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Abstrakt

V autochtonním paleogénu na JV svazích Českého masivu byla vymezena 3 pásma a 8 zón. Spodní část s Bolivinopsis spectabilis lze korelovat s paleocénem, střední část s Bulimina rugifera — Bulimina parisiensis se spodním eocénem a svrchní část s Bolivina aenariensis — Uvigerina hantkeni se středním až svrchním eocénem. V autochtonním paleogénu jsou vymezeny vranovický a nesvačilský příkop. Jejich vznik byl původně spojován se zlomovou tektonikou nebo s podmořskými kaňony. Pomocí zonací bylo prokázáno, že marinní sedimenty paleogénu transgredovaly do už existujících erozívních kaňonů.

Zusammenfassung

Im autochthonen Paläogen an den SO-Hängen der Böhmischen Masse in Südmähren wurden aufgrund der Foraminiferen und E-log-Diagramme 3 Komplexe und 8 Zonen abgegrenzt. Der untere Teil mit Bolivinopsis spectabilis ist dem Paläozän, der mittlere Teil mit Bulimina rugifera — Bulimina parisiensis dem unteren Eozän und der obere Teil mit Bolivina aenariensis — Uvigerina hantkeni dem mittleren und oberen Eozän gleichzustellen. Im autochthonen Paläogen wurden der Vranovice- und der Nesvačilka-Graben abgegrenzt. Ihre Entstehung wurde ursprünglich mit der Bruchtektonik oder mit den submarinen Cañons in Zusammenhang gebracht. Mittels der Verteilung auf Zonen wurde klargelegt, daß die marinen Sedimente des Paläogens in bereits bestehende erosive Cañons transgredierten.

PALEOGEOGRAPHY OF THE NEOGENE IN THE VIENNA BASIN AND THE ADJACENT PART OF THE FOREDEEP

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Introduction

The Vienna basin is the NW-part of the Pannonian intracarpathian basinsystem and is situated in the external zone of the Alpine — Carpathian thrust belt, covering 200 km length in the NE-SW extension and 60 km in width. Separated by the Alpine — Carpathian thrust sheets of the Waschberg — Ždanice zone the Molasse foredeep extends parallel to the Vienna Basin along the SE-flank of the Bohemian Massif with a width of 8 km near Brno up to 30 km in the Austrian part (see fig. 1 below).

Several geologists dealt with the paleogeography of the Neogene sediments of the Vienna Basin and the adjacent Alpine-Carpathian foredeep. In the Austrian part of the Molasse zone, paleogeography was provided by Braumüller (1961), Grill (1953, 1961), and Brix (1977), in the Vienna Basin by Krobot (1977) and Turnovsky (1976). In the Czechoslovakian part, paleogeography of the Molassezone was investigated by Buday (1965) and Jiříček (1983), of Ždanice unit by Špička (1971) and Chmelík (1981) and in the Vienna Basin by Buday (1960), Špička (1967) and Jiříček (1977—1983). The last two authors studied the paleogeography during the construction of the formation thickness maps. Jiříček (1978, 1986) worked on the Neogene paleogeography in the whole Vienna basin and its surroundings in the Lower Austrian to South Moravian areas in the classical and in the palinspastic view as well.

The existing paleogeographic and isopach maps, which were worked out before 1975, can no longer be used. Because of the introduction of the neostratotypes in the Central Paratethys (1968), the range of the stratigraphic units changed and was again modified later on in the different basins.

It was clearly incorrect to assume, as some geologists did, that it would be enough to define the new stages by a convergence chart in which the former Chattian and Aquitanian were compared with today's Egerian, the former Lower Burdigalian with the Eggenburgian, the Upper Burdigalian and Helvetian (Lower Helvetian) with the Ottnangian, the Upper Helvetian with the Karpatian, the Tortonian with the Badenian and the Sarmatian, Pannonian and Pontian with the same stages nowadays (Cicha et al., 1971).

With the modification of the neostratotypes their range, revised in hundreds of wells in some basins, was also changed (see fig. 2). The thickness maps of the Neogene in the Czechoslovakian part of the basin (Špička 1967) included in the former Lower Burdigalian not only Eggenburgian sediments of Hodonín-Lužice in the wells, but also the Ottnangian of Tynec-Gbely and the Karpatian of Malacky Lab.

The coloured Kúty beds with 400—1 000 m thickness were also placed in the Lower Badenian, although they actually belong to the Upper Karpatian. Because there existed no division of Badenian in an upper, middle and lower part like nowadays, the boundary was placed between the Lanzendorf and the Devin series in the midst of the middle Badenian. Sometimes the boundary Badenian-Sarmatian is situated 500 m deeper than the former boundary between Tortonian and Sarmatian. As now has been proved, the coloured series between them belongs to the Sarmatian and not to the Badenian. The coal series of Zone F, which was classified into the upper Pannonian, was included in the Pontian. The coloured series on its top, which used to be compared with the Pontian or Dacian earlier, belongs to the

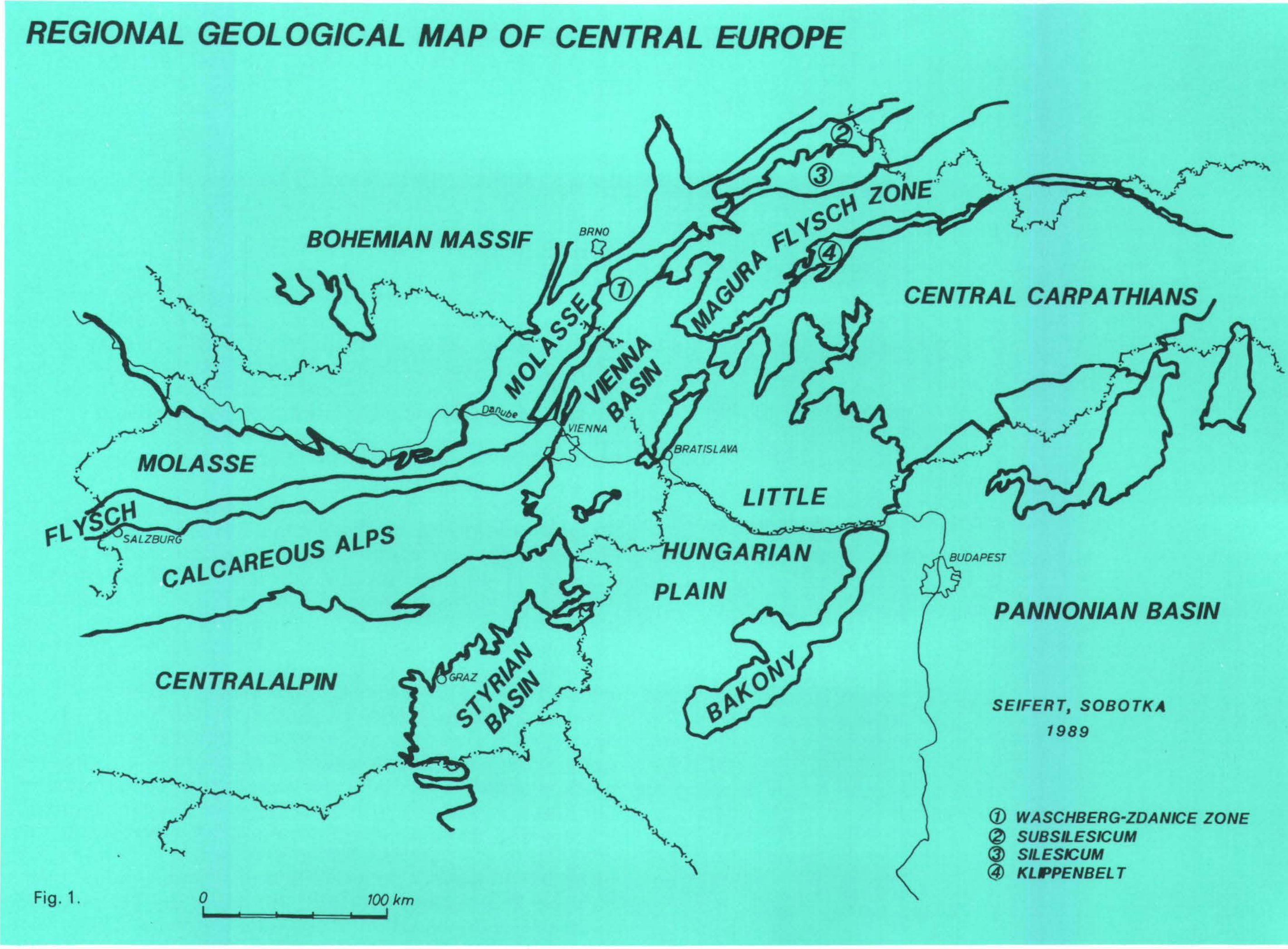


Fig. 1.

Pontian now. At last the sediments of the Levantian or Rumanian were compared previously with the early Pleistocene.

Some stratigraphic questions still remain unanswered. The Rzehakia beds, for example, are classified in Austria as Oncophora beds into the Ottnangian, in Moravia into te Karpatian. This poses some problems when attempting to arrange a homogeneous structural and tectonic map of the described area. For this reason we are forced to accept a uniform stratigraphic system based on a conclusive fauna, on electric logs and seismic or geologic profiles, as we attempt to demostrate in this paper.

The paleogeographic maps in this paper show the extension of different formations from a static point of view. The palinspastic position of the Vienna Basin on the back of the progressing Alpine-Carpathian nappe system at different times was described by Jiříček in 1986 (see also Kováč 1989). The structural evolution and the geodynamic development of the Vienna Basin and its basement were described by Wessely (1987) and Jiříček & Tomek (1981).

1. Oligocene

The perialpine Molassezone extends in a W—E direction from Switzerland to Bavaria and Austria, where the successive later beginning of the sedimentation on the flanks of the Bohemian Massif to the east is well documented (Brix 1977).

In Upper Austria the Molasse basis has an Upper Eocene age. In the area east of Steyr, we find Lower Oligocene on the basis; in the area of Melk/Danube, the sequence starts with limnic sediments of the Rupelian, which are manifest as residuals in the area of Vienna as well (Roetzel 1983).

The sediments of the Egerian transgressed extensively on the Bohemian Massif and are found far to the south below the alpine nappes, e. g. in the exploration well Berndorf 1 30 km south of the front of the nappes (Fuchs et al 1980).

The Egerian transgression followed northwards the Variscan determined graben system extending NNE—SSW along the Mailberg fault and reaches a thickness of nearly 300 m in the exploration well Grossharras 1 (fig. 3). It ended in the region of Wildendürnbach near the Czechoslovakian border.

In South Moravia the Molasse sequence starts with the Eggenburg. The supposed Egerian of the well HV 102 near Pohořelice (Cicha 1975—1988) represents perhaps the autochthonous Lower Oligocene of Vranovice graben.

In Lower Austria the extension of Egerian sediments in the Mailberg graben is limited by the NNE—SSW running Hagenberg swell (fig. 3). From it the Egerian sedimentation area extended far to the east. It included differrent facies environments: from the shallow areas in the west to the deeper ones in the east. This eastern part was incorporated into the external zone of the Alpine-Carpathian nappe system and was thrusted to the northwest. In the Waschberg-zone we can find folded Michelstetten beds and Thomasl beds (Papp 1978), in the Pouzdřany unit the Boudky beds (Upper Pouzdřany beds) and the problematic Křepice beds (Cicha 1965, Stráník 1980). These sediments were detached from their autochthonous, probably clastic basis.

