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Caspiconchiid bivalves: Widespread occurrences in late Mesozoic cold-seeps

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Several life forms in the deep sea are known to obtain their nourishment from chemosynthetic processes. Such life forms are observed at hydrothermal vents and cold seeps occurring along active and passive plate boundaries. The biotic components of cold seeps have been changing through the Phanerozoic (Campbell and Bottjer, 1995; Little and Vrijenhoek, 2003). Mollusks are the most dominant organisms in the modern cold seeps despite the dominance of brachiopods in the Paleozoic and mid-Mesozoic. The brachiopods were replaced by mollusks, mainly by bivalves, in the mid-Cretaceous (Campbell and Bottjer, 1995; Kiel and Peckmann, 2008; Kaim et al. 2010). However, details of this process in cold-seep environments have not yet been summarized. Most characteristic animals living in a cold seep environment since Cretaceous are vesicomid, mytilid, thyasirid, lucinid, solemyid, and caspiconchiid bivalves. The vesicomids and mytilids are the most common bivalves in the Recent cold-seep environments. Those bivalves entered to cold-seep environment in the late Eocene. Solemyid and lucinid bivalves can be traced back to the Jurassic. The solemyid bivalves have lived in peripheral low hydrogen sulfide zone of cold seep at least since Cretaceous. Thyasirid bivalves have inhabited the cold-seeps in Early Cretaceous. Caspiconchiid bivalves belong to an extinct lineage. These large bivalves were found in Early Cretaceous seep deposits in Greenland, California, Ukraine, and Japan, and they are also known from a single record from Japanese Late Cretaceous (Campanian) seep deposits. This suggests that Caspiconcha occurred widely in the Early Cretaceous world's oceans and some its descendants survived at least until Campanian in Japan. It is noteworthy that the locality which yields last caspiconchiid bivalves is also known from the youngest occurrence of a large number of brachiopods from a methane-seep environment. Through Early Cretaceous the caspiconchid bivalves have been competing or coexisting with peregrinellid brachiopods in the cold seep environment, both having basically the same sessile behavior. At the end of Early Cretaceous both groups almost completely disappeared from cold-seeps. Such a coincidence strongly suggests that the caspiconchiid bivalves and the brachiopods were outcompeted during mid-Cretaceous by other bivalves which started to flourish at that time. It especially concerns lucinid bivalves which gained both large individual and population sizes in the Late Cretaceous cold seeps.

Keywords: methane seep, cold seep, chemosynthesis, bivalve, fossil, Caspiconcha