The effect of post-depositional fluids on Edicaran sedimentary carbonate in South China

YAN-YAN ZHAO* AND YONG-FEI ZHENG

School of Earth and space science, University of Science and technology of China, Hefei 230026, China (*correspondence: yyanzhao@ustc.edu.cn)

The post-depositional fluid flow in carbonates can alter the primary geochemical signatures, leaving detectable signatures in the chemical sedimentary rocks. The geochemistry of veins or cements is essential to understanding the origin of post-depositional fluids. We carried out a detailed study that combines the conventional and laser methods of analyzing C-O isotopes and trace elements in Ediacaran carbonates of the Lantian formation at Piyuancun in South China. Different components of carbonates (calcite, dolomite and bulk carbonate) and different microfacies (wallrock and veins) were analyzed, respectively. The results are used to examine the primary geochemical signatures and geometry of post-depositional fluid flow. All carbonate components show $\delta^{18}O$ values of -18.48 to -12.78‰ and $\delta^{13}C$ values of -10.28 to -7.02‰ (both relative to PDB). The $\delta^{18}O$ values for all carbonate components are almost consistent, but dolomites have slightly higher $\delta^{13}C$ values than the calcite and bulk carbonate. The different components of carbonate have preserved their primary geochemical signatures based on isotope fractionations between calcite and dolomite. Thus, the dolomite would probably precipitate from the same water as the calcite. The veins can be divided into Groups A and B based on their $\delta^{18}O$ values of –17.2 to –11.3‰ and –23.7 to –18.1‰, respectively. Nevertheless, $\delta^{13}C$ values for all the veins and wallrock fall in the same range from –10.6 to –8.9‰. Group A veins have different $\delta^{18}O$ values and REE patterns from the corresponding wallrock, indicating that these veins and wallrock are not in equilibrium with each other and vein-forming fluids are of external origin. There is no correlation between $\delta^{18}O$ and $\delta^{13}C$ values for these veins and wallrock, suggesting that the wallrock was not altered by diagenesis. The low $\delta^{18}O$ values for these veins indicate that the vein-forming fluids were derived from continental deglacial meltwater subsequent to the Gaskiers iceage. Group B veins have similar $\delta^{18}O$ and $\delta^{13}C$ values to the corresponding wallrock. Their REE patterns are almost similar to those of the wallrock except a small difference in HREE. These features indicate that vein-forming fluids are similar to those of wallrock and thus of internal origin. The precipitation water for these veins and wallrock is probably related to seawater. Therefore, the post-depositional effects of diagenetic fluids are recorded by the vein-wallrock compositions.

Zinc isotopes in the Southern Ocean – A tracer of biogeochemical cycling?

Y. ZHAO[1]*, D. VANCE[1] AND W. ABOUCHAMI[2]

[1]Bristol Isotope Group, School of Earth Sciences, University of Bristol, Wills Memorial Building, Bristol BS8 1RJ, UK (*correspondence: y.zhao@bristol.ac.uk)

[2]Max Planck Institute for Chemistry, P.O. Box 3060, 55020 Mainz, Germany (wafa.abouchami@mpic.de)

Zinc (Zn) is an important trace metal micronutrient in the marine realm. Dissolved Zn concentrations show extreme variation in the ocean, probably due to both biological uptake and regeneration as well as abiotic processes. Zn isotopes may be useful in tracking this biogeochemical cycling. Here we report the first Zn isotopic data for the Southern Ocean, using a newly developed analytical approach. Our samples derive from the IPY/Geotraces ANT-XXIV/III cruise (Atlantic sector, Southern Ocean), whose main objective was to study the biogeochemistry of trace metals in the Fe-limited Southern Ocean. Our study is focused on the distribution and isotopes of dissolved Zn across the major frontal systems along the Greenwich Zero Meridian, including 3 depth profiles and 11 samples across a surface transect.

Much higher Zn concentrations were found at the surface of the southern ACC and the Weddell Gyre (WG) relative to that of Sub-Antarctic Front (SAF). The WG depth profile showed a local Zn (and Si) concentration maximum in the upper 200m. Zn and Si concentrations show tight linear correlations at any one site. Surface waters, however, showed a monotonically poleward decreasing trend of Zn/Si. Heavy $\delta^{66}Zn$ was found in the surface waters of the southern ACC and WG. Anomalously low $\delta^{66}Zn$ at around 50m depth has been noted in two of the three depth profiles in this study. In surface waters $\delta^{66}Zn$ is fairly constant except for a pronounced fall in at the Polar Front Zone (PFZ) co-incident with a drop in concentration.

These Zn isotope variations are consistent with biological uptake of light isotopes in the photic zone. Isotopically light Zn at around 50m is consistent with findings of similarly light Zn in the shallow sub-surface at other locations, and may highlight the role of shallow recycling of cellular Zn as an important process in the oceanic Zn cycle.