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THE 4[TH] SYMPOSIUM BAIA MARE BRANCH OF THE GEOLOGICAL SOCIETY OF ROMANIA

16-18th November 2000

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Institutul Geologic al României

Bucureşti – 2000

GEOLOGICAL INSTITUTE OF ROMANIA

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FOREWORD

The Baia Mare branch of the Geological Society of Romania is celebrating this year 10 years from its re-foundation. The 4th Symposium is thus an anniversary event. That is why we thought it should have a large opening towards all geological sciences.

It might be expectable for a symposium held in Baia Mare to host debates related to ore deposits, mineralogy or petrography. But, as you can see, themes of stratigraphy, tectonics, geophysics, ecology are also here approached.

We considered this symposium to represent a good opportunity for presenting the main advances recorded in the field of geology, not only in Baia Mare region but also in surrounding areas.

We are glad to find among the authors colleagues and friends from Croatia, France, Hungary, Russia, Yugoslavia, Slovakia, Spain and Ukraine.

It is our hope for this Symposium organized in Baia Mare to signify a good occasion for informational and ideas exchange, an opportunity to strengthen our geological connections.

The Organizing Committee

FOREWORD

The Baia Mare branch of the Geological Society of Romania is celebrating this year 10 y[illegible] [illegible] an [illegible] [illegible] towards all geological science.

It might [illegible] for a symposium held in Baia Mare [illegible] [illegible] you can see [illegible] [illegible]

We considered that [illegible] good opportunity [illegible] [illegible] in the field of geology [illegible] in Baia Mare region [illegible]

[illegible] colleagues and [illegible]

[illegible] in Baia Mare [illegible] [illegible] exchange [illegible] to strengthen [illegible]

The Organizing Committee

THE STUDY OF Fe Ti OXIDES RATIO IN THE MAGNETIC MINERALS OF THE PORPHYRY-COOPER MINERALIZATION FROM VALEA MORII NOUĂ, MINA BARZA – METALIFERI MOUNTAINS, ROMANIA

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In the Barza – Valea Arsului zone the Mesozoic ophiolithic basement is covered by a Tertiary sedimentary and volcano-sedimentary coverlet that bears or cuted by Sarmatian Barza type andesite. These are quartziferous andesites with hornblende +- pyroxene +- biotite.In the eastern part of the Barza mining field apears a Sarmatian andesitic microdioritic subvolcanic body afected by transformation - minrealisation process of porphyry-gold copper type.

The neomineral associations are grouped in two concentric zones.

Potassic transformations are distinguished in the internal zone. sometimes with propilitic aspects (Borcoş et al. 1980). The metallic minerals are: magnetite, pyrite and chalcopyrie.

These are cut by the sarmatian intrusions represented by andesites and microdiorites with pyroxene and hornblende that define the Barza lithotype.

In the strict S-W proximity of the Valea Arsului apears a simmilar one located nearby Spiros pit. This subvolcan was put in evidence by a filtering-modeling study of ΔZ magnetic anomaly (Andrei et al. unpublished data, IGR Archive). Recent studies have proved that Spiros subvolcane is affected by porphyry type transforming processes. The main difference is that internal zone metallic minerals are represented by Fe –Ti oxdies and pyrite only (Roşu et al. 1988 unpublished data, IGR Archive).

Magnetic mineral of the Spiros porphyry subvolcanic structure are mainly hydrotheramal titanomagnetites, partly oxyded in titanomaghemites. Titanomagnetites of magmatic liquid origin (accesory minerals) apears subsiadiary polysynthetic twined.

Iron oxydes occurs in the internal zone too both in the gold polymetallic hydrothermal veins proximity both in the external zone.

In both situation these oxyhydroxides occurre associated with clay minerals.

Thermosusceptibilimetric analyse made in parallel with petrographic and petrophysic one showed the Fe/ Ti ratio from titanomagnetite or titanomaghemite identifyed by microscope.

On this data we tried the prediction of mineralised rocks magnetic properties.

CONSIDERATIONS REGARDING THE FUTURE OF GOLD MINERALIZATION ASSOCIATED TO THE PORPHYRY COPPER TYPE NEOGENE SUBVOLCANIC STRUCTURE TĂLAGIU (ZĂRAND MOUNTAINS – ROMANIA) OBTAINED FROM THE GEOLOGICAL AND GEOPHYSICAL DATA CORRELATION

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In the East Central sector of the Tălagiu complex subvolcanic structure there were put in evidence by drilling a subvolcano, buried at more than 200 m, made of hornblende and pyroxene andesite – microdiorite, including a porphyry copper mineralization. In the internal zone of the porphyry copper system there are developing potassium alteration-mineralization products with magnetite, pyrite and chalcopyrite dissemination, with a poor cooper percent but high gold / cooper ratio. (Berbeleac, Andrei, 1989) . To the surface, in the porphyry system volcanic andesite (the laves and the pyroclastites) of andesites with pyroxenes, andesites with hornblende and pyroxene of Volhinian Age (Roşu et al., 1997) are strong affected by argillite- phylic transformation.

Metallic minerals are represented almost exclusively represented by iron sulfides. The significant magnetization contrast between internal and external zone of the porphyry system allowed us by using of the ground magnetic maps the evaluation of the subvolcanic body dimensions – 1800/600 m (Berbeleac, Andrei, 1989).

Subsequently to the porphyry copper- gold system and in space correlation with the subvolcano there were identified in drillings, scarce at the surface epithermal mineralizations, especially veins. These veins contain Fe, Cu, and Pb, Zn +- Au, Ag sulfides in quartz, anhydrite (gypsum) and carbonates gangue (Berbeleac et al., 1995).

Obviously, to a medium content of 0.17 % Cu and 0.6 g/t Au, the porphyry copper mineralization of Tălagiu has no economic value.

Eventually the only useful mineralization could be the vein (stockwerk) one with paragenesis pyrite, chalcopyrite, Au, Ag, quartz, anhydrite, carbonates, intercepted by the F8 drilling from the Scăriştea broke (Berbeleac et al., 1995) . This drilling was set on the South – Eastern flank of the subvolcano intercepted two veins at 595 and 616 m, with the up above-mentioned paragenesis. The apparent thickness is about 1m and the average is 5.5 Au g/t respectively 30 Au g/t content.

The No. 8 drilling was set on a mercurometric anomaly (1000 mV) and a Ag pedogeochemic (55 ppm) slightly shifted to the West from the first one close related with a IP maximum belt , N-S oriented on a 800 m distance (Andrei et al., unpublished data, GIR Archives)

Hoping that the up above mentioned veins are entirely developed till the surface we assume that this mineralizated fracture could be connected by the main future gold perspective of the Tălagiu structure.

For solving all these geochemical prospecting problems there is necessary the use of the modern technology for all indicator elements.

Finally all the geochemical investigation data must be carefully correlated with the present geophysical and geological data

ABOUT A POSSIBLE DISSEMINATED GOLD MINERALIZATION IN BATARCI METALLOGENIC AREA (OAS MOUNTAINS, ROMANIA) POINTED OUT BY GEOPHYSICAL AND GEOCHEMICAL DATA

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Geological frame and veins related gold mineralization: The base metal and base metal + Au, Ag mineralizations, prevalent veins hosted, from Oas district (Jude, 1986) are emplaces in in the cover part of a buried neogene age plutonic body, marked by a high positive gravimetric anomaly (Andrei et al., 1970, Borcos et al., 1990, unpublished data, GIR arch., Andrei et al., 1994). Batarci metalogenic area, situated in the western neighborhood of this body apex, is represented by two vein systems prevalent NNE trending.

Host rocks are represented by lava flows, pyroclastic breccia and hialodacite pyroclastic rocks, which eventually can represent the remaining part of an eroded freatomagmatic structure. Those rocks are generally badly altered to clay or propilitic alteration, close to the veins can be remark a quartz -adularia metasomatic process. The veins are Pb+ Zn + Ag bearing, sometimes also contain sensitive amount of gold (Jude, 1986).

Disseminated mineralization: The extensive cover by slope deposits and lack of mining and drilling on the western slope of La Radacini Hill, also the alteration hallo related to vein systems, make impossible the indubitable mapping of disseminated mineralizations by ground geological prospection. Because that electrometry method (Mihail, Nicolau, 1966; Corcimaru, 1978, unpublished data, arch. S. C. "Prospectiuni" SA), geochemistry (Tomescu, 1963; Vlaicu, 1979, arch. S.C. "Prospectiuni" S.A.) and gamma aerospectrometry prospections method (Scurtu et al., 1988, GIR arch.) get out proves for a disseminate Fe-sulfide mineralization, possible also bearing gold.

Therefore, ground magnetic data show an intense generaly hidrotermal transformation, localy developed low intensity anomaly observed refflect small areas not so affected by alteration. Image of gamma aerospectrometry (K component) show a high intensity anomaly in area of Radacini Hill and in his western slope. This suggest high K metasomatism .

The SP minimum with intense negative values (-275 mV) close related with K component maximum, declaim the presence of a stokwerk body. The area of SP minimum denote relations of this not with redox proceses, but electrofiltration one., high developed in deep. Resistivity data obtained by longitudinal gradient procedure, especialy in a VES section disposed EW (by Radacini hill) show high anomaly of ña, close corelated with SP minimum.

These releave intense silicification phenomenous, developed high in deep, especialy in pheripheral area.

The IP section, superimposed an ña VES section show a good peak correlation of these, wich suggest the corelation of high Si transformatin with disseminated sulfide content (probably especial Fe sulfides).

Lowers comparative corelation of IP positive peaks with local SP minimum declaime, in our opinion, some electrofiltration phenomenon.

Finaly, good corelations of major SP minimum with ña peaks associated with an important secundar Ag dispersion anomaly higher of 1.2 ppm (to 20 ppm) sugessted that the stockwerk is bearing a silver mineralisation, probably also with apreciable content of gold.

In consequence, the geological, geophysical and geochemical data, suggest the presence, on the western slope of Radacini Hill to the Mesului Creek, of a Fe sulfide rich, stockwerk style mineralization, bearing also gold and silver. The stockwerk have an isometric shape, up to 600-700 diameter. The hydrometasomatic paragenesis seems to be: quartz-adullaria-clay minerals- Fe sulfide -Au - Ag.

We mention that mineralized structure isn`t singular. Two almost similar structures south to the La Radacini stockwerk, on both side of Gastii Valley. Also, the gamma aerospectrometry data suggest a comparable case west and south of Viezuri vein system.

COMPARATIVE GEOPHYSICAL AND GEOLOGIC ANALYSIS OF THE PORPHYRY NEOGENE STRUCTURES OF THE SEACA-TĂTARCA AND ŞUMULEU (GURGHIU MOUNTAINS – ROMANIA)

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In the neogene magmatic complexe structure of Seaca-Tatarca and Şumuleu geologic careful investigations were caried out (Grigore, 1957; Treiber, 1959; Radulescu, 1962; Radulescu et al., 1964; Stanciu, 1973, Peltz et al., 1976, Peltz, Peltz, 1977 etc.) The up above mentiones authors investigated petrologic, geochemical, magmatogenetic and metalogenetic problems.

The advanced degree of flow deposita covering were balanced by the existence in both craterial structure of some drillings between 200–1200 m deep.

In the last 44 years the mineralizing indicators described since 18th century stimulated important prospection activities: gravimetry (Suceava, Proca, 1970) ground magnetometry (Şteflea, Şteflea, 1956; Ştefanescu, 1957, unpublished data) aeromagnetometry (Cristescu et al., 1970, 1972, unpublished data) and electrometry (Scupin et al., 1975-1977, unpublished data) as well as geochemic data (Buracu, 1959, 1960, unpublished data; Buracu, 1973; Dudnic et al., 1975, unpublished data).

Taking into acount the interest of one authors manifested for the geophysical and geochemical investigations of porphyry copper mineralizations of Metaliferi Mts. (Andrei, Calota, 1975; Andrei, 1983), in 1978 caryed out a quick geological-petrophysical research of both structures. Our present note correlates these results with the previous geological, gravimetric, ground magnetometric, electrometric geochemical data.

Esentially these activity suggested following considerations:

In the central south –eastern part of Seaca-Tătarca craterial structure in the medium superior basin of the Găinesa Valley (the left slope) we can see a perfect superposition of ΔZ magnetometric maxims zones alignments (up to 7500 nT), with a maxim strong IP zone and a minimum of $\rho_a < 20\ \Omega m$. All of these are corelated with the apex of the major gravimetric maximum of this structure. These correlated geophysical anomalies seems to reflect the presence of at a low depth, big subvolcanic intrusion, afected by porphyry internal zone endogenetic transformations (potassic or potassic-propilitic). On all anomalous area we could not detect no outcrop, igneos rocks being covered by deep slope deposit. The up above mentioned anomalous magnetometrice-electrometrice pairs, due to the presence of a Cu secondary dispersion aureola < 100 ppm, suggest that the disseminated mineralization of the porphyry system interanal zone is represented by magnetite and pyrite ("iron porphyry") at least the uppr part.

In presence of such strong magnetic anomalies, ρ_a, very intense minimum may not be exclusively atributed to some argylization procesus but to must be produced by very intense crackling and brecciations.

These are acomplished by abundent deposition of magnetite and pyrite or pyrite only on this columns or breccia dyke correspnding to some terms of the magnetometric minimum.

The existence in the South central part of the Seaca-Tatarca crater of a evoluated porphyry system, from the crackling, brecciations and endogenetic transformation point of view, but without economic importance cooper dissemination, do not exclude the presence of pyrite gold mineralization in the breccia bodies.

Unfortunately in all eight drills (200-350 m) as well as in No. 35502 drill (1200 m) dug in the craterial area, were placed in the outer limits of ΔZ magnetic anomalies, on the external zone (argilitic) area of the porphyry system. So discouraging results of drillings are not concludent for metallogenetic perspective.

The geologic, geophysic and geochemical data, of the Sumuleu crater area shows that we face with porphyry subvolcanic structure suboutcroping subvulcanice too. Although even in this case the Cu secondary dispersion aureola exceed 400 ppm and the porphyry copper type mineralization identified in Aranyasz broke outcrops in 4 drills contains 0.1% Cu, its economical value has no economical interest.

Beside this in our opinion at Sumuleu the porphyry system is less than developed than in Seaca-Tatarca. This supposition is founded on the observation that magnetometric maxmums cupled with IP maximums, bigger than 40mV/V, correlated with ρ_a of 40 -140 Ωm. The porphyry system in Şumuleu shows crackling and brecciation procesus less significant than in Seaca-Tatarca porphyry system.

To conclude, chances for pyrite-Au or polymetallic- Au mineralization discovery in the Şumuleu porphyry system breccia is lower.

To put in evidence the projection to surface of gold content mineralization there is necessary the use of the modern geochemical technology for all indicator elements. Finally, all the geochemical investigation data must be carefully correlated with the present geophysical and geological data.

EXPLORATION FOR EPITHERMAL GOLD DEPOSITS

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The successful explorationist uses knowledge of geologic relationships and ore-deposit styles, tempered by experience, to interpret all information available from a given prospect in order to develop an understanding of its mineral potential. In the case of exploration for epithermal gold deposits, this understanding can be augmented by familiarity with active hydrothermal systems, their present-day analogues. Just as geological skills and exploration experience are the defining elements of a philosophy of exploration, the needs of a company determine, as much as the funding and skills available, which level of exploration it pursues and where: grassroots, early stage or advanced targets. Epithermal gold deposits have size, geometry and grade variations which can be broadly organized around some genetic classes and therefore influence the exploration approach or philosophy.

Nearly 80 years ago, Lindgren defined the epithermal environment as being shallow in depth, typically hosting deposits of Au, Ag and base metals plus Hg, Sb, S, kaolinite, alunite and silica. Even before this, Ransome recognized two distinct styles of such precious-metal deposits, leading to the conclusion that the two end-member deposits form in environments analogous to geothermal springs and volcanic fumaroles, which are dominated by reduced, neutral-pH versus oxidized, acidic fluids, respectively. The terms we use are low- and high-sulfidation (LS and HS) to refer to deposits formed in these respective environments. The terms are based on the sulfidation state of the sulfide assemblage. End-member LS deposits contain pyrite-pyrrhotite-arsenopyrite and high-Fe sphalerite, in contrast to pyrite-enargite-luzonite-covellite typifying HS deposits. A subset of the LS style has an intermediate sulfidation-state (IS) assemblage of pyrite-tetrahedrite/tennantite-chalcopyrite and low-Fe sphalerite. IS deposits are Ag and base-metal rich compared to the Au-rich end-member LS deposits, most likely reflecting salinity variations.

There are characteristic mineral textures and assemblages associated with epithermal deposits, and coupled with fluid inclusion data, they indicate that most LS and HS deposits form in a temperature range of about 160 to 270°C. This temperature interval corresponds to a depth below the paleowater table of about 50 to 700 m, respectively, given the common evidence for boiling within epithermal ore zones. Boiling is the process that most favors precipitation of bisulfide-complexed metals such as gold. This process and the concomitant rapid cooling also result in many related features, such as gangue-mineral deposition of quartz with a colloform texture, adularia and bladed calcite in LS deposits, and the formation of steam-heated waters that create advanced argillic alteration blankets in both LS and HS deposits.

Epithermal deposits are extremely variable in form, and much of this variability is caused by strong permeability differences in the near-surface environment, resulting from lithologic, structural and hydrothermal controls. LS deposits typically vary from vein through stockwork to disseminated forms. Gold ore in LS deposits is commonly associated with quartz and adularia, plus calcite or sericite, as the major gangue minerals. The alteration halos to the zone of ore, particularly in vein deposits, include a variety of temperature-sensitive clay minerals that can help to indicate locations of paleofluid flow. The areal extent of such clay alteration may be two orders of magnitude larger than the actual ore deposit. In contrast, a silicic core of leached, residual silica is the principal host of HS ore. Outward from this commonly vuggy quartz core is a typically upward-flaring advanced argillic zone consisting of hypogene quartz-alunite and kaolin minerals, in places with pyrophyllite, diaspore or zunyite. The deposit form varies from disseminations or replacements to veins, stockworks and hydrothermal breccia.

During initial assessment of a prospect, the first goal is to determine if it is epithermal, and if so, its style, LS or HS. Other essential determinations are: i) the origin of advanced argillic alteration, i.e., hypogene, steam-heated or supergene, ii) the origin of silicic alteration (e.g., residual silica or silicification), and iii) the likely controls on grade, i.e., the potential form of the ore body, as this is one of the most basic characteristics of any deposit. These determinations will define in part the questions to be asked, such as the relationship between alteration zoning and the potential ore zone, and will guide further exploration and eventual drilling, if warranted. Observations in the field must focus on the geologic setting and structural controls, alteration mineralogy and textures, geochemical anomalies etc. Erosion and weathering must also be considered, the latter masking ore in places but potentially improving the ore quality through oxidation. As information is compiled, reconstruction of the topography and hence hydraulic gradient during hydrothermal activity, combined with identification of the zones of paleofluid flow, will help to identify ore targets. Geophysical data, when interpreted carefully in the appropriate geological and geochemical context, may provide valuable information to aid drilling by identifying, e.g., resistive and/or chargeable areas.

The potential for c significance.

The explanation for these empirical metallogenic relationships may be found in the characteristics of the magma, e.g., oxidation potential, and of the magmatic fluid genetically associated with the epithermal deposit.

For effective exploration it is essential to maximize the time in the field of well-trained and experienced geologists using tried-and-tested methods. Understanding the characteristics of the deposit style being sought facilitates the construction of multiple working hypotheses for a given prospect, which leads to efficiently testing each model generated for the prospect, using the tools appropriate for the situation. Geologists who understand ore-forming processes and are creative thinkers, and who spend much of their time working in the field within a supportive corporate structure will be best prepared to find the epithermal deposits that remain hidden.

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EMISSIONS OF METHANE FROM MUDVOLCANOES IN ROMANIA: ENVIRONMENTAL IMPLICATIONS

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Generally, the methane emissions from endogenous sources are ignored as natural contribution to the global "greenhouse gases" budget. Recent studies have shown the importance of geogases discharges and their possible impact on the global climate. Methane is about 200 times less concentrated in the atmosphere than is CO_2, but it is 20-30 times more effective in trapping heat. The importance of methane is also highlighted by the atmospheric composition change over the last 300 years. The methane concentration increased from 0.7 ppm to 1.7 ppm, which means 243%, versus carbon dioxide, which increased from 260 ppm to 350 ppm, i.e. 135%.

Important fluxes of methane were observed in hydrocarbon-prone areas, as diffuse or punctual emissions. Mud volcanoes are known as the most impressive structures build up by the upward migration of gaseous hydrocarbons, but very few data on the quantity of gases released to the atmosphere are available. Mud volcanoes were identified in 5 countries in Europe and in 29 in the whole world. Romania have important mud volcanoes fields, two of them being delimited as natural reserves: Hăşag (Sibiu) and Pâclele Mari-Pâclele Mici (Buzău). Significant methane emissions are expected to be found on large surfaces superposed to the hydrocarbon prone areas of the Carpathian Foredeep and of the Transylvanian Basin. Smaller mud volcanoes and gas vents are known in many places across these two geologic units.

Some sites with mud volcanoes are known in Transylvania. We investigated several cones near Aiud (Alba) and at Hăşag. Eastward from Aiud, at about 7 km, one cone of about 1 meter high, can be seen. At Hăşag, three conical structures are known. The biggest cone is 6-8 meters high and its diameter at the base is about 50 m. Generally, the visible activity of these volcanoes depends on the quantity of water that is present in soil.

BURIED MIOCENE VOLCANIC STRUCTURES IN HUNGARY

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IGCP 356 is a project dealing with the connection between plate tectonics and metallogeny in the Carpathian Balkan area. Its 7th work-group has dealt with the Neogene palaeovolcanic reconstruction in this territory. By using its results, OTKA T-030133 subject is now editing the map of Neogene volcanites of Hungary on the scale of 1:500,000. The area, covered with juvenile Quaternary and Neogene deposits, mounts up to more than the 2/3 of Hungary's present area and former volcanic explosion centres and volcanic products can only be reconstructed by integrated geological and geophysical investigations. On one hand coordination is necessary among data of several deep drillings, more than 60,000 square kilometres of seismic sections, aerial geophysics and ground geophysics (gravity, magnetics, electromagnetics, radiometry), on the other hand data of petrochemistry, mineralogy-petrology and K-Ar chronology from rock samples of deep drillings must be compared in the investigations. Subsurface geological and large structural correspondences of the area are attached to these investigations. Relying upon the above-mentioned, we can state that the position and movement of former micro plates greatly determined the evolutionary progress of the Miocene in the Carpathian basin. On these facts, we may say that the Neocene vulcanite's cover larger area in Transdanubia (the plain in North-western Hungary and Somogy-Baranya hill-country), the territory between Danube and Tisza and the Great Plain than well-known surface volcanites in Hungary from Visegrád Mountains to Tokaj Mountains. On the basis of existing integrated data, former volcanic centres are mainly concentrated in the environment of former micro plate borders and their lava and piroclastite products considerably exceed 50 metres in these areas.

Taking its geological structure into consideration, the calc alkali-like andesite vulcanisation started early in the Eggenburgian and the Ottnangian escorted by ignimbrite volcanic centres from Mecsek Mountains to the Salgótarján basin and the south-western part of the Bükk Mountains. The Carpathian rhyolite and dacite volcanic centres can be found mainly in Transdanubia, while the series of volcanic Badenian andesite and dacite centres forming big stratovolcanos are in the buried regions of the territory between Danube and Tisza and the Great Plain.

