A N U A R U L
INSTITUTULUI GEOLOGIC
AL ROMANIEI

Vol. 73
ISSN 1453-357X
Special Issue

THE 5^{TH} SYMPOSIUM
BAIA MARE BRANCH
OF THE
GEOLOGICAL SOCIETY OF ROMANIA

6-7^{th} November 2003
BAIA MARE

ABSTRACTS VOLUME

Institutul Geologic al României
Bucureşti - 2003
GEOLOGICAL INSTITUTE OF ROMANIA

The **Geological Institute of Romania** is now publishing tyhe following periodicals:

Romanian Journal of Mineralogy
Romanian Journal of Petrology
Romanian Journal of Mineral Deposits
Romanian Journal of Paleontology
Romanian Journal of Stratigraphy
Romanian Journal of Tectonics and Regional Geology
Romanian Journal of Geophysics
Anuarul Institutului Geologic al României
Memoriile Institutului Geologic al României

Romanian Journals supersede "Dãri de seamã ale Şedinţelor " and "Studii Tehnice şi Economice", whose fisrt issues go back to 1910. Besides regular volumes, each series may occasionally contain Supplements (for abstracts and excursion guides to congresses and symposia held in Romania) and Special Issues (for larger papers of special interest). "Anuarul Institutului Geologic al României" appears also in a new form, containing booth the annual activity report and review papers.

Editorial Office:
Geological Institute of Romania
Str. Caransebeş Nr. 1
RO - 79678 Bucureşti - 32
Tel. (+40) 1 224 20 91, 224 15 30
Fax (+40) 1 224 04 04
e-mail GEOL@IGR.RO

The editor has changed the name as follows: Institutul Geologic al României (1906-1952), Comitetul Geologic (1953-1966), Comitetul de Stat al Geologiei (1967-1969), Institutul Geologic (1970-1974), Institutul de Geologie şi Geofizicã (1975-1993), Institutul Geologic al României (since 1994).

ANUARUL INSTITUTULUI GEOLOGIC AL ROMÂNIEI supersedes ANUARUL INSTITUTULUI DE GEOLOGIE ŞI GEOFIZICÃ

The manuscripts should be sent to the scientific editor and/or executive secretary. Correspondece concerning advertisments, announcements and subscriptions should be send to the Managing Editor.

ISSN 1453-357X
Classification index for libraries 55(058)

An. Inst. Geol. Rom., 73, Special Issue, Bucuresti, 2003

SOME PROBLEMS CONCERNING THE STRUCTURAL AND PALINSPASTIC CORRELATION BETWEEN THE EAST AND THE WEST CARPATHIANS

SANDULESCU M.I. (Faculty of Geology and Geophysics, Bucharest)

E-mail: mirceasan@geo.edu.ro

The approach to the problems concerning the structural and, mostly, the palinspastic correlation along the East-West Carpathians chain are depended of the possibility to catch the units isuued from the oceanic realm versus them proceedin from the deformed continental margins. Within the East-West Carpathians segment there are, croping out or known in boreholes, all the elements to do the correlation. From inside toward the exterior the main structural assemblages are:

The Central West Carpathians-Northern Apusenides (Inner Dacides) group together units deformed during the Turonian and represent the prolongation, within the Carpathians of the Austroalpine nappe system. The Tatrides correspond with the Bihor Unit, the Subtatric nappes with the Codru-Arieşeni system, the Gemerides have the same position with the Biharia system. A peculiar position shows the Silica suture and the Bukk Terrane, the last one having perhaps an Apulian origin.

The Main Tethyan Suture which have two segments: the T r a n s y l v a n i d e s, with Cretaceous tectogeneses, is a direct prolongation into the Carpathian realm of the Vardar Zone and crop out in the Southern Apusenides being drilled below the Transylvanian Depression too and the P i e n i d e s, with End-Cretaceous and Lower Miocene tectogeneses, developing north of the North Transylvanian Fault. The later group together the Pieniny Klippen Zone (which develops continously from Poiana Botizei in Maramureş untill the Wiener Wald in the Eastern Alps) and the Magura Group (known also in the Maramureş area).

The Central East Carpathians (Median Dacides) built up of several superposed basement-shearing nappes (Precambrian and Paleozoic metamorphic formations and their Permian Lower Cretaceous envelope). The uppermos of it (the Bucovinian Nappe) suport the outliers of the obducted Transylvanian nappes (proceeding from the Main Tethyan Suture). The whole structure is of Mid-Cretaceous age. The Central East Carpathians group is progressively tectonicaly covered, toward northwest, by the overthrusting of the Pienides. Their prolongation toward the Alps is a problem. In the East Carpathians they are in a "Briançonais" position.

The Ceahlău Group (Outer Dacides) consist of the innermost nappes of the Flysch Zone (Black Flysch, Ceahlău, Baraolt,Bodoc). They are built up of sedimentary, mostly turbiditic, formations (Tithonian-Upper Cretaceous), keeping at the base of the nappes some bodys of mafic rocks (within-plate ophiolites). The Ceahlău Group is also covered tectonicalu Group is also covered tectonicaly by the Pienidian overthrust (in Ukrainian Carpathians). With respect to the Alps it is in a "valais" position.

The Moldavidian Group (Moldavides) includes the cover nappes of the Flysch Zone external with respect to the Ceahlău Group, in the East Carpathians, and the Magura Group, in the West Carpathians. The nappes were overthrusted during the Early, Middle and early Late Miocene.

The palinspastic analyse of the tethyan evolution of the Carpathians may folows the Wilson Cycle stages.

The rifting seems to start during the Permian some bimodal magmatic complexes beeng known in the Northern Apusenides and Central West Carpathians.

The openning of the Tethys should be in the Middle Triassic (at least Ladinian) documented by the age of the oldest ophiolites (MORB) known in the Transylvanian nappes (which proceed from the Main Tethyan Suture-see above). The absence of the Triassic ophiolites in the Southern Apusenides is explained by Mariane-type subductions in the Late Jurassic. The Triassic opening has joined only the eastern end of the Pienidian realm.

The spreading of the Tethys Ocean covers the late Middle Triassic-late Middle Jurassic tme span. The Transylvanian segment as well as the Vardar segment spread since the Middle Triassic (see above) until the Callovian, while the Pienidian segment opened in jurassic and spred mostly during the Middle one. It is difficult to decide if the opening of this sublatitudinal segment of the Tethys starts in the Central Atlantic and propagayed through the Aline Tethys into the Pienidian on or if the opening propagated from the Transylvanidian segment toward the Pienidian one (during the Early Jurassic?) and farther, in the Alps, in the Middle Jurassic.

The first shortenings within the oceanic Tethys occurs during the Late Jurassic and/or in Berriasian in the Transylvanidian segment, stressed out by a calk-alkaline magmatism (generated by Mariane-type subduction). This event is materialised in the Vardar Zone by the obduction of oceanic crust (ophiolites) above the Serbo-Pelagonian Massiv.

The main shortenings are grouped in two periods: a Cretaceous one (which generated the Dacides) and a Miocene one (which generated the Moldavides). Each period shows several paroxismes. During the Cretaceous there are the: Mid-Cretaceous, Intra-Turonian and End-Cretaceous, during the Miocene may be reccognized the Intra-Burdigalian, Intra-Badenian and Intra-Sarmatian paroxismes.

K/AR DATING OF THE NEOGENE-QUATERNARY MAGMATISM IN THE CARPATHIAN-PANNONIAN REGION (CPR)

PÉCSKAY, Z. (MTA Atomki, Debrecen, Bem Tér 18/c, Hungary)

E-mail: pecskay@namafia.atomki.hu

The chronologic conclusions of earlier K/Ar datings on the Neogene/Quaternary volcanic rocks in the Carpathian-Pannonian Region (CPR) have been summarized by Pécskay et al. (1995). During the last decade a considerable effort has been devoted to make a systematic geochronologic study for the sake of improving our knowledge about the evolution of the various volcanic areas in the CPR.

The main goal of this paper is to present the newly obtained radiometric data, highlighting the most important chronological results and drawing special attention to the still unresolved questions.

Recently a complex study was undertaken on the siliceous volcanic rocks widely spreading in the CPR. This approach can serve for the further correlation of the Miocene tuff sequences of the Pannonian Basin over broader area, irrespectively of their emplacement. K/Ar data indicate that siliceous explosive volcanism developed from Eggenburgian to uppermost Sarmatian times (approx. 21.0-11.0 Ma). Within this interval three main magmatic episodes can be divided, which consist indeed of several eruptive pulses (Márton, E. & Pécskay, Z. 1998.).

K/Ar ages were measured on rhyolitic, andesitic and basaltic andesite samples outcropping in the Transcarpathian volcanic field, SW Ukraine. The newly obtained radiometric data range between 13.4-9.1 Ma (Pécskay et al. 2000.), similar to the time interval of the magmatism of the adjacent volcanic regions (Vihorlat, Oas, Gutii Mts.) (Kovacs et al. 1997, and Pécskay et al. 2002.).

Miocene andesite intrusions are distributed along a NNW-SSE „belt", stretching from Moravia to the subvolcanic segment of the Eastern Carpathians. Apparent ages obtained on whole rock samples and monomineralic fractions (hornblende, feldspar) separated from these intrusive rocks reveal a time span of 13.5-8.5 Ma. Except the SE part of this „belt" (Gutii and subvolcanic segment, respectively) where the younger ages were determined the emplacement of the intrusions was coeval (13.5-11.0 Ma) (Birkenmajer & Pécskay 1999., Birkenmajer & Pécskay 2000.). Further analytical work has to be made on the andesite intrusions to make it clear how this magmatic „belt" has been developed.

References

PÉCSKAY, Z., LEXA, J., SZAKÁCS, A., BALOGH, K., SEGHEDI, I., KONECNY, V., KOVÁCS, M., MÁRTON, E., KALICIAK, M., SZÉKY-FUX, V., PÓKA, T., GYARMATI, P., EDELSTEIN, O., ROSU, E., ZEC, B. 1995. Space and time distribution of Neogene-Quaternary volcanism in the Carpatho-Pannonian Region. Acta Vulcanologica, Vol. 7 (2) - 1995: 15-28

MÁRTON, E., PÉCSKAY, Z. 1998. Complex evaluation of paleomagnetic and K/Ar isotope data of the Miocene ignimbritic volcanics in the Bükk Foreland, Hungary. Acta Geologica Hungarica, Vol. 41/4: 467-476

PÉCSKAY, Z., SEGHEDI, I., DOWNES, H., PRYCHODKO, M., MACKIV, B. 2000. K/Ar dating of Neogene calc-alkaline volcanic rocks from Transcarpathian Ukraine. Geologica Carpathica, 51, 2: 83-89

PÉCSKAY, Z., KALICIAK, M., KONECNY, V., LEXA, J., ZEC, B. Geochronology of the Neogene volcanism in the Vihorlatske Vrchy Mountain range, Eastern Slovakia

BIRKENMAJER, K., PÉCSKAY, Z. 1999. K-Ar Dating of the Miocene Andesite Intrusions, Pieniny Mts, West Carpathians, Poland. Bulletin of the Polish Academy of Sciences Earth Sciences, Vol. 47, No. 2-3

BIRKENMAJER, K., PÉCSKAY, Z. 2000. K-Ar dating of the Miocene andesite intrusions, Pieniny Mts, West Carpathians, Poland: a supplement. Studia Geologica Polonica, Vol. 117: 7-25.

An. Inst. Geol. Rom., 73, Special Issue, Bucuresti, 2003

APPLIED EXPLORATION TECHNIQUES ON THE DEVELOPMENT OF THE ROSIA MONTANA GOLD DEPOSIT, ROSIA MONTANA, ROMANIA

O'CONNOR, G.V., SZENTESY C., MINUT A., (S.C. Rosia Montana Gold Corporation S.A., Str. I.C. Bratianu, Nr. 20, 2500 Alba-Iulia, Alba, Romania)

E-mail: gary.oconnor@rmgc.ro

A number of applied exploration techniques have been used in the exploration and development of the Rosia Montana Gold deposit, Rosia Montana, Romania. The deposit is situated within the Apuseni Mountain region approximately 65 kilometres west of the regional centre of Alba-Iulia and has been the focus of ongoing gold exploitation for over 2000 years (Figure 1).

The exploration and development of the deposit has included the collection of 92,359 metres of drill samples from 695 underground and surface drill holes, including 28,439 metres of diamond drilling and 63,920 metres of reverse circulation drilling in addition to 59,584 metres of underground channel sampling from the more than 140 kilometres of known underground development at Rosia Montana. These samples and underground access formed the source for much of the applied mineralogy and exploration techniques conducted.

The exploration program has included thin and polished section mineralogical studies. The use of fluid inclusion studies, XRD and microprobe analysis has also been applied to assist in the program. The geology and alteration, as well as structural setting have been modelled utilising Vulcan three-dimensional software. The same software has been used for the development of the resource estimation model and subsequent reserve model. The resource model has been calculated using ordinary kriging, multiple indicator kriging, inverse distance squared, and nearest neighbour techniques using 10 x10m, 15 x15m and 20 x 20 x10m block sizes. The model and linked databases, using AcQuire and Micromine databases, also include all geological characteristics, geotechnical properties, metallurgical properties including recoveries, geophysical properties including hardness and abrasiveness, environmental, and geochemical properties including sulphur, sulphate and analysis of up to 47 elements as well as the ABA and ARD properties of all rock types linked to the known mineralogy and geology.

The databases and models enable Rosia Montana Gold Corporation to know and understand the geology, mineralogy as well as the geochemical and geophysical characteristics of every block and thus rock type in the deposit.

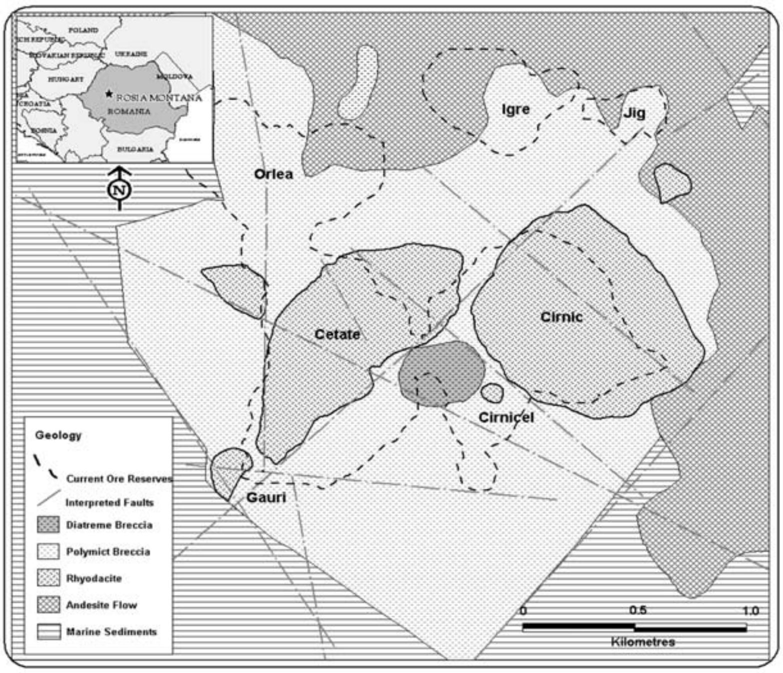


Figure 1; Geology and Location of the Rosia Montana Deposit

Geology

The Rosia Montana deposit is hosted within rhyo-dacitic extrusive dome complexes and associated phreato-magmatic breccia complexes of Mid-Miocene age (13.5 Ma). The eruption of later andesitic flows and associated pyroclastics occurred in the area at 10.9 to 9.3 Ma. The magmatic rocks are hosted within Cretaceous age sediments, comprised dominantly of shales with subordinate sandstones, conglomerates and limestone units. Late basaltic andesite events have erupted at 7.4 Ma approximately 7 kilometres south east of Rosia Montana (Rosu et al. 1997; Pecskay et al., 1995).

Mineralogy

Gold mineralisation is associated with sulphides and sulpho-salts, including pyrite, sphalerite, galena, chalcopyrite, tetrahedite (Ag-rich), proustite, argentite as well as tellurides (intermediate sulphidation). There is evidence for an early pyrite-arsenopyrite stage (low sulphidation). The Ag/Au ratio is highly variable from low to high (associated with sulphides).

Gangue minerals are dominated by quartz, rhodochrosite, calcite, adularia and barite. Carbonate (rhodochrosite) plus base-metal sulphides decrease upwards and chinga veins (sulphidic siliceous rock flour) decrease with depth (Hedenquist, J., 2003).

Variable degrees of silicification, illite haloes, argillic zones and broad propylitic alteration are present also.

Applied Mineralogy

Based on fluid inclusion studies it has been modelled that the paleo-surface occurred at an elevation of approximately 1300m asl. The current maximum elevation is 1046m asl at Cirnic (Tamas, C. 2002). Fragments of Cretaceous sediments as well underlying Palaeozoic metamorphic rocks are present in the diatreme and hydrothermal breccias, in addition to dacitic fragments, indicating extensive vertical transport. Additionally wood fragments have been seen at depths of approximately 150 m below the current surface within hydrothermal breccias as well as at the current surface at Cirnic indicating large vertical convective movement within the breccias.

Fluid inclusion studies have indicated temperatures of deposition of 212-258°C (average 230°C) for quartz and 217-253°C (average 238°C) for carbonates from very dilute (0.35-3.23 wt% NaCl) hydrothermal fluids (Leach & Hawke.1997).

Exploration Techniques

The exploration of the Rosia Montana deposit has utilised the applied mineralogical studies to direct the exploration program in identifying gold mineralisation. The acquisition of data on the diamond drilling, reverse circulation drilling and channel sampling program was conducted using pocket computers utilising “Field Marshall” software to digitally collect all geological and geotechnical data. This was down-loaded on a daily basis into “Micromine” and stored and validated in “AcQuire” data-bases. One metre samples were collected from all sampling media, with one in every 20 samples field duplicated. Samples are prepared to 98% -150 micron in LM-5 pulverisors and assayed for Au by a 50g charge fire assay charge technique and Ag, Cu, Pb and Zn by AAS at the SGS managed laboratory in Gura Rosiei. Upon submission one “blind” internationally accredited standard is submitted for every 20 samples, plus on a monthly basis approximately 3% of all samples are sent for independent check anaylsis at laboratories in Australia and Canada. Total S, sulphide and sulphate analysis has been determined by Leco furnace and multi-element analysis by ICP-MS or ICP-AES and where appropriate by cold vapour AAS.

Over the course of the program to date 5053 bulk density measurements have been made on selected drill core. Additionally all drill holes are surveyed both at surface and down hole, as have the underground drives. Aerial photography was used to produce 2m contour maps and Landsat-TM, Aster and Spot satellite imagery has assisted in remote sensing analysis of the area.

Geophysical techniques utilized have included aerial helicopter borne magnetics, the use of field magnetic susceptibility meters and ground induced polarisation and resistivity electrical methods as well as AMT surveys.

Three dimensional geology, alteration, mineralogical and resource models have utilised Vulcan software, which has also been used for generating digital terrain models. These models contain all available geological, geotechnical, mineralogical, metallurgical, geochemical, geophysical and physical characteristics of the deposit, which is used for modelling all aspects of the development of the deposit. (Gossage, 2002)

References

GOSSAGE, B. & BARNES, J. 2002, Rosia Montana Resource Estimation-RSG Global. Independent report for RMGC. 65 pages plus appendices.

HEDENQUIST, J. 2003. Observations on the Rosia Montana Gold Deposit. Report for RMGC.18 pages.

LEACH, T. & HAWKE,M. 1997 Petrologic Study of Rosia Montana, Romania. Independent report for RMGC. 15 pages.

PECSKAY, Z., EDELSTEIN, O., SEGHEDI, I., SZAKACS, A., KOVACS, M., CRIHAN, M., BERNAD, A. (1995) – K-Ar Datings of Neogene-Quaternary Calc-Alkaline Volcanic Rocks in Romania.

ROSU, E., PECSKAY, Z., STEFAN, A., POPESCU, Gh., PANAIOTU, C., PANAIOTU, Cristina Emilia (1997) – The Evolution of the Neogene Volcanism in the Apuseni Mountains, Romania: Constraints from New K – Ar Data.

TAMAS, C. 2002. PHD thesis “Breccia Pipe” Structures Associated with Hydrothermal Deposits from Romania. University of Babes-Bolyai of Cluj-Napoca.

THE DIVIDED STRUCTURE OF APATITE CRYSTALS

PETREUS, I. ("Al. I. Cuza" University Iasi, Department of Mineralogy)

Apatite crystals have a habit varying from long prismatic to short prismatic and tabular. Thin sections crosscut on hexagonal prism usually show optical anomalies exhibiting concentric, sectoral and intersectoral zoning.

Rakovan (2002) have investigated these anomalies and formulated some hypothesis about the possible causes: (a) several anomalies may be the result of induced stress by the impurities on the mineral structure; (b) the incorporation of chemical elements (Y, Sr, Mn) during the crystal growth is selective, following the properties of different crystal faces (sorption, surface complexation and catalysis). The anomalous structure determines dissymmetrizations in the crystal: in an apatite crystal, monoclinic or triclinic domains in polarized transmitted light appeared. However, electron and X-ray diffraction data showed no reflections, inconsistent with spatial group $P6_3/m$ or that indicated a superstructure. Houghes and Rakovan (2002) postulated that dissymmetrization is due to F and OH ordering along growth steps during incorporation. Rakovan (2002, p. 81) concluded, "compositional zoning and dissymmetrization remain outstanding".

The present paper interprets the sectoral and concentric zoning from apatite crystals in a completely different way, using the theory of the divided structure of crystals (Petreus, 1974, 1978, 1981). In our interpretation, the apatite crystals are divided in pyramids of their faces; each pyramid is also divided in structural units named "lineages". A pyramid is a collection of lineages, parallel with each other, and all oriented perpendicular to the pyramid base, that means to the crystal face. The crystal pyramids determine the sector zoning in thin sections. Sectoral zoning is only a phenomenon of strictly geometrical nature.

The concentric zoning is of strictly chemical nature, faithfully indicates the changes in chemical composition of growth environment, and possibly selective incorporation of chemical elements on different crystal faces.

In our study, we have analyzed the two zoning types in sections cut perpendicular to the direction [0001], in the following hexagonal, apatite crystals: prism $\{10\bar{1}0\}$ + basal pinacoid {0001}; prism $\{10\bar{1}0\}$ + hexagonal pyramid $\{10\bar{1}1\}$; prism $\{10\bar{1}0\}$ + hexagonal bipyramid $\{10\bar{1}0\}$ + basal pinacoid {0001}; prism $\{10\bar{1}0\}$ + hexagonal bipyramid {1011} + hexagonal bipyramid $\{10\bar{1}2\}$ + basal pinacoid {0001}.

We cut all these apatite crystals, perpendicular to the direction [0001], at the following levels: in the crystal center; at the half of the distance between the center of the crystal and the face (0001).

The analysis of the images resulting in all these sections reveals:

- all the sectoral zoning is the consequence of the divided structure of the apatite structure;
- concentric zoning is only of chemical nature;
- in some apatite crystals, sectoral structure is superposed on sectoral structure, as a normal result of coexistence between the divided structure of apatite crystals and chemical concentric zoning.

References

AKIZUKI, M., NISIDOH, H., KUDOH, Y., WATANABE, T., KURATA, K., 1994. Sector growth and symmetry of (F, OH) apatite from the Asio mine, Japan, Mineral Mag. 58, 307-314.

PETREUS, I., 1974. The Divided Structure of Crystals II. Secondary Structure and Habits, N. Jb. Miner Abn., 122, 3, 314-338.

PETREUS, I., 1978. The Divided Structure of Crystals in Pyrite and Beryl, American Mineralogist, 63, 725-731.

PETREUS, I., 1981. The Divided Structure of Crystals III. Terrestrial and Lunar Pyroxens. Mem. Sect. Sci. Seria IV tom IV nr. 1, Academia Romana.

RAKOVAN, J., REEDER, R.J., 1994. Differential incorporation of trace elemnts and dissymmetrization in apatite – The role of surface structure during growth. Am. Mineral., 79, 892-903.

RAKOVAN, J., 2002. Growth and surface properties of apatite. In Reviews in Mineralogy and Geochemistry, vol. 48, 52-86.

MUSEUM MINES IN ROMANIA: A DREAM?

UDUBAŞA, G. Geological Institute of Romania, 1Caransebes street, Bucharest, Romania

E-mail: Paulina.Hirtopanu@igr.ro

Recession of mining in Europe and/or closing mines due to increased ore quality requirements led to a new aspect of mines revival, which is the transformation of many mines into miseums. This is the case of many mines (once producing gold or base metals) in Austria, Germany, and Switzerland etc. By using celebrity of mines and by applying an adequate advertisment such museum mines are already value adding to the touristic potential of the areas. Not only rests of the ores can be seen and eventually collected, e.g. Hohe Tauern gold mines, but also well preserved mining tools and machineries, partly still in activity, can be seen and examined by interested people, e.g. at Rammelsberg in Germany. Even second-order mines, less celebrated, have been transformed into museum, e.g. the sedimentary iron ore mine at Elbingerode in the Harz Mountains. Useless to say, the surface facilities of the mining areas contain now many shops displaying both various cards and pieces of ores, row or polished. Among the nonmetallic mines acting both as mineral producing and as sites for visitors, the Hallstatt salt mine in Austria is the best example of combining the mining and tourism.

In Romania there are only two salt mines, i.e. Slanic Prahova and Praid, which are open for visitors and/or used for medical purposes (e.g. asthma). Unfortunately, no other examples can be given although many ore mines in Romania are celebrated and known Europe-wide ore even worldwide. They are the best candidates for being transformed into museums. Among them, first of all several "sacred monsters" of mineral occurrences (Udubasa, 1994, 2003) should be taken into consideration, i.e. Baia Sprie, Herja, Cavnic, Sacaramb, Razoare, Rosia Montana, Baita Bihor, Uroiu, Ditrau (Hirtopanu & Udubasa, 2003), some manganese ore mines in the Bistrita Mts (Hirtopanu, 2002). Some of them are type locality of several minerals or still display sites with "mine flowers" or with uncommon rich mineral associations. Even non-specialists would try to visit any of these mines at least once. The necessary investments for a minimal preparedness coupled with an aggressive advertisment could be recovered in months.

Museum mines could be supplementary points of attraction for tourists, especially for those coming from other countries. Leaflets may easily be prepared by combining historical aspects of mining and geological or especially mineralogical peculiarities of each mine. Increased attractivity could be obtained by setting up small parts of the veins, where the tourist could hammer itself and take away small samples.

References

HIRTOPANU, P. 2002, Studiul mineralogic si genetic al zacamintelor de Mn din Muntii Bistritei. Teza de doctorat, Universitatea Bucuresti, 185pp.

