HYDROTHERMAL ALTERATION AT FANCEL LAPUSNA VOLCANIC EDIFICE (EASTERN CARPATHIAN MOUNTAINS, ROMANIA) AND ITS SIGNIFICANCE IN EXPLORATION FOCUS

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Abstract: The edifice Fancel-Lapusna is included in the volcanic neogene chain of the Romanian Eastern Carpathian Mountains and it is a caldera type structure. Zoned hydrothermal alterations (propylitic, potassic, intermediate argillisation and advanced argillisation) are confined to the interior of caldera centered on the intrusive bodies in two areas in Fancel area and in Lepes-Eseniu area. Factor analysis made by altered rocks shows in first factor the typical elements for magmatic petrogenesis correlated with Cu, typical element for porphyry copper mineralisation and potassic alteration. In the second factor, As-Au-Hg-Ag association is typical for gold mineralisation correlated with advanced argilisation and vuggy quartz

Key words: andesites, propylitisation, potassic alteration, intermediate argillisation, advanced argillisation , factor analysis

The volcanic edifice Fancel-Lapusna (FL) is included in the volcanic neogene Calimani- Gurghiu- Harghita chain of the Romanian Eastern Carpathian Mountains.

FL is a caldera type structure that dominates the northern part of the Gurghiu Mountains. The edifice is an around semicircular depression, open southward, with an E-W diameter of almost 10-km. After Seghedi et al. (2000), the caldera has shaped almost 7 m.y. ago, as a result of a bulky explosive eruption, which interrupted the growth of a large complex cone. During the cone edifice stage, there were evolved two morpho-structural units: a volcanoclastic

one and a stratovolcanic one. The second unit consists in intrusive bodies, lava flows, domes, breccia bodies and pyroclastic products of prevailing pyroxene andesites and hornblende pyroxene andesites. There were observed microdiorite bodies in depth, at more 500-m (observations in core drillings, Stanciu,1973). Further andesitic domes emplaced along the caldera rim belong the post caldera activity. The interior of the present-day caldera depression exposes precaldera volcaniclastics and uncovered intrusive bodies, which have been dated with K-Ar method to be older then 9.5 m.y.

Representative hydrothermal alterations are confined to the interior of caldera, mostly centered on the intrusive bodies in two main areas in the west (Fancel creek area) and other in the east (Lepes creek-Eseniu creek area). Field mapping corroborated with microscope study led us to confine zoned hydrothermal alterations (propylitic, potassic, intermediate argillisation and advanced argillisation).

The earlier intrusive stage (andesitc-dioritic) was propylitisation. In the latest postcaldera stage of the intrusions, the hydrothermal solutions developed complex alteration zonality: potassic alteration (biotitisation) in the depth, enveloped in the upper part by argilisation. This could be considerate a porphyry system.

In the apical part of this system, it have developed a convective system, where ascended magmatic volatiles have been absorbed by meteoric water. It is present at the surface with a high grade advanced argillic alterations with vuggy silica.

