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Rom. J. Mineralogy is also the Bulletin of the Mineralogical Society of Romania, a member the EMU and IMA. Thus, this journal follows the rules of the Commission on New Minerals and Mineral Names of the IMA in all the matters concerning mineral names and nomenclature.

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Institutul Geologic al României

3rd SYMPOSIUM ON MINERALOGY: INTRODUCTORY TALK

GHEORGHE UDUBAȘA

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The 3rd Symposium on mineralogy marks the 3rd anniversary of the Mineralogical Society of Romania (MSR), a young society among the members of IMA and EMU. The MSR has now about 150 members, honorary, ordinary, and sustaining, from Romania and abroad.

The MSR symposia became already customary and (we dare say) successful, claiming better and better organizing work and a higher and higher scientific level of the papers. It is a great honour for us to see at our symposium colleagues from other countries, i.e., from Albania, Alger, Austria, Azerbaijan, Belgium, France, Germany, Hungary, Italy, Poland, Russia, Slovenia, Ukraine, United Kingdom, Yugoslavia as well as co-operation papers with specialists from United States of America and Japan. I hope no points of disappointment will occur.

The organizing work has been largely solved with the highly appreciated support of the Baia Mare geology and mining authorities, i.e., CUART S.A., University, REMIN and Mineralogical Museum. With such a support it was no problem to locate the site of the 3rd MSR Symposium in Baia Mare.

The Baia Mare (Nagybánya) mining district and the town itself belong to the classical localities in Romania and include mineral occurrences and ore deposits of prime importance. The quite young University and the Mineralogical Museum add to the already known supporting points of geology in Baia Mare. Several papers that will be presented during the sessions, the field trips and the visit at the museum should enable the visitors in getting a general view on the richness in minerals and on the complex geological problems of the area.

The mineral inventory of Romania is constantly increasing and I think the MSR Symposia contributed much to the development of mineralogical research in the country. In the review paper published in 1992 (Udubașa et al., 1992) some 450 valid mineral species were found to exist in Romania. To date the number of minerals increases to about 600, preliminary identifications included. It is important to point out that the new list of minerals in Romania does not include many doubtful species.

Among the recently identified mineral species several of them represent rarities, e.g. friedrichite, manganpyrosmalite, NH₄-illite, zoubekite etc. In addition the new development of mineralogical research considerably improved the knowledge of four groups of minerals, that are very characteristic for the Romanian occurrences, i.e., tellurium minerals, Bi-sulphosalts, skarn and manganese minerals. The arsenian nagyagite, probably a new mineral, and a Au-Te oxide have been recently identified in materials from the old, classical Au-Ag-Te ore deposit at Săcărâmb (Șimon et al.). Careful investigation on skarn related ores in Banat and Apuseni Mts. led to a considerable improvement of the knowledge of Bi-sulphosalts, both by refinement of some previously mentioned minerals and by identification of further species such as aleksite, cannizzarite, heyrovskite, hodrushite etc (Ilinca). Among the skarn minerals the borates was paid a special attention; new occurrences of szaibelyite and fluoborite and the first identification of suanite were thus noticed (Marincea et al.). The mineralogy of the manganese minerals of metamorphosed deposits is much more complex as previously known. Both in the South Carpathians (Delinești) and in the East Carpathians (Oița, Dadu, Dealul Rusului) there were described many rare minerals such as manganese humites, pyrophanite, pyrosmalite etc (P. Hârtoșanu et al.). In addition, the clay minerals were also carefully investigated resulting in many new and interesting data (Rădan, Boboș, Ciulavu).

The accompanying list of minerals in Romania includes all the species reported till July 1995. At the same time from the list were removed several minerals with uncertain status, unapproved proposals, intermediate members of the solid solution series etc. according to the rules of CNMMN-IMA. However, in the list were included some new compositions, i.e. still unnamed minerals in order to have a full spectrum of the last achievements of the Romanian mineralogists.



Abbreviations: (?) - old record, without late confirmation; ? - preliminary identification; c - cave mineral; GQ - gem quality; m - minor mineral; M - meteorite mineral; Mo - major occurrence; Ms - museum sample; P - presumed mineral, within pseudomorphs; xx - well developed crystals; μ xx - microcrystals (SEM); CAPITALS - minerals having type localities in Romania; \rightarrow - uncommon form of presentation; \bigcirc - concretions; \bullet - round aggregates; \blacklozenge - stalactites.

Actinolite			
Aegirine			
Aeschnite-(Y)			
Aikinite			
Alabandite	Mo		
Albite	xx Ms		
Aleksite	m		
Algodonite	(?) m		
Allanite-(Ce)			
Alleghanyite	m		
Allemontite	m		
Alloclasite	Ms		
Allophane			
Alluaudite			
Altaite	xx Ms		
Alunite	Mo		
Alunogen			
Amblygonite			
Amesite			
Analcime			
Anatase	m		
Andalusite			
ANDORTITE	xx Ms		
Andradite	xx Mo Ms		
Anglesite			
Anhydrite	xx Ms		
Ankerite	Mo		
Annabergite			
Anorthite			
Anorthoclase			
Antigorite	Mo		
Antimony	m		
Antophyllite			
Aphthitalite			
Aragonite	xx Ms		
ARDEALITE	c		
Arfvedsonite			
Argentite			
Argentopyrite	m		
Arizonite			
Arsenic	Ms		
Arsenolite			
Arsenopyrite	xx Ms		
Arsenosulvanite	m		
Artinite			
Astrophyllite			
Augite	xx Ms		
Aurichalcite			
Autunite			
Awaruite	m		
Azurite			
Baddeleyite			
Barite		xx Mo Ms	
Barroisite			
Bassanite		c	
Bastnäsite-(La)			
Beidellite			
Bementite		m	
Benjaminite		m	
Berthierine			
Berthierite		Ms	
Betekhtinitite		\rightarrow P	
Beryl		xx Ms	
Biotite		xx Mo Ms	\bullet
Birnessite		m	
Bismite			
Bismuth			
Bismuthinite		Mo Ms	
Bismutite			
Bixbyite			
Blödite			
Böhmite			
Bornite			
Boulangerite		m μ xx	
Bournonite		xx Mo Ms	
Brannerite		m	
Bravoite		m	
Brochantite			
Brookite			
Brucite			
Brushite		c	
Bursaite		m	
Bustamite			
Bytownite			
Calaverite		m	
Calcite		xx Ms	\bullet
Calderite			
Caledonite		m	
Cancrinite		Mo	
Canfieldite			
Cannizzarite			
Carbonate-hydroxylapatite			
Carnallite			
Carrollite		m	
Cassiterite		m	
Celadonite			
Celestine		xx Ms	
Celsian		m	
Cerussite			
Cesarolite		m	
Chabasite		Ms	
Chalcanthite			
Chalcocite			
Chalcophyllite			
Chalcopyrite		xx Mo Ms	
Chalcostibite		xx m Ms	
Chamosite		\bullet	
Chevkinite			
Chlorapatite			
Chlorargyrite			
Chloritoid		Mo	
Chondrodite			
Chromite		Mo Ms	
Chrysocolla		Ms	
Chrysotile		Mo	



Cinnabar	xx		Erionite	
Clausthalite	m		Erythrite	
Clinochlore			Euchroite	
Clinocostatite			Eulytite	
Clinohumite			Eukairite	
Clinoptilolite	Mo		Evansite	
Clinozoizite			Famatinite	
Clintonite			Faujasite	?
Coalingite			Fayalite	M Ms
Cobaltite			FELSÖBANYITE	
Cobalt pentlandite	m		Ferberite	xx Ms
Coeruleolactite	m		Fergusonite-(Y)	
Coesite	?		Ferroaxinite	
Coloradoite			Ferrocolumbite	
Colusite			Ferro-cdenite	
Copiapite			Ferrohörnblende	
Copper			Ferrosilite	?
Cordierite			Ferrotantalite	
Coronadite			FIZELYTE	xx Ms
Corrensite			Fletcherite	m
Corundum			Fluoborite	
Cosalite			Fluorapatite	xx
Cotunnite			Fluorapophyllite	xx
Covellite			Fluorite	xx Ms
Crandallite			Forsterite	GQ
Cristobalite	μxx		Franklinite	m
Crocoite			Freibergite	xx Ms
Cronstedtite	xx Mo Ms		Freieslebenite	
Crossite			Friedelite	
Cryptomelane			Friedrichite	m
CSIKLOVAYITE	(?)		Frobergite	m
Cubanite			FÜLÖPPITE	
Cumingtonite			Gahnite	
Cuprite			Galaxite	
Cuprobismutite			Galena	xx Mo Ms
Cupropavonite			Galenobismutite	
Cyanotrichite			Gedrite	
Cymrite	m		Gehlenite	xx Mo Ms
Danburite	(?)		Geikielite	m
Dannemorite	Mo Ms		Geocronite	m
Datolite	(?)		Germanite	m (?)
Diadochite			Gersdorffite	
Diamond	(?)		Gibbsite	
Diaphorite			Gismondine	xx
Diaspore			Gladite	m
Dickite			Glaucodot	? Ms
DIETRICHITE			Glaucosite	Mo
Digenite			Glaucophane	
Diopside	Ms		Gmelinite	
Dioptase	xx Ms GQ		Goethite	Ms
DOGNACSKAITE	(?)		Gold	xx Mo Ms
Dolomite	xx Ms		Goldfieldite	m (?)
Domeyikite			Gorceixite	
Dravite			Görgeyite	
Dumortierite	m		Goslarite	
Dyscrasite			Graphite	Mo
Elbaite	xx		Gratonite	
Emplectite			Greenockite	
Empressite			Greigite	O
Enargite	xx Mo Ms		Grossular	xx Mo Ms
Enstatite			Groutite	m
Epidote	xx		Guanajuatite	m (?)
Epistilbite	xx		Gustavite	m (?)
Epsomite			Gypsum	xx Mo Ms c



Haidingerite			Kieserite	
Halite	xx Mo Ms		KLEBELSBERGITE	xx Ms
Halloysite			Kobellite	
Halotrichite			Kostovite	?
Hammarite	m		Kotoite	
Harmotome	xx		KRAUTITE	m
Hastingsite			KRENNERITE	Mo Ms
Hauerite	m (?)		Krupkaite	m
Hausmannite			Kutnahorite	
Heazlewoodite	m		Kyanite	Mo Ms
Hedenbergite	Ms		Langbeinite	
Helvite			Laumontite	xx
Hematite	xx Mo Ms GQ		Lautite	?
Hemimorphite			Lead	(?)
Hercynite			Leadhillite	
Hessite	Mo Ms		Leonite	
Hetaerolite			Lepidocrocite	
Heulandite	xx		Lepidolite	
Hexahydrite			Leucophoenicite	m
Heyrovskite	m		Libethenite	
Hibschite			Lillianite	m
Hisingerite			Linarite	
Hodrushite	m		Lithiophilite	
Holdawayite	m ?		Lizardite	Mo Ms GQ
HÖRNESITE			Löllingite	
Hübnerite			Loparite-(Ce)	
Humite			LUDWIGITE	Mo Ms
Huntite	(?)		Luzonite	
Hurcáulite	m		Mackinawite	m
Hyalophane			Maghemite	
Hydrobiotite			Magnesiocromite	
Hydromagnesite			Magnesioferrikatophorite	xx
Hydrotalcite			Magensioriebeckite	
Hydrotungstite			Magnesiotaramite	
Hydroxyapophyllite	xx		Magnesite	Mo
Hydroxylapatite			Magnetite	xx Mo Ms P
Ice	xx Mo, ◆		Malachite	xx Ms
Idaite	m		Maldonite	m
Illite			Mallardite	
Ilmenite			Manganite	
Ilmenorutile			Manganpyrosmalite	
Ilsemannite	m		Manjiroite	m
Iivaite	Mo Ms		Marcasite	xx Mo Ms ◆
Inesite			Margarite	Mo
Ingodite	m		Marialite	
Iron	?		Massicot	
Isocubanite	m		Matildite	
Iwakiite	m ?		Maucherite	
Jacobsite	Mo Ms		Meionite	
Jalpaite	(?) m		Melanophlogite	→ P
Jamesonite	xx Mo Ms		Melanterite	
Jarosite			Meliphanite	m
Jerrygibbsite	m		Meneghinite	m
Johannsenite	Mo		Mercury	(?)
Jordanite	m		MERRIHUETITE	M
Joseite (A)	m		Mesolite	
Joseite (B)	m		Metacinnabar	
Junoite	? m		Miargyrite	
Kaersutite			Microcline	
Kainite			Millerite	
Kalinite			Mimetite	
Kamacite	M		Minium	
Kaolinite	Mo		Mirabilite	
Kermesite			Moissanite	



Molybdenite	Mo		Proustite	
Monazite-(Ce)			PSEUDOBROOKITE	xx Mo Ms
MONSMEDITE	? xx Ms		Pseudomalachite	
Montbrayite	(?) m		Pumpellyite-(Fe ²⁺)	
Montebrasite			Purpurite	
Monticellite			Pyrargyrite	
Montmorillonite	Mo		Pyrite	xx Mo Ms ◆
Mordenite			Pyroaurite	
Muscovite	xx Mo Ms		Pyrochlore	
MUTHIMANNITE	m		Pyrolusite	xx
Nacrite			Pyromorphite	
NAGYAGITE	xx Mo Ms		Pyrope	xx
Natroalunite			Pyrophanite	
Natrolite	μxx		Pyrophyllite	Mo
Natron			Pyrostilpnite	
Neotocite			Pyroxmangite	xx Mo
Nepheline	Mo		Pyrrhotite	xx Mo Ms ○
Nickeline			Quartz	xx Mo GQ
Nickel-skutterudite			Quenstedtite	
Nimite			Ramdohrite	m
Niter			Rammelsbergite	
Nontronite			Realgar	xx
Norbergite			Rectorite	
Nsutite			RHODOCHIROSITE	xx Mo Ms GQ
Nukundamite	m		Rhodonite	xx Mo Ms GQ
Okenite	μxx Ms		Rhönite	
Oldhamite	M		Ribbsite	? m
Oligoclase			Richterite	
Omphacite			Riebeckite	
Opal	GQ		Robinsonite	m
Orpiment			Rozenite	
Osbornite	M		Rutile	xx Mo Ms
Owyhecite			Safflorite	
PADERAITE			Samsonite	(?) m
Palygorskite	μxx		Sanidine	xx
Paracelsian			Saponite	
Paragonite			Sauconite	
Parajamesonite	?		Scheelite	xx Ms
Pargasite			Schirmerite	(?) m
Parisite-(Ce)			Schorl	
Pavonite	m		Schreibersite	M
Pearceite			Scolecite	xx
Pectolite			Scorodite	
Pekoite	m		Seligmannite	(?) m
Pennantite			SEMSEYITE	xx Mo Ms
Pentlandite			Sepiolite	
Periclase			Siderite	xx Ms Mo
Perovskite	M		Siegenite	
PETZITE	xx Mo Ms		Sillimanite	
Pharmacosiderite			Silver	Mo xx
Phillipsite			Skutterudite	
Phlogopite	xx Mo Ms		Smithsonite	Ms
Pickeringite			Sodalite	Mo Ms
Piemontite			Sonolite	Ms
Pigeonite			Sperryite	m
Pilsenite	m		Spessartine	Mo
Pitticite			Sphalerite	xx Mo Ms
Plagionite			Spinel	
Platinum	(?)		Spionkopite?	?
Plumbogummite			Spodumene	xx Mo Ms
Plumbojarosite			Spurrite	Mo Ms
Polybasite			Stannite	
Polyhalite			Staurolite	xx
Prehnite			Stephanite	



Sternbergite			Vivianite	xx Ms
Stevensite			Voltaite	xx Ms
Stibiconite			Wairakite	
Stibnite	xx Mo Ms		Wavellite	Ms
Stilbite	xx		Weissite	
Stilpnomelane			Whewellite	Ms
Strontianite	m		Whitlockite	M
Strüverite	m		Willemseite?	
STÜTZITE	m		Winchite	
Suanite	m		Witherite	Mo Ms
Sulfur	xx Mo		Wittichenite	
SYLVANITE	xx Mo Ms		Wöhlerite	
Sylvite			Wollastonite	xx Mo Ms
Symplesite			Wulfenite	xx
SZABELYITE	Mo Ms		Wurtzite	xx → ^P
SZMIKITE	◆		Wüstite	m M
Szomolnokite			Xanthoconite	
Taeniolite			Xenotime-(Y)	
Taenite	M		Yarrowite	?
Talc	Mo		Zaratite	?
Tavorite			Zeophyllite	
Teallite	(?) m		Zincite	
Tellurantimony			Zincocopiapite	
TELLURITE			Zinkenite	
TELLURIUM	Ms		Zircon	xx
Tellurobismuthite			Zoizite	
Tennantite			Zoubekite	m
Tenorite			Zunyite	μxx Mo Ms
Tephroite	Mo			
Tetradymite			Unnamed minerals:	
Tetrahedrite	xx Mo Ms		PbBi ₄ Te ₄ S ₃	
Thaumasite			As-nagyagite	
Theophrastite			Au-Te oxide	
Thomsonite			SbTe ₂	
Thorite			Ti-hematite.	
Tilleyite	Mo Ms			
Titanite	Mo			
Tochilinite	m			
Todorokite	m			
Topaz	m			
Torbernite				
Tosudite				
Tremolite	Mo			
Tridymite				
Triphylite				
Troilite	M			
Tschermakite				
Tschermigite				
Tungstite				
Tyrolite				
Ullmannite				
Ulvöspinel				
Umohoite				
Uraninite	Mo			
Uvarovite	μxx			
Vaesite				
Valentinite				
Valleriite				
Variscite				
Vaterite	c			
Vermiculite				
Vesuvianite	xx Mo Ms			
VESZELYITE				
Violarite				



L'INDICE POLYMÉTALLIQUE DE CHABET
BOURKIK (PETITE KABYLIE CENTRALE).
UN AUTRE TÉMOIN D'UNE
MINÉRALISATION ANTÉCAMBRIENNE.

7

GEOCHEMICAL STUDIES OF GOLD-SILVER-
TELLURIUM MINERALIZATION IN THE
VICINITY OF SĂCĂRÂMB, SOUTHERN
APUSENI MOUNTAINS, ROMANIA

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L'indice polymétallique de Chabet Bourkik (El Ancer), est situé à une quarantaine de kilomètres à l'Est de Jijel. Il fait partie de la zone centrale du massif cristallin de Petite Kabylie.

L'affleurement minéralisé constamment de forme stratoïde, s'insère au sein d'une formation essentiellement à micaschistes, marbres et amphibolites, appelée formation des alternances. Cette dernière se positionne entre l'ensemble schisteux sommital et le complexe gneissique de base, qui constituent l'unité socle des zones internes des maghrébides.

L'étude géologique du secteur de Chabet Bourkik et l'analyse microstructurale et microtexturale, réalisées sur le corps minéralisé et sur son proche encaissant ont fait ressortir un ensemble de caractères présentant de grandes similitudes avec ceux des indices d'Azaraz-Boumlih-Achab, situées à une vingtaine de kilomètres à l'Ouest d'El Ancer. Ces caractères pris comme éléments de comparaison se rapportent essentiellement à:

- La nature lithologique de la formation porteuse de minéralisation (horizon amphibolique, marbres, micaschistes...).

- La morphologie en lits concordants aux microstructures de la roche hôte.

- Aux textures de minéral métamorphosé.

- Aux dépôts quartzo-chloritiques associés aux lits minéralisés.

Du point de vue géochimique, les résultats d'analyses obtenus sur la paragenèse métallique et les roches hôtes concernant les éléments (Pb, Zn, Cu, Fe, Ba, Ag, Cd, As, s'exprimant en magnétite, blende, galène, chalcopirite, cuivre gris, mispickel, pyrrhotite et pyrite, confirment l'existence d'un cortège géochimique tout à fait identique à ceux des indices d'Azaraz-Boumlih-Achab.

Ces similitudes suggèrent une mise en place identique à savoir, l'origine exalative synsédimentaire de la minéralisation (Aalfiz, 1990).

Nous pensons que cet horizon minéralisé est d'importance régionale et couvrirait depuis le Sud Est de Taher (Boumlih) jusqu'à l'Ouest d'El Ancer. Celui-ci a été ultérieurement désarticulé pendant les phases tectoniques postérieures à sa mise en place dans un ancien bassin d'âge très probablement antécambrien.

Références bibliographiques

- Aalfiz A. (1990) Etude comparative paragenétique et géochimique des indices minéralisés à Fe, Pb, Zn, Cu, Ba de la partie occidentale du massif cristallophyllien de Petite Kabylie - Algérie. Thèse de magister, pp. 202, Alger.

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The renowned gold-silver-tellurium vein deposits in the Săcărâmb region of western Romania have in the past been subjected to many detailed mineralogical studies, but relatively little is known of their genesis and evolution. A detailed, multidisciplinary, geochemical study of this mineralization is currently being undertaken with a view to determining the source of the fluids and the ore components, and the conditions of mineral formation, and thus ultimately the controls to mineralization.

The mineralized veins are hosted by Neogene hornblende (\pm quartz, biotite, pyroxene) andesites (stocks and lava flows) with a characteristic island-arc geochemistry (e.g. low Nb). In the vicinity of the mineralized veins the andesites are heavily altered; zoned sericitic and argillitic assemblages are the most abundant. These are associated with marked influxes of K, Rb, and CO_2 , and large losses in Na and Mg.

The veins sampled during this study show the following general paragenesis: Early pyrite > sphalerite and galena > sulphosalts and Au/Ag tellurides > rhodochrosite and calcite. Open-space cavity fill textures are common, but evidence of extensive reactivation and brecciation of the veins is also apparent. Fluid inclusions in vein quartz hosting the mineralization are 2-phase aqueous in character. Temperatures of homogenization have a mean value around 270-300°C, and the salinity is low (around 5 wt % NaCl equivalents). Evidence of boiling does not appear to be common.

Initial stable isotopic analyses have produced the following results: Vein quartz $\delta^{18}\text{O} = 13.5$ to 18.5 (‰ SMOW); calcite in host andesite $\delta^{13}\text{C} = -12.3$ (‰ PDB); vein calcite and rhodochrosite $\delta^{18}\text{O} = -13.5$ to -15.5 (‰ SMOW) AND $\delta^{13}\text{C} = -3$ to -7 (‰ PDB). Quartz and calcite are clearly not in isotopic equilibrium, indicating that either they were deposited at different temperatures, or from fluids with different compositions. At 300°C, fluids precipitating quartz would have an isotopic composition of $\delta^{18}\text{O} = 7$ to 9 ‰ SMOW; this value is close to a magmatic value and not indicative of a major component of (unexchanged) meteoric fluids.

The characteristics of the mineralization, alteration, and host rocks point to an island-arc setting similar to that seen today in the epithermal gold deposits of the western Pacific region. However, the magmatic characteristics of the hydrothermal fluids,



the lack of boiling phenomena, and the high temperatures, indicate that at least some parts of the mineralization are not typically epithermal, and probably formed at deeper (and therefore hotter) levels.

THE MICAS IN THE MARBLES OF THE WESTERNMOST PART OF THE MINING DISTRICT OF HÜTTENBERG (CARINTHIA, AUSTRIA). A MINERALOGICAL CHARACTERIZATION

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The marbles under discussion are together with different rocks in various metamorphic states parts of the "Central Zone" of the Eastern Alps. In the description of these coarse grained white or white-blue banded lower palaeozoic marbles by Kober (1938) and Solyom (1942) comparable genetic features to the marbles of the "Bretsteinserie" were pointed out (cf. Heritsch, 1921).

In connection with the formulation of the question about the possible mineralization of these marbles by metasomatic processes and the formation of more or less economic ore bodies of siderite, together with small lenses of sulfides, the mineral content of these marbles was investigated in detail. The sum of the accessory minerals varies from two to ten wt% with the special main individuals: quartz, feldspar (oligoclase), tourmaline (elbaite-dravite-mixed crystals?), fluorite, anatase, brookite, pyrite, graphite, and two different varieties of fluor-micas. Both these micas are transparent, colourless with predominant faces {001} and pseudohexagonal habitus (ϕ up to 1 mm). Black flaky inclusions (ϕ 10 to 15 μ m) in the micas were determined by X-ray methods as graphite. The two micas don't differ by magnitude, form of inclusions from each other and were only differentiated by optical measurements: muscovite with an axial angle $2V \sim 40^\circ$ and phlogopite with $2V \sim 10^\circ$. In both cases the iron content is less than 0.1 wt% FeO, the contents of Ni, Cr and Ti are relatively high (0.01 to 0.1 wt%) (Amann, 1990). Single crystal X-ray work confirmed the structure type 1M for the phlogopite and $2M_1$ for the muscovite.

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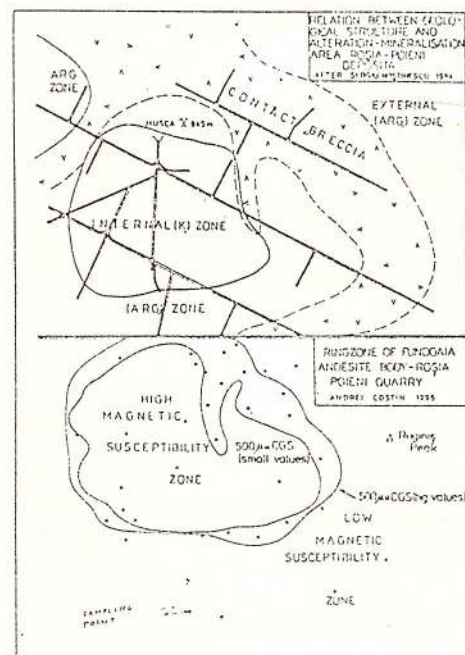
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NEW GEOLOGICAL DETAILS USING GEOPHYSICAL DATA AT ROȘIA PORPHYRY COPPER DEPOSIT

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The Roșia Poieni porphyry copper deposit is placed in a Neogene andesite structure of Metaliferi Mts. It shows of an internal zone (potassic alteration, Fe-Cu sulphures + magnetite) and an external argilic zone, that preserves magnetite relicts. Internal zone is located in the central part of Fundoia subvolcanic andesite body, which is surrounded by a contact breccia.

Magnetic susceptibility data histograms show in some sampling points two separate groups of values; low (less than 100×10^{-6} uCGS) or high (more than 1000 μ CGS). An arithmetical mean for such a point (e.g. 700 μ CGS) could be empty of geological signification. Therefore, we made two means and two isolines susceptibility maps. Both of them presented a 500 μ CGS isoline that surrounded the hydrothermal magnetite rock area. Superposing the two 500 μ CGS isolines on a third map we obtain a ringform area. It corresponds to a zone where relicts of high temperature parageneses (with magnetite) coexists with new lower temperature parageneses, without high magnetic susceptibilities minerals. This ring marks the internal part of the contact breccia area, consisting in part, as petrophysical data proved by previous internal zone elements.



SULFATIC FACIES IN THE NORTH-WESTERN PART OF THE TRANSYLVANIAN BASIN - MESEȘ AREA AND THEIR GENETIC SIGNIFICANCE

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The sulfatic accumulations from the Meseș area are situated at the level of the Foidas (Upper Lutetian) Strata and of the Turbuta Formation (Lower Priabonian) which represents the equivalent of the Jebuc Strata from the Gilău area (B. Popescu, 1984).

The mineralogical and structural-textural features of the evaporitic deposits generally reflect both the depositional context, in which the separation from natural intrabasinal solutions played an essential role, and a complex of diagenetic transformations which caused significant remobilizations and recrystallizations at the level of these evaporites. From a mineralogical point of view, they are represented by gypsum, anhydrite and subordinate celestite and barite.

A complex characterisation of the typical sulfatic facies are given, i.e.: laminitic, stromatholitic, nodular of the "chicken-wire" type, entherolitic, gypcretic and clastic.

The sulfatic associations as well as the mineralogy of the deposits, fit the schema suggested by West (1979).

IGNEOUS HISTORY AND STRUCTURE OF THE DITRĂU MASSIF

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Six complexes of rocks were separated within the Ditrău alkaline massif (DAM) by taking into consideration both the source of material and the field relations: (1) olivine ultramafics, (2) hornblende-syenites, (3) monzonites-syenites, (4) granitoids, (5) nepheline syenites, and (6) muscovitized syenites.

The investigation of feldspars (Bindea, 1992) and of minor elements (Morogan et al., 1994) pointed out that a great part of rocks (from (2) and (3) complexes) have been generated by mixing phenomena of two magma types: an initial alkali-basaltic magma and a crustally contaminated syenitic magma. As the mixing happened at relatively low T a complete homogenisation was not possible which explains the uncommon great number of rock types. In addition, assimilation and metasomatic processes further contributed to the rock diversification. For example, in the northern part of DAM there are numerous xenoliths of black quartzites and the rocks are silica-richer. Remarkable metasomatic effects are mentioned at the contact between basic-ultrabasic rocks and the younger nepheline-syenite magma but mainly between certain syenites and hydrothermal emissions.