HIRTOPANU, P & UDUBASA, G., 2003, Mineralogy of a "sacred monster": the Ditrau alkaline massif, East Carpathians (Romania). Studia Univ.Babes-Bolyai Cluj-Napoca, Geologia, Special Issue, p 47.

UDUBASA, G. 1994, Sacred monsters of mineral occurrences in Romania: past, present, future. Anal.Univ.Bucuresti, XLIII, Suppl., Abstract vol., p 34-35.

UDUBASA, G., 2003, Outstanding mineral occurrences in Romania: what's new ? Acta Miner.Petr. Szeged, Abstracts series, p 106.

An. Inst. Geol. Rom., 73, Special Issue, Bucuresti, 2003

GEOCHEMICAL STUDY OF FELDSPARS FROM CONȚU-NEGOVANU PEGMATITES (LOTRU-CIBIN MTS.)

ANDRONE, D. A-M. *(University „Al.I.Cuza" Iaşi, 20A Carol I Blv., 6600 Iaşi, România)*, KASPER, H. U., SCHOENBECK, T. *(Geological Institute of University of Köln, Zülpicher Str.49A, D-50674 Köln, Germany)*

E-mail: dandrone@gemma.geo.uaic.ro

I.Introduction

Pegmatites have for a long time justified the interest they inspire by their great variety and richness of constituents, as well as by the challenging petrogenetical and geochemical questions they imply. The granitic pegmatites are an important source of minerals with classical use, such as: optical quartz and fluorite, ceramic and dental feldspars, refractory spodumene, gemstones (beryl, chrysoberyl, tourmaline, zircon, topaz, garnet *etc.*), but also, a source of a broad spectrum of hi-tech metals with general long-range technological potential: Li, Rb, Cs, Be, Ga, Sc, Y, REE, Sn, Nb, Ta, U, Th, Hf *etc.*

The aim of this paper is to provide background information on the geochemistry of the Conțu–Negovanu pegmatites, beginning with the chemical composition and the trace element geochemistry of the K-feldspar and plagioclase from these rocks.

II. Geological setting

The Conțu-Negovanu pegmatite area is located in the central part of the Southern Carpathians, in the northernmost Lotru Mts., on the slopes of Conțu valley, a tributary to the Sadu valley. All this area is assigned to the Precambrian Sebeş-Lotru group, considered to be the most extended mesometamorphic entity in the Getic Realm. The Sebeş-Lotru group is represented by a lower migmatitic complex and upper kyanite-staurolite-bearing micaschists; these petrographic complexes host pegmatites and manganese silicate rocks, as well as tectonic inclusions of other different kinds of rocks, such as: eclogites, granulites and metaultramafites (Berza *et al.,*1994). The internal features of the pegmatite bodies show an incomplete zoning, the best represented being the aplite and the intermediate zones (Maieru *et al.*,1968). The former is constituted by albite-oligoclase, biotite and quartz, whereas the latter shows no differentiation of the quartz core and is represented by the typical mineral assemblage: albite (cleavelandite) + spodumene + quartz + (Li)-muscovite (Săbău *et al.*,1989; Murariu & Gandrabura,1992-1993; Murariu,1995a,1995b).

III. Samples and analytical methods

Eight feldspar samples have been collected from the Conțu-Negovanu pegmatites, developed in different mineral assemblages and displaying various physical properties.

In X-ray fluorescence technique, bulk analyses were performed with a Philips PW2400 X-ray spectrometer at the Institut for Mineralogy and Geochemistry of the University of Köln (Germany), using the analytical procedure called "oxiquant". Seventy-two natural rocks and clays were used to determine the calibration curves of the pertinent elements. In ICP-MS technique, the rare earth elements and some other trace elements were measured only in few samples, with a Perkin Elmer/Sciex ELAN 6000 ICP-MS (quadrupole mass spectrometer) at the Geological Institute of the University of Köln (Germany).

IV. Major and trace element geochemistry

The chemical analyses performed on the eight investigated samples allowed the quantitative data to be recalculated on the basis of 8 oxygen atoms in the unit cell and the estimation of the normative composition of the feldspars. The bulk analyses revealed that some samples may be referred to as alkali-feldspars: K-feldspars (F-51, F-52 – containing 65%-79%Or) and Na-feldspars (F-53 – containing 95%Ab; 3%An). The other samples are essentially Na-rich (up to 86%Ab), some of them containing rather important amounts of Ca (11%-26%An) and thus, are ascribed to the plagioclase feldspar series. The plagioclase chemical data show that the *albite-anorthite* solid solution terms usually found in the Conțu-Negovanu pegmatites are placed within the albite-oligoclase range. The study of the feldspar structural formulae (table 1) reveals a rather large range of *M* site occupations in plagioclase (0.721-0.963) and a much-limited one in K-feldspars (0.966-0.977). The *T* site occupation data shows almost normal values for plagioclase and K-feldspar, respectively. Obviously, in the samples with Al^{IV} deficiency, there is also a Si excess and a deficiency in the *M* site occupation altogether (F-5A, F-18, F-53). The excess of Si may reflect a sample contamination with submicroscopic quartz grains, or more likely, the presence of very small quartz inclusions in feldspars. In both cases, the contamination is scarce and the fundamental feldspar type may be precisely defined, especially if using the Na, K, Ca chemical coefficient ratio.

Trace element distribution patterns in Conțu-Negovanu pegmatite feldspars show some particular features, providing more evidence for assigning these rocks to the rare-element type pegmatites, separated by Černy (1992).

Usually, two models of substitution are considered for K-feldspar: large cations entering the *M* sites and small cations accepted into the tetrahedral sites. The most prominent trace substituents for K are the compatible elements Ba and Sr (which also substitutes for Ca) and the incompatible elements Li, Rb, Cs, Pb. *Barium* and *strontium* show concentrations of 36-50ppm and 49-61ppm, respectively; they easily penetrate the feldspar lattice and may reach high concentrations because of their ionic radii size close to that of K. *Lithium,* which is not highly concentrated in K-feldspar, displays an unusual concentration: 875ppm (sample F-52), that may well reflect contamination with spodumene and/or Li-muscovite. *Rubidium,* a typically dispersed element with strong geochemical affinity for K, shows a great concentration in K-feldspar (1745-2100ppm), which matches the data presented by Černy (1982b) and Wang *et al.* (1986) for K-feldspar from rare-element pegmatites. *Caesium* concentration is up to 32ppm, high enough for this type of pegmatites, comparatively with the highly fractionated complex pegmatites, where concentrations of Cs routinely attain 2000-3000ppm (Černy, 1994). *Lead* is a trace element whose ionic radius is close to that of K, allowing the occupation to a certain degree of identical positions with those of K in the K-feldspars. Maximum contents of Pb are quoted mainly for amazonite from the *NYF* pegmatites (typically enriched in Nb, Y, F), ranging up to 10000ppm (Foord & Martin, 1979). Pb concentration shown by the Conțu-Negovanu pegmatite K-feldspars is of 364-389ppm, the highest in all K-feldspars from the Roumanian pegmatites. The most significant substitutents in the tetrahedral sites are: Fe^{2+}, Ga, P and potentially, B and Be. As for the iron, the analytical method used does not allow to establish the Fe^{3+}/Fe^{2+} ratio in the investigated samples. Therefore, neither the Fe^{2+} for Al substitution amount in the *T* sites can be estimated. Most of the Fe^{3+} seems to be usually present as discrete particles of hematite in the feldspar. Ga, B and Be analytical data are not available.

Table 1. Structural formula of Conțu-Negovanu pegmatite feldspars

Samples	Calculated formula
F-51	$(K_{0.635}\ Na_{0.332}\ Ca_{0.010})_{0.977}\ (Al_{1.022}\ Si_{2.964})_{3.986}$
F-52	$(K_{0.762}\ Na_{0.196}\ Ca_{0.008})_{0.966}\ (Al_{1,014}\ Si_{2,979})_{3.993}$
F-5A	$(Na_{0.738}\ Ca_{0.088}\ K_{0.031})_{0.857}\ (Al_{0.969}\ Si_{3.030})_{3,999}$
F-7	$(Na_{0.796}\ Ca_{0.156}\ K_{0.011})_{0.963}\ (Al_{1.160}\ Si_{2.844})_{4.004}$
F-18	$(Na_{0.609}\ Ca_{0.102}\ K_{0.010})_{0.721}\ (Al_{0.861}\ Si_{3.142})_{4,003}$
F-34	$(Na_{0.645}\ Ca_{0.228}\ K_{0.018})_{0.891}\ (Al_{1.147}\ Si_{2.855})_{4.002}$
F-53	$(Na_{0.696}\ Ca_{0.020}\ K_{0.021})_{0.737}\ (Al_{0.856}\ Si_{3.155})_{4.011}$
F-54	$(Na_{0.712}\ Ca_{0.214}\ K_{0.015})_{0.941}\ (Al_{1.167}\ Si_{2.831})_{3.998}$

Although considering the smaller cation in the *M* site, sodic plagioclase usually shows only a limited number of substituents, the investigated samples contain several trace elements, some of them in important amounts, comparable with those in K-feldspar. *Barium* concentration is up to 184ppm, with an average value of 65ppm Ba; *Strontium* shows much higher concentration, up to 844ppm. The large substituent alkalis *rubidium*, which usually presents negligible concentrations in plagioclase, shows rather important amounts: up to 36ppm Rb. *Lead* displays also high concentration, almost comparable with that of K-feldspar: up to 184ppm Pb, with an average value of 90ppm. *Niobium* and *tantalum,* of similar ionic radii (0.69Å and 0.68Å, respectively), usually occur together during most of the pegmatite-related geochemical processes, dispersed during the first stages and finally forming proper minerals, such as columbite and tantalite. In the investigated plagioclase samples, Nb concentrations attain 0.039-3.38ppm and those of Ta are in the 0.011-2.585ppm range. The *REE* (lanthanides and sometimes associated Y) usually substitute for Ca following several substitution mechanisms. The chondrite-normalized REE distribution patterns in Conțu-Negovanu pegmatite plagioclase display important differentiation: some samples show a strong positive Eu anomaly associated with a low HREE concentration (F-5A), or associated with a positive Yb anomaly (F-53) or a positive Tm and Lu anomaly (F54). Other samples show a moderate positive Ce anomaly, which may reflect a Ce concentration in biotite occurring in the mineral assemblage (F-34), associated with increased HREE concentration. One of these samples (F-6) shows also a negative Gd anomaly, probably due to a HREE concentration in the garnet occurring in the mineral assemblage of this sample.

References

BERZA, T., BALINTONI, I., IANCU, Viorica, SEGHEDI, Antoneta, HANN, H.P., 1994. South Carpathians. *Rom. Jour. of Tect. and Reg. Geol.,* 75, Suppl.2:37-50.

ČERNY, P., 1982a. Petrogenesis of granitic pegmatites. *In:* Granitic Pegmatites in Science and Industry, Mineral. Assoc. Canada, Short Course Handbook, 8: 405-461.

ČERNY, P., 1994. Evolution of feldspars in granitic pegmatite. *In:* Feldspars and their reactions. Ian Parsons (Ed.), NATO ASI Series, 421:501-535.

DULSKI, P. 2000. Reference materials for geochemical studies: New analytical data bz ICP-MS and critical discussion of reference values. *Geostandards Newsletter,* 25: 87-125.

RESEARCH ON THE ECOEFFICIENCY OF USING THE WASTES RESULTED FROM THE WOOD PRIMARY PROCESSING AS REGENABLE POWER SOURCE

COMAN, M., OROS, V. (North University Baia Mare)

Based on the particularities issued by the increasing carbon dioxide concentration in the atmosphere and the climate changes that we have already experienced, the regenerable power sources gain more and more ground (solar power, wind power, biomass, geothermal power, sea waves power).

At global level, simultaneously with these issues, the fossil fuels price is increasing by their quantitative decline and the more severe environment protection measures.

Starting with these issues, the authors of this work are presenting the results of some local experiments that could resolve both problems in a useful manner.

The local factor is represented by the existence of huge quantities of beech wood wastes resulted from the wood primary processing. These wastes could be used as biofuel by consensus with the durable development requests, as the wood accumulates solar energy, grows in our atmosphere taking carbon dioxide from air, minerals from soil energy from the Sun and eliminates oxygen, and when it is burned off, the carbon dioxide is eliminated back in the atmosphere. On the other hand, the caloric power of the wood is comparable to the other fuels currently used to warm our houses.

The conclusion of the experiments shows that the optimum solution for the presented issues depends mostly on the technologies and plant/equipment being used. The more and more performing and variable technologies, the particular requests of the wood processing industry and financially stimulating politics make bases of the ecoefficiency for using completely these regenerable power sources.

GEOLOGICAL STRUCTURE OF THE ȚICĂU CRYSTALLINE MASSIF

DENUȚ, I. (North University of Baia Mare, Dr. V. Babes, 62A, Baia Mare, Romania/Carola Mining Company, Copiapo, Chile), RADU, D.M. (S.C. SAMAX Romania S.R.L., Str. Moldovei 15/1, 430232 Baia Mare, Romania)

E-mail: ioandenut@yahoo.com, daniel@samax.sintec.ro

The Ticau crystalline massif is situated in the NW part of the Transylvania Basin, on the middle part of the Somes River. From the structural point of view, in the previous work, the Țicău Massif is considered an asymmetrical synclinal, with a NNV-SSE orientation, with a vertical limb, complicated by the presence of a few imbricate short folds which are faulted; generally, the faults are considered to be numerous and with directional, transverse and diagonal orientations.

In order to suggest a hypothesis concerning the macroscopic structure of Țicău, the corroboration of microtectonic data with those representing the area development of the rock bodies (lithons) was needed. On this basis we consider that the ***Țicău Massif is an anticline with an axis oriented NE-SV (N54°E) and general dip of 22° toward NE***. On the south-western half of the massif, the anticline is more clearly delimited with the left limb oriented N75°V/27°NNE, the right limb N30°E/27°E, the angle of the fold about 140°, whilst in the north-eastern half this looses in depth, being more than 170°. Consequently it is a gentle fold which plunges, considered as a periclinal termination of an anticline.

From a petrographic perspective, the massif is monotonous, being characterised by the presence of rocks with a high content in quartz, as quartz-rich varieties of gneisses and micaschists as well as quartzites and quartz schists (Denut, 2000). Using the mapping data, as well as the petrographic diagnosis grafted on the delimited structure, we tried to delimit some lithological units in the massif. This operation proved to be difficult to accomplish, due to the frequent alternation and the lack of some mark lithons. We recommend for the lithologic column of the Țicău Massif, five lithozones, delimited on the different relation between the micaschists and orthoclase gneisses, in a petrographic background generally dominated by the plagioclase gneisses and quartzose rocks:

1. The Secăturii Lithozone (450m) - comprises the following succession: at the base garnet-bearing quartz-plagioclase gneisses, followed by quartz-orthoclase gneisses, orthoclase-plagioclase schists, and quartz-orthoclase schists, in the superior part plagioclase gneiss. Only one lens was found of amphibole-bearing plagioclase gneisses (at the exit of the Someş Valley toward Cheud).

2. The Higiu Lithozone (1850m) - its petrographic background consists of plagioclase gneisses with frequent intercalations of micaschists (especially with garnets), more rarely quartzites and quartz schists; we notice the presence of amphibole lenses developed in its medial part (the left and right side of Someş, Higiului Valley, Îngustului Valley - the right side and Iacobulei Valley).

3. The Porcareț Lithozone (1100m) - consists of quartz-plagioclase gneisses with intercalations of orthoclase gneisses and quartz schists.

4. The Iadăra Lithozone (1300m) - characterised by the presence of quartz-rich rocks (quartz micaschists, quartz schists and quartzites), with the most frequent intercalations of garnet-bearing micaschists and very rarely of orthoclase gneisses.
5. The Stejera Lithozone (400m) - is remarked by the constant petrographic background, consisting of orthoclase gneisses and orthoclase-plagioclase schists with very rare quartzites intercalations.
The separations as quartz lenses, with variable dimensions, are frequently found in the Higiu and Iadăra Lithozones, and rarely in the others.

The structural image of the Țicău Massif is completed by the presence of folds and faults.

Folds. These are found on a macroscopic and mesoscopic scale. The presence of macroscopic folds as more or less intense undulations is supposed, due to some variation in the orientation of the foliation from one outcrop to another. The mesoscopic folds were observed in many outcrops, especially in the micaceous rocks. They vary very much in size, from millimetres or 3-4 cm height (sometime laid in the foliation plane), up to 25 cm or even metric dimensions. There were also observed ptygmatic microfolds, with a lobate shape and the axial plane almost parallel with the foliation.

Faults. The presence of faults is undoubtable in the Țicău Massif. Firstly, we can notice some cataclasis bands - sometimes tens of centimetres wide. There is quite a distance from observing and measuring their approximate orientation to the positioning on a map. Because of their discontinuities and the lack of mark elements, it is virtually impossible to map them properly. Though, we considered necessary to delimit by faults some sectors with the constant orientation of the structural elements (foliations and lineations) and different by the adjacent zones.

In the structural landscape of the massif we notice the presence (in the left side of Someş too) of a sector dominated by the presence of tabular bodies, a result of an advanced process of crushing and grinding, centimetres, sometimes even more than 20 cm. Their orientation may or may not be parallel to the foliation planes. We consider these bands as shearing planes, the whole sector as an intensely sheared zone. Probably this is the cause of an accentuated instability of the slope in this area, support walls being required in order to protect the railway and the road.

Mineral compositions were used to calculate the "equilibrium PT" for the mineral assemblages from micaschists and amphibolites. Two distinct paths were distinguished for Ticău massif, as shown in Radu (2003, figure b, d; this volume). The Central and Eastern part is represented by rocks in epidote-amphibolite facies, while in the Western part are cropping out rocks in amphibolite facies. Maximum PT extracted from calculations, around 600°C and 8-10 kbars, are near the wet melting curve of the granite with muscovite, explaining the rare presence of pegmatites and aplites in the Western part, where the highest temperatures were recorded.

References

DENUT, I. 2000. The petrography of the Țicău crystalline massif. Anuarul Institutului Geologic al României, 72: 29.
RADU, D.M. 2003. Thermobaric evolution of the metamorphic rocks from Preluca, Țicău and Codru massifs, NW Transylvania, Romania. This volume.

HYDROXYLAPATITE, BRUSHITE AND TARANAKITE IN THE BAT GUANO DEPOSIT IN PEŞTERA CU LILIECI DIN SATUL PEŞTERA (PIATRA CRAIULUI MOUNTAINS)

DUMITRAŞ, D.G., MARINCEA, Ş. (Geological Institute of Romania, Bucharest, RO-73844, Romania), DIACONU, G. ("Emil Racoviță" Institute of Speleology, 11, Frumoasă Str., RO-78114, Bucharest, Romania)

E-mail: delia@igr.ro

Peştera cu Lilieci din satul Peştera (the Cave with Bates in the Peştera village), also known as Peştera Mare or Peştera Bădichii, is located in the Piatra Craiului Massif (South Carpathians), at about 200 m eastward from the church of the Peştera village. The cave is developed in micritic limestones of Tithonic-Kimmeridgian age, which form an olistolite in the mass of the Moieciu conglomerates (Vraconian-Cenomanian). Including the small divergent galleries, the cave has only 162 m in length.

An important deposit of bat guano was identified in a small room located at about 20 m from the entry. This room hosts an active bat colony, whose development is favored by the stable microclimate, with medium temperatures of 10 – 11°C. This deposit is typical for a "dry" depositional system. Hydroxylapatite, brushite, taranakite, quartz and a birnessite-like material mainly compose the guano mass, but at its basis calcite (on the carbonatic floor) or small amounts of illite (the $2M_1$ polytype), interstratified kaolinite-illite and X-ray amorphous iron sesquioxides (near the limit with the *terra rossa*) were also identified. This paper aims to give some preliminary mineralogical data on the main mineral species in the deposit, issued from their examination by scanning electron microscopy (SEM), energy-dispersive electron microprobe (ESEM) and X-ray powder diffraction (XRD).

Hydroxylapatite occurs as cream to orange crusts of dull appearance, generally disposed on a carbonate support. SEM imagery shows that the crusts are composed of thin roughly hexagonal individual crystals, up to 0.1-μm thick and

10 μm across, flattened on (0001). They are frequently aggregate in clusters or rosette-like bunches of crystals. The crystal masses are highly fractured, and weathering products (probably brushite, but also some gel-like, iron-bearing phases) may be observed within the fractures. As proven by the XRD study, the mineral is well crystallized: the indices of crystallinity, calculated using the method proposed by Simpson (1964) vary between 0.04 and 0.07. The cell parameters calculated by least squares for two representative samples, on the basis of 25 and 23, respectively, XRD lines in the 2θ range 10 - 86° (Fe $K\alpha$ radiation, λ = 1,93735 Å), are: a = 9.413(5) Å, c = 6.861(5) Å, V = 526.5(5) $Å^3$, and a = 9.423(8) Å, c = 6.858(6) Å, V = 527.3(8) $Å^3$, respectively. Smaller values of the c cell parameter as compared with those found for the stoichiometric hydroxylapatite [e.g., a = 9.421(2) Å, c = 6.882(2) Å, Brunet et al., 1999] suggest the presence of a carbonate-hydroxylapatite.

Brushite forms earthy, snow-white aggregate of crystals, deposed on hydroxylapatite crusts or on fissures affecting the hydroxylapatite mass. SEM study shows that the aggregates are composed of finely bladed crystals, flattened on (010) and elongated toward a direction that may be [101] or [102]; they are up to 0.1 μm thick, 5 μm wide and 10 μm long. The unit cell parameters, calculated by least squares refinement from 54 XRD reflections of the most representative diffraction pattern (sample PPL 3 A), are: a = 5.803(3) Å, b = 15.159(5) Å, c = 6.235(2) Å and β = 116.39(2)°. They are reasonably close from those given by Beevers (1958) for the synthetic brushite [a = 5.812(2) Å, b = 15.180(3) Å, c = 6.239(2) Å, β = 116.43(3)°], which suggests a composition close to the stoichiometry.

Taranakite occurs as crusts or small veins of chalky appearance composed by clusters of crystals whose SEM examination shows roughly hexagonal forms. The mineral was found at the basis of the guano mass, near the contact with *terra rossa*. The individual crystals are platy on (0001) and show very few crystallographic forms from which only {0001} and $\{10\bar{1}2\}$ can be recognized. They are up to 10 μm across and 1μm thick. The mineral is typically associated with $2M_1$ illite and low (alpha) quartz. The cell parameters of a representative sample (PPL 6 B), calculated by least-squares refinement on the basis of 35 X-ray powder reflections univocally attributable to taranakite, are a = 8.690(4) Å, c = 95.84(10) Å, V = 6268(8) $Å^3$, $a:c$ = 0,091:1. They differs from those given by Dick *et al.* (1998) for the synthetic K-taranakite, $K_3Al_5(HPO_4)_6(PO_4)_2 \cdot 18H_2O$ [a = 8.7025(11) Å, c = 95.05(1) Å], the higher value of c suggesting (NH_4)-for-K substitutions.

Quartz occurs as milky-white clusters of crystals, embedded in the phosphate mass. The individual crystals composing these aggregates are up to 10 μm in diameter. The cell parameters obtained by least-squares refinement for a representative sample (PPL 2 A) are a = 4.912(3) Å c = 5.381(6) Å and V = 112.4(1) $Å^3$.

References

BEEVERS, C.A. 1958. The crystal structure of dicalcium phosphate dihydrate, $CaHPO_4 \cdot 2H_2O$. Acta Crystallogr., 11: 273-277.

BRUNET, F., ALLAN, D.R., REDFERN, A.T.S., ANGEL R.J., MILETICH, R., REICHMANN, H.J., SERGENT, J. & HANFLAND, M. 1999. Compressibility and thermal expansivity of synthetic apatites, $Ca_5(PO_4)_3X$ with X = OH, F and Cl. Eur. J. Mineral. 11: 1023-1035.

DICK, S., GOSSNER, U., WEISS, A., ROBL, C., GROSSMAN, G., OHMS, G. & ZEISKE, T. 1998. Taranakite - the mineral with the longest crystallographic axis. Inorg. Chim. Acta, 269: 47-57.

SIMPSON, D.R. 1964. The nature of alkali carbonate apatites. Am. Mineral., 49: 363-376.

STRUCTURAL INVESTIGATIONS OF MICA MINERALS WITH THE OBJECT OF SUITABILITY FOR K/AR RADIOMETRIC DATING

FÖLDVÁRI, M., KOVÁCS-PÁLFFY, P. (Geological Institute of Hungary, Budapest) PÉCSKAY, Z. (Institute of Nuclear Research of the Hungarian Academy of Science, Debrecen) HOMONNAY, Z. (Eötvös Loránd University, Department of Nuclear Chemistry, Budapest)

E-mail: foldvari@mafi.hu

During K/Ar age determination it is a common occurrence, that the measured age discordant to the age according to the geologic position. Sometimes the measured ages of different minerals of the same rock are different. The reason for the most part is that the rocks underwent transformation processes (K-metasomatism, diagenesis, weathering etc.) since their formation. In the case of sedimentary rocks it is expected, that radioactive decomposition products accumulated earlier remain in the minerals. According to experiments the most reliable age data may be obtained on the separated monomineral fractions of a rock. In most cases the selection of the sample for the age determination based only on optical microscopic investigations and there are limited possibilities to investigate the mineral fractions in detail.

From the radiometric dating point of view it is of a special importance that the selection of the sample being the most suitable for the investigation. This is only possible by the use of complementary methods. The interpretation of the K-Ar age determination of a sample depends considerably on the use of other analytical data (geochemical, mineralogical etc.).

According to experiments mica minerals that look intact optically, often give unreal radiometric age. It seems, that the fine structural changes, that result in the change of the K and Ar proportion traceable only by complex investigations. Beside the K/Ar dating and the determination of K content joint XRD, thermal analysis, FTIR, Mössbauer spectroscopy, microprobe, studies help to trace back the transitions. The mentioned methods may give information about the different elements of the structure.