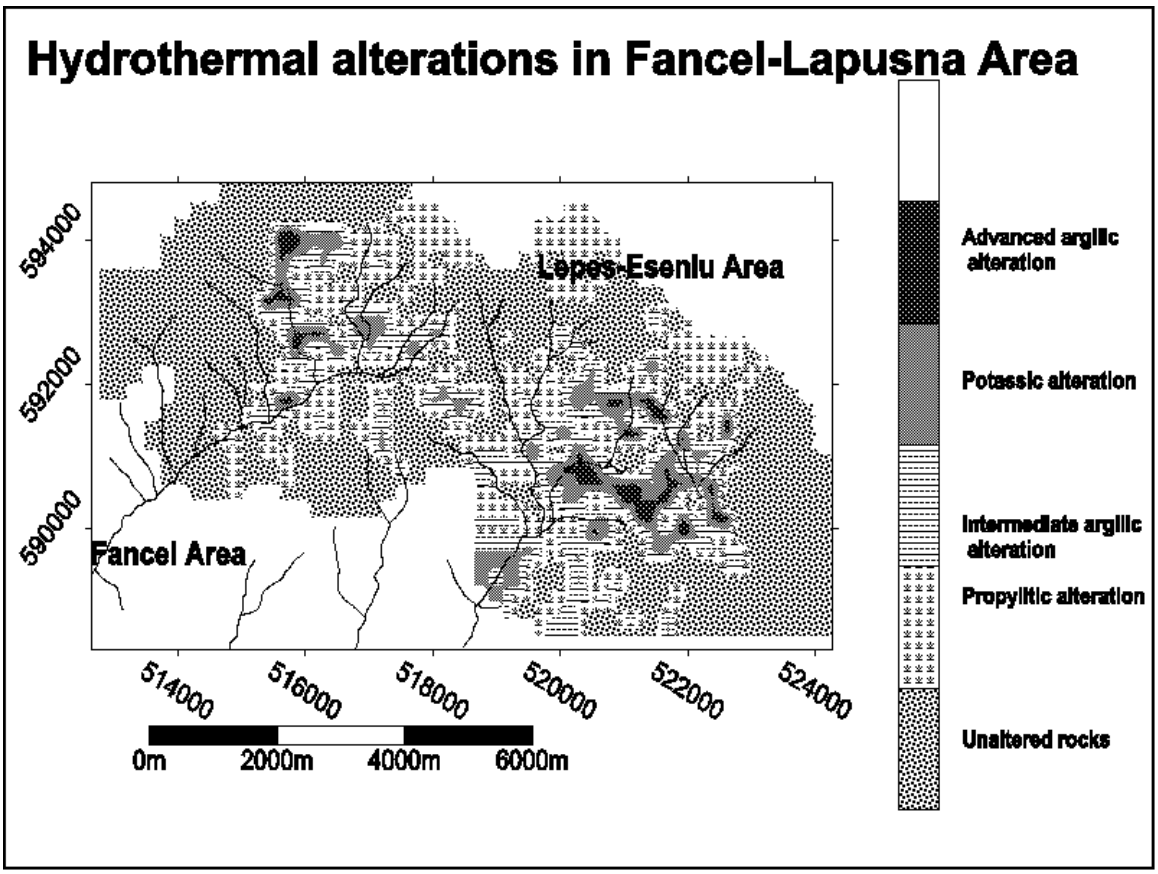
The preliminary chip rock samples was performing for mineralogical and geochemical study. The samples were analyzed by "American Assay Laboratory" Sparks, Nevada, USA. For geochemical study we used factor analysis method. It is an exploratory technique applied to a set of observed variables (the assays) that seeks to find underlying factors (subsets of variables) from which the observed variables were generated.

Propylitic alteration

Propylitic alteration transforms partial or totals the phenocrysts of maphic minerals (pyroxenes and green and brown hornblendes) and they are replaced by neominerals, like as chlorite ± epidote ± carbonate ± leucoxene (TiO_2+Fe_2O_3) ± actinot.

Serpentine, chlorite and uralit substitute pyroxene phenocrysts (augite) and the green hornblende phenocrysts are replaced by chlorite, fine powder of leucoxene and carbonate. Basaltic hornblende shows peripheral resorption effects and the crystal margins are dusty with fine grains of black iron oxides. More extensive resorption commonly occurs and the hornblende may be completely replaced by iron oxide.

Figure 1



The plagioclase feldspar phenocrysts are zoned, twinned, easy fissured with chlorite, carbonate and epidote. Epidote results from the autohydratation process.

The groundmass consists in feldspar with chlorite microliths, spherical chloritic aggregates, and hydrothermal quartz nests, carbonate and fine ground impregnated pyrite. Propylitised rocks are variably strained rusty by weathering of pyrite.

Factor analysis shows an arrangement of chemical elements related with the rock petrogenesis and a weak mineralisation in the main and second factors. The third and the fourth factors show the presence of gold mineralisation in the nearness.

Intermediate argillic alteration conserves the structure of the andesites.