9

The earliest rock type are the olivine hornblende-syenites as they appear enveloped in all the remaining rock types. The monzodiorites (from hornblende-syenites complex) are intruded by syenites (from monzosyenites complex) - Simo Valley. The nepheline syenites are the youngest rock type as they cut all the rocks described. The granitoids seemingly represent a distinct line of evolution, of the same age as the nepheline syenites. The magmatic evolution ended with a suite of vein rocks, followed by an intense hydrothermal activity.

Several main faults further complicate the structure of DAM. A fault directed NNE-SSW, which produces great displacements in the surrounding metamorphic terrains too is the reason for a northward elongation of the DAM. The fault is prior to the DAM because the syenitic magmas have been intruded along it but it has been active after the consolidation, too, because it separates the granites in Creanga Creek Valley from the rocks of monzo-syenitic complex at the W. Another fault with a E-W direction, which passes south of Jolotca Valley (partly covered by sediments) contributes to individualise the northern compartment. By direct signs is mentioned another important fault directed N-S, west of Simo Creek. It realises an uplift of the Western compartment. Along it come in tectonic contact the hornblende-syenitic complex with the monzonite-syenitic complex and, in the same time it is responsible for the disappearing of Jolotca deposit of the East. Thus DAM appears as being formed by two distinct units: the northern one, asymmetrically developed and the southern one, with a well developed ring structure.

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MINERALOGICAL ARGUMENTS FOR THE SEPARATION OF A NEW TECTONO- STRATIGRAPHIC ENTITY IN THE CRYSTALLINE-MEZOZOIC ZONE OF THE CENTRAL EAST-CARPATHIANS: BALAJ FORMATION

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The Balaj Formation (BF) forms a relatively narrow band (100-200 m) which has always superior



position in relation to the rocks of Tulgheş Group and an inferior one to the rocks of Rarău Group. It was discontinuously mentioned in the central parts of East Carpathians, between Bălan and Tulgheş localities.

From a lithological point of view, the BF is built up of an association of gneisses and quartz-muscovite schists containing albite, muscovite, epidote, chlorite and subordinately biotite.

The dominant structural elements are the following: 1) a parallel metamorphic schistosity marked by phyllosilicatic lamellae and 2) the almost equigranular quartz and albite aggregates. The albite crystals exceed two or three times the average granulation of such aggregates. The subsequent growth of a fine-grained brown-reddish stilpnomelane can locally be observed.

The mineral assemblage, i.e., sericite ($2VNp = 22$), albite (0 - 7% An) and chlorite would indicate, at a first sight, a low grade metamorphism, and the BF was included in the Tulgheş Group (Risa and Arion, 1963, unpubl. data). However, there are some significant differences. The Balaj gneisses contain plagioclases with an extreme sodic composition and with numerous inclusions of euhedral epidote, which entirely lack in similar rocks of the Tulgheş Group. The ordering degree of the K-feldspars is also higher in the BF similar to the values of potassic feldspars from Rarău Group. These observations support the idea that BF represent a polymetamorphic entity resulted from the regional retromorphism on a mezo-metamorphic substratum.

The age of the retromorphism which generated these rearrangements is prior to the setting of Rarău Nappe. The main argument is that the rocks of BF themselves are cataclastic and ultralaminated both in its basal and the terminal part.

The overthrust plane drawn at the lower limit is supported by the fact that the BF discordantly overlies different terms of the Tulgheş Group. Between the BF and the Rarău Group there is a clear metamorphic discordance.

THE METAMORPHIC HOST ROCKS IN THE NORTHERN PART OF THE DITRĂU ALKALINE MASSIF

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The Hagota-Secu area in the northern part of the Ditrău Massif consists of several pre-Alpine Nappes with overthrust planes nearly horizontal. From bottom to the top there are: Rodna Nappe, Pietrosu-Bistriţa Nappe, Sîndomic Nappe, Baratu Mare Nappe, Balaj Nappe and Rarău Nappe.

As compared to the scheme elaborated by Balintoni (1981) the Borsec Nappe, built up mainly by Mîndra porphyroids is not any more existing here; on the other hand three new nappes have been identified. Arguments for the existence of each nappe are presented.

The Balaj Nappe can be identified as the metamorphic history of the Balaj formation is different from that of the Rarău or of Tulgheş Groups and overlaying different terms of the latter.

The Baratu Mare and Sîndomic Nappes can be identified by detailed lithostratigraphic studies in Tulgheş Group. In this way, on the one hand, the existence of a rock suite with different characteristics (Sîndomic type and Baratu Mare type) could be ascertained and, on the other hand, abnormal superpositions, with regional extension, were found. The result consists of the recognition in Putna-Tulgheş zone of a Tg_4 Formation from the Sîndomic suite beneath the Tg_3 Formation Baratu Mare suite. The Sîndomic Nappe overlies the Pietrosu porphyroid. The Pietrosu porphyroid comes in contact with different terms of Sîndomic suite.

The whole Pietrosu Bistriţei Unit may be considered an immense tectonized zone because both Pietrosu porphyroid and Negrişoara Formation rocks are intensely mylonitized. This gives Pietrosu Bistriţei Unit a specific textural character (layering) differing thus from both the Rebra Group and the Tulgheş Group rocks.

All these nappes are more or less influenced by the Ditrău Massif, proving thus their pre-Alpine age.

HYDROTHERMAL AMMONIUM-BEARING ILLITE FROM HARGHITA BĂI AREA: XRD, IR- SPECTROSCOPY, DTA AND CHEMICAL ANALYSIS.

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NH_4 -illite ($NH_4 I$) has been found in argillized andezite of the fossil hydrothermal system Harghita Băi (East Carpathians). The mineral is one of the few occurrences in the world and the first in Romania, being described in different genetical environments: sedimentary, metamorphic and hydrothermal. In all the occurrences the NH_4 is a major component. The nitrogen genesis is poorly known.

The XRD pattern on NH_4 -illite shows a high intensity 001 peak with varying d values, i.e. of 10.70 to 10.20 Å (natural sample).

After treatment with ethylene glycol, the position of 001 peak shifts to higher angle. The intensity of 001 peak increases with ammonium contents. The intensity of 002 and 003 do not change. The 003 peak can not be used as a good marker, because sometimes is affected by quartz presence. The 004 reflection is very weak. The 005 reflection is very sensitive and appear at 2.04-2.05 Å. The $d(060)$ spacing is of 1.50 Å which is in agreement with

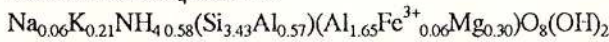


dioctahedral structure. The expandability is between 4-10 % smectite. It is 1.07-1.12. XRD pattern of $\text{NH}_4\text{-I}$ is shown in fig.1.

For the IR analyses the samples were prepared as KBr pellets. The fundamental vibrations of NH_4^+ ions are located near 3300, 3050 and 1430 cm^{-1} and are typical of N-H vibrations. Intensities of N-H vibrations are proportional with amount of NH_4 in illite interlayer. Between d_{001} spacing, amount NH_4 of illite and intensity of N-H vibrations there is a linear relationship. The IR spectrum is showed in fig. 2.

Differential thermal analysis showed four endothermic peaks at 50°C, 170°C, 530°C and 570°C. The endothermic peak at 530°C points the detachment of ammonium from interlayer site of illite.

Chemical analyses were made in Sr^{2+} form on 2 μm pure fractions. Nitrogen determination on $\text{NH}_4\text{-I}$ gave values of 1.12-1.53 wt% NH_4 . K⁺ had values between 0.08-0.40/ $\text{O}_{10}(\text{OH})_2$. It is possible to be a solid solution between K-illite and NH_4 -illite. The structural formula for NH_4 -illite is:



$\text{NH}_4\text{-I}$ is a neoformation mineral. It formed on smectite by three main stages: disorder, transition and ordering. The $\text{NH}_4\text{-I}$ is associated in few samples with pyrophyllite, which suggests similar thermal conditions for their formation ($T \sim 250^\circ\text{C}$). Fluids with appreciable contents of N_2 and NH_3 are reported in hydrothermal fields and result from early hydrothermal fluids.

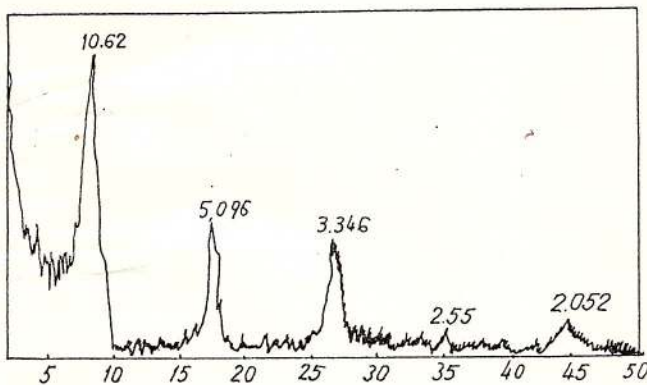


Fig.1- XRD pattern of $\text{NH}_4\text{-I}$

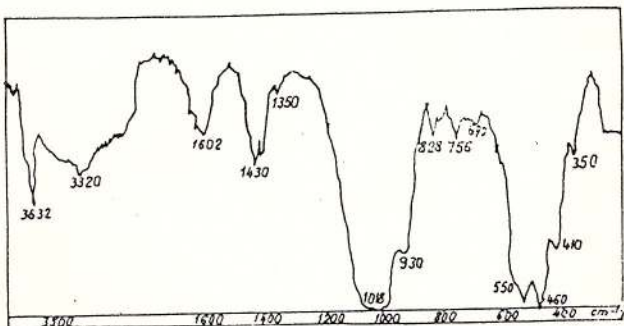


Fig.2- IR pattern of $\text{NH}_4\text{-I}$

POLYTYPE ANALYSIS ON NH_4 -ILLITE FROM HARGHITA BĂI. AN INVESTIGATION BY XRD, ED AND TEM

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Identification of polytypes of NH_4 -bearing illite ($\text{NH}_4\text{-I}$) using powder and single crystal samples, gave informations about the changes in stacking sequence and in composition with increasing alteration grade. $\text{NH}_4\text{-I}$ is a rare mineral. It was found in very low grade metamorphic rocks associated with coal (Pennsylvania), in black shales (Alaska), in anchimetamorphic shales associated with anthracite (Slovakia), as well as in argillized andesite (Japan, Slovakia and Romania).

XRD patterns of $\text{NH}_4\text{-I}$ include hkl reflections in the range $2\theta = 15\text{-}36^\circ$, suggesting the presence of the 1M polytype. ED analyses revealed a good crystallised dioctahedral illite. The cell parameters were calculated for three samples (Table). Contributions of octahedral cations and anions dominate the $k = 3n$ reflections, which are very sharp.

Table. The cell parameters of NH_4 -illite (in nm)

Sample	a	b	c
308	0.515	0.893	1.035
352	0.517	0.897	1.038
333	0.518	0.898	1.040

The TEM images of the $\text{NH}_4\text{-I}$ show a lath habit of the grains, which is typical for the 1M polytype. The latter has formed at the expense of the metastable 1Md phase with disordered structure, giving rise to ordered mixed layer illite/smectite with $R = 1$.

Sr-ISOTOPE EVIDENCE FOR THE ORIGIN OF BARITE FROM FOUR MINERALIZATIONS OF THE MOROCCAN MESETA

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The Sr-isotope ratios of barites, karst calcites, limestones and schists from four mineralizations of the Palaeozoic Moroccan Meseta have been determined.

The Sr-isotope ratios of the barites ranging from the 0.71077 ± 4 to 0.71714 ± 3 do not distinguish the four mineralizations, indicating a common origin for the radiogenic ^{87}Sr involved. The latter was not of



TEXTURAL AND STRUCTURAL FEATURES OF THE COPPER-PYRITE ORES RELATED TO VOLCANO-SEDIMENTARY COMPLEX IN ALBANIA

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A volcano-sedimentary complex represented by rocks approaching the composition of tholeiitic basalts, with carbonate shales intercalations, is located at the periphery of the ophiolitic formation of Albania.

Sulphide copper-pyrite ore deposits of volcano-sedimentary type are genetically related to the complex.

Copper-pyrite sulphide ores are of massive type and consist mainly of pyrite, chalcopyrite and with subordinate amounts of magnetite-hematite.

The ores most commonly display bedded and brecciated structures with local development of vein-like or veins. Metacoloidal-concretionary aggregates of pyrite, sometimes strongly corroded and replaced by chalcopyrite and sphalerite are the most widespread textural features. Rod-like aggregates of hematite with radial arrangement are also abundant, showing various grades of transformation into magnetite and/or replacement by pyrite.

A volcano-sedimentary origin of the deposits is advocated on the basis of ore fabric and geological setting. Later processes involve hydrothermal-metasomatic processing of ores with a final metamorphic overprint.

NEW DATA ON JOSEITE-A FROM BĂIȚA BIHOR MINE (BIHOR MOUNTAINS, ROMANIA)

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The first occurrences of Joseite in Băița Bihor ore deposits have been described by Koch (1984) and Grasselly (1948). Recent investigations confirmed these occurrences and gave us the possibility to identify a member of the trigonal bismuth chalcogenides, namely Joseite-A. This paper presents new data on Joseite-A to improve the mineralogical characterisation of this Bi-mineral.

Joseite-A has been identified in mineralised Ca- and Mg-skarns related to the Upper Cretaceous - Eocene Bihor plutons. This pluton, with granitoid composition, generated a well extended thermal and metasomatic metamorphic aureole in the Bihor Realm and Codru, Arieșeni, Păiușeni Nappe System formations, forming various hornfels and skarns.

The studied material has been collected from Mo + Bi ± W mineralizations associated with Ca skarns belonging to Blidar Contact and from Cu + Bi + W and Pb + Zn + Cu + W mineralizations related to Mg-skarns. Joseite-A forms platy or long pseudo-prismatic crystals or aggregates, as nests or impregnations in garnet and wollastonite skarns. It is

marine origin, but resulted by Sr leached from either magmatic Hercynian rocks or, more reasonably, from the pre-Hercynian schists during the Hercynian orogenesis. The sample of schist analysed has given an isotopic composition of 0.71712 and 0.71460 corresponding to 300 and 350 Ma, respectively.

The Sr-isotope ratios of the Palaeozoic limestones similar to those of the associated barites, show that these rocks underwent metamorphic recrystallisation during the Hercynian orogenesis and the Sr is assumed to be derived from the same source of the barites. This conclusion also explains the isotopic signature of the karst calcites, formed after limestone recrystallisation.

MINERALOGIE DES TOPAZES DU HOGGAR CENTRAL

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Un magmatisme spécifique dans le Hoggar central conduit à la formation d'un granite à albite et topaze faisant partie des massifs panafricains tardifs. Ce granite particulier non signalé dans la chaîne Pharusienne se distingue par sa composition minéralogique constante: Quartz, albite, FK, mica lithinifère (protolithionite ou zinnwaldite) et topaze. Ce dernier représente l'expression minérale la plus parlante du caractère alumineux d'une part et de la richesse en Fluor d'autre part.

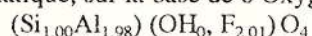
L'étude minéralogique des topazes permet de différencier les topazes magmatiques des topazes hydrothermales par leur chimisme ainsi que par leur structure.

Les topazes magmatiques sont liées aux granites à albite-topaze aussi bien dans les leucogranites de la région de Tamanrasset que dans les granites de la région de Laouni. Les topazes hydrothermales ont été prélevées dans des filons de quartz-greisen, dans des greisens ainsi que dans la pegmatite de Hananère.

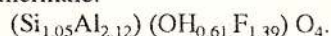
Les analyses à la microsonde électronique ont montré clairement que les topazes magmatiques sont plus riches en silice et en fluor que les topazes hydrothermales, mais elles sont plus pauvres en alumine.

L'étude de quelques topazes à la diffraction des rayons X montre une abondance relative en ion hydroxyle OH par rapport au Fluor pour les topazes d'origine hydrothermale.

1 - Formule structurale d'une topaze magmatique, sur la base de 6 Oxygènes:



2 - Formule structurale d'une topaze hydrothermale:



associated with cosalite, emplectite, tetradymite, bismuthinite and native bismuth. Joseite-A lamellae have a lead-grey colour with yellow tints. Under the microscope, it is well polished, having a low polishing hardness, high spectral reflectance and white-yellow colour. No bireflection is found. The sections parallel with "C" axes have medium anisotropism, from light grey brown to dark grey brown. The sections normal to the "c" axes are isotropic. Some crystals show "spindle" texture.

The X-rays data for Joseite-A are: 3.08 (100); 2.24 (30); 2.11 (20); 4.40 (20); 4.41 (20); 3.61 (10); 3.31 (20); 2.57 (6); 2.25 (30); 2.12 (14); 2.06 (7); 1.97 (4); 1.89 (14); 1.78 (3).

The microhardness value is 45 Kg/mm². The microhardness indentation is almost perfect, showing only slightly concavities on one side. Some shells are present on the upper half of the indentation.

The chemical composition by electron microprobe mean is: Bi - 81.8970 %; Te - 11.1006%; S - 6.212% and minor amounts of Sb, Pb, Cu, Se and As which corresponds to the Bi_{4.04}Te_{0.9}S₂ formula (total atoms = 7). The chemical analyses point up a slightly higher Bi and slower Te contents versus Bi₄TeS₂ ideal formula.

The association of Joseite-A with native bismuth, bismuthinite and tetradymite in the Bi mineralization from Băița Bihor and the lack of Bi tellurides show the conditions for the generation of Joseite-A are characterised by the high sulphur fugacity and an enough high temperature to form the mineral.

The Băița Bihor Bi ores, together with other Upper Cretaceous - Eocene related Bi occurrences are in good agreement with the idea of the generation of bismuth minerals in continental arc tectonic setting which involves the continental crust contribution.

INTERLABORATORY CALIBRATION OF THE ILLITE "CRISTALLINITY" SCALE

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Over 10 years have passed since the "crystallinity" of the phyllosilicates became an indicator of the very low grade metamorphism, i.e., the so-called "no man's land", between the diagenesis and the greenschist facies.

During this period a great number of researchers tried to elucidate the history of diagenesis and metamorphism for sedimentary basins. After a few years, a problem became obvious, namely, the illite "crystallinity" varies significantly with the type of the diffractometer used, the X-ray diffraction settings, sample preparations, etc. Therefore, a calibration and standardisation of the "crystallinity" data is urgently needed, if a comparison between different research groups is intended.

Our DRON diffractometer has been calibrated against the Phillips diffractometer used by Prof. H.J. Kisch at the Ben-Gurion University of the Negev. The five polished slate standards and a muscovite crystal provided by Prof. Kisch were measured using the following settings: DRON 3 generator/GUR 8 goniometer, CuK α , normal focus tube, Ni-filter, scintillation detector, TC = 2.5sec., scan rate 1°2 θ /min, chart speed 600mm/hour (1 cm equals 1°2 θ), slits: Soller 1.5°, two divergence slits namely horizontal (1mm) and vertical (10mm), receiving slit 0.25mm. The second Soller slit has been removed to increase the intensity of the peaks.

We obtained a very good correlation (the correlation coefficient $r = 0.995$) expressed by the equation $IC_{DRON} = 1.437 IC_{Phillips} + 0.012$.

For our diffractometer standardization we used five samples which were run as natural and glycolated oriented slides (< 2 μ m fraction) and polished slates.

Good correlations have been obtained for the values obtained on:

- slates and natural oriented slides:
 $r = 0.952$ and $IC_{Slates} = 0.801 IC_{Nat} + 0.900$
- slates and glycolated oriented slides:
 $r = 0.862$ and $IC_{Slates} = 1.230 IC_{EG} - 0.642$
- natural and glycolated oriented samples:
 $r = 0.900$ and $IC_{Nat} = 1.518 IC_{EG} - 1.854$.

MEASURING FRACTAL DIMENSION - IRON AND MANGANESE HYDROXIDES DENDRITES

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Since Benoit Mandelbrot created the fractal geometry, much has been done in the field of the fractal growth, and especially in the study of dendrites.

In this paper there have been studied dendrites from several locations. The host rocks are: tuffs, jaspers, clays, mylonites. They are of different ages and they mainly consist of manganese and iron oxides and hydroxides. There are two main kinds of dendrites: those grown from a fissure system and those nucleated on a surface.

There has been analysed the shape of the dendrites and obtained the fractal dimension D. Their specific shapes allow us to use three methods: box-counting, measuring the perimeter and the branches' length. The dendrites were studied as 2D images and it was found that they have a variety of fractal dimensions (from 1.23 to 1.89). The box-counting method as well as the random walk method give the same result in almost all the cases. The results of the branches' length method is also similar. This makes them all valid for using in a fractal analysis of the dendritic shapes and they are good in verifying the obtained results.



METAMORPHOSED STRATIFORM MASSIVE SULPHIDE DEPOSITS AT BAIJA BORŞA, MARAMUREŞ: NEW PETROGRAPHIC AND MINERALOGICAL DATA

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Structural, petrographic and mineralogical investigation of several polymetallic pyritic massive sulphide deposits in the Baia Borşa orefield, Maramureş County, give results consistent with their origin as the products of vulcano-exhalative activity, contemporaneously with formation of their enclosing Cambrian host rocks, the Tulgheş Tg₃ series, which is dominantly composed of rhyolitic volcanics. Greenschist facies metamorphism and accompanying deformation during at least two orogenic events (Lower Palaeozoic, Variscan) has, however, led to significant morphological and mineralogical modifications to the deposits.

Evidence of extensive remobilisation of ore components is widespread and is observable on both the micro- and macroscales. Tectonically controlled distributions of the more ductile sulphide minerals can be correlated with local metamorphic stress-strain regimes preserved in the rock. Particularly in the Măcârâu and Ivăşcoia deposits, chalcopyrite, and to a lesser extent galena, appear to have been preferentially removed from the massive ore and reconcentrated in the pressure shadows of quartz lenses within the subjacent disseminated schists and in other areas of reduced stress. Silver and gold are significantly enriched in such ore types, compared to massive ore lenses. Argentian tetrahedrite and other Ag-sulphosalts (e.g. pyrrargyrite) are abundant, and Au, as electrum, is relatively frequently observed in polished section. Additionally, remobilised sulphides occur in veins which cut more massive parts of the ore and also heal fractures in cataclastically deformed pyrite. This is in sharp contrast to the massive pyritic ores which show little evidence of metamorphic modification, except for corrosion and recrystallisation of pyrite and cataclastic deformation. Widespread fracturing and faulting of the sequence brought about by the intrusion of the Toroiaga magmatic complex has further affected orebody morphology and has led to some further cataclasis of pyrite and local brecciation of that mineral. Minor hydrothermal veining associated with this activity has locally overprinted the syngenetic ores, introducing a variety of more exotic minerals, including Pb- and Ag-sulphosalts, but has not affected the gross tenor of the deposits to any significant extent.

A large body of electron microprobe data on the compositions of sulphide and sulphosalt minerals within the orebodies confirm that the epigenetic mineralisation is compositionally distinct from that of the syngenetic ores. Of particular importance in this regard are the Fe contents of sphalerite, which are appreciably higher in the epigenetic mineralisation, and the concentrations of Ag, Bi, Se and Sb in galena. Although all galena types are marked by relatively

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high concentrations of both Ag and Bi, the two elements correlating strongly with each other, the contents of Se and Sb show a marked difference between the two types, with the syngenetic galenas being enriched in the former and the epigenetic galenas in the latter. Such data represents a panacea for the discrimination of cross-cutting vein-type phenomena as the products of either (syn-metamorphic?) mobilisation of ore components or resulting from epigenetic overprinting. A wide range of tetrahedrite-tennantite minerals are present, with argentian tetrahedrites more widely observed in Cu-rich ore types, and (Ag-free) tennantites being dominant in pyritic Pb-Zn rich ores. Except in the ores richest in Cu, where Ag-tetrahedrite is of importance, the chief carrier of silver in the ores is believed to be galena.

THE OCCURRENCES AND COMPOSITION OF NATIVE GOLD IN THE ORE DEPOSITS IN THE BAIA MARE AREA

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The hydrothermal ore deposits of the Baia Mare district are related to Neogene volcanic rocks (Badenian-Upper Pannonian). In the western area of the district (Ilba-Băiţa) the gold occurs both in the base metal ores, forming microinclusions in chalcopyrite, galena, sphalerite, pyrite, and quartz. At Ilba about 60% of observed gold grains (fineness of 720) occur in quartz. The fineness increases at Băiţa, i.e. of 760. Small amounts of gold appear included in goethite (8 and 4%). In the central area (Săsar deposit) the gold is associated either with quartz (about 30%), iron oxides (5%), sulphides (38%) and carbonates (27%). The gold in the quartz veins has nearly the same fineness (610-763) as compared to the gold associated with pyrite in the stockworks (640-730). The eastern area (Dealul Crucii-Cavnic) ore veins bear both base metal sulphides and gold. At Herja, the native gold is rare and associates with sphalerite and calcite. At Baia Sprie the gold is mostly associated with sulphides (mainly pyrite, about 68%) and has a fineness of 715-740 as compared with the gold in quartz (about 31%) of significant lower fineness (650). At Şuitor most of the gold is included in quartz (80%) in the upper part of the veins and associates with sulphides (82%) in the lower part. The gold fineness is of 730-785. The gold in Băiţ area (Breiner) is included either in pyrite and sphalerite (about 60%) or in quartz (40%) and shows a higher fineness (875-980). Most of the gold in the Văratec ores is related to chalcopyrite (32%) and quartz (40%) and shows also a relatively high fineness (800-860). The average size of gold grains (inclusions) varies from 0.05 mm, when associated with sulphides, to 0.02 mm, when associated with quartz.



THE POSSIBILITIES OF GEOLOGICAL
CORRELATION ON THE BASIS OF
EXTRATERRESTRIAL SPHERULES
OCCURRING IN HUNGARY

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On the basis of the investigations carried out
until now in Hungary we can perform spherule-based
geological correlations in the following periods:

TRIASSIC

Middle Triassic, Anisian stage, Pelsonian
substage, Balatonites balatonicus zone: Aszófő
(Balaton Higland): glassy spherules; Misina, Mecsek
Mts. (South Hungary): "extremely small spherules".

Ladinian-Carnian stage: Recsk Mts. (NE
Hungary): glassy spherules. Glassy spherules
occurrences of similar age are known from Greece,
Italy and Austria.

Norian-Rhaetian stage: Several occurrences in
the Buda Mts. with limited possibilities of correlation
(Glassy spherules).

JURASSIC

Bathonian-Callovian stage: Recsk Mts. (Glassy
spherules).

Callovian-Oxfordian stage: Gerecse Mts.
(Kálavária Hill, Tata): The oldest known occurrence
of magnetic spherules. In the case of both Jurassic
occurrences wide-ranging correlation is impossible.

CRETACEOUS

Upper Cretaceous, Upper Santonian-Lower
Campanian stage: A wide zone of occurrence of glassy
and magnetic spherules extending in Hungary:
Magyarpolány 42 borehole (W Hungary) to Nekézseny
(NE Hungary) (Glassy and magnetic spherules).

Campanian-Maastrichtian stage: Isolated
occurrences in W Hungary.

The Upper Cretaceous occurrences have been
interpreted as belonging to the global Upper
Cretaceous belt rich in spherule zones.

EOCENE

Upper Eocene: Csetény borehole 72 (NW
Hungary): Glassy spherules. It can also be associated
with the global occurrence-belt.

OLIGOCENE

Very rich occurrences (mainly magnetic
spherules) were found in the Cserhát Mts. (N Hungary)
without correlation possibilities.

MIOCENE

Badenian stage: Sopron borehole 89 (W
Hungary). Several localities were identified in the
Börzsöny Mts. (N Hungary) and Bükkmogyorósd
(Bükk Mts., NE Hungary) with glassy and magnetic
spherules.

PLIOCENE

Pannonian stage: Very rich occurrences of
glassy spherules were found in the Little Hungarian
Plain (NW Hungary).

PLEISTOCENE

A lot of magnetic spherules from various
localities.

HOLOCENE

Placer type sediments bearing large amounts of
glassy and magnetic spherules make up all investigated
areas along Hungarian rivers.

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LOW-K CALC-ALKALINE GRANITOID SUITE
IN THE DANUBIAN REALM - SOUTH
CARPATHIANS

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The pre-Variscan granitoid bodies which occur
in the basement of the Lower Danubian Unit (South
Carpathians) have been intensively investigated from
the viewpoint of their petrography, geochemistry and
their relationship with the geological context.

Some published major element, trace element
and/or without rare earth element (REE) data on four
of these granitoids were selected to allow classification
and petrogenetic evaluation.

Major element data on normative diagrams
support the existence of a distinct low-K calc-alkaline
(trondhjemitic) suite. Its components are the Retezat
granitoid pluton approximating tonalite-granodiorite-
trondhjemitic (TTG) rocks, the Petreanu, Furcătura and
Buta bodies approaching a trondhjemitic-granodiorite-
granite composition. All these bodies seem to form a
high-Ca granitoid suite as well, exhibiting
geochemical and mineralogical parameters consistent
with their derivation from an igneous source (I-type).
They generally show medium to high fractionation of
the REE patterns with small (-) or no Eu anomalies,
suggesting few differences up to a quite similar mode
of magma generating and a probable genetic link.

