Clumped Isotope Compositions of Marbles: an example from the Backbone Range of Taiwan

A.H. LASKAR[1], T.F. YUI[2*], M.C. LIANG[1]

[1] Research Center for Environmental Changes, Academia Sinica, Taipei, Taiwan
[2] Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan

Clumped isotope composition of carbonates provides a way to retrieve temperature conditions in ancient systems without the knowledge of the isotopic compositions of co-existing phases. In this study, we present clumped isotope compositions of marbles from the Backbone Range of Taiwan. These marbles has experienced greenschist-facies metamorphism. The possible implications of their clumped isotope compositions are discussed.

Selected marble samples from both thin marble layers and massive marbles of the Backbone Range (Table 1 and Fig. 1) were analyzed for their bulk stable isotopes and clumped isotope compositions ($\Delta 47$). $\Delta 47$ of these samples ranges from 0.350 to 0.484 per mil (Table 2). The corresponding estimated temperatures range from 95 to 205°C (Table 2 and Fig. 1), following the calibration by Guo et al. (2009). The calculated O-isotope compositions of the co-existing fluid phase ranges from -1.9 to +10.7 per mil (Table 1), based on the calibration of O'Neil et al. (1969). The resulting temperature estimates are lower than and do not correlate with the observed metamorphic grade trend of the Backbone Range. The results may thus indicate temperatures of the last dynamic open-system recrystallization of marbles due to tectonic movements, especially for those samples near marble-country rock contact. On the other hand, the higher temperature estimates, mainly from samples located at interior part of massive marbles, may alternatively signify closed-system cooling/closure temperatures during rock exhumation. If the latter proposition holds, such samples may provide valuable information on the cooling/exhumation rate of the whole mountain belt. In summary, the present study demonstrates that clumped isotope composition of marbles indeed has the potential revealing key process characteristics during mountain building.