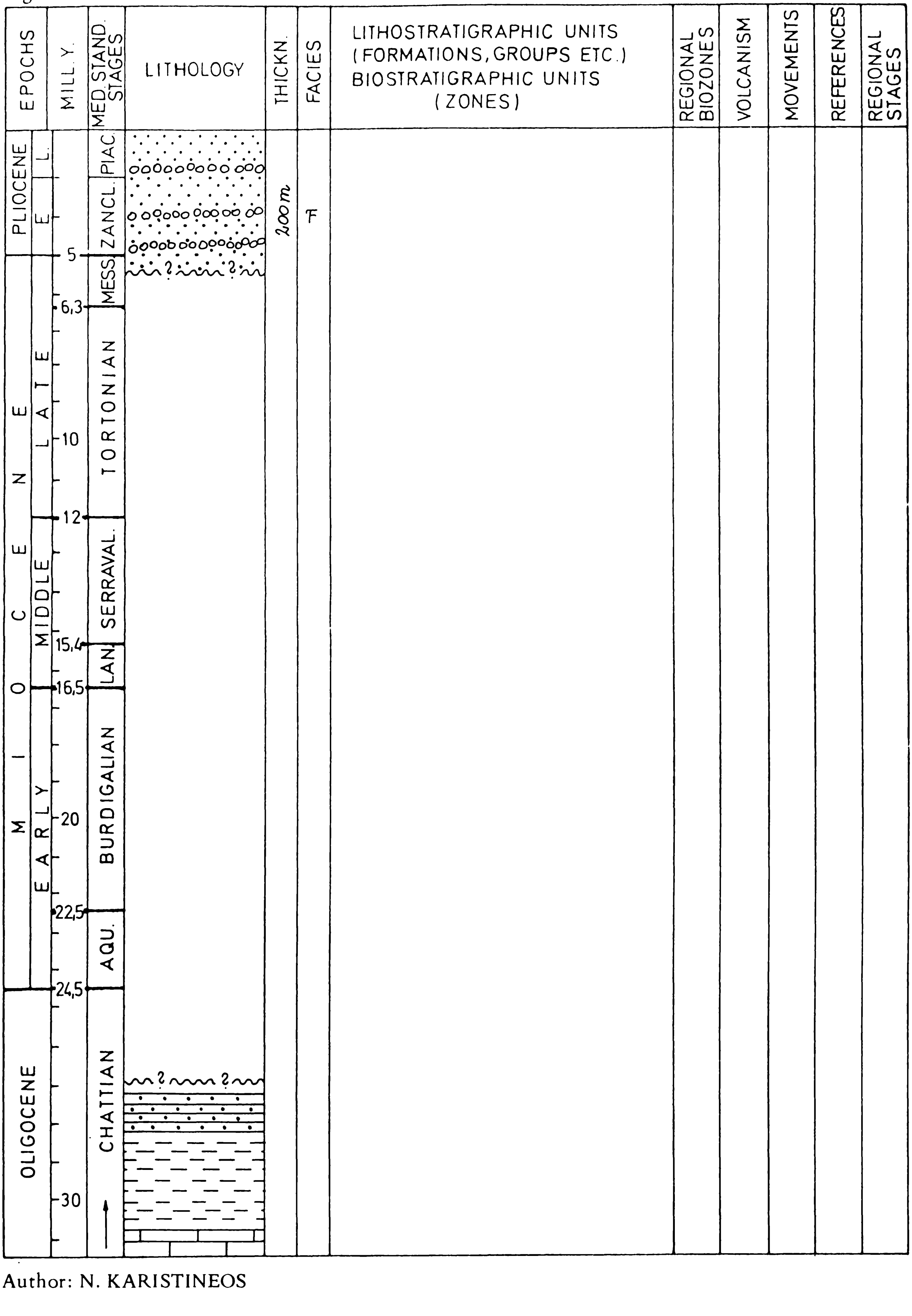


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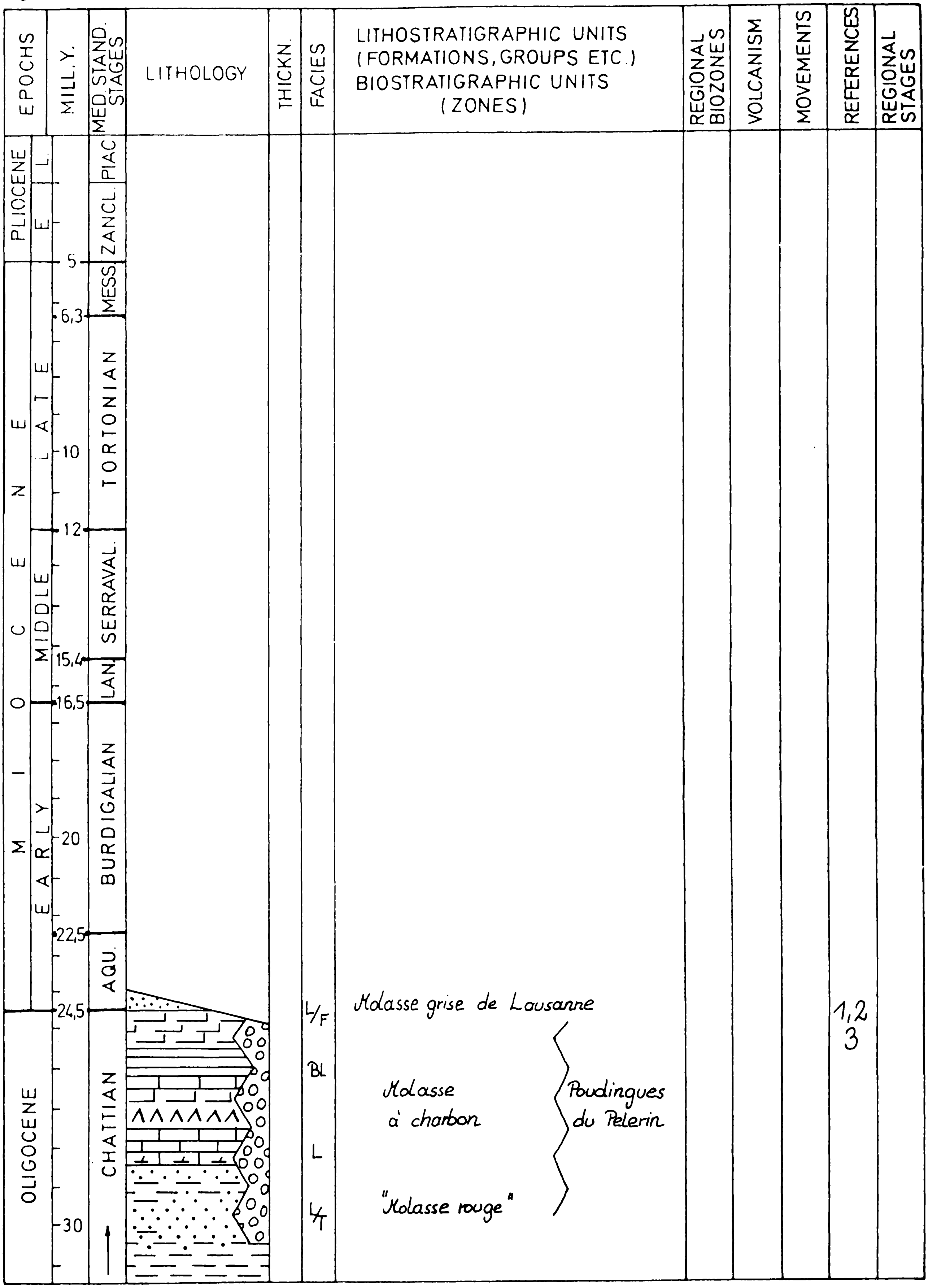
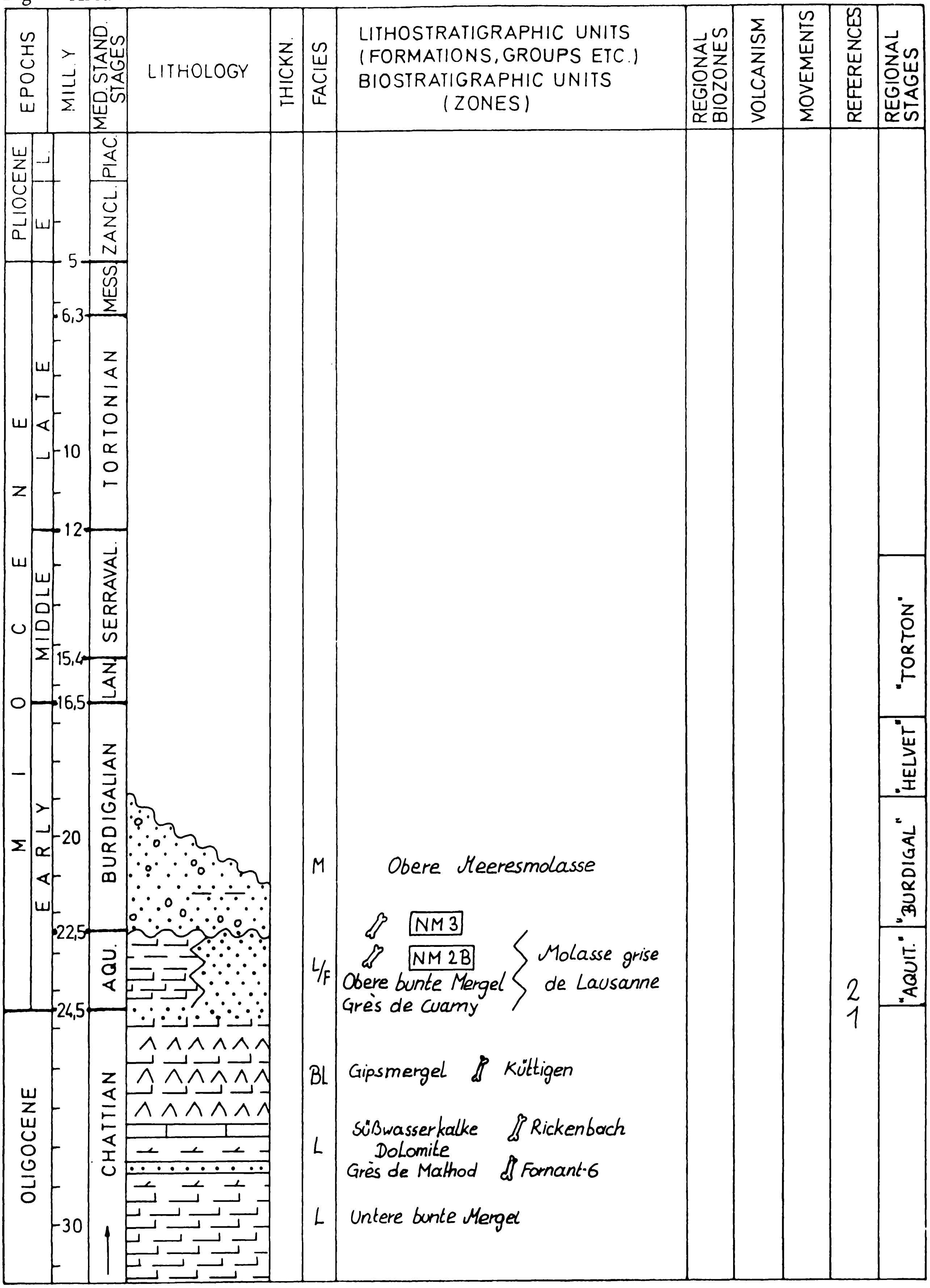
Fig. 7: Area No. 200 c1: SUBALPINE MOLASSE - WESTSCHWEIZ, CH




Author: M. WEIDMANN

Fig. 8: Area No. 201 c1: MITTELLÄNDISCHE MOLASSE – WESTSCHWEIZ, CH




Author: M. WEIDMANN

## IV. REFERENCES

The list of references given here contains all literature cited in the two volumes of the edition "Neogene of the Mediterranean Tethys and Paratethys–Stratigraphic Correlation Tables and Sediment Distribution Maps."

References are listed for chapter two: "Stratigraphic Correlation Tables (Text and Tables)" and chapter three: "Sediment Distribution Maps for selected Time-Intervals through the Neogene."

The references for chapter two require some additional remarks: each correlation table in volume two of this edition contains a reference column. Numbers within this column correspond directly to the lithostratigraphic units, biostratigraphy etc. The numbers of these references correspond to those listed in the first volume of this edition. Under the Area number and the reference number in chapter two of this volume, the reader can find the author(s) cited in the list of references given here.