THE VOLCANOLOGIC STRUCTURE OF THE
GUTÂI MTS. (BAIA SPRIE-ŞUIOR-CAVNIC
AREA) USING REMOTE SENSING METHODS

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The Gutâi Mts. belonging to the North-Western
part of the Neogene volcanic chain (Eastern
Carpathians) contain various volcanoclastics, lava
flows and subvolcanic bodies (as they were
petrographically, geochemically and stratigraphically
discriminated). They form complicate structures, more
or less unravelled concerning volcanological aspects.

The photogeological study and the Satellite
Imagery interpretation on the Eastern part of the Gutâi
Mts. (Baia Sprie-Şuior-Cavnic area) led to the
outlining of the Baia Sprie craterial structure, defined
by stratovolcano-type edifices. They are included in an
extended craterial upper-structure with spatially and
temporally flowing volcanic units like Jereapăn,
Mogoşa and Igniş.

Another perfectly outlined structure,
subsequently to the first one - the Gutâi craterial



structure - is of a less extension (or more eroded). It is individualized by the major median E-W fracture, which limits the Northern part. The Creasta Cocoşului dyke along this fault suggest a snapshot process. The major Dragoş Vodă fault from the Baia Sprie structure, as well as these faults and the details of their dynamics suggest their joining to a subduction dynamic style.

The structural details of the two craterial edifices reveal in this study may offer distinct views on the metallogenic process.

MINERAL RELICTS IN GARNETS FROM ILE DE GROIX, BRITTANY, FRANCE

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Ile de Groix is situated on the southern coast of Brittany and represents the emerged part of a Palaeozoic metamorphic belt consisting of rock formed under high pressure and low- or medium-temperature conditions (blueschist and eclogite facies). Metabasic rocks (glaucophane schists and eclogites) are composed of blue and blue-green amphiboles (crossite, glaucophane, barroisite), alkali pyroxenes (aegirine, omphacite), garnets, epidotes, white micas, minor amounts of quartz, chloritoid, titanite, rutile and some other accessory minerals.

Garnets are almandine rich, with about 20% grossular content and minor (below 5%) amounts of pyrope and spersartine molecules. They show normal zonation, with Mn-rich core and increasing contents of Fe and Mg to the rim, but at the edges of porphyroblasts the zonation pattern is slightly reversed.

Garnet grains contain numerous inclusions of almost all minerals present in the rocks. However, small crystals of pyroxenes, amphiboles and rutile have been detected only in the outer part of the grains.

Garnet cores contain mainly epidote inclusions and opaque Ti-Fe minerals of very diversified chemical composition. Electron microprobe analyses reveal that the very cores of garnets contain almost pure magnetites and Ti-magnetites, whereas between core and rim ulvospinel with 8-12% TiO₂, stoichiometric ilmenites and Fe-rutiles with 4-30% FeO can be observed. The outermost parts of garnets contain needles of almost pure rutiles.

In garnets of the Si-rich parts of the complex there have been detected small (less than 0.5 mm in length) needles of deerite - hydrous iron silicate forming in HP-LT metamorphic environments. There can be also observed needle-shaped aggregates of quartz and hematite intergrowths, being pseudomorphs after deerite.

These pseudomorphs, as well as deerite relicts, succession of Fe-Ti minerals and reverse zonation pattern in garnet reflect changes of P-T conditions during metamorphism of the Ile de Groix series.

GENETIC SIGNIFICANCE AND COLOUR NATURE OF AMETHYST ZONES IN QUARTZ AGGREGATES FROM BEREGOVSKI ORE DISTRICT IN TRANSCARPATIA

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The amethyst zones form a part of quartz aggregates and alternate with bands of opal, chalcedony, partly recrystallized quartz and cockscomb type quartz. Such aggregates represent reliable markers in the Beregovski hydrothermal-metasomatic deposit. It is believed that such masses formed by coagulation of silica-rich colloids which started to crystallize under the influence of iron hydroxides (R.K. Iller, 1982).

The relationship between the amethyst colour and the iron is a well known fact. However, the structural position of Fe is still an open question. The EPR studies showed that the trivalent iron as substituent of tetravalent Si in natural and synthetic amethyst may be related to a special valence change of iron (V.G. Balakirev et al., 1979). In the UV and visible range there appear four absorption bands, i.e., at 255, 280, 340 and 540 nm (fig. 1-4). The bands at 255 and 280 nm are attributable to electron-trapping centers, bivalent iron and structural defects in quartz. By heating amethyst at 400°C such bands completely disappear (fig. 5), the spectrum becoming very similar to that of transparent quartz. (fig. 6). The bands at 340 and 540 nm are connected with electron transfer processes among the trivalent iron ions. In tetrahedral position a part of the trivalent iron may lose one p-level electron and become thus tetravalent and the free electrons produce the valence reduction of other trivalent iron ions: $Fe^{3+} + e^- = Fe^{2+}$.

The calculation of the Fe^{4+} ionic radius gave 0.56-0.54 Å, which is only about 35-40% greater than that of Si^{4+} (0.4 Å). Isomorphic substitution of Fe^{4+} for Si^{4+} may be thus convincing, obeying the isomorphism rule. This is not the case if Si^{4+} and Fe^{3+} ionic radii, i.e. 0.4 Å and 0.64 Å, respectively. Hence it may be concluded that the tetravalent iron ions represent centers of the violet colour of amethyst.

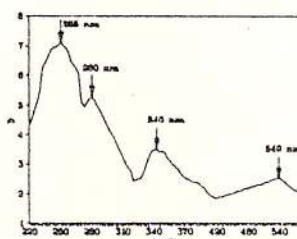


Fig. 1. Optical adsorption spectra of amethyst (sample 718/438-3).

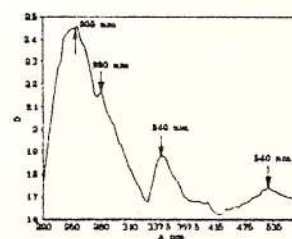


Fig. 2. Optical adsorption spectra of amethyst-visible quartz (sample 1505/515).



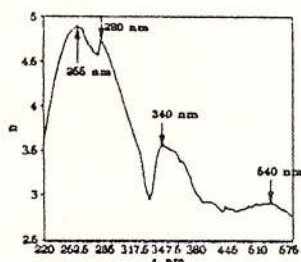


Fig. 3. Optical adsorption spectra of amethyst (sample 71B/43B-2).

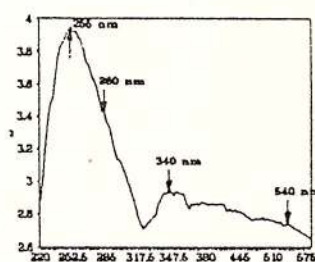


Fig. 4. Optical adsorption spectra of clear quartz from poor-violet colour (sample 1505/B).

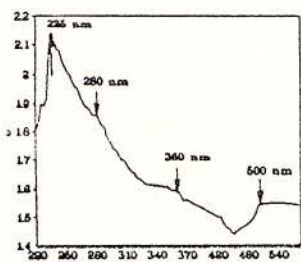


Fig. 5. Optical adsorption spectra of discolouring amethyst (sample 71B/43B-2).

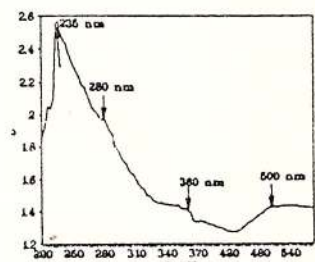


Fig. 5. Optical adsorption spectra of transparent quartz (sample 725).

ON THE POSSIBILITY OF VALORIFICATION OF GOLD AND POTASSIUM FELDSPARS FROM ROȘIA MONTANĂ DEPOSIT

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The Roșia Montană deposit, very rich and intensively worked for native gold accumulations in the past, is now mined for the finely disseminated gold in the host dacite. The researches carried out by G.I.R. proved the ore could also be an important source for potassium feldspars.

The run-of-mine ore, processed by flotation, is a low grade Au-Ag mineralization located in a dacitic volcanic structure. The dacitic rock was, in the central zone of the deposit, intensively adularized, sericitized, chloritized, argillized, silicified and pyritized. Melanocratic minerals (amphiboles, pyroxenes, biotite), plagioclase feldspars (albite, oligoclase) and partly orthoclase were substituted by adularia, hydromicas, kaolinite, quartz and pyrite. Thus the chemical composition is essentially modified; K_2O content of dacite grew up from 4-5% to 9-10% in detriment of Na_2O , CaO and MgO contents. The chemical composition of the run-of-mine ore is: 65-70% SiO_2 ; 13-15% Al_2O_3 ; 9-10% K_2O ; 1.5-3% Fe; 0.15-0.20% Na_2O ; 0.3-1.3 g/t Au; 11-19 g/t Ag; 2.5-3% S. The mineralogical composition of the crude ore is: 65-70% altered potassium feldspars (20-25% hydromicas and kaolinite, inclusively); 25-30% quartz; 5% pyrite; 0.12% magnetite; a.s.o. (goethite, chalcopryrite, galena, sphalerite, Ag-sulphosalts, Au). The chemical composition of the flotation tailing is quite similar to that of crude ore, the most important modification being the lowered contents of Au (0.3-0.5 g/t), Ag (8-11 g/t), S (1.1-1.3%) and Fe(1-1.5%).

The mineralized dacite shows a ratio K-feldspar + quartz phenocrysts to microcrystalline quartz-feldspar mass of 1:2.3. The feldspar phenocrysts consist of orthoclase more or less substituted by sericite, adularia and pyrite. The

microcrystalline groundmass is constituted from partly argillized and sericitized orthoclase, adularia, quartz and pyrite.

The gold is present as both micronic inclusions (10-50 μm) in pyrite, chalcopryrite, tetrahedrite and "free gold" in gangue minerals. The grain size of potassium feldspars varies between very large limits-from 10-80 μm in the groundmass up to 5-10 mm in phenocrysts - which often contain μm -sized inclusions of pyrite.

The best recoveries of both precious metals and feldspars require a very fine comminution (below 0.1 mm or even under 0.05 mm). The grinding fineness of the ore in the Roșia Montană flotation plant (i.e. 45-50% less than 0.07 mm and 55-60% below 0.1 mm) causes a low gold recovery in the industrial plant (whose tailing contains some 0.4 g/t Au).

Based upon the mineralogical study both on crude ore and flotation tailing, the technological researches have led to a flowsheet for valorification of both gold and feldspars from Roșia Montană deposit. This flowsheet comprises the following steps: crushing and comminution below 0.1 mm; flotation of gold-bearing pyrite; desclammung; Fe bearing mineral flotation; feldspar flotation. The final products are a Au-Ag pyrite concentrate and a potassium feldspar concentrate. In the laboratory stage, the gold recovery from crude ore pyrite concentrate is bigger (10 pts) than in industrial plant; the gold content of laboratory flotation tailing is 0.15-0.2 g/t. The gold bearing pyrite concentrate from the industrial plant tailing shows a recovery of 1.1% and contains 12.2 g/t Au and 110 g/t Ag (precious metal recoveries are 47.7% for gold and 17% for silver)

The potassium feldspar concentrate - obtained from both crude ore and industrial plant tailing - has a recovery of 25-30% and contains: 13% K_2O ; 0.2% Na_2O ; 0.3% Fe_2O_3 ; 16.7% Al_2O_3 ; 67.5% SiO_2 . This concentrate has been tested with good results for use in ceramics and plastics industries.

POLYSOMATISM AS A TOOL FOR MODELIZATION OF INORGANIC CRYSTAL STRUCTURES

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A family of inorganic compounds whose crystal structures are based on the same modules A, B, ... forms a polysomatic series $A_n B_m$. Individual polysomes can occur as single phases or just as growth faults and products of solid state reactions within a matrix of a stable member. In this case non stoichiometry can be expected; in fact, chemical composition (and cell parameters) of a polysome are linear combinations of the building modules. Polysomatism is well documented in minerals, e.g. the series of biopyriboles which is based on mica (talc) and pyroxene modules (Veblen, 1991).

The use of polysomatism can be particularly useful as a tool for obtaining a model of the crystal structure when diffraction data collected from a poorly crystallized material do not allow a direct solution of



the structure. The use of polysomatism shall be illustrated for the following cases.

NAFERTISITE, $\text{Na}_3\text{Fe}_{10}[\text{Ti}_2\text{Si}_{12}\text{O}_{37}](\text{OH},\text{O})_6$ (Ferraris *et al.*, 1995), a new layer titanosilicate from Kola Peninsula (Russia). It is monoclinic ($A2/m$, $a = 5.353$, $b = 16.176$, $c = 21.95$ Å, $\beta = 94.6^\circ$, $Z = 2$). By comparison with the chemical composition and cell parameters of other titanosilicates and mica, the crystal structure of nafertisite is shown to consist of two modules $(\text{Na},\square)_2(\text{M},\square)_3[\text{Ti}_2\text{Si}_4\text{O}_{17}](\text{OH})_2$ (nafertisite-like B module) and one module $(\text{Na},\square)(\text{M},\square)_3[\text{Si}_4\text{O}_{10}](\text{OH})_2$ (mica-like M module). A polysomatic series BM_n can then be defined where, so far, members with $n = 0, 1, 2, \infty$ are known, *i.e.* hafertisite, astrophyllite, nafertisite and mica, in the order. This is called heterophyllosilicate series because the crystal structures of the members consist of 2:1 HOH layers, where O is an octahedral sheet and H is a tetrahedral-like sheet which differs from the T sheet of the phyllosilicates for the insertion of the Ti octahedra.

CARLOSTURANITE, $\text{Mg}_{21}[\text{Si}_{12}\text{O}_{28}(\text{OH})_4](\text{OH})_{30}\cdot 11_2\text{O}$ (Mellini *et al.*, 1985), an asbestiform silicate from serpentinites of western Alps (Italy). It is monoclinic (Cm , $a = 36.7$, $b = 9.4$, $c = 7.3$ Å, $\beta = 101^\circ$, $Z = 2$). By comparison with the chemical composition and the crystallographic features of serpentine minerals, the crystal structure of carlosturanite is shown to consist of five modules $\text{Mg}_3[\text{Si}_2\text{O}_5(\text{OH})_4]$ (serpentine-like S module) and one module $\text{Mg}_6[\text{Si}_2\text{O}_3(\text{OH})_{14}]\cdot 11_2\text{O}$ (hydro-silicate X module). A polysomatic series S_nX can then be defined (named inophite series) where members with $n = 5$ and ∞ are carlosturanite and serpentine, respectively. Several other polysomes have been observed as fault lamellae within carlosturanite. Practically, this mineral is a water- and magnesium-rich, silicon-poor serpentine-like asbestiform silicate which is quite widespread in western Alps, where it has been mistaken for chrysotile since ever.

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MIDDLE MIOCENE VOLCANICLASTIC DEPOSITS AND RELATED PROCESSES IN GUTÂI MTS. (EAST CARPATHIANS, ROMANIA)

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Gutâi Mts. are part of the Neogene volcanic chain of East Carpathians. They are composed of a wide variety of lavas, volcanoclastics, intrusions and extrusions forming together a stratovolcanic succession.

Middle Miocene volcanic activity began with explosive eruptions recorded in a thick pile of

volcanoclastic deposits partly interlayered within sedimentary ones. It lays over the southern part of Gutâi Mts., from Racsă area towards Baia Mare city.

The volcanoclastic deposits are composed of ignimbrites and co-ignimbrite ash-fall deposits and volcanogenic epiclastic deposits. The non-volcanic sedimentary deposits are represented by marls, clays and subordinately sandstones and conglomerates.

Ignimbrites show a matrix-supported fabric, are poorly sorted and ungraded, with different grain sizes. They are composed of juvenile clasts, pumice and crystals of plagioclase feldspar, quartz and biotite and accessory and accidental lithics (sedimentary, metamorphic and igneous rocks).

The ash matrix is composed of glass shards and crystal fragments. Pumice clasts are flattened, stretched and aligned according to the flow, assessing their welding. The glass shards within the matrix represent the vesicle walls and show the effects of deformation during welding compaction. Some of them retain original bubble-wall shapes.

Co-ignimbrite ash fall deposits are composed of glass shards with cusped and platy shapes, moderately abundant crystals of plagioclase feldspar, quartz and biotite and very small amounts of unvesiculated glassy clasts.

Volcanogenic epiclastic deposits show a wide range of aspects, depending on the involved processes. Some of them are moderately sorted, stratified, ungraded and coarse (sandstones, conglomerates), composed almost entirely of volcanic clasts of pyroclastic origin. Most of them are unsorted and ungraded, non-stratified, resembling to graywackes, with reworked pyroclasts in a terrigenous matrix. They are related to sedimentary non-volcanic deposits that may contain small amounts of reworked pyroclasts.

Middle Miocene volcanoclastic deposits are composed of two superimposed sequences with a distribution depending on the paleorelief. The lower sequence, composed of volcanoclastics tightly interlayered within sedimentary deposits, corresponds only to the sink areas. The upper sequence, composed of ignimbrites and co-ignimbrite ash fall deposits, has an overall distribution.

Ignimbrite forming eruptions are considered to be responsible for the genesis of Middle Miocene volcanoclastic deposits. A "pot boiling over" or caldera collapse processes, preserving a high thermal energy necessary for the welding, are suggested.

Ignimbrites deposition was partly subaqueous and partly subaerial. Consequently, reworking processes and sedimentation took place in adjacent sedimentary basins.

MINERALOGY OF FIRE-CLAYS FROM ȘUNCUIUȘ (BIHOR COUNTY)

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The fire-clay deposit from Șuncuiuș is hosted in the quartz-detrific Hettangian - Lower Sinemurian formation of the Bihor Autochthon sedimentary sequence (Apuseni Mts.)



The deposit is constituted of a 150 m thick layer of clays developed in a Gresten-type facies which overlays Rhetic detritic sediments.

The major constituent of the clay is kaolinite, which is accompanied by partially hydrated other phyllosilicates, chlorite, detrital quartz and goethite. The fire-clay character of the rock is due to the high content in clay minerals, hematite, pyrite and/or marcasite, organic matter, carbonates.

The heavy minerals are represented by detrital staurolite, hornblende, epidote, zoisite, tourmaline, zircon and rutile derived from mesometamorphic rocks, as well as by autigenic pyrite, marcasite and sulphates.

The clay minerals were identified by means of X-ray diffraction and TEM studies, the latter ones revealing their morphological characteristics and the transformation processes they underwent. The clay fraction is represented by kaolinite d, halloytised kaolinite, illite, illite/montmorillonite, illite/muscovite; in the same fraction goethite, amorphous silica and iron oxides are also present. The white argillaceous filling of little cracks consists of halloysite 7 Å.

The transformation processes are represented by kaolinisation of micas; halloysitisation of kaolinite and montmorillonitisation of illite.

The detrital constituents of the clay originated from a Late Triassic alteration crust developed on mesometamorphic and sedimentary rocks, as well as from residual clays formed on Triassic carbonatic rocks.

ON THE MORPHOGENETIC DISTINCTION OF SPHERULES OF EXTRATERRESTRIAL, TERRESTRIAL AND INDUSTRIAL ORIGIN BY MEANS OF SEM AND EDAX EXAMINATION OF SAMPLES TAKEN FROM THE RECENT PLACERS OF CRIȘUL NEGRU

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An exact sampling and micromineralogical examination of the material of the placers of the Crișul Negru was carried out by Hadnagy. During this work he became aware of spherules in the samples. A SEM and EDAX examination of 52 spherules obtained from 24 sites was accomplished by O. Kákay Szabó on morphogenetic basis by which distinction spherules of extraterrestrial, terrestrial and industrial origin became possible. While 80 % of the spherules are partly of industrial origin with high Al, Si, Ti contents (artificial product) and partly of terrestrial origin with pyrite, sphalerite and limonite source, the other 20 % are of extraterrestrial origin (tektite and magnetospherules). Tektites occur on the eastern side of the Crișul Negru from the north to the south along a line. The magnetospherules occur also on the eastern side of the southern region and the industrial artificial products and terrestrial granules mainly in the southern region of Crișul Negru. The geographical distribution of the three genetic

types is an important feature as to the place and direction of their origin.

MINERALOGICAL CHARACTERISTICS OF THE STREAM MATERIAL, SHKUMBINI RIVER, ALBANIA

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The sand gravel of Shkumbin river of alluvial nature (Q_1^{al}) formed as a result of the mechanical fragmentation and processing of magmatic (intrusive and effusive) and sedimentary (quartzite-carbonate) rocks which feed the water gathering basin of this river.

The sand component consists mainly (85-95%) of particles of quartzite and carbonatic rocks and of modified rocks while the gravel component consists entirely of particles of magmatic, carbonatic and terrigenous rocks.

Sand grains are medium sized and gravel is also of medium size.

Sand and gravel stand in a ratio of 36:64, which is quite a satisfactory one for the exploitation of the whole sand and gravel.

The mineralogical study of the 0.3 and 0.15 mm component shows the following content: quartz particles 25%; silicic quartzite 9%; carbonatic rocks 28%; serpentinites 4%; different rocks and clay aggregates 33%; particles of feldspar and metallic minerals 1%.

SOME NEW DATA ON THE BASALTS FROM LUCAREȚ-SANOVÎȚA

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The basalts from Lucareț-Sanovița are the products of alkaline volcanism of Pliocene-Pleistocene age.

Microscopically, they present a porphyritic texture with intergranular groundmass.

The mineralogical composition consists of olivine, augite, plagioclase feldspar, apatite, magnetite, ilmenite. The volcanic glass is also present but in small amounts. The basalts contain xenoliths of crystalline limestone.

The contents of SiO_2 and Na_2O+K_2O are characteristic for trachybasalts. The lower values of MgO , Fe_2O_3 , CaO and TiO_2 and higher values of K_2O and Na_2O relative to ocean island basalts point out an evoluate character of magma which generated the alkali basalts from Lucareț-Sanovița. An enrichment in Rb, Ba and K is also present.

The very high content of Th relative to the primitive mantle shows a possible contamination of the magma with upper crustal material. The rare earth elements plotted as multiples of rare earth abundances in chondritic meteorites show an enrichment of large light rare earth, due to fractionation which depends on ionic radius.

The contents of Ti, Zr, Y and Zr, Th, Nb define intra-plat generated magmas.



EVOLUTIVE MODELS OF FORMATION OF METAMORPHIC CALCSILICATE ROCKS (SKARNS) IN THE GETIC METAMORPHICS (SOUTH CARPATHIANS)

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The spreading of the reaction skarns (metamorphic skarns) in the Getic crystalline area of South Carpathians is presented. The most important mineral relations on the basis of the detailed study of the textures and structures were established. According to these relations different mineral reactions (or equilibrium curves) were deduced. They can be identified with different experimentally determined equilibrium curves for reactions in different systems. Under these circumstances, on the basis of the diagrams in the fields $XCO_2 - T$, $PCO_2 - T$ or $P - T$ for the different systems ($MgO-SiO_2-H_2O-CO_2$, $CaO-MgO-SiO_2-H_2O-CO_2$) the estimation of the formation conditions of the reaction skarns and the direction of the progress could be made.

According to the mineral relations observed and the formation conditions established for some mineral associations, two alternative evolution models were proposed. The models proposed are as follows:

- by the metamorphosis of an original, pre-metamorphic limestone;
- by the evolution of a noncarbonatic protholite to a carbonate rock, the metamorphic skarn being a calc-silicate sequence of this evolution.

MANGANPYROSMALITE FROM BISTRIŢA MTS.; FIRST OCCURRENCE IN ROMANIA

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Manganpyrosmalite occurs in manganese carbonate-silicate ores at Dadu, Oiţa-Colacu, Tolovanu, Dealul Rusului, Bistriţa Mts. It prevails in silicate ore sequence but is present in carbonate ores too. It is frequently associated with ferrous tephroite and seems to be formed at the expense of it. It often forms veins which intersect pyroxmangite and rhodonite ores. In the carbonate ores the manganpyrosmalite builds nests and veinlets in ferrous rhodochrosite. Manganpyrosmalite appears as grains up to 5 mm in size and has a green-yellowish colour. It resembles micas but differs by being less hard and brittle. Microscopically it has a fine yellowish colour, is weakly pleochroic, has a perfect cleavage (like micas), parallel extinction, strong birefringence, and is optically uniaxial negative. As regards the paragenetic evolution, the manganpyrosmalite belongs to a late paragenesis, subsequent to regional metamorphism; it forms large unoriented crystals (static growth).

The formation order of the main manganese minerals in the above mentioned ore deposits is as follows ferrous tephroite, spessatine, pyroxmangite, dannemorite, alkali pyroxenes and amphiboles, rhodonite, manganpyrosmalite, (manganian biotite) manganophyllite, chlorite, Mn-stilpnomelane, magnetite, barite, neotocite.

X-ray study of manganpyrosmalite gave the following cell parameters: $a = 13.345 \text{ \AA}$, $c = 7.169 \text{ \AA}$, $vol. = 1107.4 \text{ \AA}^3$, rhombohed. $a = 8.07228 \text{ \AA}$.

Manganpyrosmalite aggregates seem to be formed by the substitution of ferrous tephroite due to the reaction between the last one and the volatile substances like H_2O and Cl , originated probably in a granitic body.

The hypothesis of a primary source of Cl from old lagunar deposits cannot be excluded. In this way one can explain also the Na source for alkali pyroxenes and amphiboles. In such a situation the transformation took place in a closed system as a result of an isochemical metamorphism.

SIGNIFICANCES OF PHOSPHORITIZED COPROLITES FROM CLUJ LIMESTONE, TRANSYLVANIAN BASIN, ROMANIA

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Some irregularly coiled coprolites 3 to 6 cm in diameters probable of mammalian origin, were recovered from the marine deposits of the Transylvanian Basin at Cluj Limestone level, Upper Eocene. The nodules have a homogenous light-brown colour sharply contrasting with the grey colour of the surrounding anoxic (wackestone) rock.

The bulk mineralogy of all samples deduced by XRD using CuK_{α} radiation indicates the presence of very poorly crystalline apatite phase, respectively carbonate - hydroxyapatite ("dahllite"). The microscopical examination, excepting the amorphous phase, did not reveal any organic skeletal fragments, very probable due to the complete substitution of the entire mass in the phosphorizing processes. However, the coprolites belong to a specimen with an upper position in the marine food chain, so that remnant bones had to exist before the diagenetic processes started.

Preservation of macrofaunal excrements on the sea-floor requires certain restricted conditions such as oxygen-depleted environment excluding so scavenging and boring benthos. Their fossilisation involves growth of autigenic carbonate-fluorapatite ("francolite") either as a pore-filling cement or as a replacement of pre-existing calcium carbonate.

In the existing models for the sub-actual similar coprolites, the fecal remnants constitute an isolated methanogenic environment and the effects of early diagenesis entailed a net mobilisation of Ca , F and probably P and a net export of C that cause the precipitation of a high-Mg calcite crust around it. Thus, in the first stages of the diagenetic evolution, the



crust can impede diffusional exchanges and thereby prevent a well-crystallisation of carbonate-fluorapatite, so that only the carbonate hydroxyl-apatite would be present. The poorly crystallised, F-deficient apatite is assumed to represent an unstable precursor or an intermediate phase that would have converted eventually to a more typical sedimentary carbonate-fluorapatite. In time, a phosphorized coprolite will lose the crust because P-minerals tends to replace thermodynamically less stable calcite. Only after that the carbonate-fluorapatite crystallisation will be promoted.

In our case, the availability and mobility of P in near-surface marine sediments was the result of a particular strain of bacteria and/or a high content of reactive P derived from dissolution of bones remains in the coprolites. This process caused coprolite to become phosphorized preferentially relative to the surrounding host sediment. However, the mineralogical composition of coprolites infirm the presumed diagenetical evolution. The losing of the crust did not offer the possibility for a extensive crystallisation of carbonate-fluorapatite, consequently the mineralogy of coprolite was blocked to the first evolution stage. A possible explanation is the carbonate nature of the host sediment. The high-alkalinity of environment can inhibit the growth of carbonate-fluorapatite because of the effects of CO_3^{2-} substitution on its solubility and cristallinity. In such conditions, even a possible net import of F⁻ by diffusional exchanges, cannot determine the francolite formation. This example illustrates a possible restriction to the proposed models.

SOME MINERALOGICAL FEATURES OF LACUSTRINE DEPOSITS. EXAMPLES FROM RONA LIMESTONE, SĂLAJ DISTRICT

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During the Upper Maastrichtian-Middle Eocene much of the Transylvania and adjacent areas underwent prolonged periods of continental sedimentation under a warm seasonal climate. Within these sequences there is a variety of lacustrine and pedogenetic carbonates.

Lacustrine deposits of Rona Limestone were accumulated in a hydrologically closed system with rapid changes of lake level due to fluctuations in rainfall and run-off and oscillations of the solute content of waters, especially the Mg/Ca ratio. The very gentle gradients of the margins influenced, even at small scale, fluctuations in lake level, with significant environmental changes.

