

Reconsideration of overturn model of Akiyoshi limestones -Overturned fold structure of Permian complex at Mine city, Japan-

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Akiyoshi limestone is Carboniferous-Permian limestone that distributes widely at central area of Yamaguchi prefecture. Since Ozawa (1923) discovered that a large area of the limestone is overturned, many researches have done for the overturned structure. Among them, Sano and Kanmera (1991) proposed a model for the collapse of subducting seamounts in the trench region, which revolutionized the previous interpretation. In recent years, however, different views on the depositional environment and geological structure have been reported (e.g., Wakita et al., 2018; Haikawa, 2019), suggesting that the problem of inversion structures and their causes has not been solved. Until now, most studies have focused on limestone, and detailed studies of non-calclastic facies have been scarce. In order to understand the geological structure of the non-calclastic facies in the Akiyoshi Belt, we carried out geological investigations in the Ota Unit and the Beppu Unit on the south and northwest sides of the Akiyoshi Limestone. The geological structure was estimated based on the description of the primary sedimentary structures, chert-clastic rock sequences and fold structures.

The Oda Unit of the Late Permian accretionary complex is located in Isa town, south of the Akiyoshi Limestone. This unit is structurally and stratigraphically lower than the Akiyoshi Limestone. The incomplete sequence of basaltic calcareous shale, limestone, calcareous siliceous shale/chert interbeds, chert, varicolored shale, mudstone and sandstone is observed. The strata are ENE-WSW strike and high angle north and south trending, and north upward-younging, and are cut by NE-SW and NS faults. No geological map scale fold structure is observed.

The Beppu Unit, which is a Late Permian accretionary complex, is located northwest of the Akiyoshi Limestone in the Ofuku town. It is composed mainly of chert, siliceous shale, mudstone and sandstone with a small amount of acidic tuff. Chert is widely distributed in the Iwanotaki area, and a NW-SE-striking, low-angle, SW-dipping overturned anticline exists in the chert. The southwest wing of this fold is normal, and the northeast wing is overturned. The chert-clastic rock sequence is also reversed in this overturned zone. The upper part of the Beppu Unit is overlain by pebbly mudstone of the Tsunemori Formation with a small distribution. The Tsunemori Formation is a Late Permian sedimentary rock consisting mainly of pebbly mudstone, mudstone and a small amount of sandstone. Pebbly mudstone includes limestone boulders over a few meters in length. The Tsunemori Formation was interpreted as an accretionary complex by Sano and Kanmera (1991), but based on the lithology, stratigraphy, lack of deformation, redeposited calcareous fossils, plant fossils, and organic maturation, it is more likely to have formed in a shallower fore-arc basin or continental shelf sedimentary basin rather than an accretionary complex (Wakita et al., 2018; Shihara and Tsuji, 2022). The Tsunemori Formation, which is distributed on the west side of the Akiyoshi Limestone, has overturned fold structure with a low-angle axial surface, and limestone overlies on top of the structure at a low angle as if to cut the structure (Shihara and Tsuji, 2022). This limestone is continuous with the overturned Akiyoshi limestone. This means that the geological structure of the overturned Akiyoshi Limestone is completely different from that of the lower strata. Based on these, the following processes are hypothesized for the relationship between Akiyoshi Limestone and Tsunemori Formation. First, during the mud of Tsunemori Formation deposited, the seamount overlying Akiyoshi limestone collapsed and was mixed into the mud. Subsequently, the Tsunemori Formation was stressed and overturned folds structure were formed. At last, the overturned Akiyoshi limestone moved above the Tsunemori Formation. This movement of the limestone cut off the upper part of the Tsunemori Formation.

Keywords: large-scale overturned structure, overturned fold, accretionary complex, Akiyoshi Belt, Seamount subduction, Mine City