SHORT INTRODUCTION TO THE GEOLOGY OF AUSTRIA

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LANDSCAPE

The Austrian landscape is of great variety but dominated by the long W-E stretching mountain range of the Eastern Alps. The western and central parts show glaciation locally and have peaks exceeding 3000m. The highest mountain, the Großglockner with 3797m, lies in the Hohe Tauern. The height of the mountains decreases to the east, and the Alps turn to a NE direction, continuing in the Carpathians. The lowlands of the Alpine foredeep extend to the north and surround the hilly triangle of the Bohemian Massif.

Intramountainous basins, particularly the Vienna and the Styrian Basin, are sunken in the Alpine belt. The main river system of the Danube drains Central Europe into the Black Sea. Only a small western part of Austria is connected to the Atlantic by the Rhine.

TECTONIC UNITS (Figure 1-2)

The northern part of Austria belongs to the Bohemian Massif, a deeply eroded relic of the Variscian mountain system. Metamorphic rocks and granites of Precambrian and Paleozoic age prevail. Since the Permian, erosion has taken place. This unit continues to the south on the subsurface as the basement of the Molasse Zone. It developed into the Alpine foredeep since the Late Eocene and consists of clastic marine and fluviatile sediments up to 4000 m in thickness. Discontinuous Mesozoic (Jurassic-Cretaceous) and very rare Late Paleozoic sediments are preserved as erosional relics on top of the crystalline basement. The southern parts of the Molasse are strongly disturbed by the overthrust of the Alps in the Neogene.

The Helvetic Zone: borders in continuation of the Western Alps as a narrow strip the northern margin of the Eastern Alps. Further to the east it is overthrust, appearing only in windows and in the form of the Gresten Klippen belt. The facies and stratigraphical range change from west to east.

The Flysch Zone: to the south comprises a complex of sandstones, marls and clays with turbiditic sedimentation, partly below the CCD. It is overthrust on the Helvetic Zone. To the west it continues in the Western Alps and to the east in the Carpathians as far as the Ukraine. It is termed the Rheno-Danubian Flysch. This zone is considered as the younger (E. Cretaceous to Eocene), sheared-off sedimentary cover of the Penninic Zone.

The Penninic System: of the Western Alps continues below higher tectonical units of the Eastern Alps, appearing in large windows along the central axis of the Alps. The most prominent among these is the so-called Tauern Window. Generations of "nappists" and "autochthonists" fought over this stucture. The Penninic Zone comprises a crystalline (Precambrian? and E. Paleozoic) basement, the "Central Gneiss", and a cover of Late Paleozoic to Mesozoic metasediments. All series underwent Alpine metamorphism.

The Austro-Alpine System: represents an internally complicated and imbricated nappe system thrust from the south and superimposed on all above-mentioned zones. Two or three (Upper-, Middle?-, Lower-Austro-Alpine) tectonical subunits have a crystalline basement and a distinct Paleozoic-Mesozoic sedimentary cover. The Northern Calcareous Alps form a Mesozoic limestone belt more then 500 km long and up to 50 km wide along the northern flank of the Alpine range (and contain more than 6000 registrated caves). In the south they are connected with a unit of Paleozoic rocks, the "Grauwackenzone", dipping north under the Calcareous Alps. These units belong to the Upper Austro-Alpine subsystem. The Grauwackenzone and the crystalline basement together with the Lower and Middle Austro-Alpine form the "Central Zone" of the Eastern Alps.

The Southern Alps: are separated from the Austro-Alpine system by the "Periadriatic Lineament-fault". They exhibit a Paleozoic to Mesozoic sedimentary sequence and continue in the Dinarides.

