A first insight into Mid-Piacenzian Warm Period seasonality: Clumped isotope analysis of bivalve shells

Andrea Chiari[1], Niels de Winter[2], Gaia Crippa[1], Giulio Pavia[3], Martin Ziegler[4]

[1]Department of Earth Sciences 'A. Desio', University of Milan, Via Mangiagalli 34, 20133 Milan, Italy
[2]Department of Earth Sciences, Faculty of Science, Vrije University Amsterdam, 1081 HV Amsterdam, The Netherlands
[3]Department of Earth Sciences, University of Turin, Via Valperga Caluso 35, 10125 Turin, Italy
[4]Department of Earth Sciences, Faculty of Geoscience, Utrecht University, 3584 CB Utrecht, The Netherlands

Clumped isotope thermometry (Δ_{47}) is a technique that is being increasingly applied to biogenic carbonates, as it provides a powerful tool for reconstructing seawater palaeotemperatures without requiring past $\delta^{18}O_{sw}$ value assumptions. Bivalve shells are recognised as one of the most valuable archives for its application, as they often live in settings affected by changes in $\delta^{18}O_{sw}$ values. Here, we perform for the first time clumped isotope analyses to bivalve shells from an Italian Pliocene succession, using a sclerochronological approach to reconstruct seasonal variations. We analyse four pristine shells belonging to taxa with different growth rates: two slow-growing *Glycymeris bimaculata* (Poli, 1795) and two fast-growing pectinids, *Aequipecten opercularis* (Linnaeus, 1758) and *Perapecten scabrellus* (Lamarck, 1819). The combination of species with contrasting growth rates allows reconstruction of seasonality of different record lengths: 2-3 years (Pectinidae) to more than 10-15 years (Glycymerididae). These taxa come from the Rio Vaccaruzza section (Villalvernia, Piedmont, Italy), deposited in the Tertiary Piedmont Basin and attributed to the Mid-Piacenzian Warm Period (3.3-3.0 Ma). Specimens were collected from Bed 3 of the Rio Vaccaruzza section, characterised by muddy sand deposits of the Sabbie di Asti Formation. The depositional environment is interpreted as an infralittoral setting influenced by hyperpycnal flows, leading to bottom-water instability and salinity fluctuations. Under this depositional setting, clumped isotope analysis is crucial as it enables independent reconstruction of seasonal seawater temperatures and $\delta^{18}O_{sw}$ variability recorded in bivalve shells. Preliminary Δ_{47} and $\delta^{18}O$ data indicate higher mean annual water temperatures compared to the modern Northern Adriatic Sea, along with seasonal $\delta^{18}O_{sw}$ value fluctuations consistent with a shallow-marine environment affected by variable freshwater input.