The facies are stacked like transgressive-regressive cycles, in a sequence being recognisable two main lithofacies associations: (1) Lacustrine association that starts the sequence, with lime mudstone to packstone with scarce molluscs and chariophyte debris, interbedded with black-greenish shales sometimes organic rich. The lacking of

bioturbations at some levels indicate the presence of water stratification and anoxia. (2) Palustrine association that ends the sequence, with pellet and intraclast grainstones or packstones, the intraclasts being reworked fragments of brecciated sediments exposed at lake margins. Pedogenetically-modified limestones are characterised by development of calcareous soils, exhibiting features as brecciation, root tubules, microkarst, various cavities or iron oxide mottling.

Remarkable is the evolution of the mineralogy of carbonates in the sequence: if in the lower part, the low-Mg calcite is prevalent, the top of the sequence has important amounts of high-Mg calcite and dolomite. This suggests rapid changes in lake level and for the periods with low level, the increase of the Mg/Ca ratio as Ca is depleted by early stage precipitates. The low-Mg calcite may be present too, but like filling of different types of voids as result of the meteoric diagenesis in the vadose zone.

The XRD analysis of the clay fraction from carbonates and shales, on oriented samples, evidences a clay mineral assemblage with smectite (Al-Fe beidellite), illite (ferriferous illite) with a poor cristallinity and minor amounts of illite/smectite mixed-layers.

As referred to a sequence, the amount of illite increases upward, on the basis of the smectites decline. Thus the maximum illite participation is located at the top of the sequence, in the palustrine deposits level, and here particularly preserved like an argillaceous green filling of the root traces or desiccation cracks. The evolution of the smectite to the illite is due to the successive wetting-drying cycles.

MINERALOGICAL EFFECTS OF SHOCK METAMORPHISM AND COMPOSITION OF OLIVINE FROM THE MOCS (SYN. MOCI) CHONDRITE

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The Mocs* (syn. Moci) meteorite classified as 1.6 chondrite by VAN SCHIMUS and WOOD (1967) and recently reclassified as 1.5-6 by MIURA *et al.* (1995), fell on February 3, 1882, 16.00 hrs., over a large area (15 km by 3 km) in Transylvania (Cluj District). Olivine from six fragments of the Mocs chondrite was analyzed by optical microscopy, scanning electron microscopy with energy dispersive X-ray analysis and X-ray powder diffractometry. Olivine occurs as grains in matrix or chondrules; barred olivine chondrules composed of parallel sets of prismatic olivine crystals and devitrified glass and porphyritic olivine chondrules



which consist mainly of fine-grained olivine crystals and glassy materials of feldspar composition.

In order to determine the mineralogical effects of shock metamorphism (induced by collisions in space of the Mocs chondrite parent body), in every thin section, ten to twenty of the largest, randomly distributed olivine single crystals were examined 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. The shock effects observed are: undulatory extinction, irregular fractures, planar fractures, mosaicism and planar deformation features. These, correlated with the presence of small amounts of maskelynite (An_{12-19}) indicate that the maximum shock degree this meteorite experienced was S-5 (*cf.* STÖFFLER *et al.*, 1991).

The quantitative chemical analysis of 77 olivine grains in matrix from all thin sections (6), determined by a JEOL JSM-5400 scanning electron microscope with JED 2001 energy dispersive X-ray analysis at the Yamaguchi University, shows a variation in composition from Fa_{23} to Fa_{27} mole% fayalite (Avg. Fa_{25} ; PMD 2.3%), indicative of the L-group. The Fayalite content of olivine from chondrules ranges from Fa_{23} to Fa_{27} mole% fayalite (Avg. Fa_{25} ; PMD 1.74%).

According to DEER *et al.*, (1992), olivine composition can be measured also by X-ray powder diffractometry as Fa (mol per cent) = $100 - [4233.91 - (1494.59 \times d_{130})]$. By using a RIGAKU computer assisted diffractometer (radiation $CuK\alpha$; $\lambda = 1.54059$) at the Yamaguchi University, the d_{130} value of olivine from the Mocs meteorite was calculated as 2.781 Å and the fayalite content as Fa_{23} mole% fayalite (Forsterite, ferroan as of IMA files 1993), consistent also with the L-group. The cell parameters and density determined from the X-ray diffraction pattern are: $a = 4.779$ Å; $b = 10.279$ Å; $c = 6.032$ Å; $V = 296.857$ Å³ and $D_x = 3.466$ g/cm³.

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* Although called Moci or Mociu in Romanian literature or museums, one of the script requirements of the Meteoritical Society is that meteorite names should conform to the spelling given in the Catalogue of the Meteorites (4th ed.) by A.L. Graham, A.W.R. Bevan and R. Hutchinson, British Museum, London, 1985, where the original name of this meteorite is Mocs.

HIGH GRADE AND LOW GRADE MYLONITES IN PRE-ALPINE SHEAR ZONES FROM LEAOTA MOUNTAINS, SOUTH CARPATHIANS

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A polystage nappe stack involving medium to high grade rock complexes (Cumpăna and Sebeş? units) and low grade sequence of Căluşu Fm. has been separated as litho-tectonic units on the basis of structural-petrological criteria (Iancu, Mărunţiu, 1989, 1994 a,b). Lithologic entities (Voineşti, Lereşti, Căluşu, respectively) were previously cartographically separated by Dimitrescu (1978) and Gheuca, Dinică (1986), found them to be in a normal stratigraphic sequence.

Greenschist facies and medium to high grade mylonites in well expressed shear zones are arguments for different structural levels of the shear processes delimiting the mentioned lithotectonic units.

Occurrences of polycycle blastomylonites were described by Tatu (1989) and low grade mylonites were identified by Tatu, Robu (1987) at Lereşti-Căluşu contact in Moeciu area.

This paper is a first attempt to characterise a pre-Alpine deep seated shear zone on the basis of high grade mylonites affecting Cumpăna (Voineşti) rock assemblage. Different types of protholites (Albeşti granites, gabbros, micaschists, etc) preserve effects of prograde eclogitisation resulting amphibole - omphacite - pyrope - kyanite - phengite mylonites. Detailed mineralogical characterisation and PT path model are presented by Johan *et al.*, (1993), Johan *et al.* (in press). Progressive deformation in mafic protoliths and kinematic criteria (zoned porphyroclastic garnets with asymmetric tails of amphiboles, S-C structures or plano-linear fabrics) are arguments for dominant simple shear processes in eclogitic facies conditions. These criteria fit the prograde mineral evolution described by Johan *et al.* (1994).

Gt-Bi bearing mylonites in quartzo-feldspatic rocks in the same shear zone might be interpreted as effect of progressive blastesis and deformation at large scale.

Universal stage measurements on amphiboles and white micas from the mylonites and of quartz from quartzo-feldspatic or micaceous gneisses showed differences in distribution of maxims for C-axes of quartz crystals from different types of rocks.

A correlation of microfabric models with blastesis-deformation relations identified at microscopic scale is attempted for progressive history of mylonitisation in respect to retrograde shear processes of medium to high grade rocks.

Areal distribution of low grade mylonites are spatially related to tectonic contact between Căluşu (with prograde greenschist to epidote-amphibolite facies regional metamorphism) and Lereşti formations. Physical conditions of low grade mylonitisation suggest relatively shallow level of shear processes. Kinematic criteria are visible at outcrop scale.



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NOTE ON THE Cu-Ag-Pb/Bi SULPHOSALTS FROM BĂIȚA BIHOR AND VALEA SEACĂ

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Wittichenite, cuprobismutite, hodrushite and a Cu-Ag-Pb/Bi phase - further on, noted as "PP" (paderaitite?-¹P homologue?) phase have been found to co-exist in mineral samples from Băița Bihor. Samples of mineralised skarns from Valea Seacă, yielded an assemblage with wittichenite, hodrushite, PP phase and a Cu-Ag-Pb/Bi sulphosalt which is compositionally distinct from PP phase - further on, noted as phase "P" (¹P homologue?). The Cu-Ag-Pb/Bi minerals are associated with chalcopyrite, bismuthian tetrahedrite (~22-26 mol% Cu₁₃Bi₄S₁₃, ~2-5 mol% Cu₁₃As₄S₁₃), tetradymite and a bismuthinite derivative chemically corresponding to hammarite-friedrichite (n₈=0.34-80.5%), for which, however, no indication of the existence of superstructure and "cation" ordering is yet available.

Wittichenite shows a rather wide compositional range (in wt.%, average values of 16 analyses in brackets): Cu=32.46-39.28 (38.86); Ag=0.2-5.29 (0.79); Bi=39.92-46.58 (42.75); S=18.3-19.53 (19.08); Te=0-1.75 (0.18). Cuprobismutite has the following average formula (n=5): (Cu_{20.09}Ag_{0.37}Fe_{0.68}Zn_{0.1})_{22.05}(Bi_{26.58}Sb_{0.07})_{26.65}(S_{50.84}Te_{0.05}Se_{0.12})₅₁. The average X:M ratio (X=Bi,Sb; M=Cu,Ag,Fe,Zn) is 1.21, in good agreement with that of the structure derived formula of synthetic cuprobismutite: X:M=1.22 (Ozawa, Nowacki, 1975), but somewhat different from those reported by other sources (e.g., 1.08- Oen, Kieft, 1976). A number of 27 chemical analyses of hodrushite, gave the formula: (Cu_{7.75}Ag_{0.27}Fe_{0.5}Zn_{0.06})_{8.58}(Bi_{11.69}Sb_{0.03})_{11.72}(S_{21.93}Te_{0.02}Se_{0.05})₂₂, in good accordance with the results by Kodera et al. (1970).

The chemical analyses of PP phase (table 1) resemble those of paderaitite (Mumme, Zak, 1985), but show somewhat different substitution between metal positions. The sum of metals is generally lower than that required by the structure derived stoichiometry (M₂₀S₂₂), yet greater as compared to the results in the original paper by Mumme, Zak (1985). Also, the

charge balance yields comparatively better values, suggesting that the participation of Cu^{II} in the structure need not to be invoked. Indirect arguments for assigning PP phase to paderaitite come from the paragenetic relations within the Cu-Ag-Pb/Bi assemblage, which in this way, would include closely structurally related phases: paderaitite, hodrushite and cuprobismutite. The three minerals follow a deposition sequence in this order, i.e., a continuous enrichment in copper; the replacement textures are in each case remarkably euhedral: e.g. relics of PP phase in hodrushite, or of hodrushite in cuprobismutite have crystallographically controlled limits and orientations. Lacking relevant X-ray data, some ambiguity cannot be avoided, however. Moreover, the chemical analyses could equally be interpreted in terms of a ¹P homologue; normalizing the formula for 18 "cation" charges, the resulting mean occupancy values for Cu^I and Cu²⁺ (Zak et al., 1994) are respectively, 1.77 and 1.05 that is, compatible with a substitution of ¹P homologue type.

Table 1. Chemical analysis of PP phase from Băița Bihor (1-5) and Valea Seacă (6-10).

	1	2	3	4	5	6	7	8	9	10
Cu	8.05	8.28	7.07	7.82	7.12	8.85	8.53	12.03	8.98	8.44
Pb	4.46	4.57	3.63	3.81	3.59	8.50	8.01	6.79	8.54	7.78
Ag	4.48	4.39	4.98	4.73	4.99	2.66	3.16	0.72	2.66	3.02
Fe	0.14	0.09	0.07	0.03	0.03	-	-	-	-	-
Zn	-	0.17	-	0.05	0.21	-	-	-	0.15	-
Bi	63.10	63.21	64.84	64.99	65.24	61.83	62.34	62.49	61.92	62.85
S	17.82	17.69	17.80	17.95	18.06	18.22	18.29	18.75	18.00	18.42
Te	0.67	0.70	0.70	0.62	0.79	-	0.14	0.13	0.18	0.13
Se	0.30	0.24	0.26	0.19	0.21	0.16	0.12	-	-	-
Tot.	99.09	99.43	99.42	100.19	100.42	100.22	100.59	100.91	100.14	100.64

Phase P from Valea Seacă has an average formula (3 analyses; base is 18 "cation" valences): (Cu_{1.45}Ag_{0.71}Pb_{0.18})_{2.31}Bi_{5.16}(S_{8.89}Te_{0.01}Se_{0.03})_{8.93}, closely resembling the Cu-rich makovickyite (Mumme, 1990; Zak et al. 1994). Cu^I occupancy numbers, ranging 1.46-1.56 are ¹P compatible. The Pearson charge balance is between 8.01 and 8.03. For complete characterisation of phase P, X-ray data are still necessary.

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SOME ASPECTS CONCERNING THE BAUXITE FACIES IN THE NORTHERN APUSENI MTS.

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The stratigraphic and paleo-geomorphologic circumstances of the bauxite formation in the North Apuseni Mts. are related mainly to the geotectonic evolution of this region during the Late Jurassic to Early Cretaceous. The process of bauxitization, the accumulation and preservation of the bauxite deposits were directly related to the karst development and



CLAY MINERALS OF THE WEATHERED ULTRABASIC ROCKS, SHENGUNI ZONE, NORTH ALBANIA

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The weathering crust of the ultrabasic rocks in the Shengjuni area consists of laterites with significant amounts of clay minerals. Massive clay with white-yellow-red-brown colour, consisting of intraclasts and ground-mass are found.

The latter contain a wide variety of mineral species or interlayer mixtures such as montmorillonite-nontronite, smectite, corrensite as well as small amounts of palygorskite, sepiolite, chlorite, kaolinite and aliettite. The associated minerals include pyroxens, anthophyllite, quartz, magnesite, dolomite, chromite, goethite-hematite, rhodochrosite, feldspar, calcite etc.

Clay material make up to 50-80% of the whole rock.

Commercially significant are the palygorskite, sepiolite and aliettite forming needle-like aggregates ranging in size from 2 to 10 μm .

We also have obtained good results in preparing pesticides from this clay material with active inorganic matter (sulphur-oxide chlorine Cu) and active organic matter (zinc 1.5% - T.M.T.D. 50%)

FLUORAPATITE FROM ȚIBLEȘ NEOGENE INTRUSIVE MASSIF (EAST CARPATHIANS, ROMANIA)

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The Țibleș Mts. belong to the Subvolcanic segment (Țibleș-Toroiaga-Rodna-Bârgău) of the Neogene volcanic chain of the East Carpathians. They consist of calc-alkaline intrusive rocks-mainly monzodiorites, diorites and microgranodiorites (Udubașa et al., 1983). The intrusions pierce Paleogene-Lower Miocene sedimentary deposits generating large areas of hornfelses.

In the north-eastern part of the Țibleș Massif, on the Izvorul Mesteacăn Valley, a postmagmatic association, very rich in mineral species was described (Kovacs et al., 1985) in the contact area of a Paleogene sedimentary xenolith (150 m in length) with a monzodioritic body. Many minerals and especially apatite, phlogopite and rutile are very well represented.

Well developed columnar crystals of apatite, up to 4 cm in length, occur especially on the joints of the brecciated igneous rocks from the endocontact zone. The apatite are intimately associated with pseudo-hexagonal crystals of phlogopite (of max. 1 cm in size).

evolution. The relationship between the two processes was a manifold one, as the karstification has been pre-existent to bauxite accumulation, syngenetically to this and also present in the subsequent stages.

Petrographical features of the bauxites in several deposits from Pădurea Craiului and Bihor Mts., are discussed to evoke the superimposed genetical and epigenetical features.

Mineralogical and geochemical facies and trends are used for arguments. They were strongly influenced by the vadose/phreatic regime both primarily and also during the epigenetical stages. Local and lateral reworking of the bauxitic material was also taken into account in considering the shape of the ore bodies, and the aspect of the "under-ore" breccia.

FORMATION OF BANDED ILVAITE SKARNS AT RIO MARINA, ELBA ISLAND, ITALY

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At Rio Marina, Elba Island, Italy, skarns develop in Mesozoic metasediments by metasomatic alteration of, 1) massive calcitic marbles, 2) schists and 3) calcschists, in connection with regional late Cenozoic granitic activity. Skarns of the first type are composed of hedenbergite, ilvaite and quartz as major minerals; skarns of other types also show the development of epidote. Locally type-1 skarns may be banded, in that they are composed of oscillatory precipitation of quartz and ilvaite or ilvaite and hedenbergite on a centimeter scale. The direction of the bands is parallel to the contacts between the metasomatic zones and external skarn front and may cross-cut the lithology of the marbles. Geochemical (major and trace elements) studies on the banded skarns suggest that these rocks may have developed on pure marbles in agreement with field observation, and that both banded and non banded skarns develop from the same protolith and from the same fluid. An addition of Fe, Si, Mn, heavy REE, (Mg) is observed together with a loss of Ca and CO_2 . The elements P, Al, Ti, Zr are inert together with the light REE. Al may be added in some cases. Qualitative and semi-quantitative discussion on the genesis of oscillatory precipitation is proposed; the formation of banded skarns requires the coupling between the precipitation of the minerals in the bands and the dissolution of the carbonates. To this coupling may be associated a feedback loop between the two precipitating minerals.

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The complex investigations done on the apatite pointed out the presence of the fluorapatite with Cl (X-ray diffraction and IR absorption data). Besides CaO (54.32), P₂O₅ (40.09) and P (2.41) the chemical analysis of fluorapatite confirms the presence of the Cl (1.52), CO₂ (0.35) and H₂O (0.06). On the basis of this chemical composition the calculated formulae of the Țibleș fluorapatite is Ca₅(PO₄)₃[F_{0.73}Cl_{0.25}(OH)_{0.02}].

REE composition pointed out the big amounts of LREE and the strong Sm negative anomaly in the apatite/chondrite normalized diagram. The presence of the Eu³⁺ and Mn²⁺ was emphasized by the cathodoluminescent emission spectra.

Fluid inclusions data show that fluorapatite was formed at a minimum temperature of 40°C from highly concentrated saline solutions (28-36 NaCl equiv. wt%). The parent fluids of apatite were diluted by less saline solutions during the late stages of crystallization and/or after the precipitation of apatite.

The fluorapatite appears as the first crystallized phase among the minerals (more than 30) of the postmagmatic assemblage.

Fluorapatite from Țibleș Massif represents a novelty for the Neogene volcanic chain of East Carpathians and as for the whole Romanian territory as well due to its presence in this assemblage, to its composition and as well to its morphological features.

THE EVOLUTION OF THE MAGMATIC ACTIVITY IN THE POIANA BOTIZEI - ȚIBLEȘ AREA; A NEW APPROACH BASED ON RADIOMETRIC DATING

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The Țibleș Mts. belong to the Țibleș-Toroiaga-Rodna-Bârgău Subvolcanic Unit which represents the median segment of the Neogene volcanic chain of the East Carpathians. Poiana Botizei area represents the transitional zone to the Subvolcanic Unit (related to the Oaș-Gutâi volcanic chain).

In the both regions, the Neogene igneous rocks exclusively consist of intrusive rocks forming small intrusions (max. 1km in length) in the Poiana Botizei area and a polystadial subvolcanic complex with a main intrusion (more than 5km in length) developed in the south-eastern part in the Țibleș Mts. The intrusions are in relation with the Paleogene-Lower Miocene sedimentary deposits crosscutting them and generating large areas of hornfelses.

The igneous rocks are typical calc-alkaline showing a wide compositional range and as a whole belonging to the two main magmatic phases - an acidic phase (microgranodiorites and dacites) and an intermediate - basic phase (diorites - gabbros, monzodiorites, andesites and basaltic andesites) respectively.

Recent radiometric datings (more than 25 K-Ar determinations were carried out in the

geochronological laboratory in Debrecen) on the fresh intrusive rocks emphasized a new image of the magmatic activity in the Poiana Botizei-Țibleș area. The K-Ar data do not confirm the previously considered ages of the igneous rocks (Pontian or Pontian-Pliocene according to Edelstein et al., 1980). The ranges of the K-Ar ages obtained on the igneous rocks from Poiana Botizei area and Țibleș Mts are 11.2-9.0 Ma and 11.5-8.3 Ma respectively (Pannonian). The radiometric data of the Țibleș Mts. igneous rocks confirm the previous geological data regarding to the relationship between the two main phases (the first acidic phase and the second intermediate phase according to Udubașa et al., 1983). Contrary to expectations, the small intrusions situated around the ring or in the north-western part of the massif do not belong to the second magmatic phase. They are slightly older (10.6-11.5 Ma) than the igneous rocks of the first phase (10.0 Ma). K-Ar data of the Poiana Botizei area emphasized that the acidic rocks appear as being younger than the basic-intermediate ones (a reverse situation comparative with that of Țibleș Mts.)

The 7.8 Ma and 8.0 Ma ages obtained on two samples of hydrothermal sericite from the mining works from Țibleș Mts. (Bonhomme, unpubl. data) assert the ages of the fresh igneous rocks.

The K-Ar datings on the igneous rocks from Poiana Botizei-Țibleș area pointed out that the intrusive magmatic activity was contemporaneous with those of Toroiaga-Rodna-Bârgău Subvolcanic Unit and with the paroxysm of the volcanic activity of Oaș-Gutâi Mts.

THE COMPOSITION OF GOLD FROM THE UKRAINIAN CARPATHIANS

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Many mines of free gold have been discovered in the Ukrainian Carpathians (Table). The gold of these ores has various chemical compositions that are an indicator of the regional geochemical properties of gold and of its crystallisation conditions.

Gold from the Neogene volcanic rocks contains much silver (15-40%). The minor elements contained by gold show different levels of concentration, i.e., about 0.0n-0.n% Cu, Zn, Pb, As and about 0.0n% Fe, Te, Sb, Hg. Besides gold there are also electrum and auroan silver ("küstelite").

Gold from the old metamorphic rocks is comparatively poorer in Ag (9-17%) but exhibits quite different minor element contents, i.e., 0.0n-0.n% Fe, Pb, As, Hg and 0.0n% Cu, Zn, Sb. Gold from clastogene deposits in different localities of the Ukrainian Carpathians has various chemical compositions, but it often contains about 5-14% Ag.



There is gold with 25-35% Ag in some clastogene deposits as well as electrum with 1-5% Hg and goldamalgam. The contents of the minor elements in gold from clastogene deposits are as follows: about 0.0n-0.1n% Cu, Pb, As, Sb, Hg and about 0.0n% Fe, Zn, Te.

Location, rock, mine	ratio $C_{Au}/(C_{Au}+C_{Ag}) \cdot 100$	
	variations from to	the most frequent meanings
Beregivsky, the Neogene volcanic rocks, Muzhievsky mine	500-850	600, 650, 720, 760
Vyshkivsky, the Neogene volcanic rocks	500-700	
Rachivsky, the old metamorphic rocks: - Sauljak mine - Bily Potik mine	750-930 780-950	830, 860, 910 880, 890, 900, 910
Chyvehynsky, the clastogene deposits: - the Sojmulsky conglomerates of Chalk - contemporary alluvium	840-950 600-980	930, 950 860, 910, 930, 950
Verchovynsky, contemporary alluvium	600-960	
Jablunivsky, the clastogene deposits: - the Slobidsky conglomerates of Miocene - contemporary alluvium	920-980 880-990	930, 950, 980
Perechynsky, contemporary alluvium	860-950	910, 930
Nyzhnevoritsky, the Paleogene clastogene deposits	790-960	910

AUTHIGENIC RARE EARTH MINERALS IN KARSTIC BAUXITES AND KARSTIC NICKEL DEPOSITS

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The karstic bauxites and karstic nickel deposits are a very special environment for search of authigenic rare earth (RE) minerals. Twenty years ago there was no information about these minerals in bauxites. Since then our knowledge has much increased, including discovery of several new RE minerals and varieties in karstic environment. It was the result of understanding of the behaviour of REE during the formation of bauxites, as well as the use of electron microprobe in the study of RE minerals.

Authigenic RE minerals are the most frequently fluorocarbonates of the bastnäsite group. Relatively rare are RE phosphates, such as monazite and goyazite-(Nd). Most of the analysed

bastnäsites show a deficiency of fluorine in the structural formula. This element was replaced by OH groups giving rise to the formation of hydroxylbastnäsites. In some karstic nickel deposits in Greece fluorine is completely missing in the RE minerals; instead RE-hydroxylcarbonates have formed. These new RE minerals, hydroxylcarbonate-(Nd) and hydroxylcarbonate-(La) are end members of the series (La, Nd)CO₃F-(La, Nd)CO₃OH.

It is very probable that in the Cretaceous bauxites of Romania the authigenic RE minerals could be found, like in the Nagyarsány bauxite deposit in the southern Hungary, of the same age and belonging to the same geotectonic unit.

LEAD ISOTOPE AND ORE MINERALS GENESIS IN BAIJA MARE DISTRICT, MARAMUREŞ, ROMANIA

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The Neogene epithermal gold-bearing polymetallic veins of the Baia Mare district result from polyphased histories, characterised by successive stages of mineral deposition (Cavnic, Baia Spric, Şuior, Săsar). Lead isotopes analyses have been performed on lead-bearing minerals belonging to several metallogenic stages in order to identify the source-rocks of metals and to estimate the relationship between successive mineral associations.

Lead isotope signatures are well clustered for all deposits (206Pb/204Pb: 18.78 to 18.88), indicating a common source for all of them. These signatures are consistent with Neogene volcanic rocks which thus appear as being the major source of lead and associated metals.

In spite of slight variations from one deposit to another, there is no variation at the scale of a single mine suggesting strong recycling phenomena throughout ore deposition. That means, i.e., that last Sb (Baia Spric), As (Cavnic) or Au (Săsar, Cavnic) lead-poor stages simply recycled lead from earlier lead-bearing minerals to allow the formation of the famous Pb-Sb (Ag, Cu) sulfosalts (bournonite, semseyite, jamesonite, andorite, etc). Mineralogical studies and lead-isotope geochemistry are complementary tools in the understanding of inheritance and recycling phenomena in ore deposition.



**PALYGORSKITE IN MAGNESIAN SKARNS
FROM BĂIȚA BIHOR (REZBANYA) : A
SECOND ROMANIAN OCCURRENCE**

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A new find of palygorskite in the unusual context of skarn areas rises to two the number of the occurrences of this mineral in Romania. As well as at Ocna de Fier, the locality of its first Romanian mention, the palygorskite from Băița Bihor occurs as cavity infillings in a coarse-grained dolomite enclosed in the skarn mass. Palygorskite fibres, up to 2 mm in length, overcoat scalenohedral calcite. Physical constants are: $n_{\text{mean}} = 1.55$, $D_{\text{meas}} = 2.25$, $D_{\text{calc}} = 2.342$. Microprobe analyses gave an average composition of: $\text{SiO}_2 = 51.93\%$, $\text{Al}_2\text{O}_3 = 12.26\%$, $\text{Fe}_2\text{O}_3 = 0.25\%$, $\text{MgO} = 13.39\%$, $\text{CaO} = 0.63\%$, $\text{K}_2\text{O} = 0.05\%$, H_2O (theoretical) = 19.60%. The main IR absorption bands recorded between 4000 and 250 cm^{-1} are located at 3692, 3624, 3588, 3520 cm^{-1} (OH stretchings), 1626, 910, 875 cm^{-1} (OH bendings), 1190, 1130 cm^{-1} (bridged Si-O-Si vibrations), 1090, 1024, 998 cm^{-1} (Si-O stretchings), 632, 580, 520 cm^{-1} (Si-O bendings), 626 cm^{-1} (Al-O stretching), 485, 445, 415, 390 and 268 cm^{-1} (essentially cation - oxygen vibrations). The both palygorskites from Romanian skarns were found to be orthorhombic. Refined cell dimensions are: $a = 5.218 \text{ \AA}$, $b = 17.907 \text{ \AA}$, $c = 12.7185 \text{ \AA}$ for the Băița Bihor palygorskite and $a = 5.183 \text{ \AA}$, $b = 18.046 \text{ \AA}$, $c = 12.31 \text{ \AA}$ for the Ocna de Fier one. Some chemical peculiarities of the palygorskites in skarn areas (i.e. higher contents of Al and Ca) can explain their stability during hydrothermal alteration and weathering

**PREHNITE IN CALCIC ENDOSKARNS FROM
SURDUC : A LOOK ON A NEGLECTED
MINERAL SPECIES IN ROMANIA**

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Prehnite, an ubiquitous alteration product in calcic systems, was found in an unreported endoskarn occurrence, at Surduc (Banat Mountains). This endoskarn is developed at the contact between granodiorites belonging to Surduc 3 intrusive phase (Maastrihtian - Paleogene in age) and gabbros belonging to an earlier intrusive stage, the so-called Surduc 1, of Coniacian-Maastrihtian age. The primary skarn paragenesis consists of andradite (andr. 91.04 to andr. 98.36), calcic plagioclase (Ab. 44.79 Or. 4.02 An. 51.19) and diopside. Prehnite is clearly pseudomorph on plagioclase, occurring as a late hydrometasomatic product. The average of three microprobe analyses gave: $\text{SiO}_2 = 40.87\%$, $\text{Al}_2\text{O}_3 =$

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27.03 %, $\text{FeO} = 0.39\%$, $\text{Fe}_2\text{O}_3 = 1.20\%$ (assumed after wet - chemical tests), $\text{CaO} = 25.50\%$, $\text{MgO} = 0.32\%$, $\text{MnO} = 0.14\%$, $\text{H}_2\text{O} = 4.31\%$ (thermogravimetric). The mineral is white to greenish in colour and has as main physical constants: $n_{\text{mean}} = 1.615$, $D_{\text{meas}} = 2.950$, $D_{\text{calc}} = 2.944$. SEM, XRD and IR studies indicate the orthorhombic symmetry and a high-ordered structure. Lattice constants, refined on the basis of the X-ray powder data (23 reflections obtained) are: $a = 4.623(4) \text{ \AA}$, $b = 5.477(4) \text{ \AA}$ and $c = 18.46(1) \text{ \AA}$. The thermal pattern shows that dehydration took place during two stages, marked by endothermic effects on the DTA curves at 785°C (-0.65% H_2O) and 868°C (-2.66% H_2O). The infrared absorption spectrum recorded in the frequency range between 4000 and 250 cm^{-1} has as a main feature the dominance of the pattern of hydroxyl groups (bands at 3484, 940 and 870 cm^{-1}), Si-O bonds (bands at 1090, 1072 and 1000 cm^{-1}) and Al-O bonds (bands at 812 and 756 - 740 cm^{-1}). Si-O, Al-O vibrations and some other cation (essentially Ca)-oxygen vibrations were recorded below 700 cm^{-1} (bands at 668, 640, 532, 472, 426, 380, 346, 298 and 262 cm^{-1}) and are difficult to be assigned.