Investigations were carried out partly on very pure mica samples separated from magmatic rocks with well-known stratigraphic position and also justified by radiometric age, to receive standard data, on the other hand:

- Comparative investigation of biotites of different acid tuff horizons (Lower, Middle and Upper Rhyolite Tuff),
- Correlation investigations of biotites of Miocene tuff horizons related to different volcanic centres (Bükk Foreland, Cserhát Mts., Romania-Transylvanian Island-Mts., etc.),
- Investigation of biotites with a radiometric age undoubtedly different from the geologic age,
- Investigation of biotites and other mica minerals of different genesis (sedimentary, igneous, metamorphic)

The results of the investigations until now suggest:

- The determination of K/Ar age take place on separated minerals without grinding, the other instrumental analytical investigations customary on powdered samples. According to our experiments and also data gained from literature the influence of the mechanical activation results in the pulverization of the structure of the mica mineral and the fine structure is not the same as at the measurement of the age. To clear the details one part of the investigations were carried out samples with and without grinding.
- According to the first experiments muscovite is more sensitive to grinding as biotite. The differences first of all in the case of thermoanalytical investigations are significant (molecular water uptake, low temperature dehydroxylation).
- The originally slightly weathered biotite decompose further during the pulverize, while the totally intact biotite is less sensitive to the grinding.
- Scattering of K/Ar data is connected with the parameters indicative of weathering (K content, molecular water content, low temperature dehydroxylation etc.)
- Investigations were carried out on different grain size fractions of the standard biotites. The experience is that the K/Ar age of distinct intact biotite grain size fractions differ from one another. K content and data of thermoanalyses of the different fractions of these samples are comparable with the radiometric age.
- Mössbauer investigations until now did not reflect oxidation processes between biotites that were originated from the same occurrence, however they show anomalous radiometric age. Based on the microprobe analysis the stability of the structure of biotites having more two valence cations in the octahedral layer (especially if it is less Fe^{2+}) is greater (resists better to weathering too) and these give better radiometric age.

The study is supported by the National Science Foundation (Project No. T 034 227). The authors express their gratitude for the support.

An. Inst. Geol. Rom., 73, Special Issue, Bucuresti, 2003

CORRELATING THE TUFFACEOUS DEPOSITS FROM MARAMUREŞ BASIN, NW ROMANIA

FÜLOP, A., (North University Baia Mare), CRIHAN, M. ("Petrol-Gaze" University Ploiesti)

Maramures Basin, located eastern from Gutai Mts. in the north western part of Romania, is a Neogene basin filled with Miocene sedimentary deposits with acid volcaniclastic of pyroclastic origin, interlayered. The pyroclastic sequences contain the well-known "Barsana tuff", the fine-grained tuffaceous component, largely transformed into zeolites. Some preliminary results have emphasized the complex intrabasinal relationships between syn-eruptive and post-eruptive resedimented pyroclastics and intrabasinal sedimentation. They reflect the magmatic origin of volcanic explosions combined with subsequent depositional mechanisms involved by the submarine environment. Three major tuffaceous levels have been identified.

The oldest tuffaceous deposits, underlain by the Paleogene flysch, occur in the eastern slope of Iza valley. They are represented by alternations of fine tuffs and pumice rich lapilli tuffs, suggesting the upper sequence of the distal facies of subaqueously emplaced pyroclastic flows. They have been dated as Early Badenian deposits. They may be correlated with a complex tuffaceous deposit identified on Arsita valley suggesting a proximal facies of pyroclastic flows.

Most of the tuffaceous deposits occur in the western slope of Iza valley, where two Late Badenian tuffaceous sequences have been identified.

The first sequence, well represented on Morii valley, is composed of pumice lapilli tuffs continuously overlain by fine zeolitic tuffs, suggesting resedimented pyroclastic flows with co-genetic fallout tuffs on top. This sequence has been identified in other different parts of the basin, significantly thinner.

The second sequence, composed of fine zeolitic tuffs is tens of meters thick on Morii valley, thinning towards the western part of the basin. The two Late Badenian tuffaceous deposits are separated by sedimentary deposits, a complex succession of sandstones and mudstones, suggesting hydroplastic flows triggered by a large slump or slide on the slope of the basin. These deposits have been widely recognized within the basin but getting thinner western from Iza valley.However, they are good indicators for correlating the major two levels of Late Badenian tuffaceous deposits.

(K, Na) Feldspar Systems – Raw Materials for Ceramics

GOREA, M., BALICA, C, POP, D. (Babes Bolyai University, Faculty of Biology and Geology, Department of Mineralogy, M. Kogalniceanu str. No. 1, 3400 Cluj Napoca, Romania)

E-mail: mgorea@bioge.ubbcluj.ro

Various feldspar species represent basic raw materials for whiteware, being used as firing flux. They provide the necessary melt phase that hosts the chemical reactions between the other components (especially clay minerals and silica), as well as binding matrix for the newly formed crystalline phases (mullite and quartz). The optimal amount of melt should be about 50-60 % in case of the high temperature-fired (1360°C) translucent porcelain. Also, a suitable viscosity must be reached in order to prevent any further deformation of products during the high temperature thermal treatment. Experimentally it was found that the K-feldspar give rise to a more viscous melt than the Na-feldspars, thus the first ones are more suitable for ceramic bodies, while the second ones are for ceramic glazes.

The composition of raw materials used for traditional ceramics can be described by (K_2O, Na_2O)-Al_2O_3-SiO_2 system, or its mineral equivalent Kaolinite-Feldspar-Quartz system. Their limits of variation are as follows: feldspars (20-25) %, silica (22-25) % clays and kaolin (50-52)%.

The aim of our study was to test the suitability for ceramics of a new local pegmatite type (FFC) instead of the formerly used feldspar-rich natural raw materials (FT and FA). The comparative chemical mineralogical features, as well as the thermal behavior were investigated. The chemical composition of the powdered raw materials submitted to several refinement procedures is presented below.

Sample	SiO_2	Al_2O_3	Fe_2O_3	Na_2O	K_2O	CaO	MgO	TiO_2	LOI
FT	70.40	18.48	0.22	5.43	4.24	0.56	0.05	0.01	0.61
FA	69.93	18.34	0.04	10.47	0.22	0.61	0.06	0.03	0.29
FFC	81.00	9.12	0.19	3.8	2.8	1.18	0.29	-	1.62

Mineralogical components of the sample are: FT – 92 % Na-feldspar; FA – 86 % Na-feldspar and 10 % quartz; FFC – 50 % Na-feldspar, 24 % K-feldspar and 23 % quartz. The thermal treatment highlighted one exothermal effect (melting point) – the case of samples FT (1270°C) and FA (1200°C), and two exotherms for sample FFC (1070°C, and 1150°C). In the latter case, the first effect is due to a quasi-eutectic composition in the limited solid solution of the albite-orthoclase system (eutectic temperature of 1076°C), and the second one to the melting of the remaining Na-feldspar component around the melting point of albite (1118°C).

Considering the results, the advantages of using quartz-rich, K+Na-feldspar-containing pegmatite (FFC) are as follows:

- increasing the viscosity of the melted phase
- decreasing of firing temperature with about 1000°C,
- increasing of mullite and decreasing of quartz content in the microstructure of the final product.

Mineral luminiscence in visible Spectrum using Becquerel fosforoscope

GÖTZ, A. (S.C. ICPM S.A. Baia Mare, Dr. V. Babes Street 62, Baia Mare)

The author has prepared an instrument based on Becquerel fosforoscope that was able to make observations on mineral luminiscence by excitation in the visible spectrum. The equipment, the observation methods are described, and preliminary results are presented.

An. Inst. Geol. Rom., 73, Special Issue, Bucuresti, 2003

Mineralisation Controls in the Baia Mare District, Romania

HALGA S. (SAMAX Romania SRL, str. Moldovei 15/1, 430232 Baia Mare, Romania)

E-mail : sorin@samax.sintec.ro

The base metals, gold-silver deposits in the Baia Mare district occur within the Neogene Inner Carpathian volcanic arc. Some of the largest deposits in the Baia Mare district are localised along the crustal-scale East-West striking Bogdan Voda fault zone that was active from Cretaceous (?) through to Neogene.

The primary structural control of the mineralisations in the Baia Mare district is represented by the intersection of the East-West Bogdan Voda fault zone with the Northwest trending Neogene volcanic-arc front (Ruff and Stefanini, 2001). The secondary mineralisation controls in the Baia Mare district (at the deposit scale) are represented both by structural (tectonic) and magmatic components that can be summarised as follow:

Tectonic components – the Bogdan Voda fault zone, located on the southern edge of the Gutai Mts. acted as a senestral strike-slip shear corridor with an estimated width of 1 to 5km. The shear corridor created a set of openings in concordance with the Riedel model (see Figure 1).

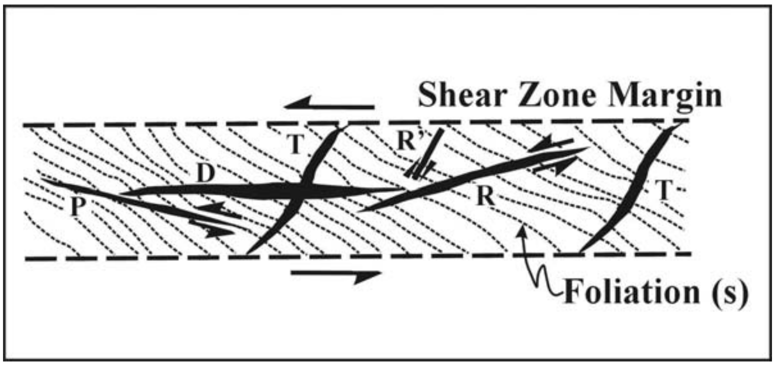


Figure 1: Shear and tension fractures in a Riedel shear-zone model

The most common mineralisations in the Baia Mare district are the ones located on T-type tension fractures: Boldut and Roata (Cavnic), Ilba (V. Baii), Sasar (Aurum, V. Rosie). Another type of vein-systems, more important in terms of volume and horizontal/vertical development is the one located on R-type shears: Baia Sprie – Suior alignment and Baiut (Providenta Divina and Robu vein systems).

Magmatic components – intrusive, effusive and explosive processes represent the magmatic components that control the mineralisations in the Baia Mare district.

In the Baia Mare district the intrusions are aligned on a WNW-ESE direction, relatively parallel to the Neogene volcanic arc-front. A clear intrusive control over the mineralisation can be observed in the following deposits: Nistru (11 Iunie), Herja, Baiut (Petru, Pavel), Poiana Botizei (Cizma, Coasta Ursului), and Varatec (see Figure 2).

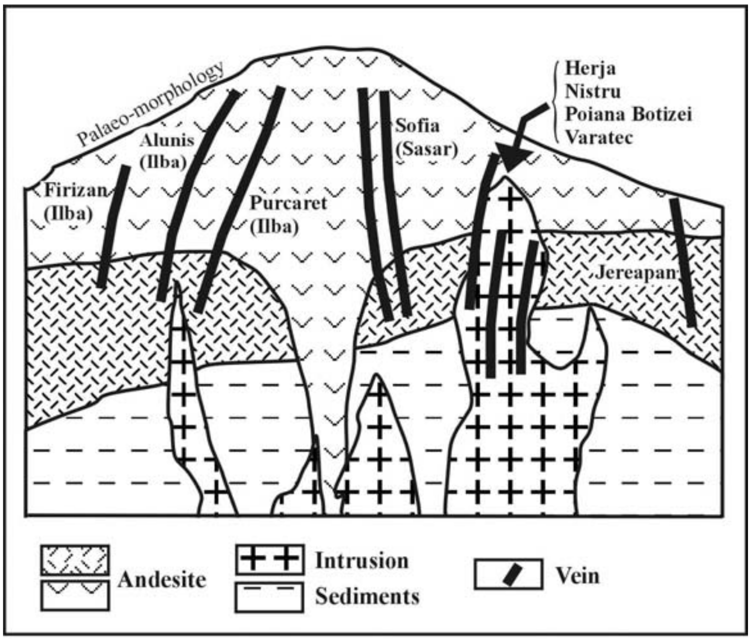


Figure 2. The magmatic control for some deposits in the Baia Mare district

Effusive products (thick lava-flows and clastic lavas) are typical host-rocks for mineralisations mainly West of Firiza Valley. This type of mineralisation can be identified at Ilba (Purcaret, Firizan and Alunis), Nistru (9 Mai), Sasar (Sofia) and Jereapan (see Figure 2). A specific case represents the Ulmoasa flow-dome dacite that is responsible for the mineralisations from Tyuzosa, Wilhelm and Fractura Nordica (Baita-Sasar).

Phreato-magmatic explosions were responsible for the host-rock formation of the stockwork mineralisations from Racsa while near-surface secondary boiling processes of rich water and volatiles magmas generated the base metal breccia-pipe deposit from Kelemen.

References:

HALGA, S., 1998. A Comparative Study of the Mineralised Structures within the Baia Mare District. Al. I. Cuza University of Iasi, PhD Thesis (in Romanian), 135 p.

RUFF, R., STEFANINI. B., 2001. Gold Occurrences in the Eastern Part of the Baia Mare District, Romania, Rom. Journ. Min. Dep., Vol. 79, Suppl. 2, 92-93

MINERALOGY, ORIGIN AND METAMORPHISM OF Mn DEPOSITS FROM BISTRITA MTS, EAST CARPATHIANS, ROMANIA

HIRTOPANU P., Geological Institute of Romania, 1 Caransebes street, Bucharest, Romania

E-mail: Paulina.Hirtopanu@igr.ro

Bistrita Mountains is a part of the Crystalline Mesozoic Zone of the East Carpathians which consists of superposed Variscan and Alpine Nappes, overthrusting eastwards over the Flysch Zone. The manganese ore is contained in Tulghes Group (Tg2 level), of the Variscan Putna Nappe, situated over Pietrosu Bistritei Nappe and supporting the Rebra Nappe. All these Variscan Nappes constitute in their turn, the Alpine Sub-Bucovinian Nappe, localised between Alpine Infrabucovinian Nappe in the East and the Alpine Bucovinian Nappe in the West.

The predominantly hydrothermal submarine source for Bistrita Mn deposits (derived from underlying oceanic basalt in Cambrian Ocean), have been established by textural, mineralogical, chemical and geochemical evidences. The banded nature of Bistrita Mn ore reflects original sedimentary layering; the original sedimentary hydrothermal textures and the geochemical signatures are preserved in Mn Bistrita deposits which were metamorphosed at variable T and P during the time. Each band represents different bulk compositions and the same lithology units are repeated on the scale of a samples and even at microscopical scale. There are 16 lithological types ore types (spessartine, tephroite, Mn-humite, rhodonite, pyroxmangite, johannsenite, nambulite etc). The mineralogy of Bistrita Mn ore includes about 325 identified minerals and variety minerals; some of them have petrological significance in the establishement of T,P, fO_2, fS2, Xfluide , etc metamorphism conditions. 78minerals are news for our country. Such big mineralogical varity is specific to the ocean floor deposits which are associated to subduction zones, where the fluid volume is very large. The chemical evidences for the submarine hydrothermalism are the frequent presence of the end terms minerals: tephroite, manganese humite, pyrophanite, rodonite, alabandite, cattierite, aegirine, jacobsite, etc. The changing P, T and oxidation conditions of the polyphasic metamorphism induced the transformation of the same mineral from one variety to an other one, like pyroxenes, amphiboles, garnets, also pyroxenes in pyroxenoids (johannsenite in rhodonite), pyroxenoid in pyroxenoid (pyroxmangite in rhodonite), etc. The repeated metamorphisms in which, beside the P,T, etc variations, the strongly varied fluid compositions, Xfluid, were source of new minerals.

The fO_2 evaluation has been made from the different phase compatibility (assemblages) for each lithological rock and/or ore type: Tg2 10^{-17}-10^{-23}, black quartzites 10^{-23}-10^{-17}, rhodochrositic ore below 10^{-25}, undersaturated associations 10^{-12}-10^{-17}, saturated associations 10^{-7} –10^{-3}. Generally, the oxidised asociations were equilibrated later than the reduced ones, represented by carbonate-silicate ore and contry rock. In the oxidised zone the fO_2 is variable, 10^{-3}/+5.

Metamorphic reactions and the P-T path of the Bistrita ores suggest that they have undergone at least five stages of recrystallisation. The sequences of mineral growth belong to M_1, M_2, M_3, M_4 and M_5 metamorphic events. We supose that the M_1 (?)was a HP/LT event, when the calderite garnets in a subducted zone probably have formed, at P ca 25-30kb and T ca 600°C. The calderite garnets are limited to particular physical conditions as proved experimentally (Lattard & Schreyer, 1983). The first garnet from BM ore was probable calderite that breaks down to the less dense paragenesses, pyroxmangite-magnetite (to the end of M_1 metamorphic event), which frecvently occurs. Pyroxmangite-magnetite assemblages expermentally appears at P and T between 26Kb/750°C and 32Kb/1100°C. During the later retrograde (?) event (M_2), the ores underwent an isothermal decompression and a widespread amphibolite to granulite facies overprinted. Uplift occurred with a continuous heating during early stages of pressure release. The johannsenite, Fe-tephroite and rhodonite (from pyroxmangite) assemblages were formed during M_2 event, generally at low pressure and high temperature (ca 5kb/700°C). In the first stage of M_3 metamorphic event there were formed tephroite from Fe-tephroite and rhodonite from johannsenite; in the second stage of M_3 the Mn-humite and the nambulite assemblages from tephroite-rhodonite, the mangangrunerite evolved from pyroxmangite, and a pyroxene rich in jadeite and aegirine evolved from unknown old jadeite-omphacite pyroxene. During the M_4 metamorphic event the conditions of metamorphism were drastically changed by appearance of alkali amphiboles and pyroxenes. This moment marked a return again to a HP/LT metamorphism, but at its lowest conditions. Based of jadeite content in pyroxene, we evaluated the pressure at ca 9kb and temperature ca 450°C. The M_4 event may be related to an Alpine type subduction, involving continental collision and enabling Alpine Nappes to develop, while the M_1 event was probably interoceanic subduction related event. The M_5 shows dominantly greenschists assemblages, overprinting all the previously ones. Manganiferous phyllosilicates (manganpyrosmalite, friedelite, schallerite, caryopilite, nelenite) grown at the expence of anhydrous silicates as a function of the fluid composition, i.e., the availability of chlorine and arsenic, in a very H_2O rich fluid. The presence of CO_2 in these fluids is indicated by the retrograde formation of Mn-carbonates. Also, bannisterite, ganophyllite, stilpnomelane, serpentine like minerals and many types of chlorite abundantly occur.

The clockwise trend of metamorphism is in agreement with the structure of the complicated tectonic setting of the Crystalline Mesozoic Zone, being specific for superimposed zones by trusthing. Mn ores from BM belong to the type of volcano-sedimentary sequences derived from disrupted ophiolite+chert+sediment associations (cf. Mottana, 1986). The Bistrita ore is "an oceanic" sequence reworked in a volcano-sedimentary environment so as to contain contaminated bulk compositions characterized by both oxidised and reduced assemblages. We supose, that the Bistrita Mn ore belongs, like Haute-Maurienne, St Marcel, Andros occurrences (Mottana,1986), to the blueschist-facies terrains.

References

LATTARD, D. & SCHREYER, W., 1983. Synthesis and stability of the garnet calderite in the system Fe-Mn-Si-O, Contrib.Mineral., v.84, p.199-214.

MOTTANA, A., 1986. Blueschist-facies metamorphism of manganiferous chert: A review of the alpine occurrences, Geological Society of America, Memoir 164, p.267-299.

LEAD – ZINC ± GOLD MINERALIZATIONS FROM PURCĂREȚ AREA (ILBA)

IŞTVAN, D. (S.C. IPEG MARAMUREŞ S.A., Baia Mare, Str. Victoriei nr. 146), VIDA, S., MORAR, O. (S.C. HM FLASH TRADING S.R.L., Baia Mare, Str. Garii 3B/79)

E-mail: flashbm@rdslink.ro

Baia Mare metallogenetic district is the most important metallogenetic area from Eastern Carpathians, associated to a transform crustal fault: Cârlibaba – Baia Mare – Carei. In Baia Mare area, this fracture represents the limit between the Carpathian geosyncline and the Median Pannonic Massive. It is an area with a prolonged volcanic activity (from Badenian to Pontian), with still active geothermal anomalies, which underlain an elongated pluton responsible for this metallogenetic activity.

Lead – zinc ± gold (base metal ± gold) mineralizations from Purcăreț are emplaced in Racşa – Ilba – Băița metallogenetic field, associated to a rise of the Paleogene basement with abundant intrusions (Mesteacănul valley, Nistru – Nepomuc). Major fractures are present (V. Băii Nord, Țapu – Alexandru, Mihai – Nepomuc), fields of fractures (V. Roşie, Fața Mare, Gheroldy – Plopăț, Nucuț – Baltoş) and small Sarmatian andesitic structures as well (Fătuțoaia – Speranța, Nistru – 9 Mai).

Southern from the area with mineralizations, an area filled with volcanic rocks delineates a „volcanic graben" between the regional Dragoş Vodă and Bogdan Vodă faults. It becomes wider from east (Baia Sprie) towards west (Băița – Ilba).

Purcăreț structure has about 3-4 km diametre and consists of a suprastructure composed of Nistru pyroxene basaltic andesites (Sarmatian) and Purcăreț pyroxene ± hornblende fluidal andesites (Sarmatian – Pannonian), with a total thickness of 400 m in the central area and 200 m at the borders. It is emplaced southern from Mihai – Nepomuc fracture and hosts a group of vein type mineralizations, which have been investigated since 1977 and are still mined.

The ore has a breccious texture, 50-500 m thickness and an average thickness of 0,4-6,6 m with a common paragenesis (pyrite, sphalerite, galena ± chalcopyrite, marcasite). Gold is present either in a free form or associated to sulfides allowing separation of two levels: a base metal ± gold level and a gold-rich level (with high grades). The first level has 200 m thickness and the second one has up to 100 m thickness.

The vein orientation is very different: NW – SE (530, 520, Purcăreț II, 500, Purcăreț I veins), NE – SW (550, 513, Purcăreț III veins) or E – W (524, 525 veins). At the upper part of some veins, an important secondary gold enrichment occurs associated to the oxidation zone. Some of the veins are not outcropping (for example Purcăreț structure has been initially considered a typical structure shielded by rocks following the ore) and others have a vertically reduced development (generally with a peripheral position from Purcăreț Peak).

One may explain the vertical development of ore in areas with a high thickness of Sarmatian – Pannonian andezitic rocks rather by the mechanical compatibility to fracture of these rocks, than by the genetically association with a volcanic structure, suggested by the lack of a planar zonality typical for ore generated by post magmatic fluids related to such a structure.

A certain zonality emphasized on a N-S direction may reflect the presence of paleogeothermal conductive systems with southern feeding, systems that may remobilize and redeposit preexistent crustal concentrations.

An. Inst. Geol. Rom., 73, Special Issue, Bucuresti, 2003

PETROLOGICAL AND GEOCHEMICAL CONSIDERATIONS ON THE OHABA CHONDRITE

IANCU, O. G., (University "Al. I. Cuza" of Iasi, Department of Mineralogy and Geochemistry, 20 A Carol I Blv., RO-6600 Iaşi, Romania)

E-mail: gabiiancu@geo.uaic.ro

The Ohaba meteorite fell in October 11, 1857, in Transylvania (Alba District). After appearance of a fireball, followed by detonations, a stone of 16.25 kg was found by a priest (Graham et al., 1985). The fragments recovered are kept in 16 museums from 11 countries. The Museum of Natural History from Vienna is the repository of the main mass (15.73 kg; Fig. 1). The meteorite was previously classified as an H5 veined ordinary chondrite, based on olivine composition – Fa_{20} published by Mason (1963).

Fig. 1 – The main mass of the Ohaba meteorite, from the Museum of Natural History, Vienna

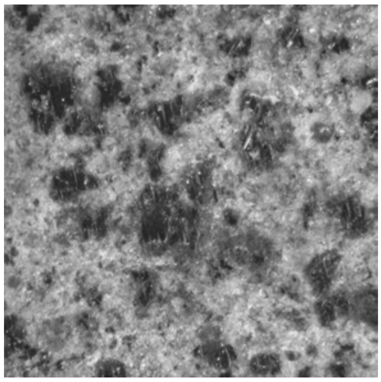


Fig. 2 – Macroscopic features of the Ohaba meteorite, sample from the Mineralogical Museum of the „Babeş- Bolyai" University, L = 5 mm

Two polished thin sections representing the Ohaba chondrite were studied under the microscope in both transmitted and reflected light. In order to determine the shock degree of this chondrite, in every thin section, ten to twenty of the largest, randomly distributed olivine single crystals and the largest plagioclase grains were examined with 20x- or 40x-objectives (cf. Stöffler et al., 1991) and with the electron microprobe. Quantitative chemical analyses of the constituent minerals were obtained on the carbon-coated, polished thin sections by using a JEOL JSM-6400 scanning electron microscope at the Museum of Natural History from Vienna. The instrument was operated at an accelerated voltage of 15 kV, a 38.5 nA beam current and 39 mm working distance. About 30 points of both olivine and orthopyroxene were measured on each thin section.

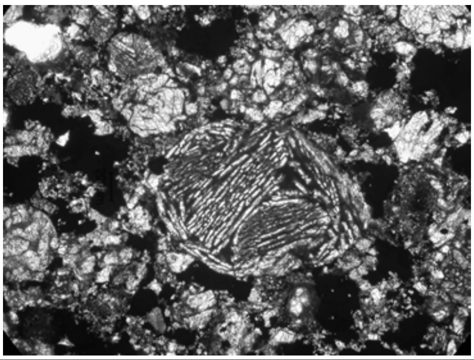


Fig.3 - Readily distinguished BO chondrule, 1N, sample from the Museum of Natural History, Vienna

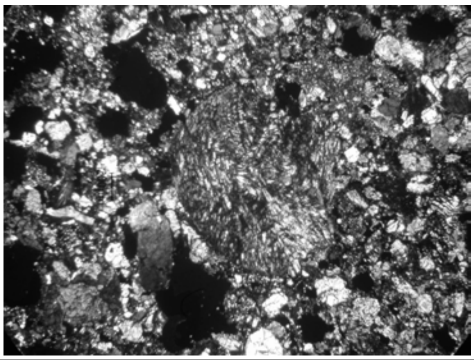


Fig.4 - Readily distinguished GOP chondrule, 1N, sample from the Museum of Natural History, Vienna

The microscopic study in thin sections revealed the presence of the following types of chondrules in the Ohaba chondrite: readily distinguished PO – porphyritic olivine, RP – radial pyroxene, BO – barred olivine (sometimes polysomatic; Fig. 3) and GOP – granular olivine-pyroxene chondrules (Fig. 4), ranging in size from 300 µm to up 1200 µm. The matrix is recrystallized, the feldspar ($An_{15}Or_3$) occurs in grains smaller than 50 µm and the igneous glass is absent. Pyroxenes are mainly orthopyroxenes but less than 10% of the grains are clinopyroxenes with Wo_{37} (mole percentage), which is similar to diopside composition. Other minerals identified in polished thin sections are kamacite, troilite, taenite, plessite, cromite and magnetite.

Based on petrographic data, the Ohaba chondrite is classified as petrologic type 5 (cf. Table 1), consistent with the data printed in Graham et al. (1985).

Analysis of 15 olivine grains from two thin sections shows a variation in composition from Fa_{14} to Fa_{15} mole% fayalite (avg. Fa_{15}; PMD 2.2%). Twelve orthopyroxene grains from thin sections show a range in composition from Fs_{13} to Fs_{16} mole % ferrosilite (avg. Fs_{14}; PMD 6.06%).

