

## A cold-seep assemblage associated with authigenic carbonates from The Pliocene Urago Formation, Kazusa Group, Japan

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The Ten-en is located in the Kamakura City, northern part of the Miura Peninsula, Japan, where Calyptogena-bearing sandstones associated with authigenic carbonates of the Pliocene Urago Formation of the Kazusa Group are exposed. Calyptogena and authigenic carbonates occur in the cross-laminated tuffaceous medium- to coarse-grained sandstones. There is no Calyptogena and authigenic carbonate occurring in the neighbor outcrops where stratigraphically correlated sandstones are exposed. The two cores (bored normally to the bedding at the Ten-en; NO.1, 25.5m long; NO.2, 40m) and the neighbour outcrops are correlated by some tuff beds. Detailed lithological and isotopic analyses using the two cores indicate that the Calyptogena assemblage was a cold-seep dependent.

Calyptogena-bearing cross-laminated tuffaceous medium- to coarse-grained sandstones are in the upper part of the cores: the core depth 0-15m of core NO.1, and 0-17m of core NO.2. Below these sandstones, lithologies are arranged, in the descending order: tuffaceous muddy sandstones (the core depth 15-21m of core NO.1, and 17-22.8m of core NO.2), tuffaceous medium- to coarse-grained sandstones (the core depth 21-23.5m of core NO.1, and 22.8-25.5m of core NO.2), tuffaceous muddy sandstones (the core depth 23.5-25.5m of core NO.1, and 25.5-30m of core NO.2), and thick tuffaceous medium- to coarse-grained sandstones (the core depth 30-40m of core NO.2). Articulated bivalves are in the core depth 2.5-3m of core NO.1, and 2-2.5m, 3.5-4m, and 5.5-6m of core NO.2, and disarticulated ones are in core depths 0-1.5m, 2-3.5m, and 4-5m of core NO.1, and 1.5-2.5m, 3-5m, 5.5-6.5m, 7.5-8m, 8.5-9m, and 10.5-11m of core NO.2. The disarticulated ratios are 73% in core NO.1, and 70% in core NO.2 (disarticulated shells are counted as one shell, for quantitative comparison with articulated shells). These suggest that these bivalves had been reworked more or less from their living places.

The authigenic carbonates are precipitated in the following core depths: 0-1.2m, 2-4m, 5-6.1m, 6.5-10.3m, 10.8-11.8m, 13-13.6m, 13.2-13.6m, 14.8-15.2m, 15.7-16.4m, and 18.4-18.5m in core NO.1, and 1.6-2.8m, 3.2-4.3m, 4.7-9.9m, 10-10.7m, 10.8-11.4m, 12.7m, 13.7-14m, 14.3-14.5m, 14.8-15m, 15.3-15.9m, 16-17.7m, 20.2-20.3m, 21.2-21.4m, 21.5-21.7m, 29m, 29.8-30m, 30.8-31.2m, 34.2-34.3m, and 34.7-35.1m in core NO.2. There is no clear relation on the stratigraphic occurrences between Calyptogena shells and authigenic carbonates. In core NO.2, authigenic carbonates are composed exclusively of micritic dolomites in seven horizons of core depths 2.2m, 5.6m, 10.9m, 14.4m, 20.2m, 29.8m, and 34.9m, and the carbonates in 6.5m are composed of dolomites (81 wt%), high-Mg calcites (11 wt%), and low-Mg calcites (8 wt%). The  $d^{13}C$  of the authigenic carbonates in these eight horizons range from -36 to -26 per mill vs. PDB, indicating precipitation under the influence of anaerobic methane oxidation.