View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by NERC Open Research Archive

Alkaline magmatism and REE resources: a European overview, and links to Canada

Kathryn Goodenough[1], Eimear Deady[2], Adrian Finch[3], Richard Shaw[2], Paul Lusty[2], and Frances Wall[4]

1: British Geological Survey, West Mains Road, Edinburgh EH9 3LA UK

2: British Geological Survey, Environmental Science Centre, Keyworth, Nottingham NG12 5GG, UK

3: Department of Earth Sciences, St Andrews University, St Andrews KY16 9AJ, UK

4: Camborne School of Mines, University of Exeter, Penryn, Cornwall TR10 9FE, UK

In recent years, the European Union (EU) has prioritised the issue of critical raw materials[a] – those materials which are important for the economy, but have risks to their supply. Of the materials identified as critical, the rare earth elements (REE) are considered to have the highest supply risks, since > 90% of global production comes from China. Several programmes are underway in Europe to investigate the supply chain for the REE and other critical materials. These include the EU-funded EURARE project[b], which aims to set the basis for the development of a European REE industry; and the Security of Supply of Mineral Resources (SoS Minerals) research programme in the UK.

As part of these projects, we have studied European REE resources, in particular primary resources associated with alkaline magmatism in continental rift zones. The most significant REE resources so far recognised in Europe are associated with Mesoproterozoic alkaline magmatism around the margins of Archaean cratons in Greenland and Sweden. Carbonatites in Greenland and Scandinavia, formed during Neoproterozoic, Devonian and Jurassic rift phases, also represent potential REE deposits that are typically enriched in the less valuable light REE (LREE). Cenozoic rifts associated with alkaline magmatism arc across central and southern Europe, 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, and the plutonic rocks that may contain REE enrichments are not exposed at the surface.

Canada shares much of its tectonic history with parts of Europe, and thus there are many similarities in the primary REE resources. The Strange Lake pluton, on the Québec – Newfoundland border, is similar in age to intrusions in the Gardar Province of Greenland, and may represent part of the same Mesoproterozoic rift system. Both Strange Lake and the Ivigtut pluton (Gardar Province) are peralkaline granites in which rare metals have been mobilised and concentrated by late-magmatic hydrothermal fluids. The Thor Lake REE deposits in Canada lie within a Palaeoproterozoic alkaline to peralkaline layered intrusive complex that resembles Greenland's Ilímaussaq Complex. Carbonatites of the Neoproterozoic St Lawrence Rift system in Canada are similar in age to carbonatites with REE potential across Europe. There is thus much to be gained in studying these systems together to investigate the processes by which the REE are enriched.

a: http://ec.europa.eu/enterprise/policies/raw-materials/critical/index_en.htm
b: www.eurare.eu