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Rare Earth Element Deposits of Africa

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As of early 2016, there were 11 advanced Rare Earth Element (REE) projects (projects with reporting code compliant resource estimates) on the African Continent: 7 of these having completed successful preliminary to advanced feasibility studies and are on track for development [1]. Together, the African deposits contain just over 8 million tonnes of *in situ* rare earth oxides, 3.3 million tonnes of this resource being at indicated or higher levels of confidence [1].

Enrichment of REE to economically exploitable levels usually requires the superposition of multiple processes whereby primary enrichment levels in the source rock(s) are enhanced through sub-solidus metasomatic and/or supergene alteration [e.g. 2,4].

The deposits presented here represent a range of genetic types. Carbonatites, with hyperalkaline undersaturated syenites, are the most REE enriched suite of magmatic rocks. The Kangankunde, Songwe and Wigu Hill REE deposits are hosted in evolved ferroan dolomite to ankerite carbonatites and attained ore grade REE via a combination of magmatic differentiation followed by sub-solidus redistribution and concentration of the REE by hydrothermal fluids. Available data suggest that the hydrothermal alteration in these deposits was essentially a closed system: the REE being deposited by fluids circulating largely within the bounds of the complex.

By contrast, the unusual heavy REE enriched Lofdal deposit is thought to have been deposited during metasomatism of country rock gneisses by REE rich hydrothermal fluids derived from nearby carbonatite intrusions [3].

While carbonatites achieve elevated primary levels of REE and represent prospective targets for REE deposits, as important is the relative ease with which carbonatites are eroded - with soluble carbonate and phosphate mineral phases removed in solution leaving the relatively immobile REE progressively enriched in the residuum. The Mount Weld (Lynas Corp) deposit – currently the only significant producer of REE outside of China – is of this type: the orebody averages over 8% total REE as oxide (TREO) in a laterite overlying primary carbonatite having TREO below 0.5%. In Africa, the Ngualla Hill, Mrima Hill, Zandkopsdrift and Xiluvo deposits are of this "lateritic" variety whereas ore grades of REE and P in the Glenover deposit were generated through supergene karst processes. Supergene alteration tends not to cause significant fractionations between individual REE (with the possible exception of Ce) whereas hydrothermal/metasomatic alteration by ligand-rich fluids can cause fractionation of the relative abundances of individual REE [e.g. 4].

Final concentrations of REE in a deposit reflect the combined action of primary magmatic/hydrothermal enrichment plus enrichment during supergene alteration – this enrichment will dominate the relatively small primary concentration differences resulting from tectonic setting (intra-craton, circum-craton mobile belts, etc). Despite this caveat, only 1 of the African REE deposits – Glenover – is situated on a craton. Both the development and long term preservation of REE mineralised regolith zones requires tectonically stable conditions with little denudation and these may well impose a tectonic setting effect on the distribution of REE deposits.

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