Depositional process of masive sandstone beds of the Upper Cretaceous Himenoura Group distributed in Amakusa-Kamishima Island, Kyushu, Southwestern Japan

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The purpose of this study is to clarify the formation process of the massive sandstones deposited in submarine fans. The massive sedimentary structures frequently occur in the submarine gravity-flow deposits. It has been suggested that the following two processes may form the massive sedimentary structures: the rapid deposition from high-density turbidity currents (Lowe, 1982) and the deposition from sandy debris flows (Shunmugam, 1996). However, it has not been clarified which process is dominant at the actual submarine fans. The identification of the sedimentary processes from massive sandstones were difficult because they lack characteristic features in macroscopic observation of outcrops.

To this end, Naruse and Masuda (2006a, b) observed the experimental gravity-flow deposits in the microscopic (SEM) scale, and suggested that there are two types of grain fabric corresponding to the types of gravity flows (i.e., turbidity currents or debris flows). This difference in microscopic feature can be used as a criterion for identifying the sediment transport processes from massive sandstones.

This study analyzed the massive sandstones in the submarine fan deposits using the difference in the tendency of the grain fabric clarified in the experimental study described above. This study investigated the Upper Cretaceous Himeura Group distributed in Kamiamakusa City, Kumamoto Prefecture, Kyushu, southwest Japan. The Himenoura Group consists of two formations: the Hinoshima and Amura formations. The Hinoshima Formation in study area is divided into three depositional facies. Facies 1 is composed of mudstone-dominated alternating beds of sandstone and mudstone. The thickness of the sandstone beds is five to several tens cm. Facies 1 is interpreted as the deposits in the distal lobe environment. Facies 2 consists of alternating beds of thin-bedded (less than 5 cm) sandstone and mudstone. Facies 2 is interpreted as the deposits in the proximal lobe. Facies 3 is composed of gravelly mudstones containing various sized blocks of deformed sedimentary rocks, which are interpreted as slump deposits. These characteristics of Facies 1–3 indicate that the Hinoshima Formation deposited in the lobe of the submarine fan system. On the other hand, two depositional facies were identified in the Amura Formation. Facies 4 is composed of alternating beds of sandstone and mudstone with ratio of approximately 1:1, which is interpreted as levee deposits. Facies 5 consists of sandstone-dominated alternating beds of sandstone and mudstone, and it is considered to be channel-fill deposits. Based on these characteristics, the sedimentary environment of the Amura Formation is the deposits of the submarine channel-levee system.

The procedure of the analysis is following. First, oriented samples of the massive sandstone beds were collected. Next, thin sections of the oriented samples parallel to the bedding plane were made, and then were photographed with a polarization microscope. The outlines of the sand particles were manually traced in the microscopic images. Then, the traced images were binarized with particles and matrix. Particles were approximated to ellipses using the image analysis software ImageJ, and then the directions of the long axis of the particles were measured. Finally, the imbrication angles were measured on the thin sections that were taken from the section vertical to the bedding plane and parallel to the preferred

direction of the long axis of particles measured in the horizontal section.

As a result of the analyses, the grain fabric in the massive sandstone beds within both of the lobe (the Hinoshima Formation) and the channel-fill deposits (the Amura Formation) were uniform from bottom to top, which indicate that these sandstone beds were high-concentrated turbidites. This fact suggests that high-concentrated turbidity currents may play an important role in the transport process for coarse sediments in the deep-sea floor independent of the environment.

Keywords: Massive Sandstone, Turbidite, Grain Fabric, Himenoura Group