**NEW DATA ON THE BERYL IN A LESSER
KNOWN PEGMATITE OCCURRENCE:
CURMĂTURA VIDRUȚEI (LATORIȚA
MOUNTAINS - SOUTH CARPATHIANS)**

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Beryl, a quite frequent mineral in the Romanian pegmatites (12 occurrences reported so far), was rather merely mentioned than mineralogically investigated. This note aims to provide data regarding a typical occurrence at Curmătura Vidruței, previously known as Țancu I (Diaconu *et al.*, 1972, unpubl. data).

The host pegmatites are enclosed in the Steaja Formation (Săbău & Gheuca, 1995, unpubl. data), part of a Precambrian polymetamorphic nappe pile. From the litological point of view, this unit consists of plagioclase-, biotite-gneisses and quartzites containing numerous pegmatite lenses. The mineral assemblage in the pegmatites is fully represented by quartz, oligoclase, microcline, muscovite, beryl, tourmaline, apatite, and almandine-spessartine garnet.

The beryl crystals, greenish-white in colour, are unusually large (up to 50 cm in length) and characteristically strained during post-metamorphic higher-level refolding. The physical constants are : $n_g = 1.581$, $n_p = 1.575$, $D_{\text{meas}} = 2.862 \text{ g/cm}^3$, $D_{\text{calc}} = 2.670 \text{ g/cm}^3$. A wet chemical analysis yielded (wt.%): $\text{SiO}_2 = 64.98$, $\text{Al}_2\text{O}_3 = 18.01$, $\text{Fe}_2\text{O}_3 = 0.31$, $\text{BeO} = 11.18$, $\text{FeO} = 1.15$, $\text{MnO} = 1.20$, $\text{MgO} = 0.16$, $\text{CaO} = 0.05$, $\text{K}_2\text{O} = 0.13$, $\text{Na}_2\text{O} = 0.44$, $\text{H}_2\text{O} = 1.92$. Lattice constants, refined on the basis of 27 X-ray powder reflections are: $a = 9.208 \text{ \AA}$, $b = 9.197 \text{ \AA}$, cell volume 675.379 Å^3 . The infrared absorption spectrum recorded in the frequency range between 250 and 4000 cm^{-1} essentially shows sections which correlate with the H_2O vibrations



(bands at 3700, 3596 and 1632 cm^{-1}), Si-O bond vibrations (1204, 1020, 968, 680 cm^{-1}), Be-O bond vibrations (810, 746, 592 cm^{-1}), and Al-O bond vibrations (526, 496 cm^{-1}), as well as other bands recorded at 650, 440, 380, 368, 345, 262 cm^{-1} .

MINERALOGY OF CORONITIC METAGABBROS FROM CIBIN MTS.: EVIDENCE FOR HIGH-P METAMORPHISM

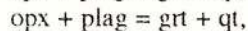
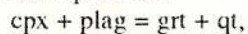
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Tectonically overlain by metasedimentary rocks of Sebeș Group, along a pre-Alpine structural discontinuity, a dismembered ocean-type association belonging to Lotru Group crops out in central and southern part of the Cibin Mts. (Alpine Getic domain)

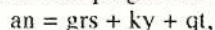
Small bodies of metagabbros, associated with amphibolite, plagiogneiss and metaperidotite, have been identified within Lotru Group in the upper reaches of Sterpului valley. These metagabbros are characterised by well preserved magmatic structures represented by modal and grain size layering which progressively pass to mylonitic fabric (flasser gabbro) developed in amphibolite facies conditions. Common to slightly amphibolitised gabbros are reactions which produce garnet coronas between pyroxenes and plagioclase showing the partial subsolidus re-equilibration of primary igneous assemblage.

Coarse and fine grained gabbros have been investigated by SEM and electron microprobe. In spite of slight iron-rich character of minerals in fine grained gabbro, these rocks generally contain: primary orthopyroxene (En_{56-66}), re-equilibrated clinopyroxene ($\text{Jd}_{4.1-6.5}$), plagioclase with An content changing from 71-79 to 40-55 at the contact with garnet corona, and garnet (Prp_{18-31} , Alm_{37-53} , Grs_{22-34}) with minute kyanite and quartz inclusions. The amphibole has variable compositions related to microtextural domains from tremolite-actinolitic hornblende as secondary aggregates on orthopyroxene to hornblende as pseudomorphoses on clinopyroxene.

Garnet coronas separating ortho/clinopyroxene and plagioclase, represented by simplified pressure-dependent equilibria:



and the evidence for breakdown of anorthite component of plagioclase involving reaction:



are diagnostic for re-equilibration of primary gabbroic assemblage under high-P granulite conditions.

Later exhumation of granulitized metagabbros led to development of amphibolite facies assemblage (hornblende + plagioclase \pm biotite + titanite) compatible with those of the country rocks.

THE MICROCHEMICAL COMPOSITION AND THE THERMODYNAMIC CONDITIONS FOR THE STAUROLITE-GARNET-BIOTITE ASSOCIATION IN THE MICASCHISTS OF THE BAIA DE ARIEȘ (APUSENI MTS.)

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Samples of staurolite, garnet and biotite from the micaschists belonging to the Precambrian Baia de Arieș Series from Sălcia were analysed by the electron microprobe.

The micaschists contain staurolite porphyroblasts (less than 10 cm in size), isolated garnets (less than 3.5 cm), sometimes compact aggregates of garnet and garnets included in staurolite; the associations also contains biotite and muscovite.

The microprobe analyses prove the following:

- the staurolite (8 point analyses) displays a homogeneous composition;

- the garnets included in the staurolite reveal a pronounced compositional zonality, with Mn decreasing from the centre towards the rim.

The scarce Mn content and the high Mg one are relevant for the finely lamellated biotite at the contact with the garnet.

Using the garnet-staurolite pair the following PT conditions were inferred: $T = 545-548^{\circ}\text{C}$ and P about 6 Kbar, corresponding to the amphibolitic facies.

RELATIONSHIPS BETWEEN INTERNAL STRUCTURE OF ALKALI FELDSPARS AND FLUID REGIME IN GRANITOID SYSTEMS

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Evolution of twinning structure, Si/Al-ordering and microdefectnes in alkaline feldspars under influence of water fluid during subsolidus cooling have been studied in different types of granitoid rocks.

The albite-pericline twin domains form as a result of the monoclinic-triclinic inversion of feldspar structure. First of all small-scale twinning structure of orthoclase with high internal strain is connected with the geometry of the twin boundaries.

The influence of water fluid on twinning structure produces an increase of domain sizes and reduces the structural strain. The original twinning structure (cryptotwin) shows a monoclinic diffraction symmetry caused of by small size of the twin domains. The increase of twinning scale changes the diffraction symmetry into triclinic one. Thus, the water fluid catalysis alters domain structure and results in coexistence of two "phases" of potassium feldspars



with different diffraction symmetry in the frame of a single crystal. Among the monoclinic feldspar two structural types can be distinguished: (1) monoclinic structure with equal concentration of Al in T_1O and T_2m positions and (2) geometrical monoclinic structure with a very small scale twin domains, some domains having triclinic symmetry.

The change of symmetry is only locally developed and is accompanied by removal, introduction and redistribution of tetrahedral cations (Al, Si, Fe), large cations (K, Na, Ca) and impurity cations (Rb, Tl, Pb, Mn). During such processes different types of structural and charge defects allows to reconstruct the conditions of transformation of original structure as a result of water fluid influence.

The scale of the twinning structure and microdefectness of alkali feldspars is not identical in samples from granitoids with different genesis (charnockites, rapakivi, granites, ordinary granites), pegmatites and metasomatic rocks. It shows a good correlation with H_2O/CO_2 ratio in fluid. The potassium feldspars from Precambrian granitoids revealing geometrically monoclinic symmetry and ordered feldspar (orthoclase) are typical of the rocks formed under conditions of "dry" system (charnockites, plagiogranites). It is supposed that coexistence of monoclinic and triclinic "phases" resulted from an incomplete solid state transformation of geometrically monoclinic feldspars. The transformation degree can be estimated from the ratio of such "phases" and perthites morphology.

Alkali feldspars with similar ordering ($t_1 = 0.8-0.9$) but with different symmetry, have been studied by XRD analyses on samples representing different types of chamber pegmatites and their zones. Monoclinic feldspars are supposed to be cryptotwinned with complex domain structure. The "phases" with different symmetry in single crystals are characterised by the size range of twin domains. The amount of triclinic "phase" correlates well with the concentration of structure charge defects of $(Si, Al)O_4$ -tetrahedra.

Metasomatism in rocks containing orthoclase-microperthite produces and increase of the triclinic phase, a decrease of the perthite amount and relaxes the structural strain.

SOME NEW PETROLOGICAL DATA ABOUT BĂIȚA RHYOLITES

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The Băița-Crăciunești volcanic structure is situated in central part of the South Apuseni Mts. This area is characterised by a large development of the Mesozoic ophiolitic rocks represented here by tholeiite series and subsequent calc-alkaline series, both of island arc type. In Eocretaceous, the rhyolite bodies (Băița rhyolites) were intruded into the Mesozoic magmatic and sedimentary rocks.

The Băița breccia bodies have been formed as a result of the strong explosions, due to the second boiling processes underwent by fluids associated to these rhyolites. Within the rhyolite body breccia pipe has been formed, while breccia dykes have been identified both in the rhyolite body and in the environmental rocks. The breccias are heterolithic consisting of fragments belonging to ophiolitic complex and rhyolites. Significantly is the fact that sometimes the breccia matrix is a rhyolitic one. Subsequently, the breccias were refractured and circulated by hydrothermal fluids which led to the intensive alteration and high mineralization of the rocks. Taking into account the breccia features, their relationships with the host rocks, with the alteration and mineralization products, we consider them as being hydrothermal magmatic breccias, but we not exclude the phreatomagmatic character for a part of them.

Concerning the mineralization, the Băița epithermal gold (\pm base metal) ore deposit, known even since Roman times, consists of veins localised both within rhyolites and contact zones between rhyolites and environmental rocks. At the upper part, the veins pass in a dense network of veinlets forming high native gold-bearing stockwork while, at greater depth, the veins join in a principal vein hosted by intense kaolinization and silicification of the rocks, characterised by a relative enrichment in base metals. Taking in consideration the height of mineralised column (about 700m), the hydrothermal processes were ample, specially in Băița rhyolites (adularized, argillized, silicified).

Therefore, at Băița-Crăciunești both intrusive breccias and the gold (\pm base metal) mineralization together with the most intensive alteration products are associated to the Băița rhyolites.

COPPER MINERALIZATIONS RELATED TO VOLCANO-SEDIMENTARY COMPLEX AT THE PERIPHERY OF THE ALBANIAN OPHIOLITES

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Two narrow belts of volcano-sedimentary complexes are known at the periphery of the Albanian ophiolites. The belts consist of Ti-rich basalts of nearly tholeiitic composition with interbedded argillaceous and radiolaritic shales.

Important sulphide copper-pyrite ore deposits are related to this complex. Morphological types as pipe-like, lens-shaped and lens-layered shaped are characteristic for these ore deposits.

Three types of ore deposits have been distinguished:

- Volcano-sedimentary type (the most important one) with nearly sharp contacts with the surrounding rocks.
- Hydrothermal-metasomatic type with large disseminated mineralization zones, contained by rich chalcopyrite-pyrite lenses.



• Filling veins represented by quartz-sulphide ores.

Generally the ores have a simple mineral composition. The dominant minerals are pyrite and chalcopyrite, but in some cases sphalerite and oxide minerals (hematite and magnetite) may locally be present in significant amounts.

These mineralizations are clearly distinguished from those related to the volcanic sequences of the ophiolitic complex.

GROWTH FAR FROM EQUILIBRIUM AND THE IMPORTANCE OF THE SHAPE

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The growth may be viewed as a volumic expansion of a phase into another one; in many cases the two phases are separated by an equilibrium line. The process may take place far from equilibrium or close to the equilibrium, but never at the equilibrium line. For the growth process to take place it is necessary that the system change his state from a conservative one into a dissipative one. There are four distinctive essential shapes which may appear in this situation: the compact shape, the self affine surfaced shape, the dense branching shape, and the DLA shape. In different systems various perturbations may affect the shape. One of these perturbations may be the anisotropy which may be related with the growing phase, and with the environmental phase as well (Ben-Jacob et al., 1994). If the anisotropy exists, then the succession of the essential shapes is: polyhedral, skeletal cellular, dendritic, DLA. The natural growth processes are closely related to these essential shapes. The self affine surfaced shapes are all the islands, the magmatic bodies, etc. The coral colonies fall into dense branching shape and so on.

Single crystals, because of their anisotropy will adopt the hopper, cellular, dendritic shapes. Mineral aggregates (such as copper dendrites) will grow isotropic because the crystalline anisotropy is located below the grain size.

Excepting the compact shape, and the hopper shape, all others may be fractal, which may be viewed as an argument for the assumption that their growth process was far from equilibrium.

CLASSIFICATION OF THE SKELETAL SHAPES AND MORPHOLOGICAL TRANSITIONS

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Little attention has been paid to skeletal crystals in geological literature. However, they may provide useful information for the evolution of their host rock, and they are of a great interest for crystallographic and mineralogical research.

There were described in mineralogical literature, for almost all minerals one or more skeletal

shapes which are directly related to the degree of undercooling or supersaturation. A classification of the skeletal shapes based on this knowledge is possible and such an attempt is presented. This classification is based on some observations on the olivine and pyroxene morphologies from slag, and of some published data (Lofgren 1975, Donaldson 1976, Shoutghate 1982) as well. The change of the possible skeletal shape with variation of the degree of undercooling will be called a morphological transition. There are two possible morphological transition types: the first one is represented by discrete transition from an essential shape (hopper, cellular, dendritic) to another one and the second one is referred to the quantitative variation of the geometrical characteristics of the shape (i.e. the arm-spacing of a dendrite). During the growth, the system may loose its crystalline feature and adopt an irregular shape, which is also a morphological transition. These irregular shapes are close to the Diffusion Limited Aggregation (DLA) morphology (Witten & Sander, 1975). It has to be noted that the dendritic and the DLA shape may be fractal.

Generally speaking, a mineral can pass through all morphological transitions. Sometimes one or more morphological transitions are avoided for reasons that are not known yet (ice seems to be an example).

After (or during) the growth, the system may return close to equilibrium. Then the skeletal crystals fill-in and primary inclusion may form.

POLYSTADIAL TECTONIC HISTORY OF REBRA SERIES METAMORPHICS AS REFLECTED BY GARNET EVOLUTION

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The paper is based on field researches, and microscopic and microprobe analyses. Regardless the host rock chemical compositions, garnets of the Rebra Series are mainly almandines that show a large size variability even in the same sample. Microprobe analyses were carried out on garnets of different sizes in 1-2-3 points or across profiles through larger grains, up to 2.0 centimetres in diameter.

The garnets have generally formed during two growth phases under prograde conditions. In a first stage the cores (Z_1) of the larger (centimetric) grains and small grains of dendritic habit were synkinematically generated. In the second, postkinematic, stage the earlier cores were coated by layered overgrowth zones (Z_2). Also to this stage belongs a second generation of dendritic garnets some few mm in size. Locally a third phase may be suspected, possibly represented by submillimetric grains grown on corroded surfaces of earlier-formed garnets.

Garnet-hornblende geothermometry reveals temperatures of 550-600 °C at peak conditions during metamorphism.



CHLORITOID-BEARING BLASTOMILONITES IN THE RODNA MOUNTAINS

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Chloritoid-bearing rocks from the Rodna Mountains are blastomylonites developed along Alpine and pre-Alpine shear zones. They show a mylonitic foliation S_3 and a striation lineation sometimes associated with a concordant mineral lineation evidenced by phyllosilicates. The blastomylonites were formed on low- and medium-grade metamorphic rocks and consist of at least two generations of assemblages. The older of them is represented by quartz-plagioclase-biotite-muscovite \pm garnet, being in disequilibrium with the newer one (some of the minerals of the above assemblage are preserved only as pseudomorphs). The new generation is mainly formed of three assemblages: quartz - chlorite - chloritoid - sericite \pm cyanite \pm stilpnomelane; quartz - chlorite - sericite - albite \pm carbonate; quartz - sericite - biotite - epidote.

Within the blastomylonitic rocks, chloritoid is present wherever - in the presence of Fe^{2+} - an Al_2O_3 - enrichment took place by preferential depletion of alkalis and lime under conditions of high strain. The study of thin sections evidenced a two-stage blastesis of chloritoid: synkinematic, with regard to S_3 (chloritoid crystals with $S_i \neq S_c$ or cores of larger grains, with $S_i \neq S_c$), and postkinematic growth (chloritoid "rosettes" with $S_i = S_c$ or rims on synkinematically-grown cores).

MINERALOGICAL AND PETROGRAPHICAL FEATURES OF THE EOCENE VOLCANICS OF THE SHAHDAG SINCLINORIUM IN THE LESSER CAUCASUS (AZERBAIJAN)

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The study area is located at the north-western part of the Sevan-Akeri zone. It occupies the Eastern extension of the Dilzhan-Krasnoselsky sinclinorium being separated from that by the Mrovdag interzonal fault. Large-scale volcanic activity characterises the structure in question during the Eocene period. As a result a thick pile of volcanics has been accumulated ranging from basic to intermediate and acidic compositions. The geodynamic regime during the development of Eocene volcanicity in the Shahdag sinclinorium was different from that characterising the Jurassic volcanicity of the Loky-Karabakh zone. The volcanics of the Shahdag structure belong to different rock series including calc-alkaline, sub-alkalic and alkalic suites. Rock types as trachydacites, pantellerites, and commendites containing mineral assemblages with acidic andesine (30 - 40% An),

31 orthoclase, quartz, aegirine and arfvedsonite are described. The occurrence of the acidic alkalic-series rocks, belonging to both potassic and sodic types, as well as the presence of mafic alkalic minerals (aegirine and arfvedsonite) in their composition are for the first time mentioned in the Shahdag sinclinorium.

FLORENCITE FROM SOPRON AREA (W- HUNGARY) RE-EXAMINATED BY EMPA

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Florencite, $[REE Al_3(PO_4)_2(OH)_6]$ has been found in fragments of muscovitic kyanite - Mg-clinochlore (leuchtenbergite) schists on or near to the surface in Sopron Hills, belonging to the Eastern Alps, as described in [1]. This mineral is considered as an important step of metamorphic monazite formation [2]. Electron microprobe re-examination of two samples confirmed some of the results of the former investigations while others have been corrected. Both samples contain: kyanite ~ Mg-clinochlore, florencite > muscovite >> apatite, rutile, and Th-minerals. Monazite was found only in one of the samples both as separate grains and as inclusions in florencite.

The florencite is often zoned; some zones contain Th-minerals, others monazite (or, maybe, rhabdophane) inclusions or inclusion chains. Other inclusions are Mg-clinochlore, muscovite, apatite. *Quantitative analyses* indicated La...Sm and Gd > 0.1 w-%; their ratio change from place to place. Al and P contents are close to the stoichiometric values. Minor elements are Ca and Sr, replacing REE. Th is present only in certain zones. No Mg was detected. This element and the low REE contents found earlier (see [1]) can presumably be attributed to the Mg-clinochlore inclusions. The observed zoning is mainly caused by Ca, sometimes by Th. Monazite grains have also been analysed, the results are summarized in the table.

This work was done in frame of research program T 015993 supported by Hungarian National Science Foundation (OTKA).

References:

[1] Fazekas V., Kósa L., Schmezsi B (1975): *Földtani Közlöny*, **105**, p. 297-308. [2] Sawka, W.N., Banfield J.F., Chappell B.W. (1986): *Geochim. Cosmochim. Acta*, **50**, p. 171-175.

Sample	Florencite				Monazite			
	S-1		S-4		Tho- rian	Sepa- rate	Incl- usion	
	7 analyses Aver.	Range	Th- rich	5 analyses Aver.				Range
Y ₂ O ₃	0.03	0.07	0.04	0.01	0.03	0.04	0.06	0.20
La ₂ O ₃	6.59	3.35	4.19	7.53	1.77	6.98	14.69	8.37
Ce ₂ O ₃	15.43	1.52	8.58	15.88	2.13	15.66	36.57	30.23
Pr ₂ O ₃	1.43	0.85	0.77	1.34	0.46	1.38	3.51	3.73
Nd ₂ O ₃	4.76	4.34	2.17	3.94	1.59	4.32	12.13	14.45
Sm ₂ O ₃	0.49	0.49	0.22	0.34	0.20	0.38	1.21	1.98
Eu ₂ O ₃	0.04	0.09	0.00	0.01	0.05	0.05	0.09	0.17
Gd ₂ O ₃	0.39	0.16	0.27	0.36	0.11	0.47	0.89	1.00
Tb ₂ O ₃	0.01	0.06	17.07	0.02	0.04	1.45	0.80	8.41
SrO	0.11	0.09	2.19	0.12	0.11	0.16	0.00	0.06
CaO	1.17	1.65	3.07	0.97	1.44	0.58	0.18	1.71
Al ₂ O ₃	29.75	1.59	21.38	29.89	1.29	30.63	0.04	0.12
P ₂ O ₅	27.61	0.97	25.15	26.47	1.06	26.53	29.36	28.32



THE EVOLUTION OF THE HANEȘ HYDROTHERMAL SYSTEM INFERRED FROM THE ORE MINERAL FEATURES

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The complex studies of the Haneș ore mineral assemblages (morphology, mineralogy, geochemistry, mineral inclusions, sulphur isotopes) led to a new image of the evolution of this hydrothermal system.

Using pyrite morphology, three supersaturation-temperature domains corresponding to morphologic trend zones, have been depicted:

I. S_H-T_H domain superposed to C-O-P-{hkl} zone, representing two apices, bordered by breccia zones; these ones could be attributed to hydrothermal vents;

II. S_H-T_H/S_M-S_H transition domain according to (1) C-O-P zone and (2) the appearance of the positive and negative striated pyritohedron, superposed to the breccia zones;

III. S_M-T_H domain corresponding to C-P zone situated at the upper part of the hydrothermal structure;

All these data permitted the outlining of a hydrothermal process model with a great approximation degree. The following evolutionary trend was presumed:

1. the ascension of some fluids of high supersaturation and temperature (400-500°C);

2. the recurrent boiling processes, as an effect of the adiabatic detente, having as a result the repeated precipitation of some sulfide sequences (pyrite, sphalerite, chalcopyrite) and some successive re-balances in the $ZnS-CuFeS_2-Fe_{1-x}S$ system (chalcopyrite, pyrrothite, tetrahedrite mono- and multiphases exolutions in sphalerite; sphalerite stars in chalcopyrite; sulphur isotopic balances);

3. the chalcopyrite-cubanite system balance followed by the mackinawite formation, as an effect of the drastic decreasing of the temperature (from 400-500°C to about 200°C);

4. the fluid evolution towards a low temperature (below 100°C) in the late stage, suggested by a subsequent growth (arborescent structure) of the pyrite micronic crystals, ("fleurs de silice", Le Ribaut, 1975), specific to the sedimentary domains.

The gold transport is presumed as a simple hydrosulfide complex, like $Au(HS)_2$, due to the kaolinite presence in the clay mineral paragenesis, suggesting a near-neutral region (Seward, 1984). The precipitation of the gold complex may be determined by decrease of sulphur activity, sometimes accomplished by (1) the boiling and the precipitation of the sulfides, at the lower part of the ore deposit, (2) the dilution of fluids due to the meteoric waters and oxidation, at the upper part of the deposit.

Abbreviations: T-temperature; S-suprasaturation; H-high; M-moderate; C-cube; O-octahedron; P-pentagonal-dodecahedron.

Total	87.76	2.22	85.24	86.81	1.10	88.59	99.44	98.81
Ionic numbers for			11 oxygen				16 oxygen	
Y	0.001	0.003	0.002	0.000	0.001	0.002	0.004	0.017
La	0.208	0.104	0.151	0.242	0.258	0.222	0.863	0.500
Ce	0.484	0.059	0.308	0.508	0.081	0.494	2.131	1.795
Pr	0.045	0.027	0.028	0.043	0.015	0.043	0.204	0.221
Nd	0.146	0.133	0.076	0.123	0.051	0.133	0.689	0.836
Sm	0.015	0.014	0.007	0.010	0.006	0.011	0.067	0.111
Eu	0.001	0.003	0.000	0.000	0.001	0.001	0.004	0.010
Gd	0.011	0.005	0.009	0.010	0.003	0.013	0.047	0.054
Th	0.000	0.001	0.380	0.001	0.001	0.028	0.029	0.310
Sr	0.006	0.005	0.125	0.006	0.006	0.008	0.000	0.006
Ca	0.107	0.150	0.322	0.090	0.133	0.054	0.032	0.297
Al	3.008	0.100	2.468	3.075	0.111	3.112	0.007	0.023
P	2.004	0.050	2.085	1.955	0.032	1.935	3.956	3.888
Sum	6.034	0.076	5.965	6.061	0.077	6.056	8.031	8.073

THE MORPHOLOGY AND GEOCHEMISTRY OF THE VALEA MORII MAIN ORE MINERALS. AN ATTEMPT TO RECONSTITUTE THE MINERALIZING EVOLUTION

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Pyrite, chalcopyrite, sphalerite and magnetite were used to reconstruct the evolution of the Valea Morii porphyry copper-hydrothermal system. Thus, pyrite displays three morphologic trends with a zonal distribution similar with hypogene alteration zonality, defining three supersaturation-temperature domains of the porphyry copper system.

The correlation among the mineral inclusions of pyrite (chalcopyrite, magnetite ± hematite, rutile, iron carbonates, K-Cl-Fe complex chloride type), the minor element content and the gold concentration of the pyrite, chalcopyrite, sphalerite and magnetite, emphasised the following evolutionary trend of the Valea Morii porphyry copper-hydrothermal system:

1. A co-magmatic stage characterised by: (1) hydrothermal fluids with high salinity and high temperature of the hydrous saline melt type, and (2) a vapour-rich phase type, coexisting with residual silicate melt. The processes of this stage, met in the potassic zone are shown by the C-O-P-{hkl} pyrite morphologic trend and a S_H-T_H domain. The gold transport is assumed as $AuCl_2^-$ complex.

2. The hydrothermal stage exhibits a fluid evolution characterised by a dilute aqueous solution, with lower salinities and temperatures. This fluid is responsible for the polymetallic and gold mineralization, met as a vein suite. In this case the gold transport was probable as $Au(HS)_2^-$ complex.

A sericitic-argillitic alteration zonality, characterised by the C-O-P, C-O-P-{hkl} and C-P pyrite trends, and two suprasaturation-temperature domains, (1) S_H-T_H ----- S_L-T_H and (2) S_M-T_L , is also associated.

This last stage is linked to co-magmatic one, and probably, was controlled by the opening of the system, and accompanied by an adiabatic expansion and a breccia formation.

Abbreviations: C-cube; O-octahedron; P-pentagonal-dodecahedron; H-high; M-moderate; L-low; S-suprasaturation; T-temperature



RARE EARTH ELEMENT ABUNDANCES OF THE OPHIOLITES FROM SOUTH APUSeni MOUNTAINS (ROMANIA)

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The present paper reviews the REE characteristics of the ophiolites from South Apuseni Mts., based on previous papers and additional 14 analyses.

