

Quantification of mineralogical heterogeneity in peralkaline complex hosted rare metal (REE-Y-Zr-Hf-Nb) deposits and the impact on mineral processing

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Peralkaline complexes host REE-Y-Zr-Hf-Nb mineralizations and contribute to the global resources of these critical metals. However, mineralogical diversity, grain size heterogeneity, complex and small scale intergrowth of different ore minerals as well as spatial heterogeneity require complex beneficiation processes and may reduce the economic potential of such deposits. These mineralogical properties are key parameters for the development of a technically and economically viable beneficiation strategy and for future geometallurgical domaining.

This study is focused on the quantitative characterization of mineralogical, geochemical and textural heterogeneity of peralkaline granite hosted rare metal deposits using the example of Khalzan Buregtei (Mongolia). Therefore, systematic sampling was carried out along inspection lines through the outcropping mineralized parts of the complex. Samples are studied using bulk rock chemical data, polarization and electron microscopy. QEMSCAN© analysis is applied for the quantification of textural parameters like phase specific grain size and ore mineral association. Clustering of ore and gangue minerals makes the ore amenable to effective sorting at particle sizes significantly exceeding liberation sizes. For example, zircon, major carrier of HREE, Hf and Zr, shows a strong association with secondary quartz and hematite. This textural assemblage allows efficient extraction of particles in the coarse grain size fraction of 250 µm using magnetic separation. A pre-concentration of zircon, thereby, is done without the expensive comminution to very fine liberation grain size of at least 40 µm. This study shows how detailed and quantitative mineralogical characterization can support the development of beneficiation strategies for economic use of peralkaline hosted critical metal deposits.