In the Sarmatian and the Lower Pannonian dominantly rhyolite, subordinately andesite and dacite volcanic series were born, their tuff covering and lava domes can be found in the eastern region of the Great Plain (Nyírség), and are several thousand metres thick. There are very thick alkali trachyte (Kisalföld – the plain in North-western Hungary) and alkali basalt lava domes and tuff craters in regions of stabilized plates in Transdanubia and the territory of Danube and Tisza. The palaeostructure and morphology of expected eruption centres and their products will be shown by the help of existing examples.

STATE AND PERSPECTIVE OF MINING IN THE SLOVAK REPUBLIC

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From the primeval times the territory of the Slovak Republic was source of mineral wealth due to its geological structure and presence of mineral deposits. First instruments made of copper found here came from the time 3,500 BC, they were accompanied also by gold things. However, evidences of mining from this time were found only in the copper deposit in Špania dolina – Piesky near Banská Bystrica. Iron ore mining started first by Celts, extensively were mined mainly gossans on sideritic deposits in Spišsko-gemerské Ore Mts.

Medieval times (i.e. 13-th to 15-th centuries) were the flourishing time of "free mining towns", where gold, silver, copper and iron were mined. Well known localities from this period are Banská Štiavnica, Kremnica, Smolník, Ľubietová, Zlatá Idka and others.

Slovak deposits were one of the main bases of industrial revolution in Hungary from 18-th to 20-th century. During this time mainly Fe, Cu, Pb-Zn, Hg, Sb, Ni-Co, salt and magnesite were mined.

Mining of different commodities continued also after WWI, but new period of prosperity and extensive geological prospecting came after WWII with a revival of economy and with industrialisation of Slovakia.

Some of mines were closed in the beginning of sixties, but mining remained one of strong pillars of the Slovak industry. In this period was majority of Slovak mines subsidised by the state.

Crucial and deep changes befall Slovak mining industry after 1989, when Czechoslovakia entered free market of raw materials. Many of existing mines came into so-called attenuation mode and finally were closed due to non-profitability. Many of miners lost their jobs what in many regions significantly increased rate of unemployment.

Today there are two active ore mines (operated by Siderit Nižná Slaná Inc. – iron ore, and Slovenská banská Ltd. – gold ore), four mines exploiting industrial minerals (operated by SMZ Jelšava Inc. and Slovmag Lubeník Inc. – magnesite, Petra Inc. – gypsum, Želba Inc. - barite) and five brown coal mines (operated by HBP Prievidza Inc. and Baňa Dolina Inc.) in the Slovak Republic. Bentonite, perlite, kaoline, ceramic and refractory clays, basalt, dimension stone, dolomite, limestone, silica, talc, zeolite, foundry sands and construction materials (crushed stone, gravel sands and brick clays) are mined in open pits, halite is obtained by underground leaching from salt-wells, small amount of oil and natural gas are obtained from wells (oilers).

Majority of metal reserves is marked as potentially economic considering market mineral prices and mine production costs. Majority of domestic consumption of metals is covered by import. Domestically produced iron ore covers only a small portion of needs of the Slovakia's iron and steel industry.

Slovak Republic is especially rich in industrial minerals, mainly magnesite, limestone, dolomite, gypsum, talc, halite etc.; limited are, however, sources of mineral fuels.

Some of industrial mineral deposits (magnesite, talc, gypsum and limestone) are of great importance for the future of Slovak mining industry. The main problem for the existing mining enterprises and for potential ones is a lack of investments and outworn Mining Law.

Table 1 Selected mineral statistics (Slovak Republic, as of 1 January 2000)

MINERAL	GEOLOGICAL RESERVES	MINING OUTPUT IN 1999
Brown coal & lignite [kt]	1 155 000	3 732
Natural gas [Mm^3]	28 000	235
Mineral oil [kt]	11 900	59
Magnesite [kt]	1 170 000	1 143
Dolomite [kt]	620 000	1 504
Limestone [kt]	5 625 000	6 978
Barite [kt]	3 230	44
Gypsum & anhydrite [kt]	1 154 000	117
Rock salt [kt]	1 203 257	125
Iron ore [kt]	99 000	891
Gold [kg]	38 700	392

NEW INTERNATIONAL COOPERATION STUDIES ON UPPER CRETACEOUS MAGMATIC SERIES AND ASSOCIATED MINERALISATION IN THE CARPATHIAN – BALKAN OROGEN

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From the middle of the 19th century until the end of the 20th , hundreds of geologists have investigated, with many different methods and goals, various segments of the Upper Cretaceous magmatic and metallogenetic belt running from the Apuseni Mountains and the Banat in Romania, through the Serbian South Carpathians, and the Srednogorie-Balkans in Bulgaria, to the Black Sea in Turkey. As a result of geography and history, the impressive published literature is mostly scattered in journals of many countries (Austria, Hungary, Romania, Yugoslavia, Bulgaria, Turkey, Macedonia, Croatia, Greece), being almost absent in international geological journals. Both the scientific interest and the practical need of finding and exploring world-class mineral deposits have lead to the implementation, in the last 10 years, of easier communication of persons and ideas, of several international projects.

The IGCP (International Geological Correlation Program) Project No 276 "Paleozoic geodynamic domains and their alpidic evolution in the Thethys", was active between 1990-1995, the IGCP Project No 356, " Plate tectonic aspects of the Alpine Metallogeny in the Carpathian-Balkan region," was active between 1994-1998 and the IGCP Project No 430, "Mantle dynamic implications for Thethyan natural hazard mitigation," was launched in June 2000; a new IGCP project entitled "Upper Cretaceous terranes and Alpine continental collision in the Carpatho-Balkanic area" is now proposed.

European funded projects ALCAPA, EUROPROBE-PANCARDI and GEODE-ABCD are also a good framework for international cooperation, as well as bilateral agreements, as that between romanians and serbians in 1997 for an international workshop and excursion in Iron Gates of Danube.

In the hope that for the South East Europe the positive political and economic trend at the end of the year 2000 will continue in the next decade, more national, bilateral and international studies are welcome.

PRESSURE DETERMINATION FOR SUBDUCTION AREAS. ILLUSTRATION ON THE APUSENI MOUNTAINS

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Pressure calculation formulas and values for the Apuseni Mountains were determined using mechanic theories, material resistance theory as well as the mineralogical paragenesis as resulted from thin sections on samples from the Apuseni Mountains.

1. By means of rocks mechanics theory, the tangential tension (strain) generating subduction surface is equal with the rock shear resistance (Rf). It is composed of the sum of tangential tensions τ, given by lithostatic pressure and tangential tension τf, due to the tectonic pressure which pushes the plates. Rf and τ being known, τf could be determined, and subsequently all tensions values involved in subduction

2. Using material resistance theory , strain formulas calculations were determined, for several loads: lithostatic pressure, constant or uniform-increasing lateral push, horizontal or perpendicular to the subduction plane. Connecting these formulas with Mohs break hypothesis, the tension formulas for subduction area were obtained.

. The Apuseni Mountains mineral assemblages, as resulted from the thin sections, were plotted on the pT diagram, resulting their pT formation values (Fig. 2).

Finally, the three methods gave similar results. The distribution of the tensions in the Apuseni Mountains subducted area is shown in Figure1.

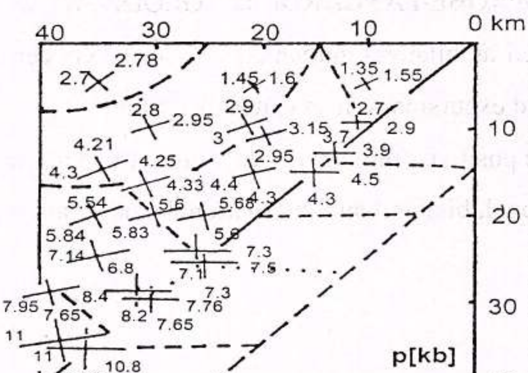

Fig.1. σ - subduction pressures, as resulted from mechanic theory.

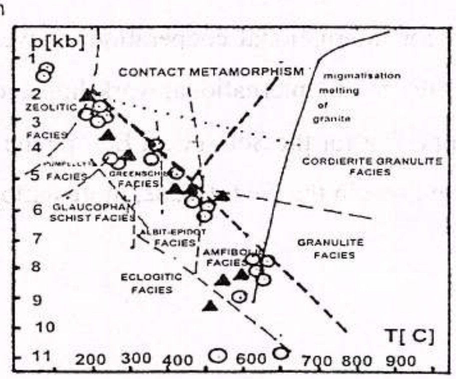

Fig. 2. Rock assemblages from Apuseni Mountains (triangles), and calculated pT (circles) disposed on Heitanen diagram.

JOINT PROCESSING OF GRAVITY AND MAGNETIC PROFILES

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In the lecture 2D processing of gravity and magnetic data is presented. To set up the startmodel a series of causative body determining algorithm were used. The result of calculations gave solutions, which could be interpreted as structural lines, volcanic body and surface of basement. The final geophysical model was constructed, using a 2D modelling software.

GIS CENTRAL EUROPE
TOWARD A METALLOGENIC AND ENVIRONMENTAL GIS OF CENTRAL AND SOUTH-EASTERN EUROPE

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GIS Central Europe was designed and initiated by BRGM in 1999 to be a homogeneous geographic information system for Central and South-Eastern Europe based on original syntheses and compilations. It covers an area of 1.7 million km² and extends for some 1750 km from the West Carpathian Mountains in the west to the Gulf of Antalya (southwestern Turkey) in the east (Cassard, 1999a). Some 15 countries are concerned by this synthesis which covers the the Carpathian – Balkan Arc, the Dinarides – Hellenides Belt, the Rhodopean Massif and Western Anatolia.

GIS Central Europe has been conceived as a tool aimed primarily at the mining and academic sectors. For the former it will be an invaluable aid to mineral exploration and mine development, especially as it takes into consideration the environmental problems induced by the extractive industry and its downstream activities. For the latter it will aid in developing new metallogenic models, and should contribute to resolving certain R&D problems such as the relationship(s) between the mineralized belts and collision zones, subduction zones, thermal anomalies, etc., or the structural controls of the mineralization, or yet again the spatial and temporal distribution of the paleohydrothermal systems.

The GIS, with its multicriteria thematic data layers, should prove invaluable for such scientific study. Its potential contribution in scientific terms is closely related to the quality of the data layers and the capacity of the user to optimize them. The GIS layers are not limited in either number or type, and the potentialities of the tool are largely dependent on the will to introduce further quality data.

GEOLOGICAL AND GEOCHEMICAL REMARKS ON LITHOGEOCHEMICAL HALOES FROM VARATEC MTS., ROMANIA

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Varatec Mountains represent the easternmost segment of the Oaş - Gutâi magmatic and metallogenic district, within the Neogene volcanic chain of Romanian East Carpathians.

Subduction related intermediate calc-alkaline volcanism developed on a Paleogene flysch sedimentary basement, contemporaneous with the Maramureş Basin Miocene molasse formation. Stratovolcanic products consist of lava flows - basaltic andesites and andesites, and volcaniclastics often interlayered with sedimentary deposits. Intravolcanic intrusions consist of andesites, rarely microdiorites. Some of the intrusive bodies reveal an E – W array, along the main fracture system, related to the major transcrustal fault Bogdan Vodă.

Widely spread hydrothermal alterations related to both high sulfidation and low sulfidation systems occur. Mineralizations from Varatec Mountains belong to the Herja - Băiuţ epithermal district developed on an E-W trending area, 35 km long and 3 - 9 km wide.

Several ore deposits have long been known and mined in this area, consisting mainly of veins, inter-veins fissured and impregnation zones, stockworks, breccia pipes. Mineralizations have a prevailing base metal character with high contents of gold in the upper parts. Higher concentrations of copper were reported both at the auriferous level and in the upper part of some Pb-Zn mineralizations.

Lithogeochemical studies investigating primary geochemical haloes related to known mineralizations (e.g. Jereapan ores) as well as those related to concealed mineralizations, not yet intercepted by mining or exploration works, were carried out. Geochemical features of mineralizations at the present time level of erosion have been assessed on the basis of the established haloes geochemical zonation. Primary monoelemental and enhanced multiplicative haloes were outlined, based on background and threshold values. Thus several anomalous zones were contoured. Distribution maps of discriminant and factorial scores yielded from computerized multivariate geostatistics were also considered. Geostatistically discriminated groups of data revealed at least three types of element association, when submitted to Factor analyses, defining distinct geochemical types. Interference of distinct factors, with different loadings, suggested the high complexity and heterogeneity of the anomalous environments, and of the mineralizations, consequently. Synthetic geological and geochemical approach suggested a new model for Jereapan and neighboring ores, due to (at least) one high crustal level (calc-alkaline) intrusion.

GEOLOGICAL STRUCTURE FROM THE NORTHERN PART OF THE MOLDAVIAN PLATFORM

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The work presents a geological-structural study based on own observations and on the unitary interpretation of a great number of data, obtained from field researches, from analysing the drilling data, as well as from the results of the geophysical investigations. All these data, analyses and interpretations brought new contributions on the knowledge of the sedimentary cover, from the northern part of the Moldavian Platform.

The researches on the basement, made in several stages, showed that the crystalline schists are represented by different types of gneisses, pierced by pegmatites and granitoids. These rocks are the result of the metamorphic process, of a sedimentary prevailed material in an amfibolic facies.

Under the mentioned crystalline schists, Eoproterozoic in age and the associated magmatic bodies, forming together the upper structural stage of the platform basement, structures much older (Archaic in age), representing the lower structural stage, developed. This is constitute mainly by magmatic bodies, including the crystalline schists resulted after a metamorphism in a granulitic facies.

In the investigated perimeter the lower structural stage is delimitated by the maximum gravimetrical anomalies, which are extended to the north and north-east of the Prut river, outlining a regional area surface; together with the associated tectonic and the magmatic bodies; in the present study this area is named the "Geological Bucovinian North Structure".

The Eoproterozoic movements brought out deformations, which could be great fractures, on crust nature. From these, the Serpenita-Vorniceni fracture could be remarked, with an E-W orientation, acting on a vertical direction and separating the north sector, uplifted from the southern one; both areas, from the northern and southern sectors belong to the "Geological Bucovinian North Structure". The above-mentioned fracture had also a horizontal translation movement, which led to the misplaced of the northern part to the west, on a distance of around 8 km, well individualized in the Vorniceni area.

Another fracture, with a regional character, displaying a NW-SE orientation and named Oroftiana - Epureni, separates the basement as a diagonal shape, on the same direction, delineating also the Eoproterozoic basement of the platform, located to the west and south-west in respect with the "Geological Bucovinian North Structure", with an Archaic basement.

The interpretation of the obtained results from magnetoteluric drillings as well as from the gravimetrical ones indicated that the basement had a subduction to west-south-west, beginning with the

Oroftiana - Epureni fracture. Thus, starting with -400 m isobate, from the Hudesti - Lisna alignment, the basement morphology lowering to WNW of Dorohoi until -1600 m.

The magnetoteluric drilling data allowed us the following observations:

- In case of the lines with high values of resistivity, these are delimitating and separating magmatic bodies, like the batholite from the south-east Mileanca - Tataraseni zone; than, based on the gravimetric and magnetic data interpretations, the area of the intrusive bodies from the Dealu Ratos - Serpenita alignment, was separated

Analyzing the shape of the high izoresistivity lines, some areas almost round were identified, which were interpreted as being the surface of eruptive necks; some of them could belong to some explosion cones (pypes, tubes).

It is to mentioned that also the lithological features as well as the palaeontological content of the cover sedimentary succession are presented; a contribution in the enrichment of the palaeontological inventory of the Paleozoic, found in Havârna drill it is also to remark.

New data on the petrographical characteristics of the Paleozoic deposits, based on the tuff presence as well as on the dolomitic limestones, from the Silurian, are also given.

NORTH BUCOVINIAN GEOLOGICAL STRUCTURE OF THE NORTHERN PART OF THE MOLDAVIAN PLATFORM AND THE POSSIBLE MINERAL ASSOCIATION RELATED

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The present work contains an actual topic and represents a special interesting for the geological knowledge of an important sector of the Moldavian Platform.

By interpreting the gravimetrical anomalies of the izogale line morphology and by the analysing the geological signification of the fractures and of the magmatical bodies, intruded in basement of this area, the" North Bucovinian Geological Structure" was defined. The above mentioned geological structure is delimitated, in the west and south-west part, by the Oroftiana-Epureni fracture, with a NW-SE orientation, to the north by the Prut River, where it remains open; but on the regional maps a continuation of this structure, a little over the Nistru river, to the north and closing to the east, in the middle part, between the two rivers, could be observed.

Within this structure, several tectonical areas, delimitate by faults, with different ages, as well as by magmatic bodies, intruded in the metamorphic series and by a volcanic activity were separated.

By analysing the structural data of the high isoresistivity lines, some semicircular areas were identified; one of them could be associated with columns or explosive cons, of kimberlitic type.

The possible mineralizations, with related mineral resources, result also from the analyses of several sectors, located within the perimeter. From these areas, the following zones could be analysed: a) the structure resulted from the intrusion of the batholitic magmatic body, delimitated in the sector Tatareni SE, which the apophysis could attend the surface of the crystalline basement; b) the intrusive bodies from the WE alignment, between the Ratos Hill and Serpenita; c) the volcanic activity and the eruption cons respectively, to which could be associated a post-magmatic mineralization; d) the possible presence of some explosion cones (pypes, tubes) of kimberlitic type, from the Cotusca-Sarata Greaca fault zone or from other sectors, could be also discussed and analysed.

SILURIAN VOLCANISM OF THE NORTHERN PART OF THE MOLDAVIAN PLATFORM

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In the carbonaceous formation, Silurian in age, from the Havârna drilling, located NE of Dorohoi, centimetrical level tuffs, with a single layer more thick, up to 80 cm, are present. In the Saveni drill, located in the same carbonaceous formation, a vitroclastic clayly tuff, four centimetres in thickness, was identified.

The microscopically studies of the tuff from the Havârna drill, shows that this one is a volcanoclast, containing grains with less then 2 mm diameter and includes vitroclasts, cristaloclasts and rarely lithoclasts.

From the genetical point of view, one can state that the mentioned tuffs are piroclastites, formed during the explosive eruptions and containing ponce rock, glass fragments respectively, with vesicular structure, with more than 50% porosity and an acid composition, autoclasts formed from rock fragments (lithoclasts) as well as glass and hydroclasts formed through the freato-magmatic eruptions.

After the accumulation pattern of the above mentioned piroclasts, these belong to the falling type deposits, associated with the eruptions, freato-magmatic in character and deposited in an island area, both in an aerian and underwater environment.

Concerning the distance from the source area, generating the piroclastic material, it could be considerate that it was located in the proximal zone, in respect to the Havârna drill and in the distal one, in respect to the Saveni drilling, where a granular and compositional (vitroclasts) sorting was observed.

On the magma type that generated the tuff material, on mineralogical data and on chemical analyses, we can conclude that we are in the presence of an acidic magma, rhyolitic respectively.

This work hereby attests the Silurian volcanism activity in the northern part of the Moldavian Platform.

CONSIDERATION ON THE GEMSTONES ASSOCIATED WITH THE PALEOCENE VOLCANOCLASTIC ROCKS LOCATED BETWEEN SARBI-GURASADA-BURJUC LOCALITIES (MURES COULOIR – APUSENI MOUNTAINS)

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The studied area is situated North from Sarbi-Gurasada-Burjuc localities (being delimited eastwards by the first, and westward by the last one). The geological formations are represented by laramian volcanic rocks belonging to an internal continental arc (Savu et al., 1992). Basalts, andesites and leucocrate rocks, which constitute a calc-alkaline volcanic series, mainly represent the petrographic types.

The pyroclastic deposits host a very heterogeneous and rich assemblage of gem minerals:

- variously colored jaspers (yellow, reddish, brownish) to be found on most of the valleys (Tisei, Vicii, Gurasada, Scolii, Tiganului) in the region;
- massive chalcedonies mainly of blue and white colour along Carmazanasti and Gurasada valleys, as well as vein-type chalcedonies with two-colored alterating bands (white-greenish or white-grayish) (Manastirii and Campuri valleys);
- less frequently, agates with variously alternating colours (red-grey-green) especially along Gurasada Valley and Mare Valley;
- silicified wood, as small, medium and large fragments (the last ones being more than 50 kg in weight) along almost all the valleys in the region (Gurasada, Mare and Tatarasti);
- white-greenish opals of a vein-type, located on Scolii Valley.

The microscopic study of the gemstones collected from this area indicated the presence of microcrystalline and fibrous quartz showing concentric, layered, fibro-radial textures or forming small geodes.

The variety, quality and amount of gems identified in the neighborhood of Sarbi-Gurasada Burjuc localities indicate that this region is one of the most promising gemological provinces in Romania, from both a scientific and an economical point of view.

INTERCORRELATED STUDY (FORAMINIFERA AND CALCAREOUS NANNOPLANKTON) OF THE SARMATIAN DEPOSITS FROM THE MELICESTI SYNCLINE (SUBCARPATHIANS OF MUNTENIA)

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There were studied from micropaleontologic point of view (foraminifera and calcareous nannoplancton) samples collected from the Macesu Formation, Sarmatian in age (Volhynian - Basarabian). The following biozones were identified:

- the foraminifera zone Lobatula dividens, which can be correlated with the calcareous nannoplankton zone NN 7;
- the foraminifera zone Varridentella reussi;
- the foraminifera zone Elphidium reginum; the boundary between theVarridentella reussi Zone and Elphidium reginum Zone is approximately coincident with the boundary between the nannoplankton zones NN 7 and NN 8;
- the foraminifera zone Porosononion sarmaticum, which can be correlated with the upper part of the NN 8 Zone and the lower part of the NN 9 Zone;
- the foraminiera zone Porosononion aragviensis, which corresponds to the Zone NN 9 and, possibly to some part of the NN 10 Zone Like in other areas from the Subcarpathians the alternance of the calcareous nannoplankton assemblages of Pannonian type with those of Dacic type, was noticed.

GENETICAL MODEL OF THE MAGMATITES AND THE ASSOCIATED MINERALIZATIONS FROM THE NISTRU AREA (GUTÎI MOUNTAINS)

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The subvolcanic magmatic bodies from the Nistru area follow, in succession, the phase of Sarmatian pyroxene andesites. They are spatially associated to the volcanic rocks, being distinguished by morphological and structural aspects as well as by petrographic types. The relations between the main types of magmatic rocks emphasize their sequential emplacement: the first sequences form stocks of small sizes with irregular forms represented by the porphyric facies of the quartz-microdiorites with lateral transitions to andesitic facies and by porphyric quartz-monzodiorites. These stocks are accompanied by apophyses from which the ones of the quartz-micromonzodioritic which outcrop on the Nistru Valley; the second sequence of magmatic subvolcanic rocks is represented by dykes, apophyses and sills of a few meters size that pierce the stocks. These are represented by equigranular quartz-microdiorites under the form of a dyke that pierces the porphyry quartz-microdioritc stock, and porphyry microdiorites under the form of intrusive apophyses included in the porphyry quartz-microdioritic stock. Clear intrusive relantionships are observed between of the quartz-monzodioritic stock and the apophyses with composition and texture similar to quartz-andesite lava flows. The porphyry microgabbro forms a small sill occurring within the quartz-monzodioritic stock.