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# VI. INDEXES

## STRATIGRAPHIC CORRELATION TABLES (Vol. 1: text, vol. 2: tables) ACCORDING TO AREA NUMBERS

## STRATIGRAPHIC CORRELATION TABLES (Vol. 1: text, vol. 2: tables) ACCORDING TO COUNTRIES IN ALPHABETIC ORDER:

USSR (SU)

WEST GERMANY (D)

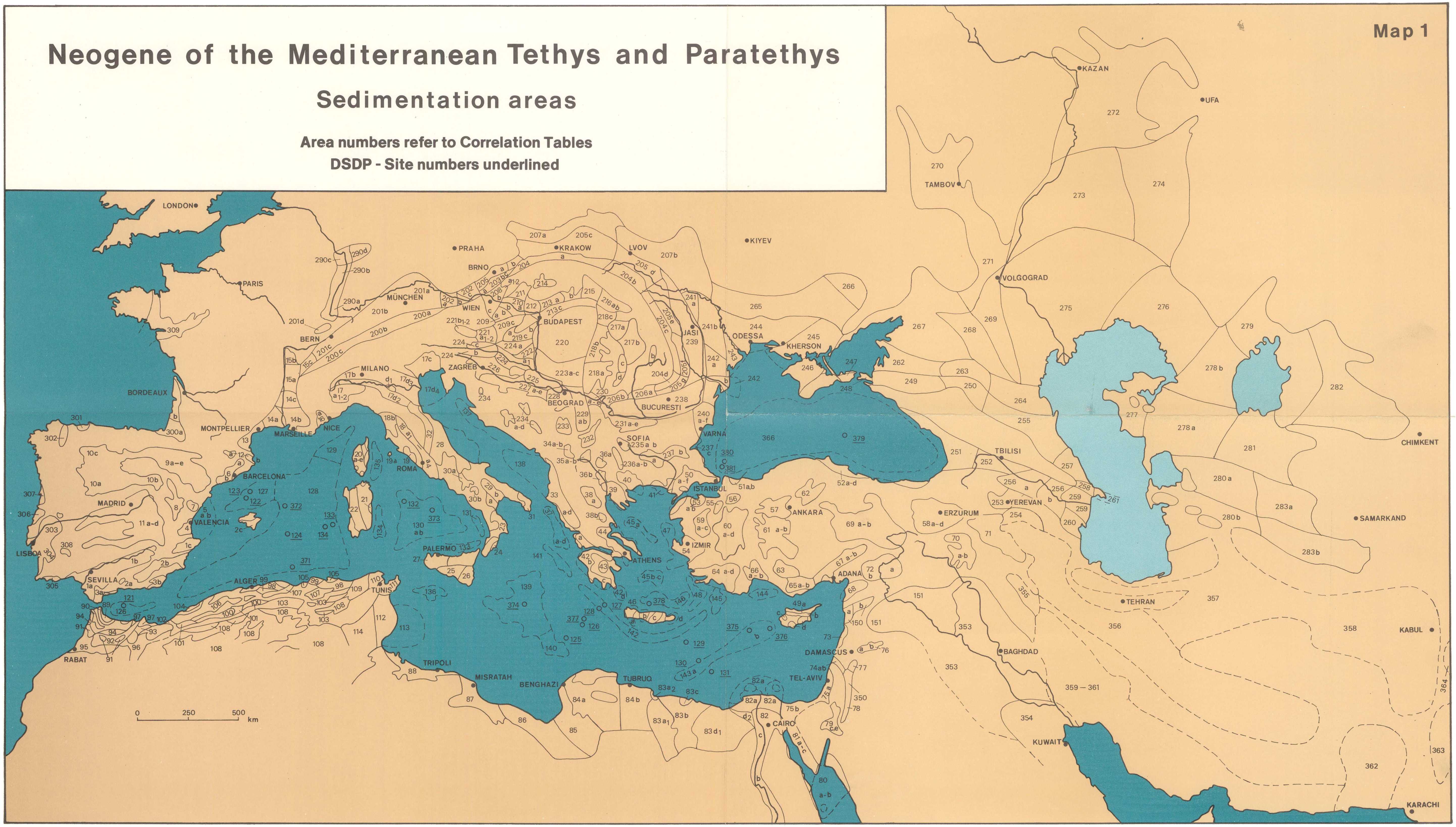
## LIST OF DETAILED AREA MAPS

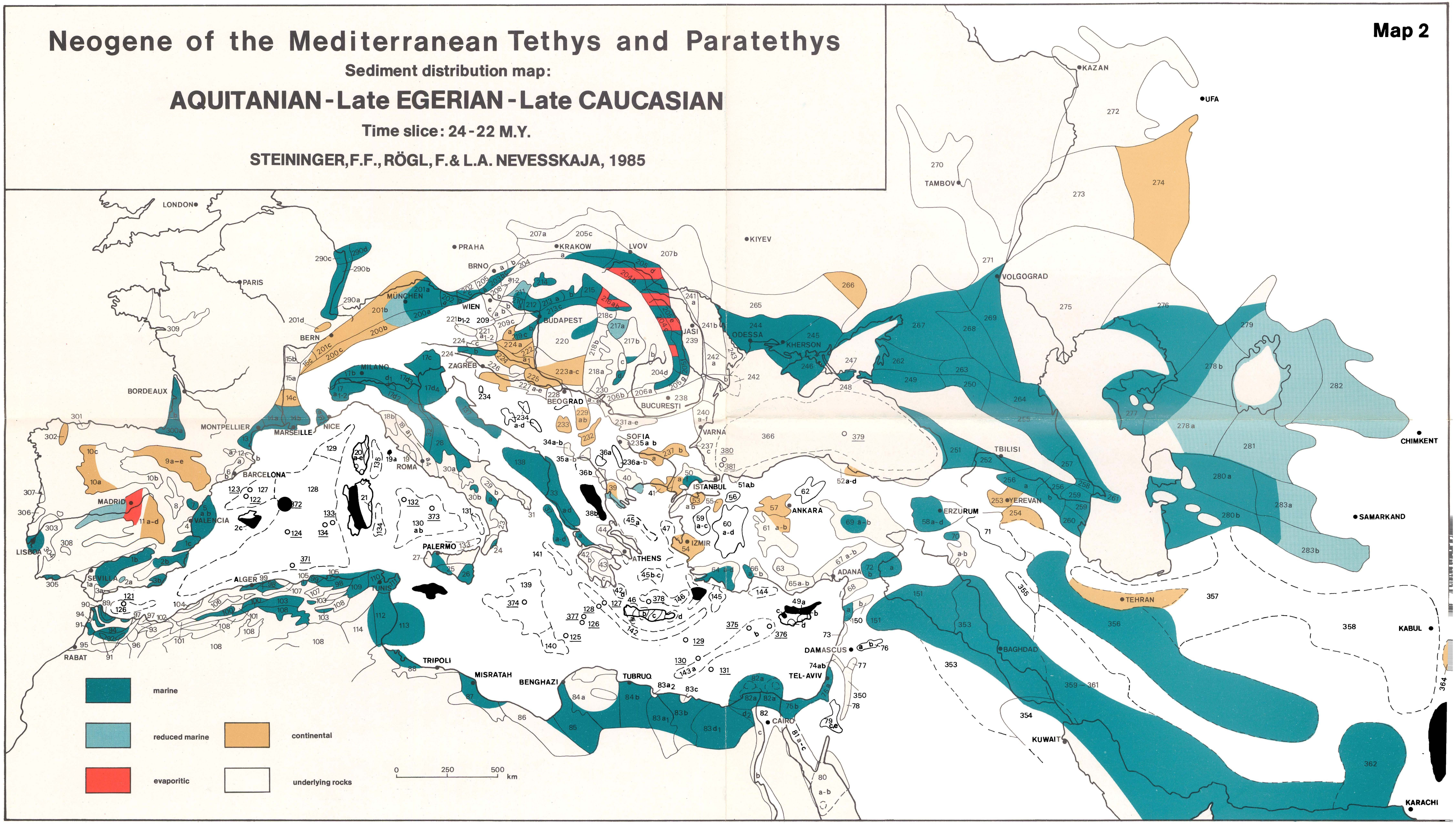
vol. 1, page

# Neogene of the Mediterranean Tethys and Paratethys

## Sedimentation areas

**Area numbers refer to Correlation Tables**
**DSDP - Site numbers underlined**




Neogene of the Mediterranean Tethys and Paratethys
Sediment distribution map:
AQUITANIAN - Late EGERIAN - Late CAUCASIAN
Time slice: 24 - 22 M.Y.
STEININGER, F.F., RÖGL, F. & L.A. NEVESSKAJA, 1985
Map 2
marine
reduced marine
continental
evaporitic
underlying rocks
0
250
500
km