The Melk beds transgressed only in the Austrian part on the flank of the Bohemian Massif. In the opposite direction rose the front zone of the Alpine and Magura flysch in the

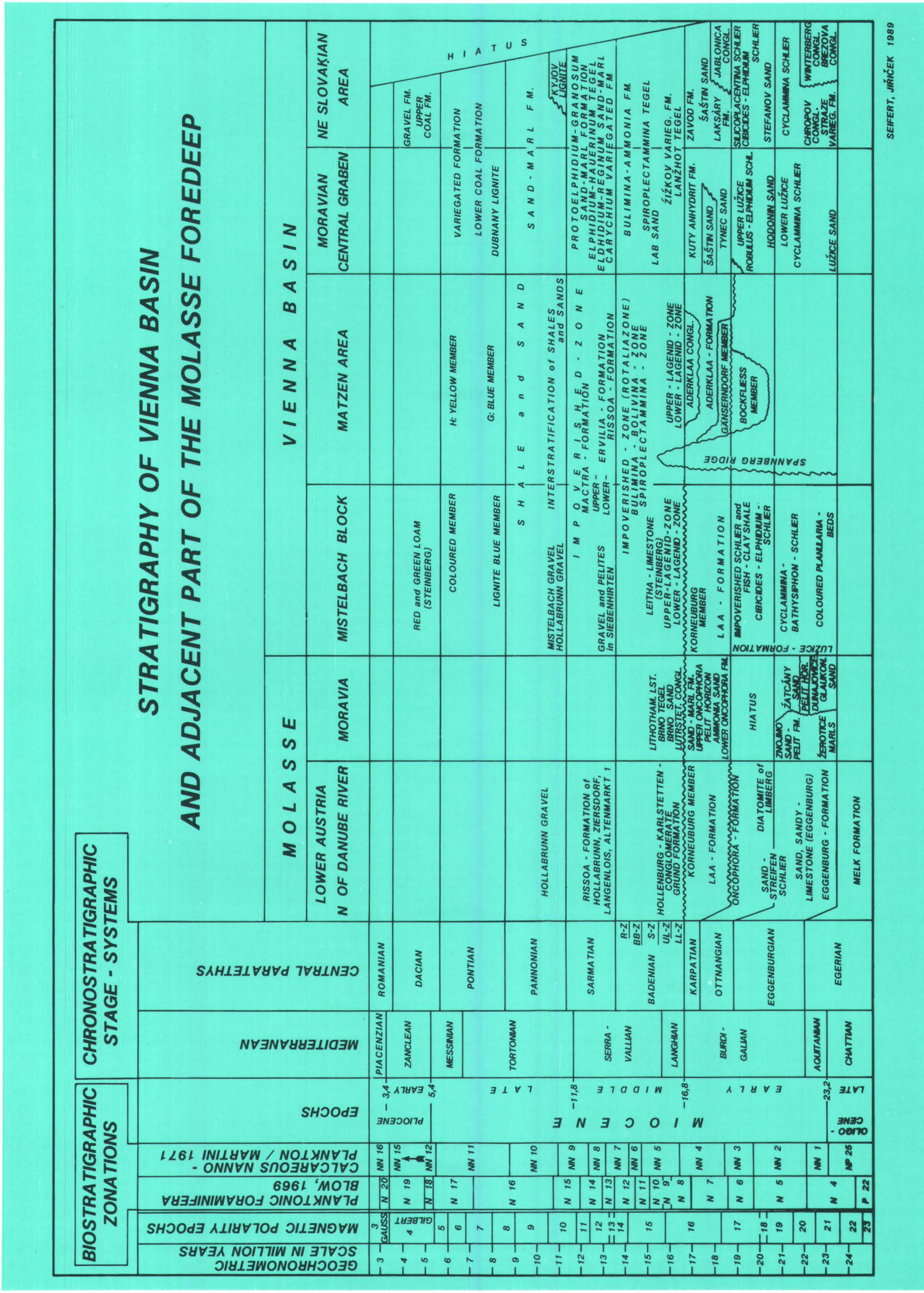

STRATIGRAPHY OF VIENNA BASIN
AND ADJACENT PART OF THE MOLASSE FOREDEEP
BIOSTRATIGRAPHIC ZONATIONS
CHRONOSTRATIGRAPHIC STAGE - SYSTEMS
GEOCHRONOMETRIC SCALE IN MILLION YEARS
MAGNETIC POLARITY EPOCHS
PLANKTONIC FORAMINIFERA BLOW, 1969
CALCAREOUS NANNO - PLANKTON / MARTINI 1971
EPOCHS
MEDITERRANEAN
CENTRAL PARATETHYS
MOLASSE
LOWER AUSTRIA N OF DANUBE RIVER
MORAVIA
VIENNA BASIN
MISTELBACH BLOCK
MATZEN AREA
MORAVIAN CENTRAL GRABEN
NE SLOVAKIAN AREA
HIATUS
SEIFERT, JIŘÍČEK 1989

Fig. 2.

south-east. On its back the presence of Lepidocyclinidae and Miogypsinidae was found in wells near Reinthal and Rabensburg in the northern part of the Vienna Basin (see fig. 3). The question whether this deposition is autochthonous or integrated in the thrust sheets has not yet been solved.

The Egerian sediments of the Waschberg — Ždanice unit are proven to be in an allochthonous position in the Austrian ultradeep wells Maustrenk ÜT 1a and Zistersdorf ÜT 2a below the Vienna Basin and the Alpine-Carpathian nappe system, as well as in the Moravian Pouzdřany and Ždanice units. East of this area sediments remained in an autochthonous position.

The south part of the Egerian Molasse transgressed on the Helveticum nappe both in the Austrian and in the Moravian parts (Jiříček 1982). In the investigated area folded Egerian sediments were found together with Helveticum below the external Flysch nappes in the exploration well Urmannsau 1 west of Vienna (Kröll, Wessely 1967).

In the region from north of Vienna to South Moravia occured the transgression of the sandy-shaley Ždanice-Hustopeče Egerian, while in the remaining part of the Carpathian belt mainly Krosno sandstones transgressed on the Oligocene Menilit beds and partly on the Upper Eocene Submenilit beds. These sediments built the basis of the Ždanice unit, which was detached from the Subsilesian unit of the Helveticum (Jiříček 1982).

The Egerian sediments in the region of the Vienna basin occur mainly in the Waschberg Ždanice zone, which developed out of the main sedimentary basin during Oligocene — Lower Miocene from Eastern Austria to Western and Southern Slovakia.

2. Lower Miocene

Originally, the Lower Miocene included the stages of Aquitanian to Lower Helvetian. In today's interpretation these stages correspond with the Upper Egerian to Ottnangian (fig. 2). The upper limit of Lower Miocene was shifted to the termination of the Karpatian according to a decision of the International Stratigraphic Commission (RCMNS) in 1975. In the Lower Miocene we can place the last thrust tectonic in this region.

The broad perialpine Molasse zone, which extends from Switzerland to Bavaria and Austria, continues to Moravia in the pericarpathian foredeep. During the shortening of the sedimentation area we can notice not only a shift of the Molasse axis onto the flanks of the Bohemian Massif in front of the nappes, but also a pass of the sedimentation over the partly sunken front zone of the nappes into the area of the Vienna Basin towards the SE.

2.1 Eggenburgian

During the Savian Phase in the Eggenburgian the Alpine-Carpathian nappes moved over the ridge of the southern Egerian Molasse more and more to the foreland and built a new foredeep. Its sediments not only transgressed forward northwest along the flank of the Bohemian Massif, but they also passed southeast over the sunken front range of the Magura Flysch zone into the forming Vienna Basin. At the contact of these two units, where the Eggenburgian sediments hold an autochthonous position on the basement, today the Waschberg-Ždanice unit is located. In this unit sediments of the same age were folded and incorporated into the nappes. When we flatten this folded zone in the palinspastic map, we can realize the original sedimentation area (Jiříček, 1986). The Molasse zone extended NE to Ostrava. From there a subbasin in the direction to the Klippenbelt zone turns with the last Eggenburgian presence near Žilina into the Vienna Basin.

On the southeastern flank of the Bohemian Massif we can follow the Eggenburgian sediments from Krems in Lower Austria via Retz to the Litenčice hills in northern Moravia (fig. 4). On the border region clastic sediments are developed with coarse grained sandstones or coloured clays, which transgress on the crystalline. This is where the locations of Maissau, Loibersdorf, Eggenburg, Šatov, Chvaletice and Slup belong. The maximum extension occurred with the 30 km distant transgression into the Horn subbasin in Lower Austria (Kapounek et al. 1965), (fig. 4). The inner part of this plateau is covered by glauconitic sandstones and fish debris containing claystones which transgressed on the autochthonous Upper Jurassic, Upper Cretaceous and Egerian basement. This facies has been proven in wells in Lower Austria and South Moravia. On this whole above mentioned nearshore plateau, the Lower Eggenburgian with Neocyprideis fortisensis (KAY) is almost exclusively present, while the Upper Eggenburgian and Ottnangian was, as far as accessible, eroded as a result of the Karpatian unconformity (Jiříček 1978, 1983). In the later folded Waschberg-Ždanice zone, the sedimentation took place in the outer shelf to the slope area in water depths of some hundred meters. Sometimes in this sequence flyschoid sediment structures were observed in outcrops and cores of wells in the Waschberg zone.

This sediment type developed to the south to the "Sandstreifenschlier" of the autochthonous and allochthonous Molasse north and west of Vienna (Brix et al. 1977). A similar development with a Cibicides fauna was found in the Šakvice marls in the Pouzdřany and Ždanice unit (Stráník 1980). We can follow this type up to Mikulov, Valtice and Lednice, where distal influence of delta sedimentation with Silicoplacentina fauna was noticed (Jiříček 1983).

From the foredeep the Eggenburgian sedimentation passed over into the forming Vienna Basin between Mistelbach, Schrattenberg and Mikulov and advanced to the line Mistelbach — Zistersdorf to the south (fig. 4). In the northern part the sedimentation was concentrated in four depressions, e. g. Lužice, Kopčany, Štefanov and Senice.

In the Luzice depression the Eggenburgian sequence developed in front of the Týnec-Steinberg flanks of the Kahlenberg Flysch nappe. We can follow Eggenburgian sediments in the wells from Hodonin to Lužice, to Břeclav and to Reinthal to the southwest up to the Mistelbach block. In this region the formation reaches its greatest thickness of nearly 600 m northwest of Mistelbach. Towards the east it decreases and pinches out near Rabensburg at the Czechoslovakian border. Through the traverse extending Kopčany channel to the east the Eggenburgian reached the area near the Klippenbelt (fig. 4). On its outside Eggenburgian has been proven in the Štefanov depression in numerous exploration wells in the area of Štefanov and Petrova Ves. At the inner side of the area near the Klippenzone it was recorded in the Senice depression in the wells of Šastin, Kovalov, Lakšárska Nová Ves and in Studienka 95 in the Levare depression. In the whole region the Eggenburgian is represented by basal conglomerates with Flysch or Trias carbonate components. The breccias in the area of Stillfried might be the terrestric southernmost equivalent. Large Pectinids exist in the lower part of Eggenburgian, whereas the upper part consists of a huge sequence of Schlier sediments with Cyclammina praecancellata (see fig. 2). The paleogeographic maps of Cicha (1965) and Kovač (1986) show that a connection of this sedimentation area with the Tethys existed during Lower Eggenburgian and was subsequently interrupted.