The magmatic rocks in subvolcanic facies are affected by hydrothermal alterations extremely significant for their role in the metallogenetic activity. In the early stages of their evolution, the hydrothermal fluids produce the autometasomatism of the rocks that is characterized by: the propylitic alteration with extensive character within the intrusions and volcanites; the potasic alteration associated to the quartz-micromonzodioritic stock that is characterized by the mineral assemblages biotite, K-feldspar and sericite. The subsequent stage in the fluids' evolution is determined by the hydrogen-ion metasomatism characterized by a large variation of the effects. This way are individualized: the phyllic alteration accompanied by a bor metasomatism; the argillic alteration follows after the alteration types specific to the intrusions affecting the upper parts of the vein fields especially the pyroxenic andesites lava. The silicification and adularia alteration are situated in the upper parts or accompany the phyllic alteration being disposed in the adjacent areas of some mineralizations. The distribution of the mineralizations in distinct vein systems, characterized by paragenetic sequences and vertical and horizontal zoning according to the position of the subvolcanic bodies, suggests their association with two magmatic spaces with particular development.

THE PETROGRAPHY OF THE ÞICAU CRYSTALLINE MASSIF

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For the classifications of metamorphic rocks from the Ticãu crystalline massif (NW part of the Transylvania Basin), it was used the petrographic classifications of the metamorphic rocks proposed by Lorenzo (1980) adjusted to the Romanian language by Seclãman (1989), which use the mineralogical and structural criteria. Thus, for to define the main petrographic types, from the same samples were made and analysed one, two (most frequently) or three different thin sections, having different orientations. The quantitative ratios between the main minerals of the association, observed in the field of the microscope, were comparing with the diagrams mineral percentages.

The studied rocks are belonging to the crystaloblastic rocks group - structurally subgroup of schistose rocks (crystalline schists). There is just a single variety of a main petrographic type (quartzite) that is belonging to the subgroup of massive rocks. Also, it has been identified rocks belonging to the cataclastic rocks group. As regards the crystalline schists, for to establish the main mineralogical groups, as well as the main varieties that can be separate using the quartz percentage, it was used the quartz-silicates-carbonates diagram. Thus, we can to define rocks that belong to the oxide schists group (quartzites) and silicate schists group, for a majority of them establishing the varieties as quartzose schists and quartz-bearing schists.

For to define the main petrographic types, it were used two diagrams, depending on the main minerals of the assemblage:

- for the mineral assemblages which include micas and feldspar in a high percentage (more 20%), it was used the micas (chlorite)-plagioclase-orthoclase diagram;

- for the assemblage, which includes mainly amphibole, plagioclase and biotite in a percentage high than 50%, it was used the hornblende-plagioclase-biotite (chlorite) diagram.

Thus, it were described and defined the following petrographic types:

- from the crystaloblastic rocks group: micaschists, plagioclase gneisses, orthoclase gneisses, orthoclase-plagioclase schists, quartz-orthoclase schists, amphibolites, quartzites and quartz schists;

- from the cataclastic rocks group: fault breccia and blastomylonites.

Following the structural criterion and especial the mineralogical criterion, from these main categories, were separated a large number of petrographic subtypes and varieties. It was also describe the pegmatites.

NATURAL AND TECHNOLOGICAL RISKS IN MARAMUREª COUNTY WITH SPECIAL REFERENCE TO BORªA TOWN

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Maramures County (6,215 km^2) has a very diverse natural environment due to a huge morphological relief variety, that includes parts of the Carpathians of Maramures and Bucovina provinces, the Transylvanian Tableland, the Silvana Hills and the Somes Plain extending beyond Baia Mare Depression. Each of these units has a particular structural, petrographical and morphological complexity as well as mode of manifestation of current relief modelling processes. In view of it, there is a striking step-like display of morphoclimatic and hydrogeographic phenomena, in the form of local and regional associations exhibiting specific morphometrical and present-day modelling features. Althrough three-fourth of the territory is mountainous, yet the mountains being low and medium-high, and the depressions numerous (with hills and plains), the area is quite accesible, therefore very populated and used for agriculture, sheephreeding and mining.

The present material discusses the forms of risk phenomena, their mode of manifestation, triggering causes, prevention measures and ways of reducing the negative consequences. A number of maps (digital, slopes, geological, geomorphological and present-day processes, geotechnical and hydrotechnical) on various scales were produced by means of G.I.S. techniques. Interpretations and conclusions are also reported. The final part of the paper provides some analyses and detailed mappings (1:10,000) of a few characteristic perimeters that pose serious problems to land stability and social-economic activities, e.g. complex slope processes in fragile zones and erosional processes. The map of risks is particularly important. The causes underlying the development of adverse phenomena are mentioned for every situation, and proposals to remedy and prevent them are put forward, especially because several economic activities have of late been carried out, often in disregard of environmental ecological protection standards.

THE CONRAD PORPHYRY COPPER AND THE AKBAKAY GOLD DEPOSIT (KAZAKHSTAN)

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These two deposits were visited and studied (along with six others) by an international group of experts in the framework of an Itinerary Workshop of the Deposit Modeling Program of IUGS/UNESCO on Paleozoic granite-related Au, Cu, Mo, W, REE Deposits in Kazakhstan and Kyrgyzstan in September 1997. The scientific conference held in Almaty and the ensuing field trip was organized by Prof. G. Gaál (Helsinki/Budapest) and Academician G.R. Bekzhanov (Almaty).

(1) The Conrad (Konyrat) porphyry copper deposit is situated on the N shore of Lake Balkhash, at the town of Balkhash, in an Upper Paleozoic volcanic belt. There are disseminated and stockwork type mineralisations in chimney filling explosion breccias within a caldera, at the crossing of two structural lines. The hosting granodiorite and acidic paleovolcanites suffered hydrothermal alteration (silicification) and metasomatism (chloritisation: beresitisation, listvenitisation). The main mineral assemblages are: (1) Lower Horizon: pyrite, chalkopyrite, molybdenite, magnetite; (2) Upper Horizon: enargite, tennantite, chalkosite. The lower one is being mined in a 800 m diameter, 360 m deep open pit, by the South Korean Samsung Company, on leasing.

(2) The Akbakay (White Pan) epithermal gold deposit: 75 k SW of Lake Balkhash, in the middle of the Desert of Starving (Betpakdala). Devonian granodiorite intruded into greywacke-type Ordovician turbidites of a fore-arc accretional paleosuture. The associated Au, W, Sn and Mo mineralisations are hydrothermal and metasomatic: auriferous quartz veins and beresitic bodies, respectively. The main minerals are pyrite, arsenopyrite, stibnite, and native gold. The ore shoots are bound to crossings of slightly and steeply dipping veins. The open pits have been exhausted. Underground exploitation is going on down to 180 m depth (shafts and adits). The mine is 100 percent Kazakh state property, and well prospering.

-- A detailed Field Guidebook (in English) has been published in Budapest, by the Geological Institute of Hungary.

THE CONCEPT OF ENVIRONMENTAL GEOLOGY

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Environmental geology studies the interaction between man and the geologic environment. It represents the management of a natural system concept that has been recently in the term "durable development". The key of the durable development is represented by the efficient management of the environment through the equilibrium between the resource necessity and the impact products through their valorification.

The geologic environment comprises, besides the Earth's physical components – rocks, sediments, soils, fluid – its surface with the forms of relief and especially the process that alter in time the Earth's surface. The environment is a resource and a risk factor of the human the development society; the environment is essential for life.

The central philosophy of environmental geology is environmental management (the natural geological system utilization for human society developments but not however costs from the point of view of environment) and relies the following general criteria:

1) the geological resource management;
2) the understanding and adjustment to the compulsions required by the geological environment on engineering activities;
3) the utilization of the geologic environment for waste deposition in order to reduce at minim the contamination and pollution problems;
4) the emphasis of the risk natural factors and the reducing of their impact on the human life.

THE URBAN IN PERSPECTIVE OF ENVIRONMENTAL GEOLOGY

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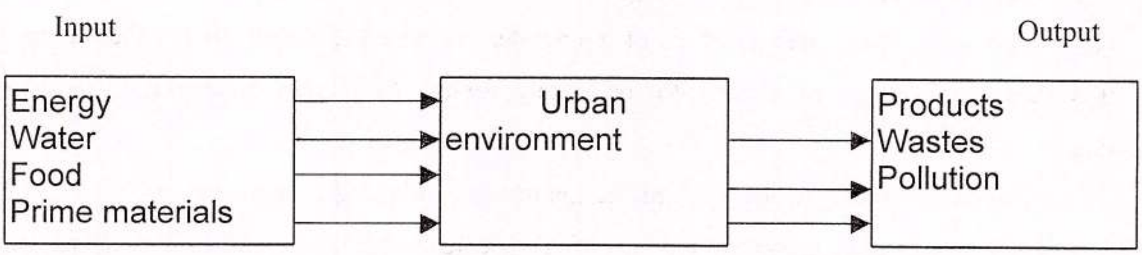
Environmental geology deals with the interaction management between the human being and geological environment; interactions that presents the most complex aspects in the urban environment or in the surrounding area. At the end of this millenium 3,5 milliard people, i.e. approximately 50% of the Earth's population will live in the urban environment Which represents 1% of the Earth's surface. In these regions (the urban environment) the interaction between the human being and the geological environment is the most intensive.

The urban environment can be regarded as a "machine" that consumes a lot of input elements and produces different output elements.



This "machine" needs continual maintenance by the adjustment of its infrastructures when needed. This "machine" relies on the stability of the geological environment. At the same time its security is threatened by the natural risk factors (natural phenomena that become a problem when they interact with human infrastructures). The concentration of the population in urban are increases the vulnerability of this machine even in the case of the minor natural risk factors.

The efficient functioning of this machine is secured by a strategical planning (the urban strategy) that should emphasize the development opportunities the compulsions that restrict it.

The answer of the planning may be proactive (future planning) or reactive (needed when unprecedented factors or factors of reduced frequency appear).

THE GEOMETRY OF IGNIMBRITES AND ITS SIGNIFICANCE

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Gutai Mts are part of the Romanian East Carpathians. The oldest volcanic rocks from the mountains are Middle Miocene (Lower Badenian). They form a thick sequence of volcaniclastics interbedded with sedimentary deposits which outcrop on the southern part of the mountains, on an area of 20 km length and 10 km width.

The sequence is well known as "the rhyodacitic formation". Actualy it is composed of rhyolitic ignimbrites and ignimbrite-derived volcaniclastics associated with mostly volcanogenic sediments.

Ignimbrites are the most representative component of the sequence. They form the lower part which lay immediately above the paleorelief of the Paleogene sedimentary deposits.

The facies study of the main outcrops of ignimbrites concluded that they present the intermediary facies of a thick cooling unit of densely to moderately welded ignimbrites, emplaced by progressive aggradation.

A number of 45 drilling works pierced the ignimbrites allowing a computational model of their distribution. It shows a wedge geometry WNW – ESE oriented. The lower surface corresponds to the morphology of the Paleogene paleorelief modelled by the alluvial system. This is a very irregular surface dipping from WNW to ESE and from N to S where basin conditions are close. The upper surface is flat, slowly dipping from N to S. The morphology of the two limit surfaces reflects the topographically controlled character of the ash flows and their tendencies to flatten the paleorelief, typical for gravitational flows. As a result, the thickness varies significantly between 300m and 50m, as a whole decreasing from WNW to ESE with local increase when ponded.

The geometry of the ignimbrites shows that large volumes of ash flows have been involved offering a valuable indicator about the flow mobility and the eruptive style of the source. The aspect ratio, as a measure of flow mobility, suggests HARIs (high aspect ratio ignimbrites, Walker, 1983; Carey et al., 1991) emplaced from DFS (non turbulent dense flows, Sparks, 1976; Fisher et al., 1993), topographically controlled ash flows.

A gas-retention regime suitable for welding (Sparks, 1999) indicates a short time deposition and compaction of a large volume of ash flow at few tens of kilometers away from the source, corresponding to a limited in time, high eruption rate. All these assumptions are compatible with explosion and collapse of an unstable column associated with caldera formation (Druitt, in Gilbert and Sparks, 1998).

EXTRUSIVE VOLCANISM IN OAS-GUTAI MTS.

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Oas-Gutâi Mts. represent the northernmost part of the Romanian East Carpathians. The complex volcanic structure of the mountains is the result of an acid explosive volcanism developed around 15 Ma years ago, followed by an intermediate mostly effusive volcanism, developed between 13.5 – 7.0 Ma.

Besides lava flows , a series of extrusions developed during the second phase; some of them have already been described during the last years (Fulop, Halga, 1995; Fulop, Kovacs, 1996, 1999).

The extrusive volcanism is best represented in Oas Mts. where the general trend of extrusions suggests a NW-SE tectonic control. In Gutâi Mts. several extrusions have been recognized, more or less E-W aligned on the southern border of the mountains where they are less represented than other volcanic structures.

The shape and the morphology of extrusions are good criteria for their recognition, particularly in Oas Mts. and subordinately in Gutai Mts. There are typical small circular domes, elongate larger domes and extrusive dome coulees and/or coulees, sometimes cut by faults.

The internal structure shows both thick massive lavas and lavas with columnar jointings. Feeder tubes are rarely preserved.

The acidic rocks (60 – 70 % SiO2) are predominant: dacites, much subordinated rhyolites and acidic andesites.

Most of the extrusions are associated with volcaniclastics which are suggesting typical processes developed during dome growth and lava cooling. They depend on the subaerial and/or subaqueous environment of extrusion. Talus breccias and autobreccias suggest gravity faillure of parts of the dome. The same non-explosive but quench fragmentation of coherent lava is responsible for hyaloclastites formation. Both in situ and resedimented hyaloclastites are associated with phreatomagmatic breccias and pumice and ash deposits related to the explosive disintegration of lava during the gravitational collapse of the dome.

Endogene and exogene domes, composite domes with parasitic structures, cryptodomes and complexes of domes have been emphasized. They all have features preserving the history of growing and cooling and recording environmental conditions.

"MINE FLOWERS" FROM BAIA MARE REGION

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"Oh, how much I love this town!" The old houses are kindly greeting you, traveller, just like old wise fellows. My wish is to die where I was born...But if I am to die in the mountains, I wish to be buried in the romantic valleys of Baia Mare." These are the words of Petofi Sandor – the poet, during a visit in Baia Mare region.

The town is well known not only for its picturesque landscape but also for the mining craft – with roots springing from the darkness of ages.

The first written document regarding mining craft is a diploma dated back in 1327, issued by king Carol Robert, where the town is referred to as "Zazar". Two years later, in 1329 the same king allows the land between the towns Baia Mare (Rivulus dominarum) and Baia Sprie (Mons Medius) to be forested in order to revitalize mining in the area. Since then, mining has been continuously developing with various intensities, at first with gold and silver ore exploitation, later extending to base metal ores as well.

By the year 1411 there was a coin money batter at Baia Mare. The only coin batters in the zone were at Buda, Kremnice, Kosice and Baia Mare, as revealed by a document dated 1433.

The geologic structure of the zone owes to the Neogene Volcanism. This volcanism yielded the picturesque peaks of the Gutin Mountains, as well as the gold-, silver- and base metal ores. Mining of these ores is continuing in our days, in active mines like Ilba, Nistru, Baita, Valea Borcutului, Sasar, Herja, Suior, Cavnic, and Baiut. Regardless the economic importance of the mined ores, important are the mineral parageneses that amazed the entire world. Samples from this zone are remarkable pieces for several museum and private collections. The best example is the Mineralogy Museum in Baia Mare.

Specific parageneses, typical for this zone only, were formed. Thus, thick stibnite crystals from Baiut cannot be mistaken for stibnite crystals from Baia Sprie or Cavnic. Also typical are the vivianite crystals from Nistru, the pink calcite crystals from Sasar, the wolframite and scheelite from Baia Sprie, the stibnite and semseyite from Herja, or the quartz and barite from Cavnic.

Several minerals, such as fuloppite, fizelyte, andorite or semseyite, were described for the first time ever in Baia Mare zone.

This tiny presentation is only for a tiny part of the wonderful world of minerals.

MELT INCLUSIONS GEOCHEMISTRY OF ROMANIAN EPITHERMAL AND PORPHYRY-COPPER SYSTEMS

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Melt inclusions, small blebs of silicate melt trapped in igneous phenocrysts, preserve information on the instantaneous composition and evolutionary conditions of magmatic systems. Because they are contained within relatively incompressible mineral hosts, they retain the volatiles that normally escape from magmas during degassing. We discuss here preliminary results on melt inclusions obtained from silicic calk-alkaline rocks associated epithermal systems in Baia Mare district (Inner Carpathians) and from the andesite-diorite intrusion associated Valea Morii porphyry-copper deposit (Apuseni Mts.).

The melt inclusions of quartz phenocrysts from Pannonian volcanics (dacites) from Baia Mare district, spatially related to some precious/base metals deposits were analysed by EPMA. Major element chemistry of glass inclusions shows high SiO_2 and K_2O contents and low FeO, MgO and TiO_2. High Cl/F value is typical for the arcs tectonic setting.

The plagioclase phenocrysts in andesite-diorite porhyry intrusion of Valea Morii (Apuseni Mts.) contain recrystallised melt inclusions (with glass, bubble and daughter minerals) that were remelted in the laboratory. Major element analyses for different inclusions are variable, according to the position in the host plagioclase (zoned) and the degree of remelting. The residual silicate melt trapped in plagioclase has a metaluminous to slightly peraluminous composition and a variable Cl content (up to 0.33wt%) and S values up to 0.12wt%. High concentrations of Cu were also detected. SEM observed some Cl-rich clusters in the glass inclusions. The presence of hydrous silicate phases and also a fluid phase (brine) was evidenced by Raman spectroscopy in some inclusions hosted by plagioclase. These data indicate that the highly saline magmatic-hydrothermal volatile-enriched phases which are responsible for hydrothermal alteration and deposition of metals (Cu, Au, ...) exsolve directly from felsic magmas.

DETECTION OF FRACTURED USING GEOELECTRIC AND ELECTROMAGNETIC METHODS

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ELGI, Budapest.

The poster presents a case history for determining of structural zones in massive granitic rocks. The surface of the granite is almost on the surface covered only a few meter thick young sediments. To find the zones — which could play important role in the hydrogeology of the area — geoelectric and electromagnetic methods were applied.

FIELD SURVEY OF SPHERULES AND THE OTHER MICROMINERALS FROM THE CORNE^{a}TI (JÃDANI, MEZÕZSADÁNY) METEORITE FALL AREA

(Timis County, Romania)

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According to the Transylvanian mineralogist Joseph Krenner's description, on the 31st March 1875 at approximately 3-4 p.m., in the intra-village area of the Cornesti village (now located in Timis county, Romania; in the time of the phenomenon it was named Jãdani (Romanian language) or Mezõzsadány (Hungarian language), a meteorite fall occurred. Several villagers saw it. This small village is located very close to the Timisoara city, two km far from the Timisoara-Arad main road.

We organised a field trip to this area during the summer of 1999,in the period of the total suneclipse, which occurred on the 11th August. This area was located in the totality stripe of the eclipse.

During this field campaign, we succeeded interviewing a few villagers who were direct descendents of the inhabitants who had been living in the village 125 years ago. It is worth mentioning that even the actual house numbers are identical with those of three meteorites fall period. It means that the village have not been changed much since the. Unfortunately, the number of the inhabitants showed a decreasing tendency, but we could still found a clever person, Mr. Iacob who was able to show us the houses or the pieces of ground where the houses of the former eyewitness once existed.

The seven samples were mostly collected from these sites: Bireiescu Mãriuta, Plesu Iuliu, Lazãr Ardelean, Paul Sârbovan, Spãtaru Constantin and Petru, Spãtaru Florea and Achim Ghiuro. We carried out the hydrogravimetric concentration of the samples on the collection sites, obtaining concentrates which were very poor in heavy minerals.

The meteorite fragments presented the following decreasing order of then weights: 63,1g; 37,6g; 22,85g; 11,56g; 5,56g and 3,55g respectively. So, the global weight was 144,12g.

We tried to establish the complete micromineralogical spectrum of the samples, using complex and accurate analyses with JEOL, EDAX, a.s.o.

The major aim of the research consisted in the identification of the particles of cosmic origin, especially of the magnetic spherules and tektites.

We are aware of the fact that this type of research is mainly based upon qualitative and quantitative microprobe analyses. However, as these analyses are in course of being carried out, we are only able to provide mineralogical partial results for the moment. So, the allogenous group of the total heavy mineral spectrum is dominated by the cata - and mesometamorphic minerals (disthene, staurolite, nigrine, biotite, sillimanite, schörl, magnetite, braun amphibole, zircone, aso.) Their proportion of 39,12% exceeds that of the minerals of allogenous epimetamorphic origin (braun tourmaline, epidote, zoisite, green hornblende, nefrite, heavy sericite, hematite, routile, aso.), which only represent 14,20%. The total heavy mineral compound is as high as 53,32%, exceeding the magmatical minerals which constitute 22,05% of the allogenous mineral fraction. The allogenous mineral group alltogether represents 73,37% of the total heavy mineral content in the studied samples. The minerals of magmatical origin are both represented by minerals originating from basic rocks (such as magnetite, hematite, epidote, hypersthene, ilmenite, leucoxene, diopside, aso., which are average amount of 14,72%)and by minerals (such as zircon, sphene, monazite, indigolite, magnetite, routile, safire, aso., which only constitute 7,33% of the acidic magmatical mineral fraction. Obviously the autigenic minerals, mainly represented by limonite, are insignificant, as compared to those of allogenous origin, (24,15%). While the biogenical minerals can still be mesured in percentages (0,48%), the minerals of probably cosmic origin (magnetic spherules and microtektites) can only be quantified as a number of items. In the analysed samples a magnetic spherules amount of at least 20 and a microtektites amount of at least 10 were conventionally considered as being a rich content, while amounts of 10 and 5,respectively, were evaluated as a poor content. The results of this research reinforced our previous observation that the samples originating from alluvia were much richer than those collected from diluvia or from the soil. The magnetic spherules were mainly found in sample nr.5 (in Easter extra village area). In this sample the 0,25-0,125 mm granulometrical class was predominately found (30,18%)followed by the "fine sand" class (26,69%) and the "silt" class (21,16%) .In accordance with the results of our previous research (performed in the Mociu, Mãdãra° and Taut area, Romania) in the Cornesti meteorite fall area we were also able to demonstrate a positive spherule and tektite distribution anomaly. These data require further evaluation, the results of which will be reported later, another scientific paper.

MONAZITE AND ALLANITE FROM THE DITRAU ALKALINE MASSIF, EAST CARPATHIANS, ROMANIA

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The Ditrau alkaline intrusive complex occurs in the pre-Alpine metamorphic rocks of the Bucovinian Nappe in the East Carpathians, in which it produced a marked thermal aureole. It is like a dome of elliptical shape (14x19km diameter) with un imperfect ring structure. The petrographic complexity involves large series of ultrabasic to acid, silica saturated and silica undersaturated alkali rocks: granites, syenites, nepheline syenites, diorites, tinguaites, lamprophyres, camptonites, spessartites, microdiorites and microsyenites, nepheline syenite aplites, carbonatites. Also, at the immediate contact there appear beautiful hornfelses with biotite, cordierite, andalusite, wollastonite, corundum, spinel, alkali amphibole and chloritoid.