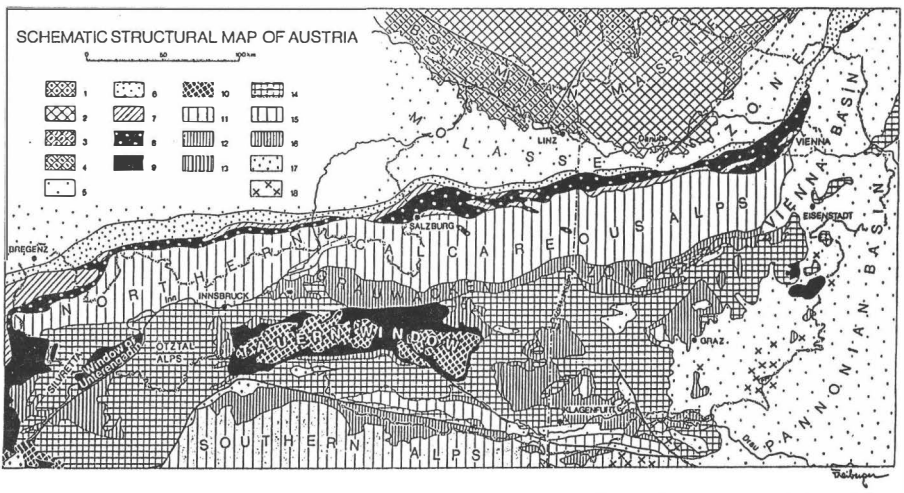


Fig. 1: Schematic structural map of Austria (after P. BECK-MANNAGETTA & A. MATURA, 1980). 1—4 = Bohemian Massif; 1 = Post-Variscan sedimentary cover; 2 = Moldanubian Zone; 3 = Moravian Zone; 4 = Bavarian Zone; 5 = Tertiary basins; 6 = Subalpine Molasse; 7 = Helvetic and Klippen Zone; 8 = Flysch Zone; 9 = Metasedimentary rocks of the Penninic Zone; 10 = Crystalline basement of the Penninic Zone; 11—14 = Austro-Alpine Unit; 11 = Permomesozoic in North-Alpine facies; 12 = Palaeozoic; 13 = Permomesozoic in Central Alpine facies; 14 = Crystalline basement ("Altkristallin"); 15 = Permomesozoic of the Southern Alps; 16 = Palaeozoic of the Southern Alps; 17 = Periadriatic intrusive masses; 18 = Neogene andesites and basalts. Cross-section see fig. 2.

(from JANOSCHEK & MATURA, 1980)

Intramountain basins developed during the Neogene in the Alpine-Carpathian nappes. The most well known (due to extensive oil and gas exploration) is the Vienna Basin. It is an asymetrically E-SE dipping, pull-apart basin, downfaulted in these nappes and filled by more than 5000 m of marine and lacustrine Neogene sediments. The autochthonous sequence of the Molasse Basin has been drilled in the deep well Zistersdorf ÜT1 at a depth of 7100 m, below the Alpine nappes (Ringhofer, 1986). A second large Neogene Basin is the Styrian Basin in the SE, a bay-like extension of the Pannonian Basin. Within the Alps, small basins containing lignite formations of Early to Middle Miocene age are developed.

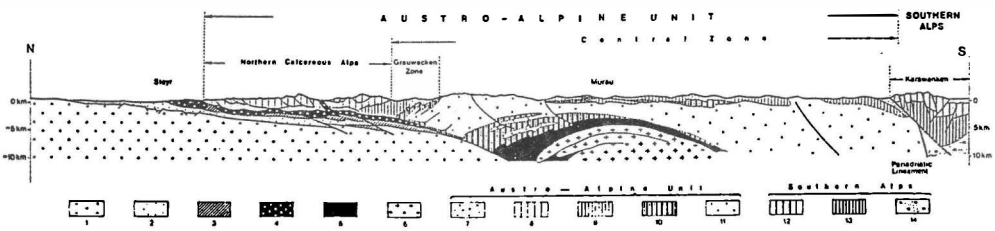


Fig. 2: Schematic cross-section of the Eastern Alps along the line Linz — Klagenfurt (modified after S. PREY, 1976; for exact position of the cross-section see fig. 1). 1 = Extra-Alpine basement of the Bohemian Massif; 2 = Molasse Zone and intra-Alpine Tertiary (post-upper-Eocene); 3 = Helvetic Zone and Klippen Zone; 4 = Flysch Zone; 5 = Metasedimentary rocks of the Penninic Zone; 6 = Crystalline basement of the Penninic Zone; 7—11 = Austro-Alpine Unit: 7 = Gosau Formation; 8 = Permomesozoic (unmetamorphic) in North-Alpine facies; 9 = Palaeozoic (low-grade metamorphic); 10 = Permomesozoic (low-grade metamorphic) in Central Alpine facies; 11 = Crystalline basement ("Altkristallin"); 12—14 = Southern Alps: 12 = Permomesozoic; 13 = Palaeozoic; 14 = Crystalline basement.