Taking into account the iron-content of olivine plotted against iron-content of orthopyroxene (Keil and Fredriksson, 1964), Ohaba meteorite may be considered as an ordinary chondrite – H_5, belonging to the primitive meteorites class (Fig. 5), consistent as well with the data published by Graham et al. (1985).

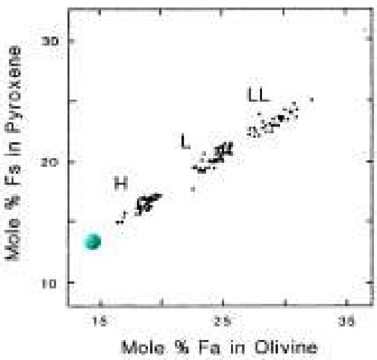


Fig. 5 - Iron-content of olivine plotted against iron-content of orthopyroxene (from Keil and Fredriksson, 1964)

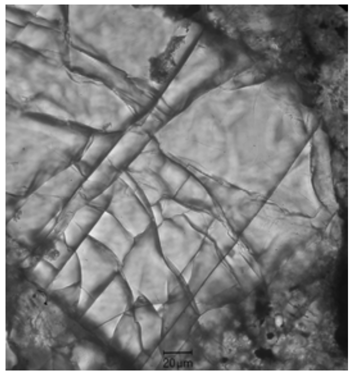


Fig. 6 – Olivine with one set of paralel planar fractures, 1N

In order to determine the mineralogical effects of shock metamorphism in the Ohaba meteorite, ten to twenty of the largest, randomly distributed olivine single crystals were examined in every thin section by optical polarizing microscope with 20x- or 40x- objectives (cf. Stöffler et al., 1991) and with a JEOL JSM-5400 scanning electron microscope for higher magnifications. Because olivine shows planar fractures (Fig 6), undulatory extinction and irregular fractures and plagioclase has also undulatory extinction, the shock degree of this chondrite may be estimated as S-3, weakly shocked (cf. Table 2).

Table 1. Petrographic type determined by textural characteristics of the Ohaba meteorite (cf. Taylor, 1992).

Texture of chondrule	Texture of matrix	Igneous glass	Development of feldspar	Low-Ca pyroxene	PMD (Avg.)	Petrologic type
Readily distinguished	Recrystallized	Absent	Grains <50μm	opx+cpx (~10%)	Fa: 2.2 Fs: 6.1	5

Table 2. The estimation of shock degree for the Ohaba meteorite (cf. Stöffler et al., 1991).

Olivine	Plagioclase	Effects resulting from local P-T excursions	Shock degree	Shock pressure (Gpa)
Planar fractures, undulatory extinction, irregular fractures	Undulatory extinction	Opaque shock veins Melt pockets	S-3 weakly shocked	15-20

We are grateful to Dr. Gero Kurat and Dr. Franz Brandstaetter from the Museum of Natural History, Vienna, for helpful discussions and for providing me the samples used in this study.

This work was supported in part by a Grant from the Romanian National University Research Council.

References

GRAHAM, A.L., BEVAN, A.W.R., HUTCHISON R., 1985. Catalogue of meteorites; with special reference to those represented in the collection of the British Museum (Natural History), 4th ed., *British Museum (Natural History),* London, 460.

MASON, B. (1963) Olivine composition in chondrites. *Geochimica et Cosmochimica Acta, **27***, 1011-1023.

STÖFFLER, D., KEIL, K., SCOTT, E. R. D.,1991. Shock metamorphism of ordinary chondrites, *Geochim. Cosmochim. Acta*, 55, Pergamon Press.

KEIL, K., FREDRIKSSON, K., 1964. The iron, magnesium and calcium distribution in coexisting olivines and rhombic pyroxenes in chondrites. *J. Geophys. Res*., 64, 3487-3515.

An. Inst. Geol. Rom., 73, Special Issue, Bucuresti, 2003

NEW CALEDONIA – MINING AND ENVIRONMENTAL PROTECTION. IMPRESSIONS FROM THE INTERNATIONAL SYMPOSIUM "PRESERVATION ET RESTAURATION ECOLOGIQUE EN ENVIRONMENT TROPICAL MINIER"

KÁLMAR, J. (Geological Institute of Hungary, Budapest)

E-mail: kalmarj@mafi.hu

Between 15-20 July 2003 there was an International Symposium "Preservation et restauration ecologique en environment tropical minier" in Noumea (New Caledonia) organized by the New Caledonia University and the Institute for Research and Development. The author participated along with dr. Laszlo Kuti, the head of the environmental geology department of MAFI with a paper on "Geological conditions of the natural reclamation of the mine tailings and dumps".

New Caledonia is located in the western part of the Pacific, on the Tropics, about 1500 km from Australia, and represents a fragment of the megacontinent Gondwana, drifting away from the Australian plate since the Upper Cretaceous. It is composed of Precambrian gneisses and micaschists, which along a N-S lineament are thrusted over the mesocretaceous ophiolites. These ophiolites with numerous ultrabasic rocks (dunites, peridotites, harzburgite), partly serpentinised host nickel deposits, accounting for 10-15% of the worlds production.

The primary nickel deposits (nickeliferous pyrhotite, pentlandite, nickeline, olivine and Ni-bearing pyroxenes) are present in ultrabasic rocks. Nickel has been mobilized during serpetinisation, creating veinlets and small lenses of garnierite (a complex of minerals like pimelite, Ni-bearing saponite, wilhelmite and nickeliferous chrysotile). The garnierite veinlets form breccias structures mineable if the total content exceeds 2% Ni. Higher content of Ni, up to 8% are found also in the lateritic crust coverint the main plateau and the higher peaks. As by-products there is cobalt, chromium, titanium, vanadium and rare earths.

The extraction technique is relatively simple. The ore is dried, calcined in coke rotary kilns and melted in electric ovens, separating the magnesium and nickel slag. This is injected in seawater recipients creating pellets with 20-25% Ni which are delivered to the steelworks.

Mining of nickel has begun in the late XIX century and boomed near the First World War. During WW 2, New Caledonia was a target for Japanese invasion that was never achieved as it was protected by Australia. Up to the 70's due to intensive mining, on the steep slopes there were millions of cubic meters of tailings composed of serpentinite and lateritic clays. The erosion, which is very active on the island, has transported massive amounts of tailings blocking valleys, sea gulf areas damaging the fish and the mangrove areas. Also the clays suspended in the water have affected the coral reef.

Under the pressure of the authorities and environmental groups on the island, mining companies have been forced to change the technology, from stripping and mining to metallurgy. A good example was during the visit to Koniambo where Falconbridge has launched an environmental project. The final result of the project for 2006 is 200,000 t of ferronickel will be accomplished following the strictest environmental protection rules. There are terassing works, re-vegetation of old tailings projects, and a network of dams for water de-pollution.

The Symposium was attended by specialists from 22 countries, with environmentalists, biologists, chemists, mining and metallurgy consultants all attending. The presence of 2 Europeans was saluted, with the author having to explain to non-specialists the geologic problems with an environmental impact linked to mining works.

PREPARATION OF A LOESS SEDIMENT AS A CANDIDATE REFERENCE MATERIAL - GEOPROFICIENCY TEST (GeoPT) FOR ANALYTICAL GEOCHEMISTRY LABORATORIES ROUND 13

KASPER, H. U. (Geologisches Institut, Universitaet zu Koeln, Zuelpicher Str. 49A, D-50674 Koeln), POTTS, P.J., WEBB, P. C (Department of Earth Sciences, The Open University, Milton Keynes, MK7 6AA, UK), THOMPSON, M. (Department of Chemistry, Birkbeck College, Gordon House, London, WC1H 0PP, UK), CHENERY, S.R.N. (British Geological Survey, Keyworth, Nottingham, NG12 5GG, UK), PREUSSER, F. (Institut für Geologie, Universität Bern, Baltzerstrasse 1-3, CH-3012 Bern)

E-mail: hu.kasper@uni-koeln.de

The sample was prepared as a GeoPT proficiency testing sample and further to contribute data to the certification as a candidate reference material. The loess sample was collected and prepared under the direction of H.U. Kasper, University of Cologne, Germany.

More than 10% of the land surface worldwide is covered by loess (e.g. Rhine basin, Chinese loess plateau, North-American prairies, Siberian loess plateau). Loess is a wind blown dust accumulated in periglacial areas during the ice ages. Today loess formation is still a major land forming process in e.g. the interior arid parts of Eurasia. The cultural development of man is closely related to loess distribution as it is a very fertile soil and, thus, loess regions are the most productive agricultural areas. In addition, loess palaeosol sequences are of significant importance for palaeoclimate reconstruction.

However, regardless of its importance in many fields of geosciences, there is no international geochemical loess standard available at all. The material provenance is from Nussloch, 10 km South of Heidelberg and 3 km East of the upper Rhine Graben, Germany (49° 19' N, 8° 43' E and 217 m above sea level. The basement of the loess consists of Middle Triassic limestone and dolomite ('Muschelkalk'). The main section comprises 16 m thick loess deposits from the Würmian. The sample was collected from the upper Würmian loess that was deposited as part of the last glacial - interglacial cycle, 15,000 - 20,000 a BP.

Examination of this sample indicates that the main mineralogical components are quartz, feldspar, carbonate phases, mica, clay minerals and iron-rich minerals. The sample also contains accessory zircon, rutile, tourmaline, anatase, brookite, garnet, epidote and amphibole.

The location is easily accessible and close to the type locality of loess described by K. C. von Leonhard in 1824. The sample material is available in any desired quantity. As LOESS-1 is of Pleistocene age, lying well below ground level, it is free of any anthropogenic contaminants. The element concentration is most probably representative for loess sediments.

Sample processing performed in co-operation with RETSCH® followed a rigorous scheme of drying, crushing, sieving and repeated partitioning to a final of 160 packets of 60 g each.

Homogeneity testing was based on analyses of duplicate test portions taken from each of 10 (for minors 16) packets, which had been selected at random. These samples were analysed in duplicate by WD-XRF at the Open University for the major and minor elements (SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, LOI) on glass discs and the trace elements (As, Ba, Co, Cr, Cu, Ga, Mo, Nb, Ni, Pb, Rb, S, Sc, Sr, Th, U, V, Y, Zn, Zr) on powder pellets, following the procedures described GeoPT 1 report. For the elements for which values could be assigned, homogeneity was considered to be satisfactory for use in the GeoPT13 round.

Results from eighty-nine laboratories are presented for GeoPT13, round thirteen of the GeoPT international proficiency testing programme for analytical geochemistry laboratories. Following elements were judged to have satisfactory distributions: SiO_2, TiO_2, Al_2O_3, Fe_2O_3T, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, CO_2, LOI, As, Ba, Be, Bi, Ce, Co, Cr, Cs, Cu, Dy, Er, Eu, Ga, Gd, Ho, La, Li, Lu, Nb, Nd, Ni, Pb, Pr, Rb, Sb, Sm, Sr, Tb, Th, Tl, Tm, U, Y, Yb and Zn. Hf, Mo, Sc, Ta, V, and W were assigned as provisional values.

Time-space evolution of the Neogene magmatism in Gutai Mts. (Eastern Carpathians, Romania)

KOVACS, M. (North University Baia Mare), PECSKAY, Z. (Atomki Debrecen), FULOP, A. (North University Baia Mare), EDELSTEIN, O. (Baia Mare), GABOR, M. (Transgold SA Baia Mare)

Gutai Mts. belongs to the Eastern Carpathians Neogene-Quaternary volcanic arc. A complex calc-alcaline volcanism had taken place during Miocene in this area, related to the Tertiary subduction of the European plate beneath Alcapa and Tisza-Dacia/Tisia microplates. Two main types of volcanism developed in Gutai Mts.: a felsic/acidic calc-alkaline "back-arc"type and an intermediate/andesitic calc-alkaline arc–type.

A new model of evolution of the magmatic activity has been established in Gutai Mts. on the basis of a great number of K-Ar datings (82 reliable K-Ar ages, 38 of them unpublished yet) correlated with the biostratigraphic data and the superposition relationships of the volcanic rock types.

The volcanic activity had started 15.4 Ma ago in the southwestern corner of Gutai Mts., by an explosive phase caldera related rhyolitic ignimbrites belonging to the felsic calc-alkaline volcanism. Rhyolitic volcaniclastics are interbedded with Early and Late Badenian sedimentary deposits in this area, while eastwards, similar volcaniclastics related to another explosive source developed in spacial connection with Early Sarmatian sedimentary deposits (Fulop, 2001, 2002). Some other Badenian and Early Sarmatian acidic volcaniclastic rocks (based on biostratigraphic data) developed in the southeastern part of Gutai Mts.

The intermediate calc-alkaline volcanism had taken place during Sarmatian and Pannonian (13.4-7.0 Ma) when the large majority of the outcropping volcanics have been emplaced. Sarmatian volcanic activity started in the southeastern part of Gutai Mts. by submarine andesitic lava flows and a dacitic extrusive dome (13.4-13.2 Ma). An important andesitic phase consisting of predominant subaqueous lava flows and associated volcaniclastics developed in the southwestern part of Gutai Mts., with 13.1-12.1 Ma range of K-Ar ages.

The main intermediate volcanic activity had taken place during Pannonian when six different phases succeeded, according to the K-Ar datings. A first acidic phase consisting of dacitic to rhyolitic domes developed in the southern part of Gutai Mts. The K-Ar age of Danesti biotite dacite/rhyolite dome (11.6 Ma) is consistent with the biostratigraphic data. A second intermediate phase (11.5-10.5 Ma), emplacing quartz bearing andesite lava flows, lava domes and volcaniclastics, developed in the central –southern part of the volcanic area. Partly contemporaneous with the second phase, another important volcanism had taken place during 10.9-9.9 Ma, in the central and eastern part of Gutai Mts. (pyroxene-amphibole lava flows and volcaniclastics). Mogosa volcano activity, in the central-southern part of the area, is related to this phase (11.4-9.5 Ma).

The major paroxistic volcanic phase, the fourth one, having an andesitic character, developed in the northern part of the area. Widespread lava flows and related volcaniclastics belonging to different effusive complexes alternate and often overlap showing K-Ar ages in the range 10.3-9.1 Ma. The fifth volcanic phase (9.3-8.0 Ma) consists of some well-outlined extrusive domes of acidic rocks (biotite andesites and dacites).

The intermediate volcanism ceased with the basaltic phase (8.1-7.0 Ma) consisting of small intrusions developed in the central part of Gutai Mts.

The intrusive magmatic activity from Gutai Mts. -intrusions of microgabbroes to microgranodiorites, mostly porphyritic - had taken place during 11.9-9.6 Ma, corresponding to the climax of the volcanism. Quite similar K-Ar ages (11.2-9.0 Ma) have been obtained for the subvolcanic intrusions from Poiana Botizei, eastern part of Gutai Mts. (a transitional zone to the subvolcanic unit Tibles-Toroiaga-Rodna-Birgau).

RECENTLY EXPLORED SARMATIAN SEDIMENTARY BENTONITE SITE IN HUNGARY (SAJÓBÁBONY)

KOZÁK, M., (University of Debrecen, Department of Mineralogy and Geology, Debrecen), KOVÁCS-PÁLFFY, P., (Geological Institute of Hungary, Budapest), PÜSPÖKI, Z., (University of Debrecen, Department of Mineralogy and Geology, Debrecen), DEÁK, J., PATAKI, A., (Geokomplex Ltd., Miskolc,), McINTOSH, R. W., (University of Debrecen, Department of Mineralogy and Geology, Debrecen)

E-mail: puspokiz@tigris.klte.hu

We have researched a significant bentonite site of Central Europe around Miskolc by geological mapping and 20 deep drillings, supported by a national research program (NKFP 3/083/2001).

The Sarmatian series of the area is paleontologically well defined and along an interlayered andesite tuff horizon can be separated into two main parts. The expansion of the coarse terrestrial sediments above the andesite tuff refers to the existence of a sequence boundary. The lower sequence (lower member) can be interpreted as the Ser-2, and the upper sequence (upper member) as the Ser-3 transgression of the eustatic curve published for the Central Paratethys by Vakarcs et al 1998. In the lower sequence a terrestrial, a transgressive, and a highstand (5 parasequences), in the upper one, a transgressive and an early highstand systems tracts (8 parasequences) can be reconstructed.

Considering the K/Ar radiometric age of the neutral volcanic rocks the age of the sequence boundary is 12,4-12,7 m.y. and its formation was accompanied with a neutral volcanism initiated by tectonic activity. Acid volcanism and tectonic activity simultaneous with the development of the sediment sequences is indicated by rhyolite tuffs deposited in submarine conditions.

The palaeoenviroments in the lower sequence were alluvial fan deltas interdigiting with lagoonal - shallow marine facies. Above the coarse grained terrestrial basis of the upper sediment series shoreline sandy deposits and then open marine conditions appeared followed by gradual progradation of sandy nearshore sediments.

In case of the lower member, tuff accumulation was comprehensively intensive. The bentonite layers lay above acid tuffs and are covered by well-sorted sandy facies of the shoreline. Their horizontal extension is limited – because of the frequent changes of the paleogeographic conditions. Their montmorillonite content is varied between 50 and 60 %.

The series of the economically important bentonite site is a part of the upper member. Based on the data of the deep drillings here we can count with terrestrial conglomerate in the basis of the series. The overlying strata are well-sorted and well-bedded sandstones with cross stratification.

- The first flooding surface resulted in the formation of the lowermost bentonite layer (B 0) in the site, the thickness of which is 2 – 2,5 m. The montmorillonite content is 45-60 %. This bentonite layer is covered by 5 – 6 m thick sandy facies of the shoreline, closing the first parasequence of the upper sequence.
- The second flooding surface formed the formation of B I bentonite layer of the site, covered by not more than 2 m thick sandy shoreline sediments. Its montmorillonite concentration is 45-60 %.
- The third flooding surface produced the B IIa bentonite layer of the site, the thickness of which is more than 4 m, the montmorillonite concentration is between 40-60 %.
- Then the sedimentation was disturbed by an intensive tuff accumulation, but the rhyolite tuff was deposited under submarine conditions leading to the formation of the "bentonitic tuff" B IIb layer of the site. In the breaks of the tuff accumulation the bentonite formation was continuous, initiating the stratigraphically traceable changes in the quality of bentonitic tuff with montmorillonite content from 30 to 60 %.
- Covering the "bentonitic tuff" as a result of the fourth flooding surface occurs the next bentonite layer (B III) with 60 % montmorillonite concentration.
- Above the uppermost bentonite layer open marine condition became dominant, with increasing silt and carbonate concentration and with decreasing bentonite content (15-30 % montmorillonite) ("dead rock A"). The thickness of the marine deposits reaches 10 m. In the lower part it encloses the well-preserved index fossils.
- The overlying series is a cyclic sedimentation of sandy silt and fine sand (lower shoreface) gradually with the dominance of sandy facies upward (shoreface) ("dead rock B").

The main source of the bentonite formation in the area was the synsediment tuff accumulation controlled by the synchronous tectonic activity of the region. The spaces of the accumulation and preservation of bentonie layers were the lacustrine, lagoonal and shallow marine environments. The relationship between the intensity of the transgression and tuff accumulation determines not only the possibility of bentonite formation, but even the facies type and so the quality (montmorillonite content) of the forming bentonite.

TELKIBANYA (TOKAJ MOUNTAINS, HUNGARY): DATING THE HYDROTHERMAL EVENTS.

LANG, B. (Geological Survey of Israel, Jerusalem, Israel), ZELENKA, T. (Geological Survey of Hungary, Budapest, Hungary), PECSKAY, Z. (Nuclear Research Laboratory, Hungarian Academy of Science, Debrecen, Hungary), FOSTER, D. (La Trobe University, Melbourne, Australia).

E-mail: barbu_l@yahoo.com

Telkibánya is one of the oldest known mining fields in the Tertiary Volcanic Intra-Carpathian Arc. The age of the volcanic activity in the Tokaj Mountains, as in other units of the Neogene Volcanic Chain, is reliably defined by relations with sedimentary complexes and by numerous radiogenic data. The calk-alkaline volcanic eruptions in Telkibanya region took place in Badenian (14.5 Ma), Sarmatian (12.5 Ma), and Pannonian (10.5 Ma). The volcanic activity reached its culmination in the Sarmatian time.

Badenian acid, explosive volcanic activity is associated with the formation of a graben structure and has a submarine character in some places. An early hydrothermal event is related to this phase, associated to microdioritc intrusions. At the beginning of the Sarmatian stage the volcanism kept the acidic character, but this was changed with the emplacement of andesites in stratovolcanic structures. A collapse caldera was formed followed by the emplacement of subvolcanic bodies. Epithermal gold and base-metal mineralizations of adularia-sericite (low-sulfidation) type, are associated with these Sarmatian bodies.

The present study was focused on dating the main stage of the metallogenic activity by measuring K-Ar and Ar-Ar ages of hydrothermally altered rocks and monomineral adularia crystals. Measurements were independently performed in three laboratories, using conventional K-Ar technique at the laboratories in Debrecen and Jerusalem and the Ar-Ar laser single crystal technique at La Trobe University in Melbourne. As a whole, the results obtained in all three laboratories show a remarkably good agreement indicating a high degree of reliability.

Two altered andesites sampled from deep levels in the Telkibanya-2 drillhole yielded Badenian ages of 14.4 ± 1.1 Ma and 14.3 ± 1.2 Ma respectively, in accordance to their stratigraphic position. They prove the presence of an early hydrothermal event associated with the Badenian volcanics.

Most of the K-Ar ages of both hydrothermally altered rocks and adularia monominerals can be placed in a relatively narrow time interval, around 12 Ma before present time. Highly K-enriched andesites („pseudo-trachites") were dated 12.0 ± 0.5 Ma.

The ages of several adularia single crystals yielded values between 12.7 ± 0.1 Ma and 12.4 ± 0.1 Ma for individual steps as well as for the calculated isochrones. One adularia crystal yielded an older plateau as well as isochron age: 13.3 ± 0.1 Ma and 13.4 ± 0.1 Ma, respectively, which are not explained at this stage of research.

One of the adularia samples was measured by both K-Ar and Ar-Ar methods in Jerusalem and Melbourne and the ages obtained are identical (12.5 Ma). Several samples from identical locations were run in both Jerusalem and Debrecen laboratories and yielded similar results.

More recently, one of the authors (G. Pecskay) determined the age of alunite crystals from Kanya Hill (Telkibanya) in two laboratories (Debrecen and Okayama) obtaining identical values of 12.3 ± 0.6 Ma. Similar ages were determined on K-rich „pseudo-trachites" and alunites in the Regec caldera, south of Telkibanya.

These geochronological data confirm that the main hydrothermal activity (characterized by the adularia deposition) took place between ca 12 to 12.5 Ma, probably nearer to the 12.5 Ma value. In the relatively restricted area in which the mineralization occurs, the age of the Sarmatian volcanics could not be dated due to the lack of fresh rocks. Nevertheless, similar ages were reported for non-hydrothermalized Sarmatian volcanic rocks in surrounding areas. The Sarmatian hydrothermal event seems to be activated towards the end of the volcanic activity. A gap between the volcanic and hydrothermal stages, if existent, was within the analytical error of the radiogenic ages.

It should be pointed out that the radiogenic ages of the main hydrothermal events in the Baia Mare area, are at least 1 Ma younger, starting at about 11.5 Ma before present time.

SPATIAL EVOLUTION OF THE NEOGENE VOLCANISM IN HARGHITA MOUNTAINS IN CONNECTION WITH THE TECTONIC EVENTS FROM THE CARPATHIAN BENT AREA (ROMANIA)

LÁSZLÓ, A. (PROMER – RO, 4.000, Sfântu Gheorghe, Nicolae Iorga 10/A)

E-mail: infocad@planet.ro

Harghita volcanic mountains constitue the southern end of Călimani-Gurgiu-Harghita chain (Eastern Carpathians), and represent the youngest volcanic structures. The temporal evolution of volcanism in Harghita Moutnains generally overlaps the most recent geotectonic movements in the Carpathian bent area. The latter determined several peculiarities of the structural evolution of the area, and in particular of the southern end of the volcanic alignment. Among them, the two distinctive directions of the evolution of volcanism, and its progressive development within the main volcanic alignment on a direction that cross-cuts the major structures of the Eastern Carpathians can be mentioned.

The evolutional, structural, morphological, petrographic, and petrochemical features of Harghita Mountains are first of all the result of the changes in the geodynamic regime during the last 5-6 My. This is directly related to the evolution of the internal sector of the Carpathian bent, thus to the tectonic evolution of the intramontaneous basins adjacent to the volcanic area (Ciuc and Baraolt Basins, and Bârsei Depression). All these regions show very clear tectonic-structural interconnections for the Pliocene – Pleistocene interval. The tectonic and microtectonic study of the deposits in the adjacent basins revealed an alternate change of the compression along two main directions: E-W, and SE-NW. The compression gradually decreased along E-W – this being the main cause of the collision in the Eastern Carpathians, while the compression gradually increased along SE-NW, especially during Late Pliocene and Pleistocene. This change of the tectonic regime in the Carpathian bent area generated local distension processes in certain segments of the N-S tectonic alignments. As a result, depressionary areas formed and a relatively smaller amount of magma ascended from deeper levels of the astenosphere. The phenomena were mainly generated by the shift of the Moesian Platform towards NW.

Along N-S alignments in Harghita Mountains an incipient volcanic activity was noticed, that lead to the formation of relatively small-sized volcanic or subvolcanic structures, such as volcanic domes, apophyses, and dykes of a more basic nature. These phases generally corresponded to the formation of the depressionary areas, followed by a volcanic activity in the main strato-volcanic structures (Oştoroş, Ivo-Cocoizaş, Harghita Mădăraş, Luci-Lazu, Cucu, Pilişca, and Ciomad), that have built the main volcanic alignment. During Late Pontian – Late Pleistocene such phenomena were consequtively repeated several times, while volcanism shifted spatially towards SE.

GENERAL FEATURES OF THE PERIPHERAL MAGMATIC STRUCTURES ALONG THE MAIN VOLCANIC ALIGNEMENT IN THE HARGHITA MOUNTAINS (EASTERN CARPATHIANS)

LÁSZLÓ, A. – (PROMER, RO, 4.000, Sfântu Gheorghe, Nicolae Iorga 10/A.), KOZÁK, M. (Debrecen University Department of Mineralogy and Geology, 4010 Debrecen)

E-mail: infocad@planet.ro

Harghita Mountains represent the terminal sector of the longest continuous volcanic alignement in the intracarpathian area (Călimani-Gurghiu-Harghita chain). The alignement closely follows the geometry of the Carpathian arc, and its evolution is directly related to the orogenic areas of the Eastern Carpathians.