The large variety and the complexity of the mineralogy of Ditrau massif are reflected by the existence of about 200 minerals; native elements, sulphides, oxides, phosphates, sulphates, wolframates, arsenates, fluorides and different silicates (olivines, pyroxenes, pyroxenoides, amphiboles, epidotes, micas, alkali feldspars, plagioclases, feldspatoides, Ba-feldspars, chlorites and zeolites. Some rare minerals, like eudialyte, astrophyllite, columbite etc or accessory minerals like zircon, sphene, apatite, monazite, allanite etc are present as rock forming minerals of the nepheline syenite or of the carbonatites. The vein mineralisation develops in the diorite hornblendite complex in NV part of the massif. Two paragenesses are quite distinct; monazite-pyrite-carbonates-allanite and molybdenite - sphalerite-galena. Monazite display big cm-sized crystals with a brown-red colour and a radiated structure. Allanite has a black colour and is closely associated with monazite and carbonates (bastnaesite, hydroxylbastnaesite, calcite, rhodochrosite).

In thin section monazite- (Ce), the commonest one has yellow light colour and high relief and birefringence. Monazite - (Nd) is rare in Ditrau massif and has a distinct colour bright rose.

Monazite -(Ce) appears associated with ankerite, calcite, bastnaesite, hydroxylbastnaesite, allanite, pyrite, stannite, sphalerite, wurtzite, pyrochlore, plumbopyrochlore, chalcopyrite, willemseite, uraninite, durangite and borovskite (?). The calcium bearing thorium rich member of the monazite group, cheralite, isostructural with monazite was determined by the aim of XRDA. The samples analysed where collected on the waste dump of the Adit No 25 of Jolotca vein field. Microprobe analyses gave for monazite (%wt): SiO_2 0.314, CaO 0.156, P_2O_5 29.503, ThO_2 3.085, La_2O_3 19.036, Ce_2O_3 34.391, Pr_2O_3 2.606, PbO 0.264, Yb_2O_3 0.122, Er_2O_3 0.034, Gd_2O_3 0.671, Sm_2O_3 1.107, Nd_2O_3 9.024. Total 100.313. For allanite (% wt) :SiO_2 28.289, CaO 7.497, Al_2O_3 9.938, MgO 0.905, P_2O_5 0.139, Fe_2O_3 20.094, ThO_2 0.155, La_2O_3 8.356, Ce_2O_3 14.685, Pr_2O_3 1.027, PbO 0.035, MnO 2.125, Y_2O_3 0.126, Er_2O_3 0.034, Gd_2O_3 0.304, Sm_2O_3 0.481, Nd_2O_3 3.626. Total 97.817. The intergrowths of monazite with allanite occur elsewhere in the world in carbonatites or in barite carbonate rock near alkali syenite. The Ditrau alkaline massif contains thus a significant carbonatite or carbonatite-like component with significant monazite allanite as quite, intergrowths.

CALC-ALKALINE VOLCANISM IN THE GUTÂI MTS. (EASTERN CARPATHIANS); MAGMAGENESIS AND PETROGENETIC PROCESSES

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Gutâi Mts. belong to the Neogene - Quaternary volcanic chain of the Eastern Carpathians. A continental margin arc type volcanism took place in the Gutâi Mts. during the Upper Miocene related to the Tertiary subduction of the European plate beneath the Alcapa and Tisza - Dacia microplates.

A typical CA magmatic series, from basalts to rhyolites (predominant basaltic andesites and andesites), consisting of effusive and explosive volcanics and associated intrusive rocks has been developed during the main volcanic activity (13.4-9.0 Ma). A later stage (8.5-6.9 Ma) consisting of small intrusions ceased the volcanism in the Gutâi Mts.

Major and trace elements geochemistry emphasized the CA and medium K character of the volcanism and its affinities with the high Ce/Yb arcs (Ce/Yb = 15.6). The strong LILE and LREE enrichments, the HFSE depletion and Sr-Nd isotopes negative correlation represent typical magmatic constraints for a subduction zone-related magmagenesis. The main processes involved in this magmagenesis are those related to the mantle source. An upper mantle source - depleted MORB type mantle wedge (Nb/Ta = 16.1; Zr/Hf = 34.6) was emphasized for the parental magmas. This mantle wedge was sligthly metasomatized by subducted slab fluids (Ba/La = 17). The mantle source enrichment by addition (3-7%) of subducted sediments (low Ce/Pb, high Pb/Nd, enriched Pb isotope composition) represents the main mantle source related process. The parental magmas were generated by partial melting processes with amphibol as rezidual phase.

The petrogenetic processes for Gutâi volcanics are related to the evolution of the magmas in the continental crust of the overriding plate. Geochemical and isotopic data ($^{87}Sr/^{86}Sr$ = 0.7070 - 0.7094; $^{143}Nd/^{144}Nd$ = 0.5125-0.5123) assert significant crustal assimilation processes. The lack of basic and isotopically depleted magmas suggests that a first crustal assimilation took place by MASH processes. The upper crustal assimilation, involving AFC processes (strongly constrained by trace elements geochemistry and isotopic signatures) represents a major petrogenetic process. The possible contaminants consist of local upper crustal metamorphic rocks.

Besides the main FC and AFC processes, mixing and mingling were involved in the petrogenesis of the Gutâi volcanics (related to the evolution of the parental magmas in upper to mid - 10-25 km, crustal reservoirs).

MINERALOGICAL AND GEOCHEMICAL STUDY ON CARBONATE FILLING FRACTURES FROM GRANITIC ROCKS (MECSEK MTS., S-HUNGARY)

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Composition and genesis of fracture filling minerals in the Carboniferous Mórágy Granitoid Formation were studied in six boreholes near Üveghuta (Mecsek Mts., Southern Hungary). In the fractures of the granite, quartz, carbonate minerals, Fe hydroxide were found as filling materials and feldspar, epidote fragments and clay minerals were identified by petrographic observation. Additional studies, using X-ray diffraction, differentional thermal, cathode luminescence and microprobe analyses, show that the carbonate minerals are Fe-dolomite, dolomite, and calcite. This is a general formation/crystallization order of the carbonates. Quartz is always younger than carbonates.

Fluid inclusions of the fracture filling carbonate minerals and quartz were also studied. The fluid inclusions in carbonate minerals are primary H_20-NaCl inclusions and larger in size (10-20μm) than those in quartz crystals. However, the total salinities of fluid inclusions in both minerals are the same (between 0-26 eq.wt% NaCl). The homogenisation temperatures of fluid inclusions in quartz grains show a narrower and lower temperature range (100-140°C) compared to those in the carbonate minerals (100-280°C). Based on our study, three generations of carbonate materials can be distinguished: 1/ moderate-temperature (170-210°C) hydrothermal phase; 2/ low-temperature (80-130°C) hydrothermal phase; and 3/ low-temperature (40-50°C) post-hydrothermal phase. However, O-isotopic studies suggested that the carbonate minerals generated within two temperature ranges (higher 63-74°C, and lower 29-48°C).

All of these suggest that the fracture filling minerals of the Mórágy Granitoid Formation formed during hydrothermal activity and subsequent post-hydrothermal process.

EXAMINATION OF A STRUCTURAL-RECONSTRUCTION MODEL AREA IN THE NORTH-EASTERN PART OF THE CARPATHIAN BASIN

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The authors have investigated a structurally complex unit of the NE part of the Hungarian Medium-Height Mts, the region including the Bükk and the Uppony Mts. In the course of the work they used a great number of results from cartographic, profiling, geophysical, volcanological, tectonical and tectonostratigraphic investigations to create a new, alternative structure developmental model. Within this model clarification of the dominance relations of the crustal dynamic events active since the Jurassic up to the present was made possible by the concomitant investigation of the Bükkian and Gemerian regions.

The authors state that the ensemble of Triassic-Jurassic formations of the Bükk is an allochtonous mass of imbricated blanket protruding towards NW, which covered its Gemerian-type foreland and its recent basement. Differentiation between the two systems is solved on the basis of the ophiolite-suture situated in the northern marginal zone of the mountains. On the grounds of data in the literature and their own material analyses the authors present the extent, composition and mainly the structural features of the paraautochtonous Gemerian basement, the ophiolite suture and the allotochtonous Bükk imbricated cover. The results allow the conclusion that the elevated Paleo-Mesozoic imbricated series of layers constituting the northern margin of the Bükk is actually part of the Gemer basement already, and that the transverse-positional shorn folded structures of southern direction in the Bükk region are only local phenomena due to re-imbrication.

From the model it can be outlined that in the enclosing mechanism of the Carpathian Basin, NW-directional space-shortening was stronger and more decisive, and the several-hundred-kilometre-long rightward shifts between the structural belts presumed up to now are improbable. A close correlation can be demonstrated between the deformational periods of the crust and Cenozoic sedimentation and the areal distribution and intensity changes of the bimodal (neutral-acidic) volcanism.

CONTRIBUTIONS TO THE PALEOGEOGRAPHICAL EVOLUTION OF THE SOUTHERN HARGHITA AND THE NEIGHBOURING AREAS DURING THE PONTIAN-PLEISTOCENE

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The structural-tectonic evolution of the Baraolt – Southern Harghita - Ciuc (B-H-C) depressionary area from the Pontian until the Pleistocene represents one of the precursory geological events of the volcanism in Southern Harghita (SH). It played an important role in modelling the paleogeography of the area.

Starting with the end of the Pontian until the late Pliocene the B-H-C area underwent a general sinking of the alpine structures. The sedimentary deposits formed in Baraolt and Ciuc basins clearly indicate transgression stages.

From an orographic point of view, ridges and peaks formed along a general North-South direction, parallel to the main East-Carpathian structures. These events lead to the setting of a new hydrographical system; in a subsequent stage, an aqueous environment formed, which persisted until the end of Pleistocene. In the same time the structures of the main stratovolcanoes were drawn (Luci, Cucu, Pilisca); they were located in diagonal positions along the B-H-C depressionary area and formed central-type volcanic structures.

During the Pleistocene the regional tectonic events lead first of all to the uplift of the whole B-H-C depressionary area and then to the reactivation of the volcanism along the main alignment of SH. These events changed the regime and the type of sedimentation in the neighbouring basins to a regressional one, ending with the formation of continental deposits. During this period a general uplift of the neighbouring intramontaineous basins of the SH volcanic area was registered (of about 450 - 500 m).

At the beginning of the Middle Pleistocene the volcanic activity shifted towards the southeastern end of the SH alignment. The volcanic activity located around Ciomad and Pilisca structures lead to the closing of the connections between Ciuc Basin and Bicsad-Malnas Basin, giving birth to a natural barrier of volcanoclastics. This phenomenon generated a rising of the water level behind the natural dam; as a consequence, an extended aqueous environment formed in the lower Ciuc Basin where a typical Medium Pleistocene sedimentation took place.

Based on K-Ar ages, the breakthrough of the volcanoclastic barrier from Tusnad Băi can be generally located between 100 000 and 35 000 years (Riss-Würm interglacial stage). This event had important consequences on the landscape modelling in the whole area up to the neighbourhoods of Sfântu Gheorghe.

The B-H-C depressionary area represents a part of the Eastern Carpathian orogenic back-arc, which showed a peculiar paleogeographic evolution probably in connection with the vertical movements between the margins of the Eurasian craton and the Getic domain.

UPPER PALEOGENE LARGER FORAMINIFERAL ASSEMBLAGES FROM THE BÜKK MOUNTAINS (NE HUNGARY)

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The Tertiary shallow benthic zonation (SBZ) of the Tethys (Serra-Kiel et al., 1998: SBZ 1-20 zones for the Paleocene-Eocene and Cahuzac & Poignant, 1997: SBZ 21-26 zones for the Oligo-Miocene) is based on larger Foraminiferal assemblages that can be found in key-localities of particular SBZ-zones. Since these reference-sites are located mostly on the two slopes of the Pyrenees and in Northern Italy, it is necessary to extend the geographical range of the zonation by new, faunistically well-documented reference-sites. Two of such localities with their larger Foraminiferal fauna are described recently by Less (1991, 1999) from the Bükk Mountains.

The older of them represents an assemblage from the Buda type Eocene and comes from the vicinity of Kisgyör. The rich and excellently preserved fauna contains seven species of Nummulites (six radiate and one reticulate), four of Discocyclina and one of Assilina, Operculina, Spiroclypeus, Orbitoclypeus and Asterocyclina each. The assemblage is probably the richest of the Tethyan Upper Priabonian (SBZ 20 zone). The validity of six separate radiate species of Nummulites is proven by biometrical methods, too.

The younger, Upper Chattian (SBZ 23 zone) assemblage is known from two localities, namely from Novaj near Eger and from Csókás near Miskolc. This excellently preserved fauna - consisting of two species of Operculina and one of Eulepidina, Nephrolepidina, Nummulites, Heterostegina and Miogypsina each - is also one of the richest in Europe. Since the locality of Novaj, Nyárjas-tetö is declared to be the lower boundary stratotype of the Egerian stage in the Central Paratethyan subdivision, too, the Kiscellian/Egerian boundary can no longer be correlated with the Rupelian/Chattian boundary but it must be pushed upward, at about the Lower/Upper Chattian boundary (Báldi et al., 2000).

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THE ORTHOPHRAGMINID ZONATION OF THE MEDITERRANEAN UPPER PALEOCENE AND EOCENE AS PART OF THE TETHYAN TERTIARY SHALLOW BENTHIC ZONATION

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Orthophragminae (beside nummulitids the most widespread uni-cellulars in the Tethyan Eocene) is an informal collective name for Early Paleogene orbitoidal larger Foraminifera with almost rectangular equatorial chamberlets. It consists of two phylogenetically independent families, the Discocyclinidae and Orbitoclypeidae, both having lived on the deeper but still photic part of the outer shelf. Both families can be found in two bioprovinces and both they are supposed to be of American origin. However, they are neither the offsprings of the Late Cretaceous orbitoidal forms nor the ancestors of the Oligo-Miocene ones. Both families migrated eastward to the Tethys already at the middle of the Paleocene where they evolved almost independently from the American forms. In the generic level Tethyan Discocyclinidae are represented by Discocyclina and Nemkovella while Asterocyclina and Orbitoclypeus belong to Orbitoclypeidae. Despite their separate evolution, surprisingly, both families seem to have become extinct at the same time in both bioprovinces, at the very end of the Eocene.

The biostratigraphic potential of the Tethyan Orthophragminae have been discovered not long ago (Less, 1987) and recently is being enriched with ever more details (Less, 1998). Eighteen Oppel-zones, covering the approx. 25 million years time-span of the Late Paleocene and the whole Eocene have been described for the Mediterranean (by using French, Spanish, Italian, Bavarian, Hungarian, Crimean, Bulgarian and Israeli materials). They are based on the artificial segmentation of the mostly gradual internal morphological development of about twenty evolutionary lineages of the four Tethyan genera, mentioned above. The zonation is recently integrated into the Tethyan Shallow Benthic Zonation (SBZ) for the Paleocene-Eocene interval, developed by Serra-Kiel et al. (1998). The twenty SBZ-zones are based mostly on the rapid simultaneous evolution of the three main larger Foraminiferal groups; namely of nummulitids, orthophragminids and alveolinids.

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SUPERPOSITION OF TECTONIC PHASES IN THE STRUCTURAL EVOLUTION OF THE AGGTELEK-RUDABÁNYA MOUNTAINS (NE HUNGARY)

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The Aggtelek-Rudabánya Mts. is the southernmost element of the Inner Western Carpathians. Its Mesozoic sequences can be grouped into three series groups (Less, 2000 - see also for more references). Of these, the Silica series group (represented by deeper facies in the Rudabánya than in the Aggtelek Mts.) is non-metamorphosed, deposited on continental crust and forms the uppermost tectonic unit of the primary nappe structure, the Silica nappe system. The anchimetamorphic Meliata series group was deposited on oceanic and intermediate crust. It can be found partly in the evaporitic basement of the Silica nappe system, partly between it and the underlying Torna series that is epimetamorphosed and deposited on continental crust. This series with its probable Paleozoic basement, the Hídvégardó and Uppony series, is the lowermost known element of the primary nappe structure.

The structural evolution of the territory started in the Middle Anisian with rifting and then opening of the Meliata ocean between the Silicic and Tornaic depositional areas. The ocean subducted northward (according to recent co-ordinates) during the Jurassic below the Silicic crust and simultaneously obducted southward on top of the Tornaic crust. The Silica nappe system was formed after the collision by gravitational gliding to the S, having detached from its Paleozoic basement along thick plastic Upper Permian evaporites. In a later phase folding and imbrication were terminated in forming secondary klipps in about the Middle Cretaceous. The last main phase in the Oligo-Miocene was induced by the Bükk and Szendrõ Mts. having approached far from SW. As a result, the Rudabánya Mts. was dragged in three main segments from the southern vicinity of the Aggtelek Mts. to their eastern neighbourhood along sinistral strike-slips of the Darnó zone. Overthrusting of new secondary klipps and movements along complementary strike-slips of E-W direction (e.g. the Ro□òava line) were also associated with this phase.

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Less Gy. (2000) - Polyphase evolution of the structure of the Aggtelek-Rudabánya Mountains (NE Hungary), the southernmost element of the Inner Western Carpathians - a review. Slovak Geol. Mag., 6, 2-3: 260-268, Bratislava

GENERAL APPROACH OF THE METALLOGENY OF THE NEOGENE VOLCANISM IN TRANSCARPATHIA

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On the SW part of Transcarpathia, in the Ukrainian sector of the Neogene volcanic arc of the Carpatho – Pannonian region, are known several ore areas connected either with the inner part (Beregovo-Began area) or with the outer part (Dubrinichi, Olenev, Vyshkovo ore areas of the Vihorlat-Guta range). The metallogenic peculiarities of these areas are different. For the inner part of the arc the Au-Ag-complex ore spectrum is more characteristic, while for the outer part – Hg, and Bi-Te. These metallogenic peculiarities are closely connected with different geological structures, types of volcanics and place of the ore areas within the structure of the Carpathians. The region consists of a complex structure of Badenian-Pannonian rhyolites to andesites; acidic rocks (rhyolites, rhyodacites and their tuffs, ignimbrites) prevail in the inner part of the arc (Beregovo-Began area) and andesites, andesite-basalts are predominant in the outer part of the arc (Vihorlat-Guta range). On the Beregovo-Began area we can mark the differences on the level of the ore fields. Thus, on the Began ore field the barite-complex and Au-complex ore types are developed accompanied by the rare metal germanium-contained lignites. The most important on the Beregovo ore field are the proper Au and Au-complex ores, while for the Kvasovo field typical are the Ag-quartz and Au-complex ores. The prevailing morphological type of ore bodies within all these fields are the steeply falling veins and vein zones, with ore vertical depth of 900-1100 m, where the lion's share of the ore lies. Veins are usually located within systems of radial or concentric ruptures, connected to the forming of the isometrical circular volcanic structures. There is clear vertical zonality of veins. On the Began field, the upper parts of the veins consist mainly of barite and barite-complex ores, along seam dip they grade into purely complex ore, and into Au-complex ores in the lower parts. On Muzhievo sector of Beregovo field the upper parts of veins consist of proper Au ores, along seam dip grading into Au-complex ore and into complex ores deeper. Within the Kvasovo ore field the upper levels consist of Ag-quartz ores, grading along seam dip into complex ores. Pb and Zn prevail over the complex ores, Cu is sporadically seen (Cu = 0,n%). The metallogenic differences among the ore fields depend on depth of bedding and lithological composition of the pre-Neogene basement rocks, also on thickness and composition of volcanics from the Neogene complex. The explored Hg ores from Vihorlat-Guta range are connected with the contact zones of pipe bodies, dyke bodies of porphyritic diorites, basaltic andesites, rarely microgranodiorites, located in endo- and exocontact breccias. The ore swing does not exceed the first hundreds of metres. The mineralization of Bi-Ti, rare-Mo has no independent meaning. It is related to dispersion halo of Pb-Zn ores (the Remetske Gamre deposit type) which are not profitable to explore at present given its basement depth of bedding.

CONCEPTUAL MODEL FOR THE FORMATION OF THE EPITHERMAL DEPOSIT IN THE BAIA MARE ZONE

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The term epithermal was applied by Lindgren (1922, 1933) to a type of hydrothermal deposit with mineralogy and texture then considered indicative of low temperature and shallow depth. As more data have become available on the temperature of mineralising fluids, and also on the depth of mineralization based on both boiling-depths curves and stratigraphic evidence for the thickness of the cover during mineralization, it has become evident that most epithermal deposits form within a temperature range of 180 – 280° or 300°C, and at depths rarely exceeding 1.5 or at most 2 km (White and Hedenquist, 1990).

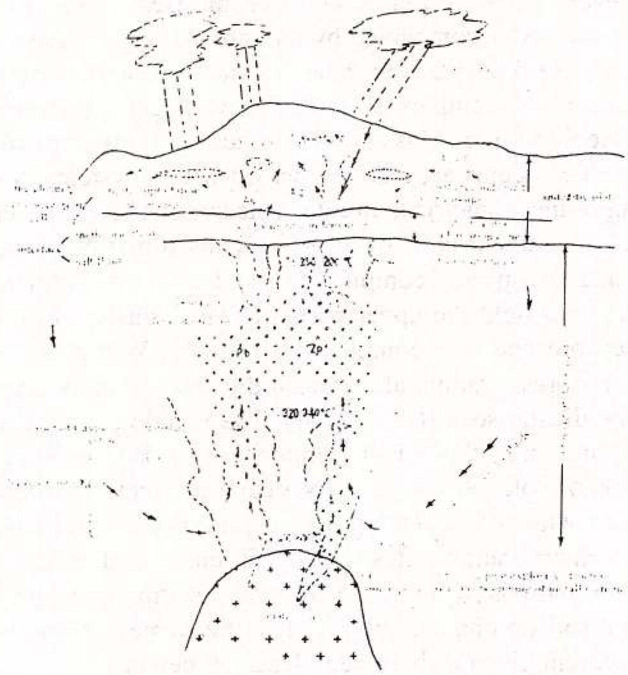

Fig. 1 – Schematic cross–section concerning the main aspects of evolution of magmatic fluids "uncoupled" in the deposits from the Baia Mare zone

The epithermal mineralizations from the Baia Mare zone include gold and silver deposits (Sasar, Dealul Crucii, Jereapan), common metals: Pb, Zn, Cu (Ilba, Herja, Cavnic, Băiut). In figure 1 are summarized the fundamental processes pointed out by the evolution of the magmatic fluids in vein fractures from Baia Mare. Therefore the plums of magmatic fluids have had a pulsatory evolution according to the episode nature of the magmatic processes. The transition of the pressure from lithostatic to hydrostatic was the releaser that propelled episodically the ascension of the dense saline fluids, to the permeability zones situated at higher levels.

The process of fluctuating boiling was the cause of the settlement of the metals in broad zones with big thickness of bonanzas type. From the figure also results the model of the convection of closed cell in the sense of Berger and Eimon (1983). This is remarked by the fact that there is no barrier of permanent permeability to create a model of strong lateral division into zones. Among the factors that were essential for the formation of the deposits from the Baia Mare zone, we mention:

- structures with steep slopes, generally faults (100 – 2500 m length);
- host rocks, of low permeability, generally sedimentary ones from the deep parts of the system;
- unlimited flow of the meteoric waters at depths;
- the intermediary boiling took place at intermediary depths in the group of temperature between 200 and 320° C.

The general characteristics for alteration are of low-sulphidation type with some elements non-characteristic elements of high sulphidation type.