2.2 Ottnangian

The main problem of the correlation of sequences emerges in the in the Ottnangian, because Karpatian sediments might be partly included. In the Neostratotype area of Upper Austria the Ottnangian is represented by the Innviertel series (Papp et al, 1968). Here we find the following sequence from the bottom to the top: marine Vöckla beds with Schlier sediments and sands with Cibicides-Elphidium, Atzbach sand, Ottnang Robulus Schlier, Ried Rotalia Schlier, glauconitic series with Mehrnbach, Braunau and Treubach sands with reduced marine fauna and finally

VIENNA BASIN AND MOLASSE FOREDEEP PALEOGEOGRAPHIC MAP WITH ISOPACHS

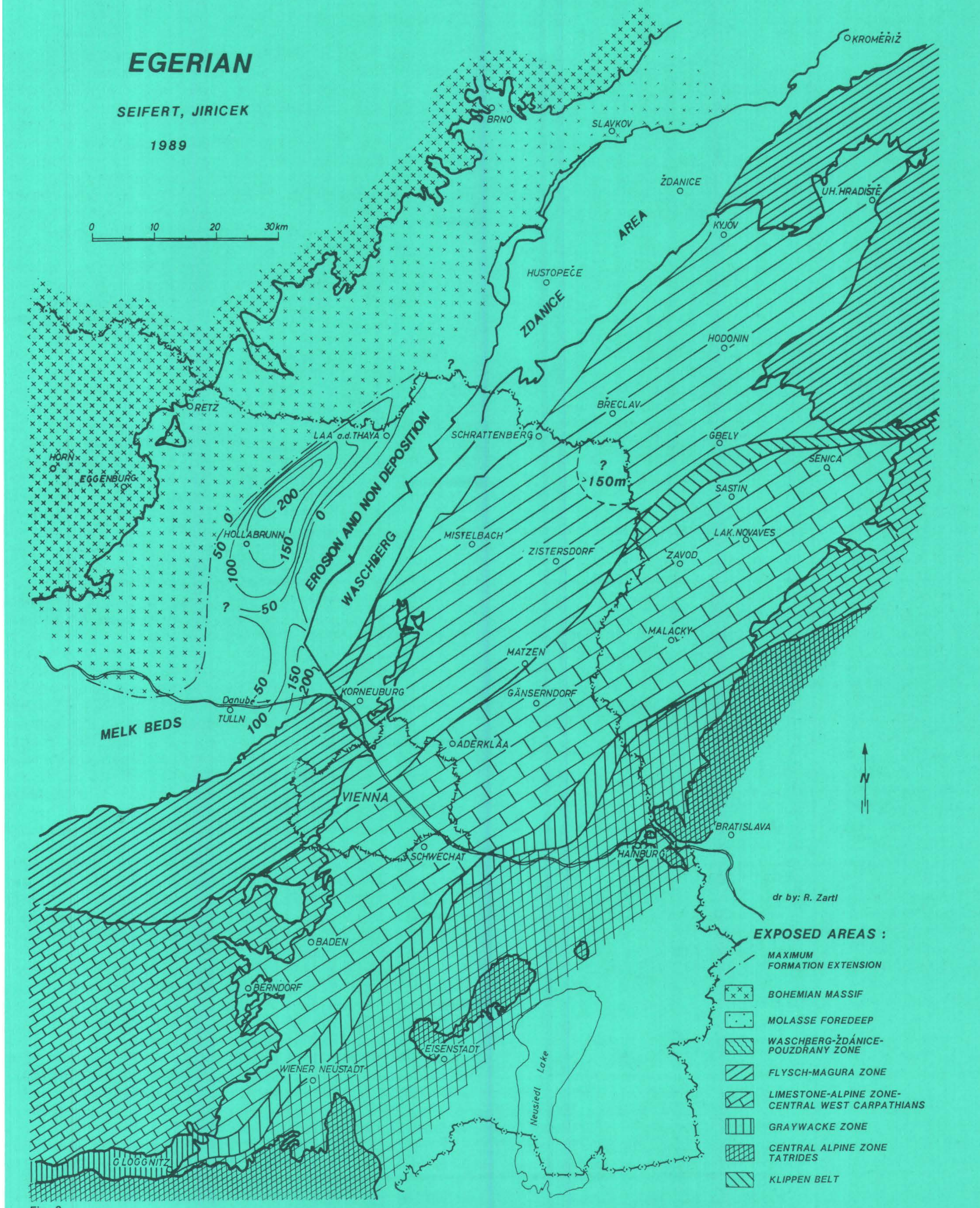


Fig. 3.

brackish Rzehakia beds (Braumüller 1961). Below this sequence Hall Cyclammina Schlier emerges, whereas above it the "Obere Süßwassermolasse" occurs, which is ascribed to Karpatian by Cicha (1967). If we correlate this region with the Vienna Basin, Hall Schlier corresponds to the sediments of Lower Lužice Eggenburgian Schlier (Jiříček 1978). On top of it the 10 to 150 m thick Štefanov and Hodonín sands appear, which could be compared with the Vöckla and Atzbach beds. Above them in the whole area of Hodonín and Lužice, Robulus Schlier of Upper Lužice beds follows, which is replaced laterally by the Cibicides — Elphidium Schlier near Týnec.

In the uppermost part of the Ottnangian, "Fischschlier" and the Silicoplacentina horizon are developed, which could be equivalent to the Ried Schlier because of the uncertain classification of the glauconitic series in the Vienna Basin. However, on top of the Silicoplacentina horizon marine Karpatian occurs here.

In the Molasse zone the Ottnangian on the SE—flank of the Bohemian Massif is represented by the Robulus Schlier (fig. 5). Its deposition area extends to the north up to Wildendürnbach — Mikulov, where the complete Eggenburgian is still present. In South Moravia the Rzehakia beds, which contain a Lower Karpatian fauna (Jiříček 1983), appear above the glauconitic sands and clays of the Lower Eggenburgian. Therefore, a hiatus is presumed which includes the rest of the Eggenburgian, the Ottnangian and sometimes also the Lower Karpatian on the northwest basin termination (Jiříček, 1983). Both, the sedimentologic development and the formation thickness allow the combination of the Oncophora beds and the Rzehakia beds to one unit (fig. 6). Therefore we realize the problem of formation classification as a palaeontologic one.

Along the line Mistelbach, Schrattenberg, Mikulov there was a broad connection of the foredeep with the Vienna Basin.

The paleogeography of the Ottnangian Upper Lužice beds concentrates in the Vienna Basin on the four above mentioned depressions. In the area near the Klippenzone, thin Ottnangian appears in the depression of Senice with Štefanov sands and thin pelite sediments on top. The same sediments obtain a thickness of 600 to 700 m in the Štefanov depression on the opposite outer side of the Klippen zone up to Gbely. In this development the Ottnangian advances through the transverse Kopčany channel into the Lužice depression, where the Lužice Schlier is separated by the Hodonin sands into an Eggenburgian Schlier with Cyclammina and an Ottnangian Schlier with Robulus. From this depression, which extends to the Mistelbach block (fig. 5), the Ottnangian transgresses along the Tynec-Steinberg line on the Flysch of the risen front of the Greifenstein nappe (Jiříček 1978). There it reaches the maximum thickness with 800—900 m. In the opposite direction to the northwest, the marine Ottnangian is proven in wells near Lednice east of Mikulov, where it overlies thick Eggenburgian Schlier. A distinct regression appears towards the end of the Ottnangian. It is most probable that the uppermost part of the Šakvice marl in the Pouzdřany and Ždanice unit and the upper part of the Ždanice-Hustopeče beds in the Waschberg-zone belong to the Ottnangian.

2.3 The Bockfliess Beds

A great delta complex is situated south of the Central Vienna Basin with a thickness up to 800 m east of Matzen (fig. 6). It developed out of the Lužice basin over the eroding relief of the Alpine-Carpathian nappes, first across the Flysch, then onto the Limestone Alps. A river system brought the sediment input from the south. The water depth did not exeed 250 m, the facies was brackish; salinity decreased towards the top of the formation, where total regression and an unconformity can be observed. Because of its microfauna, it was thought to be Upper Ottnangian. However, a new investigation of the fauna is now underway. Regarding the paleogeographic view, it is provisionally parallelized with the Lower Karpatian in Czechoslovakia (fig. 6), although they might be identified as two different units in modern seismic profiles.

2.4 Karpatian

The beginning of the Karpatian is characterized by the prominent Older-Styrian folding, which caused the overthrust of the Alpine-Carpathian flysch of the Penninicum on to the Eggenburg-Ottnang Molasse in Lower Austria and South Moravia. In connection with this tectonic movement the Pouzdřany, Waschberg and Ždanice zones were formed as the northwestern external zone of the mountain belt. On this occasion an enormous relief inversion developed; the flanks of the Bohemian Massif were tilted to the southeast, and progressively younger sediments of the marine Karpatian and Rzehakia beds transgressed to the northwest. After a decrease of the pressure of the Pannonian plate and the termination of the thrust movement from the southeast against the Bohemian Massif, the whole region reacted with an uplifting. This movement caused the regression of the sea from west to east and to northeast. It was in this way that the "Obere Süßwassermolasse" in Upper Austria was formed. In Lower Austria the sea regressed to the line Tulln-Eggenburg and covered most of the Waschberg, Ždanice and Flysch units (fig. 7). This sequence is partly preserved in the Korneuburg basin, in the area up to the Austrian-Czechoslovakian border and in the Southern Moravian graben region. Towards the end of the Karpatian, sedimentation moved back to the northeast and continued in the Laa basin and the connected northern Vienna Basin.

On the base of the Karpatian we can place the Rzehakia beds of the foredeep (fig. 6). Their brackish sediments reach in some areas the basis of the Lower Badenian as equivalent to the marine, more then 1 000 m thick beds of the Laa formation. In the wells close to Dunajovice near the Austrian-Czechoslovakian boundary the Rzehakia beds develop into Congeria beds and Ammonia sands, in whose marly layers a fauna of Karpatian age with Cyclammina carpatica and Uvigerina primiformis was found.

Similar confusions of Rzehakia beds with marine Karpatian sediments are known also from the Southern Slovakian area, the Salgotarjan basin, Lwow area (Lemberg, USSR) and from Georgia (USSR). It was for this reason that Jiříček (1975—1988) proposed to classify these deltaic and lagoonal sediments as equivalent to the marine Karpatian. In this case the assumption of a hypothetical brackish sea, extending from Switzerland to the Aral region, is no longer valid (Papp 1948—1975, Schlickum-Strauch 1968, Cicha 1967—1987, Čtyroký 1972—1982).

The progressive Karpatian transgression in the foredeep of Lower Austria and South Moravia in the northwest direction can be observed because of the disappearance of the different units, first of the thick Rzehakia beds (fig. 6). Then the Congeria and Ammonia sands disappear, which were recorded on top of the Eggenburgian in the wells near Laa, Wildendürnbach, Nový Přerov, Březí, Dolní Dunajovice, Mikulov up to Nesvačilka.

From Hrušovany and Židlochovice to the basin termination pelitic sediments of the marine Middle Karpatian are in contact with this Eggenburgian. On the border of the foredeep, the Upper, Uvigerina bearing sandy-shaly Karpatian almost touches the underlying Eggenburgian (fig. 7). In its continuation to Moravský Krumlov and Brno-Líšeň, only the Rzehakia beds appear. In the past these were thought to be of the same age. The greatest subsidence and sedimentation rate took place east of Laa where the predominantly shaly sequence reached a thickness of around 1 100 m.

