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CONTENTS

SUBSURFACE WATER FLOW SYSTEMS OF THE PANNONIAN BASIN

J.Deák (Research Center for Water Resources,Budapest, Hungary) P.Liebe, Gy. Tóth.

Pannonian-basin is filled by course- and fine-grained sediments of Pliocene and Pleistocene, and fissured, karstified rocks of Mezozoic. These excellent aquifers have made the surface-waters possible to downdraft for depths of more kilometers.

Deep-circulating groundwater flow systems taking place in the porous sediments of the central subsidence area of the basin (Great Hungarian Plain) are presented.

The intermediate flow-regions occupy the upper part of the basin fill, composed predominantly of loose clastic Quaternary sequences. These groundwaters are the source of water supplies producing $2*10^6$ m^3/d of drinking water.

The underlying regional flow-system contains thermal water and hydrocarbon resources of considerable economic value.

The existence and effects of these groundwater flow systems through ten-thousends of years were proved by environmental isotope (^{14}C, ^{18}O, ^{4}He), geochemical and geothermal data. Seepage velocities and regional hydraulic conductivities are supported by ^{14}C dating of groundwaters. Stable isotope data (^{18}O and ^{2}H) prove the validity of ^{14}C ages following the changes of paleoclimate.

Hydrochemical data are used for testing models of groundwater velocities and directions, calculated from pressure distributions.

The computer models developed using geological and isotope data, and assuming the same paleo-hydrological conditions gave acceptable results regarding to the groundwater flow velocities, the convection of heat and the depressions caused by groundwater exploitations.

Additional complex and more detailed studies are needed for high accuracy forecasting the effects of ground water exploitations.

EVOLUTION OF TETHYS IN EUROPE DURING MESOZOIC AND CENOZOIC. A BRIDGE BETWEEN TWO MEGA-CONTINENTS.

J. Dercourt (Université Pierre et Marie Curie, Paris, France)

The European lithosphere was thiner than the African one during Mesozoic and Cenozoic and consequently was repeatedly invaded by epicratonic seas; whereas Africa was not; there, continental sediments dominated.

Europe is a longitudinal divided continent:

(1) to the west, it is the cratonic part of heterochronous plates; the circum atlantic passive margins appeared step by step from South to North;

(2) to the East, is an active margin starting west of Rhodopian. Subduction reaches Indochina from Triassic to Paleocene. It is documented by intense calcalcaline magmatism and back arc basins such as the Black sea;

(3) in between, a complex lithospheric **seuil** made of many microplates each having a cratonic part (shallow or deeply submerged) and an oceanic one. The **seuil** was initiated as soon as Permian and enlarged during Triassic, Jurassic and early Cretaceous, It bridges the European and African cratons and divides Eastern Tethys from Atlantic Tethys. Later on, subduction in the intra-**seuil** oceanic segments, a collision occured step by step and progressively the complex alpine belt with nappes and strike slip faults was formed. The larger linear oceanic strip included in the **seuil** are subducted and generated magmatism and back-arc basin or thinned, highly subsident, cratonic crust (e.g. Para-Tethys, western Meditteranean, Egean basin.....).

Europe was continuously located in the northern hemisphere. The very sensitive location of Tropic of Cancer in southern Europe is the main parameter which rules the facies distribution. The **seuil** rules the oceanic currents and so many tethyan facies.

CENOZOIC EVOLUTION OF THE PANNONIAN BASIN

Gy. Pogácsás (MOL Plc., Budapest, Hungary)

Over the past few years several sub-basins of the Pannonian Basin have been explored with details (incl. 3D) seismic surveys and deep drilling. In the mean time, the Hungarian Geological Survey drilled several 0.5-2 Km deep continuously cored test holes and carried out paleomagnetic measurements on samples collected by 0.5 m intervals.

Magnetostratigraphic, sedimentological, paleontological and radiometric age data were correlated with seismic and well log profiles in order to derive the tectono-stratigraphic evolution of the Pannonian Basin.

Sequence stratigraphic correlation based on seismic and well data provided the chronostratigraphic framework for the reconstruction of the multi-phase territory subsidence.

Results of these studies indicate that basin fill formations can be assigned to two sedimentary megasequences deposited in depocentres of different size, depth, genesis and structural styles.

The Paleogene - Middle Miocene megasequence with 3-4 Km maximum thickness infills halfgrabens bounded by listric faults, crested collapse grabens related to (flat-ramp) listric faults and rifts between blocks in differential rotation relative to each other. Subsidence and sediment fill of these Syn-rift depocentres were controlled by strike slip movements between (and within) discrete microplates. As a result of lithospheric stress variations, this megasequence is locally and strongly deformed. Large displacements along listric faults have resulted in tilting and formation of unconformities between Middle Miocene (Syn rift) and Upper Miocene-Pliocene (Post rift) sediments.

The Upper Miocene-Pliocene megasequence of 4-6 Km maximum thickness is represented by molasse formations deposited by prograding deltas in relatively isometric basins during the post-rift (thermal) subsidence phase.

The active tectonic processes in the Pannonian Basin culminated during Middle and Late Miocene times but, in certain zones less intense strike-slip faulting continued during Pliocene and Quaternary.

Correlating the study results of mollusca (Korpás-Hódi et al in press, Magyar in press), ostracoda (Korecz in press), dinoflagellata (Sütô-Szentay in press), high resolution sedimentology (Juhász-Szalay et al in press) from continuously cored wells with the latest seismic sequence stratigraphic results (Újszászi et al in press, Vakarcs et al in press, Várkonyi et al in press, Szabó et al in press, Várnai et al in press) the conclusion can be drawn that there are at least two 3rd order sequences in the Late Miocene-Pliocene time interval. The older sequence was deposited during the Late Miocene and was capped by the 5.5 Ma (oldest Pliocene) unconformity. The younger one is situated between the oldest Pliocene (5.5 Ma) and the Pleistocene (2.4 Ma) unconformities. The Late Miocene 3rd order sequence is built up by 5 smaller (4th order) cycles.

SEQUENCE STRATIGRAPHY CONCEPTS AND THEIR APPLICATION TO EUROPEAN BASINS

P. R. Vail (Rice University, Department of Geology and Geophysics, Houston, Texas), T. Jacquin (CNRS, Paris, France) and P. Ch. de Graciansky (Ecole des Mines de Paris, Paris, France)

Application of sequence stratigraphic interpretation procedures to European outcrop and subsurface data show that the Mesozoic/Cenozoic stratigraphic section can be subdivided into four types of long term stratigraphic cycles (>10,000 years). These cycles are called: 1) Continental Encroachment cycles, 2) Transgressive/Regressive Facies cycles, 3) Depositional Sequence cycles and 4) Parasequence cycles. The determination of the ages and distribution within western Europe of cycle types 1, 2 & 3 are the objectives of the project "Mesozoic/Cenozoic Sequence Stratigraphy of European Basins." Progress on determining the age and distribution of these cycles in western Europe will be reviewed.

The primary cause of the four types of stratigraphic cycles is thought to be changes in shelfal accommodation. Shelfal accommodation is the change in accommodation space caused by relative changes of sea level (tectonics and eustasy) on the coastal plain, shallow marine or subaeral exposure surfaces. Sediment supply and initial depositional profiles cause important variations. Sediment supply controls the volume of sediments and may cause minor variations in timing, but does not significantly affect the age of the cycles. The initial depositional profile is a major control on stratal patterns and lithofacies, especially during lowstands.

Documentation of the age of the stratigraphic cycles is primarily based on biostratigraphy. New biostratigraphic charts with an updated numerical time scale are being prepared to help correlate the sections as accurately as possible. Recognizing lowstand and highstands deposits directly from fossil assemblages is also an important role of biostratigraphy. Magnetostratigraphy within the biostratigraphic correlation framework is also used where possible to more accurately document the stratigraphic correlation. Geochemistry is also proving to be an important tool for recognizing stratigraphic cycles.

CHARACTERIZATION OF TUNCBILEK FLY ASH

O. Bayat /Leeds University, Mining and Mineral Eng. Dept., Leeds, England/, A. Yamik

Morphological, chemical and mineralogical speciation of Tuncbilek fly ash sample from a lignite has been investigated by SEM, XRD and chemical analysis. It was found that sub-samples of fly ash exhibit the typical, relatively simple, four major crystalline phases: quartz, mullite, hematite and ferrite spinel. Major differences in chemical composition were observed in these samples. Spherical particles, varying in size from submicron to about 30 m, were only observed in FA3B and FA3D. Crystalline formation was observed in FA3A and FA3C sub-samples. No plerosphere formation was noticed in any of the materials. The amorphous silicate component of FA3B and FA3C sub-samples was in the form of cenospheres and may have been formed directly from clay minerals during coal combustion.

EVOLUTION OF THE ORIGIN AND GENESIS OF THE GEOTHERMAL WATERS IN THE DANUBE BASIN

D. Bodiš (Dionýz Štúr Institute of Geology, Bratislava, Slovakia), O. Franko, J. Michalko, P. Povinec

Waters of the Slovak part of the Pannonian Basin are interesting. A good scheme of their paleohydrogeology is facilitated by the knowledge of the vertical and horizontal distribution of their chemical and isotope compositions which correspond very well to each other. T.D.S. and chloride content increase with depth, whereas hydrogencarbonate content and understandably $rHCO_3/rCl$ coefficient decrease.

This trend corresponds well with $\delta^{18}O$ content which decreases with depth from - 13.18 ‰ in the drillhole Diakovce (700-800 m) to - 7.31 ‰ in the drillhole DS-1 (2000-2500 m). These data prove that the sedimentary area gradually became a fresh water one which corresponds with known geological data. It is noteworthy that the original waters are replaced by meteoric as deep as about 1500 m (on the margin) - 2000 m (in the centre). This is proved by $\delta^{18}O$ content in the Danube River water, the values of which vary between -11.0 and -13.5 ‰.

PRELIMINARY CORRELATION OF PLANKTON GASTROPODS WITH NEOGENE TIME SCALE BY MEANS OF MAGNETOSTRATIGRAPHY

M. Bohn-Havas (Hungarian Geological Survey, Budapest, Hungary), M. Lantos

Two groups of marine planktonic gastropods, the heteropods and pteropods, have been preserved in fossil records. Pteropod can be useful biostratigraphic tool for regional correlations of marine deposits in Tertiary. Pteropods in the Central Paratethys are mainly represented by Euthecosomata that was distributed from Middle Eocene to Middle Miocene.

Diagnostic value of pteropods for biostra-tigraphy has been studied for several decades on different areas of Central Paratethys. Middle Miocene deposits are generally the richest in pteropod species.

In Hungary, most of Badenian pteropods have been found in core hole sections. Their occurrences have been correlated with foraminifer and nannoplankton zones. Badenian pteropods occur only in the upper part of zone NN5. Vaginella was the first pteropod that appeared, followed by other species (Limacina, Clio, Cavolina). This increasing diversity coincides with increase of specimens and spatial distribution.

Paleomagnetic measurements were also carried out on samples from three core holes drilled in different part of Hungary. Polarity zones of the sections were correlated with geomagnetic polarity time scale employing K/Ar ages and nannoplankton zones.

Pteropods occur in a dominantly normal polarity interval which can be correlated with a part of magnetic Anomaly 5C. Thus preliminary age for the first appearance of Vaginella can be estimated to have been 16.7 Ma, and the diversity increased at 16.6 Ma.

TERTIARY GEOLOGY AND MINERALOGY OF SEDIMENTARY BENTONITE DEPOSITS FROM SUNGURLU-MECITÖZÜ REGION, CORUM PROVINCE, CENTRAL TURKEY

F. Coban (ITÜ Maden Fakültesi, Istanbul, Turkey)

In the studied area around Mecitözü and Sungurlu /Corum Province/, Paleozoic, Mesozoic and Tertiary rocks and sediments are found. Tertiary series could be divided into Eocene, Oligo-Miocene and Pliocene subdivisions. Eocene sediments are composed of sandy limestone, marl, tuff and lenses of sandstone. These are deposited in a shallow water environment. Oligo-Miocene sediments consist of red coloured conglomerate, laminated sandstone and mudstone. These clastic rocks have been deposited in fluvial environment. Bentonite occurrences containing Upper Miocene sediments are represented by a series which contains gypsum-bearing fine grained sandstone, volcanic tuff levels and minor amount of mudstone alternation.

Bentonite deposits have been formed in two ways.

1./ Alteration of Oligo-Miocene volcanic tuff levels,

2./ Weathering of Permo-Triassic metamorphic and Eocene sedimentary rocks.

The altered tuffs and detrital materials have been transported a short distance and redeposited in a playa lake environment. Some of the bentonite beds contain rounded detrital materials /mica, volcanic-metamorphic rock fragment, gypsum, quartz/ and varying in thickness from 25 cm to 2 m. Bentonites are made of montmorillonite /85%/, feldspar, illite-smectite, kaolinite and quartz. Calcite, mica, gypsum and rock fragments are the common impurities. According to the field observations and petrographic, mineralogical data, the bentonite occurrences are of sedimentary origin.

GEOLOGY, MINERALOGY OF GYPSUM-BEARING MIOCENE SERIES AND GEOCHEMICAL CHARACTERISTICS OF GYPSUM FROM SIVRI-HISAR - ESKISEHIR REGION, WESTERN ANATOLIA, TURKEY

F. Coban (ITU Maden Fak., Istanbul, Turkey), F. Suner

The studied area is located between Sivrihisar and Kayakent, SE of Eskisehir, Western Anatolia. In the region Upper (?) Paleozoic to Quaternary lithologies were observed. Basement rocks, from Paleozoic to Upper Cretaceous are metamorphics and ultrabasics, which are disconformably overlain by Miocene and Pliocene sedimentary rocks. Gypsum was found in the lacustrine Miocene series which are composed of smectite, illite, sepiolite and minor amount of interstratified clay minerals. Carbonate minerals such as dolomites and calcites were observed together with the clay minerals. In this assemblage dolomites were formed showing ideal crystal structure, d (104) = 2.88 A; sepiolites by direct precipitation under the effects of lacustrine conditions. Gypsum formations were observed under the sepiolite bearing levels alternating with Fe-oxide rich and red clay, tuff zones. These gypsum occurrences were classified in two groups as primary large forms, secondary nodular forms, as the results of petrographical and geochemical studies. XRD investigations have also indicated the ideal structure of this evaporative mineral.

Geochemical studies have also shown that there are no significant differences in trace elements content except that the total trace elements and especially Na contents were higher and K, Mg contents lower in the gypsum deposited alternating with volcanic series than those of carbonate series. The level of the trace element content in sepiolites was nearly similar to the gypsum alternating with volcanic series. It was concluded that the formation conditions of these two occurrences might have been similar. Because of the high Na content of the gypsum alternating with volcanics it was thought that there was an evaporative period with high Eh - pH conditions. The large crystals might be the result of these parameters. On the other hand non-continuous formation was assumed. This formation must carry a multi - periodic and genesis character and be slightly in different compositions, which has caused nodular gypsum formation from pore solutions under the conditions which were also partly responsible for the deposition of carbonate bearing levels.

NUMERICAL MORPHOMETRIC ANALYSIS AS A USEFUL TOOL TO EVIDENCE SUBSURFACE STRUCTURES AND NEOTECTONICS. APPLICATION TO DIFFERENT GEODYNAMIC CONTEXT

B. Deffontaines (Geotectonic Department, Université Pierre et Marie Curie, Paris, France)

Classical exploration methods (microtectonics, stratigraphy...) may reach their limits when there is few outcrops, lot of vegetation and active anthropic activity. This lead to use and develop methods based upon digital topography to give a better structural and neotectonic understanding. The digital elevation model (DEM) and its applications (slope, hill-shading, numerical cross-sections, summit level and drainage network anomalies analyses) are particularly helpful for such studies.

The methodology based upon morphoneotectonic treatments such as summit envelope surface (SES), longitudinal profile analysis, hierarchisation frequency (F=N/S), density (D-L/S), remote sensing (Landsat , SPOT, ERSI)..., are developed and applied. They evidenced topographic anomalies which may be interpreted as neotectonic features, or be considered as indicators of possible recent deformation.

The compulsory study done in the fields, allows to confirm or to infirm the morphoneotectonic sketch map and to locate the main characteristics of the defined discontinuities and especially the nature and the quantification of the deformation (age, amplitude).

THE EVOLUTION OF THE INTRAMONTANE BASINS DURING THE PERMO-CARBONIFEROUS AT THE WESTERN-EDGE OF THE BOHEMIAN MASSIF: ENVIRONMENT OF DEPOSITION - ECONOMIC GEOLOGY.

H. G. Dill (Federal Institute for Geosciences and Natural Resources, Hannover, Germany)

Permo-Carboniferous clastic, volcaniclastic and volcanic rocks crop out in narrow throughs and small embayments that are lined up like pearls on a string along the deep-seated highland boundary fault between the Mesozoic Tableland and the Bohemian Massif: /from SE towards the NW/ Schmidgaden, Weiden, Erbendorf and Stockheim subbasins. The age of deposition of their rock series, exceeding 1500 m in thickness in the SE part of the basin, ranges from Westphalian through Saxonian. These series are unconformably overlain by the Triassic clastic sequences. In the SE /Weiden basin/ the upper Carboniferous clastic rocks of the "Bechtsrieth Fm." reflect fining-upward cyclothems, commencing with alluvial fans and fading out with tuffaceous fine-grained carbonaceous rocks in a lacustrine environment. In the northwestern Stockheim basin, however, as a result of caldera evolution pyroclastic rocks with dacites, rhyolites and andesites prevail over epiclastic-volcaniclastic rocks.

During deposition of Autunian "Schadenreuth" and "Weiden Fms." red beds with calcretes attesting to a playa environment may be encountered in all subbasins under study. A renewal of calcalkaline volcanism took place in the Erbendorf basin, at the Autunian-Saxonian boundary. Following this igneous activity sheet flood, braided stream and eolian depositions came into being during Saxonian times. In the Stockheim basin these rocks are transgressively overlain by the well-known "Kupferschiefer", whilst towards the SE jasper-bearing dolomites evolved as a result of paleopedologic processes on an old peneplain that truncated "Rotliegend" depositions. During the incipient stages of basin subsidence - upper Carboniferous - these basins extended in NE-SW direction. By the beginning of the Permian an anti-clockwise rotation of lineamentary fault zones from NE towards the NW began, leading to the ascend of lavas along these faults and a re-organization of basin configuration with an encroachment of Permian sediments upon the Variscan paleohighs towards the NE and SE. Detailed investigations were focussed on ore mineralization and carbonaceous matter. In context with the afore-mentioned environment analyses of these Permo-Carboniferous rocks, these studies resulted in subdivision of these basins into 4 types:

Typ A: intramontane fault-bounded basins barrens as to volcanic activity with their organic matter derived from the input of land plants /mineable coal seams, source rock qualities mainly for gas/.

Typ B: intramontane fault-bounded basins with basin subsidence accompanied by the venting of lavas and deposition of volcaniclastic rocks /mineable coal seams, gas prone/ uraniferous and base-metal-bearing carbargillites/.

Typ C: lacustrine rocks in half graben-like depressions /source rock qualities for oil, bentonitic clays/ with organic matter partly of algal origin.

Typ D: narrow volcanic depressions /source rock qualities for oil, smectite-bearing clays/.

These intramontane basins closely resemble late Paleozoic and Cenozoic basins /Cerilly, Lodéve, St. Hippolyte, Uinta basins/ elsewhere, which are well-known for their uranium and hydrocarbon potentials.

PRZEMYSL „SIGMOID ", AN INHERITED STRUCTURE OF THE EASTERN OUTER CARPATHIANS A VIEW FROM ANALOGUE MODELLING.

N. Ellouz (IFP, Rueil-Malmaison, France), B. Colleta, E. Roca, R. Szczucki

The Carpathian chain results mainly from two distinct compressive tectonic events: a middle Cretaceous phase responsible for the emplacement of the inner Carpathians and a later Neogene phase responsible for the structuration of the outer Carpathians (late Cretaceous-early Miocene flysch units).

The Paleogene outer Carpathian flysch sequences were deposited in a complex setting, changing from NW to SE. Some NW-SE paleohighs were individualized, which strongly influenced lateral facies variations. Inherited from the Mesozoic tectonic episodes that deformed the Central European Platform, these paleohighs were compressionally reactivated during the Neocimmerian time (i.e. Late Jurassic to Albian), or after the Senonian. Early foreland tectonic inversions, took place synchronously with the development of the northeastward migrating Carpathian foredeep, where the late Cretaceous-early Miocene flysch was deposited.

From Poland to Romania, the tectonic features of the outer units and underthrust autochthon have been characterized along several balanced cross-sections, in the Western and Eastern Carpathians. After restoration, a calculation of the shortening rate has been estimated , which allows to propose a 3D palinspastic restoration of the Cretaceous and Paleogene flysch basins.

To test the coherency of these palinspastic restoration and to estimate the 3D geometries, sand-box model analysed with X.Ray tomography have been used. We focused our study in a tranfer zone situated near the Poland/Ukraine boundary, the so-called, Przemysl "sigmoid" zone. In this area the front of the Skiba-Skole flysch unit shows an important virgation, which does not affect the geometry of frontal thrust (i.e. Stebnik-Sambor units).

We tested several boundary conditions simulating:
- the heterogeneities of the substratum due to the pre-tertiary tectonic events.
- the distribution of various detachment levels. Three detachment levels, the lower Cretaceous blackshales, the Oligocene bituminous schists (Menilites) and, in Ukraine, the Badenian salt , have been simulated in the experimental box by using silicone layers.
- two episodes of deformation, separated by a post-Laramian erosion phase.

