Rare Earth Elements in phosphorites from the Bled El Hadba deposit (NE Algeria): concentration, behaviour and depositional environment

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The phosphorites of the Bled El Hadba deposit are located south-eastern Tebessa region (NE Algeria). They are aged of Late Paleocene to Lower Eocene and are a part of Gafsa-Metlaoui-Onk phosphorite basin. The phosphorite layer, as whole Djebel Onk mining basin, is divided into three sub-layers: lower, principal (or main) and upper sub-layers. The petrographic study of samples from each sub-layer shows high-abundant glauconites in addition to coexisting pellets and coprolites. The geochemical study was carried out on these three types of particles using "in situ" laser ablation technique (LA-ICP-MS). The results show P_2O_5 contents varying between 17 wt% and 24 wt%. The studied particles display high concentration of Rare Earth Elements (REE) with a variation depending on the type of grains and their stratigraphic position relative to the phosphate layer (ΣREE ranging between 194 and 2050 ppm). The REE are enriched in the main sub-layer where the glauconites exhibit contents exceeding 2000 ppm (average = 1346 ppm). This enrichment of REEs could be interpreted by substitutions of several elements by REEs (e.g., Ca, Fe, Mg, V, P) in phosphate minerals of the studied particles.

REE patterns normalized to Post-Archean Australian Shale (PAAS) show a negative Cerium (Ce) anomaly in all particles indicating an oxic deposition environment. They also show a slight positive anomaly of Europium (Eu) which indicates a reducing to sub-reducing conditions. The presence of these two anomalies of Ce and Eu together is probably a result of the "'upwelling" phenomenon and the mixing of deep seawater (reducing environment) and shallow seawater (oxic environment) during phosphorite rocks genesis in the deposit basin.

Keywords: Phosphorites, Glauconite, Geochemistry, REE, Bled El Hadba, Djebel Onk