In the northern part of the Vienna Basin, sedimentation continued from the regressive Ottnangian to the Karpatian. The Karpatian started with a transgression and is divided into three substages. The sediments of the lower stage cover nearly the whole western part, the area of the Mistel-

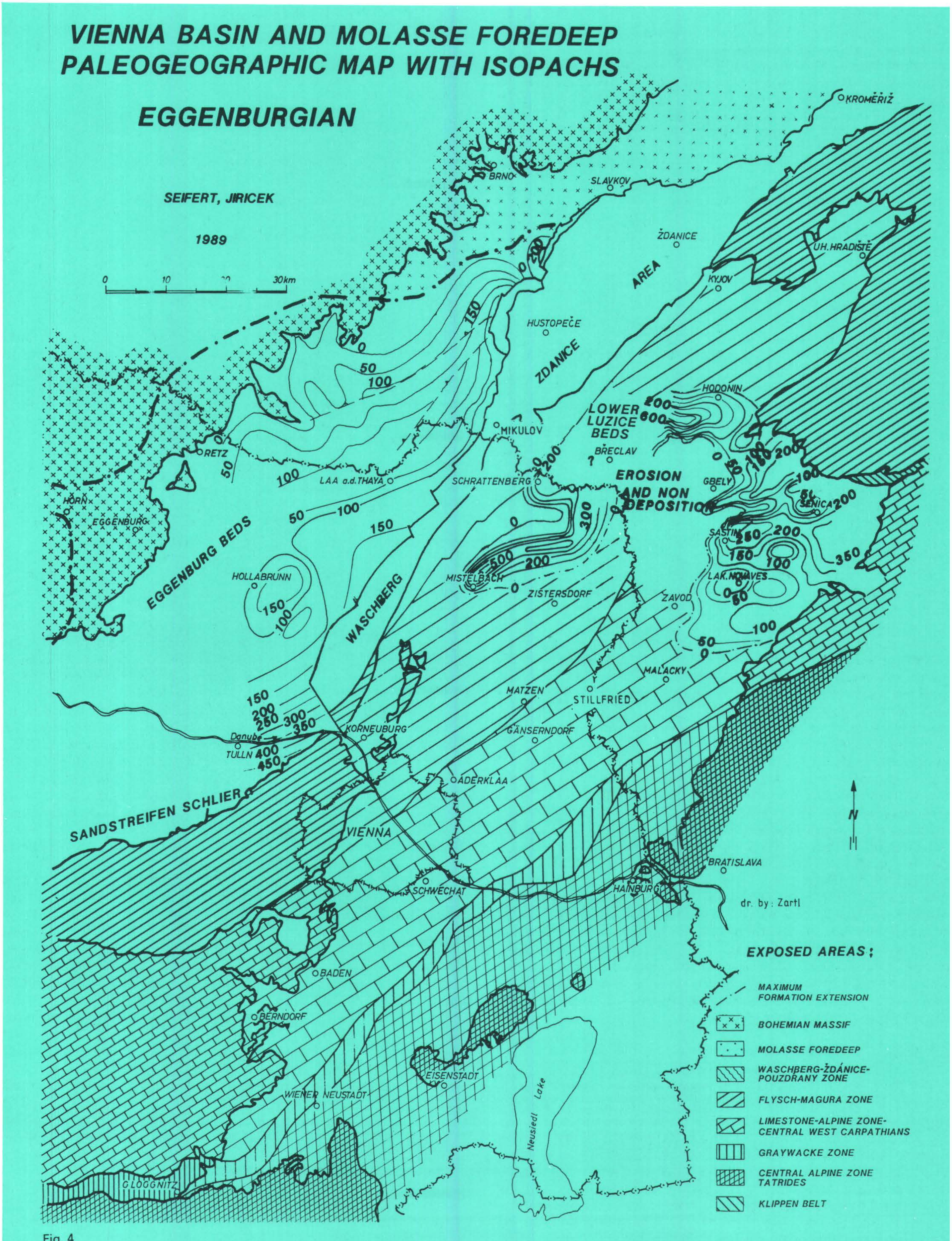

VIENNA BASIN AND MOLASSE FOREDEEP
PALEOGEOGRAPHIC MAP WITH ISOPACHS
EGGENBURGIAN
SEIFERT, JIRICEK
1989
0 10 30km
KROMĚŘÍŽ
BRNO
SLAVKOV
ŽDANICE
UH. HRADIŠTĚ
KYJOV
AREA
HUSTOPEČE
ŽDANICE
HODONIN
LOWER LUZICE BEDS
MIKULOV
BŘECLAV
RETZ
EROSION AND NON DEPOSITION
GBELY
SENICA
LAA a.d. THAYA
SCHRATTENBERG
HORN
EGGENBURG
EGGENBURG BEDS
ŠAŠTIN
HOLLABRUNN
MISTELBACH
ZISTERSDORF
LAK. NOVAVES
ZAVOD
WASCHBERG
MALACKY
MATZEN
STILLFRIED
KORNEUBURG
GÄNSERNDORF
Danube
TULLN
ADERKLAA
SANDSTREIFEN SCHLIER
VIENNA
N
BRATISLAVA
SCHWECHAT
HAINBURG
dr. by: Zartl
BADEN
BERNDORF
EISENSTADT
WIENER NEUSTADT
Neusiedl Lake
GLOGGNITZ
EXPOSED AREAS:
MAXIMUM FORMATION EXTENSION
BOHEMIAN MASSIF
MOLASSE FOREDEEP
WASCHBERG-ŽDÁNICE-POUZDRANY ZONE
FLYSCH-MAGURA ZONE
LIMESTONE-ALPINE ZONE-CENTRAL WEST CARPATHIANS
GRAYWACKE ZONE
CENTRAL ALPINE ZONE TATRIDES
KLIPPEN BELT

Fig. 4

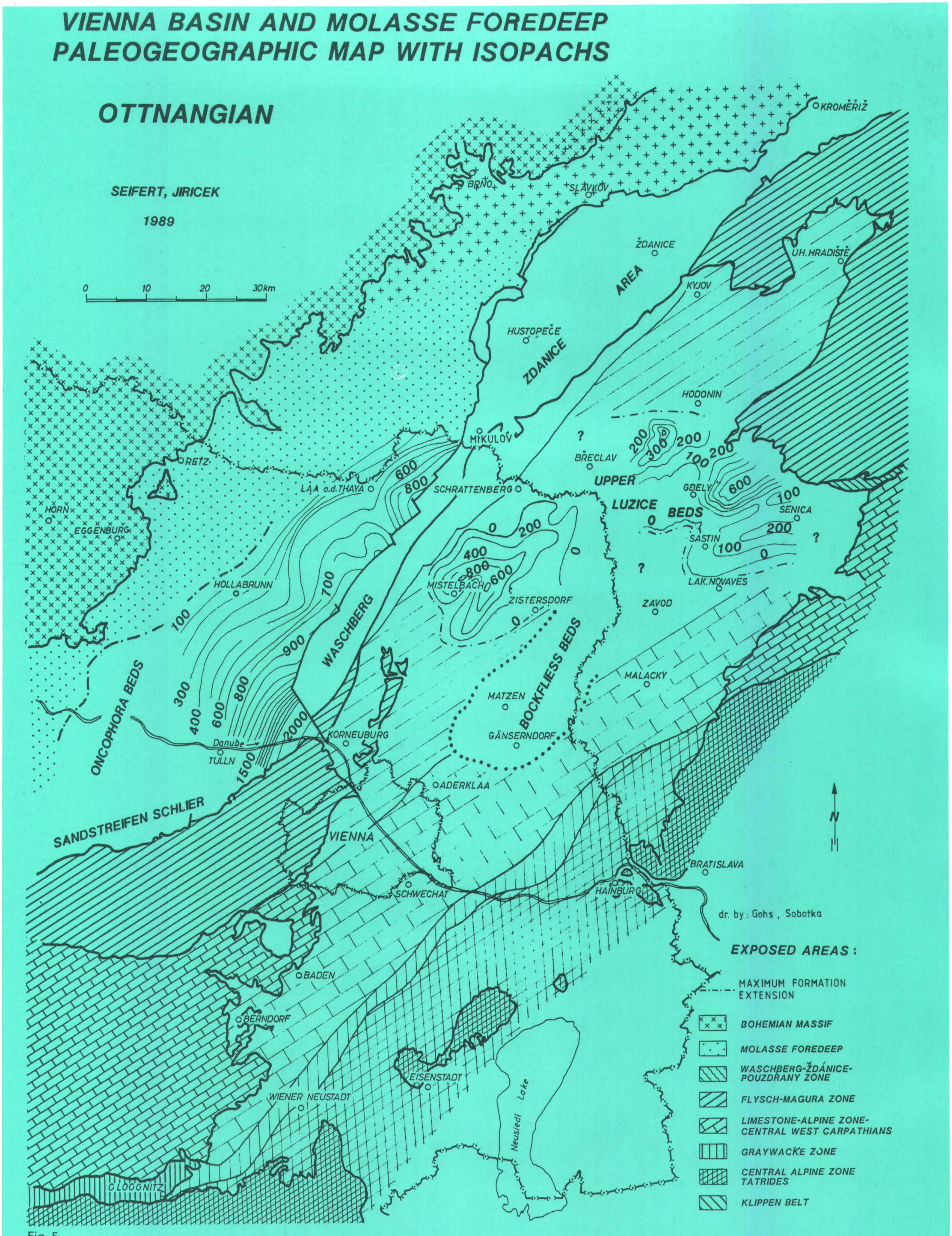

VIENNA BASIN AND MOLASSE FOREDEEP
PALEOGEOGRAPHIC MAP WITH ISOPACHS
OTTNANGIAN
SEIFERT, JIRICEK
1989
0
10
20
30km
KROMĚŘIŽ
BRNO
SLAVKOV
ŽDANICE
UH. HRADIŠTĚ
KYJOV
AREA
HUSTOPEČE
ZDANICE
HODONIN
MIKULOV
BŘECLAV
UPPER
LUZICE BEDS
GBELY
SENICA
SASTIN
LAK. NOVAVES
ZAVOD
RETZ
HORN
EGGENBURG
LAA a.d.THAYA
SCHRATTENBERG
MISTELBACH
ZISTERSDORF
HOLLABRUNN
WASCHBERG
BOCKFLIESS BEDS
MALACKY
MATZEN
GÄNSERNDORF
ONCOPHORA BEDS
Danube
KORNEUBURG
TULLN
ADERKLAA
SANDSTREIFEN SCHLIER
VIENNA
BRATISLAVA
SCHWECHAT
HAINBURG
dr. by: Gohs, Sobotka
BADEN
BERNDORF
EISENSTADT
WIENER NEUSTADT
Neusiedl Lake
GLOGGNITZ
N
EXPOSED AREAS:
MAXIMUM FORMATION EXTENSION
BOHEMIAN MASSIF
MOLASSE FOREDEEP
WASCHBERG-ŽDÁNICE-POUZDRANY ZONE
FLYSCH-MAGURA ZONE
LIMESTONE-ALPINE ZONE-CENTRAL WEST CARPATHIANS
GRAYWACKE ZONE
CENTRAL ALPINE ZONE TATRIDES
KLIPPEN BELT

Fig. 5

bach block, and extend from the north to the Levare graben to the southeast (fig. 7). In the western part the Laa sandfacies is developed, which advances to Moravia as Tynec sand. On the Tynec-Gbely elevation it is replaced by marine Schlier sediments, which surround the whole northern part of the basin into the depression of Senice. Near the Little Carpathians the marine Schlier sediments of the Lakšáry beds are underlain by the Jablonica conglomerate.

In the Middle Karpatian thick delta sequences were developed, which surrounds the Slovakian part of the basin from Gbely to Studienka as Šaštín sands. The course of the rivers was directed from south to north.In the Upper Karpatian nearly the whole area of today's Vienna Basin was coverred with sediments. The largest basin subsidence shifted during the Karpatian from the eastern part of the basin to the middle part near the Austrian-Czechoslovakian border (compare fig. 6 and 7). The western part was uplifted and erosion and non deposition took place from Matzen to Zistersdorf in the area NW of the Spannberg ridge (fig. 7).

The vertical profile in the Slovakian part shows a sequence of 600—900 m Lakšáry Schlier sediments of the Lower Karpatian, then the 100—400 m thick brackish to limnic Šaštín sands of the Middle Karpatian and at last the marly-sandy 1 000 m thick marine to brackish Zavod formation of the Upper Karpatian (fig. 7).

The Bockfließ beds in the Austrian part of the basin correspond perhaps with the Lower Karpatian in Slovakia (fig. 6). The younger Gänserndorf beds are a limnic-terrestric sequence south of the central region of the basin with a thickness of 400 m near Rabensburg in the northeastern corner of the Austrian part and more then 500 m near Gänserndorf. Sandstones, conglomerates, coloured claystones with evaporite layers together with a limnic-terrestric fauna and Characeae bearing layers are characteristic and can be compared with the Middle Karpatian in the Slovakian part.

