

# SEG 2022 Conference: Minerals For Our Future

---

## Rare Earth Element Mobilization and Enrichment in Alkaline Complexes

Dennis O. Achoki

RWTH Aachen University, Aachen, Germany

Rare Earth Elements (REEs; lanthanide series, Sc and Y) have vital applications in today's society and demand for them has been projected to rise in the next decades. Their most important applications include manufacturing of magnets used in motors of electric vehicles and wind turbines; in making components of smart phones and computers; and in a number of light-weighting applications for the aviation industry. Alkaline igneous complexes have emerged as fertile provinces for REEs and Y. Fractional crystallization of the parent alkaline magma leads to an enrichment of incompatible elements, of which REEs and Y comprise, in late-stage magmatic-hydrothermal fluids. The exposed roof zone of an alkaline intrusion and surrounding fenite aureole in the Iivaara alkaline complex of Finland provide a natural laboratory to study the origin, mobilization and enrichment of REEs and Y. Petrographic and textural examination of 10 hand samples and 15 thin sections representing all the rock types found in Iivaara reveal the complex to be comprised of ijolite, nepheline syenite, vein type pyroxenite, syenite fenite, quartz fenite and gneiss country rock. Apatite, a major host of REEs and Y, has been identified in all rock types of the Iivaara complex. Polarization microscopy and high resolution Back Scatter Electron (BSE) imaging show magmatic and hydrothermal textures for the apatites and related minerals. Hydrothermal fluid – apatite interaction is recorded as compositional zoning rims and dissolution features. Electron Probe Microanalysis (EPMA) and Laser Ablation-Inductively Coupled-Mass Spectrometry (LA-ICP-MS) have been conducted to analyse for the major and trace elements in apatite. REEs and Y have been detected in apatites of all rock types albeit with variability among the different rock types and within individual apatites. In this work I propose that REEs and Y mobilization and enrichment take place as element exchange and addition reactions that involve charge balancing.