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Oligocene-Miocene cold-seep from Shimanto accretionary complex: Focused on formation process of the cold-seep

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Many modern cold-seeps have been found along landward slopes of trenches or troughs where accretionary prisms frequently formed. However very limited studies have been done on cold-seep in accretionary prisms. Thus, we have only limited knowledge on formation processes, cross-sections, and relationship between chemosynthetic fauna and the geochemical cycles of cold-seeps formed in accretionary prisms. Matsumoto and Hirata (1972) reported visicomyid and thysirid bivalves, modern counterparts of both of which are known as chemosynthetic bivalves, from carbonate nodules from Muroto City, Kochi Prefecture, where composed in accretionary complex (Taira et al., 1980). However, the locality has not been fully studied. This study aims to reconstruct formation process and cross-section of the cold-seep in accretionary complex setting.

The late Oligocene to early Miocene limestone body, containing chemosynthetic bivalves, yielded in mudstone of in the Hioki Complex, which is part of accretionary complex of the Southern Shimanto Belt. The limestone body, ca. 4 m in maximum diameter, is subdivided into three parts. The lower part is composed of mixed mudstone and concretionary part, which is composed of calcite microspar, in lower part. Middle part is composed of microsparry calcite. Upper part shows chaotic texture, which is composed of micrite, radially grown calcite, microspar and sparry calite. Paragenetic sequence can be observed as micrite, radial calcite, microspar and sparite in ascending order. The chaotic structures are often found in ancient and modern cold seep carbonates. Only the upper part contains fossil bivalves. δ13C of the authigenic carbonate cements range from -38.5 to -10.6 ‰ (VPDB). These lower carbon isotopic composition indicate the carbonate formed under influence of anaerobic oxidation of methane. Fossil bivalves occurred only in the upper part. Those are mainly composed of Vesicomyidae, Thyasiridae, Lucinidae and Solemyidae. Those bivalves are known as chemosynthetic bivalves. Aforementioned evidences indicate the rock is a cold seep deposit.

Based on distribution pattern of textures, paragenetic sequence of minerals and mode of occurrence of fossils, we interpreted formation processes of the cold-seep deposits as follows. 1) Starting of cold seep. Carbonate ions and hydrogen sulfide contents in pore water in close proximity to the sea floor were increased. On the sea floor, chemosynthetic community, mainly vesicomyid bivalves, was started to form. 2) Activity of cold seep was increased and more authigenic carbonate precipitation occurred. During the carbonate precipitation, but before completely solidified, pore fluids and/or gasses broke up micritic sediments and formed chaotic texture. At this stage, chemosynthetic community was flourished. 3) With decrease of cold seep activity, microspar formed. 4) Sparite precipitated in remaining pore spaces.