

# The paleo ocean temperature recorded in carbonate clumped isotope of early Pleistocene fish otolith fossils from the Dainichi Formation of the Kakegawa Group, Shizuoka

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The Dainichi Formation of Kakegawa Group distributed in southwestern Shizuoka Prefecture is shallow sea sediment of early Pleistocene (~2 Ma) and contains various marine fish otoliths. Otolith is calcium carbonate structure in the inner ear of vertebrates and used as balance indicator. Otolith of teleost fish especially grows large and many of them weigh over ~10 milligrams. They often keep firm structure in stratum. We analyzed the bulk and clumped isotopes of fossil and modern otoliths of several species including *Sillago* sp. *Nibea* sp. *Apogonichthys* sp. in order to examine their potential for the ancient temperature archive.

The carbonate clumped isotopes thermometry is a technique to reconstruct the temperature of mineral precipitation without the isotopic information of the parent water. The abundance anomaly of <sup>47</sup>CO<sub>2</sub> ( $\Delta_{47}$ ) generated by acid digestion of calcite is an index of temperature (Ghosh *et al.* 2006). There are few studies about otolith  $\Delta_{47}$  value although its rigid microstructure is tolerant against diagenetic alteration. The temperature calibration of fish otolith  $\Delta_{47}$  value by Ghosh *et al.* (2007) is marginally different from the original calibration of Ghosh *et al.* (2006). The small discrepancy might reflect a vital effect, or systematic error in temperature estimation of fish growth (Eiler, 2011). We used temperature calibration depending on synthetic calcites developed by Kato *et al.* (2019).

The  $\Delta_{47}$  values were 0.709–0.723‰ (13.0–17.4°C) for fossil *Sillago*, 0.717–0.719‰ (14.0–14.7°C) for fossil *Nibea* and 0.724‰ (12.4°C) for fossil *Apogonichthys* with typical measurement error of ±0.01‰. While the modern otoliths yield  $\Delta_{47}$  temperatures well reproducing the modern ocean temperature. The result of paleo temperature reconstruction is ~5°C colder than  $\Delta_{47}$  temperatures from modern otoliths. The paleo water  $\delta^{18}\text{O}$  value reconstructed from fossil otolith  $\delta^{18}\text{O}$  corrected by  $\Delta_{47}$  temperature was –1–2‰VSMOW. This value is significantly lower than present ocean  $\delta^{18}\text{O}$  and may indicate strong influence of fresh water in the depositional setting of the lower Pleistocene Dainichi Formation.

## References;

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