Eustatic control on superheavy $\delta^{34}S$ pyrite trends from late Ediacaran-early Cambrian carbonate successions of the West Gondwana: sulfate distillation cycles in shallow water platforms?

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Pyrites from Neoproterozoic successions often present extremely ^{34}S-enriched isotope compositions, referred to as superheavy pyrites. The genesis of these anomalous signals has been debated either in terms of paleodepositional controls, resulting from microbial sulfate reduction under sulfate-limited conditions, or in terms of late diagenesis thermochemical sulfate reduction. Constraining paleodepositional effects over these signals is thus crucial to decipher if they track changes in the ancient sulfur cycle. We present multiple sulfide-sulfur isotope compositions from two late Ediacaran-early Cambrian basins from Brazil. The Tamengo Formation represents carbonate deposition in the paleocontinental margin, whereas the Bambuí Group records a restricted epeiric carbonate ramp deposited in the core of the West Gondwana. Both basins record positive $\delta^{34}S_{py}$ excursions coupled to regressive cycles, reaching $\delta^{34}S_{py(VCDT)}$>+40‰. $\delta^{34}S_{py}$ *vs* $\Delta^{33}S_{py}$ relationships match Rayleigh distillation trends suggesting sulfate exhaustion along these cycles. Our data suggest that the anomalous ^{34}S enrichment in pyrites is a continental-scale event controlled by eustasy and sulfate-limited conditions in shallow water environments, with sulfate re-supply possibly controlled by transgression of more concentrated ocean waters over these basins.