The sand-box experiments demonstrate very clearly the impact of the lateral heterogeneities in the distribution of the main detachment levels , which strongly influence the propagation of the deformation. Thus, we can explain the strong virgation in the surface organisation of the flysch thrust sheets, and the disappearence of some units (i. e. Borislav-Pokut) from Ukraine to Poland, by a staircase basal thrust trajectory, from the L. Cretaceous to Oligocene detachment levels, or even to the Badenian salt in Ukraine.

PETROPHYSICAL CHARACTERISTICS OF THE MAMURA FORMATION /LOWER CRETACEOUS/ WESTERN DESERT, EGYPT

A. M. El Sayed (Geology Dept., Faculty of Science, Ain Shams University, Egypt)

Various petrophysical parameters have been laboratory measured for 32 core samples obtained from three drilled holes. They are belonging to the Mamura Formation /Lower Cretaceous/. Lithologic discrimination has been investigated by different cross-plots. The grain density- porosity relation was the most effective combination.

The measured formation parameters such as porosity, formation factor, permeability, compressive strength, matrix conductivity, mounce potential, packing index and rock density have been studied for the obtained core samples. Consequently, reliable reservoir relationships were performed.

Using multiregression analysis technique, storage capacity statistical models have been created in order to predict and delineate reservoir porosity from other routine parameters.

RESERVOIR OF GEOTHERMAL WATERS IN THE DANUBE BASIN

M. Fendek (Dionýz Štúr Institute of Geology,, Bratislava, Slovakia), O. Franko, A. Remšík

The geothermal water reservoir is spatially delimitated by two boundary conditions. The first is the 40 °C water temperature. Waters of this and a higher temperature may be utilized for direct heating. So the hydrodynamical tests on wells have only been performed to the approximate depth of 1000 m. At this depth the reservoir temperature is about 45-50 °C and the surface temperature about 40 °C. The yield of outflow from wells with temperatures below 40 °C is low due to the low effect of thermolift. The reservoir top is confined with a plain at 1000 m depth. The second boundary conditions is the course of the impermeable basement (aquiclude) of the reservoir. A complex of aquicludes or a hydrogeological complex 5 irrespective of its stratigraphical range is regarded as the impermeable basement. The absolute transmissivity coefficient T_p in this complex is smaller than $0.5.10^{-11}$ m^{-3}, so the area of the reservoir at the depth 1000 m is given by the intersection of the plain with the impermeable basement - the aquiclude.

Since the structure of the depression is dish-like, the impermeable basement slopes down to the depression centre from all sides. From the margins the basement is dipping at 30 ° and the dipping is decreasing towards the centre. The maximum depth of the reservoir is 3300-3400 m in the area of

Gabčíkovo-i.e. in its centre. The maximum length of the reservoir at the level of 1000 m is 60 km in the NE-SW direction and almost 70 km in the NW-SE direction. The volume of the delimitated structure is 4031 km^3. The average percentage of aquifers in the structure is 34 %. The average value of aquifers porosity is 0.2. The natural reserves of geothermal waters represent 274.10^9 m^3.

FEASIBLE INTERPRETATION OF BURRIED MAGNETIC ANOMALOUS SOURCES IN THE TRANSCARPATHIAN DEPRESSION /EASTERN SLOVAKIA/

I. Gnojek (Geofyzika, Brno, Czech Republik), J. Vozár

The magnetic map of the East Slovakian Lowland /the Slovak part of the Transcarpathian Depression/ demonstrates a remarkable anomalous pattern the sources of which pertain to different geological structures situated in variant depth levels.

The striking short-wave and high-amplitude anomalies belong the Miocene-Pliocene neovolcanics, mostly andesites, which border the Lowland from the W /Slanské vrchy Mts./ and from the NE /Vihorlatské vrchy Mts./ and which partly also outcrop in the South of the Lowland. Rather different parameters of magnetic anomalies can be seen on the anomalies pertaining to the covered neovolcanics mostly situated in the depth of hundreds of meters. Generally, the magnetic map reveals expressively larger distribution of the neovolcanics in comparison with those mapped on the ground.

A specific type of anomaly was found in the SW vicinity of the Vihorlatské vrchy Mts.. Its source was proved by one drill-hole in the depth of 2700-2900m and it is represented by a spinel chrysotile peridotite with a big amount of secondary magnetite as a product of serpentinization which evokes extremely high magnetic susceptibilities exceeding 200.10-3 SI units. The last studies conduce to the Paleogene age of these rocks.

The long-wave anomaly with the amplitude almost 70nT fills the whole central part of the East Slovakian Lowland. It has not been proved by drilling, yet. Their source modelled as a l-2 km thick body is expected to be involved in the basement of the East Slovakian Neogene Basin reaching the depth even 6 km in its deepest part. The source is supposed to be a vaulted structure in the depth interval 4-10 km consisting in basic to ultrabasic rocks which may be a remnant of an oceanic crust. SW continuation of the body below the Slanské vrchy Mts. to the close vicinity of the serpentinized ultrabasics SW of Kosice has not been excluded.

TERTIARY EVOLUTION OF THE CENTRAL KIZILIRMAK BASIN /TURKEY/

M. C. Göncüoglu /METU, Ankara, Turkey/, V. Toprak, E. Olgun, I. Kuscu, A. Erler, K. Yaliniz

Central Kizilirmak Basin is located within the Central Anatolian Crystalline Complex /CACC/. CACC represents the thickened and metamorphosed northern passive margin of Tauride-Anatolide platform and is formed due to southerly obduction of ophiolites from Neotethyan Ocean and subsequent collision with an ensimatic arc. Post collisional thermal relaxation and uplifting during Late Cretaceous-Paleocene created several extensional basins in the region. Extensive alkaline volcanism, strong lateral facies changes and rapid variations in thickness support evidence for active synsedimentary faults at basin margin.

A reversal from extensional to compressional system occurred during Eocene as indicated by Early Eocene transgression at the basin margins and Middle Eocene megaslump development associated with transportation of huge basement olistoliths /20 km/ into the distal parts of the basin. This compression is followed by northward thrusting of basement slices. The thrusting continued during Late Eocene-Early Miocene and resulted in the formation of several northward sloping disconnected foreland basins which are filled with evaporite bearing continental clastics.

Late Miocene-Pliocene period is characterized by a new phase of extension in the region. Calcalkaline and alkaline Central Anatolian volcanic belt is associated with this extension. Kizilirmak fault, a dominantly dip-slip fault, is one of the major faults of this period. The area is largely covered by lacustrine to fluvial rocks deposited in several continental basins formed during this period.

STRUCTURE EVOLUTION OF BASEMENT OF THE PANNONIAN BASIN

J. Haas, (Geological Research Group of Hungarian Academy of Sciences Budapest, Hungary), S. Kovács

The basement of the Pannonian Basin is build up by terranes of various origin. Present-day setting of them is the result of large-scale displacements during the Alpine collision phases.

Two megaunits of basically different characters can be distinguished on the opposite sides of the Mid-Hungarian Lineament.

South to the lineament the Tisza Megaunit is located - a splitted chunk of the European Plate margin. North to the lineament terranes of Alpine-Dinaridic origin can be found.

Based on fitting of the main facies zones reconstruction of Early Alpine (Late Permian-Triassic) position of the terranes were carried out.

History of the Pannonian pre-Neogene terranes was controlled by plate-tectonic evolution of the Tethys oceanic branches and global eustatic and climatic changes.

The main etaps of the evolution are as follows:

* Pre-Alpine multi-phase evolution
* Early Alpine divergent phase - Vardar rifting
* Penninic opening and separation of the Tisza Megaunit from the European margin in the Jurassic
* Closing and obduction of the NW end of the Vardar branch near to the Jurassic/Cretaceous boundary
* Main collision places in the Mid-Cretaceous - intense nappe formation
* Formation of large deep basins North and South to the Pannonian terranes in the Late Cretaceous
* Mesoalpine tectogenesis
* Large-scale lateral displacements (terrane-escapes and lenghtening) in the Late Eocene - Oligocene - Early Miocene collision phases.

METALLIC AND GLASSY SPHERULES FROM THE CRISU NEGRU, ROMANIA, RECENT ALLUVIAL FORMATIONS

Á. Hadnagy (Geological & Geophysical Institute, Mineralogical Laboratory, Bucharest, Romania)

Naturally concentrated heavy fluvial sand from Transylvania and in western part of Romania contains small quantities of metallic and non-metallic spherules. Large numbers of black magnetic/and nonmagnetic spherules ranging in diameter from a few micrometers to over I mm are raining into the Crisu Negru/Fekete Kôrös or Black Kôrös/ hydrological basin and adjacent areas of Western Mountains /Carpathians - Mtii. Apuseni/.

Black magnetic spherules in association with glass spherules and coky particles and its magnitude point to industrial pollution, probably coal-and coke-burning facilities around the perimeter of the basin as the source.

The form and mineralogy of these spherules clearly indicate that they are products of melting at high temperatures. Many, perhaps the majority are hollow.

Some have a high polish with blue-silverwhite or black lustre; others are dull and pitted and are grayish-black. Since metallic particles represent only a small fraction of fly ash. The internal - and extramorphoscopical microstructures derived from industrial processes are similar to those of particles derived from cosmic sources. Numerous spherules reported by other investigations have cores of metallic nickel-iron that clearly identify them as ablation droplets from iron meteorites. It is true that magnetic spherules of meteoritic, volcanic and industrial origin can mimic one another in appearance. Attempts to distinguish them on the basis of composition and distribution have been only partially satisfactory.

NEW INFORMATION FROM OLD DATA: SEISMIC STRATIGRAPHY OF THE WILLISTON BASIN, CANADA

Z. Hajnal /Department of Geological Sciences, University of Saskatchewan, Saskatoon, Saskatchewan, Canada/, C. Zhu.

Ten time-stratigraphy sequences were mapped in the Phanerozoic strata of the northern Williston Basin, based on the seismic stratigraphic analysis and well control. Seven additional subsequences were distinguished in the uppermost Cretaceous. These time-sequences and their unconformities reveal that the northern Williston Basin development experienced three stages: a passive continental margin, stable cratonic basin, and disintegration of the intracratonic basin. The relationships of the strata to the sequence boundaries indicated five major erosional periods and nine subsidence events. The major erosional episodes occurred during lowstands of the global sea level, and the major subsidence cycles took place during the sea level highstands. The concordance of times between the major basin tectonic events and the corresponding sea level changes require influence of global tectonic processes.

CONTRIBUTION TO SOLUTION OF PALEOGEOGRAPHY OF THE HRONICUM SEDIMENTATION AREA

M. Havrila (Dionýz Štúr Institute of Geology, Bratislava, Slovakia)

Attempt for paleogeographical reconstruction of the Hronicum by proving of lateral position of the Biely Váh and Čierny Váh facial areas on the basis of the occurrence of the Raming limestones, Cordevolian in age, along the contact of the prograding carbonate platform with the basin. The formation of the Raming limestones is understood in the sense of R. Lein (1989) and presented as a complex of facies composed of gravitational slope sediments - turbidites. The members of the Raming formation, the Grafenstein and Göstling limestones, understood as normal and distal turbidites and unnamed proximal turbidites, were described. The "higher nappes" (Havranica, Jablonica, Nedzov, Strážov) are understood as part of the Hronicum.

PALEOENVIRONMENTAL CHANGES AND EVOLUTION OF FOSSIL COMMUNITIES (EXAMPLED BY MIOCENE MOLLUSCS FROM THE CARPATHIAN FOREDEEP AND VIENNA BASIN, CZECH AND SLOVAK REPUBLICS)

Š.Hladilová (Department of Geology and Paleontology, Faculty of Sciences, Masaryk University, Brno), J.Hladíková

A detailed paleoecological study of marine molluscs in combination with isotopic and sedimentological analyses enabled to reconstruct the paleoenvironmental changes in two sedimentary areas.

The Miocene marine sediments of the Carpathian Foredeep can be found - besides the present foredeep area proper- also in some isolated denudation relicts at the eastern margin of the Bohemian Massif. Three of these rellicts (localities of Hostim, Nové Syrovice and Kralice nad Oslavou) were studied. The Early Badenian marine transgression was documented at Hostim. At this locality, the sea was shallow (up to 20 m), with high water dynamics and normal marine salinity. A very similar paleoecological situation (depth to 30 m) was documented at Nové Syrovice where the Early Badenian transgression probably redeposited older Miocene sediments. At Kralice nad Oslavou, the sediments of Lower Badenian age were formed in the sea with normal salinity, at a greater distance from the shoreline and in the depth of 60-90 m. In the uppermost parts of the profile at this locality, the Early Badenian marine regression was documented paleoecologically as well as isotopically.

The second studied region near Rohožník belongs to the Vienna Basin. The marine transgression did not penetrated into this area before the Middle Badenian, the sea was euhaline, with high water dynamics, good aeration, and it was lightened sufficiently. Along the coast, a relative stable facies of algal limestones originated. In the direction into the basin, algal limestones were laterally substituting with the facies of basal conglomerates and sandstones. During the Middle and Upper Badenian, the differentiation and deepening of the basin resulted locally in lowering of the water dynamics and circulation and in decrease of the oxygen contnet near the sea bottom. The occasional reviving of coastal dynamics caused redepositions of a coarse grained sediments from the shore zone into the deeper parts of basin. In the Upper Badenian and Sarmatian, the sea shallowing resulted in an increase of water dynamics and decrease of water salinity. The salinity changes as well as the transportation of organic remnants are documented also by the carbon and oxygen isotope composition of molluscan shells.

THE SEQUENCE STRATIGRAPHY OF THE LITTLE HUNGARIAN PLAIN'S BASIN

M. Hódi-Korpás (Hungarian Geological Survey, Budapest, Hungary), Gy. Don, P. Scharek

In connection to the geological mapping project of the Little Hungarian Plain we have started to research the Pannonian formations from the year of 1992 using the methods of the sequence stratigraphy. Our aim is to sketch the Pannonian development of the sedimentological ambient of the Basin.

The brack-water Mollusca and Ostracoda fauna has a close restriction to the facies, the delta progresses with progradation, therefore its occurrence is not isochronic.

We mark out the isochron surfaces with the correlation of the para-sequence sets based on the high resolution sedimentological processing.

It is a discussed question that could the eustatic changing of the see-water level succeed in the Pannonian Basin, or not?

Our point of view is that yes. In the Pannonian sediments of the Little Hungarian Plain the No 3.1 and the No 3.2 third type order cycles of Haq et al (1987) could be identified, the second one a bit uncertainlierly.

The subbasins of the Parathetys separated from the oceans and each others could be in connection in the case of the higher water level periods for a short time according to the Mollusc fauna.

RESULTS OF THE RESEARCH OF ABIOTIC COMPONENT OF ENVIRONMENT IN THE GREAT BRATISLAVA AREA

J. Hricko (Geocomplex a.s., Bratislava, Slovakia), J.Viskup, J. Vozár

A paper deals with a major results of the research, which has been performed in frame of the project: Bratislava-environment, abiotic component. This project was executed during period of 1991-1992 in so-called Great Bratislava area.

Following activities have been carried out: interpretation of the air photos and satellite images; compilation of the radon risk maps, maps of the maximum expected seismic intensity; geochemistry of the soils, stream sediments, solid rocks, surface and ground waters as well as snow samples; airborne gamma-spectrometry and radiohygienic-radioecological analysis of the obtained maps; assessment of the antrophogenic geomagnetic activity and electromagnetic pollution; atmogeochemical survey with the goal to determine the content of the natural lead and zinc rising to the surface along deep-seated faults in molecular form; structural-geological and tectonic analysis of the surface and deeper zones using complex of geophysical methods. All results are stored in databank for future use.

GEOLOGY OF THE SLOVAK PART OF THE DANUBE BASIN IN THE SENSE OF REINTERPRETATION OF OLDER AND INTERPRETATION OF NEW GEOPHYSICAL DATA

I. Hrusecky (VVNP, Research Oil Company, Bratislava, Slovakia), M. Pereszlenyi, J. Hok, J. Sefara, D. Vass

Danube Basin is situated in Austria, Hungary and Slovakia. Slovak part of the basin creates its northern part. Upper portion of Neogene filling /Pannonian-Quaternary/ reaches in its central part thickness of 5500 m and depth of Pre-Neogene basement is almost 8000 m. Lower Pre-Pannonian geological architecture has a conspicuously block character, upper portion /Pannonian-Quaternary/ has delta development features.

Block development of the Slovak part of the basin was controlled by left slip along P.D.Z. /Principal Displacement Zone/ in NE-SW direction, which passes through the centre of the basin and continues to Hungary. The most intensive rhythm of this development appears to have place in time from Sarmatian to Lower Pannonian and the process takes place in the NNE-SSW oriented compression field.

Pre-Neogene basin basement is built up of various units. In the western part there are Tatric crystalline rocks formed /from south to north/ into one to three superimposed tectonic scales. These tectonic scales reach successively Pre-Neogene surface in eastern direction and the lowest of them continues further to P.D.Z. and there dips in great depth under a thick pack of strong reflecting rocks. The mass of Veporic crystalline rocks penetrates into the basin from east. Veporic crystalline rocks also plunge under this thick reflecting complex in W and SW direction. Southeastern part of the basin in Slovakia is built up of Paleozic-Mesozoic-Paleogene platform rock sequences of Bakony-synclinorium. Thick complex of stratified rocks, probably of Upper Paleozoic-Mesozoic and perhaps partly Paleogene age, forms Pre-Neogene basement in the self central part of the basin.

OCEANIC CRUST MATERIAL IN GEOLOGICAL HISTORY OF THE WESTERN CARPATHIAN OROGENY: AN ATTEMPT FOR GENETIC CLASSIFICATION

P. Ivan /Department of Geochemistry, Comenius University, Bratislava, Slovakia/, S. Meres, D. Hovorka

Systematic study of trace elements distribution, including REE, in Paleozoic and Mesozoic metabasalts of the Western Carpathians, together with other litostratigraphic, tectonic and petrological data, allowed preliminary genetic classification of oceanic, and/or semioceanic types of crust relics. Geochemical type of metabasalts served as the main criterion for the classification which yielded the classification of relics into two groups: /I/ relics of initial crust of back-arc basins containing metabasalts similar to E-MORB/OIT, and/or BABB and, /2/ relics of developed crust of back-arc basins with metabasalts of the N-MORB type. Metabasalts belonging to the first group are accompanied by frequently dominating clastic metasediments whereas the second group only comprises small amount of metapelites. Other members of the ophiolite sequence are classification in both groups is based on /a/ metamorphic history /relics metamorphically reworked or lacking reworking in the zones of subduction/ and /b/ on the tectonic position. According to the tectonic position, metabasalts representing the crust of back-arc basins may be further divided into: /i/ extensive nappes, /ii/ olistholites and enclaves, and /iii/ pebbles in conglomerates. The most significant relics of non-developed crust of back-arc basins in the Western Carpathians include the Rakovec Group and the Zlatnik "sequence" of the Dobsina Group. The relics of the developed crust may be assigned to the Pernek complex of the Little Carpathians crystalline /all Paleozoic in age/.

DELTA SLOPE DEPOSITIONAL PROCESSES IN THE "SMALL" DELTAS OF NEOGENE EAST SLOVAKIAN BASIN /WEST CARPATHIANS, SLOVAKIA/

J. Janocko /Dionýz Štúr Institute of Geology, Kosice, Slovakia/

The analysis of depositional processes operating on the slopes of "small" deltas points to energy of depositional environment, delta type and spatial distribution of facies. Three deltas of various ages were studied and compared in the Neogene East Slovakian Basin, which is a back-arc pull-apart basin.

I. Eggenburgian /Celovce Fm., NW part of basin/: Delta slope deposits build up 6 facies, 4 parasequences can be recognized. The development of these parasequences reveals sedimentation from traction currents /massive gravels infilling channels/ gradually passing into turbulent flow /massive sands with sharp, occasionally sole marked base/ overlied with sediments of decelerating suspension currents /horizontally laminated fine sand and silt/. Debris flow and flashy flood sediments are common as well.

2. Upper Badenian - Lower Sarmatian /Klcovo Fm., W part of basin/: The most common sediments are sediments of traction currents /massive gravels infilling channels/ revealing heavily sediment laden streams and hyperpycnal flow in the water basin and sediments of debris flows /massive gravels with sharp base and matrix-supported structure/.

3. Lower an Middle Sarmatian /Stretava Fm., W part of basin/: Delta front deposits can be divided into mouth bars sediments /traction currents and following wave reworking/ and outer delta front deposits /debris flow, turbidity currents/.The analysis of delta slope processes of 3 deltas points to their various development: the deposition on the high-angle slope /type I/, the deposition on the delta slope of "Gilbert" fan delta /type 2/and the deposition on the gentle slope of braided delta /type 3/.

INVESTIGATING LANDFILL SITES FOR GAS EMISSION

Iren S. Jasko (Quartz Scientific Co. Ltd, Watford, England)

It is well recognised that the formation and emission of gases from landfill and other contaminated sites is affecting the use, reclamation and redevelopment of such sites.
An investigation of gaseous emission is most often required to assess hazard on, or prior to redevelopment of, sites or adjacent areas which have been used for the deposition of biodegradable waste.
The biodegradation process, the gas movement, the factors affecting it and the potential gas migration's dependence on geological characteristics are considered.
The measurements taken need to determine the composition of the emitted gas, the concentration of the major components (i.e. CH_4, CO_2, O_2) and the rate of emission.
Types of site investigations, i.e. preliminary and detailed assessment, and regular monitoring and sampling methods are discussed.
The types of gas monitoring equipment and their principles of operation are described.
In the UK a number of guidelines were issued by government agencies - e.g. Waste Management Paper No. 27, The Building Regulations - give advice on survey, monitoring and limits of safe gas emission.