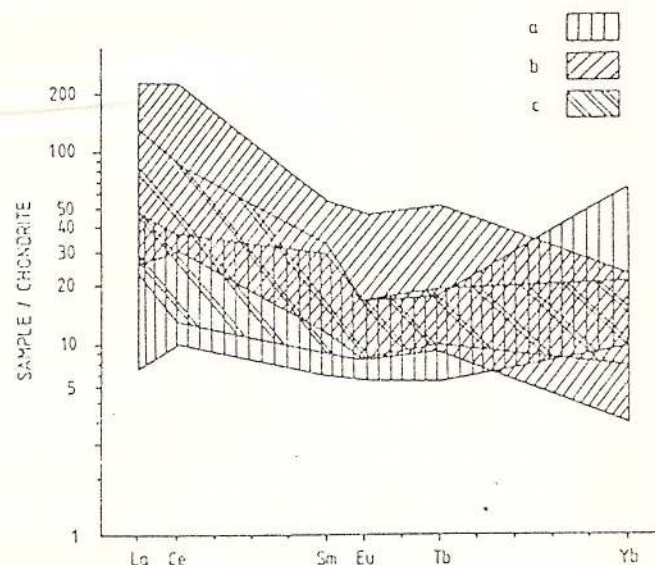
The ophiolite suite of the South Apuseni Mts. has been interpreted in relation to two tectonic settings and consists of the following series:

- tholeiitic series and calc-alkaline series of a volcanic arc;
- spilitic series of Feneş Formation, and basalts of the Criş Basin related to ensialic marginal basin.

REE contents, chondrite-normalised values, Σ REE and some characteristic ratios, i.e., Eu/Sm, $(La/Yb)_N$, $(La/Ce)_N$ and $(Ce/Yb)_N$ of the tholeiitic, calc-alkaline and spilitic series are discussed.

Interpretation of these data suggests the following:

- the tholeiitic series has the lowest Σ REE and the calc-alkaline series the highest Σ REE;
- Eu/Sm ratio of the tholeiitic series exhibits a larger variation as compared to the calc-alkaline series and spilitic series;
- LREE/HREE ratios of the tholeiitic series have a restricted variation range and mean value as compared to the calc-alkaline series and spilitic series;
- chondrite-normalized patterns of the tholeiitic series, calc-alkaline series and spilite Feneş Formation series provide valuable information about their petrogenesis and additional data to confirm the ophiolite genetic model already proposed by us.



The range of REE contents for ophiolites from South Apuseni Mts.

- a) tholeiitic series;
- b) calc-alkaline series;
- c) spilitic series.

MAJOR AND RARE EARTH ELEMENT DISTRIBUTION IN BIREFRINGENT GRANDITE FROM OCNA DE FIER, BANAT, ROMANIA

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Anomalous birefringence has long been known in skarn garnet (Brewster, 1840; Sjögren, 1886; Goldschmidt, 1912; Deer, Howie, Zussman, 1993).

Grandite from the ~65 Ma old skarn deposit at Ocna de Fier-Dognecea (Banat, Romania) is no exception. Granditic skarn in the Ocna de Fier metallogenetic field occurs quasi-continuously for more than 7 km, from the Ignatius open-pit in the north, down to the Lacului Mic valley in the south. The first data on garnet birefringence from the Terezia and Iuliana open-pits were published by Sjögren (1886). It was later found that birefringence is typical for most garnets in the impressive granditic skarn bodies (sometimes 150 m wide and over 100 m deep!) of the whole Ocna de Fier metallogenetic field.

Only one garnet analysis from Ocna de Fier (Bergéat, 1910) and three more from Dognecea (Seebach, 1906, Zombory, 1934) were published so far. Data presented here confirm the dominant andraditic character of granditic garnets from Ocna de Fier.

Thirteen garnet samples collected at different depths on both sides of the skarnified calcareous syncline, were SEM-EDS investigated for major element content. Correlation between optical behaviour of Ocna de Fier grandite and its chemistry is documented: birefringent grandite is intermediate andradite-grossular, while isotropic grandite is andradite end-member. REE SIMS analyses showed correlation of REE with birefringent and isotropic grandite. Based on personal observation and literature data, an explanation for the anomalous optical behaviour of these grandites is attempted.

ENCLAVES IN THE NEOGENE CALC-ALKALINE ROCKS IN THE SUBVOLCANIC ZONE OF THE EAST CARPATHIANS: ORIGIN AND SIGNIFICANCE

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Well known because its petrological variety, ranging from rhyolites and rhyodacites to various types of andesites and microdiorites, the Rodna-Bărgău subvolcanic zone occupies a peculiar position within the Neogene magmatic province of Romania. The magmatic rocks occur as dykes, laccolites or sills which penetrate Precambrian metamorphic rocks and Paleogene sedimentary deposits, defining two NW-SE



trending alignments parallel to the Transcarpathian Flysch Fault. The presence of enclaves is a obvious feature of many outcrops in which they range from sparse to abundant. They typically are up to 10 cm in diameter, subangular to angular and equant to tabular in shape. The homogeneous igneous enclaves (autolith) occur as glomeroporphyritic aggregates of hornblende (magnesian-hastingsite), plagioclase (42-52% An), garnet (50 to 55% almandine) or pyroxene (augite). The presence of characteristic "metaaluminous" phases (e.g. augite, hornblende) together with "peraluminous" ones (garnet) in both host rocks and homogeneous enclaves points to the derivation of the corundum-normative magmas of the first alignment from a diopside-normative parent (alignment II). Xenogenous igneous enclaves (xenoliths) are contrasting fragments of basalts, hornblende, pyroxenite, andesites or microdiorites modified to various degree by recrystallization. They are both inherited from earlier magmatic episodes and flow-induced by interrelated magmatic events. Metamorphic enclaves, characteristically peraluminous, represent fragments of crust rocks accidentally incorporated into the rising magma. They contain biotite, cordierite, sillimanite, andalusite, almandine and inherit typical foliated or granoblastic textures. At last, sedimentary enclaves, which normally show textural and mineralogical evidences of thermal metasomatism, have an expected calcic nature, containing andradite (94 to 97% Andr) and wollastonite in a coarse-grained calcite aggregate.

THE INFLUENCE OF THE MINERALOGICAL, CHEMICAL AND PHYSICAL CHARACTERISTICS ON THE POSSIBILITY OF BENEFICATION OF RED MUD FROM ORADEA AND TULCEA ALUMINA PLANTS

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Red mud is a solid residue obtained after the treatment of bauxites by the Bayer process. The red mud samples from the two Romanian plants represent a homogeneous red coloured material with an extremely fine granulometry. The chemical composition of the red mud samples is: $\text{Fe}_2\text{O}_3 = 30-50\%$; $\text{Al}_2\text{O}_3 = 18-21\%$; $\text{CaO} = 12-15\%$; $\text{SiO}_2 = 6-13\%$; $\text{TiO}_2 = 5-6\%$; $\text{Na}_2\text{O} = 4-6\%$; L.O.I. = 10-15%; several minor elements were determined: V, Ga, T.R., Be, Ni, Co, Cr, Mo, Zr, Hf, U, Th. Size distribution of red mud samples consists of 83-96 % minus 40 μm particles. The average specific gravity of both red mud samples is 3 to 3.15 g/cm^3 . Although the mineralogical compounds present a very different specific gravity (hematite 5.2, diasporite 3.4, calcite 2.6, complex Si-Al-Ca-Na compounds and Ca-Na titanates 1.9 to 2.2) due to their fine dimensions and associations, the separation possibility of minerals by hydrogravimetric methods are limited. Magnetic susceptibility of the raw material is 100 to 500.10⁻⁶ CGSEM and is caused mainly by the low content (0.5%) of magnetite

(ferromagnetic), the other iron minerals - hematite, goethite, ferrous diasporite - being paramagnetic (50 to 110.10⁻⁶ CGSEM). The associations between iron minerals, aluminium hydroxides, carbonates and complex Si-Al-Ca-Na or Ca-Na-Ti compounds and their extremely fine dimensions create many difficulties in the magnetic separation of the material.

Structural characteristics of the mineral compounds (crystalline, cryptocrystalline, amorphous states), their origin (undissolved mineralogical components of the bauxite, new phases formed during the treatment by the Bayer process) and extremely fine granulometry required the use of a complex methodology to determine the mineralogical composition and the structural relations between minerals. Complex analyses allowed the determination of the mineralogical composition as follows: iron oxides (hematite, martite, goethite, magnetite) 30 to 50 %, aluminium hydroxides (ferrous diasporite, diasporite, boehmite, gibbsite) 15 to 20 %, calcite 10 to 20 %, Ca-Na titanates 7 to 10 %, Al-Ca-Na hydrosilicates 20 to 30 %, other minerals (rutile, zircon, quartz, clay minerals, organic matter) 1 to 2 %.

The main chemical components (Fe_2O_3 , Al_2O_3 , TiO_2) are present in various phase minerals. Most of Fe_2O_3 is present as paramagnetic iron minerals - hematite, martite, goethite, ferrous diasporite; the only ferromagnetic mineral - magnetite (0.5%) - is quite insignificant. Al_2O_3 is partly structured as aluminium hydroxides and partly as complex components (Al-Na-Ca hydrosilicates). Most part of TiO_2 is present as Ca-Na titanates and only a little part is as isomorphous constituent in iron oxides and diasporite; rutile (less 1 %) is not economically important.

The complexity of the mineralogical composition, the presence of the main chemical components (Fe_2O_3 , Al_2O_3 , TiO_2) in several mineral phases, the extremely fine size of particles and the frequent intergrowths between the mineral constituents prevent the use of mechanical methods for beneficiation of red mud from Oradea and Tulcea alumina plants.

INFLUENCE OF OLD MINING WORKINGS ON THE HEAVY METAL CONCENTRATIONS IN RIVER AND SEA SEDIMENTS IN NORTH GERMANY

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The high ratio of mud deposition in the harbours of Bremen/Bremerhaven (Weser), Hamburg (Elbe) and Rotterdam (Rhine) and the high concentration of heavy metals in the muds is a topic of prime environmental importance. The sediments source is represented by the whole river basins areas.

The high deposition ratio is related to intense soil erosion due to the deforestation in the last 1200 years as well as to the tree defoliation as a result of acid rains. Using the data on the Weser river it is shown that the heavy metals association found in the



muds of the Bremen harbour is identical to that of the Harz mining district. The mining load of the Harz mining district could be followed in the river sediments down to the Deutsche Bucht (North Sea). Similar conditions appear in the case of the heavy metals sediments in the Hamburg harbour with the source area in the Erzgebirge via Elbe and in the Rotterdam harbours with the source area in the Rheinisches Schiefergebirge via Rhine. The very long duration (more than 1000 years) of such metal supplies makes their elimination difficult.

CRYSTALLOCHEMICAL FEATURE OF APATITES AND FELDSPARS AS INDICATORS OF GEOCHEMICAL PROCESSES

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Natural and synthetic apatites have been studied by means of X-ray powder diffraction, IR, Raman spectroscopy and thermal analysis.

Methods of synthesis of hydroxylapatite with different crystallinity degree were worked out. The variations of basic solution concentrations, temperatures and time of drying get an ability to determine the degree of crystallinity and the quality of the product in the dependence of these values. Synthetic hydroxylapatite has several modifications with different degree of crystallinity: well crystallised (at weak concentration of initial solutions), middle and poor crystallised (at concentrated ones). Our study revealed that apatites with different content of carbonate ions in structure are formed significantly in basic conditions ($\text{pH} > 9$), without CO_3^{2-} - in neutral solutions ($\text{pH} \sim 7-8$). This product was suggested to be used as bone-substitutional material. Positive informations have been received.

A knowledge of crystallochemical peculiarities of synthetic apatites was the clue to understanding the apatite formation mechanism in nature.

The paleontologically derived apatites of different geological ages by means of X-ray diffraction and molecular spectroscopy to estimate the possibility of using them for geological dating has been studied.

The natural apatites of different genesis were found to be fluorhydroxylapatites of fairly crystallinity, but they were different for various deposits. The carbonate hydroxylapatites show a poor crystallinity degree in modern samples, which has been enhanced in fossil ones. Crystallochemical properties of apatites depend on conditions of mineral formation. These conclusions are supported by X-ray diffractograms, IR and Raman spectra.

A large feldspars collection of different genesis has been also studied. The procedure of structural feature determination extended over a series of sanidine-adularia-microcline feldspars has been developed according to Raman spectra. A comparison between data obtained and the results of X-ray

diffraction and IR spectroscopy estimates showed that they were in a good agreement. Raman spectroscopy allowed us to study microquantity of mineral substance without its destroying. The relationship between visible light produced fluorescence and factors of mineral formation can be followed. Problems of Al/Si structural ordering, positioned distribution of alkaline cations in framework silicates finally defined their important genetical features which were determined by the mineral symmetry. The space group of sanidine by means of IR and Raman spectroscopy methods have been found out and some problems of space group refinement for feldspars and other minerals have been discussed.

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POLYTIPIISM OF MICAS: DISTRIBUTION, CHEMICAL-STRUCTURAL PECULIARITIES, GENETIC AND PRACTICAL SIGNIFICANCE

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Mica polytypism is a complex crystal-chemical phenomenon. On the one hand, the relationship between the polytypic modifications and crystallization conditions is obvious. On the other hand, the contribution of each particular factor is, in most the cases not clear for the formation of one or another polytype. An exhaustive theory regarding the polytypism is still lacking. Therefore the mica polytypism as an indicator of mineral formation must be used with care. The main aim of this paper is to reveal the evolution of the chemical-structural regularities of the polytypic modifications related to the rocks and ores crystallization conditions. Ukraine is a very suitable geological region to solve such problems because Ukrainian micas are represented by a great number of mineral types and varieties which formed within wide intervals of geological time, temperature and pressure.

The following micas polytypes have been identified in Precambrian and Phanerozoic geological formations of Ukraine: 1M, 1Md, 2M₁, 2M₂, 2O and 3T as well as the complicated nonhomogeneous 4M₃ polytype. The most widespread is the 1M polytype but its structural peculiarities have not been revealed. It is not clear why the 2M biotite occurs in granite of the Ukrainian shield. It is possible that they formed under non-standard conditions. Earlier micas in pegmatites were referred to as lepidomelane-1M and biotite-1M, later on as muscovite-2M or series as different polytypes of lithian micas. A series of lithian-iron micas is present in some chamber pegmatites: 1M→3T→1M.

In the metamorphic complexes there are two main suite series: muscovite-1Md→1M→2M₁ and biotite -1Md→1M→1M+2M₁. Muscovite-1M and celadonite-1M are present in hydrothermal



metasomatic formations where they accompany sometimes rare metal and gold ore formation. However, their crystallochemical and genetic nature is not quite clear.

It is difficult to explain the presence in some hydrothermal veins of the rare iron-bearing lepidolite, as 2O and 1M polytypes. The fibrous gumbelite from the Donbas coal fields represents a 2M₂ polytype and it has been studied in some details.

MEASURING FRACTAL DIMENSION- SPHALERITE EXOLUTION IN CHALCOPYRITE FROM THE TOROIAGA AREA

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There are several methods of measuring fractal dimensions and each one is useful in restricted cases. The box-counting method is one of the most popular one and is based on the covering the object with square boxes at different scales (Takayasu). It is like digitizing the image with digits progressive smaller. Finally a graph is obtained in which the number of "digits" which had "contact" with our image is plotted against the corresponding dimension of a digit edge. The axes of the graph must be logarithmic, and if the object measured was fractal then the points will approximate a line. The slope of the line is the fractal dimension (the tangent of the angle). The box counting method compared to another method which measure only the outline of the object will show that in that case (sphalerite exsolution) the last is unsuitable.

Sphalerite exsolution may adopt a fractal shape. When studied in 2D sections (polished sections) they cover a wide area of values (from 1.40 to 1.60). This will prove that the growth process is related to the local growth conditions (i.e. distribution and contiguity of the discontinuities in chalcopyrite), consequently their morphology cannot be used as a marker in a metallogenetical model. The random walk method (Mandelbrot, 1967) gave smaller values (1.19 to 1.40).

SULPHIDE MINERALIZATIONS OF LAK- ROSHI DEPOSIT-NORTH ALBANIA

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The Lak-Roshi sulphide ore deposits in North Albania are linked to J₂₋₄-volcanic rocks of spilite-keratophyre series. They form both veins of disseminated mineralizations related to hydrothermal-metasomatic activity and massive ores developed under volcano-sedimentary conditions.

The low-temperature mineralizing process resulted in several types of ores, i.e. (1) massive pyrite-chalcopyrite ores, forming conformable bodies in spilites (calcitized basalts-andesites); (2) veins and disseminated chalcopyrite-pyrite-sphalerite ores developed also in spilites (calcitized basalts-dacites),

and (3) disseminated chalcopyrite ores in keratophyres (dacites).

The hypogene vertical zoning is revealed both by the top-bottom distribution of Zn-rich and Cu-pyrite ores, respectively and by the presence of massive ores in the centre and of veins-disseminated ores at the periphery of the ore bodies. Some data have been also obtained as regards the distribution of different elements of element pairs such as Co-S, Cu-Ag, Zn-Cd and As-Sb. Typical features (mineral associations, minor elements, ore structures and textures etc) of each type of ores are presented too.

MINERALOGICAL CHARACTERIZATION OF THE GREEN CLAY FROM THE RONA LIMESTONE

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The mineralogical study focused on the green clay which surrounds the typical silica nodules ("septaria") of the Rona limestone. The diffractograms on oriented samples show a 2:1 type mineral, very similar with the 2:1 clay mineral in the carbonate rock. The low intensity of the (002) peak, the opening of the (001) peak, parameter BB_1 less than $4^0 2\theta$ and the expandability index (I_R) less than 1 suggest a ferriferous illite having a low crystallinity degree and expandability. On the same sample, the XRD study on powder mounts reveals a mixture of calcite, quartz and a clay mineral very similar to the glauconitic minerals, but in a very uncommon facies.

The XRF analyses reveal a maximum content of total Fe in the green clay sample. Compared with the bulk rock samples, the ratio is about 7:1 and with an Eocene granular glauconite from Luna de Sus, the ratio is 2.5:1.

The Mössbauer spectrum of the green clay is characterised by three doublets representing the octahedral Fe interactions: two for Fe³⁺ (cis and trans positions) and one for Fe²⁺ (in cis position). The Fe³⁺:Fe²⁺ ratio is of 4.5:1.

AN OPTICAL METHOD TO MEASURE THE ORIENTATION OF EUHEDRAL PYRITE AND MAGNETITE IN METAMORPHIC ORES

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Pyrite and magnetite play an essential role in the mineral assemblages of many metamorphic ore deposits. Pyrite is very abundant in the sulphide ore deposits from the East Carpathians and magnetite in the oxide ore deposits from the South Carpathians. It occurs mainly as euhedral crystals up to 1 cm in size.



In a previous work (Popescu, 1967), it was pointed out that the pyrite shows a tendency to be oriented with the ternary axes perpendicular to the ore schistosity. Subsequently, a similar behaviour of the magnetite in chlorite schists and banded iron ores was noticed (Popescu, 1971).

The tendency to be oriented with one of the ternary axes perpendicularly to the schistosity is a common feature of all forms of pyrite (cube, cube-octahedron, pyritohedron) occurring in all metamorphic sulphide deposits of the East Carpathians and Dobrogea. Magnetite occurs as well-developed octahedra, with one face to the schistosity plane of the host chlorite schists and of the banded iron ores.

Since the poles of the ternary axes of magnetite octahedra superpose over the poles of octahedron faces, their position in relation to the schistosity plane was measured by means of an improvised goniometer (an Universal stage lacking lenses fixed on an ore microscope). So it was possible to measure the angles between magnetite octahedron faces and the schistosity planes. Fragments of suitable size (3x4 cm) cut samples of chlorite schists with magnetite octahedra, as well as polished sections were thus investigated. The octahedron faces of cubical magnetite crystals of a sample have been brought in the field of the microscope. The results of the measurements were plotted into a Schmidt diagram where the centre was considered the schistosity pole. In the case of magnetite the ternary axis is centred around the pole of the schistosity plane. Measurements on pyrite crystals with a combination cube-octahedron showed a greater dispersion of ternary axes around the pole of the schistosity plane.

Starting from the fact that both pyrite and magnetite intimately associated with micaceous minerals that control the schistosity of the host-rocks and ores, the preferred orientation of the ore minerals was explained by assuming their epitaxial growth on "former" micaceous minerals, i.e. on biotite and muscovite (Popescu, 1971).

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TRACE ELEMENT BEHAVIOUR IN GRANITIC ROCKS FROM THE NORTHERN PART OF SEBEȘ MOUNTAINS

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In the northern part of the Sebeș Mts., some shear zone-related granitic bodies have been described. By their mineralogical composition they are granodiorites showing two structural types: porphyry type and equigranular type. The porphyry type are, by far, more widespread. The thick bodies point up a characteristic zoning: the core has equigranular structure and the porphyry character has a peripheral position. Some porphyry varieties, with the

groundmass showing 0.1-0.3 mm size would be considered as dacites, and other bodies with a groundmass coarser than 0.3 mm should be porphyry granodiorites. They appear as dyke sets cutting at a low angle the mineralised blastomylonites.

In order to get some data regarding the origin of these granitic rocks, ten analyses for REE, Nb, Ta, U, Th and other trace elements have been made by ICP-MS mean. The diagrams Hf/Zr, Rb/Zr, La/Th and Th/U show a good and normal correlation. The Cr and Ni contents are very low, being impossible to use them for correlation diagrams. The Nb/Zr, Rb/Zr, Rb/Y, Rb/Sr ratios are almost homogeneous showing perhaps a homogeneous protolith.

The normalised rock/primitive mantle, and rock/chondrites diagrams point out a normal behaviour for the magmas generated from a crustal protolith. The Eu/Eu* is less than 0.85 showing a depletion in Eu, and Gd/Yb_(n) values vary between 1 and 3.5 showing no depletion in HREE. In the Rb vs. (Yb+Ta), Rb vs. (Y+Nb) discrimination diagrams, the granitic rocks plot in the VAG field and on the Nb/Y diagram the VAG and syn-COLG field host the data.

The normal behaviour of HREE is broken by downgoing curve from Yb to Lu in the spidergram. Only two samples from altered granitoids show an upgoing tendency for the normalised Yb to Lu values.

The mineralogical composition, the structure of the granitic rocks, the behaviour of REE and other trace elements suggest the crustal nature of the protolith, its homogeneity and an anatectic process for magma generation.

ZOUBEKITE, (AgPb₃Sb₄S₁₀), FROM CIOCLOVINA SHEAR-ZONE MINERALIZATION, ROMANIA

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In this paper we report the first occurrence of zoubekite, AgPb₃Sb₄S₁₀, in Romania, at Cioclovina in the western part of the Sebeș Mts. Zoubekite occurs with ullmannite, proustite, pyrargyrite, an unidentified Ag-Sb phase, galena, and chalcopyrite. These minerals are paragenetically equivalent and are part of a late mineralising event in a pyrite-arsenopyrite-base metal shear-zone.

Zoubekite forms irregular lath-shape grains, 1-3 μm long, usually as inclusions in ullmannite, proustite or pyrargyrite. Optical properties are consistent with those described by Megarskaya et al. (1986) for the zoubekite from Příbram. Average electron microprobe analysis of zoubekite from Cioclovina in Table 1 are comparable to that from Příbram (Megarskaya et al., 1986). The calculated formula of zoubekite from Cioclovina (based on S=10):

(Ag_{1.02}Cu_{0.01})_{Σ=1.03}(Pb_{3.95}Fe_{0.01})_{Σ=3.96}(Sb_{3.99}As_{0.04})_{Σ=4.03} S_{10.00} is close to ideal formula AgPb₃Sb₄S₁₀. Reflectance



measurements have not been carried out as zoubekite grains are too small at Cioclovina.

Table 1. Electron microprobe analyses of zoubekite (wt.%)

Locality	Ag	Pb	Sb	As	Cu	Fe	Zn	S	Total
Cioclovina	6.37	47.00	27.90	0.18	0.02	0.01	0.00	18.43	99.89
Pribram	5.75	46.30	27.39	-	0.27	0.02	0.35	18.30	98.38

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Megarskaya L., Rykl D., Táborský Z. (1986): Zoubekite, $AgPb_4Sb_4S_{16}$, a new mineral from Pribram, Czechoslovakia. *N.Jb. Miner. Mh.* III, 1-7.

THE RELATIONSHIPS BETWEEN THE ACTIVITY OF ELEMENTS FROM HYDROTHERMAL SOLUTIONS AND THEIR PRESENCE AS MINOR ELEMENTS IN THE RESULTING SULPHIDES

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The status of a "minor" element is not only related to its bulk content in a given ore, but also to the presence and type of the associated sulphide minerals. Appropriate substitutions cannot always be fulfilled due also to PT restrictions and a minor element, commonly found in a mineral, may form proper minerals. For example, the As-poor pyrite does usually exist in ores lacking arsenopyrite, but sometimes the pyrite can be As-rich, without having arsenopyrite in its near vicinity. The As:S ratio is also of high importance in deciding if As-rich pyrite or an association pyrite-arsenopyrite will form. In many studied ores there are numerous elements exhibiting a double status, either being minor, i.e., isomorphically included in an appropriate mineral or forming proper minerals. Beside the absolute content or activity of an element the ratios of the accompanying anions are of utmost importance as regards its status.

GEO THERMOMETRY OF METAPELITIC ROCKS FROM THE WESTERN PART OF THE PRELUCA CRYSTALLINE MASSIF, MARAMUREŞ

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The Preluca Massif, situated about 30km south of Baia Mare, is an island of Upper Precambrian crystalline rocks within Upper Cretaceous-Sarmatian sediments. In the extreme western part of the massif, the Upper Terrigene Formation (Balintoni, 1982) is represented by a series of rocks in which micaschists are dominant. These are characterised by the paragenesis garnet-staurolite-biotite-muscovite-quartz. Kyanite and chloritoid appear sporadically and together with retrograde development of chlorite define the rocks mineralogically.

Microprobe analyses of garnet, staurolite, biotite, muscovite and chlorite within micaschists from the Grajdului Valley were carried out. The results, including profiles across zoned garnets, confirm the idea that the paragenesis in these micaschists was formed as a result of prograde regional metamorphism, and that this paragenesis is overprinted by reactions taking place under retrograde conditions.

Using the compositions of silicate phases, it was possible to carry out a number of geothermometric calculations. Garnet-biotite and garnet-staurolite pairs gave temperature estimates between 520 and 530 °C, which are interpreted to approximate the conditions of peak metamorphism. Using the garnet-chlorite geothermometer, a temperature of 480 ± 13 °C was obtained, which suggest that chlorite was formed after biotite. A pressure estimate of 5 kbar was used in these calculations. Running the data on the computer program THERMOCALC 1.1 (Powell and Holland, 1988), values of 600 ± 65 °C were obtained for the peak metamorphic assemblage and 520-525 °C for the retrograde assemblage, assuming pressures of 6 kbar both cases. The difference between temperature estimates are explained as a result of different calibrations applied, but are not considered to be statistically significant in view of the relatively large errors associated with geothermometric techniques. These estimates are consistent with the stability fields of the component minerals and correspond to the staurolite zone of the amphibolite facies. No evidence of metamorphism at higher grades was recognised. The erratic occurrence of kyanite and chloritoid in only a minority of the studied samples is attributed to the limitations upon their crystallisation presented by bulk rock chemistry. Ongoing research is aimed at determining paragenetic relationships and metamorphic conditions within similar rocks from elsewhere in the Preluca Massif.

MICROSPHERULES OF UNIDENTIFIED ORIGIN IN THE MIDDLE TRIASSIC OF THE MECSEK MOUNTAINS, SE-TRANS-DANUBIA, HUNGARY

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During the very detailed study of the Triassic formations of the Mecsek Mountains SEM investigations were carried out on the samples of some outcrops with rocks of Middle Triassic age (Anisian-Ladinian) which are mostly carbonatic, at some levels more dolomitic and/or more argillaceous.

A characteristic horizon of the Lower Anisian is the Vöröshegy dolomite, which contains remnants of patch-reef-like biogenic structures. Originally these were determined as corals. In the samples taken from their outer crust as well as from the crust of the oncoids of the oncoid- and trigonodus-bearing samples of the topmost Ladinian, the electron microscope revealed the presence of tiny spherules, that could not



be attributed to any of organic remnants (e.g. algae, nanofossils, spores or pollens).

Listening to lectures on spherules, I started wondering whether those tiny enigmatic spherules might be of similar origin.

If we accept the working hypothesis that the spherules are micrometeorites, or they have been generated by disintegration of bigger meteorites during their crossing the atmosphere, we have to accept the idea that they may be present in any formation of the Earth's history. The microspherules, independently of their origin - identical with that of the spherules, or entering the atmosphere as cosmic dust - must be even more largely distributed, since they keep floating in the air for a long time and become dispersed rather evenly. At the same time, microspherules can not be detected with the methods standardly used for the study of spherules. Namely they get readily washed out during preparation, and even if they are left, they would not be observed under the binocular microscope. Consequently, they can be detected only by means of more special investigations. It is no wonder that they have been found exactly in these samples, since living organisms used to agglutinate such tiny grains, using them for constructing their structures ("biological trapping"). Furthermore, the sedimentation rate was low enough for their relative enrichment.

