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## Geological characterization of the Evate carbonatite

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The Evate Carbonatite is an apatite-magnetite carbonatite located in the Nampula Province in northeastern Mozambique. Discovered in 1980, it constitutes the largest carbonatite within the Monapo Alkaline-Carbonatite Complex and arguably hosts the largest phosphate deposit in southeast Africa. Historical exploration work has been undertaken by the Bulgargeomin, Intergeo and Norsk Hydro companies [1]. From 2008 to 2012 Vale Mozambique undertook a comprehensive exploration program at the Evate carbonatite including extensive diamond drilling which has significantly advanced the geological understanding of the carbonatite.

The Evate carbonatite is characterized as a sill with a main orientation of N20°E and a dip of 40°-50° to the southeast, with a strike-length of 1.8 km and a thickness of 600 m in its central portion. Modelling of its magnetic anomaly indicates that the Evate carbonatite may extend to a depth greater than 1,000 m from surface.

Examination of drill core indicates that the Evate carbonatite can be subdivided into four main lithological units: (1) carbonatite (containing over 90% calcite); (2) magnetite apatite carbonatite (over 50% of calcite); (3) magnetite carbonatite (over 50% calcite) and (4) nelsonite (a phoscorite, containing less than 50% of calcite, but with abundant magnetite, apatite and subordinate olivine and phlogopite). Layering in the intrusion is observed at both the centimetre and metre scale by i) variations in the relative abundance of calcite, apatite and magnetite and ii) variations in grain size of the constituent minerals. Sharp changes in grain size between layers of similar composition suggest periodic crystal setting and accumulation. The Evate carbonatite is therefore a classic product of a magmatic chamber in which the three main constituent minerals are precipitating and accumulating. These oscillations are the result of changes in magma composition as the crystallization of one specific mineral dominates at different times. This process is analogous to that commonly observed in some basaltic magmas in mafic/ultramafic complexes, when olivine, orthopyroxene and plagioclase selectively crystallize [2]. The presence of phoscorites in the Evate carbonatite is the result of the process of accumulation from fractional crystallization and not from the formation of a phoscoritic magma through magma liquid immiscibility. Therefore, most of the phosphorous and iron contained in the magma have segregated and were able to form nelsonites, which occur as layers in the Evate carbonatite.

The Evate carbonatite configuration is different to the majority of carbonatites in the world which are found in anorogenic environments. In Evate, the carbonatite complex and the contained magmatic layering are parallel to the foliation of the gneissic host rocks suggesting the sill intruded into a tectonically active environment and was deformed by subsequent tectonic events that affected the Monapo Complex [2,3].

*References:*

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