One of the specific features of the Harghita volcanic alignement it that the main volcanic structures are simple and relatively less eroded, as compared to the other Neogene intracarpathian volcanic alignements. This allows the study of the evolution of the volcanic structures, i.e. the spatial and temporal emplacement features.

Along the two borders of the main Harghita volcanic alignement, several small-sized magmatic structures (volcanic, subvolcanice and intrusive) occur. They display a range of morphological, structural, petrographic and petrochemical specific features:

- the peripheral magmatic structures are located along relatively parallel alignments, as compared to each others as well as with the main east-carpathian geological structures. The alignements show a preferential NNE-SSW orientation, marking previous systems of fractures, and thrusts that were reactivated during the Pontian-Pleistocene interval (Răchitiş? – Homoroadelor valleys– Cetății Hill from Rupea, Văcăreşti-Gârciu, Racu, Siculeni – the small-sized volcanic structures from Chirui-Lueta-Vlăhița area (geophysically dated), Şumuleu, Spitalului Hill, Sâncrăieni – the group of volcanic bodies Tirco, Malnaş-Bicsad, the peripheral volcanic bodies of the Ciomad structure);

- the processes of the inital magmatic stage took place along NNE-SSW tectonic alignements, successively developing from north-west to south-east. The main, central stratovolcanic structures formed in subsequent volcanic stages, while the activity of the smaller-size volcanic structures alignements stagnated;
- the smaller-size volcanic bodies alignements cross-cut the main fracture field (north-west – south-east) that is connected with the emplacement of the main stratovolcanic structures (Oştoroş, Harghita Ciceu, Harghita Mădăraş, Luci-Lazu, Cucu, Pilişca, Ciomad). They have a continuous development beneath the main volcanic bodies, as argumented by geophysical data. The "peripheral" magmatic structures are defined as those marginal structures that outcrop beneath the larger amount of volcanoclastic materials belonging to the main stratovolcanic structures, and that can be directly studied;
- the "peripheral" magmatic bodies in the Harghita massif consist of small-sized efusive, rarely extrusive (ex. Şumuleu) volcanic structures, subvolcanic, intrusive, exogene volcanic dome-types, endogene (of various morphologies), dykes, intrusive bodies, subvolcanic, veins (identified in boreholes), usually formed as a result of relatively poor magmatic supply;
- most of the "peripheral" magmatic structures were formed during a single phase; the exceptions are represented by the Şumuleu volcanic structure, and the Bicsad-Malnaş structures;
- the "peripheral" magmatic structures are characterized by the petrographic associations represented by basaltoid andesites, pyroxenic andesites, and andesites with pyroxenes and hornblende. The typical mineralogical association consists of plagioclase + clinopyroxenes + orthopyroxenes +/- olivine +/- hornblende. Exceptionally, the magmatic structures of the Bicsad-Malnaş alignement (formed by magma mixing processes) show an association consisting of plagioclase + clinopyroxenes + orthopyroxenes + amphiboles + biotite +/- olivine +/- quartz (Luget structure), or plagioclase + clinopyroxenes + orthopyroxenes + olivine + biotite + amphibole +/- quartz (Murgul Mic structure), while those which are peripheral to the Ciomad volcanic structure contain the mineralogical association plagioclase + amphibole + biotite +/- clinopyroxenes +/- quartz. The latter represent the youngest, and in the same time the most eastwards alignements of "peripheral" magmatic structures;
- within the "peripheral" structures, the bulk rock includes a large amount of relatively fresh xenolithes, and less frequently enclaves. Their presence and characteristics indicate a minimal contamination during the magma ascension;
- when represented in the Peccerillo-Taylor (1976), (SiO_2/K_2O) diagram, most of the "peripheral" volcanics plot within the calcalkaline (Racu - Siculeni, Văcăreşti - Gârciu, M. Ciuc – Jigodin - Sâncrâieni, Tirco), and respectively the K-rich calcalkaline series. Those from the Bicsad-Malnaş (Luget) structures plot into the shoshonite field, while (Murgul Mic) into that of banakites.

PETROLOGY OF THE MARBLE-ENCAPSULATED ECLOGITES FROM APUSENI MOUNTAINS

MARUNTIU, M. (DSCIM, University of Bucharest, TATU, M. (Romanian Academy, Institute of Geodynamic), MENOT, R. P. (University Jean Monnet, Saint Etienne, France)

E-mail: marcel_maruntiu@yahoo.com

Outside the Getic domain, the classic zone of high-pressure rocks development in the pre-Alpine basement of the Carpathian realm, new exotic occurrences have been recently identified in the Apuseni Mountains. The Apuseni Mountains represent the eastern edge of the Tisia block, and they were formed during the Alpine (Middle Cretaceous-Miocene) orogeny. This block consists of different Alpine litho-tectonic units separated by sinistral strike-slips or by north - north-west vergent thrusts. Each unit contains Precambrian and/or Variscan composite polymetamorphic and magmatic basement, and Palaeozoic - Mesozoic (up to Late - Cretaceous) covers. The basement of the Apuseni Mountains evolved as discrete terranes with distinct compositions, ages and petrologic evolution. These terranes formed in various geotectonic settings and have been accreted during Carboniferous to form a consolidated crust at the end of the Variscan orogenic cycle. Eclogitic rocks are hosted within northernmost edge of the Precambrian polymetamorphic basement of the Baia de Aries Alpine unit mainly represented by biotite gneisses, micashists, amphibolites, marbles, quartzites and anatectic biotite granites of calc-alkaline Vinta type. Meters to decametre-sized eclogite bodies are dispersed several kilometres along the NE-SW trending metamorphic foliation in Buru-Surduc-Ocolisel area. Typical occurrences of well preserved eclogites have been identified in Iara valley as "vein-like" bodies encapsulated in large diopside-tremolite bearing marble masses and associated with garnet – kyanite - sillimanite microblastic gneiss.

Iara eclogite range in composition from subalkaline basalt to Fe-Ti rich basaltic andesite and exhibit signatures characteristic of BABB with weakly enriched HFSE from P to Yb and moderately enriched LILE typical of evolved MORBs. REE patterns at 25-95 x chondrite are nearly flat to slightly LREE enriched with $(La/Yb)_N = 1.32-4.45$.

The eclogitic rocks contain structural, mineralogical and compositional relics of eclogite facies re-equilibration associated with an important sequence of retrograde products and characteristic breakdown textures (diopside-plagioclase symplectites, amphibole-plagioclase kelyphites) indicating the transformation to amphibolite and finally to greenschist facies. Eclogitic relics, represented by garnet, Na-rich clinopyroxene, amphibole, plagioclase, zoisite and rutile, are accompanied by diopside, amphibole, plagioclase, biotite, chlorite, ilmenite, titanite, and quartz.

Garnet (Alm41-61, Py12-31, Gr11-30, Sp0.5-4) present complex prograde zoning marked by almost 10% increase of pyrope content from the core to the border, and by the progressive decrease of grossularite and almandine contents. Na-rich clinopyroxene (Jd15-27) occurs in the matrix and as inclusions in the garnet. Secondary clinopyroxene associated with plagioclase in symplectites developed in expense of Na-rich cpx, and the recrystallised clinopyroxene in the matrix have Jd content lower than 10 mol%. Amphibole of pargasite composition is largely present in the matrix. The amphibole inclusions in the garnet are pargasite-tschermakite with higher Mg/(Mg+Fe2+) and NaB and Ti contents.

The P-T conditions during the different evolutionary stages were calculated from assemblages restricted to microtextural domains where local equilibrium could be preserved.

A possible pre-eclogite (prograde) stage is documented by inclusions of euhedral brown tschermakitic amphibole within the core of the garnet. This early stage is followed by the increase of both temperature and pressure, the assemblage reaching the eclogite climax with T up to 680oC and P = 16-18kbar as documented by Na-rich clinopyroxene and plagioclase inclusions in the garnet. Retrograde pass to amphibolitic conditions is marked by a slightly increase of temperature up to 740oC during the first stage of exhumation (P = 13kbar), as recorded from secondary clinopyroxene associated with plagioclase and matrix- and corona-textured amphibole.

The occurrence of high-pressure relics in the Baia de Aries terrane as part of pre-Alpine basement of Apuseni Mountains indicates an important thickening of the crust, probably related to subduction or continental collision. The P-T pass of these eclogites is typically for collisional tectonics with the decompressional regime owing to tectonic movements and erosion. Although the timing of high-pressure metamorphism of the first mentioned eclogites in Apuseni Mountains has not yet been constrained, it could be related to the early-Variscan HP tectonothermal events in Europe.

Acknowledgements. Financial support for the analytical work was provided by grant from the "EU Access to Research Infrastructures action (IHP Programme)".

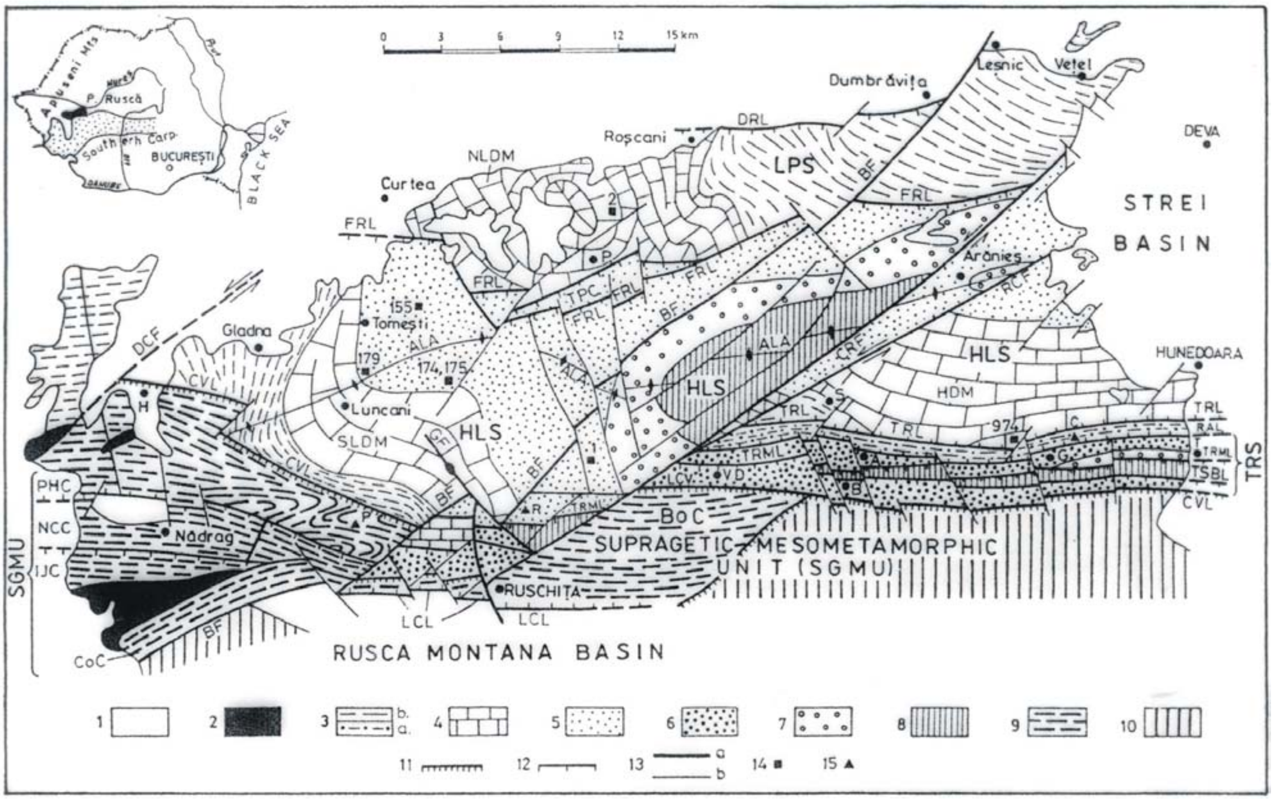
NEW LITHOSTRATIGRAPHIC AND TECTONIC ELEMENTS IN THE POIANA RUSCĂ EPIMETAMORPHIC UNIT (SOUTHERN CARPATHIANS)

MURESAN, M. Geological Institute of Romania, 1 Caransebes St., 78344 Bucharest

E-mail: muresanca@xnet.ro

NEW LITHOSTRATIGRAPHIC ELEMENTS. 1) The Nădrag Crystalline s. l. – **CNd s. l.** (Antecambrian) extended with the mesometamorphites into the Padeş-Hăuzeşti (**PHC**), into the Cornet Compartments **(CoC)** and into the Bordu **(BoC)** Compartments. **2)** CNd s. l. (in our opinion, similar to Valea Bordului – Cornet Crystalline of SGMU) it was taken out of Poiana Ruscă Epimetamorphic Unit (**PREU**) and added to the Supragetic Mesometamorphic Unit (**SGMU**). **3)** Within the PREU we distinguished two piles of epimetamorphites separated by a stratigraphic and metamorphic unconformity: **a) The Bătrâna Crystalline (FCBt) –** Lower Ordovician; metamorphosed later during the Caledonian movements at the end Lower Ordovician (Mureşan, 2000, 2003); **b) Poiana Ruscă Crystalline s. s. (PRC s. s.) –** Devonian and Lower Carboniferous; metamorphosed during the Sudetic Phase (Kräutner et al., 1973). **4)** In the pile of metamorphic schists which normally lie on SLDM (Ro1) one could separate Ro2 and Ro3 terms owing to the identification of Faţa Roşie Member known up to then only in the northern part of PREU.

NEW TECTONIC ELEMENTS. 1) By attaching NdC s. l. to SGMU, in the western part of Poiana Ruscă Massif, one could draw here too the **Cinciş-Vadu Dobrii Line (CVL)** (in our opinion, charriage of SGMU over PREU). **2)** In the eastern compartment of FCR, several important directional tectonic lines have been revealed: **TRL** (southern tectonic limit of the Hunedoara Dolomites Massif = Ro1 term), **RAL** (between the schists of the Ro1 and Ro2 terms and those of the Ghelar Group – Gh), **TRML** and **TSBL** (between Gh and BtC, representing the tectonic borders of the Teliuc-Bunila Tectonic Slice – **TBTS**, made up of the the metamorphic schists of BtC (Maier et al., 1969). **3)** The northern part of PREU is tectonically limited by the **DRL** which we have drawn in the South right after the Upper Cretaceous Formations from Leşnic-Roşcani region. **4)** PREU was divided into: **a) Teliuc-Ruschiţa Subunit – TRS** (south); **b) Hunedoara-Luncani Subunit – HLS**; **c) Leşnic-Poieni Subunit – LPS**.



TECTONIC AND LITHOSTRATIGRAPHIC SKETCH OF THE POIANA RUSCĂ EPIMETAMORPHIC UNIT (PREU)(partially after: Kräutner et al., 1965, 1969, 1973, 1990; Maier et al., 1969; Mureşan, 1968, 1973, 2000 and unpublished data) ***1****, Mesozoic and Tertiary Deposits;* ***2****, Intrusive banatitic bodies;* ***PREU****: (****3*** *+* ***4*** *+* ***5*** *+* ***6*** *+* ***7*** *+* ***8****):* ***PRC s. s.*** *(****3*** *+* ***4*** *+* ***5*** *+* ***6*** *+* ***7****):* ***3*** *+* ***4****, Roscani Group (Ro) – Upper Devonian-Lower Carboniferous (****3 a****, Ro1 & Ro2 Formations;* ***3 b****, Ro2 & Ro3 Formations;* ***4****, Ro1 Formation);* ***5*** *+* ***6****, Ghelar Group (Gh) – Middle and Upper Devonian (****5****, Northern Facies;* ***6****, Southern Facies); 7, Govăjdia Group (Gv) – Lower and Middle Devonian;* ***8****,* ***CBt****;* ***SGMU*** *(****9*** *+* ***10****): 9,* ***CNd s. l.****;* ***10****,* ***Nondivided mesometamorphites –*** *Antecambrian;* ***11****, Charriage (****CVL****, Cinciş-Vadu Dobrii Line);* ***12****,* ***Directional tectonic lines*** *(****TSBL****, Teliucul Superior-Bunila;* ***TRML****, Teliuc-Ruda-Muncel;* ***RAL****, Retişoara-Alun;* ***TRL****, North Teliuc-Valea Runcului;* ***FRL****, Faţa Roşie;* ***DRL****, Dumbrăviţa-Roşcani;* ***LCL****, Lunca Cernei);* ***13****,* ***Fault*** *(****13 a****, important:* ***CRF****, Chergheş-Ruschiţa:* ***RCF****, Runc-Cutin;* ***BF****, Bătrâna;* ***DCF****, Drinova-Curtea;* ***GF****, Gropit;* ***13 b****, secondary);* ***14****, Palynomorphes association;* ***15****, Mountainous summit.* ***ABBREVIATIONS****:* ***HDM****, Hunedoara Dolomites Massif (Ro1);* ***SLDM****, Luncani Dolomites Massif (Ro1) – southern zone;* ***NLDM****, Luncani Dolomites Massif (Ro1) – northern zone;* ***ALA****, Arănieş-Luncani Anticlinorium;* ***Tectonic compartment of CND s. l.****:* ***PHC****, Padeş-Hăuzeşti;* ***NCC****, Nădrag-Crivina;* ***IJC****, Izvodia-Jdioara;* ***CoC,*** *Cornet;* ***BoC****, Bordu;* ***TRS****, Teliuc-Ruschiţa Subunit;* ***HLS****, Hunedoara-Luncani Subunit;* ***LPS****, Leşnic-Poieni Subunit (****PTC****, Poieni tectonic Compartment);* ***P****, Padeş Summit (1377 m);* ***R****, Rusca Summit (1356);* ***C****, Cârnu Hill (757 m);* ***T****, Teliuc;* ***G****, Ghelar;* ***A****, Alun;* ***B****, Bunila;* ***VD****, Vadu Dobrii;* ***S****, Sohodol;* ***H****, Hăuzeşti;* ***P****, Poieni.*

Selected References

KRÄUTNER, H.G., KRÄUTNER, FL., MURESAN, G., MURESAN, M. 1969. La stratigraphie, l'évolution du magmatisme, le métamorphisme et la tectonique des formations cristallophylliennes de l'unité épimétamorphique du Massif Poiana Rusca. An Com. Stat Geol., XXXVII: 179-264, Bucuresti.

KRÄUTNER, H.G., MURESAN, M., ILIESCU, V., MÎNZATU, S., VÎJDEA, E., TANASESCU, A., IONCICA, M., ANDAR, A., ANASTASE, S. 1973. Le Dévonien-Carbonifère inférieur épimétamorphique de Poiana Rusca. D.S. Inst. Geol.LIX, 4: 5-63, Bucuresti.

MURESAN, M. 2000. Le stratotype du faciès septentrional des Dévonien moyen, Dévonien supérieur et Carbonifère inférieur du Cristallin de Poiana Rusca s.s. (Carpates Méridionales). Rom.J. Min. Deposits, 79, 1: 68-73, Bucuresti.

An. Inst. Geol. Rom., 73, Special Issue, Bucuresti, 2003

POST-MESOCRETACEOUS AGE OF THE LAMPROPHYRES OF THE CRYSTALLINE-MESOZOIC ZONE (EASTERN CARPATHIANS)

MUREŞAN, M. Geological Institute of Romania, 1 Caransebeş St., 78344 Bucharest

E-mail: muresanca@xnet.ro

A. The lamprophyres (Lamp) have been known for a long time in the Crystalline Mesozoic Zone, their presence in this unit being mentioned by many researchers. We can mention the descriptions and petrographic documents based on chemical analyses (presented by Buțureanu (1899 1901, 1908, 1909, 1916) and especially the modern petrological study of the Lamp made by Athanasiu (1929). He distinguished the camptonites-monchiquites series (majority of atlantic type) and the vogesites-spessartites-odinites-kersantites (less frequent of pacific type).

B. The Lamp make up veins of reduced thickness (decimetric-metric), usually strongly inclined. An almost general feature of these rocks is their strong and frequent alteration manifest in the transformation of melanocrates (pyroxenes, amphiboles, biotites) into chlorite or calcite aggregates accompanied by an “aureola” of ferrous and titaniferous minerals, formed as a result of the transformation of melanocrates; plagioclases are saussuritised and/or calcitised; the matrix is invaded by clorite, calcite and iron oxides; the fact that many of the chemical analyses of the altered Lamp enable normal (or almost normal) petrochemical classifications have suggested us that all these transformations are actually isochemical (except H_2O and CO_2).

By studying the lithological columns of over 70 drillings in the Pangărați-Belcina-Hagota-Tulgheş region (carried out by GEOLEX S. A. Miercurea Ciuc) we noticed the following facts: 1) The camptonites are the most frequent Lamp (over 85 % of the Lamp which can be determined petrographically; 2) In spite of the frequent alteration of these rocks, one can notice that most of then have porphyric structures (fenocrystals + holocrystalline matrix or fenocrystals + hyaline paste – less frequent; 3) Over 90 % of the Lamp traversing the metamorphites are altered; 4) With no exception, all the veins of Lamp are placed in the tectonic breccias, which accompany the fractures having affected the crystalline schists; 5) The Lamp are not breccified, wich shows that after their intrusion, the fractures where they are to be found were not reactivated a.ny more; 6) Two or even three petrographic types of Lamp could coexist in the same drilling; 7) No contact phenomena in the host rocks can be noticed round the Lamp; 8) The Lamp can have the most diverse spatial positions, in accordance with the with the orientation of the host-fractures. 9) A greater concentration of Lamp veins around the DAM as compared with the more remote zones has not been noticed,

C. As Lamp are related to no sedimentary deposits and being located in metamophites, their age has beenhighly disputed, the age of their formation extending from Upper Paleozoic to Neogene. Most hypotheses are based on the presence of veins of Lamp in the Ditrau alkaline Massif (DAM), consequently the Lamp located in the metamorphites are of the same age as those in this intrusive massif. We consider that in order to elucidate this question at this stage at least partly, one should use as principal criterion the presence of Lamp in various mesocretaceous charriage nappes in the Bucovinian System (established by Săndulescu, 1975, 1984). 1) Thus, in Rarău Nappe (the highest mesocretaceous unit with mesometamorphites and with ante-mesocretaceous deposits – Mureşan, 2002), situated in the upper part of Bucovinian Nappe, Lamp existing in the mesometamorphites were mentioned by Kräutner & Popa (1971), Popescu (1972), Săndulescu, (1975), Petrescu (1977) and others. In the crystallinne socle previous to DAM of Bucovinian Nappe (this socle is made up of metamorphites of Rebra Group, Negrişoara Group, Pietrosul Bistriței Porphyroids and Tulgheş Group), where numerous researchers also found Lamp (eg.: Kräutner, Popa, 1971; Popescu, 1972; Mureşan,1979-1997 – geological reports in I.G.R. Arch.; Bindea et al., 1987; Şabliovschi et al., 1982; Ionescu L., 1999). 2) Veins of Lamp are also mentioned in the crystalline schists of the Subbucovinian Nappe (eg.: Ionescu C., 1962; Pitulea, Muşat, 1965; Rădulescu, Rădulescu, Teuca, 1967; Mureşan, unpublised data; Erhan, 1974; Munteanu et al., 1998 ; Dumitraşcu, 2001; Podaşcă, 2002). 3) We have less information regarding the lamp in Infrabucovinian Nappes, such as the ones in Vatra Dornei Tectonic Window (Bercia, Bercia, 1970; Dumitraşcu, 2001; Podaşcă, 2002). It results from the above mentioned elements that the lamp are more recent than mesocretaceous nappes of Bucovinian system, also maintained by the fact that these rocks are not tectonically breccified (point B 5) which proves that they are actually posterior to these nappes (had the Lamp been previous to these tectonic units the frequent reactivation of the fractures – where the Lamp are situated – during the mesocretaceous charriages – would have breccified most of them). TO CONCLUDE: a) the Lamp, located in the metamorphites of the Crystallinne Mesozoic Zone, are post-mesocretaceous; b) The same conclusion must be drawn for the similar petrographically Lamp which cross the DAM (capmtonites, spessartites, vogesites etc); c) There is no genetic relation between the described Lamp and DAM, the latter being ante-mesocretaceous (K/Ar data – Kräutner, Bindea, 1998).

D. The Lamp suite in the Crystalline Mesozoic Zone of Eastern Carpathians is similar to that of banatitic magmatism, consisting of numerous odinites, kersantites, camptonites etc veins of paleogen age, to be found in Poiana

Rusca Massif (Southern Carpathians) (Kräutner, Kräutner 1971, 1972 – Geological reports. Arch. I.G.R., Bucureşti). This similarity may be indicate that the Lamp in the Eastern Carpathians are of Paleogen age.

Selected References

ATHANASIU, I. 1929. Études géologiques dans les environs de Tulgheş (distr. Neamț). An. Inst. Geol. Rom. XIII: 165-511, Bucureşti.
BUȚUREANU, V. 1899. Études pétrographicues et chimiques sur les roches éruptives du district Suceava, II-ème part. Bul. Soc. Şt., VIII: 191-103, Bucureşti.

ARGUMENTS REGARDING THE EXISTENCE OF THE CALEDONIAN METAMORPHITES IN THE POIANA RUSCĂ EPIMETAMORPHIC UNIT (SOUTHERN CARPATHIANS)

MUREŞAN, M. *Geological Institute of Romania, 1 Caransebeş St., 78344 Bucharest*

E-mail: muresanca@xnet.ro

Poiana Ruscă Epimetamorphic Unit (PREU) is composed of two Paleozoic epimetamorphic piles: **Bătrâna Crystalline (BtC) –** lower and **Poiana Ruscă Crystalline s. s. (PRC s. s.) –** upper. By noticing the unequal thickness of BtC metamorphites on both clines of Arănieş-Luncani Anticlinorium **(ALA)**, one can consider (Kräutner et al., 1968, 1969, 1973; Kräutner, 1987, 1993) that there is a premetamorphic stratigraphic unconformity, between these two entities. At the same time it is considered that this is due to the partial erosion of the primary deposits in present-day BtC, which had taken place before the Devonian-Lower Carboniferous pile deposited (present-day PRC s. s.), followed by the common metamorphism of both entities during the Sudetic Phase. This interpretation is based on the continuity of ALA in both entities as well as on the presence in their metamorphites of same microstructural elements of the some type and having the same position. Initially, BtC was thought to belong to the Predevonian Paleozoic (Kräutner et al., 1973) and later to Silurian-Upper Ordovician? (Kräutner, 1976; Kräutner in Kräutner et al., 1990), respectively to Silurian (Kräutner, 1987). Farther on follow our main arguments in favour of the formation of the primary pile of BtC during Lower Ordovician and of the metamorphosis of the pile during the Caledonian movements at its end; thus proving that the unconformity between PRC s. s. and BtC is both stratigraphic and metamorphic.

