

Mass occurrence of the enigmatic gastropod *Elmira* in the Late Cretaceous Sada Limestone seep deposit in southwestern Shikoku, Japan

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Elmira is a medium- to large-sized gastropod genus, which has so far been recorded only from a presumably Eocene methane-seep deposit in Cuba, and its systematic affinity and paleoecology are unknown. We report a mass occurrence of *Elmira* sp. from a Late Cretaceous seep deposit in Shikoku, Japan, called Sada Limestone, with its mode of fossil occurrence, carbonate petrology, and stable carbon isotope analyses. Sada Limestone is characterized by the dominant occurrence of a large-sized thyasirid bivalve "*Thyasira*" *hataii* and serpulid worm tubes. The mass occurrence of *Elmira* sp. occurs as a lens-shaped carbonate body, 6.5 m in length and less than 2 m in thickness, intercalated in the thyasirids-rich limestone. The *Elmira*-rich lens body has a flat top and a concave base, and consists of multiple shell accumulation layers, which were formed by winnowing and filling of a depression in slope mud. The rare occurrence of *Elmira* sp. elsewhere in the Sada Limestone suggests that it lived in local aggregations in the vicinity of the depression. The matrix of the *Elmira* mass occurrence is rich in dolomite and ankerite and is less depleted in ^{13}C ($\delta^{13}\text{C}$ values of calcite: -5.3 to -2.4%; of dolomite: -8.3%) than the calcitic matrix of the surrounding limestones. This suggests that the *Elmira* mass occurrence was cemented below the sulfate reduction zone and thus with little influence of anaerobic methane oxidation. It is, therefore, difficult to consider that *Elmira* sp. harbor chemosymbiotic bacteria. As some trochiform gastropods do in seep sites, *Elmira* sp. was maybe a bacteria grazer gregarious on bacteria mats and/or hard bottoms.

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