

Early Triassic $\delta^{18}\text{O}$ pattern of marine carbonate sediments: Diagenetic or close to primary carbonate isotope signal?

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The oxygen isotope composition of recently marine precipitated minerals can give information about the ambient sea temperature or isotope composition. This is of special interest when investigating paleoecological conditions. However, the influence of diagenesis has to be taken into account. Oxygen isotopes of carbonates are regarded in general as very prone to diagenesis. Only unaltered brachiopod shells and, with many reservations, calcite micrites are said to have the potential of preserving their primary oxygen isotope signal (e.g.: Marshall 1992). Bulk carbonates sampled without scrutinized screening for diagenetical influences are regarded as unreliable with respect to oxygen isotopes.

We have investigated the oxygen isotope composition of several Early Triassic sections from different regions. Some of the samples have been taken by removing weathered surfaces, veins and stylolites and grinding the sample. Other samples have been produced with a microdrill, and several samples have been drilled from each hand specimen to investigate the patterns and different fractions present in the rock sample. The investigated sections are in the Dolomites (Northern Italy): Uomo, Pufels; Iran: Abadeh, Zal, Amol; China: Chaohu; Japan: Kamura. The isotope measurements generally show a cloudy pattern, giving evidence of the influence of diagenesis. Besides that some other patterns are present: At the Permian-Triassic boundary a decrease in oxygen isotopes is recognizable in most of the sections (except Chaohu section) and at the Smithian-Spathian boundary an increase in $\delta^{18}\text{O}$ of 1.5 to 2 ‰ is evident. As this pattern has been found in sections of the Tethys and Panthalassa realm, it seems to represent a global event. Possible causes might be:

- 1) A diagenetical event: influence of diagenetical waters passing through the sediment body.
- 2) A chemical event: changing the water chemistry to precipitate high magnesium carbonates (dolomite) might cause a change in oxygen isotope composition, as this causes a change in the fractionation factor,

- 3) A temperature event: a drop in temperature changes the fractionation to heavier isotope values,
 - 4) An isotope effect: removal of light oxygen isotopes (e.g. by the build-up of a polar ice shield) or the addition of heavy $\delta^{18}\text{O}$ (rather difficult to produce, e.g.: opening to the ocean of a secluded basin/sea with strong evaporation and therefore isotopically heavily enriched water).
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- 1 does not seem to be very probable, as diagenesis usually is caused by local or regional formation waters or migrating fluids and therefore should be caused by local or regional factors; as the different sections are representing different seawater depths also a change in sea level cannot produce this pattern.
 - 2 might be a possible cause, although dolomite usually is regarded as diagenetically formed mineral. Possible mechanisms to produce a dolomite formation in the sediment must be evaluated.
 - 3 is a possible mechanism, however, there is no evidence for a world-wide significant change in seawater temperature (around 6°), and temperatures calculated from the carbonate $\delta^{18}\text{O}$ are not realistic (too high).
 - 4 can also produce the shift in oxygen isotopes, however, the shift present in the sediments would correspond to a build-up of ice caps similar as the last ice age. As there is no evidence for decrease in temperature and formation of ice at the Smithian-Spathian boundary, these mechanisms can be ignored.

The increase of $\delta^{18}\text{O}$ in marine carbonates from the Smithian-Spathian boundary is most likely caused by a change in ocean chemistry, resulting in precipitation of high magnesium calcite. Processes leading to this effect have to be evaluated.