VOLUME ESTIMATES FOR RESERVOIR FORMATIONS

T. Jaskó /Quartz Scientific Co. Ltd., Watford, England/

Estimates of rock volumes are the most important data in prospect evaluation. The quality of resource and reserve estimates depends largely on the accuracy of volume data.

Every potential source of error adds to the uncertainty of volume values. Depth conversion, contouring, closure determination, planimetry and limits of computational precision all cause different kinds of distortion.

Petroleum exploration targets from various European sedimentary basins were selected for study. Finding the main sources of error led to a better understanding of the volume estimation process. It also pin-pointed the areas where technical improvements were likely to have the greatest impact.

Computer contouring, planimetry and volumetrics can improve the accuracy of data as well as speed up the estimation procedure. Quick volumetric programs provide the range of data required for effective Monte-Carlo modelling of reservoirs.

HIGH-RESOLUTION SEQUENCE STRATIGRAPHY OF LATE MIOCENE AND PLIOCENE SEDIMENTS IN THE PANNONIAN BASIN, HUNGARY

E. Juhász (Hungarian Geological Survey, Budapest, Hungary), J. Farkas-Bulla, T. Hámor, M. Korpás-Hódi, P. Müller, B. D. Ricketts, Á. Tóth-Makk

The Pannonian basin is the global (Pannonian) prototype of intramontane, extensional, back-arc basins. It is related to adjacent collision belts and subduction zones. The preservation of systems tracts is highly favourable in basins of this type, where the sediment influx is dominant (500-2000 m/Ma) over the erosive energy of the system.

The fossil content proves that the Upper Miocene-Pliocene sediments were deposited here in a brackish lacustrine, later in a fluvial environment. The endemic character of the mollusc fauna causes difficulties in the extrabasinal correlation, so the chronologic values are based mainly on magneto-, radiometric-, and mammal stratigraphic data.

On the basis of detailed facies, sedimentological, palaeontological and well-log analysis with about 4000 m of continuous core, two 3rd order sequences were detected in the Late Miocene and Pliocene sediments of the Pannonian basin. The older sequence was deposited in the Late Miocene, and was truncated by the roughly 5.5 Ma Pliocene unconformity. The younger one is situated between the former and the roughly 2.4 Ma Pleistocene unconformities. The Late Miocene 4rd order sequence starts with a transgressive systems tract, about 50 m thick, which is followed by high-stand sediments, built up by more, maximum 5, 4th order sequences. The thickness of the 4th order sequences range from 40-50 m (in the basinal areas) to 300-800 m (in the marginal areas).

The genetic cycles of the sequences show a general upward coarsening character as for the stacking pattern. The correlation of the genetic cycles of the systems tracts in the boreholes proves that the studied Upper Miocene sediments were deposited during one single sedimentary cycle. The Pliocene represents a new cycle.

PRINCIPLES AND PECULIARITIES OF LATE-NEOGENE SEDIMENTATION IN THE MIDDLE OF THE PANNONIAN BASIN

Gy.Juhász (MOL Plc.- Oil & Gas Laboratories, Budapest, Hungary)

The regularities in the sedimentation of the Pannonian lake are relatively well-known, as for the deep-water sedimentation of basin plain and gravity flows, resulting basinal muds and turbidites with associated facies, as well as the tremendous riverine discharge of siliciclastic sediments, resulting fine-grained Gilbert type deltas, with steep slope and thick delta front multistory mouth-bar sequences. The role of shelf can be neglected in the basin, therefore the delta slope and basin slope environments practically merged here, and can be identified as one thick muddy facies association in the sedimentary sequence. In the uppermost part of the sequence the alluvial sediments can be found in a varying thickness.

The different facies associations can be detected over long distances all over the basin, and are well mappable, even the deltaic successions are very continuous caused by the large sediment supply and the lobate type deltas. The main delta systems came from the NW and from the NE directions in the Hungarian part of the basin. Sedimentary supply was some coarser-grained and larger from the NW and finer-grained from the NE, depending on the hinterland. This caused some differences between E and W in the geometry of facies, which was also affected by the paleomorphology and thermal subsidence of the basin.

Peculiarities are caused on one hand by relative sea-level fluctuations, on the other hand by the above mentioned differences in sediment supply. The relative water-level changes were affected mainly by strong tectonics, differential thermal subsidance, and probably also by eustacy, although we have known nothing about the connections, and there are no faunistical evidences. Changes can be caused also by changes of climate. Nevertheless, the fluctuations can be detected by the great variances in the thickness of the delta front, delta plain facies associations, and a confusion in the sedimentary succession in the NE part of the basin, which could not be interpreted earlier. Here the offshore and delta front successions intertounge in a large scale. The whole thickness of this interface area can reach 1000m, while close to here, inside the basin the thickness is only 50-100m, representing only incised valley fills. The intertounging zone can be detected around the NE part of the basin, its width is about 20-30 km.

Evidences show that the eastern shoreline moved in this intertounging zone for a long time while progradation of deltas and transgression (relative sea-level rise), causing aggradation, alternated each other several times, creating this strange succession in the NE part. In the W part of the basin, however, this disturbance cannot be identified, exept the extreme thickening of the multistory delta front units. It was caused by the fact, that the delta system, arriving from the NW, was larger with rapid sediment supply, where the rate of deposition exceeded or kept equilibrium with the rate of accomodation.

METAMORPHIC BASEMENT OF NAGYBÁNYA (BAIA MARE) AND SZILÁGY (SALAJ) BASINS

J. Kalmár (Hungarian Geological Survey, Budapest, Hungary)

In depth of Nagybánya and Szilágy, as satellite basins of Pannonian Basin, the metamorphic basement continuates prevariscian metamorphosed formations which are known in boreholes from southern and eastern part of Great Hungarian Plain.

Nagybánya Basin is situated between Gutin (Gutîi) mts, Preluka (Preluca), Cikó (Ticau) and Bükk (Bâc) metamorphic islands. Eastward of Erdôszáda (Ardusat) - Buság (Busag) line, as it results from borehole samples, the basement is constituted by Preluka-Cikó type paragneisses, quartzites, mica-schists and magmatogene rocks, as amphibolites and biotitic gneisses. Westward of this line, in few boreholes, garnet-rich mica-schists which thin leptinite intercalations appear, continuing, in depth Prihodiste-formation of Bükk mts.

Metamorphic basement of Nagybánya Basin sinks in NW direction from a few hundred m (Kovás [Coas]) at approx. 2000 m under the border of Gutin Neogene Magmatic Belt.

Szilágy Basin is situated between Bükk and Cikó mts, Benôfalva (Benesat) - Őrtelek (Ortelec), so called Para-Mezes line, Meszes (Mezes) and Réz (Plopis) mts., opening largely westward, toward Pannonian Basin.

In the northern and northeastern area of Szilágy basin, the metamorphic basement is represented by terrigen and magmatogen terms of Bükk mts (Lespezi and Prihodiste Formations). In SW corner of this basin, including Hegyes (Heghies) and Szilágysomlyói Magura (Magura Simleului) islands, multiple metamorphosed and sheared terrigen and, subordinatelly, acid magmatogene schists are known. They are comparable with the metamorphic rocks which were found in basement of Trans-Tisia, southern Danube-Tisa Interfluve and south-eastern Transdanubia. They constitute a "splint" of southern border of Tisia-domain, which penetrates into Szamos-Berettyó type metamorphics.

In southern Szilágy basin, the constitution of metamorphic basement participate rocks which built up Réz mts., i.e. quartzitic schists, mica-schists, paragneisses, biotitic and muscovitic gneisses and amphibolites. Correlating the boreholes between Berettyóábrány (Abram) - Tasnád (Tasnad) - Erdôd (Ardud), it results, that the Bükk-type and Rez-type metamorphic rocks are similar. In Transtisia, they are corresponding with Kôrös - Berettyó and Álmosd units.

The metamorphic rocks of basement of both basins, having still heterogene petrography, present as common feature, a last metamorphic mineral blastesis: statistically oriented biotite, muscovite and albite or ortoclase porphyroblasts.

This facts demonstrate, that the actual configuration of basement was defined after last (presumed, Hercinian) metamorphic events. The metamorphic basement participed at Meso-Cretaceous tectonic events, i.e. at collision between Tisia Microplate and the basement of Transylvanian Basin, as resulting a rejuvenation of K-Ar ages.

Fault system, which separate a great number of blocs and compartments in both basins is relatively young; after facial study of Miocene deposits, their activity began in Badenian and continuate till present day.

OXYGEN AND CARBON ISOTOPIC COMPOSITION OF FORAMINIFERAL AND MOLLUSCAN TESTS FORM THE WESTKARPTHIAN NEOGENE

J. Kantor (Dionýz Štúr Institute of Geology, Bratislava, Slovakia),
E. Harčová, K. Fordinál, K. Šútovská

Stable isotopic investigations were performed on carbonate tests. The set of assemblages studied from the South Slovakian basin (borehole LKŠ-1, near Lučenec) belongs to the Karpathian, zones N-7 and NN-4. All foraminiferal $\delta\ ^{18}O$ [‰] values are negative. They range -1,83 to - 0,50 (mean=-1,36) in the planktonic Globigerina praebulloides and -0,76 to -0,03 (mean=-0,30) in the benthic Florilus boueanus. In both groups slight enrichment or depletion in ^{13}C with regard to the PDB standard occur. Negative $\delta\ ^{13}C$ permil values are charakteristic for the carbonate carbon of the bulk sediments.

Badenial faunal assemblages were studied from two localities of the NE-Slovakian part of the Vienna basin: Devínska Nová Ves (borehole DNV-1) and Stupava (HPG-3). In both a lower psammitic and upper pelitic facies occur. They are mostly regarded as Kosovian and belonging to the upper part of the NN-6 and to the NN-7 zones.

In the molluscan debris from the psammitic facies of DNV-1 $\delta\ ^{18}C$ permil values range 0,01 to 0,81 and from the pelitic one 1,17 to 2,92. Foraminifera from the later are characterized by positive $\delta\ ^{18}C$ and negative $\delta\ ^{13}C$ values. The benthic Uvigerina secreting ^{18}O in equilibrium has $\delta\ ^{18}O$ values 1,48 to 2,41 (mean=1,90) and $\delta\ ^{13}C$ -0,89 to -0,25. In the planktonic Globigerina ex gr. bulloides $\delta\ ^{18}O$ ranges 0,15 to 0,65 (mean=0,39) and $\delta\ ^{13}C$ -1,26 to -0,79 (mean=-0,98).

At Stupava low ^{18}O contents prevail in the fauna from the psammmitic facies. The measured limits and mean values in $\delta\ ^{18}O$ [‰]: Parvilucina -0,46 to 0,52, Clithon -1,00 to 0,21, Turritella -0,95 to 0,21, Rissoa -1,80 to -0,41, Ammonia -0,01 to 0,11, Elphidium -0,38.
Specimens from the pelitic facies have significantly higher $\delta\ ^{18}O$ permil values: Varicorbula 1,93 to 2,72, Cyclocardia 1,69 to 2,14, Uvigerina 1,77 to 2,04, Melonis 0,74 to 0,95, Orbulina -0,57.

The observed isotopic distribution patterns are governed mainly by temperature, depth of the habitats, ^{18}O, ^{13}C contents of the water and by precipitation of the carbonate isotopes in or out of equilibrium. Non isotopic data were also used in the interpretation.

EVAPORITE FACIES IN THE NEOGENE EAST SLOVAKIA BASIN

S. Karoli (Dionýz Štúr Geological Institute, Kosice, Slovakia)

The Neogene East Slovakian Basin is an intramontane depression with marine evolution in the lower part. In the upper part delta and lake sediments prevail. Two distinct evaporite /salt-dominated/ formations are known from boreholes in marine sequence. The lower one, Karpatian Sol,ná Bana Formation, about 300 m thick, was deposited in partly desiccated NW-SE graben during repeated disconnections from the central basin. Marginal development on its NW flank displays a facies mosaic of open-marine, mudflat and salt pan settings. Primary layered sediments /largely halite-siliciclastic mudstone alternation/ at the basal part were periodically exposed and coarse clastic collapse breccias originated due to fresh water dissolution. Thin breccias with hopper crystal relics in the upper part of formation have mainly desiccation origin. Regular laminae of halite within pelites in a few cores from the basin centre probably represent hopper crystals and rafts which precipitated at the water/air interface and sank on the bottom.

Upper, Middle Badenian salt horizon /The Zbudza Formation/ occurs in three partial, tectonically separated basins and does not exceed 200 m. Tens of meters thick halite beds intercalated by clayey sediments are most characteristic. Halite consists of chevron, cloudy crystals, commonly vertically aligned with irregular, disrupted clayey laminae. These features are symptomatic of a rapid bottom halite growth in shallow-water basins.

Facies and paleogeography show /apart from climate/ an essential role of tectonics for evaporite evolution. While the Karpatian evaporites are of local significance only, the Middle Badenian evaporites are widespread in the Inner and Outer Carpathians. They were deposited in restricted, satellite basins at the beginning of the Neogene Tethys disintegration.

P-T CONDITIONS AND OXIDATION STATE OF UPPER MANTLE IN THE SOUTHERN SLOVAKIA REGION

P. Konecny (Dionýz Štúr Institute of Geology, Bratislava, Slovakia), M. Huraiová

Upper mantle rocks in the Southern Slovakia /northern margin of Pannonian basin/ are represented by lherzolite xenoliths accompanied by olivine and clinopyroxene xenocrysts entrained in Pliocene-to-Pleistocene alcali basalts. The lherzolites contain four-phase assemblages: olivine + ortopyroxene + clinopyroxene + Cr-Al spinel. No metasomatic changes were observed. Their dominant protogranular structures are considered to have preserved original equilibration conditions. Pressure-temperature conditions derived from pyroxene thermobarometry /Wells, 1977; Stormer, l976; Köhler & Brey, l990/ cover interval 850-1050oC and 10-27 kbars representing subsolidus conditions. Oxygen fugacity calculated after Wood & Virgo /l989/ cluster around FMQ buffer /FMQ-2 to FMQ+1,8, mean value FMQ-0.7/ with slight shift to more reduced conditions as it is reported for most continental xenoliths /Bryndzia & Wood, l990/.

Silicate melt and CO_2 inclusions frequently occur in olivine and clinopyroxene. Raman spectroscopy has revealed up to 2.4% CO and o.4% N_2 in fluid inclusions. The oxygen fugacities were calculated for XCO_2=0.976-0.988, inferred from the composition of fluid inclusions, assuming the oxidation of CO to CO_2. Values of oxygen fugacity varies around FMQ buffer and are in consistence with oxidation state derived from mineral assemblages. Maximum fluid pressures obtained from the densest CO_2 inclusions reach up to 8 kbars /~29km/, implying most probably the upper mantle origin of trapped fluids.

Upper mantle in the Southern Slovakia shows high pressure-temperature gradient similar as for the regions with alkali province getherm /Jones et.al., 1982; O,Reilly & Griffin, l985, l990/, caused most probably by upper mantle uplifting, overheating during alkali magma generation and thinning the Earth crust approximately to 27 Km in Pannonian region /Cermák et al., l986/.

EVOLUTION OF ALKALI BASALT VOLCANISM IN SOUTHERN SLOVAKIA BASED ON K/Ar DATING

V. Konečný (Dionýz Štúr Institute of Geology, Bratislava, Slovakia),
K. Balogh, D. Vass, O. Orlický, J. Lexa

Alkali basalt volcanism in southern Slovakia has been active during the Pontian time - approximately 6.5 - 6.0 Ma (the Podrečany basalt formation) and during the Pliocene to Quaternary time - 5.3 - 1.2 (0.35 ?) Ma B.P. (the Cerová basalt formation). Basalts are situated on stabile blocks bordering young extension basins and their activity took place during thermal phase of their subsidence. A local updoming has associated with volcanic activity of the Cerová basalt formation, indicating perhaps the presence of mantle plume responsible for generation of alkali basalt magma.

Relative position of volcanic products, remanent magnetic polarity measurements and K/Ar whole rock and isochrone ages indicate, that volcanic activity has taken place at least in eight pulses.

Lava flows and sporadic maars formed in fluvio-lacustrine environment along the northwestern margin of the Lučenská kotlina basin are characteristic for the Podrečany basalt formation.

Products of the oldest phase of the Cerová basalt formation are situated at the highest level of the present landscape near the Hungarian border owing to the mentioned updoming. They are represented by several cindercones and lava plateau overlaying a flat relief.

Cinder cones, spatter cones, maars, diatremes and lava flows are characteristic for younger phases of the Cerová basalt formation. Short lava flows accumulated around their source cones, while longer ones followed valleys in the dissected relief, generally northward. Owing to the mentioned synvolcanic updoming their relative elevation in the present landscape is related to their age - older volcanic products occupy relatively higher position.

A phreato-magmatic activity creating maars was characteristic for the youngest phase of the Cerová basalt formation. Maars belonging to this phase are situated at the lowest level of the present landscape including recent alluvial flats.

STRUCTURAL AND PALEOGEOGRAPHICAL DEVELOPMENT OF THE CENTRAL WESTERN CARPATHIANS WESTERN MARGIN

M. Kovác (Geological Institute of the Slovak Academy of Sciences, Bratislava, Slovakia), F. Marko, I. Barath

Neogene development of the Central Carpathians western margin was influenced by West Slovakian Wrench Corridor.

The Lower Miocene structural rebuilding of the orogen thrust front and hinterland was controlled by ENE-WSW treding dextral wrench zone. In transpressive regime Eggenburgian - Ottnangian sedimentary basins opened.

After Karpatian, due to collision of the western part of the orogene with North European Platform, tectonic escape of the Carpathians to NE began and the West Slovakian Wrench Corridor gained a sinistral transtensive character. The Lower Miocene basins disintegration was followed by the Middle Miocene basins opening.

During the Upper Miocene the basin formation was influenced by W-E to WNW-ESE extension. Similarly as in the Middle Miocene the basins deposition centres migrated to the hinterland of the orogene.

The Miocene changes of the fault cinematic function were reflected by the rotation of main compression from NW-SE to NE-SW direction, induced by W-E shifting of the Carpathian collision.

THE ASSESSMENT OF THE ENGINEERING-GEOLOGICAL FACTORS OF THE ENVIRONMENT IN SLOVAKIA

M. Kováčik (Dionýz Štúr Institute of Geology, Bratislava, Slovakia), M. Lobík, M. Kováčiková, Ľ. Petro, Z. Spišák

In the late of the 80s a theoretical engineering geological research was focused on the assessment of the engineering-geological factors of the environment in the Slovak republic.
A large project of the multi-discipline environmental mapping of the selected regions started in 1992. A set of environmental maps concerning engineering geology is a part of this project.
The methodology of the regional investigation and construction of maps in the scale of 1:50 000 has been developed for the following geodynamic phenomena: slope failures, sheet and gully erosion and weathering. These phenomena have the greatest importance from the economic point of view in the selected regions. It is expected to study different phenomena in other regions of Slovakia (e.g. collapsibility in loess, karst, land subsidence).
Engineering geological contribution to the set of environmental maps comprises the following analytical maps: 1. map of the susceptibility to deformations of slopes, 2. map of the vulnerability of the area to erosion, 3. map of the resistance of rocks against weathering 4. map of the bearing capacity of construction soils, 5. map of the geological potentials and barriers. The maps 1 and 2 assess the present stage of the processes and the prognosis of the future development due to the natural or artificial factors. Maps 3,4,5 are simple analytic maps which display the present conditions in the area. This set of maps is supplied by the synthetic map - engineering geological zoning map. This map is constructed according the standard obligatory methodology for this type of maps in Slovak republic.
All these special geological maps have not only the great theoretical but also practical importance for the local authorities in land-use planning and in protection of the environment.

GEOTHERMAL ACTIVITY OF THE DANUBE BASIN

M. Král (Geocomplex a.s., Bratislava, Slovakia)

An extensive programme to utilize the low enthalpy geothermal energy resources in Slovakia disclosed a number of suitable localities. Among them the most perspective is the Danube Basin. Temperature and heat flow density data from 50 wells describe its geothermal activity.

Temperature conditions in the Central Pliocene depression hint at significant hydrogeological disturbance of the temperature field. It is due to cold meteoric waters infiltration into relatively thick and permeable Quaternary and Rumanian sequences resulting in the downward cooling of the rock environment. Geothermal investigation of the observation well GPB-1 Bohel,ov situated in the central depression of the Danube Basin was performed within the years 1982-l99l. The vertical average velocity water flow in the Quaternary and Rumanian sediments was estimated to be 35.6 mm/year, in the upper part of gravels and sands it reaches 57 mm/year.

Heat flow density data in the Danube Basin were corrected on the basis of physical and geological models taking into account surface water infiltration and using mathematical methods. Hydrogeologically undisturbed data were used for the new heat flow density map construction. The highest heat flow is typical for the central part of the basin where the intensive geodynamic extension can be supposed during its origin and evolution. Corrected heat flow density map is the base for the hydrogeothermal structure evaluation and it is important for the calculation of natural geothermal reserves and resources.

MAGNETOSTRATIGRAPHY OF PANNONIAN S.L. DEPOSITS OF HUNGARY

M. Lantos (Hungarian Geological Survey, Budapest, Hungary), T. Hámor.

Extensive magnetostratigraphic studies were carried out on samples from deep core holes in Hungary. The objective was to place the Pannonian s.l. /Late Miocene and Pliocene/ stratigraphic units in the time scale. Polarity zones of the sections were correlated with geomagnetic polarity time scale employing K/Ar ages, paleontology and seismic stratigraphic profiles.

