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Contrasting Neoproterozoic magmatic arc systems of Ribeira belt, SE Brazil: geodynamic implications

MONICA HEILBRON[1], MIGUEL TUPINAMBÁ[1], CAROLINE ARAUJO PEIXOTO[1], CLAUDIO DE MORISSON VALERIANO[1], SANDRO MAURI[2], JOVENTINE DECOL[1], FELIPE CORRALES[1] AND HENRIQUE BRUNO[1]

[1]Rio de Janeiro State University
[2]UERJ-Rio de Janeiro State University

The Neoproterozoic is recognized worldwide by the development of linear orogenic belts, with magmatic arcs that share close similarities with modern arc systems. Continental and intra oceanic arc types, subduction roll back and arc recycling, as well magmatic lulls are well described, just as took place in Phanerozoic systems. More importantly, they are the locus of crustal birth and growth, interfering in many aspects with the geodynamics of our planet, and ultimately controlling climate and life.

The present research within the Neoproterozoic Araçuaí-Ribeira Orogenic System (AROS) brings up new field, geochronology, isotopic and geochemical data that reveal a protracted and diachronic tectonic evolution. The contrasting Inner (IMAS) and Outer (OMAS) Magmatic Arc Systems show important along-strike differences due to paleogeography of a V-shaped ocean pointing northwards, with two branches that progressively widen southwards.

The IMAS is a continental magmatic arc developed on a Rhyacian continental ribbon that has Archean inheritance. It is a ca. 2000 km long accretionary terrane where different basement constitutions may have played a role in the heterogeneity of the arc related magmatism. In the Ribeira segment, U-Pb ages constrain a ca. 670-620 Ma period of arc production, although few Cryogenian ages suggest that convergence started before. As the lower crust is exposed, orthopyroxene-bearing granitoid rocks frequently occur. To the north, in the Araçuaí gulf, ages are younger, reaching ca. 585 Ma, with an ophiolitic mélange complex attached to the arc. Isotopic signatures point to continental arc setting.

Conversely, the OMAS outer system records a long period of convergence that comprises two magmatic stages and related sedimentary basins: ca. 860-790 Ma with magma generation in an immature intra-oceanic setting (advancing stage); and ca. 670-620 Ma with the development of geochemically more evolved magmatic arc rocks with increasing participation of the subducted metasediments and cannibalization of deep parts of the arc itself.

Finally, through multiple collisions (ca. 630 Ma, 605 Ma and 535 Ma) the two magmatic arc systems were progressively amalgamated to the São Francisco and Angola Paleocontinents, closing the paleo-ocean and building West Gondwana, one stable supercontinent that dramatically modified the geography of the planet.