Metallogeny of the Făgăraş Mountains (South Carpathians, Romania): an overview with focus on the gold-bearing rocks

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This study evaluates the relationship between the metamorphic and mineralization processes in the Făgăraş Mountains (South Carpathians, Romania). Recent emphasized gold-bearing areas are discussed in this work. We present the preliminary data on the gold contents in different rocks and minerals, in relation with their geologic and tectonic setting.

The Făgăraş Crystalline, representing the crystalline basement of the Făgăraş Mountains, is the eastern sector of the Getic Crystalline, the only one affected by Alpine low grade metamorphism (M_3). There is a lithologic contrast, with genetic connotation, between the lower (gneissic) and the upper (mostly micaceous) structural levels and the Pre-Alpine metamorphic history with two medium grade events of regional metamorphism, M_1 (Cadomian) and M_2 (Variscan). Within Făgăraş Crystalline, the upper structural level corresponds to the Făgăraş Series, comprised of two formations, Şerbota (micaceous and phaneroblastic) and Suru (quartz-micaceous and microblastic, plus interlayered amphibolites closely associated with carbonate rocks). The lower structural level corresponds to the Cumpăna Series, also comprised of two formations, Cumpăna (augen gneisses) and Topolog (mica gneisses with lenses of amphibolites closely associated with quartzo-feldspathic gneisses).

On the basis of the published data and our observations, the mineralizations from Făgăraş Mountains could be classified as follows: A. premetamorphic regionally metamorphosed (A.I. Pb-Zn stratiform mineralization within carbonate-dominated rocks; A.II. Ni-Cu-Co mineralization associated with bodies of metabasic and metaultrabasic rocks); B. Alpine or Alpine remobilization in metamorphic domains (B.I. pollymetalic mineralization: Pb-Zn-Cu, Pb-Zn ± Au, Ag; B.II. mineralization of Fe-Ti oxides, graphite ± sulfides and Au); C. associated to post-metamorphic (post-M_3) tectonic planes (C.I. sulphide ± Au mineralization associated to major faults from Făgăraş Mountains).

Concerning the gold concentrations, we analysed representative samples from: 1) both levels of Făgăraş Crystalline; 2) hydrothermalized tectonic breccias from major tectonic nodes (e.g., Perişani, Nucşoara); 3) quartz segregations from Cozia-Lotru and Sebeşul de Jos-Nucşoara major faults; 4) basalt dyke from a NW-SE strike fracture.

The analyses show gold presence (as “invisible gold”) within rocks and minerals belonging to the Făgăraş Series: up to 3.12 ppm Au in quartz segregations within the mylonitic rocks of the Suru Formation and up to 0.98 ppm Au in quartz segregations within the micaceous rocks of the Şerbota Formation. The concentration of the gold is higher (5.46 ppm) in graphitic mylonites occurring on the Suru Nappe overthrust plane. According to the above classification, the mineralization associated with these mylonites is of type B.II (related to a shear zone). Unmineralized amphibolitic and carbonatic rocks exibit very low contents of gold. The basalt dyke contains 0.005 ppm Au. Gold concentrations in rocks belonging to the Cumpăna Series are lower than of rocks from the Făgăraş Series. However, some of the orthoamphibolites (+ sulfides) lenses from Topolog Formation have significant gold values. The highest gold contents were found in hydrothermalized tectonic breccias generated at the intersection between the Palaeogene longitudinal faults and Miocene – Quaternary transversal faults. The mineralization associated with these breccias is of type C.I. (see above) and consists of pyrite ± galena, sphalerite, marcasite, etc. Thus, on the Curmatura Oticului Fault, the Cernat Valley sector, a sample of hydrothermalized breccia contains 4.47 ppm Au. The matrix of the breccia consists of chlorite, sericite, clay minerals and fine disseminated pyrite; the composition of the clasts is dominated by quartz. On the Cozia-Lotru Fault, in a hydrothermalized breccia from the Perişani tectonic node, a content of 29.97 ppm Au was determined in the sulphide mineralization (predominantly pyrite and marcasite) and 0.98 ppm Au in the adjacent chloritic zone.

Further research is necessary to understand the relationship between the gold-bearing mineralizations and their settings.

Age and evolution of the Wetterstein Carbonate Platform in SW Serbia (Zlatibor Mountain)

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Triassic shallow- and deep-water carbonates occur together with Triassic radiolarites widespread as olistoliths and slides in the Middle to early Late Jurassic mélange of the Dinaridic Ophiolite Belt in the Zlatibor Mountain. These slides occur tectonically on top of the Drina-Ivanjica Palaeozoic and the late Middle to early Late Jurassic ophiolitic mélange respectively the ophiolites and not below as interpreted before. These slides were interpreted to derive from the Drina-Ivanjica Unit, where they should have formed the original sedimentary cover, disintegrated in the Late Jurassic. According to our investigations the slides of this carbonate-clastic mélange differ in age, facies and palaeogeographic origin. The carbonate rocks are originated from a relatively broad shelf in the Triassic facing the Neotethys Ocean to the east, maybe also from the adjacent Drina-Ivanjica Unit and from further east. In contrast, the Triassic radiolarites and the ophiolitic rocks, which occur mostly below the carbonatic mélange, derive from the Neotethys Ocean basin floor. These mixtures of different rocks forming mélanges are part of the Dinaridic Ophiolite Belt.

The key for the reconstruction of the Jurassic history of mélange formation is the knowledge of the palaeogeographic derivation of the different slides in the Triassic passive continental margin arrangement facing the Neotethys Ocean further to the east. Especially for the Late Triassic the facies zones arrangement (Hauptdolomit [Dolomia Principale]/Dachstein Carbonate Platform and equivalents to the hemipelagic Hallstatt Facies belt facing the Neotethys Ocean) is proven from the Austroalpine/Western Carpathian domain to the Albanides.

A kilometre-sized block in the Zlatibor carbonate mélange provides a complete succession of the Wetterstein Carbonate Platform (WCP) evolution, dated by means of conodonts. The complete section of the WCP evolution starts in the Klisura Quarry with bedded cherty limestones on top of a bentonite layer, which forms a thrust on top of Late Anisian Bulog Limestones and can be followed along a forest road in westward directions and than along the road from Sirogojno to Rožanstvo. The lower part of the succession is preserved in the Klisura Quarry and the upper part of the succession including the drowning event is preserved in an old quarry and few other places along the main road in direction Rožanstvo. The age range of the Wetterstein Formation as part of Wetterstein Carbonate Platform remains until now enigmatic and is estimated as Ladinian to Late Carnian. The Wetterstein Formation should pass directly in the Norian/?Rhaetian Dachstein Limestone without interruption of e.g., siliciclastics, drowning-sequences or longer lasting gaps.

According to our new data the platform starts to prograde in Early Carnian times over hemipelagic Late Ladinian cherty limestones with fine-grained allodapic limestones (Trnava Member of Grivska Formation). Shallow-water reef-slope and reefal limestones still evolved in the Early Carnian (Wetterstein Formation). The top of the platform is recrystallized by karstification and partly dolomitized. After a period of omission caused by uplift, new subsidence started in early Late Carnian. This is documented by a drowning/flooding sequence of same age. The evolution of the onset and the drowning of the Wetterstein Carbonate Platform prove a palaeogeographic derivation of this block in the mélange from the