# Neogene of the Mediterranean Tethys and Paratethys

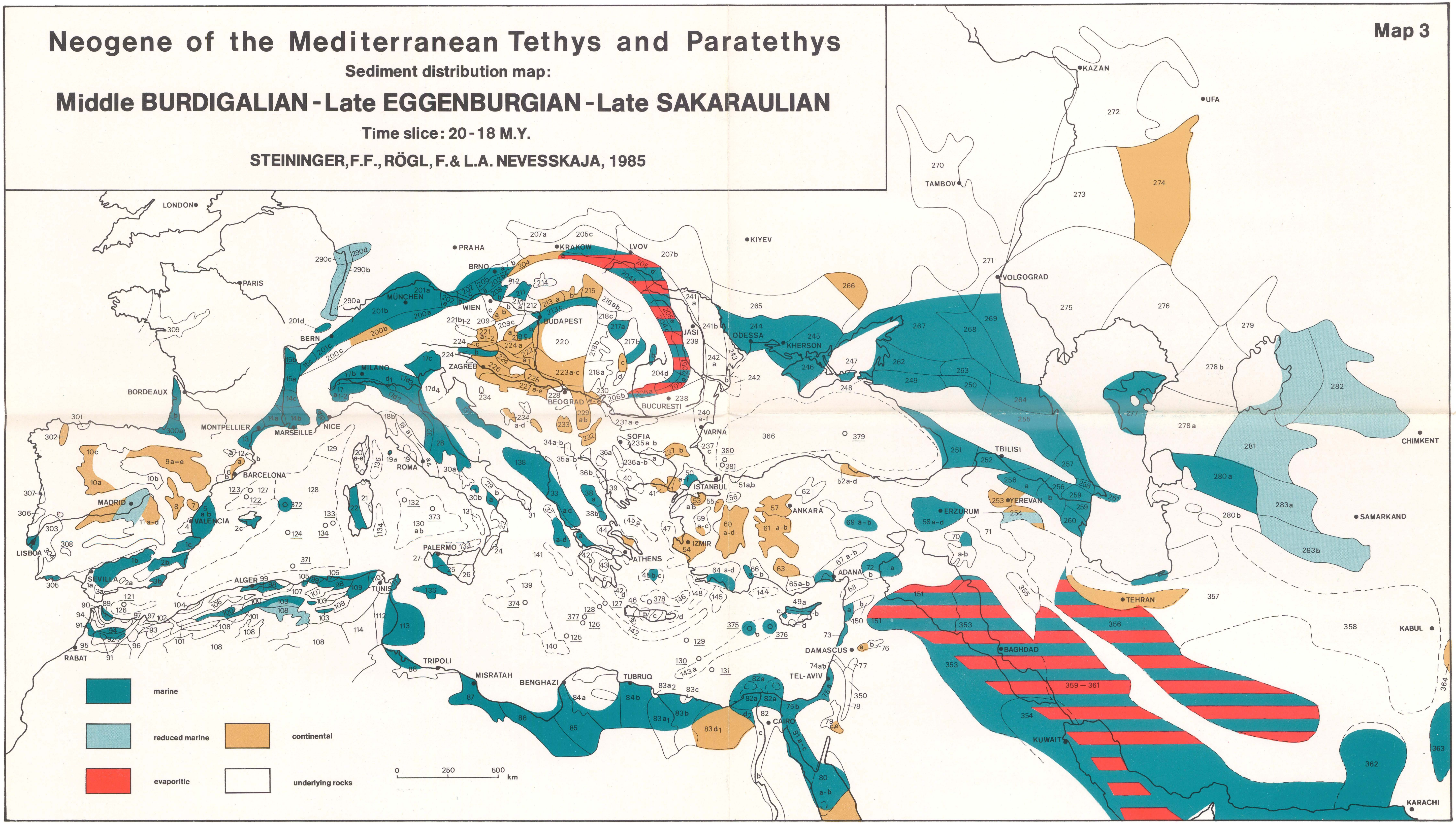
**Sediment distribution map:**

## Middle BURDIGALIAN - Late EGGENBURGIAN - Late SAKARAULIAN

**Time slice: 20-18 M.Y.**

**STEININGER, F.F., RÖGL, F. & L.A. NEVESSKAJA, 1985**

Map 3



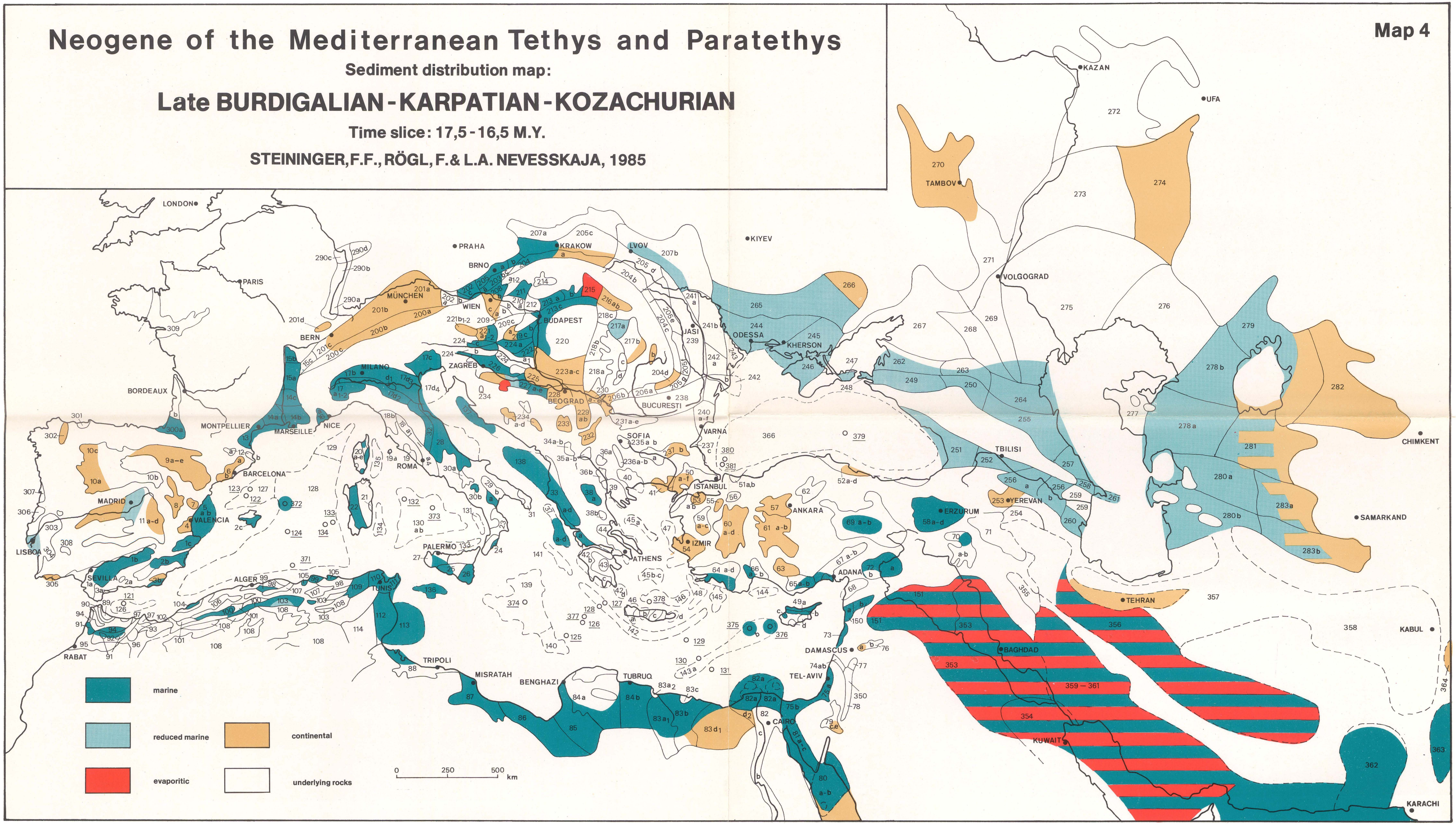
