Near-equilibrium temperatures derived from the clumped isotope signatures of methane seep carbonate: Japan Sea and the northwest Pacific

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Recent improvements in analytical technique have allowed the clumped isotope (Δ_{47}) to become a promising tool in understanding the formation temperatures of modern methane seep carbonates [1]. However, one recent study [2] has yielded significantly higher temperature signatures (up to 50 °C) when compared with the actual seafloor temperatures. This suggests that problems still exist with either calibration or our understanding of the isotopic systematics.

In this study, we analyzed the clumped isotope signatures of carbonate collected from sediment cores in the Japan Sea and the northwest Pacific. Applying a laboratory-specific calibration, the average formation temperatures of carbonates from Oki Trough, Joetsu Knoff, Mogami Trough, Hidaka Trough, and Senoumi are 3.2±0.6°C (*n*=8), -1.7±1.2°C (*n*=13), -0.3±0.9°C (*n*=4), 4.5±2.3°C (*n*=5), and 6.1±1.3°C (*n*=4), respectively. Considering the analytical precision, they are comparable with the seafloor temperatures, which are ~0.4°C, 0.4°C, 0.6°C, 3.0°C and 9.0°C, respectively.

Additionally, temperature differences (e.g. ca. 5°C) between sampling areas with similar seafloor temperatures may also reflect controlling factors other than temperature; for instance, carbonate particles precipitated from various sources, or/and the kinetic effect.

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[1] Wacker et al. (2014), Geochim. Cosmochim. Acta 141, 127-144.
[2] Loyd et al. (2016), Nature Communications 7:12274, 1-12.