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Provenance and tectonic setting of Proterozoic metasedimentary sequences of the São Roque Domain, Ribeira Fold Belt, Brazil: a combination of whole-rock geochemistry, Sm-Nd isotopic systematics and detrital zircon U-Pb geochronology

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The Proterozoic São Roque Group (Ribeira Fold Belt, southeast Brazil) is a metasedimentary sequence deposited in a marine environment consisting of proximal metasandstones and meta-felspathic wackes with some volcanic layers (Boturuna Formation) and more distal metawackes and metamudstones (Piragibu Formation). A combination of zircon provenance studies in metasandstones (textural and trace-element analysis and U-Pb geochronology) and whole-rock major and trace-element geochemistry and Sm-Nd isotopic systematics in metamudstones was used to understand the provenance and tectonic significance of this sequence, and their implications to the evolution of the Precambrian crust in the region.

Whole-rock geochemistry indicates that the sources are largely granitic (as indicated for instance by the LREE-rich moderately fractionated REE patterns and subtle negative Eu anomalies) with some mafic contribution (responsible for higher contents of $Fe2O_3$, MgO, V, and Cr) and were subject to moderate weathering (CIA - 60 to 82).

The trace element signatures in detrital zircons indicate that most of them are derived from plagioclase-rich felsic rocks, as indicated by strong positive Ce anomalies, high (Lu/Sm)N ratios, low U/Yb, and a concave-down shape of the intermediate REE in chondrite-normalized plots. A significant proportion of the zircon crystals show rounded cores with growth zoning truncated and overgrown by a thin rim that has dark color in cathodoluminescence images. These overgrowths are chemically distinct, being enriched in trace elements, especially the LREE, and were dated at 584$\pm$47 Ma, reflecting the regional Neoproterozoic metamorphism.

Sm-Nd isotope data for Piragibu Formation metamudstones show four main groups of Nd TDM ages at ca. 1.9 Ga, 2.1 Ga, 2.4 Ga and 3.0 Ga. The younger ages define an upper limit for the deposition of the unit, and reflect greater contributions from sources younger than the >2.1 Ga basement. The oldest Nd TDM age (3.0 Ga) is similar to those of 2.2 Ga granitic clasts from the Boturuna Formation metaconglomerates.

The age spectra of detrital zircons from five samples of quartzite from the São Roque Domain show a wide range (1.7-3.4 Ga). The youngest detrital crystals, although subordinate, place a minimum limit for the depositional age of the São Roque metasedimentary sequences at $\sim$1.8-1.7 Ga, which is consistent with U-Pb dating of interlayered metavolcanic rocks. The coincident age peaks of Nd TDM and U-Pb detrital zircons at 2.1-2.2 Ga and 2.4-2.5 Ga, combined with the presence of a small amount of zircons derived from mafic (gabbroid) sources with the same ages, are suggestive that these were major periods of crustal growth in the sources involving not only crust recycling but also juvenile additions.

A similar geochemical behavior, consistent with sediments deposited in a passive margin basin for both Formations (Piragibu and Boturuna), suggests that these were coeval, probably with lateral correlation. However, the mudstones (Piragibu Formation) have Ce-depleted REE patterns compatible with clays from open sea, suggesting a more complex paleo-environment, probably with interaction between passive margin basin and volcanogenic sources related to oceanic island arc.