(1) The two piles present various degrees of intensity of the synkinematic metamorphism: **a)** The BtC metamorphites are to be found in the biotite zone in the central part of ALA (in the basin of Batrana Valley) (Kräutner et al., 1969, 1990) where one can get he almandine isograde from in the eastern part of Teliuc-Bunila Tectonic Slice – **TBTS** (Maier et al., 1964, 1969). **b)** The PRC metamorphites were initially formed in the chlorite zone. **(2)** The metamorphites in the twoo entities present different blasteses: **a)** BtC is characterised by **monostage synmetamorphic blastesis** and intensity of metamorphism (wich took place under barrowian conditions – Kräutner et al., 1976) increases rom west eastwards as we have shown above. **b)** In the PRC s. s. metamorphites, one can distinguish two main stages of mineral growth (Kräutner et al., 1969; Kräutner, in Kräutner et al., 1990): **synkinematic blastesis**, simultaneous with the formation of S1 schistosity, in the greenschists facies (chlorite isograde), under barrowian baric conditions (Kräutner et al., 1976); **postkinematic blastesis**, found in the south of PREU, starting west of Ghelar (biotite), continuing to Vadu Dobrii (biotite and garnet) and to the Ruschita-Valea Negrii region (where nonoriented biotite, garnet, bluish-green hornblende, cummingtonite, plagioclase – containing 11-14 % An appear – Pavelescu et al., 1964), a situation which shows an increase in intensity of the metamorphism in the east westwards. In the northern part of PREU, the second blastesis appeared sporadically by forming the nonoriented stilpnomelane. The two stages of the blastesis were close to each other: the first one was formed during in Sudetic Phase and the second one at the end of the movements during this phase (Kräutner, in Kräutner et al., 1990). **(3)** In BtC metapelites, one can notice the chloritisation of the biotite, particularly below the PRC s. s. transgression limit (we noticed this on both clines of ALA), this meaning a retromorphisme synchronous with the regional Sudetic progressive metamorphism of PRC s. s. **(4)** The style of folding is different: in TBTS, the BtC metamorphites form narrow megascopical folds (almost isoclinals, sometimes inclined to northwards) as compared with the large and straight ones in PRC s. s. (see Maier et al., 1969). In addition, the microstructural elements (lineations, microfolds, fissures) in the BtC rocks present a strong dispersion in the corresponding diagrams (made by: Bercia, 1967; Bercia & Bercia, 1964), wich cannot be noticed in the case of PRC s. s. metamorphites. Consequently, in our opinion, one can assert the coexistence of Caledonian microstructural elements with the Sudetic ones, overprinted on the former. We mention that both the geological map of Teliuc-Ghelar region (Maier et al., 1969) and the quoted diagrams show two folding directions, which form an angle of about 10º. **(5)** The BtC primary pile belongs to Lower Ordovician, in accordance with the association of palynomorphes put into evidence by Maria Mărgărit (in Berghes et al., 1988 – Arch. I.G.R., Bucureşti) in the samples of BtC metamorphites which make up the whole TBTS. The correlated intervals of existence of these palynomorphes and above all the presence of Baltisphaeridium *gdovia* TIM. (emend.), found in Lower Ordovician, enable us to state that the BtC primary pile is of same age. **(6)** The same age is also stated by the striking similitude between the BtC lithology and the Tg4 formation (the latest lithostratigraphic term known in the Tulgheş Group of the Crystalline Mesozoic Zone in Eastern Carpathians) which belongs (like the whole Tg pile) to Lower Ordovician (Mureşan, 2000). Indeed, the predominant lithology of Tg4 is represented by sericit-graphit schists, with intercalations of blastodetritic rocks, black quartzites, greenschists, and, occasionally, limestones; metagabbro bodies are also known, lithology noticed in BtC too, except blastodetritic rocks, whose equivalent could be the quartzites bearing muscovite, intercalated in the BtC pile **(7)** The existence of some monzonite metamorphosed bodies (Maier et al., 1964, 1969), found exclusively in BtC pile shows that granitoids intruded in this entity before the caledonian regional metamorphism (prekinematic granitoids). **(8)** We can state that BtC metamorphism took place at the end of Lower Ordovician because of the similitude with Tg4, whose Caledonian metamorphism (like that of the whole Tg) took place at such a moment (Mureşan, 2000), a conclusion which is based on the age of 472 m.y. (determined by Mînzatu, 1975). Between the BtC and the beginning of the formation of the primary PRC s. s. pile during Lower Devonian, there was a very long period of exondation and erosion, corresponding to Middle and Upper Ordovician and to Silurian too.

Selected References

KRÄUTNER, H.G., KRÄUTNER, FL., MURESAN, G., MURESAN, M. (1969) La stratigraphie, l'évolution du magmatisme, le métamorphisme et la tectonique des formations cristallophylliennes de l'unité épimétamorphique du Massif Poiana Rusca. An Com. Stat Geol., XXXVII, Bucuresti, 179-264.
KRÄUTNER, H.G., MUREŞAN, M., ILIESCU, V., MÎNZATU, S., VÎJDEA, E., TĂNĂSESCU, A., IONCICĂ, M., ANDĂR, A., ANASTASE, Ş. 1973. Le Dévonien-Carbonifère inférieur épimétamorphique de Poiana Ruscă. D.S. Inst. Geol.LIX, 4: 5-63, Bucureşti.
MUREŞAN, M. 2000. Le stratotype du faciès septentrional des Dévonien moyen, Dévonien supérieur et Carbonifère inférieur du Cristallin de Poiana Ruscă s.s. (Carpates Méridionales). Rom.J. Min. Deposits, 79, 1: 68-73, Bucureşti.

GENERAL LITHOSTRATIGRAPHY OF CALEDONIAN METAMORPHITES (BĂTRÂNA CRYSTALLINE) IN THE POIANA RUSCĂ EPIMETAMORPHIC UNIT (SOUTHERN CARPATHIANS)

MURESAN, M. Geological Institute of Romania, 1 Caransebeş St., 78344 Bucharest

E-mail: muresanca@xnet.ro

The Poiana Ruscă Epimetamorphic Unit (**PREU**) consists mostly of Variscan pile included in **Poiana Ruscă Crystalline s. s. – PRC s. s.** (Devonian-Lower Carboniferous; regional metamorphism of barowian type, in Sudetic Phase – Kräutner et al., 1973), transgressively lying on Caledonian metamorphic socle, represented by **Bătrâna Crystalline – BtC** (Lower Ordovician and the regional metamorphism at the end of Lower Ordovician – Mureşan, 1998, 2000, 2003).

CBt is known in three sectors: **a) in the central part of Arănieş-Luncani Anticlinorium – ALA** (Kräutner et al., 1968, 1969, 1973), where BtC appear from under the Lower Devonian; **b) in the Teliuc-Bunila Tectonic Slice (TBTS)**, made up exclusively of metamorphites of the BtC (Maier et al., 1969; Kräutner et al., 1969); **c) in the Valea Morii-Poiana Crivina Zone** (NW of Ruschiţa) (Mureşan, unpublished data). In the BtC pile (> 2500 m), we were able to identify two lithostratigraphic terms: **Valea Cerna Formation (VCF)** – lower, and **Valea Morii Formation (VMoF)** – upper.

1. <u>Valea Cerna Formation (VCF)</u> (> 1200 m) cartographically occupies the whole central part of ALA and makes up the whole TBTS. We were able to establish the Stratotype for VCF in the eastern part of TBTS, where there are numerous outcrops, and the structure is normally and constantly descending southwards. Lithologically, this sequence is characterized by the frequent decimetric-metric (sometimes decametric) flyschoid (in our opinion) alternances made up of graphitic ± quartzitic schists and sericite-chlorite schists (Maier et al., 1964, 1969; Kräutner et al., 1969), with intercalations of greenschists, quartzites with muscovite, black quartzites, muscovite-biotite schists, biotite schists, quartzites with biotite and almandine. The quartzites with muscovite we use them to divide VCF into two entities: **Valea Tătăuşului Member (VTM) –** lower and **Teliucul superior Member (TeSM)** – upper. In VCF, there are a few small bodies of metagabbros (in Valea Bătrâna; at Socet; on the Teliuc-Ghelar road; in the 4352 Ruşi drilling) and of wehrlitic metaserpentinites (Socet). In TBTS, in the lower half of the VCF pile (Valea Govăjdia and Valea Mănăstirii), there are a few small bodies of metamorphosed monzonites (Maier et al., 1969), which we consider to be prekinematic granitoides as against the regional Caledonian metamorphism at the end of the Lower Ordovician.

1.1. Valea Tătăuşului Member (VTM) (> 600 m) includes, in TBTS, the main levels of quartzites with muscovite, intercaleted in the above-mentioned alternances, as well as the (metric-decametric) intercalations of greenschists, black quartzites and, sporadically, thin limestones (north of the Teliucul Superior). The higher part of VTM includes **Valea Mănăstirii Quartzites – VMQt** (25-50 m thickness), which large cartographic extension along TBTS. The BtC primary pile belongs to Lower Ordovician (Muresan, 2000, 2003) in accordance with the association of palynomorphes put into evidence by Maria Mărgărit (in Berghes et al., 1988 – Arch. I.G.R., Bucureşti) in the samples of VTM metamorphites (in TBTS). In TBTS, a sequence of VTM has been intercepted by the 4352 Ruşi drilling (8 km East of PREU) in the metamorphic socle of the tertiary Strei Basin; this sequence includes quartzites biotite schists ± graphite ± almandine, with intercalations, at various levels, of quartzites with muscovite, muscovite-biotitie schists, amphibolic schists ± biotite and albite (the more metamorphosed equivalent of greenschists) and, rarely, limestones; metagabbros have also been intercepted (in the 1030-1070 m interval). Also in TBTS, VTM was found (in the 0-475m interval) by drilling 22.120 / 27 (900 m North of Poieniţa Voinii), which went through an (metric-decametric) alternance of graphite schists (predominant) and sericite-chlorite ± quartzitic schists, in which there are intercalations of quartzites with muscovite and greenschists (Pavelescu et al., 1962 – Arch. I.G.R, Bucureşti); after a fracture (at the 475 meter), appear the Ghelar Group (Middle and Upper Devonian). In the northern part of ALA's central part, drilling 24.850 (1 km South of Ferigi) (Teodorescu, 1965 – Arch. I.G.R., Bucureşti) intercepted in VTM (0-495 m interval) a metric-decametric alternance of graphitic ± quartzitic schists and sericite-chlorite schists, in which there are intercalated quartzites bearing muscovite, greenschists and black quartzites. At the basis of the drill, there are metagabbros (495-525 m).

1.2. Teliucul Superior Member (TeSM) (> 500 m thick), located above VMQt of VTM, includes, in TBTS, graphitic schists, with intercalations of greenschists (usually metric – as, for instance, the greenschists ± biotite at the beginning of the road to Ghelar), black quartzites, sericite-chlorite ± biotite schists and quartzitic schists with biotite and almandine (Valea Mănăstirii).

The TeSM pile can also be identified in the lower part of the succession of metamorphites in the **Valea Morii-Poiana Crivina Sector** (NE of Ruschiţa), where it is made up of graphitic schists, with intercalations of sericite-chlorite schists, greenschists and black quartzites. Previously, this sequence was attributed to the Lower Devonian, of the lower part of the PRC s.s. pile (Kräutner et al., 1969; Mureşan et al., 1972). The numerous intercalations of greenschists in the graphitic schists present here indicates that this lithostratigraphic classification is not correct, because this term of PRC s. s. does not include such an petrographic association. In this sector, the second formation of the BtC, Valea Morii Formation lies normally over the TeSM.

2. Valea Morii Formation (VMoF) includes a predominantly terigene pile (> 1500 m), made up of sericite-chlorite ± quartzitic ± biotite schists, in which thicker layers (20-50m) of greenschists and carbonatic rocks (limestones and dolomites) are intercaled; the graphitic ± quartzitic ± biotite schists and the black quartzites appear more seldom in VMoF. Previously, this succession was attributed (Pavelescu et al., 1964) to the basal part of the Ghelar Group - Gh (Middle Devonian), which pertains to PRC s. s. We have included this sequence in the VMoF because: **a)** such a succession is not known in the Gh pile; **b)** the pile lies normally over VTM, which is a component part of BtC; if the analyzed term had belonged to the Gh basis, it should have lain on the lower Devonian entity of PRC s.s; **c)** immediately West of the Gropi Fault (oriented NW-SE), in the Ruschiţa region, the Gh rocks show a more intense metamorphism (Pavelescu et al., 1964) than those of VMoF. The TeSM and VMoF ensamble represents the re-appearance, West of the Chergheş-Ruschiţa Fault (CRF), of the TBTS, which, as shown, is made up exclusively of metamorphites belonging to the BtC.

POSITION OF THE NĂDRAG CRYSTALLINE s.1. IN POIANA RUSCĂ MASSIF (SOUTHERN CARPATHIANS)

MUREŞAN, M. Geological Institute of Romania, 1 Caransebeş St., 78344 Bucharest

E-mail: muresanca@xnet.ro

The Poiana Ruscă Epimetamorphic Unit (PREU) occupies the northern half of the **Poiana Ruscă Massif (PRM).** In the south, PREU being overthrust by **the Supragetic Mesometamorphic Unit (SGMU)**, along the Cinciş-Vadu Dobrii Line – CVL (Fig.). **A. (1)** In the west of PRM, in the Nădrag region, Giuşcă et al (1956) separated a mesozonal series (consisting predominantly of micaschists ± garnet ± staurolite, frequently retromorphosed), which forms a Hercynian nappe (pushed from south northwards), situated over the epimetamorphites in the north and in the south. **(2)** Later on, Kräutner et al. (1965, 1968, 1969, 1972) were grouped these mesometamorphites in the **Nădrag Crystalline (NdC).** NdC contains predominantly micaschists (containing biotite, garnet and, sometimes, staurolite), often retromorphosed, with intercalations of limestones, dolomites, acid metatuffs, rarely black quartzites, the whole making up two directional tectonic compartments, consequently having no direct lithostratigraphic connection with the **Poiana Ruscă Crystalline – PRC** (Predevonian-Devonian-Lower Carboniferous; the primary epimetamorphism in the Sudetic Phase – Kräutner et al, 1973). Nevertheless, NdC was included by the authors in PRC (and consequently in PREU), being considered to be a more metamorphosed possible equivalent of the Padeş Group (Lower Carboniferous –

Kräutner et al, 1973), the upper part of the PRC pile. (3) Later on, in the Hăuzeşti-South of Gladna region, Kräutner (in Kräutner et al, 1990), separated the **Hăuzeşti Crystalline - HzC**, made up of retromorphosed muscovite-chloritic schists (containing biotite), with intercalations of dacitic metatuffs, rarely, actinolitic schists, limestones, metagabbros and Hăuzeşti Porphyroids (Kräutner, Kräutner, 1963; Maier, Solomon, 1967). Then, in the Culmea Padeşului zone and north of it, Tudor (1996 – Doctoral thesis, Arch Iaşi Univ.), separated the **Bordaru Series – BdS** (attributed to Precambrian), made up of predominantly terrigenous metamorphites (occasionally containing garnet, staurolite and kyanite – Berghes et al, 1988), often retromorphosed, with intercalations of acid metatuffites, rarely, limestones, basic and ultrabasic rocks As the two entities are similar from a petrographic point of view and directly connected with each other cartographically and structurally, we have included them in a single lithostratigrphic entity – **The Padeş-Hăuzeşti Succession (PHS)** which makes up the **Padeş-Hăuzeşti Compartment – PHC** (previously, area of Pd2 and Pd3) tectonically separated, in the south, from the NdC metamorphites of Nadrag region and, in the north, from the epimetamorphites of the Roşcani Group (former Padeş Group), by a directional tectonic plane (see Fig.1 in Mureşan, 2000). On the basis of lithological resamblances, of the similarity of the degree of metamorphism and of the presence of regional retromorphism, we included (Mureşan, 2000) the PHS and NdC (of the Nădrag region) in a comprehensive entity – **The Nădrag Crystalline s.1. (NdC s.1).** I excluded CNd s. l. (as the Bătrâna Crystalline – Lower Ordovician; Caledonian epimetamorphism) from PRC (wich became PRC s. s.), but I maintained it in the PREU (Mureşan, 2000). (4) Previously, certain authors (Papiu, 1953, 1956; Savu, 1953; Papiu et al 1963; Popescu, 1964; Chivu & Serafimovici, 1967; Balintoni & Iancu, 1986), maintained (in various variants) that south and south-west of the **Luncani Dolomites Massif – LDM** (corresponding to the term Pd1), the Culmea Padeş zone included, one can find the **"Padeş Phyllites Series" (PdPhySe)**, older than the adjacent metamorphites. We note that Papiu et al (1963) and Popescu (1964) pointed out the existence of a short overthrust of this serie over LDM. This idea was developed subsequently by Balintoni & Iancu (1986) who included PdPhySe (attributed to Lower Paleozoic) in the Gladna Nappe (pre-laramian), situated over LDM (attributed to Middle Paleozoic); in the south, the authors separated this nappe from the metamorphites of NdC (attributed by the authors to Upper Proterozoic) by a directional fault. Since each entity (NdC and PdPhySe) was given a different age by the authors, we can say that they excluded any chronological and lithostratigraphic connection between the them. **B. <u>Affinities of NdC s.1. with the Valea Bordului-Cornet Crystalline (BoCoC).</u>** BoCcC, defined by Kräutner (in the Kräutner et al, 1990), forms two tectonic compartments which are part of SGMU (Fig.): **The Cornet Compartment – CoC** (to the SW of the PRM) and the **Bordu Compartment – BoC** (north-west of Ruschiţa). BoCoC contains micaschists with biotite, garnet, staurolite and kyanite (already mentioned in such rocks NW of Ruschiţa – Pavelescu, 1958), with intercalations of amphibolites and limestones. BoCoC, considered to be Antecambrian, was included in the Făgăraş Group (Kräutner, in Kräutner et al., 1990) and its retromorphism was attributed to early Caledonian movements. **We have included BoCoC in NdC s. l**. on the basis of: **(1) common lithological elements: a)** the micaschists are dominant in both entities; **b)** the intercalations of carbonatic rocks (dolomites and particularly limestones) are to be found permanently; **c)** the basic rocks (amphibolites, metagabbros) exist in both entities. **(2) the degree of metamorphism**: in both NdC s.1. and BoCoC one can find biotite, staurolite and kyanite. **(3) regional retromorphism** widely spread in both entities. **C. Finally**, we also add to NdC s.1.the strip of schists containing biotite and almandine (frequently retromorphosed) with intercalations of carbonatic rocks, which are present south of Ghelar Group metamorphites – **Gh** (Devonian – Kräutner et al., 1973) in the Ruschiţa-Dealul Boul-Valea Lupului region. These rocks, delimited by CRF in the east and by Bătrâna Fault **(BF)** in the west (Fig.), were previously attributed (Pavelescu et al, 1964) to the term Pd1. Kräutner (in Kräutner et al, 1990) drew a directional fault which delimited this strip from the Gh succession in the north. We can state that this tectonic contact represents in fact the reappearance here of CVL as a result of its strike-slip southwestwards by CRF, from south of Vadu Dobrii. (Fig 1). The described rocks being strike-sliped by the same CRF of the Bordu Compartment **(BoC)**. **D. Conclusion**. Owing to its metamorphic and lithostratigraphic features, NdCS s. 1. cannot belong to PREU, in fact being a component of SGMU.

Selected References

BALINTONI, I., IANCU, V. 1986. Probleme de metamorfism, litostratigrafie şi structură ale cristalinului din masivul Poiana Ruscă. Acad. R.S.R., Stud. Cerc. Geol., Geofiz., Geogr., Seria Geol., 31: 51-57, Bucureşti.

KRÄUTNER, H.G., KRÄUTNER, FL., MUREŞAN, G., MUREŞAN, M. 1969. La stratigraphie, l'évolution du magmatisme, le métamorphisme et la tectonique des formations cristallophylliennes de l'unité épimétamorphique du Massif Poiana Ruscă. An Com. Stat Geol., XXXVII: 179-264, Bucureşti.

KRÄUTNER, H. G., MUREŞAN, M., ILIESCU, V., MÎNZATU, S., VÎJDEA, E., TĂNĂSESCU, A., IONCICĂ, M., ANDĂR, A., ANASTASE, Ş. 1973. Le Dévonien-Carbonifère inférieur épimétamorphique de Poiana Ruscă. D.S. Inst. Geol.LIX, 4: 5-63, Bucureşti.

MUREŞAN, M. 2000. Le stratotype du faciès septentrional des Dévonien moyen, Dévonien supérieur et Carbonifère inférieur du Cristallin de Poiana Ruscă s.s. (Carpates Méridionales). Rom.J. Min. Deposits, 79, 1: 68-73, Bucureşti.

KRÄUTNER H.G., BERZA T., IANCU V., HANN H., RUSSO-SĂNDULESCU D., MĂRUNŢIU M., SEGHEDI A., OAIE GH., DIMITRESCU M., RĂDAN S. 1990. Sinteza geologică a regiunii Rusca Montană-Ţarcu-Godeanu. Arh. I.G.R.,Bucureşti.

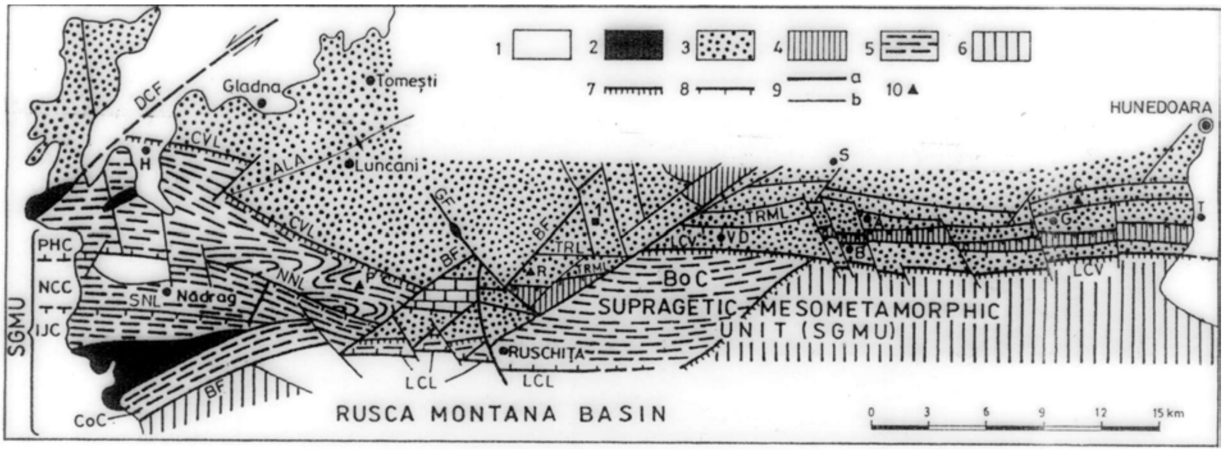


Fig. – NĂDRAG CRYSTALLINE s.l. IN THE POIANA RUSCĂ MASSIF (partially after: Kräutner et al., 1965, 1969, 1973, 1990; Maier et al., 1969; Mureşan, 1968, 1973, 2000) 1, Mesozoic and Tertiary Deposits; 2, Intrusive banatitic bodies; ***POIANA RUSCĂ EPIMETAMORPHIC UNIT – PREU (3 + 4):*** *3,* ***Poiana Ruscă Crystalline s. s. (PRC s. s.)*** *– Devonian and Lower Carboniferous; metamorphosed during the Sudetic Phase; 4****, Bătrâna Crystalline (CBt)*** *– Lower Ordovician; metamorphosed later during the Caledonian movements at the end Lower Ordovician;* ***SUPRAGETIC MESOMETAMORPHIC UNIT – SGMU (5 + 6):*** *5,* ***Nădrag Crystalline s. l. – NdC s.l.*** *– Antecambrian;* ***6, Nondivided mesometamorphites*** *– Antecambrian; 7, Charriage (Cinciş-Vadu Dobrii Line – CVL); 8, Directional tectonic lines (NNL, North Nădrag; SNL, South Nădrag; LCL, Lunca Cernei); 9, Fault (9 a, important: CRF, Chergheş-Ruschiţa;* ***BF****, Bătrâna;* ***DCF****, Drinova-Curtea;* ***GF****, Gropi; 9 b, secondary); 10, Mountainous summit: P, Padeş (1377 m); R, Rusca (1356);* ***OTHERS ABBREVIATIONS****:* ***ALA****, Arănieş-Luncani Anticlinorium;* ***Tectonic compartment of NdC s. l.: PHC****, Padeş-Hăuzeşti;* ***NCC****, Nădrag-Crivina;* ***IJC****, Izvodia-Jdioara;* ***CoC****, Cornet;* ***BoC****, Bordu; Localities:* ***T****, Teliuc;* ***G****, Ghelar;* ***A****, Alun;* ***B****, Bunila;* ***VD****, Vadu Dobrii;* ***S****, Sohodol;* ***H****, Hăuzeşti.*

MAGMA-MIXING EVIDENCES INFERRED BY PETROGRAPHIC, MELT AND FLUID INCLUSIONS STUDIES

PINTEA, I. *(Geological Institute of Romania, Cluj-Napoca Branch, P.O. Box 181, 3400 Cluj-Napoca, 1 Romania)*
MOSONYI, E. *(University Babes-Bolyai, Cluj-Napoca, Department of Mineralogy, Kogalniceanu str., Nr. 1, 3400 Cluj-Napoca, Romania)*

E-mail: ipintea@email.ro

Magma mixing between basic and acidic end members in Neogene-Quaternary volcanic chain from East Carpathians is a common process (e.g. Masin et al, 1995). Description of such a phenomenon is obviously done by carefully petrographic, melt and fluid inclusion observations.

The microtextures as sieve and resorbed features in plagioclases, pyroxenes and amphiboles are reported in this study. They are direct results of interactions between phenocrysts or xenocrysts and repeated mafic input into a felsic magma chamber (Fig. 1 and 2; both are from the same location in the basaltic andesite from the Moldovanu Peak zone, Calimani Mountains). Reactions and compositional changes generated distinctly melt and fluid inclusions assemblages like as silicate melts, (glass or recrystallized) globular opaque inclusion (Fe-S-O immiscible melt) vapor-rich and brines inclusions.

Temperatures and pressures estimations on feldspar melt-equilibria and SiO2 phase-equilibrium diagrams were based. An % in zoned plagioclases and reactions in quartz-xenoliths showed temperatures between 870 - 1200°C and 1 -2 kb pressure for magma-mixing processes.

