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REE in karst bauxites: the Campania example (southern Italy)

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Global production of Rare Earth Element (REE) has dramatically increased in the last years, hence the strong interest to identify new deposits and to understand the processes responsible for their formation. Among REE concentrations related to weathering, the current targets are represented by the ion-adsorption deposit-types, occurring in China, in which REEs are adsorbed onto the surface of clays. Laterites have been also intensively investigated since the discovery of the secondary deposit of Mount Weld (Australia). Most REEs behave as immobile elements in laterites, and tend to be enriched compared to the underlying parent rocks. Many authors debate on a possible REE fractionation along the laterite profiles, resulting in the formation of supergene LREE-minerals.
Bauxites are economic Al accumulations, derived from the weathering of alumosilicate-rich parent rocks resulting in the development of laterite profiles. Components as Ca, Mg, K, Si are leached and residual Fe, Al and Ti precipitate in form of hematite»goethite, gibbsite [Al(OH)3] or amorphous Al hydroxides and anatase. Metabauxites can contain boehmite or diaspore [AlO(OH)]. Chemical composition (including REEs content) of lateritic bauxites generally mirrors the original composition of the parent rock. Geochemistry of REEs in karst bauxites, which lay on carbonate bedrocks and may be also allochthonous to them, is not so straightforward.
Cretaceous karst bauxite deposits in the Apennine chain (Southern Italy) are presently uneconomic. A full mineralogical and geochemical study has been performed on several deposits of the Campania district, and three representative profiles have been sampled. In all deposits the bauxite ore has an oolitic-pisolitic texture, but contains also detrital intervals. The mineral association consists of boehmite, kaolinite and hematite, with less goethite and anatase. The main REE-bearing mineral is detrital monazite. In detail, we could detect (SEM) other LREE-phosphates (florencite type minerals) in the Regia Piana deposit and possibly LREE-enriched goethite at Dragoni. QEMSCAN® analysis allowed the identification and location of discrete particles of monazite and xenotime, but because of their very small dimensions (typically <10 microns) it was difficult to determine the exact chemical composition without further investigation. Chemical analyses have shown a total REEs content of 620 ppm on average in all bauxite deposits, with a maximum value of 1454 ppm of total REEs at the top of the Regia Piana profile. The LREE (La-Eu) contents in the samples vary between 200 and 1400 ppm, with positive Ce and La anomalies. The HREE (Gd-Lu) contents are always around 40-60 ppm. The relationship between REEs and the Al and/or Fe values is not clear, probably because the REE content may be slightly biased by the detrital characteristics of the bauxite. The higher Ce and other LREE values, detected at the top of several deposits rather than at the bottom, can be related to LREE supergene minerals occurrence in the higher parts of profile.
The Campania deposits represent an interesting case study for REE concentration in karst bauxites. A similar LREE fractionation process could be applied to other bauxite deposits, though related to more favorable parent rocks with sub-economic REE-grades.