Remnants of ”nelsonitic” apatite as a possible source of phosphorous from epithermal and porphyry copper deposits of Carpathians (Romania)

I. PINTEA[1,*], S. S. UDUBASA[2], E. GHINESCU[1], E. L. IATAN[3], I. BERBELEAC[3], L. PETRESCU[2]

[1]Geological Institute of Romania, 012271 Bucharest, Romania (*correspondence: ipinteaflincs@yahoo.com)
[2]University of Bucharest, 010041 Bucharest, Romania
[3]Institute of Geodynamics of Romanian Academy, 020032 Bucharest, Romania

Multiple melt immiscibility could be envisaged at the bottom of the magma chambers from the Miocene Carpathian area, including Eastern Carpathians (e.g. Baia Mare region) and Metaliferi Mountains (western Romania), by the presence of apatite remnants and silicate melt inclusions from the petrogenetic minerals. Both regions bear the most important epithermal and porphyry Cu-Au-Mo deposits of Romania. Apatite is ubiquitous, included in pyroxene, amphibole, biotite, feldspar and quartz from rhyolitic to basalt andesites. There are many generations of apatite associated with ilmenite, magnetite, globular sulfide, Fe-spinel and magmatic anhydrite. Together with ilmenite as globular pair, randomly and zonal inclusions in pyroxene and plagioclase appear, and they suggest that an immiscible (Fe-Si/Fe-S-O) and (Si-P-Ti/Fe-Ca-P) melt assemblage was formed before trapping. They were also trapped as solid phases in silicate melt inclusions or solid remnants in the sieved plagioclase. Generally, plagioclase was growing after resorbed pyroxene inheriting the partially dissolved apatite and showing a specific microtextural feature keeping an amorphous opaque central zone. As such apatite is transferred by partial dissolution from mafic minerals to feldspar and quartz in a dynamic decompression environment liberating phosphorus in the exsolved magmatic fluid phases emphasized by the presence of Raman stretching of PO_4^{3-} in the corresponding fluid inclusions from the epithermal and porphyry copper systems (e.g. vivianite and hydrothermal apatite are often mentioned). Fe-rich, Fe-S-O, Fe-Ca-P and Fe-P melts are the most favorable to be conjugate with the silica-rich counterpart in the magmatic system underlying the shallow porphyry copper structures and epithermal ore deposits in the Miocene Carpathian volcanism from Romania. More investigation is required by using EPMA, SIMS, Raman, high-temperature microthermometry a.m.o. to elucidate the magmatic immiscibility in both regions.