Nano-mineralogy & -geochemistry of karst bauxites (Greece): Implications of the origin of the deposits

P.N. GAMALETSOS[1,2,3,*], A. GODELITSAS[2], T. KASAMA[1], J. GÖTTLICHER[3], R. STEININGER[3]

[1] Center for Electron Nanoscopy, Technical University of Denmark, Denmark (*correspondence: plagka@dtu.dk)
[2] School of Science, University of Athens, Greece
[3] ANKA Synchrotron Radiation Facility, Karlsruhe Institute of Technology, Germany

Recent research with respect to the nano-mineralogy and -geochemistry of karst bauxites from Greece [1] is reviewed herein, while new insights into significant trace elements (including As, V, HFSE and REE) and the origin of these deposits are also presented [2].

The study of Fe-depleted (high grade) bauxite samples in microscale by SEM-EDS/WDS and Synchrotron Radiation (SR) measurements (μ -XRF & μ-XAFS) showed the presence of a Fe^{3+}-Cr^{3+}-AlOOH (diaspore), while the study in nanoscale by TEM-EDS & EELS revealed the existence of Fe^{3+}-oxide nanominerals and TiO_2 polymorph mineral nanoparticles [1]. It is argued that this Fe-Cr-diaspore (Fe^{3+}-Cr^{3+}-AlOOH) concerns a low-T authigenic phase, which was formed during diagenesis together with TiO_2 mineral micro- & nano-particles. The latter phases remain rather stable during epigenesis related to iron mobility and the formation of Fe nanominerals. The observed Fe nanominerals may be associated to epigenetic processes. It is also implied that younger karstification/weathering processes had minimal effect to Ti and Fe mineral nanoparticles and nanominerals [1]. New μ-XRF and μ-XAFS investigations of Fe-rich (low grade) samples revealed that As^{5+} is associated to Fe-Cr-Ti in pisoliths but, remarkably, not to S attributed to sulfides. Vanadium (most likely as V^{5+}, though contribution of V^{4+} cannot be excluded) is related to Ca, K, and possibly to Sc, whereas Ga is related to Al [2]. Detrital micro-sized chromite grains and positive anomalies of compatible elements (Ti, Cr, V, Ni, Sc) indicate a partial mafic-ultramafic origin (Tethys pre-Cretaceous ophiolites). The presence of HFS elements (Zr, Ce) and actinides (U, Th), whereas discrimination diagrams of contrasting elements (e.g., Th/Sc vs Zr/Sc) and geochemical fingerprints (including REE anomalies, i.e. Eu/Eu* and Ce/Ce*) strongly support a major contribution of acidic to intermediate igneous rocks derived, most likely, from pre-Jurassic peri-Tethyan large volcanic provinces.

[1] Gamaletsos P.N. et al., Am. Mineral. (under review).
[2] Gamaletsos P.N. et al., To be submitted to Ore Geol. Rev.