Detailed geochemical data before and after snowball (Ghaub) glaciation in Namibia

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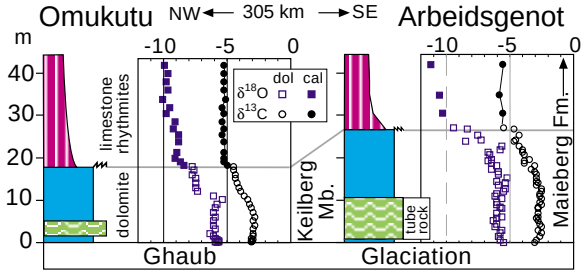
The association of Neoproterozoic glaciations and large $\delta^{13}C$ anomalies in marine carbonates was firmly established over 15 years ago by Knoll et al. (1986). However, only recently has the detailed structure of the anomalies and their stratigraphic relations to glaciation emerged. High-resolution, stratigraphically-constrained isotopic data have motivated new interpretations of Neoproterozoic glaciations (e.g. Hoffman et al., 1998) and now form the basis for simple quantitative models. In Namibia, for example, a highly reproducible, >10‰ negative $\delta^{13}C$ anomaly immediately precedes the Ghaub glaciation and indicates that the onset of this ice age cannot be explained simply in terms of low pCO_2 resulting from intense organic carbon burial (Halverson et al., *in press*).

The resolution and fidelity of isotopic data in Neoproterozoic cap carbonates is now sufficiently high to track the geochemical consequences of snowball glaciation early in its aftermath. We present new, closely-spaced $\delta^{13}C$ and $\delta^{18}O$ data from the lower Maieberg Formation, cap carbonate to the Ghaub glaciation (Figure 1). These data reveal remarkable fine-scale structure in isotopic trends that are reproduced (within 1‰) in widely spaced sections. $\delta^{13}C$ smoothly declines from a high of -3‰ in the lower half of the basal 'cap dolostone' (Keilberg Member) to -4.5‰ in the upper half before abruptly dropping to -5.5‰ across a flooding surface atop the dolostone (Figure 1). These trends are directly linked to the sedimentology, elemental chemistry, and mineralogy of the cap carbonate.

Figure 1. Plot of $\delta^{13}C$ and $\delta^{18}O$ data through two sections of the lower Maieberg Formation.



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Seasonal variation of Sr isotope ratios of the aeolian dust in rainwater

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Mineralogical and strontium isotopic compositions and amounts of aeolian dust contained in rainwater in Japan may reflect the variation of air circulation above the Asian continent and the transportation rate of aeolian dust to the Pacific Ocean. Accordingly we have made observation of these in Fukuoka, Kyushu, Japan, since 1998 to the present to see their seasonal and yearly variations.

The rainwater generally contains aeolian silicate dust and organic dark material about six times of the silicates. In summer time the organic material may comprise mainly of pollens derived from vegetation in Kyushu, however, it seems mostly to be transported with the aeolian dust from China in other seasons. The silicate dust in rainwater annually amounts to 0.92 g/m^2/year in Kyushu, most of which is observed from February to April. A sedimentation rate of aeolian deposite is 0.54 g/m^2/year in northern part of the Pacific Ocean (Leinen and Heath, 1981), and the particle fallout rate is 0.62 g/m^2/year at Midway in the Pacific Ocean (Uematsu et al., 1985). Therefore the annual amount of the aeolian dust in rainwater observed in Kyushu is almost the same order as these observations in the Pacific Ocean.

Seasonal variations of amounts and strontium isotope compositions of the aeolian dust show the same pattern of their variation in these four years with their peaks in March-April (0.2 ~ 0.4 g/m^2/month and 0.717, respectively) and valleys in July-August (0.01 ~ 0.02 g/m^2/month and 0.710, respectively). Minerals contained are quarts, plagioclase, K-feldspar, biotite, muscovite, chlorite, amphibole, talc, pyroxene, and clay minerals. Spherical magmetite is often observed in winter, probably suggesting its derivation from coal ash in China. In summer minerals are generally fine grained (1 ~ 2 μm) and comprise much clay minerals.