NEW DRAINING TECHNOLOGY TO PREVENT THE DEVELOPMENT OF LANDSLIDES

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I. PRELIMINARIES

Alignment correction has taken place in the year 1982. at a section on national trunk road No 67 Kaposvár-Szigetvár, in the vicinity of Simonfa village. A climbing lane had been inserted into a steep stretch, where the widening was oriented toward the cutting side on the combined cross-section. A significant and characteristic, 10 to 15 cm deep transversal displacement of the pavement developed on the site in June, 1988. Further 30 to 35 cm horizontal and 3 to 5 cm vertical displacement of the road section developed till the end of year 1991. As for reconstruction, soil replacement had been carried out on 120 m length just below the pavement. Still, this arrangement has not stopped the movement and new fissures appeared on the pavement, similar to those before, but in somewhat different distribution pattern. The sliding began to accelerate and it became necessary to impose 30 km/h speed limit onto the damaged stretch in June 1998., because, by that time the "step" attained 25 to 30 cm depth. At that time also the boundaries of the sliding became visible on the nearby hillside.

II. REASON OF DAMAGE

Among the reasons for the development of the situation we may count the geological conditions, the particular stratification on the site, together with the specific geometry of the road section in relation with terrain formations. Namely, finely grained, unstable, water-sensitive soils, that are prone for liquefaction and wash-out, lie atop the almost water-impermeable hard clay base, in a region where the transversal inclination is fairly steep. The given soils belong in the fine sand group with no cohesive attributes.

Two particular damaging effects contributed to the process:

- loss of stability through filtration,
- loss of the equilibrium balance in the soil mass.

The two processes are in correlation with each other. The condition loss goes together with the wash-out and liquefaction processes, what means that intermittently and for basically very short periods the increased internal pressure initiates the displacement of the tiny grain particles. Consequently, the wash-out alters the grain distribution in the mass, that contributes to liquefaction. The latter is intensified by the frequent dynamic vibration that arrives from road traffic.

The hydraulic stability loss caused by wash-out demonstrated itself both during the boring process and in the laboratory. The granulometry of the soil altered whereby the soil that contained originally cohesion providing silt and clayey particles became an almost pure sand and, gained a "sand skeleton" when the tiny particles were leached out from it. In the same time, however, the clayey particles accumulated in the soil on the valley side, retained more moisture and, created a water-soaked subsoil.

In such cases, parallel to the gradually deteriorating soil condition caused by filtration, is added the decreasing equilibrium balance of the earth mass, therefore, the technical interference becomes inevitable.

The accomplished local borings and exploration work together with the oncoming laboratory analyses revealed the causes of the experienced events, supplied the relevant soil characteristics and gave the contours of the developed landslide both in horizontal and vertical terms.

III. THE DRAINAGE SYSTEM

Without touching the pavement, a combined French drain was built on the upper part of the deteriorated road section, parallel to the road, at the toe of the cut slope. The drain started in a shaft. The upper part of the "combined drain" was the place of the 600 mm diameter dissipating body consisting of sandy gravel. To the lower part of the drain – just below the granular body – was laid the 200 mm diameter perforated plastic collector tube, wrapped into a geotextile filtering sheet.

The 600 mm diameter dissipating body was constructed by boring the 22 m long, slightly slanting hole for a steel casing (inlaid in sections at the shaft). The internal space of the steel tube was then filled up with the sandy gravel material by rotating the spiral boring tool in the reverse direction and pulling the tube slowly and gradually backwards. A heavy duty hydraulic drilling engine was used for this purpose. The pressure gauge on the equipment indicated when a slice was correctly filled up and compacted in the tube. The technology is now patented as the appreciation of the applied ingenious and unique technical solution.

On the valley side, where the wet and water-saturated soil had to be drained effectively, 3 m diameter vertical shafts were drilled to 4,5 and 5 m depths. From them, fifteen to twenty and two meter long, 150 mm dia. perforated and geotextile wrapped plastic tubes were incorporated in the underground. Here also substitutive steel tubes were used to have the plastic tubes carried to place. Eight to twelve "feelers", or "horns" (i.e. horizontal holes) were bored in fan-shaped directions from each shaft to care for dissipating, collecting and disposing the accumulated moisture.

IV. GATHERED EXPERIENCE

The above described drainage system proved to be very quick and effective. This, however, brought the disadvantage with it, that the underground suffered rather extensive subsidence. Simultaneously, however, the soil that was loose and deficient in fines previously, acquired substantial density. The trial holes bored in the pavement later, indicated 85 cm (in the average) thick various asphalt and concrete pavement structures which had to be built during the years to compensate for the loss caused by the settlement of the road section. Other accomplished tests proved remarkable increase in acquired density in the subsoil.

Television cameras led through the tubes proved also the appropriate functioning of the system.

Consequently, the above introduced draining system offers a very economic and effective method to solve local drainage problems.

LANDSLIDE IN NORWAY AT RISSA SETTLEMENT

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[With the permission of the Norwegian Geotechnical Institute]

Uniquely on the world, seeing the pictures, the viewer becomes witness how the landslide initiated and in which manner the intensive movement developed.

The film sheds light onto the characteristic properties of the "quick clay".

An amateur clip shows, how fast a several storey building "runs" with 35 km/h speed on the slanting ground. The viewer may sense what kind of enormous forces have to act in provoking such a fascinating movement and what it means to see the great event of a large landslide. What ensues, when the stability "evaporates" suddenly.

The whole area is shown on a model, the extension of the sliding and the locations from where the pictures were taken. The point where the operator with the camera was standing got also torn off by the slide.

One can see the devastating product of the sliding and what the rescue workers did afterwards.

Having demonstrated the effect of the natural catastrophe in a manner as if the viewer were the participant of it, the film explains step by step how the oncoming technical investigation process was accomplished.

Shown is the blasting off the hillside, the locally performed tests and the laboratory processes.

Then, the rehabilitation work is demonstrated and the viewer can see the restored area.

TULGHES GROUP: DEPOSITIONAL SEQUENCE OR COLLISIONAL STACKING?

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The Crystalline Mesozoic Zone is built up by metamorphic terranes showing contrasting features. The Late Proterozoic Pietrosu Bistritei volcano-sedimentary formation lays on an Upper Proterozoic carbonate platform sequence (Rebra Group and lower Negrisoara Group). The Cambrian-Ordovician Tulghes Group overlay them. Such a sequence is very similar to those of the Avalonian terranes known in the N-America and W-Europe. On the other hand, the Upper Proterozoic Bretila Group shows affinities with the East European Platform (EEP).

Rebra and Negrisoara Groups presumably represent territories separated from Gondwana that docked to the EEP in Silurian. Tulghes Group is the Lower Paleozoic cover of at least a part of these terranes. Assuming a lower Ordovician rifting from Gondwana, alike Avalonia, Tulghes Group should have been accumulated partly predrift and partly during the drift toward the EEP. The collision with the EEP determined the detachment of the Bretila slab from the EEP and its thrust upon the Rebra-Tulghes terrane. Bretila slab dragged Tulghes Group and the underneath formations leading to the initiation of Putna Nappe and Pietrosu Bistritei Nappe upon the Rebra basement.

According to this interpretation, the four formations of Tulghes Group were contemporaneous and represent parts of an island arc complex. They were stacked altogether due to the thrusts accompanying the collision. The lowermost formations, Tg1 and Tg2, are marginal basin formations (Tg1 is the most continentward), Tg3 formation is the arc itself and Tg4 formation represents the accretionary prism. Isipoaia basic rocks between Tg2 and Tg3 formations are remnants of a secondary spreading zone. The lithologic diversity and irregularity of Tg4 formation presumably reflect its premetamorfic melange structure.

Thus, the nowadays sequence of the Tulghes Group does not have a depositional significance but only a geometric one. It is also inferred that the pre-Alpine nappes are Caledonian, possibly reworked during the Variscan orogeny.

ON THE EPICLASTIC ORIGIN OF GREENSCHISTS - EXEMPLES FROM THE CARPATHIANS

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A) In many epimetamorphic piles - EP (greenschists facies - GF), caledonian (CA) and sudetic (SU) from the Southern Carpathians (SC), Eastern Carpathians (EC) and Western Mountains (Apuseni Mts- AM), are often located the greenschists (GS) levels. Following are some representative EP with GS: 1) EP CA: SC - Group Locva (Maier, 1974; Iancu, 1986), Crystalline of Batrana - sensu Muresan, 2000 a (Krautner et al., 1969); EC - Group Tulghes - Tg (Krautner, Bindea, 1996; Muresan, 2000 b); AM - Group Muncel-Biharia (Dimitrescu, 1958, 1966, 1994; I. Muresan, 1973); 2) EP SU: CM - Group Lescovita - Le (Maier, 1974); Crystalline of Poiana Rusca s.s. (CPR s.s) - sensu Muresan, 2000 a (Krautner et al., 1969, 1973; Muresan, 1973, 1998); EC - Repedea Group and Cimpoiasa Group (Krautner, Krautner, 1970; Krautner, 1987); AM - Paiuseni Group - Pa (Savu, 1962, 1965, 1986; Giusca, 1962, 1979; Giusca et al., 1964). B) The GS (also known in literature as "basic metatuffs" or "diabasic metatuffs"), which often constitute regionally extended levels (with wich metabasites - MB (metagabbros - MG, metadolerites - MD, metabasalts - MBS) are frequently associated; E.g.: Tg, Le, CPR s.s.) are characterized by the chlorite, albite, epidote paragenesis, in frequently addition to with actinolite, zoisite, clinozoisite, calcite, cuartz, titanite, ilmenite, magnetite, apatite are found. The possible presence of paragonite is revealed by the occurrence of many GS in the muscovite+paragonite-epidote-spessartine field, on the ACF diagram (Turner, Verhoogen, 1967). Some GS also contain stilpnomelane (E.g.: Le, Tg) postkinematically grown. C) Because in actual submarine basaltic volcanism, the tuffogene products are very rare, in my opinion, it is possible that the primary material of these rocks was mostly of epiclastic (EP) origin, formed of fine particles resulting from the erosion, by waves, of the basaltic volcanoes, the contemporaneus cases of rapid destruction (weeks or months) of volcanic islands being quite numerous. The epiclastic material (EPM) that resulted could be transported at great distances (tens or hundreds of kilometres) by the marine currents. Each GS horizon was penecontemporaneous with the formation of a generation of basaltic volcanoes as, during their emergence, they had been immediately destroyed by waves, thus the basic EPM being formed. This situation explains the MB location in some GS horizons or nearly them; the formation of EP could possibly be concomitant with the basic intrusive activity, which could accompany the basaltic volcanism. If one admits the EP origin of GS, then one can coherently explain: a) general basic chemistry of GS; b) frequent impurifications of GS with terrigene material (represented by sericite, biotite, the greater quartz); c) the predominance of impurified GS over the non-impurified ones; d) frequent intercalation of the terrigene rocks (blastodetrital rocks, quartz schists, sericite-chlorite schist etc - E.g.: Tg, CPR s.s.) in the GS horizons; e) frequent and intimate alternation of non-impurified and impurified GS with terrigene material. basic. D) Unlike MG and MD (which present an incomplete synmetamorphic, textural, structural and mineralogical adaptation - E.g.: CPR s.s., Tg - Muresan, 1973, 1998, 2000), in case of GS there is a complete textural, structural and mineralogical adaptation to the thermobaric conditions of the GF. This can be explained by: a) the fine-grained texture (therefore a large reaction surface) of the primary material; b) the higher water amounts (which favoured the metamorphic reactions and the formation of the penetrative schistosity) existing within it. E) During the accumulation of the EPM, this was frequently subjected to the CO2 action (in a large measure of volcanic origin) from the seawater that extracted the calcium (CA) from plagioclases, the latter grading to albite. The bicarbonate of Ca formed in this way was: a) either removed from the material, giving rise to a rock bearing albite and relatively poor in Ca; b) it was redeposed in the material (the most frequently case - E.g.: Tg, CPR s.s.). This last situation is revealed by the chemical analyses and the petrochemical parameters that indicate the endogenetic origin of the Ca within the GS. In deed, if CaO corresponding to CO2 is removed from the analyses, aberrant petrochemical correspondents are obtenaid; othervise, the analyses show a basaltic (gabbroid) chemistry for the GS taken into consideration, except for those in which excessive calcite amounts were deposited. I consider that the CO2 action as well as other halmyrolisis processes could affect some other components of the material too (pyroxenes, amphiboles, volcanic glass particles etc); in this way, sedimentary chlorites, clayey minerals etc could be formed, that finally resulted an deposit with a complex mineralogical constitution, which later on were regionally metamorphosed. F) The geochemical features and the intercalation of the basic magmatogene rocks (MB and GS) in very thick, prevailingly terrigenous epimetamorphic piles as well as the coexistence of these with rhyolitic products (bimodal magmatism) indicate that these piles might have been formed within "back-arc basins".

GENERAL FEATURES OF SYNMETAMORPHIC MINERALOGENESIS IN GABBROID AND DOLERITIC ROCKS FROM THE EPIMETAMORPHIC PILES - EXEMPLE FROM THE CARPATHIANS

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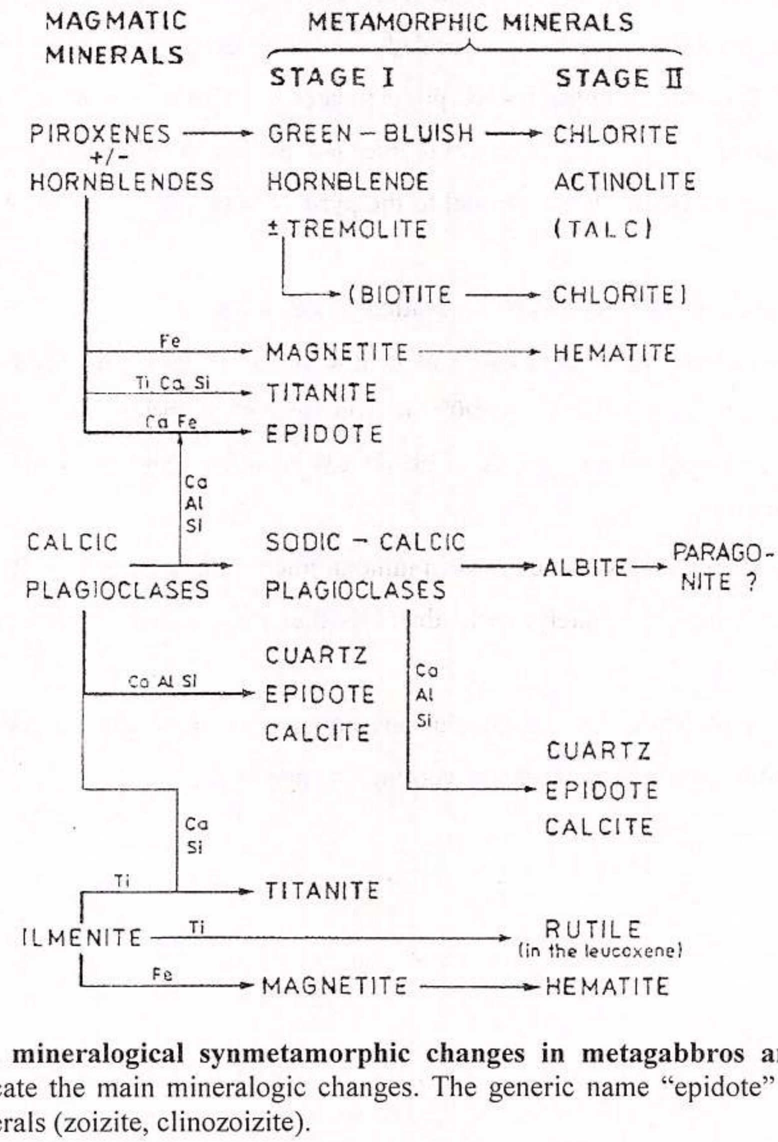
A) In many epimetamorphic piles - EP (greenschists facies GF), caledonian (CA) and sudetic (SU) from Southern Carpathians (SC), Eastern Carpathians (EC) and Western Mountains (Apuseni Mts- AM), there are intrusive bodies (usually sills) of metabasites (MB), especially metagabbroides rocks - MG (metagabbros, rarely, peridotic-metagabbros, gabbro-diorites), metadolerites (MD) and metabasalts (MBS). MB is often located at the greenschists levels. Following are some representative examples of EP with MB (MG ± MD ± MBS): 1) EP CA: SC - Locva Group - Lo (Maier, 1974; Iancu, 1986), Crystalline of Batrana - sensu Muresan, 2000 a (Krautner et al., 1969); EC - Tulghes Group (Krautner, Bindea, 1996; Muresan, 2000 b); AM - Muncel-Biharia Group (Dimitrescu, 1958, 1994; Marza, 1966; I. Muresan, 1973); 2) EP SU: CM - Lescovita Group (Codarcea, 1931; Maier, 1974; Top-Zlatarova et al., 1968); Crystalline of Poiana Rusca s.s. - sensu Muresan, 2000 a (Krautner et al., 1969; Muresan, 1973, 1998); AM - Paiuseni Group - (Savu, 1962, 1965, 1986; Giusca, 1962, 1979; Giusca et al., 1964; Dimitrescu, 1962). B) MG and MD are a complex, polystadial mineralogical assemblage, relict magmatic structures, as well as an often weakly expressed metamorphic schistosity (especially periferically at the corps of MG and MD). Within MG and MD relatively rarely orthomagmatic mineral relicts: pyroxenes - PX (titaniferous augite - TA, augite, rarely diopside), brown hornblende - BH (rarely), basic plagioclases - BPL (rarely), ilmenite (ILM), magnetite (MT), apatite and zircon occur. Two important stages of synmetamorphic transformations can be distinguished. STAGE I. PX (frequently TA) is replaced (mostly by pseudomorphosis) by green-bluish hornblende (GBH) (variable varieties; frequently ferrotremolite, ferroedinite, ferrohastingsite), accompanied by formation of epidote (EP) and titanite (TI). Concurrently, decalcification of BPL and formation of sodic-calcic plagioclase (SCPL) and of epidote-group minerals (EPGM) (mainly zoizite - ZO and clinozoizite - CZO). Most ILM is transformed into TI and MT. STAGE II. GBH partially transforms into actinolite (ACT and / or (mostly) chlorite (CHL) (in places with biotite as intermediary phase), releasing the remaining calcium to form a new generation of EPGM. In the same time, SCPL decalcifies in turn, with the formation of albite (AB), EPGM and calcite (CA). It is possible that AB partially transforms into paragonite (which can be represented by the very fine mica lamellae observed in AB). MT partially transforms into hematite (HM); ILM remains transform partially (peripherally) into rutile (RU) (from the leucoxene). Quartz (QU) (in small quantities) mostly originates from plagioclase decalcification; part of the QU might be magmatic, in the less basic varieties of MG and MD; part of the QU may have been engulfed by the basic magma from the surrounding terrigenous sediments. Transformation of GBH into CH - both hydrated minerals - indicates, besides others, the important role of water in the synmetamorphic mineralogenesis taking place in MG and MD. One can observe that the final mineralogical terms are characteristic for the GF. The obvious geochemical similarity of most MB with common basic intrusive rocks (MG and MD) proves that their regional metamorphism occurred in practically izochemical conditions (excepting for water and CO2 balance). I consider that the incomplete adaptation of MG and MD to the conditions of regional metamorphism (in the GF) is due to the initial compact structure (that made difficult the circulation of the aqueous solutions during the metamorphism, and the formation of a penetrative schistosity), to the low water amounts within MG and MD and to the more reduce reaction surfacies provided by the usually larger crystallized magmatic minerals. C) The geochemical features and the intercalation of the basic magmatogene rocks (MB, MD, MBZ and GS) in very thick, prevailingly terrigenous EP as well as coexistence of these with rhyolitic products (bimodal magmatism) indicate that these piles might have been formed within "back-arc basins".



The main mineralogical synmetamorphic changes in metagabbros and doleritic rocks. Thick arrows indicate the main mineralogic changes. The generic name "epidote" refers also to other epidote-group minerals (zoizite, clinozoizite).

MINERAL MICROINCLUSIONS IN THE PYRITE OF THE VALEA MORII PORPHYRY COPPER ORE DEPOSIT, APUSENI MOUNTAINS, ROMANIA

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Valea Morii ore deposit represents a complex Neogene porphyry copper - low - sulphidation epithermal system.

In order to achieve the purpose of this study a single but very characteristic quartz-pyrite sample (VM505) from potassic core of Valea Morii porphyry copper deposit (quarry level +505) has been selected.

The SEM-EDAX study was performed in open cavities by splitting of 17 pyrite grains of sample VM505. The EDAX quantitative analyses revealed a wide spectrum of mineral microinclusions, as follows: Na, K, Na (K) and Ca chlorides, K philosilicates, plagioclase, apatite and chlorapatite, Ca carbonates, Ti oxides and silica. These mineral microinclusions mainly appear as daughter phases trapped within the cavities usually lying parallel to the pyrite crystal growth zones. That means they are primary inclusions.

All mentioned data lead us to some observations, as follows:

1. Pyrite is co genetic with coarse quartz of sample, probably having the same magmatic origin.

2. Most of cavities are filled up to 90% in volume with chlorides and silica microinclusions suggesting that they represent either the salt - rich liquids or silicate and salt melt inclusions as in co genetic quartz (Pintea, 1997).

3. Often, the narrow empty space between mineral microinclusions and cavity walls suggests the presence of a film of liquid and water vapour that fills the interstices as in case of crystallized melt inclusions (Bodnar, 1999).

4. Apatite and philosilicates microinclusions could also prove the existence of volatile and hydrous phases probably as an effect of magma cooling and degassing.

WATER VULNERABILITY MAPPING OF A KARST AQUIFER WITH EPIK METHOD

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Underground water is one of the most important factors in the environmental geology. The water itself is a mineral resource and its quality should be protected. The water supply of several areas is based on karst aquifers that are considered as very sensitive to contamination. The hydrologic features of such an aquifer depend on numerous factors with more or less importance. Vulnerability maps cannot take all of them into consideration and they must be based on known objective geological data.

The EPIK method of vulnerability mapping (published by Doerflinger, Jeannin and Zwahlen) uses four attributes: epikarst, protective cover, infiltration conditions and karst network development, rating and weighting them. According to the theory of the developers vulnerability depends on residence time of the water in the soil and sediments overlaying the area, in the upper part of the karst system collecting diffuse infiltration and in the lower karst conduit network. There is a different way of infiltration too: the concentrated flow through ponors. The preparation of the map with GIS tools is relatively simple.

The method was applied in the zone of the Garadna valley, Bükk Mountains, part of the recharge area of springs supplying water for the town Miskolc. It resulted in a more detailed and appropriate qualification than former investigations used by defining protection zone of the waterworks. However, there were some spots where the mechanical rating, weighting and summarizing was not appropriate enough. It seems so that we should pay attention for the hydrological connections of the rated rock bodies too.

ALTERATION MINERALOGY AND GEOCHEMISTRY IN TELKIBÁNYA AG-AU DEPOSIT, HUNGARY

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Telkibánya is a site for mining and ore explorations since the early medieval age. After the introduction of the market conditions in mining in 1993, this area was considered as one of the most promiseful precious metal project target areas in Hungary. New exploration efforts started 1995 and were interrupted in 1998. Important new data were obtained by geochemical testing of drillhole samples. PIMA – infrared mineral analysis – was also applied in the same intervals. This has given a unique chance to correlate distribution of a wide range of chemical elements with quantified compositions of alteration mineral assemblages.