# Neogene of the Mediterranean Tethys and Paratethys

## Sediment distribution map:

## Late BURDIGALIAN - KARPATIAN - KOZACHURIAN

**Time slice: 17,5 - 16,5 M.Y.**

**STEININGER, F.F., RÖGL, F. & L.A. NEVESSKAJA, 1985**



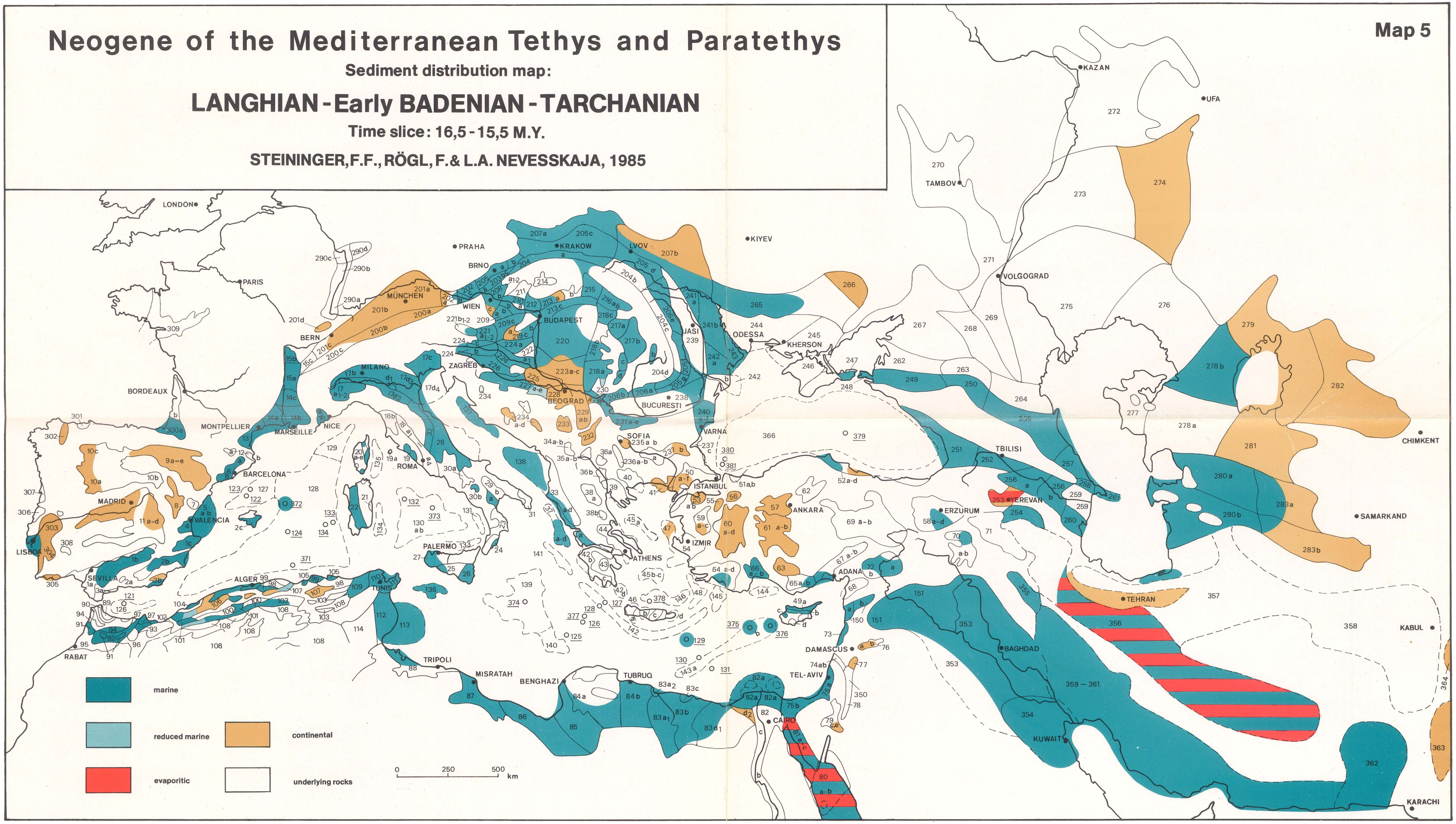
# Neogene of the Mediterranean Tethys and Paratethys

