

Isotopic investigation of the sulphur and carbon cycles in sedimentary rocks from the Yangtze Platform, southern China

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Introduction

A well preserved Neoproterozoic and Cambrian sedimentary succession on the Yangtze platform provides an excellent setting for isotopic investigations. The principal succession exposed comprises in ascending stratigraphic order the Nantuo Formation with glacial deposits, followed by the predominantly calcareous Doushantuo and Dengying formations and black shales of the lower Cambrian Niutitang/Guojiaba Formation. Paleoenvironmental conditions range from very shallow water (evaporite deposition) across the shelf into deeper water.

The prime aspects which will be addressed during this study are: seawater chemistry, biogeochemical evolution and chemostratigraphy.

Results

Sediments of Sinian age (Nantuo, Doushantuo, Dengying formations) show low to moderate total organic carbon abundances (0.01-0.1 wt%). Organic carbon isotope values range between -33 and -24‰. In contrast, early Cambrian black shales display higher organic carbon abundances (up to 5 %) and $\delta^{13}\text{C}$ values between -35 and -30‰. Carbonate carbon isotope values are displaced by 32‰.

Highly variable $\delta^{34}\text{S}$ values for sedimentary pyrite, particularly for the early Cambrian black shales, reflect bacterial sulfate reduction, sometimes under closed system conditions. Seawater sulfate as recorded in barite and phosphorite shows sulfur isotope values around -30/-34‰.

Discussion

Based on their respective isotopic compositions, the sulphur and the carbon cycle reflect global geochemical perturbations of the ocean/atmosphere system. As such, variations in the carbon isotopic composition reflect fluctuations in the fractional burial of organic matter.

Stable isotope geochemistry of impact related alteration phases from the Woodleigh impact structure, Western Australia

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The Woodleigh impact structure, Western Australia has a diameter of some 120 km based on geophysical, morphometric and surface drainage evidence which makes it one of the largest Phanerozoic impact structures [1, 2, 3, 4]. Age determinations using the K-Ar systematics of impact related illitic clay minerals together with stratigraphic age constraints indicate a mid to Late Devonian age for Woodleigh and confirm its relevance to the late Devonian mass extinction [3, 4]. To constrain the post impact hydrothermal history of Woodleigh we have determined the stable isotope compositions of shocked granitoids and alteration phases in samples from the composite fault-bounded central uplift. Shocked granitoid samples from which all alteration phases have been removed ultrasonically have $\delta^{18}\text{O}$ values of 9.2 and 10.5 ‰ that are at the upper end of the normal range for granitic igneous rocks. Alteration clays and carbonates have significantly higher $\delta^{18}\text{O}$ values from 13.4 to 18.9 ‰. The coarsest clay fractions have the lowest $\delta^{18}\text{O}$ values of 13.4 and 13.6 ‰ that are interpreted to result from contamination with primary biotite and quartz. Based on the $\delta^{18}\text{O}$ values, a temperature estimate of 200°C for the formation of the Woodleigh clays and the illite-water, smectite-water and calcite-water fractionations equations [5, 6], the calculated fluid $\delta^{18}\text{O}$ values range from 6.5 to 11.7 ‰. These compositions are highly enriched in ^{18}O and overlap the fields of magmatic and metamorphic fluids. Extensive interaction at relatively low water/rock ratios with ^{18}O -rich rock types is required to explain the large ^{18}O shift as the hydrogen isotope compositions indicate water in the impact related hydrothermal system was largely of surface derivation. ^{18}O -enrichment of the country rocks may reflect shock-induced oxygen isotope fractionation [7] and/or the involvement of ^{18}O -rich condensed meteoritic components that were injected into the crater floor [2]

References: [1] Mory A. J. et al. (2000) *Earth Planet. Sci. Lett.*, 177, 119–128. [2] Mory A. J. et al. (2000) *Earth Planet. Sci. Lett.*, 184, 359-365. [3] Uysal I.T. et al. (2001) *Earth Planet. Sci. Lett.*, 192, 281-289. [4] Uysal I.T. et al. (in press) *Earth Planet. Sci. Lett.* [5] Sheppard S.M.F. and Gilg H.A. (1996) *Clay Min.*, 31, 1-24. [6] O'Neil J.R. et al. (1969) *Journ. Chem. Phys.*, 51, 5547-5558. [7] Vennemann et al. (2001) *Geochim. et Cosmochim. Acta*, 65, 1325-1336.