The Pannonian Basin appears to have subsided rapidly but not uniformly during Late Miocene and Pliocene time. The average rates of accumulation for the individual sections range from 175 to 2000 m/Ma.

Accumulation of Pannonian deposits began at 12.5-12.0 Ma but on the basin,s margin and elevated blocks at 10 Ma.

The age of the boundary between the Lower and Upper Pannonian ranges from 8.2 to 8.9 Ma. Though the boundary is time-transgressive, it appears to correlate with the 8.5 Ma age assigned to the Pannonian-Pontian boundary in the tentative Neogene Mediterranean-Paratethys correlation table for the Alpine-Carpathian Realm.

The Miocene-Pliocene boundary /5.2 Ma/ has been unidentified on magnetostratigraphic records because a considerable time interval is not represented in the cored deposits: 5.9-4.3 Ma in the eastern part of the basin and 6-2 Ma in the western part.

High resolution sedimentologic logs have been developed during the sequence stratigraphic analysis of the cores. The sedimentologic logs and paleomagnetic records have been compared. At places, relation has been found between changes of lithofacies and magnetic intensities.

NEOGENE VOLCANIC ROCKS OF THE CARPATHO-PANNONIAN REGION: THEIR DISTRIBUTION IN SPACE AND TIME

J. Lexa (Dionýz Štúr Institute of Geology, Bratislava, Slovakia),
V. Konečný, M. Kaličiak, V. Hojstričová

The Carpathian arc during the Miocene - Pliocene time migrated northward, northeastward and eastward at the expense of subducting oceanic/suboceanic crust of flysch basins until it collided gradually with curved passive margin of European platform. Advance of the arc was compensated by interarc and backarc extension including diapiric uprise of asthenosphere, and lithosphere escape from collision zones of Alps and Balkan. This geotectonic framework and variable involvement of older continental crust in the arc besides accretionary prism of flysch basin deposits are responsible for essential features of space-time-composition distribution of the Neogene/Quaternary volcanic rocks in the Carpatho-Pannonian region.

According to compositional characteristics and spatial distribution we can distinguish four essential groupings of volcanic rocks:

1. Areal type dacite to rhyolite volcanic activity. It started during the Eggenburgian/Otnangian time in the central part of the Pannonian basin (Lower tuff), spread over westward and northeastward during the Karpatian/ Lower Badenian time (middle and upper tuff) and continued up to the Sarmatian time in the northeastern part of the Pannonian basin (Hrabovec-Novoselica-Dej tuff, Tokaj-Zemplin-Beregovo extrusions and tuffs).

2. Continental margin type andesite volcanic activity including differentiated rocks. It started during the Lower Badenian time in the northwestern part of the Pannonian basin and during the Upper Badenian time in the northeastern and eastern parts of the basin and continued in these areas until the Lower Pannonian time. Its spatial distribution is influenced strongly by backarc extension tectonics.

3. Evolved arc type basaltic andesite/andesite volcanic activity. It started during the Middle Sarmatian time in the northern segment of the Carpathian arc and subsequently migrated eastward in the form of partially overlapping segments of aligned volcanic arcs, the youngest being the Calimani-Hargita segment of the Pliocene/Quaternary age.

4. Alkali olivine basalt/nepheline basanite volcanic activity in the northwestern part of the Pannonian basin during the Upper Pannonian to Quaternary time.

CORRELATION OF MOLLUSC BIOFACIES WITH LITHOFACIES ASSOCIATIONS IN THE LATE NEOGENE (PANNONIAN AND PONTIAN) LACUSTRINE BASINAL SEQUENCE IN THE HUNGARIAN PLAIN

I. Magyar, Gy. Juhász (MOL Rt., Budapest)

A close correlation has been revealed between lithofacies associations and mollusc biofacies of the Late Neogene (Pannonian and Pontian) basinal sedimentary sequence in more than 150 boreholes from the Hungarian Plain (Alföld). The major factors that controlled distribution of the endemic molluscs were the water depth and the depositional environment.

The basal transgressive conglomerate is characterized by thick-shelled and usually large-sized forms (species of *Lymnocardium, Congeria,* etc.). The deep water formations -- basinal marls, fine-grained turbidites, and muddy slope deposits -- contain a highly adopted mollusc fauna of low diversity, consisting of *Dreissenomya digitifera, "Pontalmyra" otiophora,* and representatives of *Paradacna, Valenciennius, Congeria,* and others. Molluscs favouring shallower and well aerated water, such as *Dreissena* and *Lymnocardium,* appear in the upper part of the slope deposits and are abundant in the sandy delta front sediments. The delta plain deposits have various mollusc assemblages, shallow brackish to lagoonal and and freshwater ones (*Prosodacnomya, Melanopsis, Dreissena, Viviparus, Theodoxus, Anodonta, Unio, Planorbarius,* etc.). The fluvial-lacustrine lithofacies is characterized by freshwater genera that still live in the rivers and lakes of the Carpathian basin.

These assemblages generally occur in the cited order from the bottom of the time-transgressive sedimentary sequence upwards. Misinterpretation of this phenomenon, assigning time stratigraphic value to these assemblages, still occurs. In contrast, we think that biostratigraphic subdivision should be based on the evolution of the molluscs within each palaeoenvironment. Geographical area of the newly evolved endemic forms, together with the water table of the Pannonian lake, continuously shrank due to intensive infilling during the Pannonian and Pontian.

POREWATER EVOLUTION IN NEOGENE RESERVOIR SANDSTONES OF THE PANNONIAN BASIN

J. Mátyás /Geological Institute, University of Bern, Switzerland/, A. Matter

There are two distinctly different pathways /quoted as A and B/ of post-depositional evolution observed in the sandstones of Szolnok and Algyô Formations in SE Hungary. Since detrital petrography does not change significantly throughout the studied area, these variations can likely be related to differences in the porewater chemistry.

Stable isotopic data on fossil shell material suggest

-.4.1 % for the initial Pontian porewater and -0.5 % for the DIC-pool. The isotopic composition of the early carbonate cements is rather consistent with these initial values.

In those sandstones belonging to Group A the isotopic composition of the carbonate cements /mostly ankerites/ shows minor shift of 13C toward the more negative values. The estimated isotopic composition of the water is -5.5% somewhat lighter than the initial porewater. The porosity is - at least partly - redistributional, that is the porosity gain due to feldspar leaching was nearly eliminated by kaolinite cementation. All these facts suggest a meteoric water influx relatively early in the burial history. The light CO2 which flooded some of these sandstones recently /that is at 120-140 oC burial temperature/ likely accounts for the extremely light isotopic composition of the late calcite cements.

Sandstones belonging to Group B are dominated by ferroan calcite, illite and chlorite cements and primary porosity The isotopic composition of the calcites shows that no additional source of CO2 was involved during burial. The temperature range the calcite precipitation covers is rather narrow as shown by the relatively uniform isotopic composition. The 70-90 C which can be estimated from the IGV of the pervasively cemented parts is comparable to that range can be obtained by considering the present-day isotopic composition of the formation waters. The shift of the water isotopic composition occurs in the temperature range of the smectite/illite conversion. Since I/Sm is a major component in the adjacent shales as well as in the 2m fraction of the sandstones themselves, this reaction is the most probable source of isotopically heavy waters.

OUR INFLUENCE ON THE LITHOSPHERE - THE CONCEPT OF ENVIRONMENTAL GEOLOGY

A.A. McMillan and S. K. Monro
(British Geological Survey, Murchison House, West Mains Road, Edinburgh, EH9 3LA, Scotland)

Geology is concerned with the study of the Earth, its origin, structure, composition and history, and the nature of the processes which give rise to its present state. The evolving lithosphere provides an environment in which all the material needs of humans and other life forms are present. It is also to this environment that waste products are returned. Human activity significantly affects the nature of the top few hundred metres of lithosphere. Consequently the concept of environmental geology assumes particular importance because it is concerned directly with the well-being of the planet and its inhabitants.

As an "environmental" science geology cannot be practised in isolation. There are conflicting demands on how land is used; for agriculture, for domestic and industrial construction, for mineral extraction, for recreation and education, for conservation as "wilderness" areas. Land use planning can resolve potential conflicts by integration of geological data with other datasets. How should geologists respond to this need?

Environmental Geology has to address both the aftermath of human activity and potential problems it leaves for the future. In Europe, during the 19th and 20th centuries, urban development often progressed hand in hand with mineral exploitation. As a consequence mineral extraction has often left a legacy of engineering difficulties. The continued need for minerals has to be balanced against the conservation of a pleasant and clean environment. Making the best strategic use of resources requires significant geological input.

The future needs of society are such that longer term geological processes have important influences on planning. In the coastal zone, the effects of global warming on sea level change may significantly affect how that zone is used. The disposal of toxic waste, whether or not it is radio-active, requires prediction of geological changes over at least the next 50,000 years. The geological maxim "the present is the key to the past" could help. What criteria should geologists use to model the future?

This talk will highlight many questions, perhaps give pointers to where some of the solutions might lie and emphasise that the lithosphere continues to evolve with human activity playing a significant part in that evolution.

HEAVY METAL CONTENTS IN THE AGRICULTURAL SOILS OF ZITNY OSTROV, SLOVAKIA

Y. Mejeed (Department of Geochemistry, Faculty of Sciences, Comenius University, Bratislava, Slovakia), J. Curlik.

No systematic study of the heavy metal contents in the soils of Zitny ostrov has been reported, and the purpose of this contribution is to present the current information on background levels /totals/ of several heavy metals in these soils, to compare them with other soils elsewhere in the world, and to indicate the relationship between their contents and the physiographic regions of the studied area. It reports also on their distribution in the different mineralogical fractions and the organic fraction, on differences in their levels in different soil units, in soils developed on different parent materials and their relationship to various soil horizons, textures and drainage status. The possible anthropogenic contamination of these soils has also been estimated.

The obtained results show that the heavy metal contents are in good consistency with those compared from other sites in the world. Their distribution appears to be more close to the log - normal type. Also, their distribution looks to be more homogeneous in the whole area and only few geographic differences among heavy metal contents have been found.

Generally, they show a strong affinity to be adsorbed by both the clay minerals and the organic matter. Only in few cases they are present as independent phases.

The distribution of heavy metals in these soils is strongly related to their parent materials. No relationship has been observed with the soil units, but there is a strong relationship with the soil textures. There is an accumulation of heavy metals in the surface soil horizons, which is attributed to the characteristic evaporatic climatic regime prevailed in the studied area.

Some of the heavy metal contents exceed the limits showing signs of anthropogenic contamination.

MESOOZOIC TENSIONAL BASIN DEVELOPMENT IN THE ALPINE - CARPATHIAN SHELF

J. Michalik (Geological Institute, Slovakian Academy of Sciences, Bratislava, Slovakia)

Development of the central Western Carpathians were since Late Triassic /being separated from the European shelf by arising Penninic Rift/ connected with left lateral strike slip to ESE. Until mid Cretaceous, they have got into juxtaposition with the Outer Carpathians /occupating the eastern sector of the North European shelf/. Both the elements converged during Austrian- and collided in Laramian and Styrian phase.

Multiply origin of tensional basin systems /predominantly during middle and Late Triassic, middle Jurassic and middle Cretaceous/ accompanied this left lateral movement of the Alpine - Carpathian shelf fragment. The basins were characterized by expressive subsidence, which /at least in the initial stages/ considerable dominated over the sedimentation rate. The growth rate of the fringe bioherms along the Ladinian "Reifling - type" basins was ten- to fifty times higher /500 to 700 mm/kyr/ if compared with the basinal sedimentation rate /4 to 14 mm/kyr/. Since early Carnian these basins attained more than thousand meters depth. These basins were filled by products of the "Lunz humid event". Top Triassic tensional basins were even more strongly affected by synsedimentary tectonics. Middle Jurassic basins were characterized by expressive subsidence, which was inadequately compensated by sedimentation. Mid Cretaceous tensional basins formed during advent of Paleoalpine stress. Tectonic activity caused their subsequent filling up by early flysch deposits.

ORGANIC GEOCHEMISTRY AND HYDROCARBON GENERATION MODELLING IN THE DANUBE BASIN

J. Milicka /Kat. geochémie PFUK, Bratislava, Slovakia/, M. Pereszlényi, D. Vass

The well core samples mainly from Neogene rocks in the Danube Basin were analysed using Rock Eval pyrolysis and microphotometry. Extracts of bitumene were analysed by gas chromatography method. The results were compared with those from the East Slovakian and Vienna Basins. Based on kinetic modelling the relation between hydrocarbon and accumulation and on the other hand sedimentation conditions is documented. Rapid subsidence, burial of great volume of sediments at the oil generation zone in a relative short time span and conservation of this state till present are the favourable conditions for hydrocarbon generation and accumulation. These conditions are reached in the Danube Basin for sediments older than upper Badenian in Blatné Depression and older than middle Pannonian in Gabcikovo Depression.

PRE-TERTIARY BASEMENT CHARACTERISTICS OF THE WESTERN BORDER OF PANNONIAN BASIN IN SLOVENIA

P. Mioc (Geological Survey, Ljubljana, Slovenia), B. Anicic, M. Znidarcic

The paper deals with geological and tectonic conditions on the western rim of Pannonian Basin in Slovenia. Since in this area there is a crossing of important geotectonic units, the geological structure of the area is quite complicated. Southwards from north lies Eastern Alps (Austroalpine), Southern Alps including Karavanken, Savinja Alps and Julian Alps, followed by Inner Dinarides and at the end Outer Dinarides. Western part of the Pannonian Basin extends into the outmost northeastern part of Slovenia.

According to analysis of the border area geological structure and geological relations between single tectonic units, the extension of single tectonic units towards east into the Tertiary basis is given.

Among the above mentioned geotectonic units, Eastern Alps, East Karavanken and Savinja Alps extend into the basis of the Slovenian part of the Pannonian Basin. The mentioned tectonic units are separated from each other by strong dislocations, with Periadriatic line as the most important. The Periadriatic line separates the Eastern Alps from the Southern Alps. During the origin of the Pannonian Basin, the mentioned units sink and today present the basis of Neogene sediments. The mentioned units influenced deformations of Neogene sediment complex during the reactivation pre-Tertiary basis in Neogene. Structures were built in this time, in which later oil and gas bearing deposits were formed.

UNDERGROUND WATER IN THE SLOVAK PART OF DANUBE ALLUVIUM

I. Mucha (Consulting group "Underground Water" - Faculty of Natural Sciences, Bratislava, Slovakia), E. Paulíková, D. Rodák, Z. Hlavatý

Development of water levels and flow directions of underground water in the Danube alluvial sediments from Bratislava to Komárno depends first of all on the development of Danube river and its arms. The measurements of the water levels and water discharge in Danube performed since the end of last century and groundwater levels measured since beginning of the 50's permite to determine the long-term trends of changes in the regime of water-level fluctuations and groundwater flow. There's possibility to compile the hydroisohyps maps by the defining of the reference groundwater levels which represent the certain time-interval. These maps could be compared mutually and compared with the older hydroisohyps maps as well. Changes in the groundwater regime at the region from Bratislava to Komárno are sketched grafically.

The evaluation of the measured data showed that the bottom of Danube river decreases and the water levels at Danube decrease too, so it's evident that the groundwater level decreases too and mainly in the upper part Žitný ostrov region. The summary range of groundwater levels is changing during the long-term evolution and also there's changing the flow directions of groundwater and the infiltrated volume of water

from Danube to alluvium. The definition of long-term trends in changes of groundwater regime are the base for many practical deductions as the estimation of groundwater supplies, development of groundwater quality, necessity of irrigation and drainage systems. There could be solved the problems with soil salting, influence to ecosystems, mainly to meadow forests.

EVOLUTION OF THE PANNONIAN LAKE MOLLUSCS, IMPLICATIONS ON THE HYDROLOGY AND PALAEOGEOGRAPHY OF THE LAKE (LATE MIOCENE, EAST EUROPE)

P. Müller (Hungarian Geological Survey, Budapest, Hungary), I. Magyar

The Pannonian Lake existed for more than five million years, filling a part of an interarc basin of the Carpathian mountains. Its mollusc fauna, and probably most of its biota, originates from three main sources. Most prosobranchs and some bivalves may be derived from fluviatile ancestors, pulmonats mainly from shallow standing freshwaters, while members of two bivalve families (dreissenids and cardiids) are descendants of marginal marine ancestors. Some prosobranchs, as hydrobiids, may also belong to this last group.

The number of lineages immigrating from fluvial habitats seems to increase almost continuously during the existence of the lake. In contrast, the molluscs of marginal marine origin seem to belong to lineages present in the lake from the beginning of its existence. Their origin seems to be restricted to ancestors living in the late Middle Miocene Sarmatian sea (or lake), in a water body existing in the same basin as that housing the Pannonian Lake. Their increasing diversity most probably reflects an in situ evolutionary process. One possible exception is Cryptomactra, in all probability a descendant of a form living in contemporaneous waters in the Dacian and Euxinian basins during the formation of the Bessarabian substage.

The highly endemic character of the Pannonian lake molluscs is in harmony with the assumption that the lake never did have an on level connection with the oceans or with the neighbouring waters in the Dacian Basin. Instead, it seems that it was partly outflowless, partly had an intermittent outflow toward the Dacian Basin, which enabled a unidirectional emigration of a set of mollusc lineages, mainly belonging to the cardiids and dreissenids, the species of which have planktonic larvae. The, probably unique, case of Cryptomactra needs a special explanation.

UPPER CRETACEOUS-NEOGENE EVOLUTION OF THE NORTHERN CARPATHIAN BASIN V. THE PANNONIAN BASIN

N. Oszczypko (Inst. Geological Sciences, Jagiellonian University, Krakow, Poland), A. Slaczka

Evolution of the Northern Carpathian and Pannonian basins was determined by their different positions in the Carpathian orogenic belt. Present-day relation between these two regions is a result of the Neogene tectonism. According to palinspastic reconstruction, during the Neogene tectonic movements the Northern Carpathians were shortened more than 2.5 times. It means that at the beginning of their formation, the Carpathian Foredeep and Pannonian basins were situated far apart.

To establish relation between mentioned basins, the time and character of tectonic phenomena in both basins were compared.

In the Inner Carpathians and in Pannonian basins the Late Cretaceous and Paleogene orogenic movements caused folding and uplifting while in the Northern Carpathians these movements were only marked by the formation of accretionary prism /in the Magura basin/, changes of the rate of sedimentation, connected with variable clastic influx and changes in paleoenvironments within the basins.

Since the Oligocene the similarities of development of both basins became more pronounced /e.g. fish shales/.During the Oligocene continuous diachronic mainly compressional tectonic movements /folding, thrusting and faulting/ started across the Carpathians and terminated in Neogene in Carpathian Foredeep, with several subphases: Karpathian /Badenian, Middle/Lower Badenian and Middle Sarmatian. These key periods are also very well pronounced in the Pannonian basin by the synsedimentary extensional movements. It implies that from the beginning of the Miocene the development of the Northern Carpathian and Pannonian basins became more and more similar. Previous stages /Cretaceous and Paleogene/ of development show only general similarities connected with the global phenomena and the Neogene similarities could be a

result of approach of the Pannonian basin towards the Carpathian basin during that period.

METHOD OF ESTIMATION OF MINERAL WATER AND CARBON DIOXIDE RESOURCES AT VIRGHIS, IN THE TECTONIC BASIN OF BARAOLT, COVASNA COUNTY

C. Panaitescu ("Prospectings" S.A.; A.R.H. Romania), M. Panaitescu

The tectonic basin of Baraolt was formed during the Pliocene by the sinking of the Cretaceous foundation.

The deposits which compose the geological structure belong to Cretaceous, Pliocene and Quaternary formations.

The Cretaceous foundation is made up of closely folded stratums of Persani Mountains. The Pliocene and Quaternary formations consist of a series of detritic layers with productive stratums of lignite. The Cretaceous basement was closely folded in the austrian tectonic phase. The Pliocene sinking took place along side of a system of faults with N-S direction, same as of the Persani Mountains raising.

The Baraolt basin area is an extended hydrogeological complex made up of water bearing deposits developed above and beneath the local base of erosion being connected in. The water of inferior confined aquifer system had an artesian character.

An inflow of carbogaseous water is produced out of this basic formations, which at the changing of the occurrence equilibrium conditions develops great carbon dioxide emissions. In order to estimate the exploitable reserve of mineral water and carbon dioxide on a set of specimens of water and carbon dioxide analyses have been made /complete chemical analyses of potability, estimation of total carbon dioxide, estimation of natural radioactivity, trace elements analyses, free gas analyses/.

As a result of estimation of carbon dioxide in the non water evacuation drills, it has been chosen a set of 3 drills in which was estimated the reserves of carbogaseous waters and carbon dioxide. The estimation was made by the determination of the optimal flow using the physical method of correlation of the rate with the drawdown. The optimal rate was modelled using the impulsion answering method because the content of carbon dioxide changes with the rate. In order to calculate the exploitable reserves, the data sets were processed statistically.

GEOCHEMISTRY AND PETROLOGY OF VARISCAN GRANITOIDS OF THE WESTERN CARPATHIANS AND COMPARISON WITH GRANITOIDS OF THE PANNONIAN BASIN

I. Petrík (Geological Institute of the Slovak Academy of Sciences), V. Bezák, I. Broska, P. Uher

Two main calc-alkalic granitic suites can be discerned in the Variscan basement of the Central Western Carpathians (CWC):
(1) Possibly older (≈350 Ma after U/Pb zircon datings) mainly peraluminous calk-alkalic, monazite-bearing and magnetite-free, granodiorites / granites broadly of S-type character. They do not contain magmatic enclaves. Both intrusive (Bratislava massif) and (sub) -autochthonous (Suchý, Western Tatra) types occur.
(2) Possibly younger (≈300 Ma, zircon dating) mostly metaluminous, magnetite- and allanite-bearing, granodiorites - tonalites of I-type. They are typically intrusive (Modra massif) often containing mafic magmatic enclaves (Tribeč Mts., Sihla type in the Veporic).