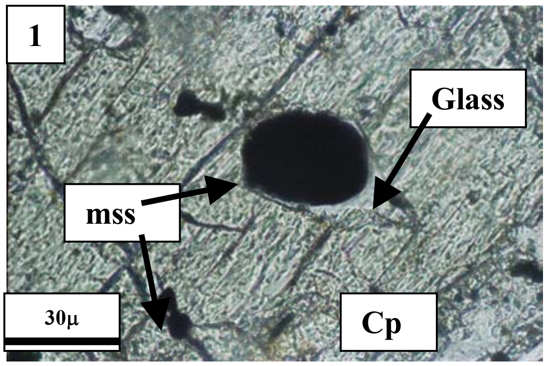


Fig. 1.: N//. Pristine globular Fe-S-O melt (mss or magnetite/ilmenite) surrounded by silicate glass trapped in clinopyroxene (Cpx) as two immiscible primary liquids.

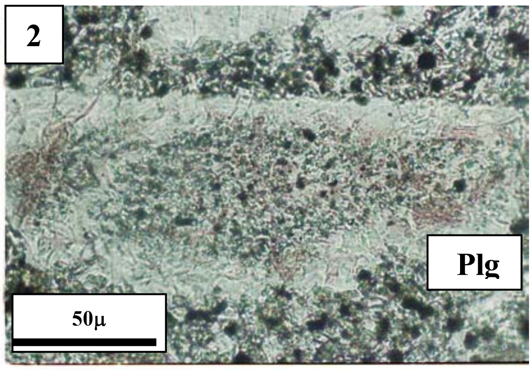


Fig. 2.: N//. Resorbed plagioclase with sieve texture in the core with opaque and silicate melt inclusions.

Reference

MASON, R. P. D., DOWNES, H., SEGHEDI, I., SZAKACS, A., THIRWALL, M.F. (1995) - Low-pressure evolution of magmas from the Calimani, Gurghiu and Harghita Mountains (East Carpathians). Acta Vulcanologica vol.7 (2), 43 - 52.

DESCRIPTIVE CHARACTERISTICS OF BENTONITE LAYERS IN A SEDIMENTARY BENTONITE SITE WITH TUFFOGENIC ORIGIN (SAJÓBÁBONY – NE HUNGARY)

PÜSPÖKI, Z., KOZÁK, M., KISS, B., (University of Debrecen, Department of Mineralogy and Geology, Debrecen), KOVÁCS-PÁLFFY, P. BARTA A. (Geological Institute of Hungary, Budapest)

E-mail: puspokiz@tigris.klte.hu

In the last decade the Department of Mineralogy and Geology of University of Debrecen carried out the basin research of the East Borsod Basin in North Hungary completing its geological mapping, reinterpreting the coal exploring boreholes of the last half-century and making the sequence stratigraphic analysis of the Miocene sediment series. The authors correlated the development of the basin with eustatic curves and interpreted the effects of tectonic activity and the connected volcanism on the development of the sediment series. In the course of the geological mapping the authors have explored a significant hypergene bentonite site (in Central Europe terms) in the upper part (Sarmatian stage) of the Miocene series. Due to its economic importance a national research programme (NKFP 3/083) gave funding to research the bentonite site by deep drillings.

Based on lithological characteristics of the bentonite layers we could determine three main facies types of bentonites in the whole bentonite bearing series: 1. the bentonitic tuff, represented by samples from B IIb layer, 2. the sedimentary bentonite with strong tuffogenic character (enclosing numerous small pumice fragment) represented by B IIa layer, 3. the sedimentary bentonite represented by B0, BI and BIII bentonite layers. The common genetic source and different facies types and quality of the bentonite layers in question were proved by mineralogical and geochemical data.

The quantitative differences of the three facies types of the bentonites can be well demonstrated by the stratigraphic distribution of the montmorillonite concentration determined by X-ray analysis on 469 samples. The montmorillonite content was calculated by three methods, using 001 reflexion and 110 reflexion multiplied by two different factors. Then the averages of the three different data were also calculated. The montmorilonite concentration varied between 10 and 71 %. The mean is 37 %, the median is also 37 %, while the mode is 42 %. But there are strong differences between the three above-mentioned facies types. The increasing trend of the montmorillonite content from the bentonitic tuff to the sedimentary bentonites proves the important role of the submarine sedimentary conditions in the formation of bentonite, while the lowest value of the standard deviation in case of the second group (sedimentary bentonite with strong tufogene character) reflects to the lower level of bentonitization in case of the bentonitic tuff, and to the importance of terrigenous minerals in case of the sedimentary bentonites.

The geochemical investigations gave evidences from the aspects of the genetic consequences. Main elements were analysed from 33 samples and resemble to the geochemical changes initiated by the weathering. The spatial distribution of the samples in the Na_2O+K_2O – SiO_2 system reflect the strong decreasing of alkaline elements and silicon content due to the bentonitizing. Regarding the samples in the ternary diagram of Englund and Jörgensen (1973) can be seen that the strong decrease of alkaline elements was simultaneous with the increasing of Fe. Main element data indicate the decreasing trend of Si, K, and Na during the bentonitization while the increasing of Fe concentration refer to strong geochemical affect of exhuming andesite tuffs in the terrestrial background of the sedimentary basin.

The trace element analyses of 14 samples were performed to indicate the genetic connections of the bentonitic tuff and sedimentary bentonites. The Nb/Y ratio of the samples as an important factor from the aspect of genetic origin of magmatic rocks (Winchester-Floyd 1977) was analysed together with some elements (Cr, Co, V, Cu) which could be transported into the sedimentary basin from the exhuming andesite tuff series, and with some elements (Sr, Ba) reflecting submarine depositional conditions. The results from trace element analysis indicate constant Nb/Y ratio simultaneous with the consequent increasing of the concentration of the terrigenous elements coming from exhuming andesite tuffs (Cu, Cr, Co, V) and of some other elements reflecting the submarine depositional circumstances (Sr, Ba). The constant Nb/Y ratio proves the common source (the same rhyolite tuff series) of the bentonites while the consequent changes in the concentration of the other elements refer to the different circumstances of the bentonitization.

References

ENGLUND, J. O., JÖRGENSEN, P. 1973. A chemical classification system for argillaceous sediments and factors affecting their composition. GFF, 95: 87-97.

WINCHESTER, J. A., FLOYD, P. A. 1977. Geochemical discrimination of different magma series and their differentiation products using immobile elements. Chemical Geology, 20: 325-343.

COLBU – BAIA BORŞA CROSSCUT, TOURISTIC DESTINATION

RACOLȚA, S. (S.C. HM FLASH TRADING S.R.L., Baia Mare, Str. Garii 3B/79)

E-mail: flashbm@rdslink.ro

The economic reform from Romania cannot be imagined without restructuring the mining and geology domain, considered before 1992 to be fundamental for the economy. The strategy for diminishing losses in that field contains a program for closing the inefficient mines and quarries. This has and will have important economic and social effects. In some of these mines one can find places, which, with minimal investments, can be transformed in tourist targets, mainly due to their special geological characteristics. This places, properly prepared and secured can be used for "real life" experiencing, teaching and training for a lot of areas: minerals, rocks, mineral ores, fossils, various geological phenomena, mining works, etc. This approach is valuable both touristically and scientifically.

This paper proposes such an endeavor for Borsa area, more exactly to arrange the Colbu crosscut (Level +1000m). Without intending to be a feasibility study, the authors present their ideas and motivations, and in the case of a potential customer wanting to start such an activity, they will strive to find financial resources and concrete technical solutions

Located in Maramures Mountains, at about 2.5 km from Baia Borsa (Borsa – Baia Borsa, 7 km) 1,000,000 Colbu crosscut crosses on a north-south direction the eastern part of Piciorul Caprei (+1804 m) and Lucaciasa (+1730 m) peaks. The crosscut has been made at about 1000 m level and is actually a 5 km long tunnel, open to south on Colbu Valley at about 1.5 km from the confluence with Cisla Valley and to north on Ivascoaia Valley at bout 1.4 km from the confluence with Vaser Valley.

The crosscut intercepted between meters 2154 – 2244 (meter 0 being on Colbu Valley) massive pyrite lead-zinc ores, belonging to Burloaia – Gura Baii sulphide level.

In the case of closing this area, which is known to imply the degradation of access roads to it and to the ore deposits, we consider to desirable to preserve of above-mentioned interval. It represents the only place in the region where the metamorphosed sulphides level can be visited in its specific lithological environment.

In addition to the above stated main argument we also had in view

On the gallery one can find Neogene volcanics from the andesitic dykes and veins series belonging to Toroiaga subvolcanic complex, metamorphites belonging to the Tulghes group, products of contact metamorphism, tectonic breccias formed on major faults. All these will keep the visitor interested, avoiding him to get bored on the road to and from the mineralized area.

Easy access: modernized road form Borsa to Baia Borsa and on Cisla Valley until the confluence with Colbu Valley and unmodernized (1.5 km until the galley entrance) on Colbu Valley

The possibility of making a great tourist circuit: Viseu – Vaser Valley – Ivascoaia Valley – Colbu Crosscut, Borsa where the underground part together with sample collection or purchase is a special attraction.

Reduced maintenance costs: natural ventilation and very good timbering of the schist zones.

Due to the imminent closing of the mining activity in the mentioned area we consider appropriate the preparing the 1,000,000 Colbu Crosscut as a tourist destination. It can become a natural museum and the last witness of the mining activity in Borsa Viseu area.

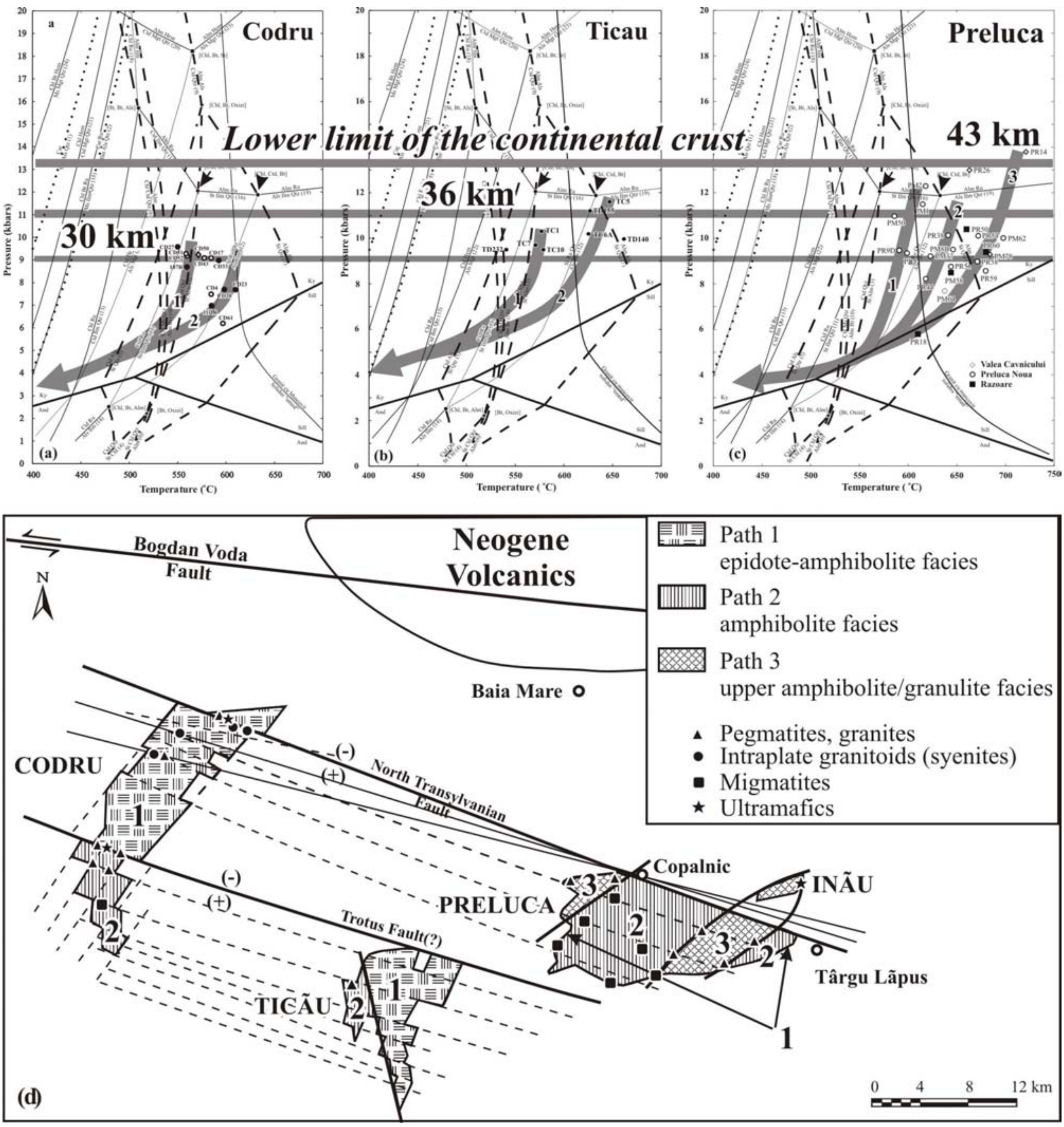
THERMOBARIC EVOLUTION OF THE METAMORPHIC ROCKS FROM PRELUCA, ȚICĂU AND CODRU MASSIFS, NW TRANSYLVANIA, ROMANIA

RADU, D. M. (S.C. SAMAX Romania S.R.L., Str. Moldovei 15/1, 430232 Baia Mare, Romania)

E-mail: daniel@samax.sintec.ro

A thermodynamic approach of the mineral assemblages from three crystalline islands, Preluca, Țicău and Codru, was considered. Petrogenetic grids and geothermobarometric calibrations were used to infer the metamorphic evolutions (PT paths) of the mineral assemblages. Representative mineral compositions from micaschists, gneisses (garnet, plagioclase, muscovite, biotite, chlorite, chloritoid, staurolite, kyanite, sillimanite, ilmenite, rutile, quartz) and amphibolites (amphibole, plagioclase, garnet, diopside, epidote, chlorite, biotite, titanite, calcite, ilmenite, rutile, quartz), were used to calculate the maximum PT of the mineral assemblages assumed to be in thermodynamic equilibrium.

Three distinct PT paths were distinguished from mineral assemblages, geothermobarometry, and petrogenetic grids correlations. These are presented in figure a, b, c. Each PT path has a distinct geographic distribution, as shown in figure d.



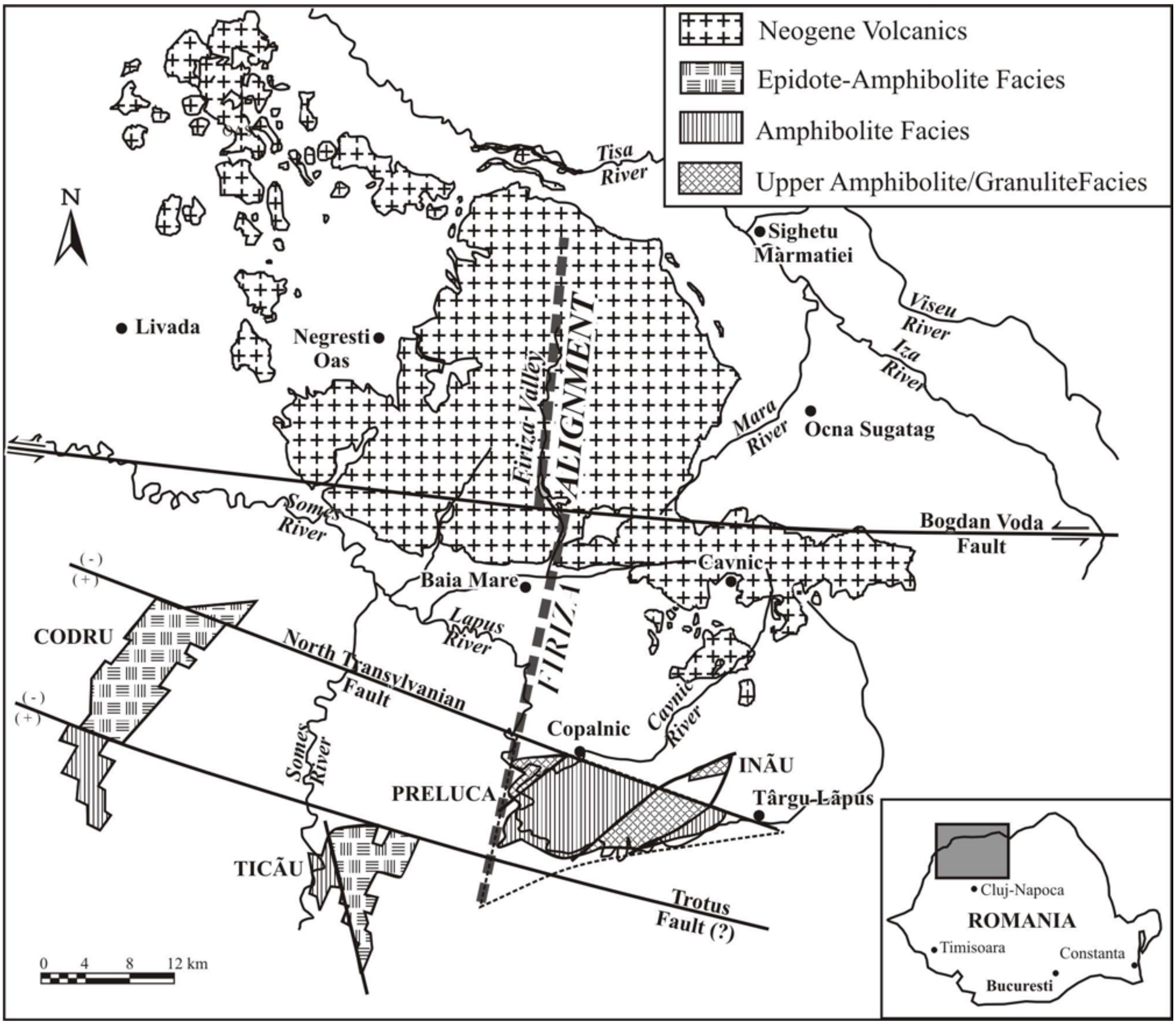
Preluca, Țicău and Codru represent fragments of continental crust, uplifted on reverse faults, from different depths (as shown in figure), as results of a compressive regime, initially from NW in Preluca, followed by a NE compressive regime in all the three crystalline massifs.

FIRIZA VALLEY, BAIA MARE, ROMANIA – A SIMPLE CONVENTIONAL LIMIT OR A TECTONIC ALIGNMENT PLAYING A MAJOR ROLE IN THE MAGMATIC AND HYDROTHERMAL PROCESSES IN THE AREA?

RADU, D.M., HALGA, S. (S.C. SAMAX Romania S.R.L., Str. Moldovei 15/1, 430232 Baia Mare, Romania)

E-mail: daniel@samax.sintec.ro; sorin@samax.sintec.ro

Researchers used the Firiza Valley from the Baia Mare district, Gutai Mts, Eastern Carpathians, Romania, during the past years as a conventional line to distinguish two different geological environments: one to the West and the other one to the East of the Valley, each environment with its own characteristics. To our knowledge, there has not been done yet any detailed analysis to show if the Firiza Valley limit is conventional or real.



Considering the ore deposition processes, a comparative analysis of the different mineral associations shows that at least three epithermal levels occur only West of the Firiza Valley: the gold-silver, the silver and the gold-bearing quartz in copper ores levels. At the same time, to the East of the Firiza Valley the gold occurs more as later stage events within base metals mineralisations (Halga, 1998).

The areas with hydrothermal alteration are more developed West of Firiza Valley. For instance, the adularia alteration is stronger and occurs on a broader area West of Firiza Valley (Stanciu, 1973).

The chemical character of the Magmatic products is also different: West of the Firiza Valley, the intermediate-acidic volcanic products are more important as volume than the intermediate-basic volcanic products while East of the Firiza Valley the proportion changes totally. The mineralogy of the igneous rocks show that the amphibole is more characteristic for the Eastern side of the Firiza Valley than to the Western side.

The crystalline massifs from northwestern Transylvania represent fragments of continental crust, uplifted on reverse faults, from different depths (see Radu, 2003a, this volume). Codru and Ţicău massifs are dominated by metamorphic rocks in epidote-amphibolite facies, representing exposures of an oxidized basement (Radu, 2003b). Preluca massif consist in metamorphic rocks in amphibolite and upper amphibolite-granulite facies, representing exposures of an reduced basement.

A tectonic alignment is proposed to assign the differences outlined above, as shown in the figure, named Firiza alignment. This alignment separates two distinct basements types: a medium grade metamorphic rocks, oxidized, relatively hydrated, at West of Firiza (Codru and Ţicău type), and a high grade metamorphic rocks, reduced, relatively dehydrated, at East of Firiza (Preluca type). These distinct basement types are called to explain the magmatic and hydrothermal processes and distribution in the Baia Mare district.

References

HALGA, S., 1998. A Comparative Study of the mineralised structures within the Baia Mare District. Al. I. Cuza University of Iasi, PhD Thesis (in Romanian), 135 p.

RADU, D.M., 2003a. Thermobaric evolution of the metamorphic rocks from Preluca, Ţicău and Codru massifs, NW Transylania, Romania. This volume.

RADU, D.M., 2003b. Thermobaric evolution of the metamorphic rocks from Preluca, Ţicău and Codru massifs, NW Transylania. University of Bucharest, PhD Thesis (in Romanian), 220 p.

STANCIU, C., 1973. Hydrothermal alteration of Neogene volcanic rocks from ore deposits in Gutai Mountains (East Carpathians). Rev. Roum. Geol. Geophys. Geogr., Ser. Geol., 17, 1, 43-62.

TRONDHJEMITIC MAGMAS ENGENDERED BY THE ISLAND ARC BIMODAL VOLCANISM IN THE MUREŞ ZONE, ROMANIA

SAVU, H. (Geological Institute of Romania, 1 Caransebeş St, 78344, Bucharest 32)

E-mail: geol.@igr.ro

During the Mureş Ocean's closure due to a bilateral subduction, within the eugeosyncline that set up there, two marginal trenches occurred: a northwestern trench of Mariana type and a southeastern trench of Andean type. Within the first trench an island arc bimodal volcanism manifested itself, while in the second trench the volcanism was a normal calc-alkaline one. The bimodal volcanism from the Mariana-type deep trench was controled by the subduction on an almost vertical plane that favoured rather distension geotectonic conditions. Under these conditions, from the metasomatized (hornblendized) mantle a low alkaline basic magma resulted there. From this magma there were engendered albite basalts, albite basaltandesites and mugearites. From the same magma, a leucocratic magma was separated by fractional crystallization. This leucocratic magma further differentiated into two magma fractions: a trondhjemitic magma rich in Si and Na that generated quartzkeratophyres, and a K-rich magma from which trachytic rocks resulted.

ALKALIC-MAFIC MAGMATISM IN THE CARPATHIAN-PANNONIAN REGION: A REVIEW

SEGHEDI, I. (Institute of Geodynamics, 19-21, str. J.-L. Calderon, Bucharest 70201, Romania), DOWNES, H. (Birkbeck/UCL Research School of Geological and Geophysical Sciences, Birkbeck College, Malet St., London WC1E 7HX, UK), VASELLI, O. (Università di Firenze, Dip. di Scienze della Terra, Via G. La Pira 4, I-50121, Florence, Italy), BALOGH K., PÉCSKAY Z. (Institute of Nuclear Research of the Hungarian Academy of Sciences, P.O. Box 51, Bem ter 18/c, H-4001 Debrecen, Hungary), Alexandru SZAKACS A. (Institute of Geodynamics, 19-21, str. J.-L. Calderon, Bucharest 70201, Romania)

E-mail: seghedi@geodin.ro

Mafic alkalic volcanism was widespread in the Carpathian Pannonian region (CPR) between 11 and 0.2 Ma, following the Miocene continental collision of the Alcapa and Tisia blocks with the European plate, just as the subduction-related calc-alkaline magmatism was waning. Alkalic mafic rocks from different regions within the CPR have been differentiated based on their age and/or distinctly different mantle-normalised trace element compositions. Trace element and Sr-Nd-Pb isotope systematics are consistent with complex mantle source regions, which were either depleted asthenosphere or enriched lithosphere. The DMM-HIMU-EMII mixing isotopic components of magmas derived from the asthenospheric mantle indicate variable contamination of the shallow asthenosphere and/or thermal boundary layer of the lithosphere by a HIMU-mantle plume component prior to and following the introduction of subduction components.

Various mantle sources have been identified: (1) Lower lithospheric mantle affected by an old asthenospheric enrichment (mostly seen in older mafic magmatism in the western part of the CPR); Younger asthenospheric plumes that show an OIB-like geochemical signature and are isotopically either enriched (2) or variably depleted (3); (4) Old upper asthenosphere heterogeneously contaminated by DM-HIMU - EMII-EMI components (most of the magmatism in the central and eastern parts of the region) and slightly influenced by previous Neogene subduction-related enrichment; (5) Old upper asthenosphere-lower lithosphere heterogeneously contaminated by DM-HIMU-EMII mixing components and significantly influenced by Neogene subduction-related enrichment.

Melt generation was initiated either by: (i) narrow, finger-like young asthenospheric mantle plumes rising and heating up to the base of the lithosphere (below the Alcapa block), or (ii) tectonic processes which allowed decompressional melting of the old asthenosphere resulting from its upwelling to replace the removed part of the lower lithosphere or to heat and melt former subducted slabs (as related to young tectonic processes in the Tisia block).

EDIFICE INSTABILTY AND RELATED PROCESSES AT COMPOSITE VOLCANOES. IMPLICATIONS FOR MINERAL EXPLORATION

SZAKÁCS AL. (Institute of Geodynamics "Sabba S. Stefanescu", Romanian Academy, Bucharest, Romania)

E-mail: szakacs@geodin.ro

Large andesite-dominated composite volcanoes are intrinsically unstable. They naturally evolve toward unstable state as they grow and mature. Instability factors are either internal or external. Intrinsic instability factors include 1) gravitational edifice loading by extrusion and shallow intrusion and 2) edifice weakening by hydrothermal alteration, volcanic seismicity, dyke/sill intrusion and fracturing. External instability is induced by 1) basement topography, structure and composition, 2) non/volcanic seismicity and 3) active tectonics.

Volcano instability may be solved through a number of processes including 1) caldera formation, 2) increasing erosion rate, 3) edifice or flank failure, and 4) volcano spreading. Caldera formation and edifice/flank collapse are milestone-events in the evolutionary history of long-lived composite volcanoes. Edifice/flank failure is a common edifice instability-solving phenomenon at quickly growing volcanoes. Diagnostic features of such events are morphological – an amphitheatre-shaped depression left behind in the edifice and the hummocky topography of the resulted debris-avalanche deposit – and lithological – the presence of voluminous debris-avalanche deposits in the geological record. Up to kilometer-sized megablocks from the edifice, called "toreva blocks", can be transported away with little or no disturbance of their internal stratigraphic relationships. Hydrothermally altered rock volumes can thus be removed from the central part of the volcanoes and emplaced at certain distances from it. Unaware mapping of such features may result in false ore indications in mineral exploration. On the other part, sudden depressurization of an evolved hydrothermal system within volcanic edifices due to edifice collapse may trigger or enhance precipitation of pressure-sensible ore minerals (e.g. via second boiling of a porphyry system). At least two large-volume debris-avalanche deposits have been preserved in the geologic record of the Calimani-Gurghiu-Harghita volcanic chain

(CGH), corresponding to two major edifice-failure events, which affected the Rusca-Tihu (Calimani Mts.) and Varghis (Harhita Mts.) volcanoes, respectively.

