

The redox conditions in the ocean of Nanhua Basin during the Tonian.

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As a key period of earth's geological history, the Tonian (1000Ma-720 Ma) recorded the critical transformation of the co-evolution between marine redox environment and early life before "Snowball Earth".

Marine sedimentary strata of the middle to late Tonian are exposed over a large area in South China. In this study, we collected 32 shale samples from the middle to late Tonian in South China, and the stratigraphic age was within 780~765 Ma. We searched for and counted the particle size and distribution range of framboids, and completed the whole rock major and trace test and LA-ICP-MS analysis for framboids. Combined with the previous research, the average particle size and distribution range of 29 samples are in the anoxic-euxinic environment, and the average particle size of 3 samples is between 6-10 μm , and there are euhedral pyrites, reflecting that the depositional environment was dysoxic, and the samples representing dysoxic, anoxic, and euxinic samples are distributed according to the stratigraphic thickness, which indicates that the ocean in the middle to late Tonian was generally in the anoxic state, and oxygenation began to appear at the same time. This indicates that the ocean remained in an anoxic state during the middle and late Tonian, and at the same time, small fluctuations in oxygen content began to occur, leading to a cyclic occurrence of sedimentary records in different oxygenated environments.

The LA-ICP-MS tests carried out on the framboids in the samples, combined with the analysis of the previous data, revealed that the contents of Mo, U, Cr, Co, Ni, and As were higher than those of the previous data in the corresponding Tonian. This indicates that a more significant increase in the content of redox-sensitive elements occurred during the middle and late Tonian in South China, with high values significantly different from those of the previous data, suggesting that the degree of ocean oxidation gradually increased during this period and retained this progressive environmental information in the sedimentary, thus revealing the redox environmental information and evolutionary trend of the ocean in the middle and late Tonian.