MAGNETIC SIGNATURES OF THE MINERALOGICAL CHANGES IN BAKED CLAYS OVER BURNT LIGNITE SEAMS

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Magnetic anomalies (up to 1900 nT) have been detected in some heat-affected areas related to natural spontaneous burning of lignite seams (e.g., in Jił and Lupoaia quarries) in the Western Dacic Basin (Romania). This magnetic signature is associated with important changes in the mineralogy of the clays, resulting in the enhancement of the magnetic properties of the rocks during the post-depositional thermal perturbation. These baked sediments which produce important magnetic anomalies consist of hardened red clays and sands with brick-like appearance (porcelanite); sometimes they show a slaggy or vitreous texture with marked vesicularity and dark colour (clinker). Clay mineral assemblages and non-clay minerals have been determined with X-ray diffraction (XRD) and in thin sections for the original rocks (not affected by heating) sampled above and below the coal bed, and equally within the coal seams (clay interbeds). The heat-affected rocks show modified or even newly-formed mineral assemblages [e.g., hematite, cristobalite, tridymite, mullite, spinel, cordierite and magnetite(?)], which can be correlated with the increasing temperature, in the successive stages from slight baking to more or less

39 total fusion, towards the burnt coal seams. The X-ray diffractograms performed on "fresh" clays (not affected by heating) and also on porcelanites and clinkers have revealed specific mineral assemblages (Rădan et al., 1994). Consequently, the magnetic signature of clay - due to the magnetic susceptibility (MS) of component minerals - has changed from the original clays ($65 \cdot 10^{-6}$ - $755 \cdot 10^{-6}$ Slu.) to the porcelanite-like clays, porcelanites and clinkers ($300 \cdot 10^{-6}$ - $161000 \cdot 10^{-6}$ Slu.). On the other hand, the mineral changes induced in the clays by heating during the natural burning of coal beds can be used as a geothermometer to control the remanent magnetization transformation in these rocks. So, the porcelanite and clinker forming temperature reached at least 1100-1200°C, exceeding the Curie point of the "ferromagnetic" minerals (s.l.). Another magnetic signature - the remanent magnetization (RM) - printed in rocks while they are forming, has been modified together with mineralogical changes controlled by the temperature variations of the natural baking process of the clays. The original clays acquiring a detrital remanent magnetization (DRM) have shown very low and low values of the total RM intensity (0.01-30 mA/m). Instead, the porcelanite-like clays, porcelanites and clinkers, which have acquired during cooling a thermoremanent magnetization (TRM) and/or thermochemical remanent magnetization (TCRM), have pointed out high and very high values of the total remanence intensity (150-7980 mA/m).

Similar data concerning the mineralogical evolution during heating processes have been obtained using specimens under palaeomagnetic lab investigation. Stepwise thermal demagnetization has been applied to study the magnetic stability. RM and MS measurements have been performed after each temperature step (20°, 30°, 50° and/or 100°C) up to 700°C. A mineralogical monitoring has been applied for some specimens, so that XRD analyses have been carried out on pilot samples palaeomagnetically investigated. The palaeomagnetic signature recorded by the Pliocene clays and the newly-formed porcelanites is another interesting approach (Rădan et al., 1992). New results are finally commented.

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CONTRIBUTIONS TO CLAY MINERALOGY AND GENESIS OF SOME ROMANIAN BENTONITES: VALEA CIIHOARULUI, RĂZOARE AND ORAȘU NOU DEPOSITS

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The most important bentonite deposits in Romania are connected with the effusive products of the Neogene Carpathian magmatism, and subordinately with some older volcanic rocks. Their origin consist mainly of the alteration of volcanic ash in situ. This study is focused on



some peculiar bentonites, originated at expense of 40 rhyodacitic dykes, plagioplite veins or lava flows, under the control of hydrothermal solutions. It is the case of Valea Chioarului, Răzoare and Orașu Nou deposits.

The Valea Chioarului bentonites consist of a hydrothermally altered rhyodacite dyke, crossing Senonian and Ypresian-Lutetian sedimentary deposits, between the Țicău and Preluca crystalline massifs. XRD data point out a Na-montmorillonite, characterised by a (001) reflection at about 12.5 Å, associated accidentally with few percents of illite and/or kaolinite in the < 2µm fraction, and with important amounts of cristobalite, with subsidiary quartz and feldspars in the bulk samples. The DTA show a Na-montmorillonite of intermediate type (between Cheto and Wyoming), as main component of Valea Chioarului bentonites. TEM provided some interesting images specific to the smectites: irregular but isometric particles of various sizes, partially folded and with rolled edges. Cristobalite appears as aggregates of small translucent grains, and some lath shaped particles may be attributed to a zeolite mineral. SEM points out the gradual devitrification of the groundmass and the neoformation of smectite minerals. The hydrothermally transformed rocks show irregular shapes and the alteration degree is increasing from depth to the surface and towards the peripheral zones of the rhyodacitic body, suggesting a supergene intervention over the hydrothermal background.

The bentonite deposits of Răzoare were generated by hydrothermal alteration of some plagioplite and pegmatite veins encompassed in the crystalline limestones and dolomites of the Rebra crystalline Group of Preluca Massif. XRD, IR and DTA point out Ca-montmorillonite of intermediate type as dominant mineral, associated with subordinate amounts of quartz, sometimes cristobalite, feldspars and also, minor percentages of kaolinite, illite and/or chlorite. TEM analysis show the characteristic isometric and irregular shapes with weak outlines or rolled edges of the smectite, sometimes associated with large particles of chlorite and lath-shaped mica-montmorillonite minerals. Typical star-shaped twins of goethite and tabular zeolite particles may be observed, as well. The hydrothermal origin of Răzoare bentonites was proved by some previous authors, but the specific note of these deposits is the peculiar composition of the parent rocks - a feldspar-rich aplite and/or pegmatite and not a volcanic vitreous material.

The Orașu Nou bentonite deposits occur as large lenses and lens-beds of argillized perlites pertaining to the first eruption phase volcanics (Badenian) of Oaș Neogene volcanic zone. Clay mineralogy, as showed by XRD, IR and DTA data, is dominated by Ca-montmorillonite of Wyoming and/or intermediate type, associated accidentally with illite and/or kaolinite. Non-clay minerals are represented mainly by cristobalite and subordinately by quartz. TEM show besides the common images of folded particles with rolled edges, some peculiar details, consisting in numerous tiny crystals, sometimes suggesting rhomboedric shapes, distributed among the smectite sheets, or even "grafted" on these montmorillonite particles. The "parasites" show sometimes fan-like disposals and are represented by zeolite minerals (chabazite). The evolution of the vitreous matter towards smectite is well pointed out by the SEM. As regards the genesis of Orașu Nou bentonites, the parent

rock composition, the shape of the bentonitized bodies and the shape of the argillized area suggest a transformation process controlled by deuteric alteration phenomena, with some possible hydrothermal influences.

ZIRCON IN SOME MAGMATIC ROCKS FROM THE APUSENI MOUNTAINS (ROMANIA): SOME PETROGENETIC CONSIDERATIONS

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The paper deals with the morphologic and optical investigation of zircons from some magmatic rocks ascribed to four important moments of magmatic evolution in the Apuseni Mountains area: Mesozoic ophiolites, Eocretacic magmatites, banatitic rocks and Neogene volcanites.

Zircon populations characteristic for each magmatic unit present similar morphologic and optical properties, probably determined by a similar magma, which evolved under different physical conditions, in successive stages.

An frequency increase of crystal zircon types from the ophiolitic rocks to the Neogene volcanic ones is obvious, but some characteristic variations of every magmatic unit can be identified.

Morphologic and optical data on the zircon crystals from all considered magmatic entities emphasize a deep magma evolution in different geological settings and at different crust levels, being affected by complex geological processes (assimilation, mixing), that determined a large variety of petrographical types and some chemical variations.

CHEMICAL AND STRUCTURAL CONSIDERATIONS OF Ca-AMPHIBOLE AND BIOTITE FROM THE NORTERN PART OF THE DITRĂU ALKALINE MASSIF (ROMANIA)

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The amphibole occurs as a substituting mineral phase, which bears characteristics of a Mg-hastingsite.

The biotite was observed as (1) individual mineral phase, (2) a substituting mineral for amphibole, (3) a mineral phase substituted by chlorite, associated with: (a) Ca-amphibole, (b) chlorite, (c) feldspar. It shows some characteristics induced by the chemical content of the metasomatic system.

There are two distinct biotite types: (1) a Mg- and Ti-rich biotite, associated with the ultramafic rocks from the northern part of the Ditrău alkaline massif and the essexites rocks and (2) an Al- and Mg-poor biotite associated with syenitic rocks.

Both described mineral phases represent two successive phases of the metasomatic processes, which affected the whole Ditrău alkaline massif.



INDEX MINERALS FOR LOW TEMPERATURE SUBGREENSCHIST FACIES METAMORPHISM IN MESOZOIC FORMATIONS OF COVER NAPPE OF THE SOUTH CARPATHIANS

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Index minerals for the alpine metamorphism of the Mesozoic deposits in the Central South Carpathians have been identified in cover nappes from Mehedinți - South Vâlcan Mountains. Pumpellyite and prehnite are widespread in metabasalts of the Obârșia and Severin nappes and in Upper Cretaceous volcanoclastic turbidites associated to mélange formations and terrigenous turbidites of the Coșuștea nappe. Index minerals indicate a low temperature, subgreenschist facies metamorphism for the Mesozoic deposits formed as underthrust units during tectonic accretion at an active plate margin.

Pumpellyite shows highly variable optical properties, mostly in volcanoclastic sandstones. Mineral chemistry studied by electron microprobe suggests that local chemical conditions and composition of precursor minerals strongly control pumpellyite chemistry.

The presence of index minerals in several Mesozoic formations of the cover nappes in the South Carpathians strongly suggests that low temperature metamorphism is subduction related; it is also possible that oceanic crust basalts might have been subjected to an earlier ocean floor metamorphism in prehnite-pumpellyite facies, as suggested by geochronological evidence.

OCCURRENCE OF RHÖNITE IN BASANITES FROM POIANA RUSCĂ MOUNTAINS

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In a small intrusive basanitic body at Cerbâl (Poiana Ruscă Mts.), rhönite was recognised after petrographic and electron microprobe investigation. The host rock consists of olivine, clinopyroxene and rhönite phenocrysts and microphenocrysts in a microcrystalline pyroxene, olivine, nepheline, biotite, rhönite and alkali feldspar groundmass. Clinopyroxene, olivine and orthopyroxene xenocrysts and clinopyroxene megacrysts have been also found. Moreover, the Cerbâl basanite contains ultramafic xenoliths with undeformed to scarcely deformed textures.

Rhönite crystals are hemihedral, sometimes twinned after (110). Rarely, individual crystals or crystal clots are corroded and surrounded by a secondary pyroxene rim. A rhönite crystal was found included in a large clinopyroxene.

Electron microprobe analyses of several rhönite crystals carried out at the Dept. Earth Sciences of Florence, present the following average chemical composition:

SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MnO	Cr ₂ O ₃	MgO	Na ₂ O	Tot.
24.48	10.02	17.57	22.91	0.13	0.09	11.52	1.11	99.95

The chemical formula calculated on the basis of 6 tetrahedral cations is: Na_{0.2857}Ca_{1.7241}Mg_{2.2798}Fe²⁺_{1.3372}Mn_{0.0146}Fe³⁺_{1.2065}Ti_{0.0005}[Ti(Al_{0.9165}Si_{1.0635}O₆)₃]O₂

Previously, Codarcea et al. (1958) in Mo-Cu monazite-bearing veins related to the Ditrău Massif alkali-syenites mentioned the occurrence of rhönite only by optical determinations and it was never confirmed by further studies (e.g. Constantinescu et al., 1983). It can be assumed that the mineral investigated by Codarcea et al. (1958) was allanite, misinterpreted as rhönite. Thus, it is likely that rhönite from Poiana Ruscă can be regarded as the first occurrence in Romania.

PETROCHEMICAL CHARACTERISTICS OF THE HĂGHIMAȘ GRANITOIDS: THEIR GENESIS (EAST CARPATHIANS, ROMANIA)

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The NNW-SSE trending granitoids situated in the Rarău-Hăghimaș Nappe crop out along 30 km, between the Livezi-Bălan-Lacu Roșu localities.

The granitoids are represented by gabbrodiorites, tonalite-diorites, granites and granodiorites, with frequently oriented structures and pierce the crystalline schists of the Bretila Series, which is regionally metamorphosed in the almandine amphibolite facies during the Precambrian.

The cross-cutting of the various granitoid types suggest the emplacement of the magmas through successive pulsations during a long time span.

Taking into consideration the parameters proposed by Chappell and White (1974), Hine et al. (1978), Pitcher (1982, 1987), Batchelor and Bowden (1985), White and Chappell (1977, 1983), Lamèyre and Bowden (1983), the Hăghimaș Granitoids formed in two distinct stages and have two magmatic sources: one in the upper mantle and/or oceanic crust (the I-type: igneous), and another in the sialic crust (the S-type: sedimentary).

The gabbrodiorites and the tonalite-diorites were generated under ocean/continent subduction conditions from magmas originating in the mantle and/or the oceanic crust, and belong to the I-Andine type (R₁-R₂ diagram, Batchelor and Bowden, 1985).

The granites and granodiorites were formed to a great extent through the fusion of the sialic crust (Q-A-P diagram, Lamèyre and Bowden 1982), the magmas being generated as a result of the collision of the continental plates; therefore they are of the S-Hercynian type.

The granites and granodiorites have, however, some parameters in common with the gabbrodiorites



and tonalite-diorites, characteristic of the I-type, namely: $\text{Na}_2\text{O} > \text{K}_2\text{O}$; Mol. $\text{Al}_2\text{O}_3 / \text{Na}_2\text{O} + \text{K}_2\text{O} + \text{CaO} < 1.1$; $\text{Fe}^3 / (\text{Fe}^3 + \text{Fe}^2) > 0.2$. These features are interpreted as influences of some quantity of melting originating in the mantle on the anatectic sialic magmas.

PETROCHEMICAL CHARACTERIZATION OF THE SYENITES FROM BANAT (ROMANIA). THE REE AND TRACE ELEMENTS: TECTOGENETIC AND PETROGENETIC CONSEQUENCES.

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Several Jurassic - ante-Oligocene syenitic bodies cross the crystalline-granitic basement of Precambrian-Cambrian age. Syenites show a concentric texture: the central part consists of nepheline syenites, and the peripheral one is formed of alkaline syenites.

The rocks exhibit peralkaline-peraluminous and subaluminous characters.

The REE contents are relatively low: they range between 94.5 - 151.7 ppm for the nepheline syenites, the values increasing up to 290.5 ppm for the alkaline syenites. The Eu anomaly is positive for most of the nepheline syenites and absent for the alkaline syenites (chondrite-normalized REE diagram). This indicates that the nepheline syenites are "cumulates", while the peripheral alkaline syenites underwent the influence of the continental crust.

The Nb/Ta (= 9.5 - 21.7) and Y/Nb (= 0.1 - 0.3) ratios suggest that the rocks originate from the mantle. The Nb-Y and Ta-Yb diagrams on the one hand, and the 10,000xGa/Al - (Nb, Zr, partly Ce, Zr) diagrams on the other, prove the A-type anorogenic character of the syenites from Banat.

Syenites formed through the partial melting of the peridotitic mantle under distensional conditions induced by the reactivation of some old faults and shearing zones of the continental crust.

PETROCHEMICAL AND TECTONIC SIGNIFICANCE OF SOME REE AND OF SOME TRACE ELEMENTS WITHIN THE GRANITOIDS FROM BANAT (ROMANIA).

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The REE contents (46.10 - 100.5 ppm) and the LREE/ HREE ratios (18.0 - 77.5) of the granitoids from Banat are low. The Eu anomaly is absent, except two out of twenty-four analysed samples. These data agree with the hypothesis of the partial melting of the crust as magmatic source.

The Ogradena, Cherbezeu and Sfârdir Granitoids (Domain Basement) likely formed

through the anatexis of some biotite plagioclase gneisses (metagreywackes). The Sicheviţa Granitoid (Getic Basement) probably formed through the partial fusion of some eclogitic sources, connected with sources from metagreywackes. The two negative Eu anomalies suggest that feldspar fractionation was, however, involved in the granitoid genesis.

The analysis of the trace elements also illustrates the involvement of the mantle or/and oceanic crust in the granitoid genesis (the Zr/Hf, Nb/Ta, Y/Nb ratios, the SiO_2 - Sr, Zn, Ba, Ga, Y diagram, the Ce/Yb (cn) - Ce ppm diagram), but the dominant role was played by the continental crust. The granitoids formed by collision, in late or post-kinematic orogenic conditions (Nb - Y, Ta - Yb, Rb - (Y + Nb), Rb/10 - Hf - Ta x 3; Rb/30 - Hf - Ta x 3 diagrams)

MINERALOGY OF RODINGITES FROM PARÂNG MTS., SOUTH CARPATHIANS

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Rodingites (Marschall in Bell et al., 1911) are defined as metasomatic transformed inclusions in serpentinised ultramafics, characterised by a specific calcic composition. This type of rocks were described in Parâng Mts. already in 1900 by Murgoci, under the name of "Granat und Vesuvianfels" being considered contact metasomatic rocks formed on xenoliths engulfed in ascending ultramafic magma.

Rodingitic rocks appear in Parâng Mts. as rounded or ellipsoidal inclusions in serpentinites (centimetric to metric in size), as well as reaction zones between serpentinites and neighbouring prasinitic rocks belonging to a metamorphosed ophiolitic melange of uncertain (Paleozoic-Mesozoic?) age. The rodingitised rocks could be assigned to gabbros and basalts fragments due to well preserved magmatic structures.

The mineralogical constitution of rodingites is very clearly zoned, comprising a core made up of relic magmatic minerals (pyroxenes, feldspars, titanite, magnetite) partially or completely replaced by vesuvianite, garnets, diopside, prehnite, chlorite and minor epidote and zoisite, and an outer blackwall zone dominated by pennine, magnetite and minor antigorite. Small fissures and cracks are filled with sometimes idiomorph diopside, vesuvianite, garnets and talc, as well as with massive granular pumpellyite.

The chemical composition of garnet (hydrogrossular) and vesuvianite is presented as result of 8 microprobe analyses, which show a slight excess of Ca for both minerals.



CHLORITOID GENERATION ALONG CRUSTAL SHEAR ZONES: A CASE STUDY FROM CENTRAL DOBROGEA

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In the "Green Schist Series" of Central Dobrogea the solitary occurrence of chloritoid in the vicinity of Altân Tepe has been mentioned for the first time more than half a century ago. However, a petrologic treatment of this occurrence has not been undertaken yet. It was only suggested that chloritoid might be linked to a specific lithostratigraphic level within the "Green Schist Series".

After a review on chloritoid formation in regional metamorphic rocks, the petrographical and chemical characteristics of the chloritoid-bearing rocks from Central Dobrogea are presented and compared to those of the surrounding "green schists". Petrological as well as structural considerations lead to the conclusion that chloritoid is not linked to a chemically distinct protholith within the stratigraphic pile. Instead, the generation of chloritoid is due to a complex interplay of mechanical, chemical and hydrologic processes that took place during metamorphic differentiation along zones of crustal shearing.

THE TYPES OF METAMORPHISM: A TENTATIVE APPROACH TO A NEW CLASSIFICATION

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A comprehensive classification of metamorphism is presented that takes into account new insights revealed by extensive petrologic research carried out during the last decades. Special emphasis is laid on the importance of strain rate during what is herein called kinematic metamorphism, as opposed to static metamorphism. Anyhow, there is really no sharp boundary between these main two types, the link between the static burial metamorphism and the dynamo-thermal orogenic metamorphism being the pre-orogenic metamorphism. This new concept implies isolation as regards time of formation, strain rate, and structural characteristics of an important category of rocks within the large group generally considered to have undergone dynamo-thermal metamorphism on a regional scale. Pre-orogenic metamorphism starts early in the development of an orogenic zone and its products are characterised by the presence of passive folds, a general coincidence of subhorizontal bedding and schistosity, and stretching lineations parallel to the trend of the orogen. Rocks generated during orogenic metamorphism are much more diversified and give evidence of mostly disharmonic deformations at considerably higher strain rates. Both types of metamorphism are consistent with the evolutionary model of crustal shearing above subhorizontal mantle currents, being at variance with subduction-related orogenic models.

43 GEOCHEMICAL STUDY OF MUSCOVITES FROM CRIȘENI-MUNTELE RECE PEGMATITES, APUSENI MOUNTAINS

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The studied muscovites associates with quartz in filling veins crossing tourmaline crystals.

The abundance of silica in these muscovites, range between 44.70 and 48.03 wt% and the amount of alumina is relatively high (32.14-35.27 wt%). The presence of Fe, Mg, Mn is the result of Al substitution in octahedral sites ($Al^{VI}:Fe^{2+} + Fe^{3+}$); the $Al^{VI}:Mg$ diagrams show a negative correlation between $Al^{VI}:Fe^{2+} + Fe^{3+}$ and Mg. Electron microprobe analyses show low contents of Mn (0.00-0.11 wt% MnO) and the $Fe^{2+}:Mn$ diagram suggest the substitution of Fe^{2+} by Mn; Fe^{3+} resulted from the calculation of atomic proportion. The Na abundance correlates with experimental data, showing that the limit of paragonite solubility in muscovite is 24 mol% Na_2O .

The correlation Fe:Ti is slightly positive, while the correlation Na:K is negative. At the same time, there is a negative correlation between Al^{VI} and Ti, and a high positive one between Al^{VI} and Al^{IV} .

In the pegmatites from Crișeni-Muntele Rece a large participation of "muscovite" is obvious; on the contrary, the amount of "ferri-muscovite", "picrophengite" and "ferro-phengite" is low. This composition and the ratio Si^4/Al^{3+} in tetrahedral sites ($a_{Si} = 20.03-23.42$) are characteristic features of muscovites from pegmatites. The crystallochemical formulas show the double position of aluminium (Al^{VI} , Al^{IV}) and a large participation of alkalis in the X sites (1.81-1.92), too. However, there is a cation deficiency in these sites; it reveals a good correlation with Al in excess in the Y sites and correspond to a typical case of alkali-deficient substitution. Projecting Al^{VI} and Al^{IV} values in Cerny's diagram (1982) one can be seen that pegmatites from this field belongs to muscovite pegmatite class.

Using the phase diagram in subsolidus field for the muscovite-paragonite system, it may be noticed that the muscovites from Crișeni-Muntele Rece crystallised in the temperature range of 340-380°C. These values are comparable to the values of 280-580°C, characteristic to muscovites from a large number of granitic pegmatites in the world.

METAMORPHIC BASEMENT OF GREAT HUNGARIAN PLAIN LOCATED BETWEEN DEBRECEN AND KÖRÖS, HUNGARY

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The metamorphic basement of the Debrecen-Körös region represents the northern sector of the Hungarian Autochthone, part of the Tisia-realm. The structure and lithology of this area is known by about 100 deep drillings which were deepened until the pre-Mesozoic



basement. Here two lithostratigraphic units appear: the Körös Mezometamorphic Complex (with Komádi, Sashalom, Endröd, Derecske, Ebes and Szeghalom subunits) covered by Álmosd Greenschist Formation.

The Körös formation is built up by muscovite-biotite mica-schists, quartzites and gneisses and by amphibolitic rocks (Szeghalom subunit). By the geochemical study, the igneous (and pyroclastic) origin of these rocks (basalts, andesites), the tholeiitic nature of the original magma (linked to opening of an internal post-arc basin) was demonstrated. The metamorphism has begun by an initial blue-schist facies (high pressure and low temperature), followed by a Barrowian-type metamorphism reaching 600°C and 5 Kb.

In the core of the anticlines, a complete metasomatic section appears beginning to untouched schists, which pass through schists with orthoclase porphyroblasts and schists with leucocratic injections to migmatites-diadysites-granites (Endröd Granite).

The Álmosd Formation represent a rest of a larger cover, which was metamorphosed during a new thermotectonic cycle.

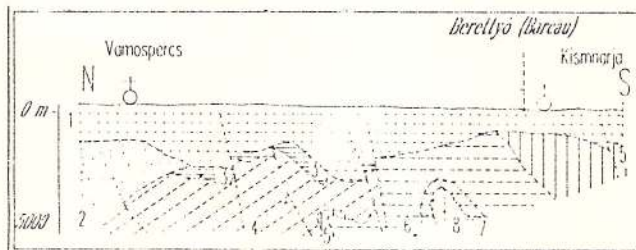
According to regional correlations, and to the K-Ar and Rb-Sr radiochronology, in the basement of Great Hungarian Plain, including also Debrecen-Körös area, two thermotectonic events were detected, 200-250 Ma and 350-450 Ma which correspond to Variscan and Caledonian orogene.

By the Alpine orogenesis, entraining the crystalline basement and the Permo-Mesozoic sedimentary deposits, the old (Variscan?) folds were reworked and regenerated, resulting a scale-type structure.

About the relationship between the metamorphic basement and the Szolnok-Maramureş Flysch belt, it is probable that in the south-eastern border of the Flysch Belt, the Upper-Cretaceous and Paleogene deposits cover transgressively the basement and the main tectonic line of the Flysch zone (the western end of the Dragoş Vodă Fault?) is situated near the axis of the flysch zone.

The Cenozoic fragmentation by faults resulted in the actual "horst and graben" structures of the basement which was buried by Neogene (Badenian, Sarmatian and Pannonian) sedimentary deposits.

According to the lithology and the metamorphic history, the basement of Debrecen-Körös region can be correlated with Romanian metamorphic formations from Preluca, Țicău, Bâc and Rez Mts. However, there are non-significant differences caused by the local condition of the sedimentation of the protoliths and the metamorphic changes.



Geologic section between Vámospercs and Romanian-Hungarian state border. Legends: 1. Neogene, 2. Paleogene Flysch. Metamorphic basement: 3. Álmosd Formation, Körös (Cris) Complex; 4. Ebes Mica-schist Unit, 5. Derecske Gneiss Unit, 6. Sashalom Migmatite Unit, 7. K-metasomatic zone, 8. Endröd Granite Unit.

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Scanning proton microprobe (PIXE) as a complementary technique to electron probe microanalysis (SEM-EDAX) has been used for measuring elemental composition of spherules occurring in Upper Pannonian and Quaternary sediments [1], [2], [3], [4].

By the continuous cores of borehole Nagylózs-1 (1325.2 m) Miocene, Pliocene and Quaternary sediments were uncovered in the western part of Little Hungarian Plain, NW Hungary.

In the Upper Pannonian layers accumulated continuously under moderate circumstances, tiny sphere and drop-like, filament shape objects were found. These are amber to light brown smooth glassy objects of 300-1600 µm decorated with accicular vesicular or grains of crystal (chillcrystals), and contain microbubbles of gas. On the basis of their normative composition, they are Ca-rich ortho-silicate glasses bearing some accessories (Fe, Mn, Ti, Ba, K, Na, S, Ni, Nb, Zr, Sc, P, Cl).

The micro-bodies are supposed to be of extraterrestrial origin (Lunar impactite or Ca-rich micrometeorite?).

Magnetic spherules collected from the alluvial plain of Danube River in Hungary are very various in their morphology, chemical composition and their surface structure and texture. It is obvious that the natural enrichment of these materials derived from the surrounding area of this fluvial basin.

On the basis of the researches three main genetic types were distinguished:

- meteoric dust spherules and spheroids,
- impactite-globules,
- spheres of uncleared origin (igneous-metamorphic).

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PRELIMINARY DATA FOR A (Au,Ag)TeO₂ PHASE FROM SĂCĂRÂMB GOLD-TELLURIDE DEPOSIT; A NEW MINERAL SPECIES OR A MIXTURE?

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Gold-silver tellurides usually decompose in weathering zone to tellurite (TeO₂) + native gold. An intermediate weathering product (Au,Ag)TeO₂ has been found in an old ore specimen (Giușca collection - University of Bucharest) from the Săcărâmb gold-telluride deposit, Romania. This phase occurs at 5-20 μm long lamellae, along the cracks in calaverite (AuTe₂) or as irregular grains in petzite (Ag₂AuTe₂) and probably represents an early weathering product of calaverite and petzite. Microscopic examination indicates that it has a low reflectance that increases with wavelength from 18.00(R₁)-19.90%(R₂) (400nm) to 28.90(R₁)-40.20%(R₂) (700nm). The reflectance measurements and quantitative color determinations are consistent with the visual impression of a "mineral" with relatively strong bireflection and color pleochroism from yellowish-brown (perpendicular to elongation) to bluish-brown (parallel to elongation). Under crossed nicols it is strongly anisotropic from bright-yellow to bright-red sometimes with bluish tints. Electron microprobe analysis indicates a phase formula (Au,Ag)_{0.89}Te_{0.98}O₂ (based on O = 2), apparently close to (Au,Ag)TeO₂ (Table 1).