The Aderklaa beds developed continuously from the underlying Gänserndorf beds and transgressed 30 km to the south. The sand-shale sequence presents a delta complex with the terrestric part between Schwechat and Hainburg in the south, the delta plain area in the region east of Vienna up to the Matzen field, the delta front in the Matzen Závod area and the delta slope in the central, Slovakian part of the basin. The limnic brackish facies and fauna in the southern part correlates with the limnic-brackish Lab (ostracode) beds of Upper Karpatian in the south Slovakian part of the basin.

On top of the Lower Miocene sequence, in a period of nearly total regression in the basin, the fluviatile Aderklaa conglomerates appeared in the area east of Vienna up to Gänserndorf and the Little Carpathians. It covered an area of 350 km² and filled the relief mainly with components of the Limestone Alps from southwest up to a thickness of 350 m. Little conglomerate complexes on the western and southeastern border of the basin correspond to it.

3. Middle Miocene

At the beginning of this period the tectonic style changed from thrusting and normal faulting to strike slip movement. Because of the oblique collision of the Alpine-Carpathian nappe system with the Variscan Bohemian Massif, the thrust movement ended from west to east (Jiříček 1979).

In the Molasse zone west of Vienna, the latest overthrust is found in the Ottnangian, in the Waschberg zone in Lower Austria during the Karpatian, in the Ždanice unit in South Moravia at the end of the Karpatian, in North Moravia in the Lower Badenian.

The Waschberg, Pouzdřany and Ždanice units rose and began to be eroded. In the remaning Molasse foredeep, the last sedimentation period began for a short time. From the Mediterranean region across the Styrian Basin and Burgenland, the north part of the Vienna Basin with continuous sedimentation was again connected with the Tethys from the beginning of Badenian.

In the Vienna Basin an enormous relief inversion took place as a consequence of the change of the tectonic style. At the same time the major fault systems — Schrattenberg, Steinberg-Zistersdorf, Lanžhot, Kúty and Lakšáry — were created.

3.1 Lower Badenian

The Lower Lagenid zone sequence started with block breccias and conglomerates, which document the uplift of the neighbouring Alpine-Carpathian Flysch and Waschberg Ždanice zone and their erosion. The predominantly sandy beds are interbedded with shales mainly in the area southwest of Laa. Across the region between Mistelbach up to Hustopeče, the Vienna basin was connected with the sedimentation area of the reamining Molasse foredeep across the Wachberg — Ždanice unit (Grill 1958, 1961), (fig. 8). The sedimentation area extended in Lower Austria to the southwest near Krems, where the outcropping sediments are called Grund beds. The sequence started with basal sands overlain by lithothamnium limestones. The main part is built by Tegel. From the Lower to the Upper Lagenid zone the change of the tectonic style continued. The Molasse Basin, the Waschberg — Ždanice zone and the western and northern part of Vienna Basin were uplifted and began to be eroded after regression of the sea took place. The sedimentation followed the new fault-formed NNE—SSW basin axis and transgressed to the north and to the south (see fig. 8). Towards the end of the Karpatian, sedimentation in the northern part was marine, in the southern part limnic. During the Lower Badenian a reversal happened. Limnic sedimentation took place in the north and marine in the south. We can observe the progressive transgression of younger and younger beds northwards on the older Lower Miocene. The thick sequence of the central Moravian deep consists mainly of "Tegel". To the south a delta complex developed in the region Aderklaa, Matzen, Gajary west of Malacky.

3.2 Middle Badenian

The uplift of the western region — Molasse foreland, Waschberg-Ždanice zone and the western and northern border of the Vienna Basin — still continued and the area became dry land, except the northern part around Opava. The width of the Vienna Basin reached its maximum extension in the Austrian part, which can be seen still today (fig. 8). This is a result of the high stand of the global eustatic sea level (Kreutzer 1986).

A river system, the so-called "Ur-Donau", proceeded along the dry Molasse zone from the west through the Zaya-Graben into the Vienna Basin and established a large delta system. The Zaya Graben was developed above an old west-east Variscan graben structure of the underlying Bohemian Massif, which showed subsidence activity again from this time up to the Pannonian. The great delta complex progressed from west to east and covered nearly 30 percent of the whole basin in marine facies in the area of Pirawarth, Matzen, Gänserndorf, Suchohrad, Jakubov, Vysoká and Gajary to the southeast.

In the northern part a regression took place, and a delta complex advanced southwards into the basin (Jiříček 1975). In the lower part the lagoonal Žižkov beds were deposited and the sequence was finished with the Lab sands.

Lithothamnium limestones are characteristic sediments in the shallow water areas at this time. They were built at the upthrown side of the Mistelbach block at Schrattenberg and Lednice in the north and at the Steinberg in the middle part of the basin, as well as on the Matzen anticline. In the southeast 100 m thick bioherms overlain by claystones grew in the Lab area south of Malacky. The Hainburg and the Leitha mountains north of Eisenstadt are covered with tens of meters of this limestone.

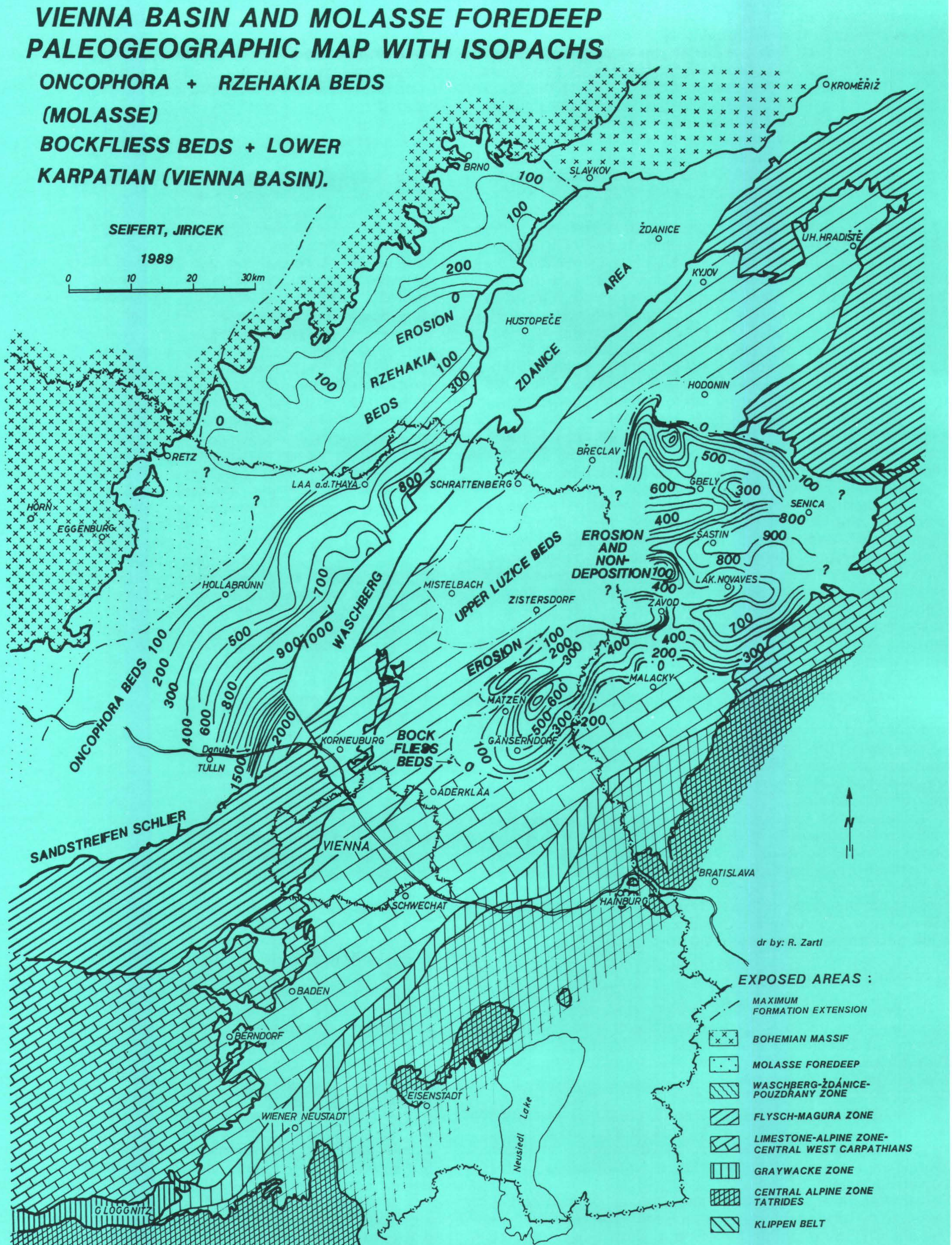

VIENNA BASIN AND MOLASSE FOREDEEP
PALEOGEOGRAPHIC MAP WITH ISOPACHS
ONCOPHORA + RZEHAKIA BEDS
(MOLASSE)
BOCKFLIESS BEDS + LOWER
KARPATIAN (VIENNA BASIN).
SEIFERT, JIRICEK
1989
0
10
20
30km
KROMĚŘIŽ
BRNO
SLAVKOV
ŽDANICE
UH.HRADIŠTĚ
KYJOV
HUSTOPEČE
AREA
ŽDANICE
EROSION
RZEHAKIA
BEDS
HODONIN
BŘECLAV
GBELY
SENICA
RETZ
LAA a.d.THAYA
SCHRATTENBERG
HORN
EGGENBURG
ŠAŠTIN
EROSION
AND
NON-
DEPOSITION
UPPER LUZICE BEDS
LAK.NOVAVES
HOLLABRUNN
MISTELBACH
ZISTERSDORF
ZAVOD
WASCHBERG
EROSION
MALACKY
ONCOPHORA BEDS
MATZEN
GÄNSERNDORF
KORNEUBURG
BOCK
FLIESS
BEDS
Danube
TULLN
ADERKLAA
SANDSTREIFEN SCHLIER
VIENNA
BRATISLAVA
SCHWECHAT
HAINBURG
N
dr by: R. Zartl
BADEN
BERNDORF
EISENSTADT
WIENER NEUSTADT
Neusiedl Lake
GLOGGNITZ
EXPOSED AREAS :
MAXIMUM
FORMATION EXTENSION
BOHEMIAN MASSIF
MOLASSE FOREDEEP
WASCHBERG-ŽDÁNICE-
POUZDRANY ZONE
FLYSCH-MAGURA ZONE
LIMESTONE-ALPINE ZONE-
CENTRAL WEST CARPATHIANS
GRAYWACKE ZONE
CENTRAL ALPINE ZONE
TATRIDES
KLIPPEN BELT

