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Multiple Sulfur Isotope evidence of an Archean age for the deposition of Jacobina Basin, São Francisco Craton, Brazil.

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The Jacobina Basin is a rift basin formed at the eastern margin of the Gavião Block, one of the most ancient units of the São Francisco Craton, northeast Brazil. The siliciclastic units of the Jacobina Basin exhibit an overall fining-upward pattern, with the basal alluvial deposits of the Serra do Córrego Fm., followed by highly mature coastal quartzites of the Rio do Ouro Fm., and by shallow-marine sediments of the Serra da Paciência Fm. The lower unit of the Jacobina Basin is also characterized by the occurrence of conglomerate beds that host Au-(U) and detrital pyrite-bearing mineralization.

A recent study [1] has shown that the Jacobina units have similar detrital zircon age spectra, with exclusively Paleoarchean ages, which in association to the detrital pyrite occurrence, point to a deposition during the Archean. Previous studies [2, 3], on the other hand, have suggested that deposition occurred during the Paleoproterozoic (between 2.1 and 1.9 Ga). Here we present multiple sulfur isotope evidence of an Archean depositional age for the Jacobina Basin.

Multiple sulfur isotope (^{32}S, ^{33}S, ^{34}S and ^{36}S) analysis was carried out using the SHRIMP-SI. Pyrite grains from conglomerates of the Serra do Córrego Fm., as well as from intercalated quartzites and metapelites of the Serra da Paciência Fm. were analysed. The detrital pyrite in conglomerate samples occur as rounded grains of massive and inclusion-bearing pyrite, both disseminated in the matrix, and less commonly as small grains hosted by quartz-pebbles. Pyrite grains from the marine rocks are generally small and euhedral grains, probably of a syngenetic/diagenetic origin.

The detrital pyrites from the conglomerate samples exhibit both mass-dependent (MDF) and mass-independent fractionation (MIF) of sulfur isotopes, with anomalous signatures of $\Delta^{33}S$ and $\Delta^{36}S$ up to 1.20 and -1.50‰, respectively. Pyrites from the marine metapelite sample carry MIF-S signatures with $\Delta^{33}S$ and $\Delta^{36}S$ up to -1.15 and 1.50‰, respectively. The marine quartzite sample exhibits the largest MIF-S anomalies ($\Delta^{33}S$ up to 2.50‰ and $\Delta^{36}S$ up to -2.00‰). The $\delta^{34}S$ values of these pyrites are restricted between -8.8 and 7.3‰.

The occurrence of detrital pyrite and uraninite in ancient placer deposits has been considered a strong evidence for the low oxygen level of Archean atmosphere, as these minerals are very sensitive to high oxygen levels, and they are absent from the geological record after the Great Oxidation Event (GOE). Low atmospheric levels of oxygen are also required for the formation and transfer of MIF-S signatures from atmosphere to sediments [4]. These conditions were attained until approximately 2.45 Ga, when MIF anomalies started to disappear from the geological record. The presence of MIF-S signatures in the sedimentary strata of Jacobina Basin is a strong evidence that its deposition had occurred under the anoxic conditions of the Archean Eon, which is also supported by the occurrence of detrital pyrite associated with Au-(U) mineralization.

References:

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