A reduced nature and relatively water-poor parental magma can be inferred on the basis of biotite composition (Fe-rich, reduced) and overal mineralogy for the S-type group. By contrast, the I-type granitoids seem to have been higher temperature oxidized and to have originated from a water richer parental magma.

While the S-type granites might have resulted from the early Carboniferous collision in the Variscan fold belt, the I-type tonalites may be related to late -Carboniferous subduction of Paleotethys along the eastern margin of Pangaea.

Being silica-poorer (Mecsek), K-richer (Velence), the granitoids of the Pannonian basin represent a conspicuous contrast to those of CWC. While monzogranitic to monzonitic granites of the Mecsek Mts. can hardly find any analogue in the CWC, those of the Velence Mts., having recently been interpreted as post-orogenic and A-type tending, have their counterparts in probably Permian A-types of the CWC: Turčok granite and Upohlav granite (pebbles in the Pieniny Klippen Belt).

A-type granites of both areas may represent a late Variscan, post-orogenic, granitoid plutonism having many analogues in the Eastern Alps and throughout the Variscan orogenic belt.

ORIGIN OF DEEP SOURCE CO2 IN THE WEST PART OF PANNONIAN BASIN: THERMO-MINERAL WATERS IN MURA REGION

J. Pezdič (J. Stefan Institute, Ljubljana, Slovenia), T. Dolenec, D. Žižek

Thermal waters with high hydrogen carbonate mineralization (to 7500 ppm) have been examined. The origin and transport of CO_2 are the main questions which should be solved to evaluate the evolution of such fluid system. The investigated district of Radenci (24 km^2) with influence area of about 300 km^2 lies in the west part of Pannonian basin. There, a great amount of clastic material of highly variable mineralogical composition had been deposited over a paleo-relief of Paleozoic metamorphic schists (phyllites) and Triassic dolomites after Middle Miocene. The isotope composition of CO_2 shows the range of $\delta^{13}C$ from -2.21 to -10.77‰ (PDB) and of $\delta^{18}O$ from -7.0 to -18.3‰ (SMOW). The water $\delta^{18}O$ vary from -4.68 to -12.45‰, up to +0.85‰ (SMOW) in the influence area. Additionally $\delta^{13}C$ of carbonate species, $\delta^{13}C$ in the organic compounds, and gas as well as dissolved compounds composition have been measured.

According to obtained data and by using thermodynamic calculations (including geothermometry and rock-fluid equilibrium balances) and by considering hydrogeological possibilities of transport through the system, we found that CO_2 (HCO_3-) could derived mostly from the decomposition of dolomite in the system: Dolomite - SiO_2 - Clay minerals at the temperature range from 80 to 150°C. Some amount of CO_2 could be derived from sulfate reduction as well as from maturation of organic compounds. Less probable is mantle origin of CO_2, because of the high metamorphosed crystalline basement which contains only calcite (marble) carbonate constituents and if it occurs concentrations are negligible compared to total.

MINERAL RESOURCES OF ESTONIA AND THE PROBLEMS OF THEIR EXPLOITATION

A. Raukas (Institute of Geology, Estonian Academy of Sciences, Tallin, Estonia)

In spite of its small area and rather simple geological structure, Estonia is rich in mineral resources, mining of which has inflected incurable wounds on the environment. Estonian phosphorite deposits are the largest in Europe /about 750 million tons of P2O5/. Reserves of limestone and dolomites /for producing lime, cement, building and facing stone and for several other purposes/ are practically unlimited. Clay deposits occur all over Estonia but the reserves of refractory clay are small. 22.3 % of the territory is covered by bogs with the maximal thickness of peat l8 m. Peat reserves are estimated at l.5 billion tons, out of which commercial reserves make up 657 million tons. Mineral water with different degree of mineralization and balneological properties is used in many parts of the Republic. Curative sea muds have been used since the beginning of the 19th century. There are also about 900 deposits of building sand and gravel. Serious ecological problems have arisen in connection with the world,s largest exploited /l9.6 million tons in 1991/ oil shale deposits in NE Estonia, supporting the generation of electric power /80% of the total mined/ and chemical /20%/ industry. Explored resources are estimated at 3800 million tons, prognostic reserves are considered much bigger, as are the reserves of alum-shale /up to 60 billion tons/, rich in uranium /at Toolse in some places up to 850 g/t/ and other /Mo, V, Th, Re a.o./ valuable microelements. As a result of mining activities both air and water are highly polluted and natural landscapes have been spoilt in about 8% of the territory of the country. Elaboration of better, environmental safe technologies and recommendations for land improvement are urgently needed.

THE POSITION OF THE INACOVCE-KRICHEVO UNIT IN THE WESTERN CARPATHIAN STRUCTURAL PLAN

J. Soták /Geological Institute, Slovak Academy of Sciences, Banská Bystrica, Slovakia/, R. Rudinec, J. Spisiak

Pre-Neogene basement in the East Slovakian part of the Transcarpathian Depression is built by complexes of calcphyllites, phyllitic schists, graphitic schists /Schwarzschieferhorizonten/, marbly limestones, metatuffites, etc., which, in the upper parts, pass into the sediments that become more flysch-like in character /Inacovce-Krichevo unit/. They contain Alpine-type ultrabasites on different degrees of alteration - peridotites lizardite-chrysotile serpentinites up to talc-chlorite schists. As for age, these over a thousand metre thick sequences belong to Uppermost Paleozoic, Mesozoic till Eocene. The complexes were influenced by post-Eocene thrusting, syntectonic metamorphism under anchi/epizonal conditions, and shearing processes recognizable through a slate cleavage, stretching lineation, crenulations, strong isoclinal overfolding, etc. The described Penninic-like complexes occur in the space where the sub-Tatric nappe pile was tectonically unroofed by the mechanism of a "pull-apart" dome.

SMECTITE ILLITIZATION - INDICATOR OF BURIAL METAMORPHISM IN NEOGENE SHALES FROM THE DANUBE BASIN

V. Sucha /Faculty of Natural Sciences, Comenius University, Bratislava, Slovakia/, D. Vass, M. Maciková

Diagenetic history of shales from the Danube Basin have been studied using detailed mineralogical analysis of the clay fraction. Main component of this fraction is mixed-layer illite/smectite mineral with variable expandability which represents content of smectite layers in mixed-layer illite/smectite was determined by X-ray diffraction. It ranged between 80% and 20 %.

Different trends were observed between the content of expandable layers and burial depth for wells representing North - South profile. The differences disappeared when plotting expandability content versus burial temperature.

Rate of diagenetic smectite to illite conversion in the Danube Basin was compared also with reactions in other two main Carpathian basins /the Vienna Basin and the East Slovak Basin/.

MARINE PALEOENVIRONMENT IN THE SOUTHERN SLOVAKIA BASIN - A CONSEQUENCE OF LOCAL OR GLOBAL EVOLUTION?

K. Sutovská (Dept. of Paleontology, Charles University, Prague, Czech Republic)

Foraminifera assemblages were used for a reconstruction of the changes of paleodepth, O2-content and paleosalinity in the Southern Slovakia Basin (S.S.B.) from Kiscellian to Karpatian. Following 9 periods with relative stable environment were distinguished: Upper Kiscellian, Lower Egerian, Upper Egerian, Lower Eggenburgian, Upper Eggenburgian, Ottnangian, "Rzehakia Mb. period", Lower Karpatian, Upper Karpatian. A diversity and abundance of the benthonic foraminiferal assemblages and P/B-ratio were specified for every period. For a comparison, the paleoenviromnemt was characterized in some parts of the Danube, the Eastern Slovakia and the Vienna Basins and the Carpathian Foredeep. An influence of the global sea-level changes (cycles TB 1.1 - TB 2.2) on the local changes of the paleoenvironment was studied.

From 5 transgressive events in the S.S.B., the Lower Eggenburgian transgression is characteristic also for another studied basins. The Ottnangian transgression can be correlated with global sea level rise (cycle TB 2.2). It manifested in another studied basins gradually in Karpatian. These transgressions are connected with high P/B ratio and high number of new species of benthonic foraminifera.

From two emergence events in the S.S.B., the Upper Eggenburgian-Ottnangian emergence can be correlated with a hiatus in the Eastern Slovakia Basin and an anoxic regime in the Danube Basin.

With exception of the Kiscellian low-oxic event, the anoxic or low-oxic events in the S.S.B. are very local. Hyposalinic facies have also a local character. High abundance of the foraminifera in Kiscellian and Upper Karpatian can be connected with a low sediment supply. In Karpatian it has local character.

Conclusions: From Kiscellian to Karpatian the S.S.B. had the specific evolution in a comparison with the Danube, Eastern Slovakia, and Vienna Basins and the Carpathian Foredeep. Only the Lower Eggenburgian transgression and the Upper Eggenburgian-Ottnangian eustatic fall were unific for the evolution of the basins.

NEOTECTONIC ACTIVE PHENOMENA AT THE EASTERN BORDER OF THE TRANSYLVANIAN BASIN

Gy. Szarka (Pro Natura, Tirgu-Mures, Rumania), G. Kiss, T. Szőcs , I. Horváth

The Transylvanian basin is situated in Eastern-Middle Europe, surrounded by the Eastern and Southern Carpathian Mountains and the Apuseni Mountains. This basin of 20,000 km2 area tectonic swale was formed at the end of the Cretaceous period, after the Laramian orogenesis. In the basin Paleogene and mainly Neogene blocks of molasse character were deposited in 1,300-4,500m thickness. From structural geological point of view the Transylvanian basin is made up of a monolitic border zone, an inter zone of salt diapirs and a middle part consisting of brachyanticlinal folds. This typical structure was formed by salt tectonics which is still active nowadays.

In the basin the salt can be detected on an area of about 16.000 m2. On the basis of the data of more than 200 exploratory drillings the average thickness of the salt layer was determined in 250 m. The estimated salt resources of the Transylvanian basin are about 8.5x1011 tons. On the border of the basin stocks were formed from the salt layer by convectional movements of the isostasy. This typical "diapir" movements were promoted by the lithostatic pressure of the surrounding mountains and by the structural discontinuities occurring on the margins of the basin. By such mechanism was formed a

column-like salt stock in Praid, on the eastern border of the Transylvanian basin which extends from the depth of 2500 m to the surface. On the surface the salt stock forms an elliptical shaped 1.4 km long and 1.2 km wide, about 95 m high salt mount which is called Salt Ridge. The salt mount is cut by the Corund creek developing a spectacular salt karst. As a result of the diapir movements, the Holocene terraces of the Corund creek have already been lifted more than 95 m in the region of the Salt Ridge. These movements were concretely proved by systematic geodetical measurements. On the basis of the measurements it can be concluded that in the growing phases of the salt mount the minimal velocity of elevation must have been more than 41.5 mm/year.

INTERPRETATION CF THE TRIASSIC SUBSTRATUM AND FOLDED HERCYNIAN BOUNDARIES OF THE PANNONIAN BASIN FROM BIBLIOGRAPHIC STUDIES

J. M. Thery /Tours, France/

Within the Mesozoic substratum of the Neogene Pannonian Basin, fossiliferous stratigraphical markers of the Lower Triassic are believed to characterize the extension of the Plate Tisza between the Northern Karpaten /Gemericum Area/ and the Southern Karpaten along hercynian lineaments. We are giving a cross section between Roznava and the Southern Budapest area with a representation of the hercynian folding in the Bükk Mountains.

Those markers are key layers above the hercynian folding around the Tisza Plate. In the Budapest trough between Roznava-Gyôr and the Raab line /Zemplin-Zagreb/, one observes a thin crust with a notable possibility of a geothermal exploitation. The data mark an extension of the Permo-Carboniferous sea within the trough.

HYDROGEOLOGY AND OIL DEPOSITS AT PECHELBRONN- SOULTZ, UPPER RHINE GRABEN: RAMIFICATIONS FOR EXPLORATION IN INTRAMONTANE BASINS

J. Tóth /Department of Geology, University of Alberta, Edmonton, Alberta, Canada/, C.J. Otto

The Upper Rhine Graben at the Pechelbronn-Soultz area is a typical intramontane rift basin which has been subsiding continuously for the last 40 to 50 Ma. The +2 km thick sedimentary fill contains areally extensive aquifers and aquitards of Mesozoic and Tertiary age. All units are divided into variably fractured blocks by occasionally rejuvenating faults. Oil occurs in Triassic carbonate and Tertiary clastic reservoirs, associated commonly with dense faulting and fracturing. Mature source rocks are found in the Jurassic, while the Tertiary is organic rich but immature, except at greater depths, approximately 10 or 20 km to the east. Oils are paraffinic and mixed paraffinic-naphthenic in the Triassic and Tertiary rocks, respectively. Formation waters move in topography-induced regional systems from recharge areas in the adjacent mountains toward the valley, and discharge preferentially through intensively fractured fault blocks by cross-formational ascension. They are less than 30 000 years old and have meteoric stable-isotope composition. Entrained hydrocarbons are thought to be trapped mechanically by slightly permeable seals and by the matrix surrounding the sandstone lenses which are fed by fluids largely through faults. Fractional exsolution of hydrocarbons is enhanced by increased water salinity at discharge regions and by decreases in pore pressures and temperatures along the flow path of the rising waters. The hydraulic theory of petroleum migration provides a unifying explanation for all observed aspects of the area,s petroleum hydrogeological conditions, including the vertical distribution of oil types, deep and near-surface temperature anomalies, artesian fluid levels, oil seeps and saline water. The theory can, therefore, be considered as a suitable basis of a novel approach to petroleum exploration in general, and in intramontane basins, in particular.

THE NEOGENE TECTONIC OF THE SOUTHERN SLOVAKIA DEPRESSIONS AND INNER WEST CARPATHIANS

D. Vass /Dionýz Štúr Institute of Geology, Bratislava, Slovakia/, J. Hók, P. Kovác, M. Elecko

Brittle deformations analysis of the Tertiary depressions fill in the South Slovakia and of the part of the Inner West Carpathians permitted the reconstruction of the paleostress-field orientation. During Neogene strike-slip faults influenced structure of the West Carpathians. Both regional fault patterns and their cinematics are results of the regional stress field.

On the end of Oligocene and during Early Miocene in the South Slovakian depressions the direction of the main compression was roughly NE-SW. During Lower Badenian the South Slovakian depressions were in the stress - field with the compression in NW-SE to NWN-SES direction. During Middle and Upper Badenian the NW-SE compression the Danube basin /Northern part/ controlled, while in the other South Slovakian depressions the extension in the same direction and vertical compression dominated. During the Pliocene and Quaternary in South Slovakia the conditions for the reactivation of NW-SE and NE-SW faults were favourable.

Fault analysis of the Inner West Carpathians enables us to reconstruct the distribution of the paleostresses in this area. NE - SW distension /Late? Eocene - Middle Miocene/ as well as NW - SE distension /Middle - Late Miocene/ are identified.

GEOCHEMISTRY OF MIXED GASES OF THE FLYSCH ZONE, PANNONIAN BASIN, HUNGARY

I. Vető (Hungarian Geological Survey, Budapest, Hungary), I. Gajdos, S. Pap

The Hungarian segment of the Flysch zone, a narrow WSW-ESE trending belt of the Pannonian Basin, underlain by the folded, overthrusted U.Cretaceous-Paleogene Flysch Basin, contains more than 50x109 m3 natural gas. While the fields of the western part of the area show an extreme compositional variation - CO2 gas, three components gas (wet gas+N2+CO2), N2-rich wet gas, dry gas - the bulk of the reserves of the eastern part consists of wet gas. Gases have been trapped in late Neogene sandstones close to the uplifted flysch sediments and to a smaller extent inside these latters. N2-rich wet gas fields are absent in the Neogene sub-basins NW and SE of the Flysch zone.

CO2 gas was likely generated by thermal decomposition of deep-lying carbonates in the Flysch Basin or beneath it. The relatively N2-rich wet gases display a surprisingly constant wet gas:N2 ratio (2-3). This fact is interpreted as either a result of a common generation or that of an en route mixing. Geological and mass balance considerations discard the Neogene strata as source of wet gas and N2 and suggest that these latters were generated in the deeper part of the Flysch basin due to a Neogene revival of thermal maturation. In the case of three components gas fields traps were filled first by CO2 then arrived the wet gas-N2 mixture. Light carbon isotopic composition proves a bacterial origin for dry gases. Neogene sediments are their likely source, while gravitational cross-flow is suggested as their transport mechanism.

MINERALOGY AND DIAGENESIS IN THE NORTH HUNGARIAN PALEOGENE BASIN

I. Viczián /Hungarian Geological Survey, Budapest, Hungary/

Sedimentary and volcanic formations from the North Hungarian Paleogene Basin were investigated by X-ray diffraction, thermal analysis and chemical methods. Basin sediments of Paleogene age are covered in the south by the overlapping sequence of Neogene age.

Terrestrial formations on the basis of Paleogene are characterized by much kaolinite of various degree of ordering and hematite.

Shales of Paleogene age /Buda Marl, Tard and Kiscell Clay Formations/ and the Schlier Formations /Eger and Garáb/ contain the typical terrigeneous clastic clay mineral assemblage of illite, illite/smectite, smectite, kaolinite and chlorite and the carbonate minerals calcite and dolomites.

The most important alteration product of the Karpathian-Badenian volcanic sequence is smectite. Less frequently the clay minerals celadonite, mixed-layer celadonite/smectite and chlorite/smectite or other silicates such as opal-CT, clinoptilolite and analcime have been formed.

The overlying Badenian to Upper Pannonian silt and clay rocks are composed of mixtures of terrigeneous and volcanogenic detritus. Volcanogenic material can be recognized by the presence of Na-Smectite, opal-CT and by enhanced contents of smectite in the 2 um grain size fraction /70-80%/.

Oligocene sediments outcropping on the present-day surface are not affected by smectite diagenesis. In the southern part of the area /e.g. Zagyva Trough/ the smectite proportion of illite/smectites drops from 100 % to 30 % in the depth interval of about 1000 m to 2700 m due to the subsidence in Neogene times.

In the Badenian to Sarmatian sequence the diagenetic transformation

Mg-calcite → calcite + disordered dolomite can be observed.

RESULTS OF THE COMPLEX ENVIRONMENTAL GEOLOGY INVESTIGATION PROGRAMME IN SLOVAKIA

K. Vrana, (Dionýz Štúr Institute of Geology, Bratislava, Slovakia),
D. Bodiš, I. Modlitba, S. Rapant

The project entitled "Investigation of geological factors of environment in Slovakia" is aimed at the most actual problems of environment in the territory of Slovakia. Coordinating organization of the project is the D. Štúr Institute of Geology in Bratislava and 10 further institutions acting in natural sciences are participating in it. The project covers two partial tasks.

The first of these tasks is aimed at the compilation of a geochemical atlas of the Slovak republic in 1:1 000 000 scale during the 1991-1995 period together with maps of associative geochemical and ecological features in 1:200 000 scale. Investigations are concentrated to the evaluation of concentrations and distribution of chemical elements including the toxic ones in river sediments, groundwaters, rocks, soils and forest biomass. The evaluation will be oriented also to the total radioactivity of territory and to that of single elements composing it.

In the frame of the second task, a set of maps representing geological of the environment in Slovakia is compiled based on regional geological maps in 1:50 000 scale. The complete set will include a geological map, map of mineral resources and forecasts, map of natural radioactivity, pedological map, map of geochemical reactivity of rocks, hydrogeological map, map of groundwater quality, geochemical map and a multicomponent engineering geological map showing complex interactions of technogenetic sphere and that of the geological environment.

The contribution presents first results of this project.

THE EVOLUTION OF THE TRANSYLVANIAN BASIN IN THE MIDDLE AND UPPER MIOCENE, BASED ON THE OSTRACODA FAUNAS

F. Wanek (Babeş-Bólyai University, Cluj-Napoca, Romania)

The Transylvanian Basin represents a retro-arc basin developed during the Middle and Upper Miocene.

The first period of the Lower Badenian transgression is characterized by nearshore, epicontinental Ostracoda faunas (Geoagiu de Sus, Ciceu Giurgesti). In the Middle and Upper Badenian deposits the rarity of Ostracodas prove deep sea facies (Henryhowella asperima, Hermanites haidingeri, Falunia plicatula, Prakrithe dactylomorpha) as well as salt formation in the deep sea basin (poor Foraminifera fauna).

Middle and Upper Badenian salt formation, Radiolarian shales, Spiratellan marls show paleogeographic connections with Maramureş, Ukrainean Sub-Carpathia and Outer Carpathia but a barrier along Apuseni Mts. towards the Pannonian Basin.

The sedimentation is continuous on the Badenian/Sarmatian boundary. The Sarmatian Ostracoda fauna is a typical deep-water one, poor in number of species and individuals, however the JIRICEK (1974) biozones can be recognized quite well. Some shallow-water, nearshore Ostracodas are known only from the area east of Sibiu till the Haţeg Basin. The frequent species Polycope konkensis, Argilloecia sarmatica suggest direct connection with Ukrainean Sub-Carpathia and Slovakia, through Maramureş.