**Sediment distribution map:**

## LANGHIAN - Early BADENIAN - TARCHANIAN

**Time slice: 16,5 - 15,5 M.Y.**

**STEININGER, F.F., RÖGL, F. & L.A. NEVESSKAJA, 1985**



# Neogene of the Mediterranean Tethys and Paratethys

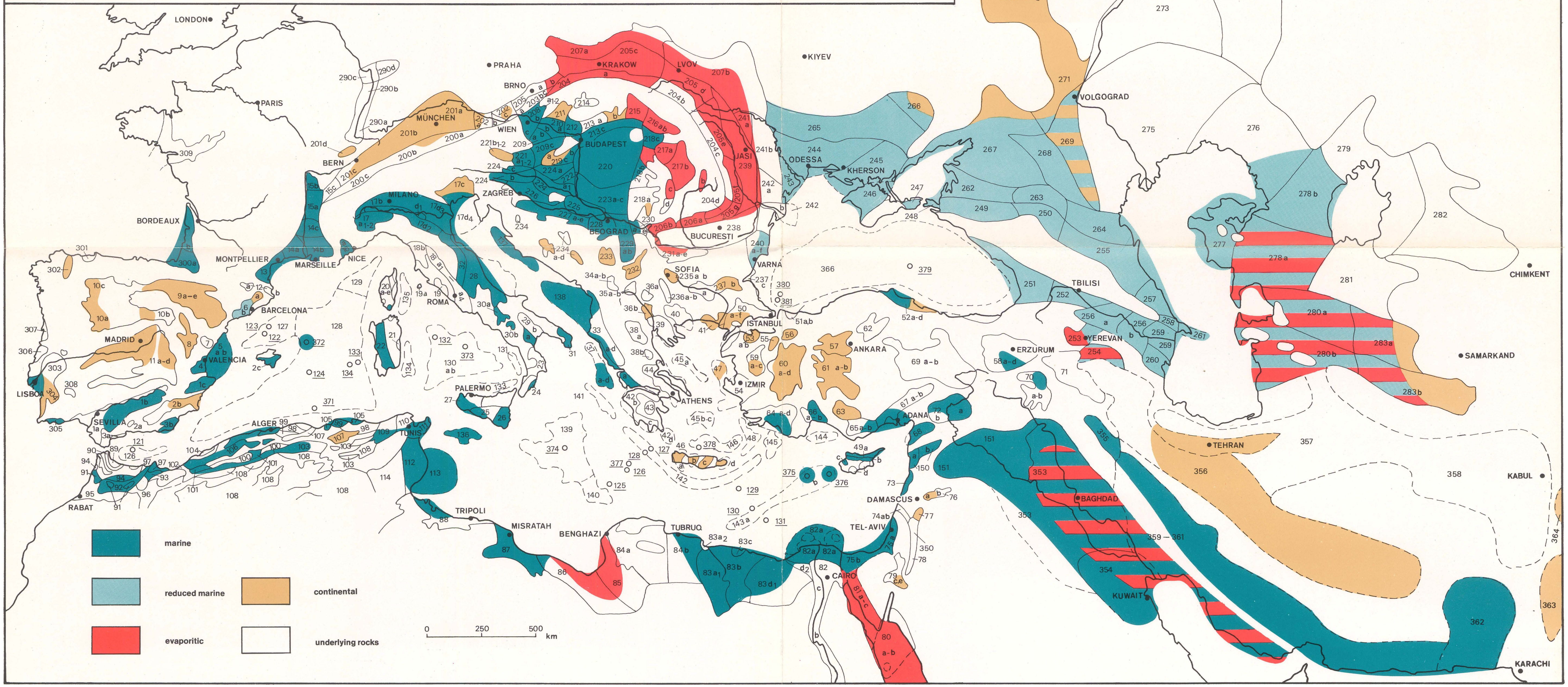
Sediment distribution map:

## Early SERRAVALLIAN - Middle BADENIAN - KARAGANIAN

Time slice: 15,0 - 14,5 M.Y.

