Tracking Neoproterozoic Magmatic Flare-Ups in Southeastern Brazil orogenic system Through Detrital Zircons Petrochronology

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Résumé

High-grade metamorphism, partial melting, and polyphase deformation frequently obliterate the early stages of Precambrian orogenic systems. Consequently, the reconstruction of lithospheric processes during early convergent cycles is challenging. Detrital zircon geochemistry is a powerful tool to access these hidden records, providing indirect constraints on the pressure, temperature, and redox conditions of ancient magmas. Trace element proxies such as Eu and Ce anomalies, and Lu/Hf ratio are particularly informative, though they are influenced by a number of factors including source composition, oxidation state, crystallization depth, and co-crystallization of accessory minerals.

Detrital zircon grains analyzed in this study were extracted from metasedimentary rocks (paragneiss and quartzite) sampled across transects that crosscut arc-related domains of the Araçuai-Ribeira orogenic system (AROS). These samples allow investigation of the magmatic evolution of the Mantiqueira Province in southeastern Brazil, a segment of the Brasiliano–Pan-African system adjacent to the São Francisco Craton. This province preserves a complex Neoproterozoic magmatic evolution, involving oceanic to continental arc magmatism, crustal thickening, and continental collision. In this province, the AROS includes remnants of three major arcs: the Tonian Serra da Prata arc, the Cryogenian Rio Negro arc, and the Ediacaran Rio Doce arc, all later affected by collisional and post-collisional reworking. Although well documented in the late Neoproterozoic, Tonian oceanic arc remnants remain underrepresented in zircon datasets.

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To target Neoproterozoic magmatic activity, we applied a two-step analytical protocol: pre-ablation was used to screen zircons ages and target only Neoproterozoic zircon grains, followed by single-spot LA-HR-ICPMS for coupled U-Pb dating and trace element analysis. This method filters out inherited cratonic minerals and late metamorphic overprints. Approximately 2,000 zircon grains were imaged (SEM-BSE and CL) and analyzed.
Preliminary U-Pb age distributions reveal three distinct magmatic flare-ups centered at ca. 850 Ma, 750 Ma, and 620 Ma. Geochemical trends suggest Eu and Ce anomalies variations through these intervals that may reflect changes in magma source, depth, and redox state, all these coupled with punctual Hf isotopy may provide a robust framework to understand magmatic cycles in AROS and their possible links with global Neoproterozoic paleoenvironmental variations.

Mots-Clés: Detrital zircon, Magmatism, Neoproterozoic, AROS