Pannonian sediments deposited continuously upon the Sarmatian. Up till now, the Ostracoda faunas can prove only the lower part of the Pannonian s. restr. (Slavonian subetage: A-C zones) in the Transylvanian Basin. The faunas containing relatively many endemical species are different from the Serbian shallow-water Lower Pannonian faunas and they have unambiguously deep-water character. The connection with Banat across the Mureş Trough is very improbable; connection with the Pannonian Basin might have existed through Maramureş, Oas Basin and Sub-Carpathia.

Sediments younger than Pannonian s. restr. are missing. Exceptions are continental sediments south, southwest of Odorheiu Secuiesc and lacustrine deposits on the western margin of the Perşani Mts.

The spatial continuity of the northern connection is interrupted by the postsedimentary uplift of the basement of the Transylvanian Basin along the line of the Meseş-Ţicău-Preluca-Ţibleş Mts.

A NEW OPTICAL METHOD OF QUANTITATIVE ESTIMATION OF ROCKS TOTAL POROSITY

A. Zilbershtein /All-Russian Sci.-Research Geological Institute, St.-Petersburg, Russia/, G. Romm

A new optical method for quantitative estimation of rock porosity is proposed.

The base of the method is the analysis of transmission of monochromatic light which passes through sample,s plates and/or thin sections.

This transmission is determined by light scattering on heterogeneities of sample,s material /pores in part/.

The approximately linear dependence between light transmission intensity and porosity /as well as density/ of samples is discovered.

ABOUT DIFFERENT TYPES OF OROGENIC BELTS, WITH A LOOK ONTO SOUTHERN AND CENTRAL EUROPE

G. Zolnai (Pau, France)

"Orogenesis" (mountain/relief forming) is commonly attributed to compressive folding. There are nevertheless sizeable foldbelts and mountain reliefs where regional shortening is not the only (main) mechanism.

One should therefore distinguish between:

- COLLISIONAL orogens, like the American Cordilleras;
- belts of CONVERGENCE, generated in already consolidated areas, having undergone a phase of earlier crustal weakening (stretching), e..g. the Pyrenees;
- FORELAND and INTRACONTINENTAL foldbelts and arches where lateral adjustments between basement mosaic-blocks (hence wrenching) are at least as effective as the regional shortening itself, ex.: Wyoming-Utah (Uinta "Range"), Jura foldbelt, Amadeus basin (Aus.);
- mountain-belts along SHEARED or PASSIVE margins: the (Tertiary) Inuitian foldbelt in Arctic Canada;
- reliefs due to BLOCK-FAULTING ("Germanotype" orogens), related to primary shearing: Vosges-Rhine graben-Schwarzwald compound, uplifts of El Biod (Sahara), Black Hills (nw USA), Boothia (Can.), Bakony (Hung.) etc;
- folds or fold-groups generated trough EXTENSION or SHEARING, over tilted blocks and/or (salt) diapirs: Parry Island foldbelt (Canadian Arctic archipelago).

In the case of intense deep shearing, drag- and drape-folds appear at the surface; compression and extension being in balance and coeval: Pannonian bsn.

In the global tectonic context, each plate has its own structural timing or history; orogenies occurring on different plates may or may not be synchronous.

The deformation mechanisms themselves are different according to stress, lithology and basement.- "Duplexes" occur in thick, competent sequences overlying flat basement (eastern USA - Canadian Rockies). - Recumbent folds are formed in soft, laminated series underlain by broken up platforms, or in case of gravity sliding (Alpine flysch domains). - Drag- and drape folds need no compression normal to their axis.

Structural heritage is of prime importance. Thus a stretched basement chessboard with a web of rifts may generate, when taken into "moderate" (100km-order) orogenic compression, a sinuous mountain-system with stable nuclei (basins) inbetween, but without some phenomena inherent to "active margins" being present.

GENESIS OF THE CHROME ORES IN THE MYLONITIZED ZONE IN THE GÜLLÜDAG OPHIOLITE, KOP REGION, EASTERN TURKEY

Ö. Basta (Mineral Research and Exploration of Turkey, Ankara, Turkey)

The Güllüdag Ophiolite which extends WSW-ENE and 8 km in width and 57 km in length, is located within the Bayburt-Erzincan-Erzurum triangle.

Within the ultramafic rocks of the Güllüdag Ophiolite, the most significant chromite deposits are located parallel to the internal structure in an alteration zone of 1.2 km wide and 25 km long and extending SW-NE direction. In Western Kop, chromite deposits in the altered zone generally strike WSW-ENE and dip to NW, in Eastern Kop, however chromite deposits strike SSW-NNE and dip to SE.

The maximum dimensions of the ore deposits in the altered zone are 400 m long, 20 m thick and 180 m deep. Out of the altered zone, the ore zones have much smaller dimensions.

Grades of the ore zones in the Western Kop range between 16.6-54.15 % Cr_2O_3. However the grades of the ore appear to be higher in the ore zones which are located along the tectonic zones.

The dominant strikes of the fault systems in the altered zone are SW-NE, and dips to NW.

The effects of the intense tectonism and granitic intrusion on the development of the altered and mylonitized zones are the discussion topics of this paper.

FAULTING AND PALEOSTRESS EVOLUTION IN THE CARPATHO-PANNONIAN AREA DURING THE TERTIARY

F. Bergerat (Tectonique Quantitative, Bte 129, UPMC, Paris, France), L. Fodor, L. Csontos and F. Marko

Microtectonic observations and analysis in and around the Pannonian basin enable to propose a model for the paleostress field changes and Tertiary tectonic evolution of the Pannonian area.

The continental escape of the North Pannonian Block (NPB) began during the Late Eocene time [1] and continued during the Oligocene by means of large shear zones such as the sinistral Pieniny Klippen Belt and the dextral Periadriatic - Mid-Hungarian line [2].

A very similar rotation pattern of the direction of the horizontal maximum stress axis is found in the whole Pannonian area [3]. This axis trend WNW-ESE during the earliest Miocene and NW-SE during the late Early Miocene, then it shifts to the north during the Middle Miocene. It trends NE-SW (and even locally ENE-WSW) in the Late Miocene, then it jumps back counterclockwise towards the north-northeast during the Late Miocene-Pliocene and towards the northwest during or after the Pliocene [3].

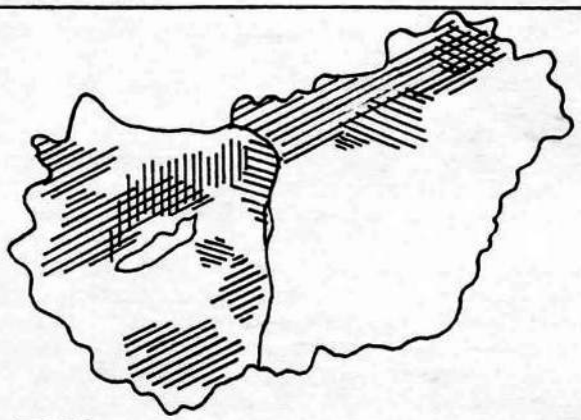
Paleomagnetic studies made in the Pannonian area [4] suggest that significant rotations took place during Early Miocene [5]. Taking into account this counterclockwise rotation of the NPB, the NW-SE compression characterized in the Oligocene and Early Miocene was in fact originally oriented close to N-S, in good agreement with the western european stress field and the Africa/Eurasia convergence [6]. During the Middle and Late Miocene, intra-Carpathian basins developed south and west of the Carpathian arc along conjugate major strike-slip and normal faults . The first stage of the structural development of these basins was a transtensional one [7]. However, during Middle Miocene, at least locally, the maximum stress axis seems to rotate to NE-SW (ENE-WSW) position inside the NPB indicating a local stress field. At the end of the Miocene and during the Pliocene, the stress field changed to a more extensional one characterised by a E-W to ESE-WNW trending σ_3. Nevertheless, strike-slip motion continued along some faults until recent times as shown by focal mechanisms of earthquakes.

[1] Fodor et al.(1991), Tethys Info. n° 5; Fodor (1991), Thèse U.P.M.C., Paris; [2] Fodor et al. (1992), Geologische Rundschau, 81/3, p. 695-716; [3] Csontos et al. (1991), Tectonophysics, 199, p. 73-91; [4] Marton and Marton (1989), Geophys. Trans., 35, p. 117-133; [5] Balla (1987), Tectonophysics, 139, p. 67-98; [6] Bergerat (1987), Tectonics, 6, p. 99-132; [7] Bergerat (1989), Tectonophysics, 157, p. 271-280.

TERTIARY PLANCTONIC GASTROPODS IN HUNGARY

M. Bohn-Havas (Hungarian Geological Institute, Budapest, Hungary)

PTEROPOD OCCURENCES IN THE TERTIARY OF HUNGARY



EOCENE

Bakony Basins
Vértes Basins

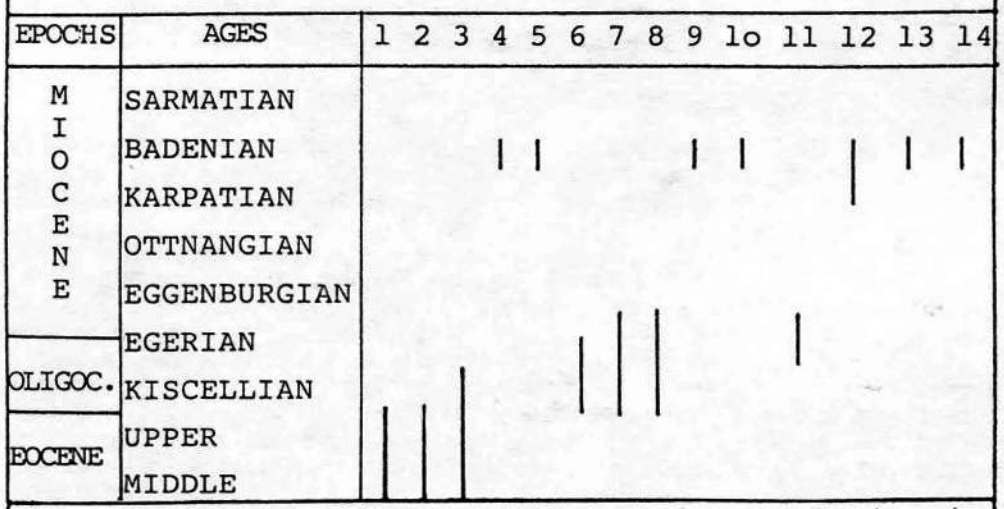
OLIGOCENE

Nagyberény area
Buda Hills
North Hungarian Paleogene Basin (Hatvan, Recsk--Parád, Tard area)
Borsod Basin

MIOCENE

Sopron Hills, Tapolca Basin, Várpalota Basin, Paks-Tengelic area, Mecsek Mts, Börzsöny Mts, Cserhát Mts, Borsod Basin.

STRATIGRAPHIC RANGES OF THE HUNGARIAN PTEROPODS



1.Praehyalocylis chivensis, 2.Creseis sp., 3.Limacina sp., 4.Limacina valvatina, 5.Limacina sp.1., 6. Clio jacobae, 7.Clio triplicata, 8.Clio multicostata 9. Clio fallauxi, 1o.Clio pedemontana, 11.Vaginella tricuspidata, 12.Vaginella austriaca, 13.Vaginella sp.1., 14.Cavolinia bisulcata

GEODYNAMIC IMPLICATIONS OF THE HORIZONTAL MOVEMENTS ON TRANSYLVANIAN BASIN SUBSIDENCE

C. Cranganu (Al.I. Cuza University, Iasi, Romania)

In schema of the horizontal movements of terrestrial crust of Rumania, caused by relative movements of the lithospheric segments belonging to Eurasian plate and to Black Sea, Moesian and interalpine microplates - schema almost concentric within the central zone of Rumanian territory - the Transylvanian Basin is caught like in a vice beginning from Carpathian orogenesis.

I consider that this situation provides some effects on basin structural evolution, inclusively on basin vertical movements (subsidence), causing situations similar to those illustrated by my figures.

The movements of lithospheric blocks have variable velocities in comparison with another from Cretaceous just to the present (see the coincidences of the orogenic phases of the three Carpathian chains). Thus, I consider that these movements have conditioned to a great extent the differential position of the Transylvanian basin basement, as I proved for Buglovian and Sarmatian. The effects of horizontal movements are felt also, in a similar measure, on the variation of Neogene sea level, on thickness of its waters, by successive contributions and expulsions determined by transgressions and regressions. Unhappily, there is not by now an estimation of displacements velocities of lithospheric segments involved in the horizontal movements, which should facilitate a quantitative estimation of influences exerted on Transylvanian basin subsidence. Nevertheless, the qualitative effects can not be neglected and they must be included into a more complex model of Transylvanian basin subsidence which to compose the subsident vertical movement with the horizontal movements associated with displacements of lithospheric segments.

Consequently, the Transylvanian basin subsidence is a particular case among the European sedimentary basins.

FISSION TRACK DATING OF THE TERMINATION OF THE EXTENSION IN THE BORDER ZONE OF THE EASTERN ALPS AND THE PANNONIAN BASIN

I. Dunkl (Lab. for Geochemical Res., Budapest, Hungary), F. Neubauer

The sequence and significance of the uplift events in the Eastern Alps is not known clearly, because the latest one, the Neogene tectonics produced rearrangement and huge amount of erosion frequently hides the result of the earlier vertical offset.

The Sinnersdorf conglomerate of Miocene age was deposited in small basins close to the margin of the Pannonian basin during the last large-scale tectonic movements of the Eastern Alps. By the determination of the fission track ages of detrital zircon crystals we made an attempt to clear the time of uplift of the source formations of Sinnersdorf beds, or by other words to determine the cooling ages of the terrains were exposed on the surface during Early-Middle Miocene. The distribution of the age of the zircon grains is rather narrow, with an average of 53-47 Ma. This age expresses the datum of the cooling below c. 200C of the Lower Austroalpine metamorphics around the studied sites. The measured Eocene age is younger than the wide spread Late Cretaceous mica cooling ages of the Eastern Alps. This may be related to an independent Paleogene uplift period.

The apatite grains gave ages in the range of 13-11 Ma (average and peak respectively). These data are considerably younger than the age of the deposition of the conglomerate. The rejuvenation of the age is acceptable, because the coal rank is rather high in the lower part of the sediment sequence (up to 1.1% Ro). The post-depositional heating related to the increased heat flux during the intensive period of the basin formation. Thus the detected Sarmatian age expresses the termination of the heating. As the length distribution of the confined tracks shows negligible shortening we can consider the apatite result as the direct dating of the termination of the extension.

THE HUNGARIAN GPS DEFORMATION STUDY PROGRAM AND ITS GEOLOGICAL BACKGROUND

M. Gazsó, (FÖMI, Satellite Geodetic Observatory, Penc, Hungary), et al.

A Deformation Study Program has been initiated in Hungary using the highly accurate and efficient GPS technique. A detailed description is given of the geological characteristics of the Pannonian Basin which consist of 4 main tectonic units.

In 1990-91 a Reference Network has been established consisting of 12 sites located on geologically stable bedrock. The zero epoch measurements of this network were carried out in late 1991. For the monumentation of the sites specially designed point marks have been applied.

The paper also discusses the potentially interesting extensions of the network for more extended geodynamic studies.

QUATERNARY CRUSTAL MOVEMENTS AND FLUVIAL SEDIMENTATION IN RIVER VALLEYS OF THE PANNONIAN BASIN

S.JASKÓ /Budapest, Hungary/

Recognition of intervals of tectonic activity is considerably helped by the study of sediments that lie under recent valley floors. Wherever the thickness or the horizontal width suffers abrupt changes at lines traversing the valley it is an indication of post-deposition movements. Several thousand boreholes were drilled in the river valleys of Hungary. The study of borehole data lead to the following conclusions:

Different parts of the surrounding hills have been elevated at different times and to different heights. Because of this, the erosion of valleys was not uniform either. Individual sub-basins of the Pannonian basin suffered different degrees of subsidence. The Upper Pliocene and Quaternary fluvial formations filling these sub-basins show differences in thickness and character.

Sometimes the different valley types can follow each other along the course of the same river according to whether the river is cutting across a range of hills or meandering on plains.

Quaternary fluvial deposits can be subdivided into two sets. Faults are much more common in the lower set than in the upper one. The upper set covers the lower one unconformably. The intensity of Infra-Pleistocene erosion varies by region.

PANNONIAN S.L. (LATE-NEOGENE) LITHOSTRATIGRAPHIC UNITS IN THE HUNGARIAN PLAIN: DISTRIBUTION, FACIES AND SEDIMENTARY ENVIRONMENTS

Gy.Juhász (MOL Plc.- Oil & Gas Laboratories, Budapest, Hungary)

Identification, correlation and mapping of the different lithostratigraphical formations in the Pannonian (s.l.) sequence in the Neogene basin of the Hungarian Plain (Alföld), E Hungary, was carried out on the basis of lithological and detailed sedimentological investigations as well as palaeogeographical reconstruction, based on the geological data of more than 900 boreholes. Eight formations were identified and mapped, seven of them are sedimentary ones.

Békés Formation: Built up by oligomict sandy conglomerates and pebbly sandstones, formed in a coastal environment along preexisting islands. It can be identified in a limited area.

Tótkomlós Formation: The calcareous marl and marl succession was formed in the basinal areas, far from sediment input. It has different appearance depending on the water depth, which could be either shallow or deep. It grades upward into marl and clay marl, and connected to steep relief it can contain pebbles. It has large areal distribution, its thickness varies between 20-300m.

Nagykörü Formation: The offshore argillaceous marls are widespread all over the basin with variable thickness of about 10-600 m. In the upper parts it contains thin silty and sandy intercalations of distal turbidites.

Szolnok Formation: The fine-grained sandy turbidites are easy to detect and map. It can be found in the deepest part of the basin. Most of the turbidites arrived from the NW-W direction in elongated fan systems along the shoreline, while some of them from the NE in one elongated fan system along the valley of the Derecske-trough. Its top follows the basement morphology, and the thickness can exceed 1000 m while pinches out towards the flanks of structural highs.

Algyő Formation: The prevailing rock types are siltstones, and also argillaceous marls, containing sandstone intercalations. It is widespread all over the basin and was formed in the slope environment. The shelf itself was very narrow in the basin, thus the lithofacies, formed in the delta slope and the basin slope, practically merge here. In the eastern areas it also contains the deep basin facies as the fine grained slope apron sediments derived from the flanks of the structural highs, the overbank deposits of the fan system and also the basinal argillaceous marls cannot be differentiated by the available data. Its average thickness is about 400-500 m, but can reach 1000 m in the deepest zones and the E part of the basin.

Törtel Formation: The medium and fine-grained sandstone and siltstone lithofacies was formed in mainly deltaic and shoreline environments. Due to the tremendous amount of sediment discharge by rivers, fluvial dominated lobate type deltas were formed, thus the deltaic lithofacies are very characteristic, widespread and thicker than usually. Multistory mouth-bar and distributary channel fill as well as crevasse-splay successions form the coarse-member of the formation. A zone of facies interfingering can be mapped in the E part of the basin, caused by the changes of relative sea level (mainly due to tectonics and probably also to eustacy), where the Algyő and Törtel Formations form intertounging. This large scale phenomena cannot be detected in the W part of the basin, only the thickening of the Törtel Formation.

Zagyva Formation: The thin bedded alternating siltstone, sandstone and claystone succession was formed in an alluvial plain of meandering streams , with oxbow lakes, a few small lakes and marshes. The thicker sandstone beds are channel fill and point bar sediments. The formation is not widespread in the Hungarian Plain, it pinches out in the Danube-Tisza interfluve, and also in the area of the above mentioned facies interfingering.

HEAVY METALS DISTRIBUTION IN THE EASTERN SLAVONIA AQUIFER AS A CONSEQUENCE OF DIAGENETIC EVOLUTION AND AGRICULTURAL ACTIVITY

S.Kapelj,* L.A.Palinkaš, S.Miko
*Institute of Geology ,Sachsova 2, Zagreb, Croatia

The study area lies in the Slavonia - Srijem deppression and the Sava river basin, respectively. Territory is covered by Quaternary deposits: terrigenous, clastic river sediments, terrestrial marsh sediments and Pleistocene loess deposits. Upper part of these sediments constitute an important water - bearing horizon in the Eastern Slavonia. The work presented here was undertaken specifically to identify the influence of agrochemicals on groundwater quality, heavy metal content, transit and residence time in semiconfined and confined water-bearing layers determinated by radiocarbon and tritium dating methods on the two locations - Vinkovci and Đakovo water-supply stations and finally to reconstruct the origin and evolution of groundwater composition according to hydrogeochemical processes during syndiagenesis and anadiagenesis.

General hydrogeological and hydrogeochemical caracteristics of investigated groundwater systems have been aquired during early diagenetic phase as a result of different climate and hydrodinamic sedimentary conditions (glacial and interglacial periods).

Anthropogenic influence on heavy metal content in water samples have been found out only in the shallow sandy seepage layer and surface waters. Direct, recent hydraulic communication between meteoric, surface and deeper water-bearing sandy layers has not been established. Semipermeabile clayey-silty sediments, due to slow water exchange, reducing conditions, fermentation processes in the presence of organic matter as well as adsorption and ion exchange were favorable for heavy metal retention and accumulation since deposition period to recent times.

Naturally increased total dissolved mercury species levels in the groundwater samples from water-bearing sandy layers as well as from clayey-silty layers, could be a consequence of mercury species transformation into more mobile, volatile forms (Hg^0, $(CH_3)_2Hg$) by the presence of organic reducing agents or/and microbiological encymatic processes.