STEININGER, F.F., RÖGL, F. & L.A. NEVESSKAJA, 1985

Map 6



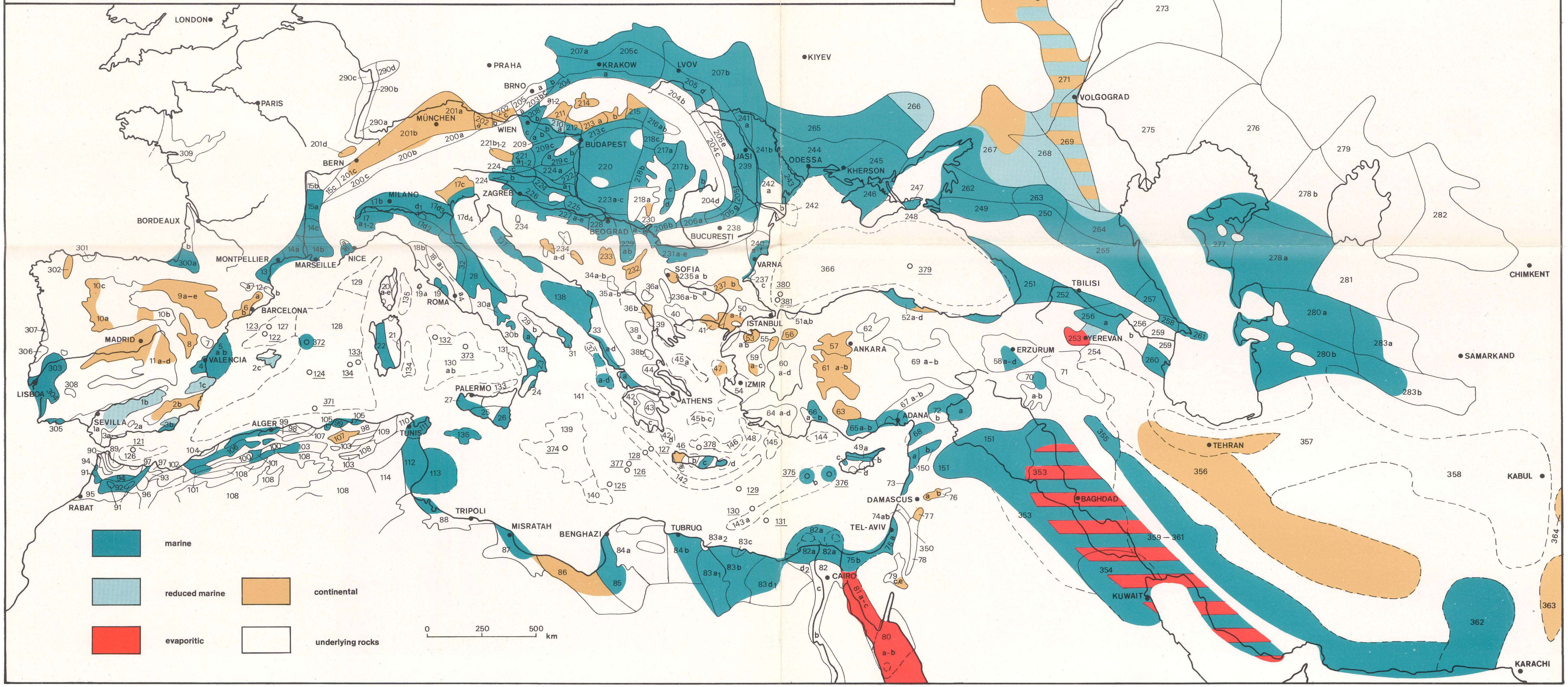
# Neogene of the Mediterranean Tethys and Paratethys

## Sediment distribution map:

## Middle SERRAVALLIAN - Late BADENIAN - KONKIAN

**Time slice: 14,5 - 13,5 M.Y.**

**STEININGER, F.F., RÖGL, F. & L.A. NEVESSKAJA, 1985**



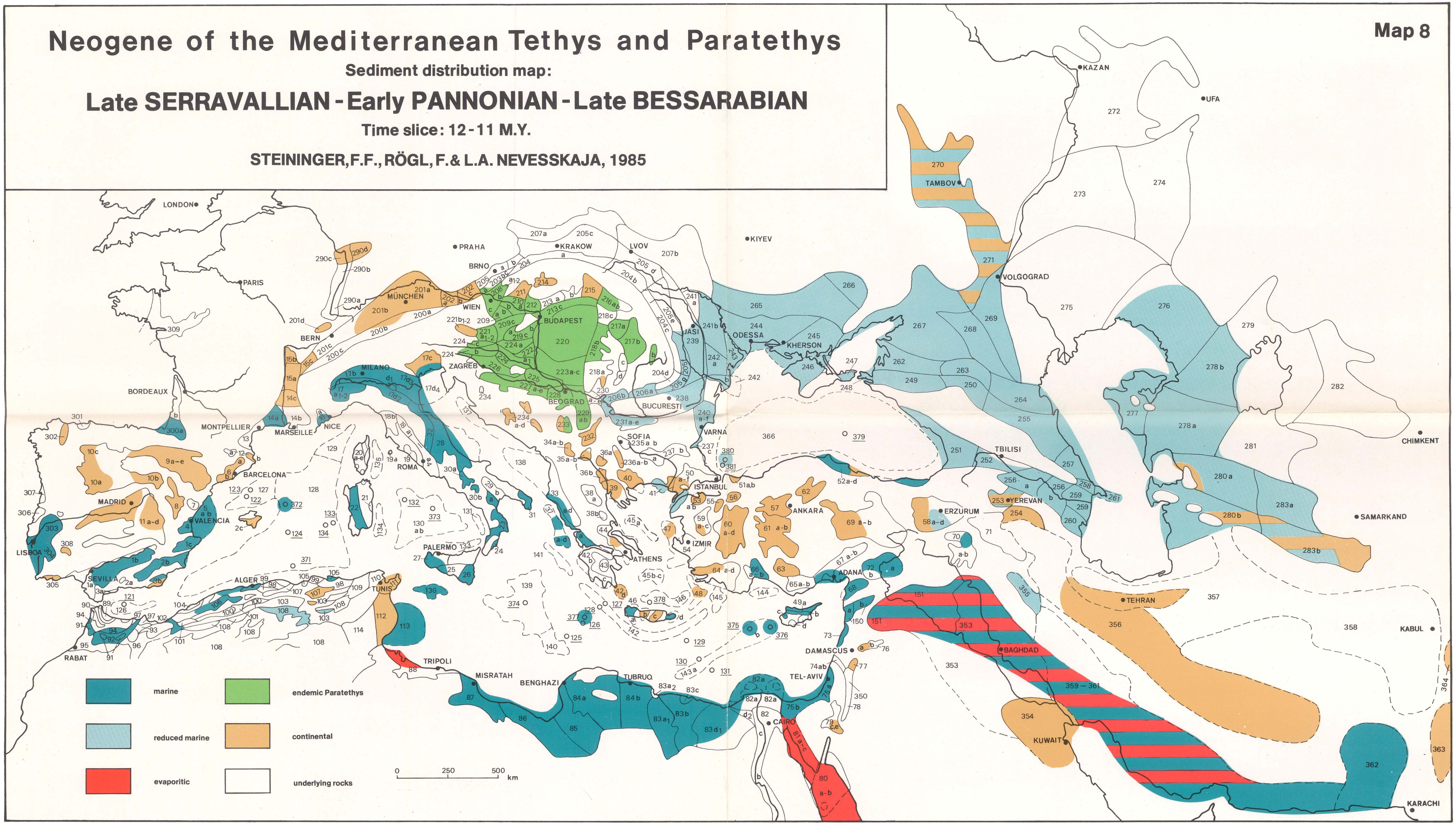
# Neogene of the Mediterranean Tethys and Paratethys