(from JANOSCHEK & MATURA, 1980)

PALEOGEOGRAPHIC DEVELOPMENT SINCE JURASSIC TIME:

The aim of this excursion program is to demonstrate agglutinated foraminifera in the Thetys and Parathetys realm. These forms are strongly connected with clastic sedimentation in the Flysch and Molasse basins, where the richest assemblages occur in the Late Cretaceous to Eocene and Late Oligocene respectively. A reconstruction of Alpine basins development is given by Faupl (1978), based on the ideas of Oberhauser (1968) and plate tectonic models of Frisch (1977). The evolution of Molasse Basin is discussed by Wagner (this paper).

Lias-Dogger: Fig. 3-5

In the Jurassic a marine transgression extended to the north on the European platform, starting with paralic coal facies in the Gresten Beds. The Penninic geosyncline began to develope as a separate ocean basin. The rifting was accompanied by coarse calstic sedimentation. The large Austro-Alpine Triassic carbonate platform with its southern fringing reefs subsided to pelagic sedimentation depths. It is bordered by submarine scarp breccias in the north.

Early Cretaceous: Fig. 6-8

The rifting shifted from the southern to the northern Penninic zone. The basin was a continuation of the Valais-trough of the Western Alps. In this basin the Rheno-Danubian Flysch Zone was developed. The different basins were separated by long W-E trending sills. The southern margin of the European platform (Helvetic Zone) subsided with concurrent calpionellid- and radiolaria-limestone sedimentation.

Late Cretaceous: Fig. 9

In Mid-Cretaceous time the southern Penninic trough was subducted continuously. This resulted in an elevation of the northern part of the Austro-Alpine plate with continental crust and Penninic ophiolithes, the so-called "Rumunian-sill". Connected with the pre-Gosavian overthrusts, sedimentation ceased in the area of the Calcareous Alps but started again in the Coniacian with shallow water deposits in the Lower Gosau formation. In the Campanian this area was formed into flysch troughs by the continuing subduction in the Penninic system. The Austro-Alpine nappes continued to thrust northwards.

Paleogene: Fig. 10

In the Flysch Zone and Gosau basins, sedimentation continued until the Eocene. In the southern parts of the Helvetic Zone (Ultrahelvetic), sedimentation took place partly below the CCD. The Helvetic shelf rose in the Paleocene but subsided again in the Middle Eocene and was again subjected to pelagic sedimentation. In the Late Eocene, the area of the Alpine foredeep - the Molasse Basin - was incorporated into the realm of the Helvetic sea.

From the Oligocene onwards a new system developed in Central and Eastern Europe: the Oligocene-Miocene Parathethys (Rögl & Steininger, 1983). At the end of the Early Miocene the sea withdrew from the Alpine foredeep, the latter becoming filled by fluviatile sediments. Intramountain basins developed, and in the Late Neogene the rising Alps formed the modern landscape.

General geological informations:

Janoschek & Matura, 1980
Matura & Summesberger, 1980
Oberhauser, 1980
Tollmann, 1976, 1977, 1985

