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Where did they come from? Constraining the depth of origin of the mysteriously prolific Israeli Glycymeris assemblage

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The Mediterranean beaches of Israel are distinguished by nearly monospecific shell pavements of Glycymeris nummaria of unknown provenance. While live observations of these small clams are rare, they are the most common beach fossil observed from Haifa to Ashkelon. This discrepancy between live and dead assemblages has yet to be fully resolved. It has been suggested that past populations were more extensive and that environmental change may have contributed to their local extirpation in the modern fauna. Curiously, these species are commonly observed within offshore sedimentary deposits interpreted as associated to past tsunami events. Radiocarbon dating has determined that the beach assemblage shells range from about 6000 to 1000 years in age, and articulated individuals within tsunami deposits match the timing of the tsunamis, but little is known about the environmental niche of this species in the Eastern Mediterranean nor its local habitat. Resolving their habitat would contribute to understanding whether they have been transported from great distances to the beaches, and thus are rarely found in the shallow nearshore because they do not live there, or if they live in the local shallows but have been reduced to extremely small numbers and therefore an environmental or ecological cause should be evoked. To resolve this, we utilized oxygen isotope paleothermometry to constrain the complete temperature life history of three specimens sampled from shells collected near Caesarea, Israel. The aim was to then compare the temperature range to known values as associated to depth along the Israeli coastline. For example, shallow waters have high temperature ranges. We determined that the three individuals survived for 1.5-2 years each, growing around 2 cm/year as determined by the seasonal temperature oscillations recorded, and recorded temperatures ranging from 19 to 24°C. Conservatively assuming a 5°C annual range of temperatures experienced in aggregate, this implies that the shells could not have originated at shallow than 30-50 m depth based on modern temperature observations. Individually, none of the shells records a temperature range more than 4 °C from lowest to highest values, implying an even deeper origin closer to 70 m. Such depths exist at least 2.5 km off the coast of Northern Israel, meaning that a strong onshore transport mechanism is needed to explain their prevalence. Based on these results, it is suggested that high-energy events are the likely cause of their appearance on the coastlines of central to northern Israel.