Occurrence of rare phosphides in ophiolitic chromitites from Greece and Russia

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Phosphides are rare in nature and only 14 phases have been officially accepted by IMA. Most of them occurred as accessory minerals in meteorites, but have been also described in terrestrial samples. The first occurrence of Ni-phosphide were observed in altered silicates of the podiform chromite of Alapevsk ophiolite, Russia [1]. However, several Ni-V-Mo phosphides are reported in concentrates obtained from the ophiolitic chromitites of Gerakini-Ormylia and Othrys complexes of Greece [2,3]. Based on their chemical composition, the following phosphides have been recognized: melliniite, nickelphosphide, $(Ni,Fe)_5P$, $(Ni,V)_2P$, $(V,Ni)_2P$ and $(Mo,V)_3(Ni,Co)_2P$. All the grains vary in size between 5 and 80 μm and show distinctive reflectance and other optical properties such as color and isotropy-anisotropy. On the contrary, Raman spectra are not significantly distinctive. The phosphides occur intimately intergrown with brecciated chromite, chlorite, quartz, awaruite, tiemannite and various sulfides. This indicates that the minerals are natural in origin. We suggest that the phosphides crystallized under reducing conditions but a conclusive genetic interpretation is still speculative embracing a number of possible hypotheses: i) high-temperature reaction of the chromitites with reducing fluids, at mantle depth, ii) low-temperature alteration of chromitite during sub-oceanic serpentinization or weathering, iii) post-orogenic, surface lightning strike or, iv) meteorite impact. However, the last two scenarios are not supported by the finding of high-pressure minerals in our assemblages.

[1] Zaccarini et al. (2016) *Minerals* **6**, 1-23. [2] Sideridis et al. (2018) *Ofioliti* **43**, 75-84. [3] Ifandi et al. (2018) *Ofioliti* **43**, 131-145.