Table 1: Electron microprobe analyses of (Au,Ag)TeO₂

Element	Au	Ag	Te	O	Total
wt%	47.61	3.49	38.39	9.87	99.36

Although back scattered electron (BSE) imaging indicates that this phase is homogeneous, a very fine grained and relatively "homogeneous" mixture of tellurite and native gold can not be ruled out. Further X-ray diffraction and scanning transmission electron microscopy (STEM) work will hopefully solve this question.

PGMs IN S. KEMPIRSAI MASSIF, KAZAKHISTAN

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The Kempirsai massif located in the southern Urals (Kazakhstan), is a typically ophiolitic sequence that contains lens-shaped chromite ore bodies hosted by serpentinized harzburgites. Platinum-group mineral (PGM) inclusions in chromites from the Kempirsai massif have been divided in two groups on the basis of textural criteria. The first group consists of PGM inclusions mainly in undeformed chromites, and the second has PGMs located in highly fractured chromite

45 as trails or serpentine veinlets. In the first group monomineralic euhedral inclusions of laurite, or composite inclusions of laurite, erlichmanite, a (Ir,Os,Ru)(Ni,Cu,Fe) sulfide and iridosmine are the most frequent assemblages. Anhedral inclusions range from monomineralic to an assemblage of three PGMs and a silicate. The common PGMs present include laurite, erlichmanite, iridosmine, osmiridium, kashinite, rutheniridosmine, a (Ir,Os,Ru)(Ni,Cu,Fe) sulfide and a (Ir,Rh,Os)(Ni,Cu,Fe) sulfide.

Textural features and mineralogical composition of PGM inclusions in "group one" favoured simple entrapment of crystallized PGMs such as euhedral laurites, or deposition of PGMs from trapped molten droplets during chromite crystallization (anhedral inclusions). In "Group two", the mineral association include the (Ir,Os,Ru)(Ni,Cu,Fe) sulfide, covellite and serpentine, as trails, or erlichmanite, a (Ir,Rh,Os) (Fe,Ni,Cu) sulfarsenide, an As-bearing (Ir,Os,Rh) (Cu,Co,Fe,Ni) sulfide, irarsite and heazlewoodite in serpentine veins. The textural features and chemical composition of PGMs from the "Group two" suggest a reconcentration of PGE probably concomitant with As introduction during serpentinization by hydrothermal fluids.

GOLD MINERALOGY IN THE SĂCĂRÂMB GOLD-TELLURIDE DEPOSIT, ROMANIA

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Three modes of gold occurrence have been recognized in the Săcărâmb gold-telluride deposit: primary gold, "mustard gold" and a curious phase named "brown gold". Distribution of these gold types in the Săcărâmb ore is controlled by their genesis. The primary gold is 860 to 870 fine and occurs as irregular grains closely associated with altaite, petzite, tellurantimony and nagyagite in the Longin veins. This assemblage replaces or mantles the earlier calaverite, krennerite and sylvanite, suggesting a decrease of tellurium fugacity (fTe) with time, during the later stages of ore deposition at Săcărâmb. A log fTe less than -8 is required to cross the calaverite-gold phase boundary and to stabilize native gold at the 300°C formational temperatures suggested by fluid inclusion data.

"Mustard gold" occurs finely disseminated, or as dendrites in tellurite (TeO₂) and is produced by oxidation of gold-silver tellurides in the weathering zone. There is no evidence in the samples examined of "mustard gold" mobility in the weathering zone. The constant fineness (887-888), reflectance and quantitative color of "mustard gold" do not permit determination of the original gold-silver mineral (i.e. calaverite or petzite).

"Brown gold" occurs along cleavages and rims of gold-silver tellurides, or as fillings in molds produced by calcite weathering. This gold was deposited deeper in the weathering zone, probably due to gold mobilization during intense weathering. The



constant fineness (862-863) and anomalously low reflectance (~28% at 546 nm), makes this gold a curiosity. The reason for the low reflectance in a sample with such a high fineness, is still unclear.

PERRIERITE-CHEVKINITE FROM TURCOAIA ALKALI-GRANITES, DOBROGEA (ROMANIA)

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In this paper we describe the first occurrence of perrierite-chevkinite in Romania, in the Turcoaia alkaline massif, Dobrogea. The Turcoaia alkaline massif consisting of syenites, alkali-granites and alkali-rhyolites occurs in the Alpine Măcin Unit in the Northern Dobrogean terranes. Pegmatites containing feldspar, quartz, biotite and amphibole are quite frequent in the alkali-granites. Zircon, magnetite, ilmenite, titanite, xenotime, allanite and perrierite-chevkinite are the main accessory minerals. In the alkali-granites of Turcoaia massif, the perrierite-chevkinite is closely associated with allanite, Fe-Ti oxides and amphiboles. Rims of amphiboles around the perrierite-chevkinite have frequently been encountered. The perrierite-chevkinite has an irregular or lammelar shape up to 500 μm , with pleochroism from dark-brown to black. Sometimes it is almost opaque revealing the presence of Ti in structure. Electron microprobe analyses of perrierite-chevkinite from Turcoaia alkaline massif show higher values for some REE ($\text{Pr}_2\text{O}_3=2.92-3.34$; $\text{Nd}_2\text{O}_3=7.07-7.34$; $\text{Gd}_2\text{O}_3=2.31-2.42$ in wt%) than perrierite-chevkinite from other occurrences. The mineralogical relationships and chemical composition of perrierite-chevkinite from Turcoaia alkaline massif support a crystallisation from evolved alkali-magma enriched in La, Ce, Pr, Nd, Gd (and possibly Fe^{3+}) and depleted in Al, Ca, Ti, Sm and Y.

MINERAL COMPOSITION AND BLOATING EFFECT OF CLAYSHALE FROM MEZICA Pb-Zn ORE DEPOSIT (SLOVENIA)

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Large amounts of clayshale can be found near the lead and zinc layers in the Mezica ore deposit.

Chemical, mineralogical and grain size investigations have been done on the representative samples in order to proof if clayshale can be used as a raw material for making expanding clay aggregate. The sampling of the clayshale layers on a total interval of about 87 m included both the soft and the compact type of clays.

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The paper summarises the influence of clayshale mineral composition (Tóth, 1982) on the degree of expansion - measured as the expansion coefficient - K (defined after Knigina, 1977) and bulk density after heating (up to 1120°C). Samples have been heated in laboratory electric furnace. Mineral composition of 19 representative samples has been determined by the X-ray diffraction and thermal analysis.

Almost equal quantities of illite and chlorite have been found in all investigated samples. These are the most common minerals, therefore the name illite-chlorite clayshale can be used. Calcite has been determined quantitatively by measuring the loss of mass - on the TG curve - because of decarbonatization at the temperature interval of $743^\circ-801^\circ\text{C}$. Its amount is about 3 mass.% and it does not differ much from sample to sample. Dolomite, pyrite and microcline have been formed only as traces in some few samples. Sometimes the plagioclases substitute the microcline. The content of quartz has been determined by the X-ray diffraction analysis. The decrease of the quartz content produce an increase of the expansion coefficient from 3.8 up to 5.8 and a decrease of the bulk density from 0.6 up to 0.4 g/cm^3 . It has been stated as well that the soft type of clayshale expands more difficult than the compact one. The soft type of clayshale has begun to bloat at 1050°C ; at 1120°C an average expansion coefficient (K) of 4.6 and an average bulk density of 0.5 g/cm^3 have been measured. The compact type has begun to bloat at 1020°C ; at 1120°C an average expansion coefficient (K) of 5.4 and bulk density of 0.4 g/cm^3 have been determined.

Mixed samples of soft and compact clayshale have been pressed and heated at 1120°C after grinding and homogenisation.

These results are in perfect coincidence with Rosenberger's (1969) and Hill-Crook's (Rosenberger, 1969) predictions on the significance of free quartz content on the expansion effect. The stated dependency is the only factor proved to influence the bloating in the investigated clayshale samples.

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ORE MINERALS OF THE Mn-Fe RĂZOARE DEPOSIT

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The regionally metamorphosed Mn-Fe deposit at Răzoare contains prevailing silicates (about 60 %), carbonates (about 30 %) and only about 10 percent oxide and sulfide minerals. Although subordinately developed the ore minerals show interesting



relationships to the associated minerals. Magnetite is by far the most frequent ore mineral and it occurs mainly as fine lenses or beds within the fayalite (-dannemorite) assemblages, sometimes closely associated with pyrrhotite. In addition to the primary magnetite there occurs also a secondary magnetite formed by decomposition of pyrrhotite. A further form of generation is represented by magnetite resulted by decomposition of the manganoan fayalite. The primary magnetite is quite pure, several wet-chemical analyses giving 62.4-66.7 % Fe_2O_3 , 23.6-24.5 % FeO and only 1.2-1.5 % MnO and 0.1-0.2 % MgO.

The jacobite is typically associated with tephroite and manganese humites, forming either subhedral grains or fine bands. The composition is quite constant, i.e. 59.6-60.9 % Fe_2O_3 , 28.9-31.1 % MnO and only 1.5-2.0 % FeO and 0.5-0.8 % MgO.

The minor elements show no significant contents in magnetite, whereas in the jacobite some relative enrichments occur, i.e., Mo is fairly constant (about 17 ppm; not present in magnetite), the Ni and Co are higher than in the magnetite as is the Zr contents (up to 500 ppm) as compared to the magnetite (30-140 ppm).

Several fine grains reminiscent of pyrophanite and iwakiite (?) have been identified too but they need further investigations.

The sulphides are more frequently met in the upper, dannemorite rich part of the ore sequence (pyrrhotite) or as secondary mineral on late fractures (pyrite). The most significant geochemical differences are the Ni and Co contents, of about 180-150 ppm to 340-300 ppm (pyrrhotite) and 11-13 ppm to 15-17 ppm (pyrite), respectively. The pyrrhotite contains also higher Cu contents (350-800 ppm) as compared to pyrite (mostly nil). Accidental values of Sn (30-38 ppm), Bi (36-40 ppm) and Ag (1-5 ppm) have been found in both sulphides.

Some further interesting yet unsolved features of the Răzoare ores are: the presence of rounded graphite aggregates showing sectorial zoning and resembling thus the pseudomorphs after diamond; fine to very fine inclusions, especially in sulphides but also in magnetite, of highly reflecting and intensely anisotropic minerals, which might belong to the group of Ni-Co arsenides and/or antimonides. Their study is now in progress.

Among the secondary minerals the presence of pyrolusite is worth of mention: it occurs in small geodes as needle-like radiating crystals, together with limpid quartz and barite crystals. The geodes are hosted by variegated Mn-Fe soft ochres.

The main oxide minerals obey thus the Mn:Fe ratio within the ore sequence (higher and lower in the lower and upper parts, respectively), which controls also the apparition of two contrasting silicate assemblages (Udubaşa et al., 1995, in press).

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ARSENOPYRITE COMPOSITION, MICROINCLUSIONS, AND PARAGENESSES, COSTEŞTI GOLD OCCURRENCE, CĂPĂŢÂNA MTS.

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In the metamorphic rocks of the South Carpathians, Romania, there are several gold-bearing, arsenopyrite-rich ore occurrences that were assigned to the shear-zone related type (Udubaşa, 1993). The gold is mainly associated with arsenopyrite and pyrite, sometimes occurring also as free gold in quartz. All the known occurrences have in common Au and As, the third element appearing as a function of the protolith nature. The differences are as follows: Au-As-Bi (Costeşti), Au-As-Cu (Valea lui Stan), Au-As-Sb (Văliug) and Au-As-Pb (Jidoştiţa).

The Costeşti occurrence consists of concordant lenses or discordant veins composed of quartz and carbonates. The host rocks are biotite blastomylonites (Hârtoşanu et al., 1992, unpubl.). The ore minerals form nests or short lenses within dominant quartz and/or carbonate (calcite, ankerite) aggregates. Arsenopyrite, pyrite are the main ore minerals, to which microscopic components may be added: pyrrhotite, galena, chalcopryite, native bismuth, native gold, bismuthinite, greenockite, sphalerite, jamesonite as well as several poorly identified mineral phases.

The arsenopyrite composition is fairly constant although the mineral appears fractured, shows recrystallization features and has varying grain size. The overall variation interval of As ranges between 32.8 and 34.6 at. %. Nickel has a limited distribution and its content is quite low, i.e., of 0.030-0.060 at. %. Cobalt is absent. By using the diagram of Kretschmar and Scott (1976) the temperature deduced is of about 500-570°C (uncorrected for pressure). Around the gold inclusions (15-25 wt. % Ag) there are both gold content and arsenic content (i.e. temperature) variations within arsenopyrite grains. Near the gold inclusion the "invisible" gold content is of about 0.1 wt. % and gradually decreases down to 0.05 wt. % at several micrometer far from it. At the opposite margin of the arsenopyrite grain no detectable gold was found. The As/T⁰C variations suggest a cryptozoning and/or a temperature gradient, from about 570°C near the gold inclusion to about 500°C in the gold-free portion. The Au/As correlation is slightly negative as is also the As/S one. Although the BSE images suggest differences among the arsenopyrite subgrains they do not have compositional differences. Such a feature might be related to variations in the sulfur isotope composition.

The inclusions in arsenopyrite are numerous and chemically complex. Besides Au or (Au, Ag) there are very fine inclusions of Bi, bismuthinite (with some lead), a phase crudely corresponding to the formula (Bi, Pb)₃S₂ as well as other BiCuAg containing sulphosalts. Around the altered arsenopyrite grains a schreibersite-like phase (with Ni dominant) was also



detected. Fine veinlets of greenockite occur within arsenopyrite too.

In the carbonate-rich veins or lenses a phase reminiscent of pyrrhotite occurs, lacking Co and Ni, but constantly showing calcium contents of 0.1-0.75 wt. %. The Ca content seems to be independent of the position of measuring points and thickness of the pyrrhotite laths. This phase might be a new variety of iron monosulfide. Within same samples very small grains of a Cr-rich phase ("merumite"-like) have been detected, showing Cr contents of 42.4-47.8 wt. % Cr.

In spite of its apparent simplicity the Costești occurrence shows some unexpected mineralogical features such as the calcium content of pyrrhotite, the presence of a schreibersite-like phase and a "merumite"-like phase, the presence of greenockite (first occurrence in such types of ores) and of the (Bi, Pb)₃S₂ phase etc. Some data regarding gold diffusion in arsenopyrite, subtle variations in the arsenopyrite composition, the negative correlation Au/As and As/S etc add to the peculiarities of this ore type.

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PREHNITE IN AMPHIBOLITES OF THE CUMPĂNA GROUP, FĂGĂRAŞ MTS.

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The presence of prehnite was recently observed within a garnet amphibolite sample from the Bolovanu metamafic body, Cumpăna Group. It occurs as lenticular and bulbous grains within biotite. For the biotite-prehnite association, Bucher and Frey (1994) show that most specialists conclude that the biotite cleavage simply forms a suitable structural site for prehnite crystallizing from a fluid; but prehnite actually replacing its biotite host has also been observed by Tulloch (1979). This second hypothesis seems to match our finding. The electron microprobe analysis of the Cumpăna prehnite is shown in the table, in comparison with an amphibolite-related prehnite analysis from Deer et al. (1963):

Oxides (wt%)	SiO ₂	Al ₂ O ₃	MgO	CaO	FeO	MnO	K ₂ O	Na ₂ O
Cumpăna prehnite	43.60	24.10	0.16	26.50	0.51	-	-	tr.
Deer et al., 1963	42.76	24.83	0.07	26.84	1.12	0.05	0.18	0.03

The presence of prehnite argues for a retrograde evolution of the rocks down to at least around 3 kbar and 270°C (maximum stability conditions for prehnite in the NCMASH system, Bucher & Frey, 1994). These observations match and support the retrograde path deduced by thermobarometric estimations on rocks from Cumpăna Group (Udubaşa et al., 1994)

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NOTE ON THE PRESENCE OF BARIUM-RICH MUSCOVITE IN MYLONITES OF THE RĂŞINARI ZONE, SOUTHERN CARPATHIANS

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A Ba-rich muscovite was recently found in a mylonite sample from the Răşinari area, Southern Carpathians. The rocks belong to the Sibişel Subgroup (Hann & Balintoni, 1988) or to the Făgăraş Group (Iancu & Mărunţiu, 1994). The muscovite seems to be optically normal. However, the investigation by the electron microprobe shows a strong zoning of the muscovite lamellae, with significant Ba enrichment in the rim. The mineral is associated with quartz, albite and epidote.

This is the first occurrence of a Ba-rich muscovite in Romania. The composition shows Ba contents ranging between 0.19-0.52 wt. % (core) and 4.4-4.6 wt. % BaO (rim). As compared to the literature data, e.g. "oellacherite" (9.89 wt. % BaO, Deer et al., 1963), the muscovite from Răşinari contains a maximum value of 4.6 wt. % BaO.

The few microprobe analyses suggest the possibility of complex substitutions between Ba, K, Si, Al. This fact is in agreement with the coupled substitution proposed by Wendlandt (1977) for Baphlogopite: $Ba^{2+} + Al^{3+} <-> K^{+} + Si^{4+}$.

The uncommon enrichment in Ba can be assigned to synmetamorphic remobilisation as a result of strong deformation along a shear zone that gave rise to the Sibişel Subgroup, seemingly a blastomylonite belt bearing features of a polymetamorphic overprint.

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NEOGENE MAGMATITES FROM THE RODNA BĂRGĂU MOUNTAINS (EAST CARPATHIANS): SOME PETROGRAPHICAL AND PETROCHEMICAL PECULIARITIES

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In the Rodna-Bărgău segment of the Neogene volcanic chain, the distinctive tectono-structural



setting confers to the magmatites some peculiarities such as their exclusively subvolcanic nature, the occurrence of rocks with transitional character between the plutonic and volcanic domains, the preponderance of the ferro-magnesian silicates and the presence of igneous garnets (almandine). Based on the major and trace element (including REE) geochemistry (ca. 77 samples analyzed) our study suggests that although there is a great variety of rocks (from basaltic andesites to rhyolites), reflected also by the large range of SiO_2 content (47.8 to 74.9 %), the different magmatic structures of equivalent petrographic type are arranged into two main NW-SE alignments. The variation of the geochemical parameters allows to distinguish at least two events in the evolution of the magmas. One generated a suite of medium to low-K calc-alkaline magmas. These magmas produced the more acid rocks of the south-western alignment which tend to evolve toward tonalites, and are characterized by low K_2O (0.92 - 2.67%), Rb (30 - 60 ppm), Sr (220 - 360 ppm), ΣREE (46.15 ppm), and by a $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of 0.702 - 0.704. The other one corresponds to the generation of high-K calc-alkaline magmas that produced the intermediate rocks of monzonitic trend from the north-eastern alignment, which are sensibly enriched in K_2O (1.84 - 3.24 %), Rb (70 - 120 ppm), Sr (340 - 580 ppm), and ΣREE (89.5 ppm), showing also higher $^{87}\text{Sr}/^{86}\text{Sr}$ ratios (0.705 - 0.708).

DISTRIBUTION OF ZEOLITES IN ALBANIA

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Many zeolite minerals have been found within effusive rocks of mainly intermediate-acid composition in North Albania. Complex investigations carried out by P. Kati, Zh. Cili and M. Shallo led to the identification of the following species: stilbite (desmine), laumontite, epistilbite, partly hydrated laumontite (leonhardite), heulandite. The zeolites are of hydrothermal and/or hydrothermal-metasomatic origin within the spilite-keratophyre suite (Qafe-Bari, Munelle, Spac, Pakice). Small zeolite concentrations have been found in the plagiogranites (Tuc area) together with quartz and sulphur. Small occurrences of zeolites in diabases and gabbro in the Derven and Kcive areas are also known.

The most important concentration of zeolites (mostly heulandite) is that in the Qafe-Bari-Munella region within hyalokeratophyres and spilites. The zeolitic rocks of brown colour form a horizon 4-5 m thick which could be followed on several km. They contain relics of quartz-albite and albite-quartz spherulites similar to those found in keratophyres proving thus their metasomatic origin.

49 A PETROLOGICAL MODEL OF THE CRUST IN THE TRANSYLVANIAN BASIN DERIVED FROM PHYSICAL PROPERTIES

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The theme of the present study starts from the inadequacies of the past interpretations from both geophysicists and geologists, which can be attributed to the attempt to isolate thermal and petrologic parameters of the rocks from each other as uncoupled independent variables.

The procedure applied was as follows: firstly a given rock type was analysed by its mineralogical constitution and chemical composition in order to numerically characterise the mineral assemblage by its cationic packing index; then by laboratory measurements on thermophysical parameters (heat conductivity, heat capacity, radiogenic heat generation, density, porosity, elastic parameters etc) the systematic interrelations have been statistically established. Finally, the values obtained have been assigned to a certain geological cross-section for computer modelling.

The described procedure was applied on rock samples collected from 51 locations in the Transylvanian region area and a set of approximately 200 observations has been statistically processed. The selection of the rock samples has been based on two criteria: (1) the rocks should be representative for the constitution of the uppermost part of the lithosphere in the Transylvanian Basin and (2) they should offer the possibility to investigate a variety of petrographic types ranging from the acid rocks to the basic ones.

From the first point of view, the crystalline formations of Proterozoic and Paleozoic age deserved consideration. Some magmatic rocks (Paleozoic granites, Paleogene granodiorites, Neogene andesites and Jurassic ophiolites) have also been analysed. The number of analysed samples corresponds roughly to the relative surface abundance (in %) of the respective petrographic type.

TELLURIUM MINERALS IN ORE VEJNALINSK DEPOSIT (LESSER CAUCASUS MOUNTAINS)

VELIZADE S.F., SHIRALIEV A.B., EFENDIYEVA E.N., NAGIYEV N.F., Institute of Geology Academy of Sciences, Baku, Azerbaijan Republic

The main minerals of Vejnalsk ore deposit are pyrite, chalcopyrite, galena, quartz, calcite, with subordinate amounts of native gold, sphalerite, magnetite, hematite, pyrrhotite. Accidentally, cubanite, altaite, native silver and tellurium and aragonite were also found. A well developed alteration zone contains goethite, hidrogoethite, covellite, bornite, chalcocite, malachite, azurite, anglesite, cerusite. Tellurides of Au, Ag and Bi are here for the



first time mentioned, i.e. calaverite, Te-bearing bismuthinite, volynskite, tetradymite, petzite and hessite, to which the native gold is closely associated. The mineralizing process has proved to be multistage and resulted mainly in filling the cracks and open spaces in the host rocks that underwent also strong metasomatic processes.

MINERAL PARAGENESIS IN COMPLEX SULPHIDE ORES OF THE SOUTHERN SLOPE OF THE GREAT CAUCASUS

VELIZADE, S.F., SHIRALIYEV, A.B., EFENDIYEVA E. Institute of the Academy of Sciences of Azerbaijan.

The sulfide ores have formed during prolonged mineralizing processes and exhibit thus a multistage character. Several generations of minerals have been depicted by using complex investigation criteria, including detailed texture studies, geochemical analyses, etc. The main minerals are pyrite, pyrrhotite, sphalerite, galena, chalcopyrite and quartz. They show different associations as function of the time-related mineralizing stages. The most frequent assemblages are: pyrite I, arsenopyrite-pyrite, fahlore-chalcopyrite-galena-sphalerite, carbonate-chalcopyrite-galena-sphalerite, sulphantimonides, galena-sphalerite-chalcopyrite-pyrrhotite, chalcopyrite-quartz, siderite-pyrite. Such a detailed analysis of the ores allowed to allot genetical significance to each assemblage and to recognize a polygenetic character of the mineralizing processes.

ROLE OF CLAY MINERALS IN ENVIRONMENT PROBLEMS

VENIALE E., Department of Earth Sciences, University of Pavia, Laboratory of Clay Research.

The environment is a new frontier which has only been partially explored, also as regarding methods of analysis. These must be reconciled by interdisciplinary approaches in order to achieve knowledge and wisdom.

The problems dealing with the environment impact may have various objectives: air and water pollution, soil contamination and urban-industrial-nuclear wastes, land reclamation and new settlements, surface and underground facilities, man-made reservoirs and dams, exploitation of mineral resources and quarry-mine restoration, by-products and their re-use, harnessing of oil-gas and water reserves, subsidence, etc. These many aspects are involving different branches of fundamental and applied research, such as environmental and engineering geology, soil mechanics, hydrogeology, agriculture, human health, etc.

"Argillology" is certainly a specialized branch of investigation in these fields. Soils and clay sediments cover more than 80% of the earth's surface. Recent experiences have clearly indicated that control

and modification of clay component properties may give more precise information toward better understanding and for solving environmental problems fairly well defined.

Due to their common availability and peculiar properties (fineness, high surface area, reactivity and polarity) natural and modified clay minerals are materials potentially involved in many processes and mechanisms (sorption-release dispersion-flocculation, swelling-shrinking spatial architecture of solid particles and interstitial pore size-shape, etc) which are leading the physico-chemical behaviour of soils, fluid flow, air-water suspended particulate, etc, thus, playing an important role in environmental research. Certain clays represent an environmental danger (geochemical concentration of poisonous elements, landslides, stone decay, etc), but others can also be positively used (clay "engineering").

Amount and type of clay minerals, ill-crystallized or amorphous coating on solid particles, associated organic matter and/or other cementing precipitates are facets of a complex fact: clays are not identical, even with similar mineralogical and chemical composition. Simplified models and the avoidance of seemingly minor factors might lead to erroneous conclusions and dreadful consequences in seeking effective remediation technologies. A better understanding of surface assisted chemical reactions is urgently needed for a more thorough assessment and prediction of the behaviours of chemicals in natural systems: the study of long-term behaviour of clays is not an option, but a necessity. Interactions in clay-electrolyte aqueous solutions, clay-heavy metals-organic substance complexes, surface and ground water pollution, soil and waste management, radionuclides colloids transport and diffusion, soil instability and consolidation-stabilisation treatments, are fundamental topics to help clarify the meaning of "environmental argillology" and its importance in determining remedial measures to be applied for the conservation and improvement of environmental quality.

Argillology should be a key component right from the beginning of most studies dealing with management of the environment, and clay specialists should be called on to participate in the decision taken. An underevaluation of the consequences of inadequate attention to perspective problems is also the most immediate cause of the present difficulties in dealing with public opinion regarding the real or presumed danger of man's encroachment of the environment. Ignoring it can result only in a "fight against wind mills".

Several case-histories of part and current events occurred in Italy which had also world-wide repercussions, will be presented:

- 1) subsoil of the "leaning" tower of Pisa and stabilisation intervention of the system soil-tower;
- 2) subsidence in the Po delta and the consequent danger of Venice flooding;
- 3) landslides in Apennines areas, and the catastrophic and tragic Vajont dam landslide occurred in 1963;
- 4) water pollution in rivers and along the coastal shelves of Italy.



CRYSTAL STRUCTURE OF SYNTHETIC ZIPPEITE

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Zippeite is a basic potassium uranyl sulphate, easily formed in nature. It occurs as yellow earthy efflorescences so that single crystal studies are impossible.

Synthetic crystals of zippeite were obtained in a pressure bomb at 150°C and a corresponding pressure of ± 25 atm. by the reaction of UO_2SO_4 at pH 3.6 in the presence of an excess of KCl.

The well formed crystals, ranging from 0.1 up to 0.2 mm are best suited for single crystal studies.

From chemical analysis and crystallographic data the formula $\text{K}(\text{UO}_2)_2(\text{SO}_4)(\text{OH})_3 \cdot \text{H}_2\text{O}$ is proposed.

Furthermore, the synthetic material is characterized by its infrared-luminescence spectrum and its solubility product.

The synthetic zippeite is biaxial negative with $\alpha = 1.625 \pm 0.001$; $\beta = 1.710 \pm 0.002$; $\gamma = 1.740 \pm 0.002$; $2V \sim 59^\circ$.

The lattice parameters are:

space group $C2/c$

$a = 8.7554 (30) \text{ \AA}$; $b = 13.9866 (70) \text{ \AA}$

$c = 17.7298 (67) \text{ \AA}$; $\beta = 104.127 (34)^\circ$

$Z = 8$; $\rho = 4.7 \text{ g/cm}^{-3}$

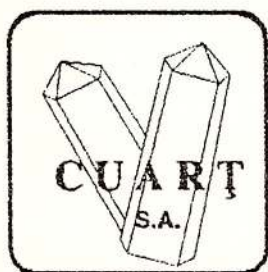
The structure consists of very condensed uranyl-sulphate layers, between which potassium ions and water molecules are present.

The structure will be proposed and discussed.



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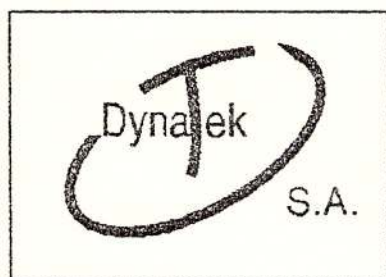
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