Fig. 3

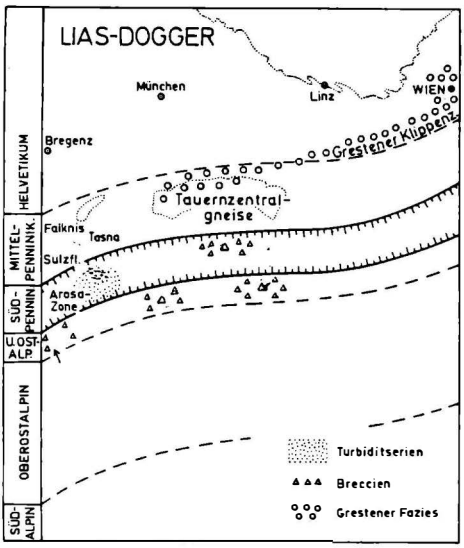


Fig. 4

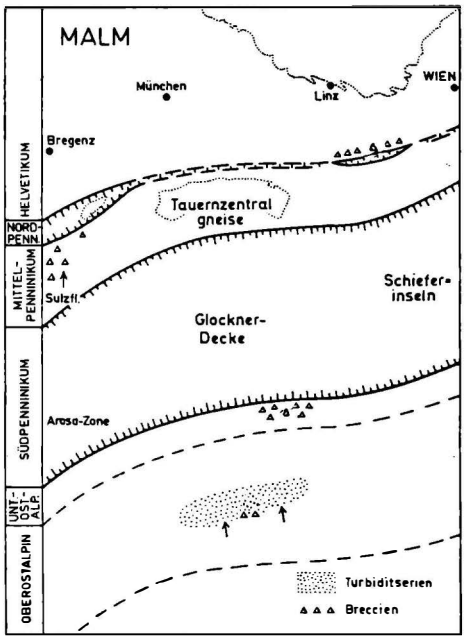


Fig. 5

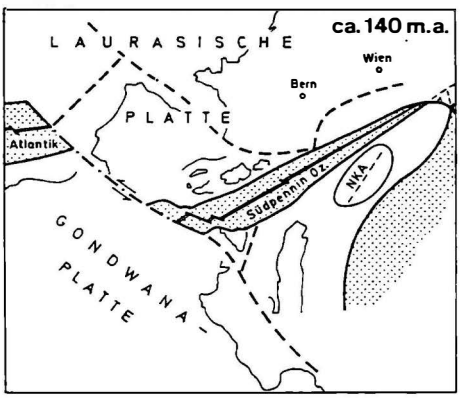
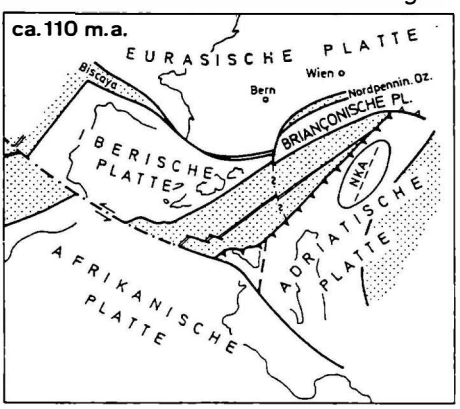


Fig. 6



Figs. 3 - 10: Paleogeographic evolution of the Eastern Alps in context to the plate tectonics of the Western Mediterranean (figs. 3 - 4, 7 - 10 from Faupl, 1978; figs. 5 - 6 from Frisch, 1977; NKA = Northern Calcareous Alps).

Fig. 7

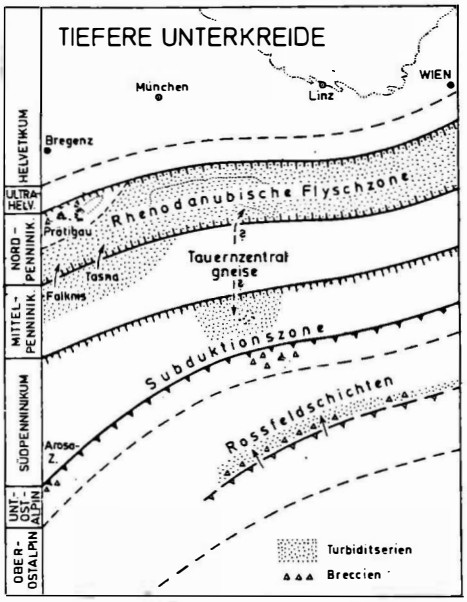


Fig. 8

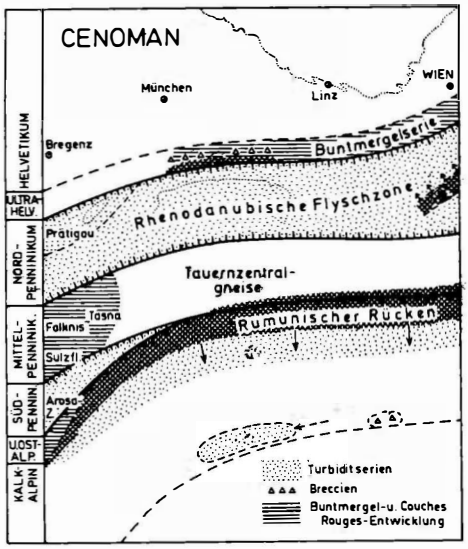


Fig. 9

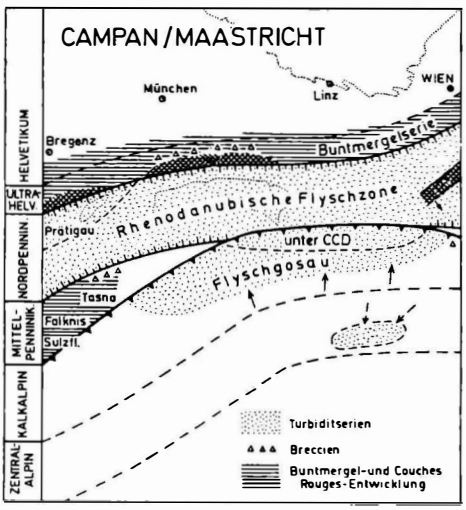


Fig. 10