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Petrogenesis of the Aris Phonolites of Central Namibia: inferences from Sr-Nd isotopes and element abundances.

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Petrogenesis of the Aris Phonolites of Central Namibia: inferences from Sr-Nd isotopes and element abundances.

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Abstract

The Aris phonolites in central Namibia are well-known for the occurrence of rare minerals and the discoveries of new minerals. These phonolites are eroded remnants of endogenous lava domes formed by the uplifting of Hohewarte Metamorphic Complex as magma is intruded from below. Scanning electron microscope and petrographic analyses show the typical major mineral assemblages aegirine, aegirine-augite, nepheline, sanidine, and albite for the two phonolite bodies at the Ariskop and Railway quarries. Several minor minerals including sodalite, REE-monazite, REE-titanite, sphalerite, galena, corundum, fluorite, thorianite, REE-carbonates, and bunsenite(?) were identified.

Primitive mantle-normalized multielement patterns of all phonolites overlap and show pronounced negative anomalies in Ba, Sr, and Ti, marked positive anomalies in Th, U, Pb, and Zr. They also show bowl-shaped REE patterns. These highly evolved sodic peralkaline phonolites exhibit negative Eu-anomalies and are enriched in incompatible elements, but low in Sr, Ba, and compatible elements ascribed to extensive fractionation of aegirine, feldspars and feldspathoids. Furthermore, their strong depletion in P and the MREE indicates an earlier separation of apatite and titanite. The phonolites show a large spread in $^{87}Sr/^{86}Sr$ ratios from 0.72947 to 0.74839 contrasted by a relatively narrow range in $^{143}Nd/^{144}Nd$ ratios from 0.51247 to 0.51255 (-1.7 to -3.1 e-values) indicating an enriched source. The Ariskop and Railway phonolites exhibit a Paleoproterozoic Hohewarte Metamorphic Complex rocks assimilation signature characterized by their isotope ratios and geochemical crustal contamination indicators. They are regarded as derivatives of alkaline mafic magmas by extensive differentiation processes.

GEOROC is very useful as it provides geochemical data on volcanic rocks from various locations around the world. Aris phonolites composition compared to GEOROC database compilation of world phonolites show distinct high contents in incompatible elements (Cs, Rb, Pb, Th, and U) suggesting a strongly enriched mantle source.