

Carbon isotopic records in 1.6-1.0 Ga sediments from Yanshan area, northern China

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The Mesoproterozoic (from 1.6 to 1.0 Ga) is referred as a remarkably long interval of relative stability in crustal dynamics, climate and oxidation state of the surface environment. Variations in the carbon isotopic compositions of carbonate and organic carbon may provide a record of changes in carbon cycle and climate, yet Mesoproterozoic carbon isotope data still remains scarce. Mesoproterozoic sedimentary sequences were widely developed and well preserved in the Yanshan Area, northern China. Based on the radiogenic isotope data, the age of this sequence was constrained between 1.7 to 1.0 Ga ago. Over 700 samples were collected from three drill cores in the Yanshan Area, northern China. Organic carbon isotopic compositions, TOC, and sulfur concentration were analyzed for those Mesoproterozoic samples. No systematic relation between TOC and $\delta^{13}\text{C}_{\text{org}}$, low thermal maturity and global correlation indicate that diagenetic influences on the carbon isotopic compositions are negligible and the primary signals of carbon isotopic compositions were well recorded in those sedimentary samples. Patterns of carbon isotopic variation in $\delta^{13}\text{C}_{\text{org}}$ may provide insight into the Mesoproterozoic carbon cycle. Most of samples from Gaoyuzhuang (ca. 1.6 to 1.4 Ga) show lower $\delta^{13}\text{C}_{\text{org}}$ values those range from -34.3 to -31.1 ‰ and have an average of -33.1‰, rich in TOC and S. For the Hongshuizhuang Formation (ca. 1.2 to 1.1Ga), $\delta^{13}\text{C}_{\text{org}}$ values range from -33.7 to -29.1‰, with an average of -32.1‰. For the Tieling Formation, $\delta^{13}\text{C}_{\text{org}}$ values range from -32.5 to -28.3‰, with an average of -29.8 ‰. $\delta^{13}\text{C}$ in carbonate samples of Gaoyuzhuang Formation range from -1.29 to 0.94 ‰. The isotopic difference between organic matter and carbonate ranges ($\Delta B = \delta^{13}\text{C}_{\text{org}} - \delta^{13}\text{C}_{\text{carb}}$) could be used as a proxy for atmospheric $p\text{CO}_2$. Very low ΔB (ca. -35.2 to -29.8‰) values indicate extreme high $p\text{CO}_2$ and a greenhouse environment at the interval of 1.6 to 1.4 Ga ago. Positive excursions and relative higher ΔB in the upper Hongshuizhuang and lower Tieling Formation suggest that enhanced burial of organic carbon resulted in the decrease of $p\text{CO}_2$ in the Late Mesoproterozoic. High S/C ratios (>0.36) indicate anoxic environment were developed in the Gaoyuzhuang and Hongshuizhuang stages, and the anoxic environment contributed to the burial of organic carbon.

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