Submarine andesite flows, claystone, siltstone (Miocene Badenian) are the oldest known formations. Badenian). The next volcanic phase produced andesite, and rhyolite flows, domes, dikes and shallow porphyric intrusive breccia bodies (Miocene – Upper Sarmatian). The rocks show intense hydrothermal alterations and ore mineralization. The geophysical data indicate that this area coincides with a concealed deep intrusion. Late fresh andesites postdate the ore mineralization (Pliocene – Lower Pannonian). Fracture zones of NNW-SSE and N-S strike host the important mineralized veins. Chlorite-carbonate alteration shows the largest areal extension, and surrounds the zone of pervasive adularia-sericite replacement. Kaolinite (halloysite)-quartz alteration replaces the potassium alteration zones. Alunite is present in N-S and NNW-SSE fault zones. Known ore mineralization is found to be related to late vein structures and stockworks. Silver is more related to higher temperature alterations (SE part). Gold is linked to N-S veins, and possibly superimposed onto earlier silver-base metal mineralization. The main silver-bearing phase is acanthite, gold occurs mostly as native free gold.

In the soil geochemistry the gold anomalies are N-S elongated and coincident with known vein structures. Hg, Sb shows correlation with Au. Silver anomalies are NNW-SSE elongated. Pb, Zn, As, Sb is correlated with silver. Downhole geochemistry of core chip samples indicated different spectra for intrusive and stratovolcanic environments. Neither of the main metals (Au, Ag) shows correlation with potassium, although potassium enriched zones are primary indicators of sulfide – precious metal mineralization.

GEOMICROBIOLOGICAL AND ECOLOGICAL INVESTIGATION ON THE MINING WASTE HEAP CAMPURELE - BAITA

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The mining waste heap is located on the Valea Rosie (Red River) valley at 3.5 km upstream from Baita village. The heap is 0.3 ha in its upper area, 31 500 m^3 in volume and 30 m in its maximal high with a natural slope of about 45^0. The deposited material was provided by exploring works as well as by mining works from Galbena gallery of the Nistru mine (Maramures department). The deposition was stopped in 1994.

The material consists in pieces of siltitic rocks (mainly clay minerals as caolinite, illite and montmorillonite), pyrrhoclastic rocks (plagioclase feldspars which are mainly substituted by alteration products as sericit and caolinite) as well as fine powdered material provided as result of degradation and desegregation of rock pieces. Besides, there are frequently ore pieces originated from the veins of metalliferrous mineralisation. They consist of microcrystalline quartzite that include impregnation of pyrite and iron oxy-hydroxides as well as sulphides of copper, zinc and lead. Frequently they also include caves filled with clay minerals. Generally the caolinite in samples represents between 25% and 42%, and caolinite with illite represent together up to 60%.

Several sampling in 14 random points and physico-chemical measuring, chemical analyses, mineralogical and microbiological investigations have been made. As a result, a significant heterogeneity of pH was found on the surface area between 2.5 - 7.0. The metal contents are between 1.06-3.88% Fe; 0.004-0.25% Cu; 0.07-4.6% Pb; 0.02-0.08% Zn and the total sulphur 1.4-3.05%.

The microbiological determinations by the most probably number method for autotrophical and heterotrophical bacteria found that chemoautotrophical bacteria like thiobacilli are present up to 10-10^3 cells/g depending on season and on the sample. Their presence is related with the sulphide content and with the acid pH of the material. The heterotrophic bacteria are present mainly in samples taken out from the oldest area of the heap where there are some small quantities of organic material arrived as dead lives from the surrounding wood. In this area there are also a weak natural invasion of vegetation consisting in tufts of graminees, isolate graminees and weed plants as well as isolate bushes of goat willow and small threes of poplar, birch, white beech, pine. All the other areas are rough with extremely rare small threes of the same species.

MERCURY IN ORES OF BAIA MARE REGION

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The main process allowing Hg accumulation is that of degassing of abyssal parts of the Earth – so called "mercury breath". Mercury degassing is displayed along some zones of deep faults of mantle stage during activation of these faults or their separate links. The position of Baia Mare ore district is the same in regional plan. This district is situated on the joint of the Carpatides and Pannonian Volhinian trough. The last is a part of the Pannonian Volhinian lineament. Such position of Baia Mare ore district explains the appearance of proper mercury minerals – as a result of mercury receiving from the Earth mantle. At the same time low contents of mercury are rather unexpected in ore forming minerals of Baia Mare. They usually are hundreds of thousands parts of percents, even in such good mercury concentrator as sphalerite. High Hg contents – tens of thousands and thousands parts of percents could be observed in sulphosalts and antimonites, inclined to occur towards the end of ore forming process, when mercury sulfides have been manifested and sometimes in galenites and gold-bearing pyrites. Economic concentrations of mercury (according to known data) as a whole have higher Hg contents than those in ore minerals. They usually are tens of thousands, rarely hundreds of thousands parts of percents. This fact requires some explanations. Maybe samples with economic concentrations were picked up in higher horizons than ore minerals. As it has been ascertained before, Hg contents decreased with increase of ore formation depth. Unfortunately, we have no data on the depth of sampling and picking up ore concentrates in Baia Mare, so that our explanations are only hypothetical. But even taking into consideration possible influence of depth during formation process on mercury contents, mercury concentrations in ore forming minerals are rather low. They increased only in the end of the process – up to cinnabar appearance. Such unusual contrast could be explained by activation of ore controlling faults before last stages of ore process with accompanying appearance of ore-bearing fluids. The information could be received during investigations of mercury thermoformes (the Ozerova term). They correspond to maximum values of mercury discharge while continuously heating samples up to 800^{0}C and continuously recording of mercury discharging. The main amount of mercury is discharged before heating up to 410^{0}C. The temperature of metallurgic process is considerably higher. Discharging mercury may be partly condensed along technologic link while gases expansion and temperature decreasing. Thus investigations of mercury behavior in ores and ore concentrates are very useful for evaluation of the ecological situation in regions with metallurgic plants.

GEOCHRONOLOGY AND GEOTHERMOMETRY IN THE LJUBIJA SIDERITE DEPOSIT, NW BOSNIA, A PRECURSOR OF THE EARLY INTRA-CONTINENTAL RIFTING OF THE TETHYS

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Introduction

There is a long lasting dispute on time and way of formation of siderite-barite-polysulfide (±Cu, Pb, Zn, F) deposits of Internal Dinarides, placed within upper Paleozoic sedimentary sequences: Foèa, Central Bosnia, Ljubija, Trgovska gora, Petrova gora, Rude-Samoborska gora and Bistra. In principle, there have been two possible alternatives, Hercynian or Alpine metallogeny, ranging from middle Carboniferous to middle Triassic time. There has also been a wide spectrum of genetical models applied in their genesis as well, from pure sedimentary, volcano-exhalative, metasomatic, vein-hydrothermal, remobilized or combination of these. Recent geochemical, isotopic and microthermometric measurements on Ljubija parageneses brought some new data, which confirm hydrothermal origin, and Permo-triassic time of mineralization.

Short review of recent investigation results

Microthermometry on quartz from ore deposits of different morphology constrained genetical model. The deposit was formed during intracontinental rifting, which generated thermal disturbance, and gave rise to deep open fractures and initiation of hydrothermal cells. Chemical character of the fluids was NaCl, $CaCl_2$ primarily, with wide range of salinity from a few % NaCl wt.equ. to more than 30 %. Influence of terrestrial waters is recognized by presence of sulfate and carbonate ions and free CO_2 (clathrates). Th varies from 100 to 250 °C. Ore body □une, originates from the two phase region of the hydrothermal convective cell and Ljubija from its lower margin. The depth of formation determined on a basis of PTX parameters of boiling fluids is between 200 to 500 m, depending on whether lithostatic or hydrostatic pressure has been applied.

Lead isotopes in galenas, using Doe-Stacey, and Stacey-Kramer models of lead growth curves, gave ages of 239 and 232 Ma. On the other hand the value of $^{206}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ fall far bellow ì values of the typical Hercinian granite related ore deposits within Pannonian realm.

Sulfur isotope data from barite are also indicative. The values ä^{34}S from 8.5-14.5 point out to influence of the Permian sea sulphate, or Permian evaporates.

Ionic chromatograpy maybe solves the dilemma, since Cl/Br and Na/Br ratios show trend appropriating to the composition of lagoon brines.

K/Ar dating of illite-smectatite from the Carboniferous slates, host rocks of siderite veins and metasomatic bodies, was based on presumption that their crystal structure suffered badly during Cretaceous and Tertiary metamorphic events, loosing Ar in uncontrolled amount. The slate, incorporated within siderite veins as an xenolite, and protected from strain and stress, however, preserved Ar developed after cooling of siderite veins. The closure-temperature of illite-smectite minerals is close to 250 °C. It means that cooling age can be accepted as the time of mineralization. The values from Carboniferous slate vary widely between 130 to 290 Ma, but the xenolithic slate gave very close values of 236 and 238 Ma.

Conclusion. The age of mineralization is still not confirmed definitely, as well as the age of many Permo-Triassic formations in the Dinarides, usually lacking fossils. The Permo-Triassic siderite-barite deposits along the margin of the Mesozoic carbonate platform demarcate opening of the Tethys. Demarcation line may be followed to Rudabanya (NW Hungary), or Erzberg in Northern Calcareous Alps.

RECENT K-AR DATINGS OF NEOGENE CALC-ALKALINE VOLCANIC ROCKS OF CARPATHO-PANNONIAN REGION (CPR)

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In order to improve the knowledge of space and time evolution of the Neogene calc-alkaline magmatism of CPR, systematic K-Ar age determinations have been undertaken in the Pieniny Mts. (Poland), in the Bükk Foreland (Hungary) and in the Transcarpathia (Ukraine), respectively. The radiometric datings have been carried out at the ATOMKI, Debrecen.

During the last two years 26 sites of the Neogene andesitic intrusions in the Pieniny Mts. (Poland) were sampled. Whole rock, groundmass and monomineral (amphibole, feldspar) fractions were measured. Most of the K-Ar ages range between ca 13.5 Ma and 11.0 Ma (Sarmatian). On the basis of the available data the time gap between the emplacement of the 2nd and 1st phase andesitic intrusions was shorter than it could be expected from their analytical errors .

The joint geochronological and paleomagnetic study of the Bükk Foreland is aimed at providing a time framework for the ignimbritic volcanism of the area, where relevant biostratigraphical data are lacking. K-Ar dating indicates that the ignimbritic volcanism occurred between 21.0-13.5 Ma. Within this interval three main events can be distinguished; 21.0-18.5 Ma, 17.5-16.0 Ma and 14.5-13.5 Ma, respectively. They are well separated by paleomagnetic declinations of the respective volcanic products (80°, 30°and 0°, respectively) .

K-Ar ages were determined on 57 samples, covering most of the Transcarpathian volcanic centers. Massive, non-vesicular rocks from both outcrops and boreholes were sampled. Radiometric dating has yielded K-Ar ages 13.4-9.1 Ma. This time interval is similar to that of the neighbouring Carpathian volcanic regions. Badenian rhyolitic tuffs buried within the Transcarpathian area have been dated by biostratigraphic methods .

PLATES COLLISION AND TECTONIC SCENARIO DEDUCED FROM METAMORPHIC EVOLUTION FOR CODRU (BÂC) MASSIF, NW TRANSYLVANIA

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The metamorphic rocks from Codru Massif were divided by Radu and Cook (1999), into Northern and Southern Areas, by different mineral assemblages identified in micaschists and amphibolites. They demonstrated that peak metamorphism (9.5-10.0 kbars, 550-600°C) was in epidote-amphibolite facies and followed a clockwise PT path.

A summary of data and results extracted from metamorphic rocks and granitoid bodies, showing the differences between delimited areas are presented in the following table.

Northern Area	Southern Area
$S_1 - S_5$ crenulations	$S_3 - S_5$ crenulations
Micaschists (MnO ≈ 0.1 %) carpholite(?)→chloritoid→garnet→chlorite albite + oligoclase (peristerite) rutile→ilmenite (with hematite exsolutions) pyrite→pyrrhotite	*Micaschists* (MnO < 0.1 %) staurolite+kyanite→garnet→chlorite oligoclase rutile→ilmenite pyrrhotite (low fS_2)
Amphibolites pargasite; $Fe^{3+} \geq 0.3$ atoms p.f.u. albite + oligoclase (peristerite) rutile→titanite→ilmenite; hematite→magnetite epidote, hematite (high fO_2)	*Amphibolites* tsckermakite; $Fe^{3+} < 0.3$ atoms p.f.u. oligoclase rutile+calcite→titanite→ilmenite; calcite (P_{CO_2})
Granitoids syenite, alkali felspatic granite ilmenite, magnetite (hematite exsolutions) intraplate granitoids, syn-collisional granitoids	*Granitoids* granite, pegmatite rutile, ilmenite syn-collisional granitoids

Using mineral reactions and petrogenetic grids a metamorphic evolution was deduced, confirmed also by geothermobarometric results, and tectonic events suggested as follows:

1. Collision – prograde heating, intraplate granitoids in Northern Area (S_1-S_2)
2. Collision between Northern and Southern Areas- compression with isobaric peak (S_3)
3. Extension – almost isotherm decompression, syn-collisional granitoids (S_4)
4. Extension – almost isobar cooling (S_5)

The prograde heating was identified only in Northern Area, the initial oxidant conditions being explained by frozen the low-grade metamorphism events as relict inclusions in porphyroblastic minerals, due to high MnO content from garnets.

The presence in two exotic occurrences (Lipaut Valley in North and Hodisei Valley in South) of the assemblages antigorite + talc is interpreted as fragments from upper mantle totally transformed as a results of the collision in wet conditions.

ZIRCON MORPHOLOGY AND GEOCHEMISTRY IN THE BARSA FIERULUI GRANITOID (SOUTH CARPATHIANS-ROMANIA)

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Barsa Fierului granitoid, met in the Barsa Fierului valley, orientated East-West, has small dimensions: seven km length and 1km width.

Petrographically, it consists of different kind of rocks, without cartographically delimitations: granodiorites, granites, tonalities, monzogranites, alkaline sienites, diorites and aplites.

Chemically, the composed rocks of the Barsa Fierului granitoid are included in the calc-alkaline suite, emphasizing an obvious high-K character, a deeply origin (mantle-low crust) and some crustal contaminations, developed during magmatic processes and magma ascension to the up part of the crust.

Zircons, proceeded from 6 samples, emphasized a common origin of the investigated petrographical types, their optical (colour, transparency, nucleus and overgrowth, zones, inclusions), morphological (predominantly P and S, a few) and chemical (major elements) feature, being specifically those crystals grown in the same crystallization environment. All investigations pointed out (i) the hafnium character of the zircon crystals and the appurtenance of the host rocks to calc-alkaline – K-calc-alkaline suites, (ii) variations of the chemistry, temperature and pressure, determining inhomogeneous of the inside of crystals, marked by the appearance of the zones and (iii) the existence of the assimilation processes, emphasized by the overgrows and nucleus crystals.

Statistical interpretations of the morphological aspects (Pupin, Turco, 1972, Pupin, 1980) showed an obvious predominance of the mantle forms (80%), crystallized in the high-alkaline granite and sienite magmas, at the upper mantle-low crust level.

The characteristics of the crystallization environment, according to zircon morphological and chemical aspects, are in concordance with those of the host rocks, excepting the petrographical types, that are more alkaline then present ones; the lack of concordance is probable determined by the exchanges have took place after zircon crystallization, in conditions of the high magmatic differentiation and the magma accessing to the high level of the crust.

BIOTITE CRYSTALLOCHEMISTRY FROM ROMANIA

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Biotite is one of the most spread minerals in geological environment from Romania, being met in different kind of occurrences:

- *Magmatic*, presently in the majority of the magmatic rocks, in different proportions, as (i) main or accessory mineral, according to the chemistry of rocks (acid-basic) and the depth of the crystallization of the body (plutonic-volcanic), or (ii) an initial mineral, grown in the initial magmatic processes, or secondary one, formed secondary, as a result of the metasomatic or hydrothermal phenomena;
- *Metamorphic*, mentioned in the most of the quartz-feldspar and amphibolitic rocks, its concentrations, being frequently used for the rock's definition;
- *Pegmatitic bodies*, concordance-discordance cutting of the crystalline formations and granitoid massifs;
- *Vein rocks,* in Permian formations or as the latest product of the different magmatic cycles presented on the Romanian territory;
- *Sedimentary,* in detritic rocks;
- *Present* alluviums, in main hydrographical basins and their main affluents.

For this study have been considered biotites from (i) *magmatic domain*: old granitoids (Macin, Tismana, Poniasca, Buchin, Ogradena, Sfardin, Highis), banatites (Bocsa) alkaline bodies (Ditrau massif), Neogene vulcanites (Baia Mare zone), (ii) *metamorphic formations*: quartz-feldspar rocks (Sebes and Semenic Mountains) and (iii) *pegmatitic bodies* (Rodna and Lotru Mountains).

Chemically, biotites are characterized by variations of the major elements oxides, comparable variations, especially for those samples, included in the same above-mentioned entities; all of them are included in true micas group, trioctahedral subgroup, representing biotite term of the black mica series.

The cristallochemical aspects, emphasized the presence of the large cations, Ca, Na and K of the X group, relatively closely by ideal, 2.00.

The Y group captions, in octahedral sites, are represented by Al^{VI}, Ti, Fe^{2+}, Fe^{3+}, Mg, Cr, Ni, sometimes Ba, but the main variation is between Fe^{2+} and Mg.

Tetrahedral cations, constituted in group Z, consist of Si and Al^{IV} and sometimes Fe^{3+} (Ditrau, Ogradena, Tismana, Macin, Bocsa).

NEOGENE ORE-DEPOSITS IN THE SOUTH APUSENI MOUNTAINS, ROMANIA. CONSTRAINTS OF A TYPICAL EVOLUTION

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The Neogene ore-deposits of the South Apuseni Mountains are related to calc-alkaline intermediate volcano-plutonic complex structures. Volcanicity had a paroxysmal period ranging between 14.8-10 Ma, with a post-emplacement progressive clockwise rotation of the rocks with a mean age of 14 to 13 Ma, being accompanied by a significant and relative continuous metallogenetic activity. Magmatism is generated by regional deep-seated tensional faults which activated by decompression partial melting a metasomatised subcontinental mantle. Concerning the major and trace elements, low isotopic ratio of $^{87}Sr/^{86}Sr$ and stable isotopes ($\delta^{34}S$) sustain the upper mantle source.

The extensional regime facilitated a "passive" emplacement of intrusions providing optimal conditions for generating high density porphyry copper systems. As a consequence, a strong specialisation for Cu(Au) of whole district has to be remarked. The tendency of enrichment in metallic components of the magmas is pointed out by Cu, Au, Ag, Pb and Zn overclark values. Relatively small sized porphyry copper bodies without or with only local subsequent convective copper enrichment processes, located in volcano-intrusive complex structures, are common. In most of the cases the epithermal veins and/or breccias are spatially related to porphyry copper structures and located in a peripheral position, giving rise to complex metallogenic structures with composite character (e.g. Valea Morii, Bolcana –Troita). There are peculiar trends of magmatic-hydrothermal processes, expressed by various types of ore deposits starting from porphyry copper ore deposits, through base metals and/or gold breccia pipe to low/ high-sulfidation epithermal ore deposits.

A very characteristic feature of the entire area is the constant presence of gold; also a positive Cu-Au correlation has been established, explained by partition of both copper and gold in supercritical magmatic fluids from a crystallizing magma. Sulphur stable isotopes of ore minerals show a strong affinity of these ore deposits to the magmatic-hydrothermal type, closely associated with magmatic intrusions emplaced at relatively shallow depths. The $\delta^{34}S$ data support a magmatic origin of fluids that evolved from porphyry copper to breccia pipe and base metal/gold veins suggesting a specific magmatic-hydrothermal evolution line, that involves an immiscibility process from the residual silicate melt and via successive boiling episodes (i. e. halite trend solutions) to a dilute aqueous solution state. This emphasizes the important role played by Cl and S as transport agents of metals during fluid evolution from magmatic to hydrothermal stages. The temperature data resulted from sulphur fractionation, minor elements partition and fluid inclusion studies are all in good agreement and range from 400 - >600°C for porphyry to 350-450°C for breccia pipe deposits and some base metal veins down to 200-300°C for epithermal deposits.

NEOGENE MAGMATISM IN THE APUSENI MOUNTAINS, ROMANIA. EVOLUTION AND GEOCHEMICAL FEATURES

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In the Apuseni Mountains the Neogene volcanic activity evolved in three main episodes, between lower Badenian (Langhian) and Early Pleistocene.

The first volcanic products are represented by poorly developed rhyodacite-dacite tuffs, hosted by Globigerine bearing marls (Langhian). The main episode, represented by calc-alkaline medium to high- K quartz andesites with amphibole, pyroxene ± biotite to dacite, began some 15 Ma ago whit an explosive character giving rise to a widespread volcano-sedimentary formation, interbedded with Spirialis bearing marls. Two intrusive activity evens, forming complex volcano-plutonic structures with high-density necks and intrusive bodies, were distinguished by corroboration of K-Ar, paleomagnetic data and spatial distribution. The first one, calc-alkaline medium- K quartz andesites with amphibole, pyroxene ± biotite, spatially developed in Zarand-Brad-Bolcana-Zlatna-Rosia Montana-Bucium area, developed between 14.8 – 11 Ma, showing a progressive clockwise rotation (60° at 14 Ma to 28° at 13 Ma). The second one, represented by calc-alkaline medium to high- K quartz andesites with amphiboles, biotite ± pyroxene, developed between 12.6 – 7.4 Ma, without paleomagnetic rotation, covers a large areas in the Deva - Sacaramb and Baia de Aries - Rosia Montana districts. Small bodies (10.5 Ma) with alkaline features (trachyandesites, microdiorites) and basaltic andesites (7.4 Ma), bearing an asthenospheric geochemical signature, are the latest products for respective areas. The last episode displays an alkaline character and occurs only in Uroiu Hill (1.6 Ma), after a gap of about 6 Ma, on different geostructural context.

Two rock series can be distinguished based on geochemical data: low- Sr andesites (oldest ones) and high- Sr andesites. Regionally and for each volcano-plutonic structure the geochemical features display systematical differences for the first and second series (successive in time); enrichment in Sr, Ba, light REE, alkali, except for young products developed on first stage structures (12 to 11 Ma). Mg# increase and $^{87}Sr/^{86}Sr$ decrease with age suggest increasing of mantle component contribution.

Regarding magmatism genesis the available (major and minor elements, trace elements, Sr isotopes) data permit some discussions, which should be proved by a complete isotopic data set (radiogenic and stable isotopes). Despite the calc-alkaline character and an obvious subduction signature of trace elements, the available isotopic data, the regional geological and geotectonic frame suggest a non-subduction related magmatism. A possible scenario, conformable with geotectonic and paleomagnetic data and Sr isotopes ratio, involves a transtensional tectonic regime directed by contemporaneous eastward translation and clockwise rotation of Tisia-Getia terrane, in area of South Apuseni Mts., on a relatively thin lithosphere. Expression of this are the deep-seated transtensional fault systems generating – graben like – small pull-apart aligned basins, which represent the structural control for magma uprising. They were activated, by adiabatic decompression, partial melting processes of a subcontinental mantle, affected by metasomatic process related to earlier subduction events.

A decoupling of magmatogenetic process for second stage products, like a consequence of short time (cca. 2 Ma) higher mobility with significant enrichment on fluids and changing features of mantle source and/or the geotectonic control is clearly show by different geochemical patterns for so called low- Sr and high- Sr series. This is convergent with pull apart connected structures affected by a second tectonic peak (deduced from rotation for first products) which also can explain differences between volcano-plutonic structures in terms of trace geochemistry.

