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Daily cyclicity in bivalve shell chemistry: Paleo-weather record or circadian rhythm?

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Bivalve shells have a long-standing reputation as archives for high-resolution (seasonal scale) (paleo)climate variability due to their incremental growth, yielding accurate shell chronologies, and their abundance, diversity, and high preservation potential in the fossil record (Schöne and Surge, 2012). Capitalizing on innovations in geochemical techniques, high-resolution sclerochronology can now resolve changes in bivalve shell chemistry beyond the daily resolution (e.g. Sano et al., 2012; Warter et al., 2018). When applied on fossil shells, these ultra-high-resolution records have the potential to bridge the gap between climate and weather reconstructions and yield unprecedented information about bivalve paleobiology, extreme weather events in past climates and even astronomical cycles (Warter and Müller, 2017; de Winter et al., 2020; Yan et al., 2020).

However, studies of sub-daily scale shell chemistry are almost exclusively limited to giant clams (Tridacna spp.), due to their high growth rates. It is hitherto unknown if and how such diurnal cycles in chemistry differ in other genera across the bivalve clade and/or whether they are exclusive to photosymbiotic clams. In addition, it is not clear whether the daily cycles are formed in response to environmental conditions (e.g. light or temperature sensitivity) or reflect circadian rhythms.

To answer these questions, we combine ultra-high-resolution (hourly scale) Laser Ablation ICP-MS trace element profiles through shells of various tridacnid species from the tropical Gulf of Aqaba with profiles through the giant scallop (Pecten maximus) from the temperate Atlantic coast of northwestern France. We observe trace element cycles on in the daily frequency domain in both tridacnids and pectinids. This shows that these diurnal cycles are formed regardless of shell mineralogy (aragonite vs. calcite), living environment (tropical inter-tidal vs. temperate sub-tidal) and occur in highly unrelated bivalve taxa. Our data helps the interpretation of similar records from fossil shells in terms of past (extreme) weather events, climate, and shell growth.

References

de Winter, N. J. et al. Paleoceanography and Paleoclimatology 35, e2019PA003723 (2020).

Sano, Y. et al. Nature Communications 3, 761 (2012).

Schöne, B. R. & Surge, D. M. Treatise Online 24, Volume 1, Chapter 14 (2012).

Warter, V., Erez, J. & Müller, W. Palaeogeography, Palaeoclimatology, Palaeoecology 496, 32–47 (2018).

Warter, V. & Müller, W. Palaeogeography, Palaeoclimatology, Palaeoecology 465, 362–375 (2017).

Yan, H. et al. PNAS 117, 7038–7043 (2020).