Canadian Perspective on REE Deposits Hosted by Carbonatite and Alkaline Complexes and Its Implication for Carbonatite and Alkaline Magmatism in Europe

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In 2021, Canada established a list of 31 critical minerals considered essential to the transition of our country and its allies to a digital- and low-carbon economy. Among these minerals, rare earth elements (REEs), which are key components in high-technology industries, have been designated as highly critical because of the risk of supply chain disruptions. Carbonatite and alkaline complexes are the main hosts of REE deposits, and most of the world's REE production is related to these igneous rocks. Although carbonatite and alkaline complexes are relatively unusual on the Earth's surface, representing <1% of all the Earth's igneous rocks, Canada hosts numerous of these uncommon igneous bodies. They range in age from Neoarchean to Mesozoic, albeit many of them are Proterozoic in age, and mainly occur within the Canadian Shield and the Canadian Cordillera. As worldwide, Canadian carbonatite and alkaline complexes are commonly spatially related to major crustal structures in intracratonic anorogenic or post-orogenic extensional settings. The Kapuskasing Structural Zone that hosts the Clay-Howells, Nemegosenda Lake, and Lackner Lake alkaline complexes and Argor carbonatite is a good example of how major crustal-scale weakness zones control the emplacement of these igneous complexes. Canada is currently a small REE producer (Nechalacho deposit—alkaline complex-associated) but is well positioned to become a significant REE producer, as the country has some of the largest known REE geological resources associated with carbonatite and alkaline magmatism (e.g., Wicheeda Lake, Kipawa, Niobec, and Strange Lake deposits). Interestingly, many of these mineralized carbonatite and alkaline complexes share common tectonic history and/or similar formation/emplacement processes with carbonatite to alkaline magmatic events in Europe. Improving our knowledge of REE-bearing carbonatite and alkaline complexes in Canada will therefore help refine petrogenetic and metallogenic models in both Canada and Europe.