INVITED PAPER

CORRELATION OF THE EASTERN AND WESTERN CARPATHIANS : STRUCTURE AND EVOLUTION

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The most important geotectonic element which must be used for the correlations of the Carpathians structures, as well as for anyone orogenic belt, is the "major ophiolitic suture"; in the Carpathians this is the Majör Tethyan Suture (which group together the geological units proceeding from the deformed Tethyan Ocean). The Major Suture units are situated between the units corresponding to the deformed Tethyan continental margins: the European continetal margin, external in respect with the suture and the Fore-Apulian continental margin, internal to it (Fig.).

The Major Tethyan Suture runs, in the Carpathians, from the Vardar Zone (Sumadja) trough the South Apuseni Mts., below the Transylvanian Depression and join, north of the North Transylvanian Fault, the Pienides. The last ones crops out from the Maramures area as far as the Eastern Alps (Rheno-Danubian flysch). They group together the Magura Group, the Pienidian Klippen Belt, but also some units known only from boreholes (below the north-eastern margin of the Pannonian Basin) as the Babesti-Tijacevo and Kricevo units or the "Hiden Window" of eastern Slovakia and western transcarpathian Ukraine. The closing of the Tethyan Ocean, within he Carpathians area shows two main periods: 1. Mid-Cretaceous - End-Cretaceous and 2. Eocene? - Lower Miocene.

The Fore-Apulian realm group together the geological units proceeding from continental crust microcontinent surrounded by the Main Tethyan Suture and the South Pannonian - Canaveze suture which is a branch of the Tethyan Ocean running in front of the Apulian Domain and separating it from the Fore-Apulian one. This model except the Bukk Unit and the neighbouring ophiolitic nappes, which are a "terrane" - type group, inserted by important right-lateral translation, within the Fore-Apulian realm.

The Fore-Apulian realm is divided - by the North Transylvanian-Mid Hungarian fault system - in two zones: the Western Fore-Apulian Zone (Austroalpine nappes, Tatric,Subtatric, Gemeric units and equivalents below the Pannonian Depression) and the Eastern Fore-Apulian Zone (North Apusenides, Villany, Mecsek? and equivalents situated below the Pannonian Depression). The Fore-Apulian realm is characterised by an general developed Mid-Turonian structuration (Pre-Gosau "phase"). Eocene (?) and Lower Miocene tectogeneses involved the northern margin of the Western Fore-Apulian Zone (overthrusting the Major Tethyan Suture). The Eastern Fore-Apulian Zone was affected mostly by the Mid-Turonian deformations and probably was clock-wise rotated in Eocene (?) or Lower Miocene.

The European Continetal margin units crops out in the East Carpathians and the South Carpathians (Fig.). Very typical continental basement shearing nappes are known in the Central East Carpathians, in the Getic+Supragetic nappe system and in the Danubian Domain. Their structuration is Mid-Cretaceous and, partly (South Carpathians), End-Cretaceous. The flysch - bearing units (Ceahlau-Severin system, the Moldavidian nappes of the East Carpathian Flysch Zone) proceed of intracontinental rifts (symetrical rifts or simple shearing rifts, with thinned crust or oceanic-type crust).

The primary basement of these nappes were consupted along a Beniof paleoplane, responsible for the calco-alcaline Neogene magmatic arc of the East Carpathians and the Banatitic magmatic arc of the South Carpathians.

The evolution of the Tethyan Ocean and its continental margins my be summarised in several stages:

a.- the rifting period, preceding the ocean opening, Late Lower Triassic and Earliest Middle Triassic;

b.- opening of the Tethys, Middle Triassic ;

c.- spreading of the Tethyan Ocean, Triassic-Early Upper Jurassic ;

d.- beginning of the closure, Late Barremian-Early Aptian;

e.-closure of the Tethyan Ocean and beginning of the collision of the continental margins - following the different segments from End-Createeou up to Lower Miocene.

The intracontnental rifts within the European continental margin evoiluted as:

a.- rifting processes in Jurassic and Earlyest Cretaceous;

b.- compressive processes from the Mid-Cretaceous up to the Earlyest Upper Miocene.

MODELLING GEOTHERMAL EVOLUTION OF THE TRANSCARPATHIAN FLYSCH ZONE

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The Eastern Carpathians chain is the result of a long and complicated evolution during which the tectonic and implicitly geographic framework changed several times before reaching the present aspect. Three main zones, in which flysch deposits are involved, can be recognized at present on the territory of the Eastern Carpathians: the Transcarpathian Flysch Zone, the Crystalline-Mesozoic Zone and the Flysch Zone. This paper deals only with the first zone

The geological structure of the Carpathians is now viewed as a collection of effects of the plate tectonics; on the other hand it is possible to construct various geothermal models that provide some insight into the tectonic history. These models must be reconciled with the knowledge of the structure of the crust, petrophysical properties of rocks and the thermal regime of the Earth as inferred from the observations at its surface The Eastern Carpathians area is relatively young and it is characterised by less than 25 m.y. since the last thermo-tectonic event; consequently, a dynamic model should be adopted. In order to explain the high heat flow (73-126 mW/m2) observed in the northern part of the Eastern Carpathians, a 2-D model, which takes into account the radiogenic heat generation and the descent of a lithospheric plate, has been elaborated. Calculated geotherms by finite element method (FEA) indicate the presence of a high temperature anomaly (exceeding 900 C) The geothermal data suggest that both the high heat flow and the building up of the Neo-volcanic chain are consequences of the lithospheric Miocene subduction in the Carpathians area.

The analysis of thermal evolution is based on a number of geological concepts. These concepts include backstripping, thermal parameters, and temperature distribution within the sediments and the thermal regime within the crust. The adopted model reconstructs the burial, thermal evolution and hydrocarbons generation along a vertical. Due to the complicated tectonics of the the Transcarpathian Flysch Zone, elements of this vertical are not necessarily stratigraphically located along the vertical, because of faulting, nor do they display the same vertical thickness as in the past, due to folding. In order to calculate the thermal history of the lithostratigraphic column, thermal boundaries conditions had to be specified. These conditions included the basement definition and the imposed heat flow at the top and bottom of the lithostratigraphic column.

The heat flow values inserted into the calculations have been derived from the FEA modelling.

NEOPROTEROZOIC INTRAPLATE MAGMATISM IN MOESIA: PETROLOGIC AND GEOCHEMICAL DATA

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Rocks from drilling cores revealed the development of Neoproterozoic basaltic volcanism (Cocosu Group) in the Precambrian basement of South Dobrogea - a sunken block of the Moesian Platform. Below the Jurassic limestones of the platform cover, the Cocosu Group overlies amphibolites and magnetite-bearing quartzites of a Middle Proterozoic Banded Iron Formation (BIF) (Palazu Mare Group, correlated with the Krivoi-Rog series from Baltica).

The mafic volcanic products make up the lower part of the Cocosu Group, previously correlated to the Blovice-Tepla ("spilitic") group from the Bohemian massif (Kräutner et al., 1988). The upper part of the Cocosu Group is an upward coarsening terrigeneous sequence of shales, clays and conglomerates. A Cadomian deformation in very low grade metamorphic conditions is responsible for the development of a penetrative cleavage in all lithologies of the Cocosu Group.

The volcano-sedimentary formation of the Cocosu Group, about 400 m thick, consists of two layers of basalt flows, of 50 and 70 m respectively; the flows are separated by pyroclastic and epiclastic sequences which represent two main upward thinning cycles of basaltic pyroclastics and epiclastics. The mafic rock suite varies from massive to porphyritic basalts and dolerites. Petrographic features indicate submarine volcanism, while the abundance of limestone clasts suggests a shallow-marine depositional environment for the epiclastic deposits.

High quality major and trace element ICP-MS analyses were performed on the presented rocks of the Cocosu Group. According to their geochemistry, all the studied rocks are alkali basalts (tephrites and basanites). Distribution of Zr-Nb-Y and Zr/Y-Zr suggests typical withinplate alkali basalts. Nb/Y and Nb/Zr ratios indicate an enriched mantle source, similar to OIB-type sources. Chondrite normalization shows strong enrichment in LREE attesting high, uniform fractionation, whereas E-MORB normalization denotes enrichment of the LILE and LREE as compared to E-MORB. Except for Sr, Rb, Ba (with initial values probably modified due to high element mobility), the best fit is that with OIB sources. High Th/Yb and Ta/Yb ratios may evidence crustal contamination of the magma.

Considering the geochemical and geological data, Late Proterozoic alkali-basaltic volcanism in the Moesian microcontinent took place in an intraplate geotectonic setting. Dykes of porphyritic diabases emplaced into the Archaean gneisses underlying the BIF probably represent feeder channels of this Late Proterozoic volcanism, suggesting that mafic magma was extruded in an intracontinental rift basin.

SOURCE CHARACTERISTICS OF THE NEOGENE-QUATERNARY MAGMATISM IN THE CARPATHO-PANNONIAN REGION

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This is an attempt to understand the source characteristics in the life cycle of calc-alkaline volcanic areas belonging to the Carpatho-Pannonian region: Bukk Mountains (21-16 Ma), Cserhat-Matra Mountains (13.5-16.0 Ma), Tokaj Mountains (13.4-9.1 Ma), Ukrainian volcanic area (13.8-9.1 Ma), Gutai Mountains (13.4-9.0 Ma), Calimani Mountains (10-6.5 Ma), South Harghita Mountains (4.3-0.03 Ma) and Apuseni Mountains (14.6-7.4 Ma).

HFSE distribution suggests that mantle wedge was closer to a MORB-like source, especially for Calimani, the other areas suggesting a large mantle source variation between MORB and OIB types.

For quantification of the assimilation-fractional crystallization and mantle source enrichment we used combined trace element geochemistry and radiogenic and stable isotopes. High $^{87}Sr/^{86}Sr$ of the most primitive rocks in the different volcanic areas suggest an enrichment of the mantle source by subduction related fluid and sediment imput. The most influenced areas by source contamination are the Cserhat-Matra, Tokaj, Ukrainian and Gutai Mountains. In comparison, the Calimani and South Harghita areas are only slightly affected by such kind of process. The modelling suggests ~3-5 % source enrichment for the Cserhat-Matra, Tokaj, Ukrainian and Gutai Mountains and a decrease of these process across the arc.

Starting from most primitive rocks (basalts and basaltic andesites) in the selected regions the volcanic products show trends to predominantly andesitic, dacitic and rhyolitic composition, suggesting the involvement of fractional crystallization processes in high level crustal reservoirs. Sometimes, the least differentiated rocks are missing and only differentiated rocks can be observed (e.g. low-K dacites from Calimani, dacites and rhyolites in Bukk). Increased $^{87}Sr/^{86}Sr$ and ^{18}O in such kind of differentiation trends suggest crustal contamination of mantle-derived magmas (most of them affected previously by source enrichment processes). Modelling suggests between 5-25 % of crustal contamination, the most and the least contaminated magmas belonging to the Calimani Mountains. The high $^{87}Sr/^{86}Sr$ rhyolites from the Bukk Mountains suggest that at least part of them are derived via crustal melting and further mixing between crustal melts and fractionated mantle-derived melts. Decreasing $^{87}Sr/^{86}Sr$ and increasing $^{144}Nd/^{143}Nd$ during the Apuseni Mountains evolution, suggest a change from subducted-modified mantle source to mantle-source affected by addition of slab melt. This evolution is similar with South Harghita and is different from all the other volcanic areas located closer to the collision area of the Carpathians.

THE MINERALOGY OF GOLD IN THE LAHÓCA CU-AU DEPOSIT, HUNGARY

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The Recsk ore complex is related to Upper Eocene volcanic-intrusive centres in the Matra Mountains, NE-Hungary. It is well known for its epithermal and mesothermal mineralizations. The epithermal Cu-Au mineralizations have been developed in the volcanic superstructure. The mesothermal base metal ore formations are related to diorite porphyry shallow intrusive and adjacent skarns._Triassic carbonate-siltstone-shale series forms the deepest known basement formations. Andesite, dacite flows and pyroclastics, extrusive domes, andesite tuffs overlie this. The sequence contains intercalation of bituminous limestone and marls and corral-algae reef limestone. At the Lahoca volcanic centre several phases of shallow subvolcanic bodies emplaced into the volcanics. These emplacements caused multiple brecciation of former volcanic rocks, later hydrothermal explosive breccias. The Cu-Au mineralization is related to these breccias. The Lahoca mineralization exhibits advanced argillic alteration, with pronounced central silicification and leaching, and presence of kaolinite, dickite, illite, quartz (occasional alunite, pyrophyllite). The outer zones are montmorillonite rich with an outer rim of chlorite-carbonate. The highest gold contents are related to the central zone, diminishing outwards. The chlorite-carbonate alteration zone is barren.

The gold occurs primarily related to pyrite, less commonly to enargite and luzonite. About 25 % of the total gold content appears as native gold. Electrum is also a common gold bearing phase.

SEM studies indicate that

- The ore samples are composed of several pyrite phases. Only certain types are in relation with gold enrichment. Marcasite from the same assemblage was not linked to gold mineralization.
- In gold bearing pyrites the Au forms thin coating on pyrite grains rather than even distributions in the pyrite lattice.
- Gold occurs in veinlets of unaltered late andesites. The intrusive counterparts of these andesites are post-ore in the nearby porphyry-copper mineralization. These serves as evidence that gold mineralization represents a separate stage of ore mineralization, post-dating the period of the major base metal enrichment.

VOLCANO TYPOLOGY THROUGH PICTURES

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A collection of colour slides is presented to exemplify types of volcanoes from all around the world.

Volcanoes occurring on land can be grouped, according to their most general morphological, compositional, structural and evolutionary features, in four major categories: shield volcanoes, monogenetic volcanoes, caldera volcanoes and composite volcanoes. Different types tend to dominate different tectonic settings. (1) Shield volcanoes are the largest and are typical for ocean intraplate hot-spot volcanism, but may sporadically occur in other geotectonic settings as well. Most basaltic ocean island volcanoes are of this type (e.g. Hawaii, Reunion, Galapagos). This type is not illustrated by the slide set. (2) Caldera volcanoes are typical for continental intraplate volcanism and they are independent from composite volcanoes and volcanic arcs. These "negative volcanoes" form trough very large explosive eruptions of acidic crust-derived magma. The examples illustrated are from the western U.S.A. (Yellowstone, Valles), Turkey (Cappadocia) and Mexico (La Primavera). (3) Monogenetic volcanoes are small volcanoes (maars, tuff rings, tuff cones and scoria cones) of basaltic or alkaline to ultra-alkaline composition occurring in clusters named "monogenetic volcanic fields" mostly in intracontinental tectonic settings. A monogenetic volcanic field can be the equivalent of a large volcanic edifice, such as a caldera volcano. Monogenetic volcanoes can be associated, however, with shield volcanoes or composite volcanoes too. Illustrated examples are given from Mexico, Japan, Germany and the U.S.A. (4) Composite volcanoes (or improperly named stratovolcanoes) are the dominant type in subduction-related island arc and continental arc settings. Rocks of andesitic composition dominate them but basalt- or dacite-dominated composite volcanoes are also known. The role of volcanic domes in the structure of these volcanoes has been underestimated for long. Calderas are present associated with, or developed in top of, many composite volcanoes. Illustrations are presented from Japan, Mexico, the U.S.A., Italy, Chile and Indonesia. Composite volcanoes may be present in intraplate settings as well, such as those illustrated from the Canary Island, Turkey and the U.S.A..

GEOPHYSICAL CONTRIBUTIONS TO UNREVELLING OF SOME TECTONIC AND METALLOGENETIC STRUCTURAL ASPECTS IN OAS-GUTAI-TIBLES MOUNTAINS AREA

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The paper presents the results of geophysical and geological data's integrate interpretation performed by the author in time, within Oas-Gutai-Tibles Mountains Neogene volcanic chain, referring to the region's pre-Neogene basement's structure and tectonics, to the structure of buried Neogene volcanite from Livada zone and to the geoelectrical methods' contributions to vein mineralization research, with examples on Cavnic-Roata mineralised structure.

The pre-Badenian basement's structure is illustrated in maps with isobates of crystalline basement's relief and of pre-Neogene sedimentary formations' relief (upper limit of Paleogene) respectively. These images were obtained on the basis of 3D gravity modelling and of integrate interpretation of gravity and seismic data, in correlation with the mining and drilling works' results.

Essentially, the structural maps quantitatively show the very complicated morphology of crystalline basement and pre-Neogene formations' relief, because of an intense partition of the formations, in blocks, with relatively up and down moved positions, among which occurred more ample or reduced unevennings, with more or less steep slopes. The pre-Neogene basement partition was made according to three fractures systems, directed as follows: E-W, representing underlatitudinal fractures field with turnings towards ENE-WSW and, sometimes, WNW-ESE, from which the most important is Carlibaba-Carei line, NW-SE, representing G13 line (Gavat - 1963) fractures field and the new ones, directed NE-SW. Initially, the correlated action of the two first fracturing systems caused or enhanced the axial up and down movements, often with oustanding extensions on the line, with general directions E-W in central-western part of the area, and with NW-SE ones in eastern part.

Subsequently, the fractures' system directed NE-SW brought about the oblique-transversal fracture of the blocks individualized in the first stage of partition, giving to the pre-Neogene basement a mosaicist aspect.

Referring to the buried volcanics, 3D magnetic data modelling (Crahmaliuc - 1998) presume that in Livada zone is an acid igneos rocks, intruded in crystalline formations, with a series of summits that pierce also paleogene formations. The 2D gravity and magnetic data modelling on the path of some seismic lines crossing E-W and N-S this plutonite's area, proves that, actually, there is an acid lava flow that moulds Paleogene and/or Badenian formations' relief, specifying also the main volcanic systems that generated it.

An important role in vein mineralizations research was played by geoelectric studies, by induced polarization and aparent resistivity methods, that often represent direct methods of outlining such mineralizations. For example, we mention the geoelectric research results from Cavnic - Roate zone It is a case study commenting the interpretative hypotheses at the date of performing these researches, in comparison with the results of the verifyings by mining works and drillings carried out subsequently.

TUFFITES AND DIATOMITIC TUFFACEOUS LEVEL OF THE LOWER ROMANIAN DEPOSITS IN NE OLTENIA

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The quarry research for coal, opened in NE Oltenia (Panga, Berbesti, Alunu and Ruget quarries), emphasized another interesting feature of the Romanian coal deposits, namely the existence of tuffaceous lenticular levels, having a small thickness. They have an ununiform development with an obvious lens character, with lateral narrowing disappearance and variable thickness, subdecimetrical generally. They have whitish grey colour and a small specific weight. In fact, they can be tuffaceous rocks, tuffaceous clays respectively, characterized by an advanced decay of the tuffaceous material; they can easily be mistaken with the weak phosphorous clays found at the same stratigraphical level (the level of VIII- XII coal beds or, by local names, III- IX coal beds).

The tuffaceous levels were also met in the Dacian- Romanian deposits in Oltenia, beginning even with the Dacian- Pontian limit or to VI- VII coal beds level (eastern Blahnita Valley), but in this stratigraphical span (Lower Romanian), proper to VIII- XII coal beds, about 7 tuffite levels are to be found.

Among all these tuffaceous levels, most of them seem to be linked to the upper IX bank from Berbesti West quarry. The microscopical analysis indicates that they are tuffaceous diatomite clays or some clayey tuffitic diatomites whose tuffitic material is represented by volcanic glass, possibly redeposited, alkaline or acid, which seems to have an extra-Carpathian origin, probably a western one. The obvious presence of some diatoms species is also to be mentioned.

Also, the spectral analysis suggests that the number of elements included in the tuffaceous clays is quite reduced (5 elements- Cu, Pb, Mn, Ni and Ti) in comparison with the largest number of elements that can be found in the phosphorous clays that can be mistaken with the tuffaceous levels shown above.

GEOLOGY: WHY, HOW LONG AND HOW SHOULD BE CONTINUED?

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The development of geology or of geological research in a broad sense was and is strongly dependent on mineral market. Nowadays it is obvious that the mining geology is in decline everywhere, at least in Europe, a continent that rarely proved to contain large or superlarge mineral deposits, except coal. In addition, some very rich deposits Europe once hosted are now nearly completely exhausted. An example from Romania: the celebrated Au Te deposit at Sacaramb / Nagyag, which produced gold since mid XVIIIth century.

The oil geology is or at least seems to be now a leading branch of geology (from a financial point of view), and is mostly performed by private companies. Quite little is left to the state - owned enterprises.

Then, what remains to be done by geological state institutions? To be closed or at least drastically diminished or to search for new applications?

The alternative strongly depends on institution management. First of all the managers are asked to find out the language to explain to the public why geology is (still) necessary, why the public money should be used also in the future for geological activities.

The ways to do this job are in no way easy as the learning of management is still at the beginning, at least in Romania. I don't intend to offer for sure answers to this difficult problem but to express some thoughts derived from the management, mainly during the last five years, of the biggest geological institution in the country, that is the Geological Institute of Romania.

Several possibilities to escape the possible collapse or severe decline seem however to exist provided as many as possible specialists are or would be involved in getting money, other than the budgetary ones. Some possibilities are as follows:

1. International cooperation
2. Institutions specialization
3. Interdisciplinary cooperation
4. Involvement in the environment protection
5. Involvement of local authorities

None of them can create a sound basis for the planning of activity, a pre-requisite of a good management, but a smart combining of them could possibly solve the future of the geological research in Romania. At least partly, as in some cases the participation of the budgetary (state or public) money is a "must" in order to keep alive some of the fundamental sciences (according to the NATO or UNESCO classifications), i.e. the Earth Sciences.

FRACTURE NETWORK INVESTIGATION WITH ELEMENTS OF FRACTAL GEOMETRY

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Due to tectonic events both the individual rocks and packages of rocks are folded, faulted and fractured. This network of fractures displays apparently irregular, chaotic pattern. Its description, investigation and mapping are one of the bases of successful hydrocarbon exploration.

The up-to-date study of fractures has two major problems:

- the fractures identified on drillcores cannot be extrapolated reservoir-wide
- the resolution of the tectonic maps based on geophysical (seismic) measurements is insufficient for the scale of fractures.

Consequently, the prediction of fracture network is an extremely hazardous, practically impossible task.

Making use of some elements of fractal geometry, namely the modified Sierpinsky gasket can conveniently bridge these gaps out.

Using this gasket, the unfractured blocks of various sizes can be localised step by step. In this manner the fractured zones, characterised by higher permeability, can be limited.

This method offers a link between the large-scale structural elements and the core-scale fractures. The very name of fractals indicates the feature of being fractured. Furthermore, thanks to their self-similarity, this scaling transformation can be performed recursively.

CONSIDERATIONS ON THE MAGMATIC EVOLUTION IN RODNA – BÂRGĂU SECTOR

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Rodna -Bârgău subvolcanic sector is particular due to the special geological-structural conditions resulting from the tectonic contact of Rodna crystalline massif with the Transcarpathian Flysch Zone. There is a large range of variation of volcanic rocks: from rhyolites and rhyodacites – to pyroxenic microdiorites and basaltic andesites, and if the enclaves are taken into consideration, also gabbroic rocks (hornblendites, pyroxenites) can be identified.