SEISMIC STUDY OF NEOGENE TECTONISM IN THE FLYSCH BELT, IN HUNGARY

K. Lőrincz (Hungarian Geophysical Institute R. Eötvös, Budapest, Hungary), G. Detzky, I. Jánvári, P. Kiss, B. Németh, P. Szili-Gyémánt

A detailed structural analysis has been carried out in the 60x40 km exploration area named 'Szolnok' based on the integrated interpretation of 1500 km of migrated seismic time sections, lithological data from 104 hydrocarbon exploration boreholes and some well-logs. In the former studies we distinguished 2 tectonic phases. Both of them were interpreted as wrench tectonism.

Now, we analyse the characteristics and the age of the younger tectonic phase in more detail. Based on the mapping of some Pannonian and Pliocene sedimentary sequences using well-logs, we intend to identify coeval en echelon flanking structures. We can conclude the direction and the size of the strike-slip zones from the isochrone surfaces of the coeval sedimentary sequences showing en echelon characters.

Besides, we carried out some shallow seismic measurements to determine the age of the younger tectonic phase. Earlier the faults related to the strike-slip zones in the Szolnok area were found in about 300 m depth under the surface on the seismic profiles. These faults can be detected in 10 m depth on the shallow seismic sections measured on the frozen river. We have only one example, but this exploration is in progress. If we have other convincing results, we perhaps can consider these features as recent tectonism.

UPPER MIOCENE SILICICLASTIC PARASEQUENCES IN WELL LOGS AND CORES (OKOLI REGION, PANNONIAN BASIN, CROATIA)

LUČIĆ, D. (INA-Naftaplin, Geol. Exploration & Development Division, Laboratory Research Dept., Lovinčićeva 1, 41000 Zagreb, Croatia), KRIZMANIĆ, K., DALIĆ, N., NOVAK, J. and JUMIĆ, Z.

In the siliciclastic deposits (marl, siltstone, sandstone alteration) found in several boreholes in the Okoli region, applying various laboratory techniques and bedding description in cored intervals, two types of the Upper Panonian-Lower Pontian parasequences were defined.

Biochronostratigraphic data obtained by palynological analyses on the basis of the dinoflagellate cysts were carried out. The Upper Miocene age of deposits was determined. Furthermore, according to Mrs. Suto-Szentais' Microplankton Zones of Organic Skeleton in the Pannonian S.L. Stratum Complex, the *Spiniferites bentori* and *Spiniferites balcanica* Zones have been recognized.

In addition to the laboratory results, in vertical grain-size profiling (GR, SP), as well as in defining the geometry and orientation of the sand bodies (DIPLOG, STRATA), well logging data were used.

The upward coarsening parasequences are interpreted to form in a brackish to freshwater environment on a sandy, wave dominated shoreline. Stratal characteristics and lithofacies' motives that comprise foreshore, shoreface and shelf-offshore environments indicate regressive style of deposition, characterized by the coastal zone progradation. Upward finning parasequences are interpreted to form in a tidal/coastal flat to subtidal environment on a muddy, tide or fluvial dominated shoreline.

However, these explored deposits were interpreted in this way for the first time. The obtained data provide a better understanding of regional geological and paleogeographical conditions as well as the lithostratigraphical evolution of the Upper Miocene sediments in this region.

TECTONICALY CONTROLLED SEDIMENTARY EVOLUTION OF THE GLOBOKO COALBEARING AREA

M. Markič (Geological Survey Ljubljana - Institute for Geology, Geotehnics and Geophysics, Slovenia), D. Skaberne

The district of Globoko in the eastern part of Slovenia represents one of more important paralic coal-bearing areas in the southwestern part of the Pannonian basin. Up to 15 lignite beds occur in the pontian brakish and freshwater weakly consolidated clastic sediments, consisting of clays, marls, silts, sands and rarely fine gravely sands. The thickness of four economically significant lignite seams reach up to 2,5 metres.

After 1989 more detailed tectokinematic and dynamosedimentary analyses have been carried out. Ten lithofacies units have been defined in the sedimentary fill studied, exceeding 300 metres in its thickness. The lithofacies units can be grouped into three coal-bearing cycles overlain by the sequence of mudy, sandy and mudy-gravely lithofacies. The lower part of coal-bearing cycles consists of symmetrical or asymmetrical lower-rang cycles composed of mudy and sandy lithofacies, whereas the upper part consists of heterolithic coal-bearing lithofacies. The assemblage of lithofacies and cycles could be considered as a record of high/low-energy environment alterations, being controlled on the one hand by the regional subsidence/stagnation processes and on the other by the local intrabasinal syndepositional tectonic movements and deformations. The Shaw's (1964) quantitative graphic correlation method, as described by W. Nemec (in: New Perspectives in Basin Analysis, p. 161-188 - Edit.: Kleinspehn,K.L. & Paola,C. - 1988), has been applied in order to estimate the intensities, spatial dimensions and directions of the basin subsidence during its evolution. The reference borehole log has been chosen in the central part of the basin and all the ten lithofacies units have been correlated to the analogue units in the surrounding boreholes. For each pair of borehole logs the line of correlation has been ascertained. Its segments were described by the line-inclination coefficients. They represent the measure of relative subsidence rates and range from 0.4 to 2.0, extremelly to 5.0. If a map of inclination coefficients is constructed, it shows the paleoslopes and paleosubsidence directions respectively.

It has been found out that the directions of differential subsidence altered significantly within the periods of deposition of individual lithofacies units. The local syndepositional tectonic deformations can be presumed along the zones of steeper paleoslopes. The syndepositional tectonic deformations - such as flexures, grabens, reverse and transcurrent faults - have been really proved by the underground geologic mapping and more detailed structure analyses, and thus distinguished from younger more or less postdepositional tectonic movements.

EVOLUTIVE CONNECTIONS BETWEEN THE TRANSYLVANIAN AND THE PANNONIAN BASINS

M. Mészáros (Babes-Bólyai University, Cluj-Napoca, Romania), D. Morariu

The Apuseni, the Tisza Unit and the Transylvanian Basin, except for the Transcarpathian Flysch and the Maramures-Szolnok Flysch occur as a consequence of the Laramic movements. The 39 pre-Paleogene deep-drillings performed in the basin intercepted several cristalline schists, Triassic deposits, ophiolites, Jurassic, Upper and Lower Cretaceous.

The Paleogene deposits outcrop in the north-western, northern, western (Alba Iulia) and southern part of the basin (Apoldu de Sus, Porcesti-Turnu Rosu).

Some Aquitanian and Burdigalian deposits also occur.

The Pannonian and Transylvanian basins started to develop only in the Lower Badenian (Moravian). During this period the Apuseni Mountains are fragmented and bay as well as marine intervals occur between the two basins (Maramures, Baia Mare, Simleu, Borod, Beius, Zarand, Caransebes-Mehadia, Mures, Brad). The Lower Badenian also means the beginning of a neovolcanic activity in the Carpathians and the southern part of Apuseni (with Dej Tuffs in the Transylvanian Basin). During the Middle Badenian (Wieliczian) the lagoonal conditions with gypsum and salt precipitation become predominant in the Maramures Bay (Ocna Sugatag). During the Upper Badenian (Kosovian) the normal marine conditions are reestablished (Borsa and Hadareni Tuffs).

At the end of Badenian, during the Sarmatian s.s. (Volhynian, Lower Bessarabian) in the brackish euxinic conditions several gas deposits occur. Coal deposits are present within the eastern bay of the Pannonian Basin (Sarmasag, Voivozi, Borod, Lugoj) and diatoms (Minis).

The Pannonian s.s. (Upper Bessarabian, Chersonian, Meotian) becomes more and more brackish-fresh-water sediments. In the eastern part of the Pannonian Basin, gas and oil deposits occur. During the Pontian and the Dacian the Transylvanian Basin as well as the Apuseni Mountains turn to dry land. Fresh-water conditions are predominant only in the eastern part of the Pannonian Basin, according to the fossil remains (Dersida). Aquatic conditions still exist in the intramountaineous basins isolated from the Carpathians.

DISTRIBUTION OF MERCURY IN SOIL, FLOOD PLAIN SEDIMENTS AND ATMOSPHERE OF ZAGREB, CROATIA

K. Namjesnik L. Palinkaš, S. Miko and K. Kramarić
Mining, Geology and Petroleum Engineering Faculty, Zagreb University
Pierottijeva 6, 41000 Zagreb, CROATIA

With completion of the reconnaissance study of heavy metal pollution of soil and atmosphere in the vicinity of major rural and urban roads in the area of Zagreb, the soil investigations have been extended on a regular grid (350 samples) of 700 km^2 to evaluate the distribution of anthropogenic heavy metal contamination. Mercury concentrations in soil, flood plain sediments, roadside soil and atmosphere were measured and correlated.

Although seasonal variations of atmospheric Hg pollution have been observed, a permanent mercury "cloud" persists over the central and eastern (industrial) part of the city with values ranging from 50 ng/m^3 (summer) to over 125 ng/m^3(winter).

Three different sources of high mercury concentrations in soil were determined on the basis of map analysis.

(1) Mercury of the atmospheric origin - obvious in central and eastern part of the city displayed by notable correlation of high soil (>300ppb) and air (>100 ng/m^3) concentrations.

(2) Suspended matter from Sava river, deposited as flood plain sediments - indicating a regional source of contamination from various industries concentrated in the Slovenian part of Sava river basin and partially overlapped by industrial activity in Zagreb. This is indicated with elevated mercury concentrations (average over 200 ppb and max. over 700 ppb) in flood plain sediments/soil which were deposited during the last catastrophic flood in 1964.

(3) Ancient Pb-Zn deposits - situated in northern Medvednica and eastern Žumberak)

It was also observed that mercury concentration, if not affected by the above sources reflects mercury content of bedrock and in the most cases does not exceed 50 ppb.

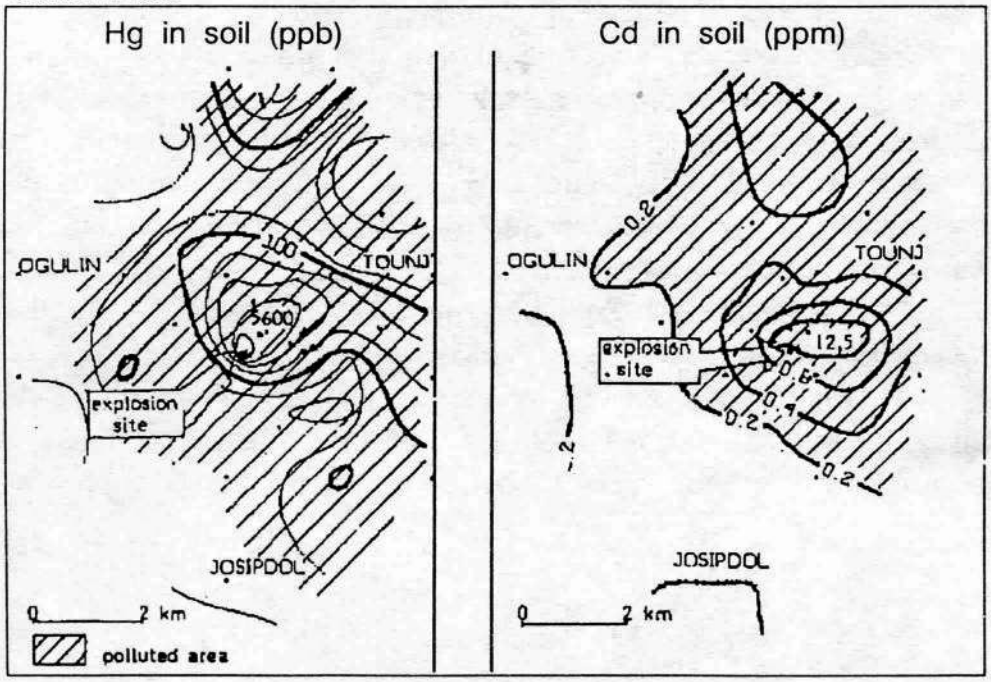
CADMIUM FOLLOWING THE EXPLOSION OF AN AMMUNITION STOCKPILE NEAR OŠTARIJE, CROATIA

L.A. Palinkaš, S.Miko, K.Namjesnik, S.Pirc

Mining, Geology and Petroleum Engineering Faculty, Zagreb University
Pierottijeva 6, 41000 Zagreb, CROATIA

Aim and objectives: Investigation of man-made dispersion halo of heavy metals in the soil surrounding the site of the disastrous explosion of ammunition stockpile in Oštarije. The surrounding area of 50 km^2, was randomly sampled on an irregular grid (34 samples).

Results: Early morning on October, 13, 1991 an ammunition stockpile (assessed at 8000 tons), was blown up and set ablaze intentionally by the Yugoslav Army during their retreat from the village Oštarije, and caused severe impact on the natural environment. One of the adversities is the augmented concentration of heavy metals in the soil due to atmospheric fallout, particularly the most toxic ones **Hg** and **Cd**. The anomalies in the center of the explosion are 200 fold for Cd (12.5 ppm) and 100 fold for Hg (5600 ppb) in comparison to the background levels of 0,1 ppm and 50 ppb, respectably. Influence of the explosion has been observed at distance of 8 km. Since great deal of the region is covered by forests and arable lands, and is a wide drainage area of the drinking water resource, the final environmental impact is to be determined.



PALAEOGEOGRAPHICAL CHANGES IN SE TRANSDANUBIA DURING THE PANNONIAN

Mária Sütő-Szentai

In the southern foreland of the Mecsek Mountains, a significantly different development of the Lower Pannonian can be observed in the western versus eastern parts of the region. In the western part, according to data obtained from Szentlőrinc-XII borehole, terrestrial sedimentation took place until the Spiniferites bentori oblongus phase. In the eastern part, comprising the Ellend and Bóly basins and Somberek area, however, the Pannonian developed conformably above the Sarmatian layers between 12 and 7 ma before present.

The first layers that are common in the two regions above the 11.6±0.5 ma time horizon belong to the Spiniferites bentori oblongus zone. Within the Pannonian, the brackish water sea reached its largest extent in the Spiniferites validus phase. At that time the water table covered the northwestern foreland of the Mecsek Mountains, the basins south of the mountains, and the Majs and Töttös areas as well.

In southern Transdanubia, above the Spiniferites validus zone, the intervals of regression are indicated by decreasing diversity of Dinoflagellata. Increasing number of species and specimens can be observed in two subsequent zones: The Spiniferites tihanyensis zone, correlated with the upper boundary of magnetic anomaly 5 in Kaskantyú-2 borehole, contains a diversified assemblage in the vicinity of Szentlőrinc, Nagykozár, Bátaszék, Somberek, Majs, and Töttös. The youngest assemblage of the Pannonian stage that is characterized by new species occurs in sediments younger than 7 ma. This association, marking the Galeacysta etrusca zone, is found in the western part of the region around Szentlőrinc, Kacsóta, Szigetvár, and further to the southeast, at the villages of Majs, Töttös, Magyarbóly, Nagyharsány, and Villány. In the latter sites, in the foreland of the Villány Mountains, this zone has a transgressive character: its argillaceous marl layers rest on the Mesozoic basement.

The subsequent decrease in the diversity of Dinoflagellata seems to have been an irreversible process. The assemblage of the freshwater Mougeotia laetevirens zone is entirely missing in the study area.

GEOPHYSICAL RESULTS IN AREA OF BÜKK MOUNTAINS AND THEIR FORELANDS

I. Szalay (Hungarian Geophysical Institute R. Eötvös, Budapest, Hungary)

The paper deals with depositional conditions and structural characteristics of the Paleogene-Neogene sedimentary (in a reduced measure volcanic) complex on seismic profiles representative of basin development in the forelands of the Bükk mountain. It enumerates evidences in favour of the composite, zonal character of the known Darno line, of lower-Miocene-Paleogene sedimentation syngenetic to tectonic processes. An attempt is made to apply seismostratigraphic interpretation used so far for the Neogene in the Pannonian basin to Paleogene complexes. It furnishes clues on the compound character of horizontal displacements assumed earlier to have taken place along the Darno line, relying of flower structures revealed in the sedimentary fill of the basin and on differences between series of sediments on either side of the fault.

THE MICROMORPHOLOGY OF COMMON MAIN SOIL TYPES IN HUNGARY

G. Szendrei (Hungarian Natural History Museum, Budapest, Hungary)

The application of soil micromorphology (microscopic investigation of soil thin sections, a method developed from a petrographic technique) has recently gained an increasing role in general and applied soil science. One of the most evident uses of soil micromorphology is in soil genetics aiming to elucidate the relationships among micromorphological characteristics and their formation processes.

The aim of this research is to prepare the micromorphological characterization of the soil types in Hungary and evaluate the results with a view to soil formation. The micromorphological descriptions of the most common main soil types (lithogenic, brown forest, chernozem, salt-affected and meadow main soil types) of high agricultural importance have recently been completed.

Attention was paid mainly to pedofeatures. According to their interpretation conclusions were drawn on the mobilization of clay, calcareous, manganiferous and ferruginous compounds.

GEOPHYSICAL DEEP STRUCTURE STUDIES OF THE TRANSDANUBIAN MIDDLE RANGE

M. R. Tátrai (Hungarian Geophysical Institute R. Eötvös), G. Ráner, G. Varga

The area of the Transdanubian Middle Range lies west of the Danube to north of the Balaton-lake. It is built up in the form of an asymmetric synclinorium with imbricate block-type patterns. Along its axis running NE-SW encountered are Jurassic and Cretaceous, on the flanks older Mesozoic and Paleozoic formations. Both evolution of formations and structural buildup of the area show a close connection with the Drauzug unit.

Seismic and magnetotelluric measurements for the study of deep structures were performed along numerous lines over this structural unit. In the course of the interpretation of these profiles various tectonic cycles can be identified. In the middle and lower parts of the crust typical parallelly running belts appear in horizontal arrangement. Complex interpretation of measured materials enables us to prepare a geophysical model of the area down to the depth of the Mohorovicic discontinuity. The paper illustrates the established model through typical seismic and magnetotelluric profiles.

THE MAIN TASKS OF ECOGEOLOGICAL RESEARCH IN BULGARIA

T. Todorov (Geological Institute of Bulgarian Academy of Sciences, Sofia, Bulgaria)

In a number of areas in Bulgaria environment is in bad even crisis condition. This suggests that ecogeological studies recently have become more actual and have acquired priority.

The following main tasks of ecogeological studies in country could be formulated:

- estimation of the state and prognosis of the anthropogenic effect on the Black Sea and the Danube. This problem is not only of national concern;
- geological aspect of protection of ground, surface, mineral and thermal waters. This problem includes the question both concerning the degree of pollution and the protection against exhausting of the noted types of water;
- engineering geology aspects of geological medium protection: present state and prognosis about its alteration under action of recent geological processes and anthropogenic loading with realization of the lithomonitoring in all country territory;
- ecogeochemical studies aiming at elucidation of the natural and anthropogenous higien-geological potential of different territories, landscapes and agglomerations in country;
- a new scientific and ecological view on the mineral resource base of country. Bearing in mind that mineral raw materials are nonrenewable natural resources this problem is very important now;
- recent seismotectonic geological processes and their activation as a result of anthropogenic activities. The problem is very complicated with respect to building new nuclear power stations and also the enlargement and exploitation of Kozlodui nuclear power station, with research work on the sites of storage of radioactive and hazardous wastes, construction of industrial, hydrotechnical and other larger sites;
- complex studies aiming at working out the ecogeological, including - ecogeochemical maps in the different scales of the solid substrate, Quaternary deposits and the earth layer in individual endangered regions of the country;
- condition and protection of geological monuments and interesting geological sites.

GEOLOGY AND PETROLOGY OF THE QUATERNARY BASALTS IN THE BIGA PENINSULA AND AN EXAMPLE TO CLAY FORMATION IN ULTRABASIC/BASIC ROCKS, NW TURKEY

B. Uz (ITU Maden Fak., Istanbul, Turkey), F. Coban, R.H. Eren, A. Bilgin

Geology, petrology of the Quaternary basalts and low-alkali clay formation which are situated in the Biga Peninsula, NW Turkey, were investigated in this study. In the study area the basement rocks consist mainly of metamorphics and serpentinites with Permian limestones in the uppermost section. Neogene units consist of clastics and volcanics of Miocene age. Volcanic rocks, which are composed of andesitic tuff, andesite and minor amount of rhyolite and agglomerate are underlain by the Lower-Middle Miocene lacustrine sedimentary rocks. Quaternary are represented by basalt lavas. Basalts occur as lava flows and are highly porous, with gas voids. They are weathered as well at their contact with the surrounding rocks, especially serpentinites. In the studied area all basalts are classified as andesitic basalt and olivine basalt. They have a *ophitic texture*. Olivine basalts are texturally ophitic in matrix and contain plagioclase, olivine and augite phenocrysts. Plagioclases are andesine and bytownite in type and in many samples altered into clay minerals, epidote, chlorite and carbonate. Olivine crystals have euhedral to subhedral crystals. Olivines are altered into serpentine and partially iddingsitized and serpentinitized. Basalts have an ophitic and glassy matrix texture. According to the petrographic and petrochemical investigations basalts are "sialic" in origin.

Low-alkaline clays (2 % Na_2O+K_2O of whole rock), 2-20 m thick, occured between serpentinites and basalts. Clay formation is of hydrothermal origin and the clay mineral paragenesis consists of montmorillonite, illite-montmorillonite, kaolinite and chlorite. Quartz, calcite, very small amounts of dolomite, feldspar, pyrite and magnetite are the gangue minerals. Low-alkaline clays are mostly used by cement industry for special-type cement manufacturing.

MIDDLE MIOCENE - PLIOCENE SEQUENCE STRATIGRAPHIC MODEL OF THE PANNONIAN BASIN, HUNGARY

G. Vakarcs (Rice University, Houston, Texas, USA), P.R. Vail, G. Tari

There are only a few published examples showing the application of the method of sequence stratigraphy in lacustrine environment. This study indicates that the brakish and non-marine prograding sedimentary section of the Pannonian basin consists of third-order depositional sequences. These sequences are built up from fourth-order sequence sets.

