

The potential for REE deposits associated with alkaline and carbonatite magmatism in Europe

Goodenough, K.M.¹, Deady, E.A.², Shaw, R.A.² and the EURARE Work Package 1 Team

1: British Geological Survey, West Mains Road, Edinburgh, UK

kmgo@bgs.ac.uk

2: British Geological Survey, Keyworth, Nottingham, UK

The rare earth elements (REE) are a group of 17 chemically similar metallic elements, including the 15 lanthanides (lanthanum-lutetium) together with yttrium and scandium. They are used in a wide range of emerging technologies, particularly those required for the low carbon economy. Both the light rare earth elements (LREE) and the heavy rare earth elements (HREE) have been identified as critical raw materials in a recent report [1]. They are of vital economic importance to the European economy and yet the European Union (EU) is almost entirely dependent on imported supplies of the REE because of a lack of domestic production [1].

The EURARE project (www.eurare.eu) aims to establish a basis for the development of a sustainable European rare earth industry. This includes a review of all REE resources and occurrences in Europe, including both primary and secondary types. Primary resources are those formed by igneous and hydrothermal processes, whereas secondary resources are those resulting from the weathering and/or erosion of primary resources. This talk will focus on primary resources, and specifically the metallogenic provinces associated with alkaline magmatism in Europe.

The largest European REE deposits are associated with alkaline magmatism in rift-related tectonic settings. Major rift systems in Europe are generally younger southwards, although there are some exceptions. Meso- to Neoproterozoic alkaline magmatism occurred around the margins of Archaean cratons in Greenland, Norway and Sweden. The northern part of the Baltic Shield hosts the major Devonian Kola alkaline province. Permo-Carboniferous rifts contain alkaline magmatism around craton margins in Norway and the UK, with subsequent Meso- to Cenozoic rifting in western Europe associated with opening of the Atlantic Ocean. Cenozoic rifts associated with alkaline magmatism arc across central and southern Europe from Spain to Turkey, including the Rhine Graben and the Massif Central. All these rift systems have the potential to host REE resources, but whereas the older provinces of northern Europe are deeply exposed, exposures in southern Europe are largely at the supracrustal level.

The currently most advanced REE projects are in intrusions associated with Mesoproterozoic alkaline provinces, these include Kringlerne and Kvanefjeld in the Gardar Province in Greenland, and Norra Kärr in Sweden. Carbonatites of a range of ages also represent potentially important European REE resources; these include Fen in Norway, Alnö in Sweden, Qaqarsuk (Qeqertaasaq) and Sarfartoq in Greenland, and Storkwitz in Germany. In Southern Europe, the shallower erosion level of the rift systems means that plutonic rocks are not exposed and potential REE resources may well exist at depth. In these areas, secondary deposits are currently of greater importance in terms of identified resources.

1. European Commission 2014. Report on Critical Raw Materials for the EU. http://ec.europa.eu/enterprise/policies/raw-materials/files/docs/crm-report-on-critical-raw-materials_en.pdf