

Early Maastrichtian (Late Cretaceous) methane seeps and their associated fauna from southern Alaska

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We investigated early Maastrichtian (Late Cretaceous) methane seep deposits hosted by the upper Matanuska Formation in the Talkeetna Mountains, southern Alaska. During two field seasons (2006 and 2007), we encountered numerous carbonate concretions embedded in the mudstone-dominated formation that is exposed along the Alfred Creek. These carbonates can be classified into several morphotypes, i.e. rounded, irregularly rounded, doughnuts, pipe, and burrow types. At one outcrop, we studied the distribution pattern of the carbonate types. At outcrop, the pipe and doughnuts type carbonates were distributed in the lower horizon, whereas, the rounded type carbonates and the irregularly rounded and burrow type carbonates were found in the middle and upper horizons, respectively. Carbon and oxygen isotopic compositions of the carbonates range from -41.5 to -6.1 per mil (vs VPDB) and from -10.7 to -0.4 per mil (vs VPDB), respectively. Among the investigated carbonates, the burrow, irregularly rounded, and rounded carbonates have more negative values of carbon isotopes indicating that these carbonates were formed under the influence of anaerobic oxidation of methane. Dozens of crustaceans and solemyid bivalves, with lucinid bivalves as a minor component, were found from the upper part of the outcrop. The recent counterparts of solemyid and lucinid bivalves are known to host chemosymbiotic bacteria in their gills. The bivalves have been commonly found around ancient and Recent methane-seeps.

It is worth to note that this is the first record of the methane-seep dependent chemosynthesis-based ecosystems from the Maastrichtian worldwide. The fauna at the Early Maastrichtian seep of Alfred Creek is dominated by infaunal dwellers: crustaceans, solemyid and lucinid bivalves. This finding supports previously reported macroevolutionary pattern in chemosymbiotic bivalves, i.e. after the decline of modiomorphid *Caspiconcha* at the end of the Early Cretaceous and its last occurrence in the Campanian, the ecological niche of epifaunal to semi-infaunal seep endemic bivalves was largely vacant and not reoccupied until the Eocene with the appearance of the vesicomid and bathymodiolid bivalves.

Keywords: methane seep, Late Cretaceous, solemyid, lucinid, stable carbon isotope, authigenic carbonate