In the contour of plagioclase feldspar appears the illite- sericite- chlorite- calcite assemblage, which substituted the plagioclase total or partially. The chlorite- montmorillonite- quartz- Fe oxides substitute the maphic phenocrysts. The rock is distinguished by neoformation assemblages: illite + sericite + montmorillonite/ chlorite ± pyrite and Fe oxides ± calcite.

The factor analysis of an intermediate argilic rocks unit shows the pathfinder elements for gold mineralisation (As, Sb, Hg) and it has a complicate distribution, in the first factor: Hg-Sb is associated with Ca, Fe, Mn, B, Sr.

Potassic alteration was observed in andesite bodies, mainly. This alteration is produced in the end of the magmatic activity and it modifies partially the rocks. The hydrothermal solutions alter the rocks and modify it :

-the groundmass, where the solutions deposit the compact neoformation assemblages: quartz + biotite / chlorite ± adularia + rutile + tourmaline ± opaque mineral;

-the plagioclase phenocrysts are pseudometamorphosed by polycrystalline component : alkali fedspar ± bladed chlorite ± neoformation biotite ± rutile;

-the hornblende and pyroxene phenocrysts are pseudometamorphosed by neoformation biotite+ chlorite + Fe oxides + rutile + epidote ± quartz.

The tourmaline appear like a 0.4 mm bladed- radiated crystals, sometimes partially transform in sericite;

Factor analysis of potassic rock samples unit indicates in the main factor the association Cu-K-Na-Ag-Zn-Mn, It is characteristic for porphyry copper mineralization and in the second factor Au has a good correlation with As and Ag, which is characteristic for epithermal gold mineralisation.

Advanced argillic alteration is associated with the process of forming of vuggy silica. The altered rocks have reddish-yellow-white color. The process of advanced argillisation represents extreme hydrolytic base leaching from all aluminous phases and under the acid sulfate waters. The adularia is transformed and substituted by bladed alunite up to 0.3 mm long. The groundmass is made of 0.01-0.1mm diameter intergrown anhedral quartz grains ± amorphous clays + diaspor ± minor tiny rutile. Diaspor is a result of supergene alteration and is associated with supergene clay minerals.

The neominerals assemblages are quartz, alunite, pyrite, diaspor, rutile and amorphous clays.

In the inner of the advanced argillic alteration zone there is vuggy silica, which results by destruction of all primary rock-forming minerals except quartz. Vuggy silica is composed of quartz, pyrite, and minor rutile and has coarse voids structure. A second variety of nearly pure quartz rocks, known as massive silica, are mineralogical similar to the vuggy silica but lacks large void spaces. Vuggy silica alteration occurs like big boulders inside the advanced argilic alterated rocks.

The advanced argillic alteration forms an envelope around vuggy silica in two areas: Grupsoara creek- Fancel valley and Lepes-Eseniu area.

The main factor of the factor analysis displays a connection between alteration and an epithermal gold mineralization, notify the good correlation between Sb-Au-As-Hg-Ag.

New geological researches of Hedenquist (1995) prove that the mineralogical assemblage of the advanced argillic alteration is specific to high sulfidation epithermal gold deposit.

The mineralization in the Fancel-Lapusna area occurs in quartz vein and veinlets and vuggy silica. Metallic minerals occur in a complex network of veinlets

and as impregnation in hydrotermally altered rocks, suggesting the presence of a stockwork type mineralization. Pyrite is the main sulfide and occurs in microveinlets, or as fine disseminated grains. Very rear appear marcasite, chalcopyrite, sphalerite and gold. Gold and base metal mineralization is superimposed mainly on the advanced argilic alteration zone.

Factor analysis made by 84 rock samples, different altered shows in first factor the typical elements for magmatic petrogenesis (V, Al, Co, Na, Mg, Ni, Cr, P, Ti) correlated with Cu typical element for porphyry copper mineralisation and potassic alteration. In the second factor, As-Au-Hg-Ag association is typical for gold mineralisation, type "high sulfidation" correlated with advanced argilisation and vuggy quartz

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