Total REEcall: Appraisal of the mineralization in alkaline-silicate systems from the Ossa-Morena Zone (in Portugal)

José Roseiro [1], Noel Moreira [1], Mercedes Fuertes-Fuente [2], Daniel Oliveira [3], José Mirão [4], Pedro Nogueira [5,6]

[1] Instituto de Ciências da Terra | Instituto de Investigação e Formação Avançada Universidade de Évora – Portugal
[2] Departamento de Geologia | Universidade de Oviedo – Espagne
[3] Laboratório Nacional de Energia e Geologia – Portugal
[4] Laboratório HERCULES | Universidade de Évora – Portugal
[5] Earth Science Institute, Departamento de Geociências da Universidade de Évora, Colégio Luís António Verney, Rua Romão Ramalho, 59, 7000-671 Évora. (ICT, University of Evora) – Portugal
[6] Instituto de Cências da Terra - Pólo de Évora (ICT) – Portugal

Alkaline silicate melts play a crucial role in the accumulation of rare earth elements (REE), niobium (Nb), and other critical raw-materials deposits. These melts typically originate from mantle-derived magmas enriched in incompatible elements that evolve through extensive fractionation, leading to them to develop high concentrations of REE, Nb, Y, Zr, and other high-fieldstrength elements (HFSE). During late-stage magmatic-hydrothermal processes, halogen-bearing fluids further concentrate such elements and migrate to shallower levels. This type of magmatism and associated metallogenic processes are usually associated with rifting events, in extensional tectonic settings.

In the Iberian Massif, a large set of alkaline magmatic plutons were emplaced during the riftrelated magmatism concomitant with the opening of the Rheic Ocean during Cambro-Ordovician times, specifically in the Ossa-Morena Zone (OMZ, SW Iberia) and in the Galicia-Trás-os-Montes Zone (NW Iberia). From the alkaline bodies that occur in the OMZ, the Alter Pedroso Massif stands out for its extreme lithological varieties that include a range of syenite rocks, including pegmatoids and highly differentiated facies. The internal structure of this massif is characterized by an apparent horizontal layering, separating a bottom unit composed of leucocratic syenite cumulates, and a top unit characterized by mesocratic aegirine- and riebeckite-syenites often intersected by numerous pegmatoid varieties. The mesocratic syenite unit often show differentiated rocks composed of distinct assemblages of accessory minerals, susceptible to be grouped into three types: (i) allanite phenocrysts in aegirine-syenites, (ii) thorite and allanite inclusions in zircons from aegirine-free riebeckite-syenites, and (iii) fluor-apatite, REE fluor-carbonates, Nb-Y and Nb-Th oxides in aegirine-riebeckite syenites. It is noteworthy the clear microzoning of the last type, in which the fluor-apatite and the REE fluor-carbonates are clearly separated from the HFSE-oxides. Fluorite and zircon are present in all these differentiated rocks. Whole rock geochemistry studies from all samples show an increase of the critical elements when compared to the "barren" syenite units, especially in REE (sum LREE over 4.000ppm), Nb (up to 1.400ppm) and Y (up to 2400ppm), with Zr over 10.000ppm. Besides the rare metal mineralization in these unusual syenite facies, the pegmatoid rocks show high accumulation of large euhedral zircon megacrystals.

In Iberia, similar REE-Nb-Y mineralization has only been documented in the Galiñero Complex (NW Spain), while in Alter Pedroso, the accessory mineralogy has been always poorly characterized. New mineralogical and geochemical data of the different facies of the Alter Pedroso Massif thoroughly record and highlight the mechanisms of the consensual metallogenic model for Zr-REE-Nb-Y mineralization in alkaline-silicate magmatic systems, namely the differentiation enrichments through liquid immiscibility or fractional crystallization.

Mots-Clés: Rare Earth Elements, Peralcaline Rocks, Ossa, Morena Zone, Mineralization.