Fig. 6

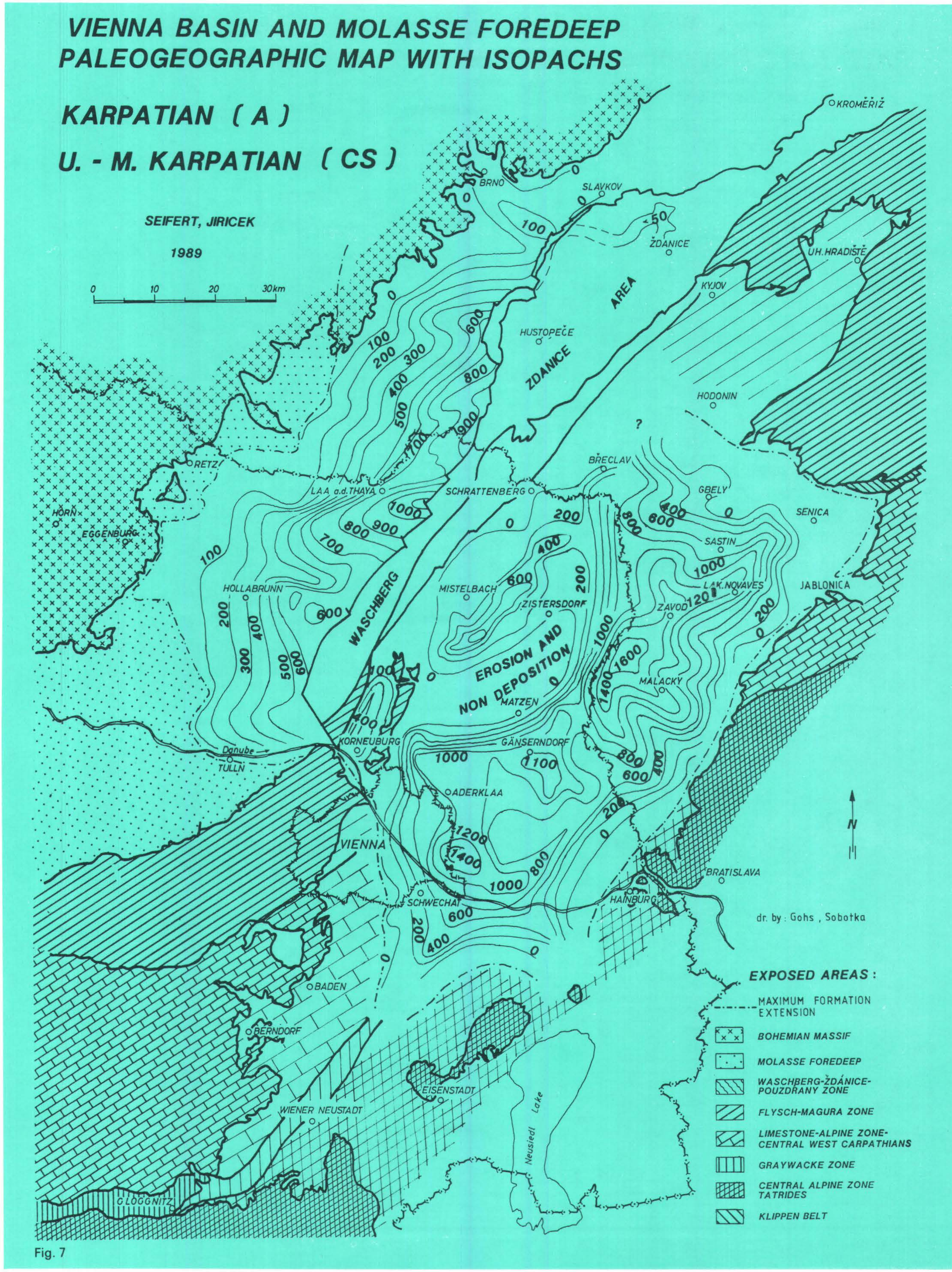

VIENNA BASIN AND MOLASSE FOREDEEP
PALEOGEOGRAPHIC MAP WITH ISOPACHS
KARPATIAN (A)
U. - M. KARPATIAN (CS)
SEIFERT, JIRICEK
1989
0 10 20 30km
BRNO
SLAVKOV
KROMĚŘÍŽ
ŽDANICE
UH. HRADIŠTĚ
KYJOV
HUSTOPEČE
ŽDANICE AREA
HODONIN
BŘECLAV
RETZ
LAA a.d. THAYA
SCHRATTENBERG
GBELY
SENICA
HORN
EGGENBURG
SASTIN
HOLLABRUNN
MISTELBACH
ZISTERSDORF
LAK. NOVAVES
JABLONICA
ZAVOD
WASCHBERG
EROSION AND NON DEPOSITION
MALACKY
MATZEN
KORNEUBURG
GÄNSERNDORF
Danube
TULLN
ADERKLAA
VIENNA
N
BRATISLAVA
SCHWECHAT
HAINBURG
dr. by: Gohs, Sobotka
BADEN
BERNDORF
EISENSTADT
WIENER NEUSTADT
Neusiedl Lake
GLOGGNITZ
EXPOSED AREAS :
MAXIMUM FORMATION EXTENSION
BOHEMIAN MASSIF
MOLASSE FOREDEEP
WASCHBERG-ŽDÁNICE-POUZDŘANY ZONE
FLYSCH-MAGURA ZONE
LIMESTONE-ALPINE ZONE-CENTRAL WEST CARPATHIANS
GRAYWACKE ZONE
CENTRAL ALPINE ZONE TATRIDES
KLIPPEN BELT

Fig. 7

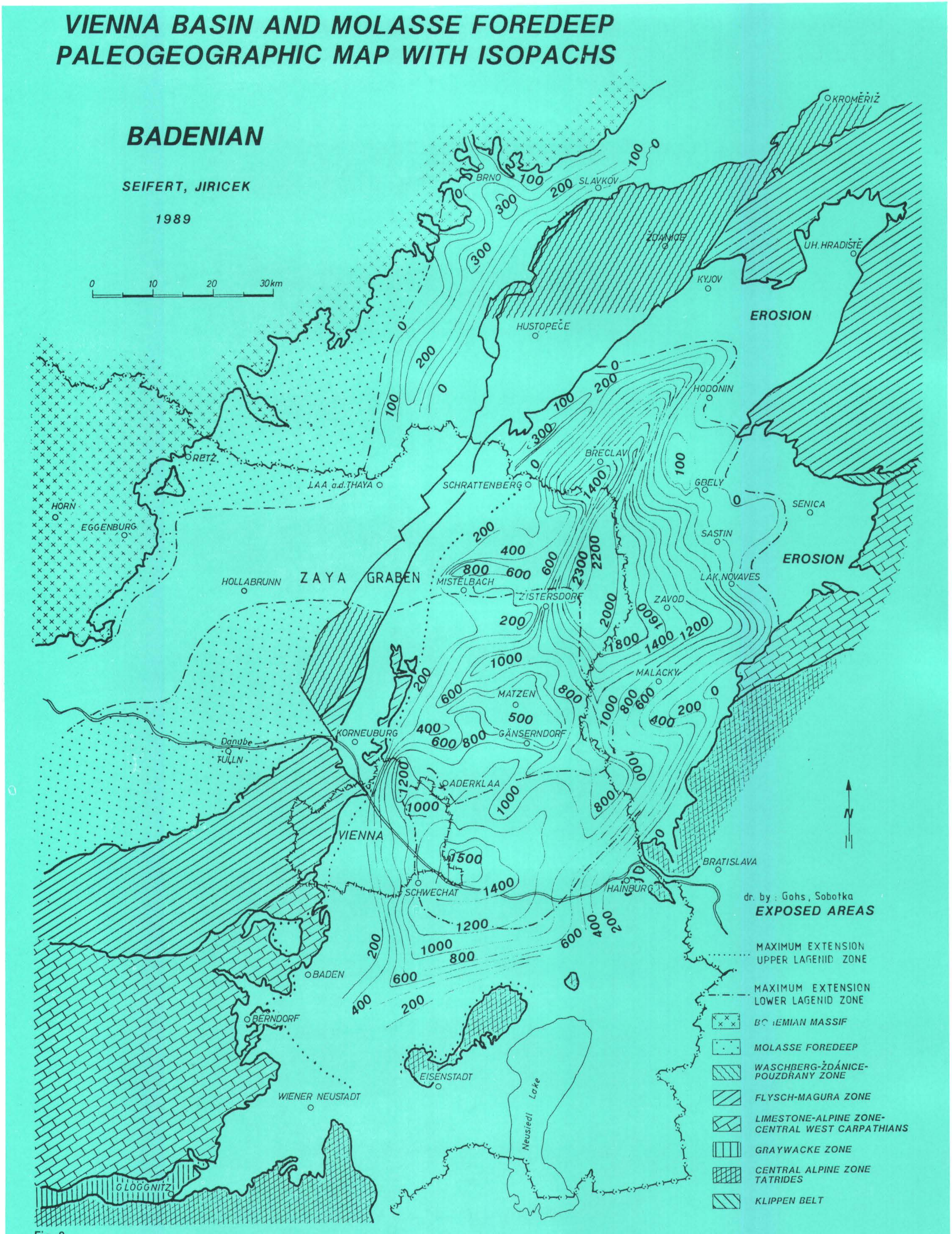
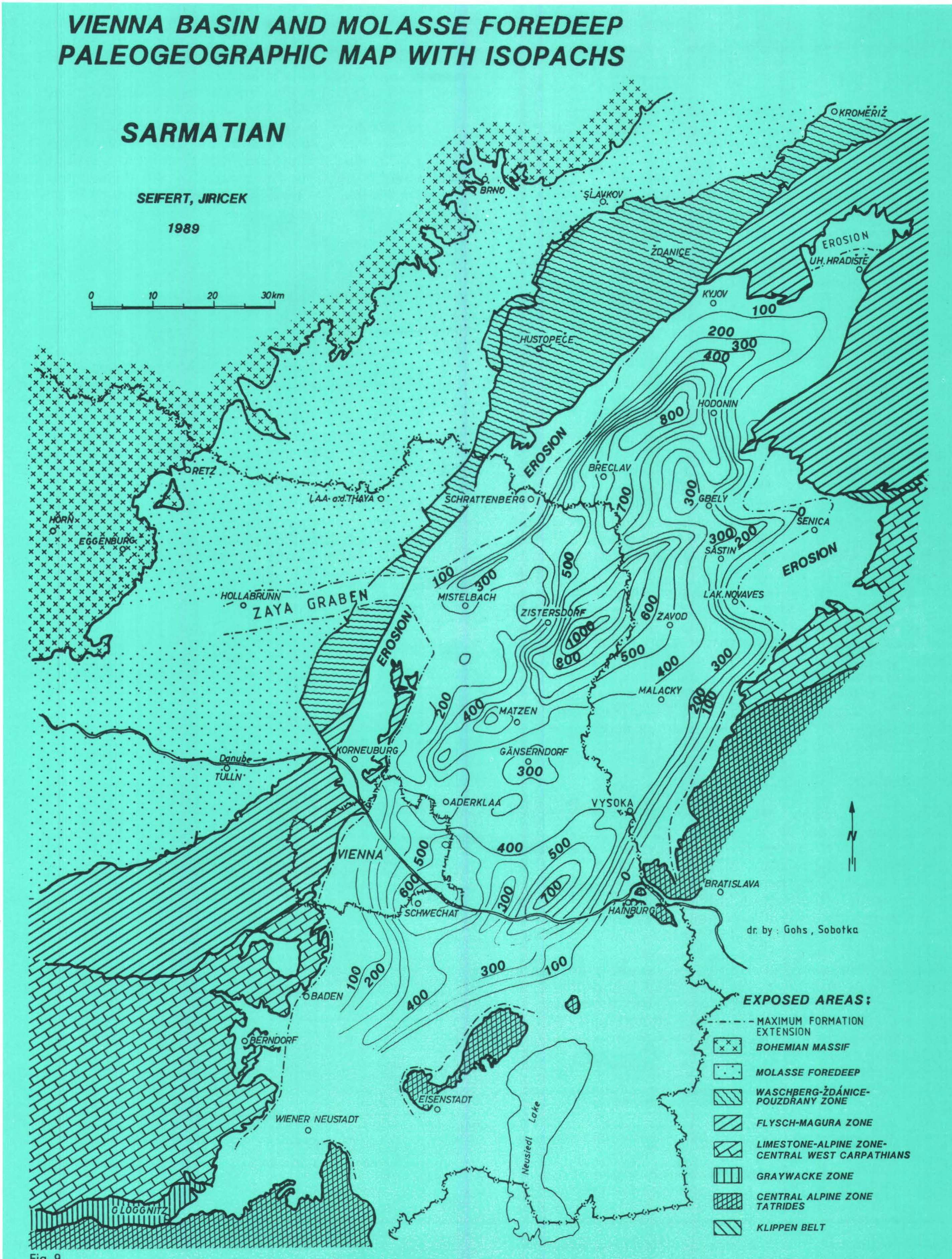

