Redox state evolution of the late Cryogenian Ocean: A case study from the Nanhua Basin

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The nature of ocean redox chemistry between the Cryogenian Sturtian and Marinoan glaciations is important for understanding the relationship between environmental conditions and the subsequent emergence and expansion of early animals, it is yet poorly understood. The Cryogenian-to-Ediacaran stratigraphic succession of the Nanhua Basin in South China provides a nearly complete sedimentary record of the Cryogenian, including a continuous record of interglacial sedimentation.The interglacial succesion of the Nanhua Basin is consists of predonminantly black shale and gray shale with Mn-ore beddings in the bottom part. A systematic investigation has been carried out using both traditional and non-traditional isotope tools.

Fe and S isotope compositions are obtained from a drill-core through Sturtian glacial diamictites and the overlying interglacial sediments in the Songtao area. Both Fe and S isotope profiles exhibit significant stratigraphic variation: Interval I, comprising upper Tiesi'ao diamictites (correlative with the Sturtian glaciation), is characterized by modern seawater-like Fe isotope compositions and heavy but decreasing upward S isotope compsitions; Interval II, comprising uppermost Tiesi'ao diamictites and the basal Datangpo Formation, is characterized by an abrupt shift to heavier Fe and S isotope compositions; and Interval III, comprising the middle and upper Datangpo Formation, is characterized by the return of seawater-like Fe isotope compositions and lighter S isotope compsitions. These results indicate the increasing oxygenation during the Cyogenian interglacial period.

Organic C isotope compsitions are obtained from three drill-cores from the Songtao, Minle and Xiangtan areas, representing for shelf, slope and basinal settings, respectively. The three profiles of organic C isotope compsitions are different from each other. The basinal section shows the lightiest C isotope enrichment and little temporal variation in C isotope compositions, and shelf setting section exhibits heavier isotope enrichment and overall increasing $\delta^{13}C$ values upward section, whereas the C isotope features of the slope section are somewhere in between. These results illustrate the spatial and temperoal redox evolutions of the Nanhua Basin.