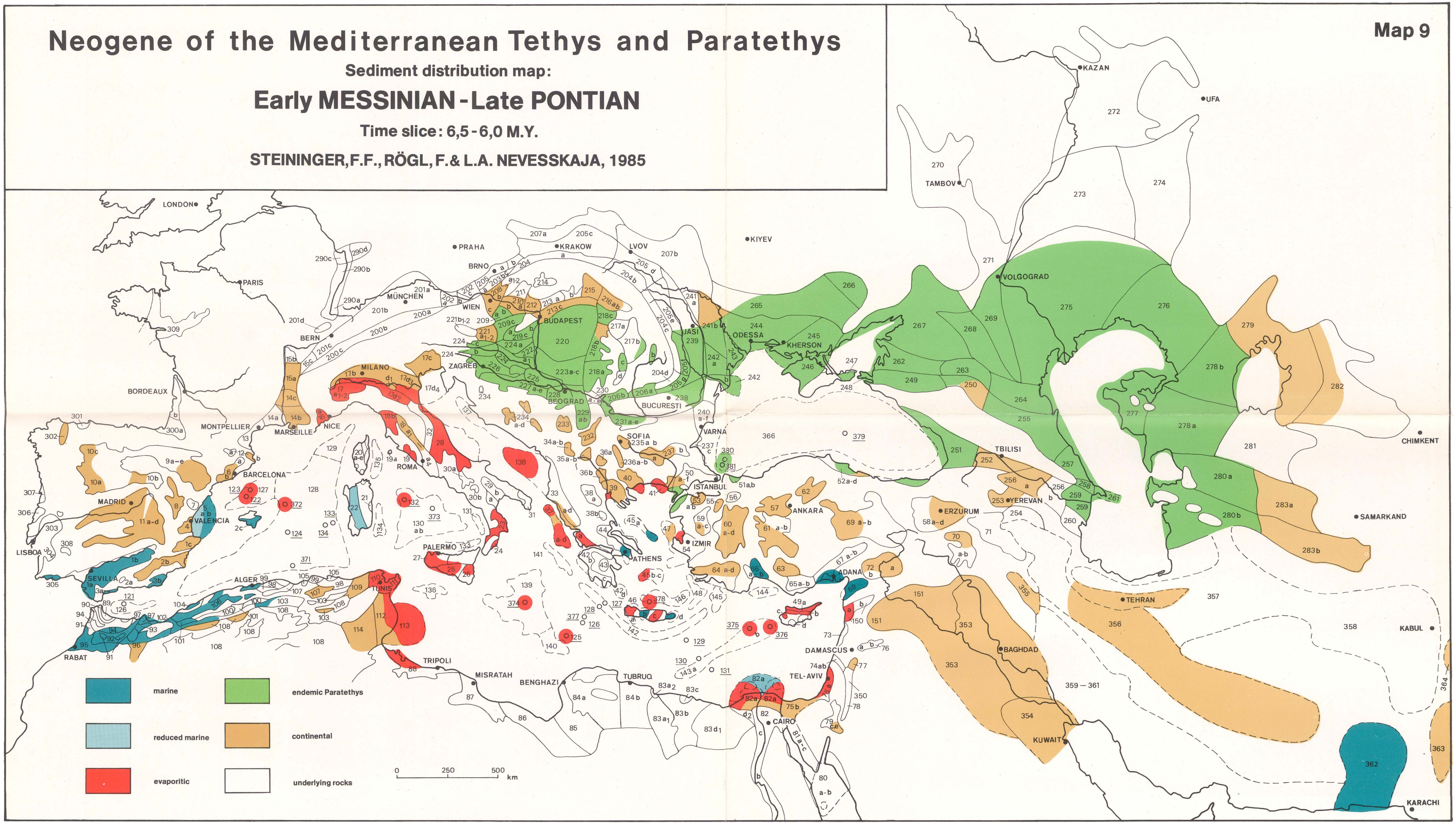
### Sediment distribution map:

## Late SERRAVALLIAN - Early PANNONIAN - Late BESSARABIAN

### Time slice: 12-11 M.Y.

**STEININGER, F.F., RÖGL, F. & L.A. NEVESSKAJA, 1985**




Neogene of the Mediterranean Tethys and Paratethys
Sediment distribution map:
Early MESSINIAN - Late PONTIAN
Time slice: 6,5 - 6,0 M.Y.
STEININGER, F.F., RÖGL, F. & L.A. NEVESSKAJA, 1985
Map 9
marine
reduced marine
evaporitic
endemic Paratethys
continental
underlying rocks
0
250
500
km
LONDON
PARIS
PRAHA
KRAKOW
LVOV
KIYEV
KAZAN
UFA
TAMBOV
VOLGOGRAD
BRNO
MÜNCHEN
WIEN
BUDAPEST
BERN
ZAGREB
MILANO
BEOGRAD
BUCURESTI
JASI
ODESSA
KHERSON
BORDEAUX
MONTPELLIER
MARSEILLE
NICE
ROMA
BARCELONA
MADRID
VALENCIA
LISBOA
SEVILLA
RABAT
ALGER
TUNIS
PALERMO
TRIPOLI
MISRATAH
BENGHAZI
TUBRUQ
CAIRO
TEL-AVIV
DAMASCUS
BAGHDAD
KUWAIT
TEHRAN
KABUL
KARACHI
SAMARKAND
CHIMKENT
TBILISI
YEREVAN
ERZURUM
ANKARA
ADANA
IZMIR
ATHENS
ISTANBUL
SOFIA
VARNA

# Neogene of the Mediterranean Tethys and Paratethys

## Sediment distribution map:

## PIACENZIAN - ROMANIAN - AKCHAGYLIAN

**Time slice: 3,5 - 2,5 M.Y.**

**STEININGER, F.F., RÖGL, F. & L.A. NEVESSKAJA, 1985**

Map 10