VIENNA BASIN AND MOLASSE FOREDEEP
PALEOGEOGRAPHIC MAP WITH ISOPACHS
BADENIAN
SEIFERT, JIRICEK
1989
0 10 20 30km
KROMĚŘIŽ
BRNO
SLAVKOV
ŽDANICE
UH. HRADIŠTĚ
KYJOV
EROSION
HUSTOPEČE
HODONIN
RETZ
LAA a.d. THAYA
SCHRATTENBERG
BRECLAV
GBELY
SENICA
HORN
EGGENBURG
SASTIN
EROSION
HOLLABRUNN
ZAYA GRABEN
MISTELBACH
ZISTERSDORF
LAK. NOVAVES
ZAVOD
MALACKY
MATZEN
KORNEUBURG
GÄNSERNDORF
Danube
TULLN
ADERKLAA
VIENNA
BRATISLAVA
SCHWECHAT
HAINBURG
BADEN
BERNDORF
EISENSTADT
WIENER NEUSTADT
Neusiedl Lake
GLOGGNITZ
N
dr. by: Gohs, Sobotka
EXPOSED AREAS
MAXIMUM EXTENSION UPPER LAGENID ZONE
MAXIMUM EXTENSION LOWER LAGENID ZONE
BOHEMIAN MASSIF
MOLASSE FOREDEEP
WASCHBERG-ŽDÁNICE-POUZDŘANY ZONE
FLYSCH-MAGURA ZONE
LIMESTONE-ALPINE ZONE-CENTRAL WEST CARPATHIANS
GRAYWACKE ZONE
CENTRAL ALPINE ZONE TATRIDES
KLIPPEN BELT

Fig. 8


VIENNA BASIN AND MOLASSE FOREDEEP
PALEOGEOGRAPHIC MAP WITH ISOPACHS
SARMATIAN
SEIFERT, JIRICEK
1989
0 10 20 30km
KROMĚŘÍŽ
BRNO
SLAVKOV
ŽDANICE
EROSION
UH. HRADIŠTĚ
KYJOV
HUSTOPEČE
HODONÍN
BŘECLAV
GBELY
SENICA
ŠAŠTÍN
RETZ
LAA a.d. THAYA
SCHRATTENBERG
HORN
EGGENBURG
HOLLABRUNN
ZAYA GRABEN
MISTELBACH
ZISTERSDORF
ZAVOD
LAK. NOVAVES
MALACKY
MATZEN
KORNEUBURG
Danube
TULLN
GÄNSERNDORF
ADERKLAA
VYSOKA
VIENNA
BRATISLAVA
SCHWECHAT
HAINBURG
dr. by: Gohs, Sobotka
BADEN
BERNDORF
EISENSTADT
WIENER NEUSTADT
Neusiedl Lake
GLOGGNITZ
N
EXPOSED AREAS:
MAXIMUM FORMATION EXTENSION
BOHEMIAN MASSIF
MOLASSE FOREDEEP
WASCHBERG-ŽDÁNICE-POUZDŘANY ZONE
FLYSCH-MAGURA ZONE
LIMESTONE-ALPINE ZONE-CENTRAL WEST CARPATHIANS
GRAYWACKE ZONE
CENTRAL ALPINE ZONE TATRIDES
KLIPPEN BELT
Fig. 9

The transgression reached the southernmost part of the basin, from where another delta complex advanced to the north to the region Schwechat-Hainburg.

3.3 Upper Badenian

In this time the transgression reached the northernmost part of the basin, where it covered the Ottnangian and Eggenburgian beds. The lower part, especially in the south, is characterized by marine claystones, sands and lithothamnium limestone beds of the Bulimina zone. In the upper part marine and brackish sands of the Rotalia zone dominate. Towards the end of the Badenian a reduced fauna appeared together with a partial regression, which can be observed at the line border of the basin.

4. Upper Miocene

In this period the separation of the Paratethys from the Mediterranean Sea and the transformation to a brackish continental sea occured.

4.1 Sarmatian

The lowest part is characterized by the above-mentioned regression and the locally developed coloured limnic beds (Carychium beds). They cover nearly the whole Czechoslovakian part of the basin up to Malacky, Lab and Vysoka (Jiříček 1975).Here we can observe the transition to the brackish beds, which are developed mainly in the Austrian part.

In the central part of the basin we assume continuous sedimentation across the Baden/Sarmat boundary. The brackish sand-shale sequence transgressed across the underlying different facies areas (zone with large Elphidiae). Above that the sandy zone with Elphidium hauerinum followed and then the sand-clay sequence with Protoelphidium granosum (fig. 2). The sediment input was brought mainly by the big delta system out of the Zaya graben, where residual Sarmat sediments were found up to Hollabrunn in the west (fig. 9). Two smaller deltas filled the basin from the north near Uherské Hradiště and the south near Wiener Neustadt. At the end of this sequence a partial regression occured. The three depocentres occur near Hodonin, Zistersdorf and east of Schwechat.

4.2 Pannonian

After the regression phase at the Sarmatian/Pannonian boundary, which can be observed at the basin border, a last transgression took place. The Paratethys was divided into the western kaspibrackish to limnic Pannonian Basin, the central halfbrackish Pannonian Basin and the eastern brackish area. At this period the Vienna Basin was a bay, situated northwest of the Pannonian Basin, and filled by the former delta systems especially by the Zaya graben delta (fig. 10).

The uplift and erosion of the Alpine orogene caused block-breccias in the south and thick sand-gravel sequences in the centre of the basin. The Pannonian sequence consists also of sand, shale, silt and marly beds. In the northern part of the basin, in Hradiště graben the sediments transgressed directly on the flysch.

The depocentres near Zistersdorf and Schwechat were shifted to the west from Sarmatian to Pannonian time (compare fig . 9 and 10).

4.3 Pontian

This period is characterized by the regression of the halfbrackish sea to Hungary. The sedimentation concentrated in a new axis near the southeastern borderline of the basin. south of Malacky, east of Schwechat and north of Wiener Neustadt (fig. 11). At the bottom, mainly in the Czechoslovakian part, the Dubňany lignite and above that the coal series of zone F are developed, which reach also the the Austrian part. On top the transition to the bluegrey marl of the zone G followed, and finally the coloured, yellow brown clays of zone H. These are limnic to terrestric sediments, which originated in marshes. In the past zone F was classified with the Upper Pannonian and zones G—H into the Pontian (Buday 1960). The stage boundary was placed deeper, because of the discovery of the brackish Pontian Ostracods. The coloured series of zone H were classified into the Dacian (Jiříček 1975). The Pontian was expanded at the whole zones F to H because of the division in three parts in the Dacian Basin and the discovery of vertebrate fossils in the coloured series in the Austrian part (Papp 1975).

5. Pliocene

The lake sedimentation withdrew from the Vienna Basin to the southeast towards Hungary. In spite of the continuous uplift of the Alpine-Carpathian orogene with the Vienna basin, some areas in this basin were still sinking. Therefore, the drainage system of the Alpine Molasse zone — the Danube river — formed, away from the Zaya graben, a new channel in today's southeern position. In the Vienna basin 200 m thick, coloured claystones were classified into the Dacian, the sands and coal bearing clays above zone H near Studienka and the river gravels, sands and lignites near the Little Carpathians in the Rumanian (Jiříček 1975).

6. Pleistocene

This has left fluviatile gravels and sands near the rivers, Loess and aeolian sands elsewhere, and alluvial fans near the Eastern Alps, the Leitha mountains and the Little Carpathians.

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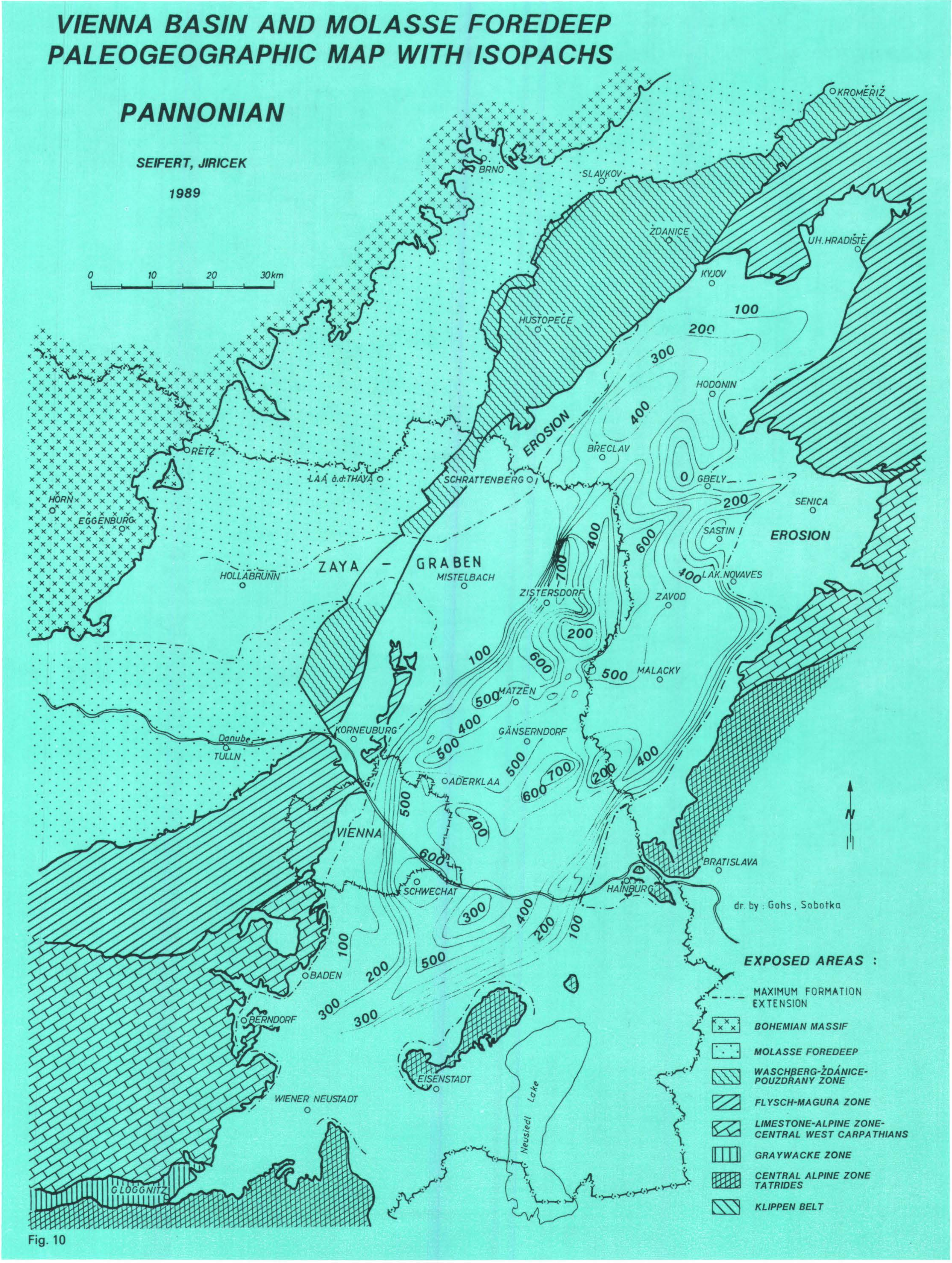
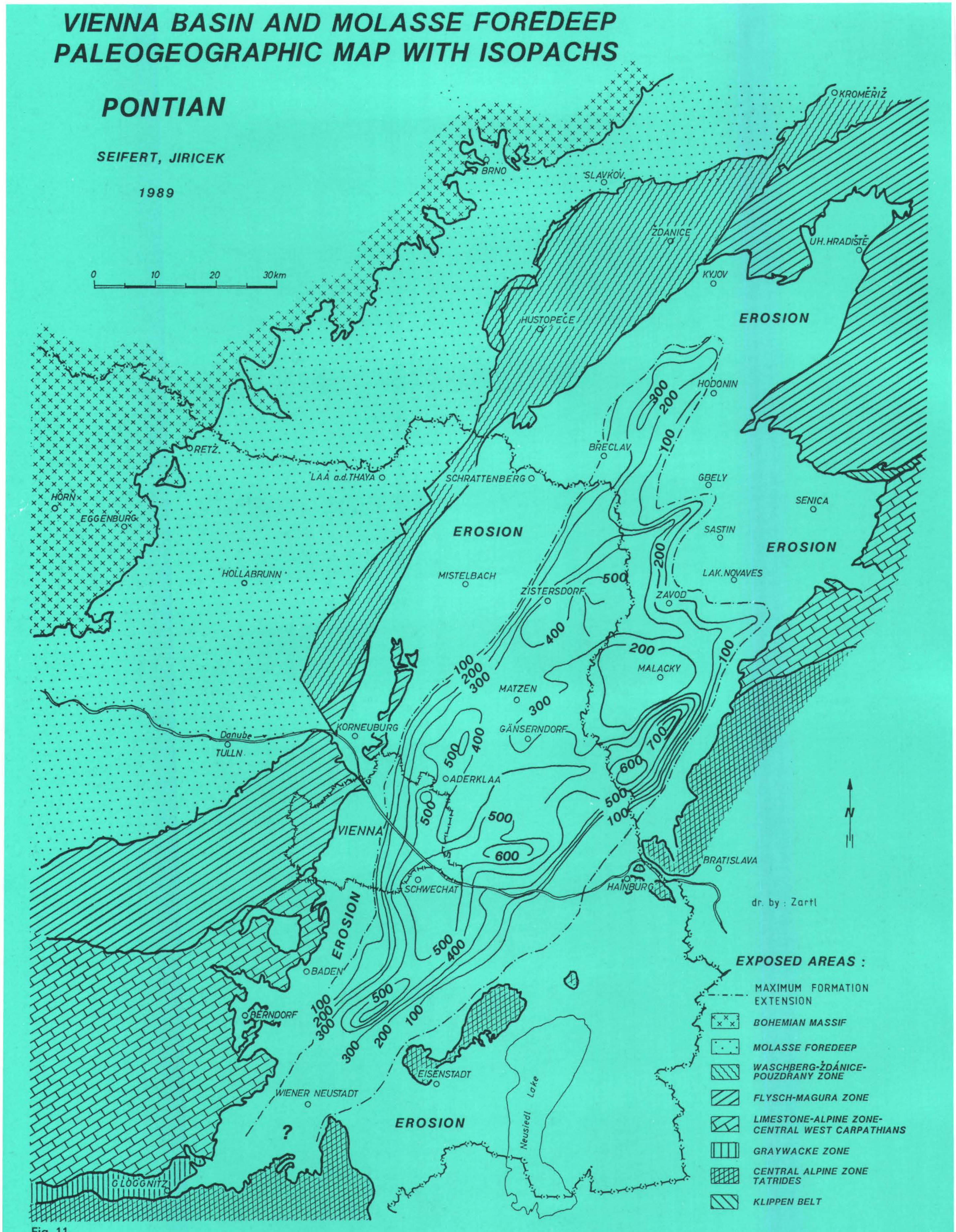

