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Major and trace-element mineral chemistry and implications for the petrogenesis of Eocene alkaline volcanic rocks from the western Rio Grande Rise, South Atlantic Ocean

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To date, little research has investigated the petrogenesis of the Rio Grande Rise (RGR) alkaline volcanic rocks despite its importance for the evolution of the region. Mineral chemistry analyses (EPMA and LA-ICPMS) were performed in the main phases from porphyritic alkali basalts and associated trachytes dredged from the western RGR by the Oceanographic Institute of the University of São Paulo. Alkali basalts from dredge site D08 have macrocrysts of diopside, olivine (Fo80-87, usually altered) and rare plagioclase (An84-87) in a matrix with clinopyroxene, Fe-Ti oxides, plagioclase (~An65) and analcime. Diopside macrocrysts are often strongly zoned and have relict primitive cores (Mg#=82-90) with high Cr (1000-4500 ppm) and Ni (120-230 ppm) and Al- and Ti-rich borders (Mg#≥74, Al_2O_3 ~7-8 wt%, TiO_2 ~2-3 wt%) also enriched in incompatible elements (REE, Y, Zr, Sr). A continuous compositional trend between these two endmembers partly reflects incomplete diffusion after infiltration of a more evolved host magma, but infrequent regular concentric zoning suggests that equilibrium was reached in some cases. Alkali basalts from dredge site D05 have rare macrocrysts (kaersutite; diopside with Mg#=74-83; low Cr, Ni; no plagioclase) in a very fine-grained matrix. The trachytes are composed of up to 85% alkali feldspar plus clinopyroxene, Fe-Ti oxides and rare plagioclase (An25-35) and have up to 15% macrocrysts of alkali feldspar (Or=36-55), diopside and, in most samples, titanite. Diopside from trachytes have Mg#=66-71 and higher Na_2O, MnO, and incompatible trace element contents as well as lower TiO_2 (0.8-1.8 wt%) and Al_2O_3 (2.1-3.9 wt%) when compared to diopside rims from site D08 alkali basalts. LA-MC-ICPMS U-Pb dating of zircon crystals directly in a trachyte thin section, preserving textural relations, yields a weighted average age of 43.9 ± 1.4 Ma, consistent with the Eocene age of the alkaline volcanism that built the main structure of the western RGR. The zoned macrocrysts record key information about the complex evolution of the RGR magmatic system and provide important clues on mantle sources and polybaric crustal-level processes affecting these magmas, which will be better constrained when combined with future in-situ isotopic (Sr, Pb, Nd) data.