Partitioning and speciation of Fe, Ti and Cr in high-quality diasporic bauxite from Greece

P. GAMALETSOS[1], A. GODELITSAS[1]*, A. DOUVALIS[2], T. KASAMA[3], R.E. DUNIN-BORKOWSKI[3], J. GÖTTLICHER[4], N. CHURCH[5], G. ECONOMOU[6] AND TH. BAKAS[2]

[1]Faculty of Geology and Geoenvironment, University of Athens, 15784 Zographou, Athens, Greece
[2]Department of Physics, University of Ioannina, 45110 Ioannina, Greece
[3]Center for Electron Nanoscopy, Technical University of Denmark, DK-2800 Kgs Lyngby, Denmark
[4]Institute for Synchrotron Radiation, Forschungszentrum Karlsruhe GmbH, Hermann-von Helmholtz-Platz 1, D–76344 Eggenstein Leopoldshafen, Germany
[5]Department of Earth Sciences, University of Cambridge, Cambridge CB2 3EQ, United Kingdom
[6]Institute of Geology and Mineral Exploration, Olympic village, 13677 Acharnai, Greece

Greece is the eleventh largest producer of bauxite in the world (2.2×10^6 tons in 2007 according to USGS). The exploitation of deposits, hosted in Mesozoic limestones of central Greece, is performed by three mining companies whereas there is also an Al metallurgical plant. The mineralogy of Greek bauxites is not particularly variable; diaspore and/or boehmite (AlOOH polymorphs), hematite (Fe_2O_3), goethite (FeOOH) and anatase (TiO_2) are major phases in the case of typical Fe-enriched (red) bauxite containing 57% Al_2O_3. Of special interest is the high quality Fe-depleted (white) bauxite composed of diaspore and anatase (powder-XRD) and containing 80% Al_2O_3. In this case the partioning and speciation of the main metal impurities (TiO_2: 3%, Fe: 17500 ppm, Cr: 1235 ppm) is crucial. A microscopic study perfomed using SEM-EDS/WDS and HRTEM/EELS shows rounded anatase microparticles and nanoparticles, dispersed into the diasporic matrix, as well as individual needle-shaped rutile nanoparticles (which are diffrent TiO_2 polymorphs with no Fe). HRTEM/EELS and Mössbauer spectra reveal that Fe is present as Fe^{3+} ions in the framework of the diaspore, and also in the form of Fe mineral nanoparticles and/or Fe nanominerals (e.g. [1]) that are between 25 and 45 nm in size. X-ray absorption spectra, obtained in the SUL-X beamline of the ANKA Synchrotron facility (Germany) confirm the existence of Cr^{3+}, most probably in the structure of the diaspore, in accordance with previous Raman spectra.

[1] Hochella Jr. M.F. (2008) *Elements* **4**, 373-379.