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## Remote Sensing Aided Geological Investigation of Rare Earth Element Mineralization in Sangu-Ikola Carbonatites, Southwestern Tanzania

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Carbonatites are unique igneous rocks that are rich in carbonate minerals. These rocks are known to host the world's largest and richest deposits of rare earth elements (REEs). REEs have become increasingly important in modern technologies such as electric vehicles, renewable energy (wind turbines), aerospace applications, and telecommunication (smartphones). This has brought great attention to research and exploration for carbonatites, as they are the principal sources of REEs and niobium.

This study presents a remote sensing aided geological investigation of carbonatites from Sangu-Ikola, with a focus on understanding the mineralization processes that have led to the concentration of REEs. The study examines the mineralogy, geochemistry, and textural features of carbonatites using an optical microscope, an analytical spectra device, and X-ray diffraction. Petrographic analysis revealed that the carbonatite rocks were composed mainly of calcite and dolomite, with minor amounts of quartz, apatite, pyrochlore, magnetite, hematite, sulfides, and mica. Remote sensing approaches were able to map tectonic blocks, structures, and alteration minerals, which are the key targets for exploration.

These results improved our understanding of the geological processes that control the formation and distribution of REE-bearing carbonatites. By unlocking the economic potential of carbonatites and exploring new targets, the study contributes to the sustainable development of critical mineral resources. This chains the high-tech economy and meets the growing demand for these critical elements.