The Middle Miocene-Pliocene infill of the transtensional Pannonian basin of Hungary involved the advance of deltas from the northwestern, northern, northeastern and southeastern basin margins. Systematic sequence stratigraphic analysis of 5000 km multifold seismic data and 80 exploration wells of the eastern, middle and southwestern part of Hungary allows identification of twelve third-order sequence boundaries in the sedimentary fill of the Pannonian basin. The number of sequences corresponds to that of the published global eustatic curve for this period of time. Based on magnetostratigraphic and volcanic K/Ar data, the ages of the sequences can be correlated tentatively with this global curve.

On seismic sections, delta progradation can be seen from the later part of sequence #4 (13.8) - #5 (12.5) Ma to the middle part of sequence #9 (5.5) - #10 (4.2) Ma. During this time period, the Pannonian basin was gradually isolated from the world sea. The brakish and non-marine sedimentary fill also consists of depositional sequences. Based on investigation of the stratal pattern and sedimentary facies of the systems tracts, these sequences display the same characteristics as the marine sequences.

All the third-order sequences consist of lowstand (LST), transgressive, (TST) and highstand systems tract (HST). The common elements of these sequences are the anomalously thick lowstand prograding complex and the relatively thin transgressive and highstand deposits. The individual third-order sequences are characterized by slightly different proportions between the systems tracts. However, in the case of any given sequence the geometry can be traced throughout the study area.

Within the third-order sequences higher-order sequences can be recognized with an average duration of about 0.1-0.5 Ma. The higher-order sequences are interpreted as fourth-order sequences and believed to be associated with Milankovich-type climatic fluctuations in the drainage areas of rivers flowing into the Pannonian lake. These fourth-order sequences mostly tend to be well developed in the lowstand prograding wedge.

HIGH-FREQUENCY DEPOSITIONAL SEQUENCES IN LACUSTRINE STRATA, PANNONIAN BASIN, SOUTHERN HUNGARY

L. Várkonyi (MOL Hungarian Oil Plc., Budapest, Hungary), P. Weimer, P. Várnai

Sequence stratigraphic concepts were developed initially for marginal to marine strata with an emphasis on passive margins. Few published examples have addressed the potential application of sequence stratigraphic concepts to lacustrine systems. Conceptually, depositional systems will respond to relative changes in lake level, and produce stratal patterns similar to those observed in marine settings.

A sequence stratigraphic study of the Pannonian Basin, one of the several Mediterranean back-arc basins, indicates a complex lacustrine fill history during the late Miocene-early Pliocene. Analysis of 2200 km of multifold seismic data and fifty exploration wells in southern Hungary indicates that the basin was filled from northwest by thick siliciclastic sediments, and the average water depth of the lake gradually decreased from 400 to 0 m.

The Pannonian Basin became isolated from the Mediterranean Sea at 10.5 Ma; because of increasing fresh water input, the basin's water became brackish, and then fresh throughout the late Miocene and early Pliocene. In spite of this isolation, third- and fourth-order depositional sequences are interpreted in these lacustrine strata. The age of the third-order sequence boundaries (6.3 and 5.5 Ma) are based on magnetostratigraphic data. The high sediment input greatly exceeded the basin subsidence, which led to the development of the higher-order sequences resolvable on multifold seismic data. All of these third-and fourth-order sequences are complete depositional sequences, composed of lowstand (LST), thin transgressive (TST), and highstand systems tracts (HST), and bounded by Type 1 sequence boundaries. The higher frequency (fourth-order) lake level changes are superposed onto the third-order cycles.

The sequences were correlated and mapped in three dimensions, and helped define new stratigraphic plays in a mature basin, primarily turbidite systems lapping out against the slope. Maturation and migration studies indicate that there is high potential for petroleum accumulation in these stratigraphic traps.

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RECENT GEODYNAMICS OF THE PANNONIAN BASIN

F. HORVÁTH

Geophysical Department, Eötvös University, Budapest

The Pannonian basin is a sedimentary depression of early Miocene through Quaternary age and formed by extensional collapse of former Alpine orogenic terranes. Normal faulting an related strike-slip tectonics culminated during the Middle Miocene and was followed by a perio of basin infilling. New data, however, suggest that tectonic evolution history of the basin is mor complex than previously envisaged.

A most important evolutionary anomaly is given by the late-stage tectonic reactivation o the Pannonian basin. This is shown by Quaternary faulting, mostly of strike-slip character bu opposite sense to the Middle Miocene displacements. Furthermore, uplift leading to large-scal anticlines and also small-scale folds has taken place in the western part of the Pannonian basi and Transylvania. At the same time, over much of the Great Hungarian Plain continuing or eve accelerated subsidence has occurred.

To explain this geodynamic scenario it is suggested that formation of a new compressiv stress regime has been underway during the Quaternary. This is because consumption o subductible lithosphere in the Carpathians was completed, and possibility for further extensio of the Pannonian basin ceased. The fate of the basin is a complete inversion.

EVALUATION OF COPPER DEPOSITS OF ERGANI (TURKEY) FROM THE PLATE TECTONIC'S POINT OF VIEW

A. Bilgin (Süleyman Demirel University, Faculty of Engineering, Isparta, Turkey.)

G. Göymen (Gazi University, Faculty of Engineering, Ankara, Turkey.)

M.Kuşçu (Süleyman Demirel University, Faculty of Engineering, Isparta. Turkey.)

Copper deposits of Ergani is located at 70 km. South-East of the Elazığ Province in Turkey. The concerned ore deposit is one of the oldest mines, has been operated since the Hittite era.

The pit covers on 2 km^2 and the thickness of the are deposit ranges between 50 m and 150 m according to the geographic locations. It is found in eugeosyncline which has been characterize by initial magmatism in the zone of Alpın orogenesis.

The rocks which are in contact with magmatic rocks ore chloritized and silicified diabase. The structural and textural characteristics of primary ore mass and nearby rocks show that they have some deformations during and after formation. Chalcopyrite and it's secondary products are produced in the mine The alteration products of the high temperature minerals as well as low temperature minerals may be found among the ore minerals. The ore shows a cataclastic character which increases toward the deep levels. A monoclinal texture is evident at high levels. Ripidolite, quartz and gel quartz are the most common gangue minerals.

Cu tenor of the ore is 10-12 % in massive are and about 3 % in disseminated ore, Additionally, it has been found that there are 15 gr of Ag and 10 - 30 gr of Au per ton in the gossan.

The studies on ore microscope and the data about the position of the ore forming minerals reflect the exhalative sedimantary type of the ore in the region.

Copper ore in Ergani can be classified as massive sulfide ore in the mid oceanic ridge due to its vall rocks. mineralogy and geological position of the ore body. These ores have been carried to the benioff zone and formed the ophiolithic melange at the late stage of the plate movements.

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Project 329

INFLUENCE OF NEOTECTONICS AND CLIMATE TO UPPER MIOCENE AND PLIO-QUATERNARY SEDIMENTATION

N. Krstich & N. Pantich

There are two major plans of the Neogene and Quaternary sedimentations in the SE part of the Pannonian basin. The first is typical for the Upper Miocene, the other for the Pliocene and the Quaternary.

The post-orogene cover of the lacustrine ("lake-sea") Upper Miocene (Pannonian and Pontian) age has been dominantly influenced by radial tectonic. In the wide area of SE rim of the Pannonian basin was fractured into numerous big and small tectonic blokcs. Tributaries, bringing the large amount of the material eroded from earlier formed and still uplifting mountains, sedimented it on the submerged delta plane of hyper picnale type onto one of the mentioned differently sinking blokcs which sink (slowly) - rivers always run to the lowest reachable point. The result is that on two neighbouring tectonic blocks there is different thickness of the deposits of one single stratigraphic unit, i. e. one biozone. There is many such examples often of different sedimentological features (best known in the town of Belgrade and its surroundings).

During the Pliocene and most of the Quaternary sedimentations mechanism was different, because the asymmetrical cycles sedimentation where climaticaly caused. Most of the Pannonian basin area was influenced by braided river courses (sand and rare gravel). The flood--planes were converting into lakes during the late phase of every sedimentations cycle (silt) bearing some gypsum crystals ond vivianite concretions. On the top of a sedimentation cycle, in spite that it top is often washed out by the erosion of the following asymmetrical cycle, there is deposit of the aride phase. In the Pliocene cycles they are ending by swampy organic clay (sometimes multiplied) of warm arid phase. In the Quaternary all the cycles should end by the eolian deposits, loess - product of a cold phase (jugded by the Quaternary deposits preserved on the horsts).

The transition from Upper Miocene to the Plioi - Quaternary sedimentations type type is not yet studied, as the transition from the warm Pliocene to the cold Quaternary.

Early-mid Miocene rotations in the Pannonian Basin

E. Márton
Eötvös Loránd Geophysical Institute
Hungary

Paleomagnetic data obtained on both sediments and volcanics reveal that the most important period of mobility in the Cenozoic must have been during the Miocene. Only to early-mid Miocene rotations, pre-late Miocene declinations NW of the Mid-Hungarian Mobile Belt are counterclockwise rotated while they are clockwise rotated SE of the same belt.

Apart from the fact that rotations are of opposite sucesses at both sides of the Mid-Hungarian Mobile Belt, an additional difference is that NW of three line the rotations seem to have been different in the Transdanubian Central Range and the North Hungarian Paleogene Basin respectively, while the area coined as South Pannonian unit was likely to rotate uniformly in the Miocene.

The possibility of interpreting the paleomagnetically indicated rotations as signifying microplate movements or local (block) rotations will be discussed in the light of the observed paleoinclinations.

Structure of the Pannonian lithosphere and utilization of deep reflection results in prospecting for hydrocarbons

Karoly Posgay*, Endre Hegedûs*, Árpád Szalay**,
Ernô Takács*, Zoltán Tímár*

In the framework of the lithosphere - asthenosphere research programme by deep reflection method endeavours were made by us to establish a methodology that permit to obtain data beginning from young sedimentary strata straight down to the asthenosphere. Such methodology permitted

1/ to determine structures in the young Neogene sedimentary complex and the pre-Neogene basement, which may be of interest for hydrocarbon exploration:

1.a/ the roll-over structural element connected to the listric fault determined along the "Hungarian Geotraverse", which has been accomplished in international cooperation;

1.b/ seismic amplitude anomalies related to structures presumedly Mesozoic that appear in the pre-Neogene basin's bottom along the "Pannonian Geotraverse" and the "Hungarian Geotraverse";

2/ to determine fractures deeply penetrating the lithosphere, which render help to the understanding of both tectonic patterns and local structures:

2.a/ to infer steep wrench-faults, slightly dipping deep faults and upthrust planes;

3/ to infer a thinning out of the crust and the lithosphere under young basins, that furnishes a fundamental clue to theories on the origin of basins:

3.a/ to infer a rise of the crust by 5-6 km and the asthenospehere by 15-20 km under the Békés basin that contains very thick (6-7 km) Neogene sediments.

* Eötvös Loránd Geophysical Institute of Hungary
** Hungarian Oil and Gas Company

TWODIMENSIONAL MODELLING OF STRATIGRAPHY AND FLUID FLOW IN THE PANNONIAN BASIN

R. van Balen[1], L. Lenkey[2], F. Horváth[2] and S. Cloetingh[1]

1: Institute of Earth Sciences, Vrije Universiteit, Amsterdam, The Netherlands
2 : Geophysical department, L. Eötvös Univeristy, Budapest, Hungary

In the Pannonian Basin evidence can be found for anomalous subsidence since Late Pliocene. In general, the basin center subsides faster then expected for thermally induced subsidence, while the basin flanks are uplifted. Results from paleo- and recent stress analyses have indicated that the Pannonian Basin was in a compressive state of stress during this time, with the main horizontal principal stress directed NW-SE. It has been suggested that this intraplate stress was responsible for the anomalous subsidence. We have investigated this possibility by performing a 2-dimensional forward numerical analyses of the Pannonian Basin. The numerical model for basin evolution is based on the stretching mechanism and incorporates finite lithospheric strength during rifting and flexural isostasy.

The modelling results show that the intraplate stresses can indeed explain the anomalous subsidence pattern, when the depth of lithospheric necking during rifting was relatively shallow. Earthquake depths indicate that this was indeed the case. Fluid flow modelling shows that there were 2 periods of extreme overpressure in the deep subbasins. One started during the arrival of the Pannonian delta (6.3 Ma), the other was contemporanous with the anomalous subisence. This indicates that the current high amount of overpressure in the deep subbasins is a recent feature. We conclude, therefore, that changes in the level of intraplate stress since Late Pliocene can explain the anomalous subsidence and overpressuring in the Pannonian Basin.

Deep Seismic Reflection Images of the Mid-Hungarian Flysch Belt

Endre Hegedüs, Károly Posgay, Ernö Takács,
Zoltán Tímár*

On the basis of deep seismic reflection investigation along the Pannonian Geotraverse the conclusion has been drawn: during the formation of the Pannonian basement a transcurrent fault system nearly 100 km wide developed. The zone of the main faults running along the axis of the Mid-Hungarian Flysch Belt penetrates below the Mohorovicic discontinuity; its depth reaches 35 to 40 km. During the active period of the fault system a compression stress field perpendicular to the fault system dominated. Within the lithosphere brittle and ductile formations can be supposed. Simultaneously to the strike-slip movements a space shortening occurred and the brittle interbeddings might move towards the ductile belts. Since that time deepening of the crust-mantle boundary can be assumed. During the filling up of the Pannonian basin the regional stress field has been changed and the fault system has been renewed to some extent. Horizontal movements 1 to 2 order smaller than the previous ones occurred.

* Eötvös Loránd Geophysical Institute of Hungary,
1145 Budapest

ORGANIC MATTER MATURATION IN THE SEDIMENTARY SEQUENCE OF THE CARPATHIAN FOREDEEP.

Y.Koltun (Institute of Geology and Geochemistry of Fossil Fuels, Lviv, Ukraine).

The majority of oil deposits of the Ukrainian Carpathians occur within the flysch sequence of the Foredeep. Organic-rich Oligocene Menilite Beds, which have a high petroleum potential, are evidently the main source rocks in this area. Their thermal maturation occurred mainly not under the influence of gradual sedimentary burial, but as a result of rapid subsidence episodes, closely related to Miocene orogeny. Two stages of their burial history can be distinguished. At the pre-emplacement stage the main maturation event for Menilite Beds occurred after the rapid deposition of the thick Lower Molasse sediments, formed as a result of the erosion of both adjacent flysch rocks from the south and platformian rocks from the north. At this stage Menilite Beds retained immature, often close to the beginning of the oil window, thus almost no oil generation is related to this period. The further maturation of Menilite Beds occurred under the influence of the subsequent overthrust tectonic movements, which caused the formation of a number of superposed tectonic units, each of them having different burial history. The thrust slices, which were uplifted by these movements, occur now within upper few kilometres of the sequence and have preserved their pre-overthrusting level of maturity. The slices, buried deeper than 3-4 km, have reached the oil window, and Menilite Beds within these units are probably the source of oil deposits in this area. Thus, the Neogene overthrust tectonic movements were the main reason for petroleum generation within the Carpathian Foredeep, while the related folding caused the formation of numerous structural traps suitable for oil accumulation.

EXAMPLE OF THE APPLICATION OF FLUID INCLUSIONS FOR CORRELATION OF SEDIMENTARY BEDS.

I.M.Naumko (Institute of Geology and Geochemistry of Fossil Fuels, Lviv, Ukraine).

The possibilities of fluid inclusions (FI) in solving the problems, related to determination of PTX-parameters and reconstruction of the endogenous mineral formation are generally known. Less studied is their role for reconstruction of sedimentary environments. Just about the fact, that FI can give the valuable data on the origin and correlation of clastic beds, as the example, testify the results of our studies of terrigenous topaz from Quarternary beds, spread on the vast area of north-western Polissia: the group of Shatsk lakes (l.Pisochne), basin of river Prypiat (r.Sluch, r.Stohod, l.Liubiaz) which have shown their almost complete similarity (Kaliuzny, Naumko, Khmelevski, Lashmanov, 1983; Kaliuzny, Naumko, Lemishko, 1985) and simultaneously the difference from the known topaz mineralization shows of the Ukrainian Shield (Vozniak, 1971; Naumko, 1986).

Interpreting these data and interpolating them on the problem in whole, author considers, that on the base of the analysis of concrete material it is possible to speak about at least three directions of the application of FI for investigations of the sedimentary beds:

-identification of sources and direction of removal of clastic material, clarification of indigenous sources of the important in typomorphic respect minerals.

-determination of spatial-genetic relations of clastic material and hypothetical source beds.

-correlation and stratification of "barren" in paleontologic respect sedimentary beds.

On principal, also the other aspects of application of FI in the practic of study of recent and ancient sedimentary beds can be called.

Radócz, Gy.-Szokolai, Gy.-Tanács, J. 1993: Geological section of the north margin of the Pannonian basin (Poster).

This section follows closely more than 100 km-s long the Cserhát-Mátra-Bükkalja pannonian lignite bed range from Erdőkürt to Sajóhídvég. The poster presents positions of the lignite beds and makes of view into deeper geological structure of nort margin of the Pannonian basin.

About 5000 pieces of boreholes exposed 0-300 m-s in depth the 100 km-s long 10 km-s wide upper pannonian lignite range.

The under the 300 m section we constructed mainly by the help of water exploratory- and hydrocarbon exploratory boreholes and geophysical data.

The oscillation section (lignite beds) of upper pannonian formations became thin to north and often are eroded. The oscillation section become thick in the Alföld direction to south, reaches the 300 m-s, its dip 2-3°. 4-5 possibly even 10-15 lignite beds (which more thick than 1 m) are in the oscillation section. These are separated by clay- and sand beds. The lignite beds identifiable well through more km-s, these are often lenticular. The intercalated clay beds become thick while the lignite beds become thin. The sand beds which separate the lignite beds are very well water reservoir.

THE TERTIARY VOLCANISM OF TRANSDANUBIA /W-HUNGARY/

V. Széky-Fux (Dept. of Mineralogy and Geology, Lajos Kossuth University, Debrecen, Hungary), I. Tormássy, Z. Pécskay

The Tertiary volcanic rocks spread over approximately 10% of the surface of Hungary. They have only been discovered in the past decades by deep structural and hydrocarbon test drills, that they are mostly covered by the young sediment of Pannonian basin. Our research was first limited to the east and the middle of the country, that is the Great Hungarian Plain. The poster, however, shows the covered volcanics of the west of Hungary, Transdanubia. The development and extension of the covered volcanic rocks were basically influenced by deep structure of the basin and the structural lines.

There are two distinct phases of Tertiary volcanism, a Paleogene and a Neogene phase, to be observed all over Hungary, including Transdanubia.

The volcanic rocks from the andesite phase of the Upper-Eocene/Oligocene extend over the northern edge of the Paleozoic basin and are to be seen from western Transdanubia across the Velencei mountains to the Mátra mountains, as far as Recsk. Their lavas and tuffs can always be found separately. They were not strato volcanos, rather fissure or detritic volcanos, or perhaps laccolite-type formations, subvolcanic bodys.

The Miocene acid activity started at the division line of the Eggenburgian-Ottnangian, and according to K/Ar chronological data, went on from the Ottnangian all through the Miocene, to the Sarmatian. Most of the rhyolites that come from there are terrigenous formations, taking their origins from monogenic volcanos.

According to presently available K/Ar radiogenic data, the Miocene andesite activity also started in the Ottnangian, and the Csákányos /Csák-2/ drill shows that it went on until the Pliocene. Their mineral composition makes Miocene andesites clearly distinct from Eocene andesites.

The latest Pliocene basalt phase of Neogene volcanism, which shows a great variety of surface formations along the northern shore of Lake Balaton, has been widely discussed and described in the past decades. Its recently exposed covered examples are to be seen on the poster as well.

TECTONICAL EVOLUTION AND MAGMATISM OF TAPOLCA BASIN

S. Józsa (Dept. of Petrology and Geochemistry, ELTE, Budapest, Hungary), E. Árva-Sós, Gy. Majoros, Z. Máthé, Gy. Szakmány

The drilling Balatonmária-1 penetrated the Neogene formations of the depression located at the southwestern end of Tapolca basin. This basin with the studied volcanites is separated from the Triassic formations of Keszthelyi Mts. by a NE-SW strikeslip fault which should have been active before the Sarmatien.

Badenian volcanites-mainly lavas-has been cuted by the drilling from 517.7 to 349.6m. Under these volcanites Paleozoic, slightly metamorphic, gray schists and Miocene transitional tuffaceous beds of continental-fluvial origin are lying. They are covered by Sarmatian shallow-water clastic-carbonatic sediments.

The volcanites are amigdalodial, compact lava rocks with minor tuff intercalations. Under the microscope porphiric microholocrystallic texture is visible. Phenochrysts of biotite, lesser amount of monoclinic pyroxene, olivine and few brown amphibole could be determined. The groundmass consists of plagioklase, monoclinic pyroxene, potassium feldspar, volcanic glass and secondary minerals. Apatite and ore minerals (ilmenite, magnetit) are the main accessorians.

The appearance of large amount of different, crustal originated, mainly granitic-granodioritic and metamorphic rock and mineral fragments indicate strong crustal contamination, which causes the transitional basaltic-andesitic geochemical character of these rocks.

The radiogene age of the basalts has been detected by K-Ar method. Data on biotite (ca. 14 Ma) reflect on badenian age of the volcanites.