A geochemical framework in retrieving the linked depositional and diagenetic histories of marine carbonates

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To obtain the important information on the history of Earth surface stored in marine carbonates, it needs a comprehensive understanding of the sedimentary environments and the diagenetic histories of marine carbonate sediments. In modern shallow-water carbonate platforms, successive changes of diagenetic zones were found as a result of a sea level drop. Although such a relationship is important in the identification of diagenetic processes, in the interpretation of global carbon isotope shifts and in finding the reasons for positive correlations between carbonate carbon and oxygen isotopes, it is not easily recognized in ancient marine carbonates because evidences for sea level change can be cryptic in rock record. To solve this issue, we carry out a combined study of rare earth elements and yttrium (REE+Y) and C-O isotopes of Carboniferous-Triassic marine carbonates from the Lower Yangtze region in South China.

The relationships between inter-REE+Y ratios such as Y/Ho vs. $(Nd/Yb)_{PAAS}$ of pure carbonates strongly indicate mixing between fresh water and seawater. The REE+Y patterns of pure carbonates show regular stratigraphic variations, reflecting regular changes of fresh water addition that were likely due to the changes of relative sea level. Changes of diagenetic zones indicated by the relationships between carbonate C-O isotopes and other evidences followed the changes of relative sea level suggested by the REE+Y patterns. Thus, combined REE+Y and C and O isotopic results of pure carbonates can provide robust constraints on the changes in the linked depositional environments and diagenetic processes of marine carbonates.