



An International Continental Scientific Drilling Program (ICDP) Workshop open call

“REEDRILL”: Drilling an alkaline-carbonatite complex to understand how fluid-rock interaction influences rare earth element mineralisation, groundwater and deep life.

Zomba, Malawi, 22nd-26th May 2023

Alkaline-carbonatite igneous complexes host the world’s largest and highest grade rare earth element (REE) deposits and are critical for the global transition from fossil fuels towards a low-carbon society. Many aspects of these igneous complexes remain poorly understood, particularly relating to variations in composition and structure with depth. Of particular importance are: (1) The relationship between carbonatites and associated alkaline rocks and how these evolve through magmatic-hydrothermal processes to form economic REE enrichment, especially how mineralising fluids vary with depth and over time and how these are controlled by local structures and magmatic conduits. (2) The hydrogeological depth profile of structural features associated with alkaline-carbonatite systems, and in particular the effect of this unique geology on groundwater hydrogeochemistry in near-surface groundwater, especially fluoride. (3) The nature of deep subsurface life in these unusual rock-types, and the relationship of the microbial community to both REE mineralisation and groundwater biogeochemistry.

To meet the above aims, we propose to undertake new deep drilling at the Songwe Hill carbonatite complex in Malawi. Songwe Hill represents an excellent example of a sub-volcanic REE-mineralized alkaline-carbonatite complex, which has been explored at shallow depths by Mkango Resources, but little is known about geological relationships at depths > 300 m. We intend to collect two 1 km cores intersecting deeper parts of the carbonatite and associated alkaline rocks. The results of the new drilling will be integrated with existing shallow cores and geophysical data. Deep drill cores will allow us to understand the transition, with depth, from REE mineralized and unmineralized carbonatite as well as contact zones between carbonatite and host nepheline syenite. We aim to investigate the evolution of mineralising fluids in these zones to further understand ore genesis, and modern fluids to understand biogeochemical depth variation and hydrogeological systems associated with alkaline-carbonatite complexes.

We would like to invite scientists, particularly economic geologists, geochemists, hydrogeochemists and microbiologists, to contribute to a three-day workshop in Zomba, Malawi, on the 22nd to the 26th May 2023. The workshop agenda will include plenary talks and working group discussions refining the science questions; considering if any additional work is needed for site characterisation; developing the technical aspects; developing the details of the science and drilling plans; planning environmental impact assessments; and discussing plans for communication and outreach. The workshop will be convened by Kathryn Goodenough, Michael Marks, Sam Broom-Fendley and John Spear, and attendees will include international scientists, members of Malawi government departments and universities, and REE exploration companies operating in Malawi.

Scientists wishing to contribute to this workshop are invited to submit an application with contact details, a 1-page CV, and a 1-page summary of their relevant expertise and intended project contribution to Kathryn Goodenough and Sam Broom-Fendley (kmgo@bgs.ac.uk, s.l.broom-fendley@ex.ac.uk) prior to Dec 11, 2022. A scientific committee will decide on invitations and travel

support (fully or partially) taking into account the relevance of the applicants' research relevant to the goals of the workshop, the workshop budget, and the need for balanced disciplines. We especially encourage applications from early career scientists, scientists based in Malawi or southern Africa, and participants from ICDP member countries.