VIENNA BASIN AND MOLASSE FOREDEEP
PALEOGEOGRAPHIC MAP WITH ISOPACHS
PANNONIAN
SEIFERT, JIRICEK
1989
0 10 20 30km
KROMĚŘÍŽ
BRNO
SLAVKOV
ŽDANICE
UH. HRADIŠTĚ
KYJOV
HUSTOPEČE
HODONÍN
EROSION
BŘECLAV
RETZ
LAA a.d. THAYA
SCHRATTENBERG
GBELY
SENICA
HORN
EGGENBURG
SASTIN
EROSION
ZAYA - GRABEN
MISTELBACH
HOLLABRUNN
LAK. NOVAVES
ZISTERSDORF
ZAVOD
MALACKY
MATZEN
KORNEUBURG
GÄNSERNDORF
Danube
TULLN
ADERKLAA
VIENNA
N
BRATISLAVA
SCHWECHAT
HAINBURG
dr. by: Gohs, Sobotka
BADEN
BERNDORF
EISENSTADT
WIENER NEUSTADT
Neusiedl Lake
GLOGGNITZ
EXPOSED AREAS :
MAXIMUM FORMATION EXTENSION
BOHEMIAN MASSIF
MOLASSE FOREDEEP
WASCHBERG-ŽDÁNICE-POUZDŘANY ZONE
FLYSCH-MAGURA ZONE
LIMESTONE-ALPINE ZONE-CENTRAL WEST CARPATHIANS
GRAYWACKE ZONE
CENTRAL ALPINE ZONE TATRIDES
KLIPPEN BELT

Fig. 10



VIENNA BASIN AND MOLASSE FOREDEEP
PALEOGEOGRAPHIC MAP WITH ISOPACHS
PONTIAN
SEIFERT, JIRICEK
1989
0 10 20 30km
KROMERIZ
BRNO
SLAVKOV
ZDANICE
UH. HRADISTE
KYJOV
EROSION
HUSTOPEČE
HODONIN
BRECLAV
RETZ
LAA a.d.THAYA
SCHRATTENBERG
GBELY
SENICA
HORN
EGGENBURG
EROSION
SASTIN
EROSION
HOLLABRUNN
MISTELBACH
LAK. NOVAVES
ZISTERSDORF
ZAVOD
MALACKY
MATZEN
KORNEUBURG
GÄNSERNDORF
Danube
TULLN
ADERKLAA
VIENNA
N
BRATISLAVA
SCHWECHAT
HAINBURG
dr. by : Zartl
EROSION
BADEN
EXPOSED AREAS :
MAXIMUM FORMATION EXTENSION
BERNDORF
BOHEMIAN MASSIF
MOLASSE FOREDEEP
WASCHBERG-ŽDÁNICE-POUZDRANY ZONE
EISENSTADT
WIENER NEUSTADT
FLYSCH-MAGURA ZONE
EROSION
LIMESTONE-ALPINE ZONE-CENTRAL WEST CARPATHIANS
Neusiedl Lake
GRAYWACKE ZONE
CENTRAL ALPINE ZONE TATRIDES
GLOGGNITZ
KLIPPEN BELT

Fig. 11

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Abstrakt

V práci jsou předloženy prvé mapy mocností miocénu pro celou vídeňskou pánev a sousední molasovou zónu. Autochtonní eger je jen na rakouském území. Jeho alochtonní část tvoří šupiny ve waschberské zóně, pouzdřanské a ždánické jednotce. Sedimenty eggenburgu jsou typické jak ve vídeňské pánvi, tak i v molase. Pouze s ottnangem jsou těžkosti, neboť rzehakiové vrstvy jsou spíše korelovatelné s karpatem. Ve spodním badenu bylo jasné spojení mezi vídeňskou pánví a molasou. Od středního badenu do pontu existovalo toto spojení pouze s rakouskou molasovou zónou.

Zusammenfassung

Die vorliegende Arbeit beschäftigt sich mit der paläogeographischen Entwicklung des miozänen Wiener Beckens. Diese Region zählt zu den ältesten Erdölprovinzen Europas und zu den am intensivsten untersuchten. Die Verbreitung, die Mächtigkeit und die fazielle Ausbildung der einzelnen Formationen stehen in direktem Zusammenhang mit der tektonischen Entwicklung des Alpen-Karpatenbogens in diesem Abschnitt. Drei Stufen können unterschieden werden: Im älteren Miozän entstand das Wiener Becken am Rücken des nordwärts wandernden Deckensystems und war ein Teilbereich der nördlich davon sich erstreckenden Molassevortiefe. Der Wechsel zwischen mariner, brackischer und limnisch-fluviatiler Sedimentation spiegelt die bewegte tektonische Entwicklung des Untergrundes wider. Ab dem Mittelmiozän war die Deckenbewegung beendet und es folgte das Pull-apart-Stadium der Beckenentwicklung. Dies war von starker Absenkung und hoher Sedimentationsrate gekennzeichnet. Große Deltasysteme füllten langsam das Becken, dessen Ablagerungsmilieu sich von vollmarin zu brackisch änderte. Im oberen Miozän verursachte die starke Hebung der Alpen und Karpaten grabenähnliche Bruchstrukturen. Die verstärkte Erosion des Reliefs bewirkte Grobschüttungen, die das gesamte Becken mit limnisch-fluviatilen Sedimenten bedeckten.

THE LOWER PANNONIAN SANDS AND THE PANNONIAN-SARMATIAN BOUNDARY IN THE MATZEN AREA OF THE VIENNA BASIN

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Based on the paleoecology of foraminifera and on geology, investigations by R. JIŘÍČEK (1978, 1985) in the czechoslovakian (and austrian) part of the Central Vienna basin resulted in a predominant deltaic nature of the gas bearing Upper Sarmatian and Lower to Middle Pannonian sand (gravel) — shale (clay) succession. A fingerlike distribution of several distinct NW-SE and N-S oriented sand and gravel beds of the Pannonian attaining a maximum thickness on the ends, has been compared by R. JIŘÍČEK with the modern birdfoot delta of the Mississippi river. These Pannonian fluctuating deltaic sand lobes of an ancient Danube river mouth are characterized by a fauna pointing to a lower salinity or fresh water in the sands than in the surrounding lagoonal shales or clays, eroding sometimes deeper shale layers, for instance of the Pannonian — Sarmatian boundary. On the contrary, other oriented sandbars containing the same faunal content as the surrounding shales, are not of deltaic origin. By compaction of the shales during burial, structural highs have been developed in the sand lobes and gas reservoirs, now gas storage deposits, have been created with different gas-water contacts (R. JIŘÍČEK, 1978, 1985).

A possible deltaic origin of the brachyhaline Sarmatian in the Matzen area has been indicated by N. KREUTZER (1974). Three conspicuous channellike trends of sands with basal extraformational alpine carbonate gravels, laterally and basally sharp bounded, exist in the 3rd/4th, 6th and 7th Sarmatian which are characterized by transgressive SP-log shapes (L. KÖLBL, 1953, H. WIESENEDER, 1959, N. KREUTZER, 1974). These partly meandering trends with a pendulum effect point to a sediment transport from the northwestern Molasse zone to south into the Central Vienna basin. The Lower Pannonian sand lobes in the Matzen area show a similar pendulum effect of the several NW-SE oriented and lensoid-shaped sand-and gravel beds, separated by shale or clay layers (Fig. 1,2). The variation of the gross-and the net thicknesses is considerable in the flanks of the 5th, 4th and 3rd Lower Pannonian, accompanied by erosional effects on the basis of the 5th and 4th, but decreases upwards in the 2nd and 1st Lower Pannonian. The boundary between Pannonian and Sarmatian, also very sharp within 1 m due to the faunal content, is generally a conformity within shale (clay) beds, containing numerous and regionally correlatable E-log resistivity markers. If sand lobes of both the 5th and the 4th Lower Pannonian become very thick and sharp based (channels), they have both eroded this boundary in numerous but small places in the whole Matzen area similar as in Czechoslovakia (Fig. 3—8). The 4th Pannonian could erode this boundary, however, only in the shaly flanks of the 5th Pannonian! In other places resedimented shales seem deposited below the 4th and 5th Pannonian. Erosional effects on the basis of the 3rd, 2nd or 1st Lower Pannonian, however, could not be detected. Important gas reservoirs, now gas storage deposits, are contained in the 3rd and 4th Lower Pannonian of the Matzen field. Based on the investigations by R. JIŘÍČEK, these sand lobes in the Matzen field should be also of deltaic origin,