Volcano spreading results from interaction between the volcanic edifice and its basement where plastically deformable rocks occur in the substratum. It consists of sagging in the central part of the edifice, and lateral spreading of its flanks, while basement rocks are squeezed, transported laterally, and folded/thrusted. The volcano-induced basement deformation may include diapiric uprise of ductile rocks such as salt and clay.

Evidence of volcano - basement interaction related to the Calimani-Gurghiu-Harghita volcanic chain includes both structural and morphological features. Geological and geophysical data show basement subsidence along most of the axial part of the volcanic chain. The wide volcaniclastic plateau extends deep into the Transylvanian Basin and its surface is tilted toward the chain axis, especially in the Gurghiu Mts. These features strongly suggest late-stage or post-volcanic basement sagging beneath the volcanoes. On the other hand, travel-time seismic profiles acquired in the north-eastern part of the Transylvanian Basin show swarms of west-verging reverse faults developed near the CGH volcanic range, which are difficult to be explained within known scenarios of basin evolution. Structures related to volcano - basement interaction may constitute convenient traps for hydrocarbons. On the other hand, unaware incorporation of such tectonic features into regional geodynamic models could lead to misleading results.

BUCIUM RODU FRASIN GOLD DEPOSIT – NEW EXPLORATION DATA IN A HISTORIC MINING AREA

SZENTESY, C., MINUT, A., O'CONNOR, G.V., (SC Rosia Montana Gold Corporation SA, Str. I.C. Bratianu, Nr. 20, 2500 Alba-Iulia, Alba, Romania)

E-mail: szc@rmgc.ro

Location

The Bucium Project lies within the 'Golden Quadrilateral', a historic mining district located in the Apuseni Mountains of Romania.

Regional Geology

The regional geology has been described by Burchfiel and Bleahu (1976) and Jankovic (1997) and has been summarised in reports for RMGC (eg Barnes and others, 1999, Keely 2000). Bucium lies within the 'Golden Quadrilateral', located in the Apuseni Mountains of Transylvania that form part of the Carpatho-Balkan province of the Tethyan-Eurasian metallogenic belt.

Rocks in the Northern Apuseni Mountains consist of Mesozoic shallow-marine and non-marine sedimentary rocks overlying Palaeozoic and Precambrian sedimentary and metamorphic rocks. North-directed thrust faults cut the southern part of the Northern Apuseni Mountains, during the Late Cretaceous, forming a series of nappes.

The Southern Apuseni Mountains consist of several large bodies of mafic rocks, probably Middle Jurassic oceanic crust, and Late Jurassic to Late Cretaceous marine to deltaic sediments including thick limestone sequences. The sedimentary rocks developed in several sedimentary basins that were amalgamated by Cretaceous structural events.

Numerous subduction-related calc-alkaline volcano-intrusive complexes developed following the collision of the Pannonian microplate and the European continental plate in the Late Eocene-Lower Miocene. Epithermal and mesothermal Ag-Au, Cu-Au and Cu deposits are associated with Badenian to Pliocene andesitic-dacitic volcanic and sub-volcanic bodies which intrude the Cretaceous and older basement.

Local Geology

The local geology has been described in detail by Keely (RMGC Internal Report, 2000) and consists of: cretaceous sediments, dacite intrusives, phreatomagmatic breccias, andesite and basalte.

The Bucium licence area has a basement of Lower Cretaceous sediments. The sediments are comprised of flysch, shales, micaceous shales and siltstones, calcareous shales and limestone and molasse, sandstones and conglomerates. The ductile sediments have been intensely folded in contrast to the more competent rocks, such as quartz pebble conglomerates. The sediments are essentially non-magnetic.

North of the village of Bucium, the Frasin Dacite has intruded Cretaceous sediments and is flanked by related volcano-sedimentary breccias. The original mineral composition of the dacite has been destroyed by strong argillic, and in places silicic and pyritic, alteration.

Flanking the dacite intrusive to the east and west is an apron of massive, unsorted, matrix-supported, polymict breccia of pyroclastic origin. The breccia contains a wide range of clasts, including limestone, black shale, sandstone, conglomerate, mica schist and dacite. The clasts in the breccia have been derived from Cretaceous sediments, from metamorphic rocks underlying them and from the dacite itself. The presence of dacite clasts shows that the breccia formed after the intrusion of the dacite. The presence of clasts of juvenile magma as well as various types of country rock means the breccia can be considered an eruptive phreatomagmatic breccia as defined by Lawless and others (1997). No evidence of sedimentary reworking was seen.

An andesitic intrusive-extrusive complex is situated south of Bucium Village. The main rock type in the northern 25% of the area is a quartz andesite, characterised by large quartz phenocrysts (up to 15mm) and large hornblendes. This rock type is well exposed in a small quarry in Valea Bisericii. The proportion of quartz phenocrysts varies and in some locations quartz is rare or absent. This rock has been previously referred to as the Contu Dacite.

The main rock type in the southern 75% of the area is a hornblende andesite with minor quartz. Hornblende phenocrysts reach 15mm but are usually smaller. This rock has been previously referred to as the Vilcoi or Arama andesite.

On the northeastern flank of the hornblende andesite complex is a breccia composed of clasts of hornblende andesite and various Cretaceous sedimentary rock types. In places it forms a thin sheet over the underlying massive andesite. This is probably a contact breccia (or magmatic-intrusive breccia of Lawless and others (1997)), formed on the margin of the andesite as it intruded and disrupted the Cretaceous sediments. A zone of contact breccia also occurs along the andesite-sediment contact at Izbicioara, where limestone and shale xenoliths form up to 40% by volume of the andesite.

On the track into Tarnita is a road cutting in which a breccia consisting of fresh clasts of hornblende andesite and argillically altered clasts of quartz andesite overlies massive argillically altered quartz andesite. This is interpreted as a hornblende andesite pyroclastic flow ripping up and incorporating clasts of older, underlying and previously altered quartz andesite.

Weakly hornblende-phyric andesite is present in the south of the licence. The approximate extent of the andesite is shown on the GIS geological maps derived from previous regional mapping. Andesite is exposed for about 50m along the western side of the valley.

A very small exposure of brecciated andesite can be seen by a stream located northeast of the main andesite body. This breccia is the only evidence of a moderately magnetic rock within an interpreted magnetic body. Apart from this exposure, the only rocks cropping out are Cretaceous sandstone and shale.

Another interpreted magnetic body, centred on the road between Izbita and Bucium is totally concealed by siltstone, shale and limestone. Other concealed magnetic bodies flank the quartz andesite southeast of Bucium.

Outliers of Pliocene or Quaternary vesicular columnar basalt or basaltic andesite cap two large hills in the northeast of the area forming the prominent exposures known as Detunata and Detunata Goala. Float from these hilltop exposures is widespread.

References

BURCHFIEL, B., C., BLEAHU, M., 1976. Geology of Romania. Geological Society of America, Special Paper, 158.

GHITULESCU, T., P., SOCOLESCU, M., 1941. Etude Geologique et Miniere des Monts Metalliferes. Anuarul Institutului Geologic al Romaniei Volumul XX: 181-463.

JANKOVIC, S., 1997. The Carpatho Balcanides and Adjacent Area: A Sector of the Tethyan Eurasian Metallogenic Belt. Mineralium Deposita 32 (5) : 426-433.

KEELEY, G., 2000. Regional Mapping at Bucium, Transylvania, Romania. Unpublished Preliminary Report.

KEELEY, G., 2001. 1:2500 Scale Mapping at Frasin Rodu, Near Bucium. Unpublished Report.

LAWLESS, G., V., AND OTHERS, 1997. Epigenetic Magmatic Related Mineral Deposits. Exploration Based on Mineralisation Models. Kingston Morrison Training Course Volume.

VAN DER MERWE, A., 2001. Rosia Montana – Bucium Heliborne Magnetic Survey Transylvania, Romania. Unpublished Report.

INVENTORY OF METAL MINING WASTES IN ROMANIA: A METHODOLOGICAL APPROACH

VELICIU, S. (Geological Institute of Romania), STRATULAT, P. (National Agency for Mineral Resources)

E-mail: sveliciu@igr.ro, s_petru@namr.ro)

The activities of capitalisation of the metallic mineral resources through geological exploration, extraction operations, mining metallurgy etc. represent only some of the main fields that lead to the degradation of the environment. Large surfaces of the access routs, building sites, waste storage areas resulted from uncover process or the processing plants are affected adversely by pollution. Results of pollution may occur directly or indirectly and may have immediate or long-term character.

Due to underground and surface excavations also the neighbouring areas suffer adverse influences such as changes in the flow of underground waters, modification of geochemical nature of the elements, erosion etc. The largest porphyry copper deposit located in the Apuseni Mts., western part of Romania ("Rosia Poieni" ore deposit) is an active acid-rock drainage (ARD-producing site). Chemical analyses show that stream waters from the region contain significant amounts of heavy metals that are potentially dangerous to the environment.

The impact of mining activities as prospecting, exploration, mining and concentration process of useful mineral substances ("dressing minerals") imply the carrying out of different assessments of the environment from the following standpoints: mine wastes, residual waters - polluted waters as a result of mining and processing of ores, physical stability of the areas where underground or surface mining voids are present as a result of mining activities, visual impact as degradation of the landscape.

The mine wastes resulted after the mining and concentration process of useful mineral substances have been separated into two categories according to their granulometry: (1) large sizes products: fragments of rocks and ore with low content of useful elements as a result of exploration and mining of deposits. They form heaps of mine wastes or waste dumps. Only in the western part of Romania a number of 179 waste dumps resulted from metal mining, exhibiting a total volume of 107 million m3 and being spread on 418 ha; (2) fine-type material as a result of concentration process. They form the decanting or tailing ponds. The metal mining in Romania uses a total of 64 major tailing ponds (29 active, 26 inactive, 9 as backup). These cover a total surface of 1,351 ha and contain 128 million tons of useless rock (useless considered for the present time).

Today one of the most important issues related to metal mining in Romania is the wastes. Historically, or even just a few decades ago, environmental awareness, legislation and management practice did not adequately consider the long-term safety and environmental risk involved in the metallic mining waste management. Issues that need addressing include also the cost of rehabilitation and setting of criteria and standards of rehabilitation. Given the widespread nature of metal mining waste, it is necessary to give a particular importance to priotisation in this area to facilitate the environmental approximation process and to consider appropriately the situation in the new Romanian legislation.

The inventory of the metal mining wastes forms the standardized information basis for environmental impact assessment using tools of geological and geochemical site assessment, environmental and spatial modelling. The objectives are: (1) to conceptualise and demonstrate a standardised regional inventory of waste sites from metal mining in Romania in relation to catchement areas, making it possible to develop a concept for impact assessment allowing to link the site related indicators with spatial information at catchment scale; (2) to compare the legal criteria for the assessment and remediation of contaminated areas with regulations adopted by Romania and with the existing EU legislative framework in the domain of waste management; (3) to contribute to the assessment of the consequences of mining accidents such as the Baia Mare and Baia Borsa events.

A MULTIDISCIPLINARY APPROACH OF LAND INSTABILITY PHENOMENA IN SALT MASSIVE AREAS

MAFTEI, R-M., RUSU, E. (Geological Survey of Romania, 1 Caransebeş st., sect.1, Bucharest, Romania)

E-mail: ralum@igr.ro

There are a lot of cases when, apparently, the landslides were unexpected yielded, overtaking economic and social objectives, totally unprepared to be protected before the disasters brought about these phenomena. The change of the slopes stress status is the result of the simultaneous action of different natural and artificial factors. Its evolution must be identified, monitored and extrapolated for a large enough period of time to take the measures to avoid or diminish some disasters, which can be yielded by landslides.

The field works were made in several perimeters, in which salt massive are present (Slănic Prahova, Telega, Ocnele Mari, Ocna Dej etc.), with rough topography and complicated geology. The works were complex, including geological and local geophysics studies (geoelectric tests).

The lithostratigraphic information and observations showed the presence of Neogene sedimentary deposits constituted by clays, shale, compact gray marls, sandstone, conglomerates, sands etc.

Lots of the land changes are due to the anthropogenic activity. They are similar, as mechanism, to the natural factors, but different as distribution and scale. Maybe, the most usual way by which the human activity can lead to the landslide appearance is by changing the water regime. The permanent or temporary blocking of the drainage paths can change the underground table and the flow system. The clearings determine the water table rising and the changes of the meteoric water soil infiltration. The ditches, the collector sewers or other pipe systems can brake off the underground normal flow. The excavation made for some important objective constructions can also affect the slope stability. The storage of the excavated material, as filling, can generate unexpected effects. The overburdening of a stable section in the upper part of the slope can unleash a larger landslide than the surface filled with excavated material and the damages may be very important.

The final category, and the most important, of the landscape changes made by the human is linked to the mining activity. In the case of the mining exploitation, the effects of the human activity can be dramatic. The mining subsidence can lead to the collapse of some old mining works and to the unleashing of the landslides. The best examples of the influence of the human factor can be observed in the salt exploitation areas (Slanic Prahova, Ocnele Mari, Ocna Dej etc.) with very active zones concerning landslides (CIOBANU & MAFTEI, 1998).

The Slănic Prahova salt deposit is situated in a hilly area, in the southern part of Eastern Carpathians, crossed by the Slănic valley. The field observations were maid on both sides of the valley, in areas which are significant concerning slope stability. There were identified old landslides, locally reactivated (Unirea and Victoria mines), active landslides (Green Pits, Green Valley etc.), underground caves roof collapse phenomena due to dissolution (Salt Mountain-Shepherd Pit, Green Pits, Pig Pit etc), creep phenomena (La Noroaie).

The Telega baths are situated around the salted lakes which are in the NW part of the Telega commune Prahova county), at the “Butoi” zone. The deposits that occur in these areas belong to the Evaporated Formation (Middle Miocene-Badenian age). Also, near the rivulet, salt occurrences are observed. The landslides are present on the left side of the Telega Valley, reaching near to the summit of the hill, where is the road to Bustenari. The landslides observed in these area are in different stages (old-stabilized to recent reactivated-the 2000 year spring- etc.).

The Ocnele Mari salt deposit is situated in the Getic Southcarpathians area. In this region there are a lot of abandoned salt mining works, which led to a underground flowing direction change; therefore, by their collapse sliding centers of the formations situated on the top of the salt appeared. In the autumn of 2001, in the second exploitation field (Ţeica), the most spectacular event in the salt exploitation history was produced. On 12 September 2001, S 377 well plunged into the lake formed as an effect of the rock mass situated on top of the cavern collapse.

The Ocna Dej massive is situated in the northwestern part of Transilvania Depression. Due to the old mining works, now closed, in the northern part of the mining perimeter, land movements appeared determined by the caving of old mines roof. Because of the cracks, there is an infiltration water circulation to the roof of the salt massive; the consequences of this fact are reflected by the carstic phenomena on salt existence, which lead, at the surface, to topographic level changes (landslides, subsidence).

The resistivity measurements by the vertical electric tests showed the distinct contribution which a simple, but accurate conceived and exact implemented, geoelectric research may have to the knowledge of the landslides’ phenomenon. Besides the general field data, regarding the physical properties of the deposits and their spatial succession, the resistivity electric tests allowed the outlining of the constitutive elements of a landslide, which have produced and will produce big problems for the affected constructions and householders from the researched area. Based on the information obtained by the geoelectric researches, we can estimate the proportion of the phenomenon and it’s evolution in time and space and we can, also, establish the dimensions of the necessary land’s stabilization geotechnic works.

References

CIOBANU, G. & MAFTEI, R. (1998): Engineering-geological researches on the Prahova-Teleajen area landslides. An. Inst. Geol. Rom., vol. 70, 320-326, Bucharest.

An. Inst. Geol. Rom., 73, Special Issue, Bucuresti, 2003

LATE RECEIVED ABSTRACT

MODELS OF LATE CRETACEOUS MAGMA GENESIS IN THE CARPATHIAN-BALKAN BELT: FROM A PARADIGM TO ANOTHER

BERZA, T. (Geological Institute of Romania)

E-mail:berza@igr.ro

Late Cretaceous magmatic rocks, both plutonic and volcanic, were intensely studied in the Romanian Carpathians under the name of "Banatites", coined by the pioneer work of von Cotta (1865) in Banat and Serbia, sometimes applied also to same age rocks from the Serbian Carpathians and the Bulgarian Srednogorie region (e.g. Giuşcă et al., 1965, Cioflica and Vlad, 1973). Thousands of geological reports, hundreds of printed scientific papers and tens of Ph D thesis have produced in the last century a huge quantity of data in Romania, Bulgaria and Serbia, including thousands of classical wet chemical or optical spectrometric analyses and K-Ar model ages, but modern geochemical and geochronological methods were applied only in the last 10 years in a few areas of the 1500 km long Banatitic Magmatic and Metallogenetic Belt (BMMB – Berza et al., 1998). The main result of the recent studies was to show I-type characteristics, enrichment in LILE and LREE versus depletion in Nb, Ta and Zr, slight negative Eu anomaly, low Sri ratio (0,704-0,706) and positive εNd(i) (+4 – 0), interpreted as pointing to magmas generated by partial melting of a Rb-enriched and LREE-depleted source with minor crustal assimilation on the way to the emplacement level (e.g. Dupont et al., 2002). A major feature of the Banatitic magmatism is the association with important ore deposits, from skarns to porphyry copper and massive sulfide types, major producers of Cu, Mo, Au, Pb, Zn, Fe in Serbia, Bulgaria and Romania (Janković, 1977, 1997, Vlad and Berza, 2003).

The geosynclinal paradigm was implicitly or explicitly used by all geologists in the first half of the XXth century and applied to Banatites by Stille (1953), Giuşcă et al. (1965, 1966), Ghiţulescu et al. (1965). Late Cretaceous to Paleocene volcanics and intrusions were labeled as subsequent (or precocious subsequent) in respect to the inversion of the Alpine geosyncline, even if references to tectonic phases (Sub-Hercynian volcanism, Laramian magmatism) suggest syn-orogene connotations.

The plate tectonics paradigm was extensively used in the last decades for modeling the origin of Banatites as subduction-related, but with different use of it in each country. In Romania the Rădulescu and Săndulescu (1973) model, still dominant and refined by Săndulescu (1985), Russo-Săndulescu et al. (1984), Săndulescu and Visarion (2000), Vlad (1997), postulates two westwards directed Late Cretaceous subductions, of Transylvanian (Main Tethys) and Severin (parallel, intra-European margin) paleo-oceans. In Serbia the eastward directed subduction of the Vardar (Tethys) ocean was claimed by Jankovic (1977, 1997) as generating Banatitic magmas. In Bulgaria, Boccaletti et al. (1974) proposed that the calc-alkaline magmatism of Srednogorie was due to the northward directed underthrusting of the Vardar lithospheric slab which (after the collision of the sialic plates) "continues, detached, descending into the upper mantle". Both the dominant calc-alkaline geochemical trend of the igneous rocks and the metallogenetic features of the associated ore deposits were extensively used for supporting the subduction models.

Extensional (post-collisional and post-crustal thickening) tectonics, with the recent advances in modeling of magma generation coeval with exhumation of metamorphic domes and subsidence in adjacent sedimentary (±volcanic) basins represents the rising paradigm. Foreseen by Boccaletti et al. (1978) for explaining the high-potassium magmatism in the eastern Srednogorie as due to Late Cretaceous "distension tectonics connected with the opening of the Black Sea", this model was used for the entire Banatitic belt by Popov (1981, 1987; Popov et al., 2000), and Berza (1999). It is well supported with sedimentologic data by Aiello et al. (1977) for the Srednogorie area and by Willingshoffer (2000) for the Apuseni and Banat areas, while the Timok volcanic area was described as a rift structure since the paper of Antonijević et al. (1974). The fact that the Late Cretaceous belt transects in the Carpathians and Balkans the main tectonic units of western Romania, Serbia and Bulgaria, as a post Mesocretaceous string of sedimentary basins, volcanic structures and thousands of intrusions showing no relation with the adjacent oceanic-type units, enhances the value of this new paradigm. In this case a decompression melting in the lower crust, in relation with post-orogenic (in respect with the Mid-Cretaceous collision) basin tectonics along major crustal structures in intracontinental position can be advocated, similar to the crustal thinning, transcurrent basin tectonics, lithospheric uplift and mafic underplating described for the (post-Variscan) Permian within-plate magmatism of the French Central Massif (Femenias et al.,2003), also preceded several tens of Ma by a subduction period. This earlier subduction leaded to a metasomatic enrichment of the upper slab mantle in LILE and LREE, but had no direct relation with the tectonic environment of the Banatitic magma genesis.

References

Aiello E., Bartolini C., Boccaletti M., Gočev P., Karagjuleva J., Kostandinov V., Manetti P. (1977) Sedimentary features of the Srednogorie zone (Bulgaria): an Upper Cretaceous intra-arc basin. Sedimentary Geol. 19, 39-68.

Antonijević I., Grubić A., Djordjević M. (1974) The Upper Cretaceous paleorift in Eastern Serbia. Metallogeny and concepts of the geotectonic development of Yugoslavia, Belgrade, 315-339.

Berza T. (1999) Tectonic setting of the Late Cretaceous Volcano-Plutonic Belt from Carpathians to Balkans. EUG X, J. Conf. Abs. 4, 469.
Berza T., Constantinescu E., Vlad S.-N. (1998) Upper-Cretaceous magmatic series and associated mineralisation in the Carpathian – Balkan orogen. Resource Geol. 48(4), 291-306.
Boccaletti M., Manetti P., Peccerillo A. (1974) The Balkanids as an instance of Back-Arc Thrust Belt: Possible relation with the Hellenids. Geol. Soc. Amer. Bull. 85, 1077-1084.
Boccaletti M., Manetti P., Peccerillo A., Stanisheva-Vassilieva G. (1978) Late Cretaceous high-potassium volcanism in eastern Srednogorie, Bulgaria. Geol. Soc. Amer. Bull. 89, 439-447.
Cioflica G., Vlad Ş. (1973) The correlation of the metallogenic events belonging to the Carpatho-Balkan area.). Rev. Roum. Géol., Géophys., Géogr., Géologie, 17, 217-224.
Cotta, von B. (1864) Uber Eruptivgesteine und Erzlagerstatten in Banat und Serbien. Edit. V. Braunmüller, Wien, 105 pp.
Dupont A., Vander Auwera J., Pin C., Marincea S., Berza T. (2002) Trace element and isotopes (Sr, Nd) geochemistry of Upper Cretaceous intrusions from Banat, western South Carpathians, Romania. Mineraliun Deposita, 37, 568-586.
Femenias O., Coussaert N., Bingen B., Whitehouse M., Mercier J.-C.C., Demaiffe D. (2003) A Permian underplating event in late- to post-orogenic tectonic setting. Evidence from the mafic-ultramafic layered xenoliths from Beaunit (French Central Massif). Chemical Geology 199, 293-315.
Ghiţulescu T.P., Borcos M., Resnic F. (1965) L'éruptif des Monts Metalliféres dans le cadre de l'orogenése alpine. Carp.-Balk. Geol. Assoc., VII Congr. Reports, III, 285-289, Sofia.
Giuşcă D., Cioflica G., Savu H. (1965) Les caractères chimiques des roches de la province banatitique. Carp.-Balk. Geol. Assoc., VII Congr. Reports, III, 291-296, Sofia.
Janković S. (1977) Major Alpine ore deposits and metallogenic units in the northeastern Mediterranean and concepts of plate tectonics. In: S. Janković ed. "Metallogeny and plate tectonics in the NE Mediterranean" IGCP 3 Volume, Fac. Min. Geol. Belgrade, 105-171.
Janković S. (1997) The Carpatho-Balkanides and adjacent area: a sector of the Tethyan Eurasian metallogenetic belt. Mineralium Deposita 32, 426-433.
Nicolescu S, Cornell DH, Bojar A-V (1999) Age and tectonic setting of Bocsa and Ocna de Fier-Dognecea granodiorites (southwest Romania) and of associated skarn mineralisation. Mineralium Deposita 34,743-753.
Popov P. (1981) Magmatectonic features of the Banat-Srednogorie Belt. Geol. Balcanica, 11(2), 43-72.
Popov P., Berza T. & Grubić A. 2000. Upper Cretaceous Apuseni – Banat – Timok -Srednogorie (ABTS) magmatic and metallogenetic Belt in the Carpathian-Balkan Orogen. ABCD-GEODE 2000 Workshop, Borovets, Bulgaria, Abstract Volume, 69-70.
Rădulescu D.P., Săndulescu M. (1973) The plate tectonics concept and the geological structure of the Carpathians. Tectonophysics 16, 155-161.
Savu H., Udrescu C., Lemne M., Romanescu O., Stoian M., Neacşu V. (1987) Island arc volcanics related to the wildflysch on the outer margin of the Danubian Autochtonous (South Carpathians). Rev. Roum. Géol., Géophys., Géogr., Géologie, 31, 19-27.
Savu H., Udrescu C., Neacşu V., Stoian M. (1992) Petrology, geochemistry and origin of the Laramian volcanics of the Mureş Couloir, between Zam and Gurasada. Rom. J. Petrology, 75, 117-130.
Săndulescu, M. (1984) Geotectonica României. Editura Tehnică, Bucureşti, 336 p.
Săndulescu M., Visarion M. (2000) Crustal structure and evolution of the Carpathian-Western Black Sea areas. First break, 18.3, 103-108.
Stille H. (1953) Der geotektonische Werdegang der Karpaten. Geologie Beih., VIII, 239 pp, Hannover.
Vlad Ş (1997) Calcic skarns and transversal zoning in the Banat mountains, Romania : indicators of an Andean-type setting. Mineralium Deposita 32, 446-471.
Vlad S.N., Berza T (2003) Banatitic Magmatic and Metallogenetic Belt: Metallogeny of the Carpathian segment (Western Romania, Eastern Serbia). GEODE ABCD Abstracts Volume, 1p., Seggauberg.
Willingshofer E. (2000) Extension in collisional orogenic belts: the Late Cretaceous evolution of the Alps and Carpathians. PhD Thesis, 146pp, Faculty of Earth Sciences, Vrije Universiteit Amsterdam.

ALPHABETIC LIST OF AUTHORS

Editorial Staff: Radu D. M.