Quantitative mineralogy in abating beneficiation of Greek placer sands for the recovery of REE-minerals

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Abstract

Quantification of valuable minerals in the ore body is of key importance for ore deposit characterization and optimization of process operations. In placer sands Rare Earth Element (REE)-bearing minerals are usually concentrated in the heavy mineral fraction. Upfront mineralogical assessment reveals the mineral associations, which are essential for selecting the proper metallurgical process and providing robust predictions in beneficiation testwork.

Two different methods, wet high intensity magnetic separation (WHIMS) and gravity separation are applied on a composite heavy mineral sand sample prepared from Nea Peramos, Kavala, North Greece, an area which is known from previous studies for its enrichment in REE-bearing minerals. The efficiency of each method is evaluated by bulk XRF and ICP-MS chemical analysis. The semi-quantitative mineralogy of the products of each test is determined by a combination of X-ray diffraction (XRD) and conventional scanning electron microscope (SEM) with energy dispersive spectroscopy as well as chemical mapping application. Preliminary HIMS results at several magnetic field intensities (15 V, 30 V, 90 V, and 150 V) revealed that highest REE recovery through allanite concentartion in the magnetic fraction is achieved even at 30 V (0.48 T). Allanite light REE (LREE) enrichment is enhanced by abundant monazite inclusions locked in the mineral. Gravity separation by heavy liquids is tested in order to separate allanite and titanite from the silicate matrix of the feed sample. Grain size analysis reveals that the highest concentration s is recorded in the -0.500 μm fraction, where the best liberation of allanite crystal is achieved . This result leads to the application of magnetic separation in order to upgrade the REE-minerals under this size fraction and finally gravity separation for allanite recovery from the other heavy minerals such as titanite. This new information can contribute to the optimization of beneficiation process to be applied for REE recovery from HM sands.