The chemistry of the magmatites shows a large range of variation of SiO_2 (between 47 % in case of mafic magmatic enclaves and 76 % in case of Parva rhyolites). The magmas had a calc-alkaline character, while the enclaves have a tholeiitic nature that can be explained by their primary, uncontaminated origin. Generally, the profile of REE variation is typical for the rocks belonging to the volcanic arcs associated with subduction areas. A significant enrichment of the light REE as compared to the primitive mantle can be noticed, as well as a Eu anomaly. The basaltic andesites show distinctive fractionations, characterized by the lowest total REE amounts thus by the lowest contamination. All the compositional data presented above clearly plead for the affiliation of the magmatic activity in Rodna - Bârgău sector to a subduction area on an active continental margin.

The most important magmatic processes involved in the evolution of the magmatites in the studied area are fractionated crystallization, crustal assimilation and the mixing of magmas with different composition.

The calculations based mainly on the Al content in hornblende geobarometer, and amphiboles - plagioclases ± garnet geothermometer, indicate the existence of pressures between 10124 bars (in case of quartziferous andesites with garnets) and 7060 bars (in case of andesites and microdiorites in Cornii structure) in the moment of crystallization of these minerals. The magma temperature had values between 881 ^{0}C and 715 ^{0}C.

GEOTHERMAL RESOURCES OF THE OAS-GUTAI AREA: AN OVERVIEW

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Surveys of the terrestrial heat flow geographic distribution in the Oas-Gutai area have been performed by IGR with IPEG Maramures support, during the last two decades.

According to the results derived from the surveys, Baia Sprie zone is associated with high heat flow values of 125 mW/m2, Cavnic zone exhibits 80 mW/m2 and Rotunda zone is characterized by 70 mW/m2. These values exceed by a factor of 1.5 or 2 what is accepted as "normal" heat flow value (60 mW/m2).

Contour maps compiled for the temperature distribution at 40 m depth show a relative dispersion in the range of 8 C to 17 C. Referred to the value of 10 C as the average annual surface temperature, it was delineated several geothermal anomalies with caloric potential possible of interest for energetic use.

As for the sources sustaining the positive geothermal anomalies, two components of the earth's heat transfer from the depth have been considered: (1) convective component marked at the surface by emergences of thermal waters and (2) conductive component connected with the Neocene magma tic structures which probably preserved some heat since there emplacement.

Geothermal waters emergences of low enthalpy have been reported on the southern flank of the Gutai Mts. at Baia Mare (40 C in a well crossing the Badenian horizons), Tauti-Magheraus (30 C at 520 m in the Pannonian deposits), Cavnic (water with temperature of 30-45 C emerging in mining galleries), Valea Creanga (well with artesian water flow at 17 C). To be observed that a general characteristic of the region is the low permeability of the geologic formations. Total heat contained into the convective systems is estimated as equivalent to 8×10^{18} calories. Due to the peculiar geological conditions linked with the origin of Neogene magmatic activity, an important amount of heat is contained in practically impervious rocks (so called "hot dry rocks" systems). So, in the Seini, Baia Mare and Baia Sprie zones, temperature could reach 125 C at a depth of 2000 m and 14-17 C at 40 m underground. Total heat involved in the "hot dry rocks" is estimated to be as 5800×10^{18} calories that means three orders of magnitude higher in comparison with the convective systems.

Economic recovery of energetic potential from such conductive dominated systems arises today still some insuperable technical problems. How ever, a feasible solution to use the geothermal potential from the Oas-Gutai area is the heat pumps for which geothermal conditions in the region offers a higher efficiency.

THE ORIGIN, EVOLUTION AND SIGNIFICANCE OF THE OSTRACOD PANNONIAN-PONTIAN FAUNA IN THE PANNONIAN BASIN

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The composition of the ostracod fauna in the Pannonian sea environment – in agreement with what is known on brackish faunas – reflects a double origin: a marine component (euryhaline forms), including only representatives of the Cytheridae family on one side; on the other, a freshwater component (halotolerant forms), with almost exclusive representation from the Cyprididae family, excepting some genera from the Cytheridae (Cytherissa, Limnocythere) and Darwinulinidae families — the last ones being elements which had been since long time adapted to the freshwater environment.

It must be noticed that all the marine elements show a stratigraphic continuity from the Badenian through the Sarmatian sea, while all the fresh water ones appear as new forms in the Pannonian sea biotopes.

The number of genera of marine origin in the Pannonian Basin is generally reduced. Among them, several groups are worth to mention: those showing high radiative adapting capabilities (Cyprdeis, Loxoconcha, Leptocythere, Euxinocythere), those with a reduced adaptability (Mediocythereis s.l., Graptocythere, Xestoleberis), whilst other clearly could not adapt to the new environmental conditions and disappeared after a short while (Cytherura, Cytherois, Loxocauda).

The freshwater fauna shows a higher generic variety, but in spite of several repeated trials the forms did not manage to successfully populate the Pannonian lake biotopes (all the freshwater forms of the Cytheridae and Darwinulinidae families, as well as all the forms of Cyprididae such as: Ilyocypris, Neglecandona, Pseudocandona, Candonopsis, Paracandona, Cyclocypris, Potamocypris). Only in a few cases, previously existing genera such as Amplocypris, Typhlocypris, Lineocypris, Cypria successfully conquered the new environment.

Under these circumstances, the significance of genera that resulted as endemic evolutions in the Pannonian environments (Caspiocypris, Reticulocandona, Bakunella, Propontoniella, Pontoniella, Camtocypria, Serbiella, Zalanyiella, Typhlocyprella, Pannonocypris; besides freshwater forms of Cyprididaee also some marine forms of Cytheridaee, such as: Hemicytheria, Kollmannella, Pannonoleberis, Pontoleberis, Tyrrhenocythere can be mentioned) increase.

The sudden and explosive development of Cyprididae and the decline of some forms of Cytheridae at the Sarmatian/Pannonian boundary suggest that the major change in the salinity of the marine environment took place at that moment (and not earlier!) of the evolution of the Central Paratethys.

The short stratigraphical range of the species belonging to the successful genera of the Pannonian environment enables them to become excellent biomarkers for regional biostratigraphical correlations.

IDENTIFICATION OF PALEOVOLCANIC STRUCTURES BY MEANS OF SATELLITE IMAGES

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The examination of aerial image on active volcanos has been has been known for more than 7 decades from international bibliography (F. Moser et al. 1958.). Bandat Horst initiated the interpretation of aerial images of Hungarian volcanic structures in 1963.

The paleo forms of Hungarian Neogene fields show medium degradation. On the basis of satellite image analyses, those volcanic structures became recognizable that haven t been recognized earlier by traditional geological-volcanological surveys. There have been several assessments of stereo aerial images, aerial and field surveys, detailed geological maps in order to prove the existence of these structures.

Shield volcano: an oval, ring-shaped structure (Mount Badacsony). It has been prepared out by erosion from the pyroclastic mantle. Its vein appears there as a ring-shaped hole where the basaltic lava has already been exploited (Zalahaláp quarry).

Neck: it s a round-shaped body consisting of tough and massive lava that emerges from the softer sediments (Recsk-Györke tető).

Caldera structures: they can be recognized even if the state of heavy degradation.

The valley originating from the centre is determinant (Gyöngyösoroszi). The rim of the caldera is steep on the inner side while it s convex on the outer one (Hollóháza). The erosion of tough lava flows alternating one another and the soft pyroclastic layers resulted in step fault morphology (Western Mátra-Muzsla). Either radial dykes on the outer slope of the stratovolcano (Northern Mátra) or ring dykes within it can also be recognized.

There is often several parasitic lava cones on the rim of the caldera mainly consisted of lava. The first type is an open crater (Gyöngyöspata-Havas), the second one belongs to that type where a volcanic plug blocked in the central vent (Hollóháza-Május hegy).

Subvolcanic bodies have come close to the surface in central or lateral position in the andesite calderas (Telkibánya) and their superficial prevalence can be delineated on the space image.

Fissure volcanic structures

There is a tough lava body prepared on a tectonic fissure. It is several kilometres long and slightly curved. There are some huge lava streams and debris flows along originating form it (Eastern Mátra-Hátrapatak-tető)

Lava-nappe stratovolcano

Starting from a plateau-like centre come lava flows with different porosity (massive, gas cavity bearing or scoria) interchange each other that are prepared stepwise according to the strata (Southern Mátra-Pálosvörösmart).

Monovolcanic stratovolcanic dome

It has a cylinder-like shape. Lava flows starting from the top are prepared on the volcanic slope differently from the pyroclastic flows that are strongly eroded.

Tuff rings

A rim system with several rings can be seen (Telki-bánya). There is a blocked volcanic plug in the eruption centre.

Lava dome: it s a point- or a round-shaped body with small diameter (0,1-1,0 kilometre) that is in sharp contrast to its environment in the space images (Hollóháza-Pálhegy, Ördögvár).

Ignimbrite flow: it s a flat, well stratified laminated area. Several deep, wide erosion valleys can be found here. Tuff strata of different flows alternate with fallen tuff many times as well on the tectonically emerged ridges. Tectonical steps can be identified at these places (Tibolddaróc).

Fallen payroclastic strata

They have laminated structure and spread over a huge area. Pyroclasics are cut up by deep, narrow and crotch-like valleys.

Hydrothermal fields (geysers, hot spring)

Taking their positions into account they can be found either within calderas or in basins surrounded by several volcanic cones (Erdőbénye-Ligetmajor).

Such tough rocks in the bow-like basin covers several square kilometres and are sharply separated by strong outlines from their environment.

Former geyser centres emerge punctually (Sárospatak-Botkő). Siliceous dykes can be recognized in the space images and they occur as linear forms that are exposed from their environment.

Hydrothermal somatic alteration is often associated with argillitization. Alterated rocks are brighter than their less altered surroundings in the space- and aerial images.

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AUTHORS INDEX

RECENZII - BOOK REVIEWS - BUCHBESPRECHUNG-ANALYSES D'OUVRAGE

L. BAUMANN, E. KUSCHKA, T. SEIFERT: Zacamintele Muntilor Metaliferi (Lagerstätten des Erzgebirges). *ENKE im Georg Thieme Verlag, Stuttgart, 2000. 300 p., 154 fig., 13 tab.; DM 59,00.(EUR 30,17).*

Unul din cele mai vechi centre miniere din Europa, Muntii Metaliferi ai Saxoniei (MMS), isi gaseste in aceasta carte o tratare monografica, conceputa ca un document geologic minier de valoare extraordinara. Zona a fost vizitata si studiata de personalitati proeminente ale Evului Mediu, printre care trebuie amintit in primul rand Georgius Agricola (Georg Bauer). Valoarea de document rezida si din faptul ca aceasta carte este scrisa "din interior", de specialisti ai celebrei Academii de Mine din Freiberg, prof. Ludwig Baumann fiind printre cei mai cunoscuti cercetatori ai MMS, cu contributii remarcabile in descifrarea complicatei lor evolutii geologice si metalogenetice.

Cartea este structurata in doua parti (partea generala si partea speciala). Prima parte are trei capitole, primul privind istoricul mineritului in MMS, al doilea - pozitia geologica-tectonica a MMS si al treilea - mineralizatiile si tipurile de zacaminte. A doua parte contine descrierea zacamintelor din cele trei zone ale MMS, i.e. estica, mediana si vestica, inclusiv regiunea Vogtland. In final, se adauga (1) o bibliografie cuprinzatoare, care include si informatii privind zacamintele din MMS de pe teritoriul Republicii Cehe, (2) un index de subiecte si de localitati, extrem de util la o carte cu o asemenea densitate de informatii si (3) o anexa cu o prezentare succinta a zonelor miniere, inclusiv muzeele aferente. Anexa ofera vizitatorilor, mai ales celor de specialitate, un excelent ghid, incluzand si adrese utile, precum si posibilitati de vizitare a unor mine vechi (in conditiile in care minele celebrilor Munti Metaliferi ai Saxoniei sunt practic inchise).

Mineritul in MMS este documentat deja imediat dupa anul 1100, cu o perioada de inflorire intre 1500 si 1600, in care au fost fondate multe orasele miniere (Schneeberg, Annaberg, Joachimstahl / Jachymov etc.), urmata tarziu, in anii 1945 de inchiderea minelor, in special a celor de argint. Numarul minelor de argint a scazut treptat, de la cca 400 in 1770 la 33 in 1900, dar productia de Ag s-a mentinut pe o linie crescanda pana in 1890, urmata de o scadere semnificativa cu 10 ani inainte de inchiderea minelor. Perioada "de argint" a fost urmata de cele de Pb-Zn si U, W-Mo, Sn-W, care s-au incheiat in jurul anului 1990.

Capitolul 2 include data geologice generale, insotite uneori de figuri nu tocmai la nivelul textului (ex. harta MMS, Fig. 2.1. este greu lizibila), cu coloane stratigrafice, date de varste, sectiuni geologice, tectonica zacamintelor (extrem de interesante fiind, printre altele, Fig. 2.10, 2.20) etc. Capitolul 3 adauga date interesante privind clasificarea pe varste a zacamintelor si apartenenta acestora la tipul singenetic sau epigenetic, precum si o prezentare detaliata a celebrelor formatiuni cu minereuri (Sn-W-Mo, Sn-W, kb, qhm, uqk, eb etc) extrem de caracteristice pentru MMS, mai cu seama pentru mineralizatiile varistice tarzii, precum si celebra asociatie Bi-Ço-Ni-As-Ag-(U), tipica mineralizatiilor post-varistice. Capitolul 3 si partea a I a se incheie cu o evaluare metalogenetica a MMS, punandu-se accent pe etapele de activare a crustei, pe distributia zacamintelor in spatiu: Ba-F in est, Ag-Ni-As in zona mediana si Bi-Co-As in vest, peste care se suprapun mineralizatiile de U (+BiCoNi), considerate a fi regenerate din formatiunile anterioare.

Partea a doua, speciala, cuprinde descrierea in detaliu a geologiei si zacamintelor din cele trei zone-domenii ale MMS, estica, centrala si vestica, cu schite si sectiuni de detaliu, succesiuni paragenetice de minerale, fotagrafii etc.

Cu exceptia catorva harti (Fig. 2.1, 4.1.), ilustratia grafica este de calitate, suficient de abundenta si variata, completand un text compact, dar aerisit, diferentiat prin caracterul literelor si cu subdiviziuni judicioase.

Desi cartea este efectiv o carte clasica de "gitolologie" abundenta de specii minerale si raritatea multora din ele ar fi necesitat macar o lista a acestora pentru toata regiunea sau, mai ilustrativ, pe cele trei domenii.

Cartea reprezinta o sursa unica de date geologice despre acest "ore spot" al Europei, care a furnizat continentului cea mai mare parte a argintului utilizat in decursul timpului (inclusiv pentru baterea dolarului, a carui denumire isi are obarsia la Joachymov) si a oferit minereuri de U, in care sotii Curie au descoperit poloniul si radiul.

Orice biblioteca de geologie ar fi incompleta fara aceasta carte, care ar merita sa fie tradusa si in alte limbi.

MAY-BRITT FÖRSTER, W. FRAEDRICH, JULIKA RIEGERT, MAIKE SCHUBERT:
Felseninsel Helgoland - ein geologischer Führer (Insula stancoasa Helgoland - un ghid geologic). *ENKE im Georg Thieme Verlag, Stuttgart 2000, 155 p., 87 fig.; DM 34.90 (EUR 17.84).*

O carte interesanta ca structura, fiind nu numai un ghid geologic pentru o insula germana din Marea Nordului, dar si o introducere in geologia stratigrafica (este drept cam extinsa, 20 pagini, fata de volumul total al textului). Gandita in special pentru amatorii de geologie sau pentru incepatori, cartea contine totusi informatii utile si pentru alte categorii de cititori, inclusiv pentru geologi. Termenii de specialitate (" chineza de specialitate") sunt explicati atat in text, cat si la sfarsit, parcurgerea cartii fiind usurata de numeroasele ilustratii (grafice sau fotografice).

Interesanta pentru oricine este istoria subrecenta (evolutia naturala a configuratiei insulei Helgoland si a insulelor invecinate) si recenta (evolutia configuratiei insulei datorita interventiei omului, fie benefica - prin construirea digurilor de protectie, fie destructiva - prin bombardamentele din timpul razboiului).

O carte utila pentru orice potential vizitator al insulei sau pentru persoane interesate de cunoasterea Landschaft-ului si geologiei partii de nord a Germaniei si a insulelor nordice.

Prof. Dr. G. Udubasa
Inst. Geologic al Romaniei

INSTRUCTIONS TO AUTHORS

ANUARUL INSTITUTULUI GEOLOGIC AL ROMÂNIEI publishes the annual activity report and review papers.

Only papers presenting concisely and clearly new information will be accepted in the volumes published by GIR. The manuscript will be submitted for critical lecture to one or several advisers. Papers will be definitely rejected after a second unsatisfactory revision by the authors. The manuscripts will not be returned to the authors even if rejected.

Manuscripts are prefered in English or French. Manuscripts submitted in Romanian will be accompanied by an abstract in English or French (maximum 10 per cent of the manuscript volume).

Papers should be submitted on diskette and typed text in duplicate to the secretary of the Editorial Board, including the reproduction ready original figures. The manuscript should comprise: text (with a title page which is the first page of it), references, key words, abstract, illustrations, captions and a summary for technical purposes.

Author(s) should add a separate sheet with a short title (colontitle) of maximum 60 strokes and a summary indicating the hierarchy of headings from the text listed in decimal classification (1; 1.1; 1.1.1) but not exceeding four categories.

Text should be on diskette, format ASCII and 2 copies, holding an empty place of 3 cm on the left side of the page. The text cannot exceed 10 typewritten pages (including references and figures).

Front page (first page of the text) should comprise: a) title of the paper (concise but informative) with an empty space of 8 cm above it; b) full name(s) of the author(s); c) institution(s) and address(es) for each author or group of authors; d) text.

Footnotes should be numbered consequtively.

Citations in the text should include the name of the author and the publication year. Example: Ionescu (1970) or (Ionescu, 1970). For two authors: Ionescu, Popescu (1969) or (Ionescu, Popescu, 1969). For more than two authors: Ionescu et al. (1980) or (Ionescu et al., 1980). For papers which are in course of print the publication year will be replaced by "in press". Unpublished papers or reports will be cited in the text like the published ones.

Abstract, of maximum 20 lines (on separate sheet), must be in English, summarizing the main results and conclusions (not a simple listing of topics).

Key words (max. 10 items), in English or French, following the language used in the text (or the Resumé if the text is in Romanian), given in succession from general to specific, should be typed on the abstract page.

References should be typed in double-line spacing, listed in alphabetical order and chronological order for authors with more than one reference. Abbreviations of journals or publishing houses should be in accordance with the recommendations of the respective publications or with the international practice.

Examples:

a) journals:

Giuşcă, D. (1952) Contributions à l'étude cristallochimique des niobates. *An. Com. Geol.*, XXIII, p. 259–268, Bucureşti.

– , Pavelescu, L. (1954) Contribuţii la studiul mineralogic al zăcămîntului de la Muşca. *Comm. Acad. Rom.*, IV, 11–12, p. 658–991, Bucureşti.

b) special issues:

Strand, T. (1972) The Norwegian Caledonides. p. 1–20. In: Kulling, O., Strand, T. (eds.) Scandinavian Caledonides, 560 p., Interscience Publishers.

c) books:

Bălan, M. (1976) Zăcămintele manganifere de la Iacobeni. Ed. Acad. Rom., 132 p., Bucureşti.

d) maps:

Ionescu, I., Popescu, P., Georgescu, G. (1990) Geological Map of Romania, scale 1:50,000, sheet Cîmpulung. Inst. Geol. Geofiz., Bucureşti.

e) unpublished papers or reports:

Dumitrescu, D., Ionescu, I., Moldoveanu, M. (1987) Report. Arch. Inst. Geol. Geofiz., Bucureşti.

Papers or books published in Russian, Bulgarian or Serbian etc. should be mentioned in the references transliterating the name and titles. Example:

Krasheninnikov, V. A., Basov, I. A. (1968) Stratigrafiya kainozoia. Trudy GIN, 410, 208 p., Nauka, Moskow.

Illustrations (figures and plates) must be numbered and submitted as originals on separate sheets (tracing papers), ready for reproduction. The thickness of the lines, lettering and symbols on figures should be large enough to be easily read after size-reduction. The original size should not extend beyond the print area of the page: column width 8 cm, page width 16.5 cm, page length 23 cm for figures; the width of line drawings should not extend over a single (16.5/23) or double (23/33 cm) page area and must be selfexplanatory (including title, authors, legend etc.). The graphic scale is obligatory.

Photographic illustrations (black-and-white only) must be of high quality and should be grouped into plates 16/23 cm in size. Each plate should have the photos numbered, i.e. Pl. I, Fig. 1; Pl. II, Fig. 1.

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Author(s) will receive only one set of preprint proofs which must be returned, with corrections, 10 days after receiving them. Only printing errors should be corrected, no changes in the text can be accepted.

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În volumele editate de institut vor fi acceptate numai lucrările care prezintă concis şi clar informaţii noi. Manuscrisul va fi supus lecturii critice a unuia sau mai multor specialişti; după a doua revizie nesatisfăcătoare din partea autorilor va fi respins definitiv şi nu va fi înapoiat.

Manuscrisele trebuie prezentate, de regulă, în engleză sau franceză; cele prezentate în limba română trebuie să fie însoţite de un rezumat, în engleză sau franceză, de maximum 10 % din volumul manuscrisului.

Lucrările trebuie depuse, pe dischetă şi text pe hârtie în două exemplare, la secretariatul Comitetului de redacţie, inclusiv ilustraţiile în original. Manuscrisul trebuie să cuprindă: textul (cu o pagină de titlu, care este şi prima pagină a lucrării), bibliografie, cuvinte cheie, abstract, ilustraţii, explicaţii ale figurilor şi planşelor, şi un sumar cu scop tehnic.

Se va adăuga o filă separată cu un colontitlu de maximum 60 semne şi un sumar, în care se va indica ierarhia titlurilor din text în clasificarea zecimală (1; 1.1; 1.1.1), care nu trebuie să depăşească patru categorii.

Textul va fi predat pe dischetă, format ASCII şi două copii pe hârtie, cu un spaţiu liber de 3 cm în partea stîngă a paginii şi nu trebuie să depăşească 10 pagini (inclusiv bibliografia şi figurile).

Prima pagină a textului va cuprinde: a) titlul lucrării (concis, dar informativ), cu un spaţiu de 8 cm deasupra; b) numele întreg al autorului (autorilor); c) instituţia (instituţiile) şi adresa (adresele) pentru fiecare autor sau grup de autori; d) text.

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Citările din text trebuie să includă numele autorului şi anul publicării. Exemplu: Ionescu (1970) sau (Ionescu, 1970). Pentru doi autori: Ionescu, Popescu (1969) sau (Ionescu, Popescu, 1969). Pentru mai mult de doi autori: Ionescu et al. (1980) sau (Ionescu et al., 1980). Pentru lucrările care se află sub tipar, anul publicării va fi înlocuit cu "in press". Lucrările nepublicate şi rapoartele vor fi citate în text ca şi cele publicate.

Abstractul, maximum 20 rînduri (pe filă separată), trebuie să fie în limba engleză şi să prezinte pe scurt principalele rezultate şi concluzii (nu o simplă listă cu subiecte abordate).

Cuvintele cheie (maximum 10) trebuie să fie în limba engleză sau franceză, corespunzător limbii în care este lucrarea (sau abstractul, dacă textul este în română), prezentate în succesiune de la general la specific şi dactilografiate pe pagina cu abstractul.

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d) hărţi:

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