Effect of organic matter input on bioturbation in submarine channel-levee deposits: an example of the Izaki Olistolith in the Oligocene Nichinan Group

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This study focused on the variation of bioturbation intensity, ichnodiversity, and total organic carbon contents in actual submarine fan deposits, aiming to clarify their relationships. For sedimentological analysis, effects of sediment reworking by benthic animals have been estimated by indices of bioturbation intensity such as “ichnofabric indices” (*ii*; Droser and Bottjer, 1986) or “bioturbation indices” (BI; Taylor and Gorldring, 1993), which are represented by proportion of bioturbated area in outcrop surface. Recently, it was suggested that number of ichnotaxa (ichnodiversity) varies associated with changes of sedimentary environments, so that differences of ichnodiversity can also be an indicator of sedimentary environments (Buatois and Mángano, 2013; Callow et al., 2014). It is considered that various paleoenvironmental factors may affect the variation of bioturbation intensity or ichnodiversity (Orr, 2001). Particularly, fluctuation of organic matter input can significantly change the activities of benthic animals as shown in studies of biodiversity of recent shallow-marine benthic communities (e.g. Hyland et al., 2005). However, there are a few researches to discuss the relationships between ichnoassemblages and organic matter conditions (e.g. Wetzel and Uchman, 1998).

To this end, we observed the ichnoassemblage of the Izaki Olistolith within the Oligocene Nichinan Group in the southern part of Kyushu Island, southwest Japan. The Izaki Olistolith is composed of the alternating beds of turbidite sandstone and mudstone which are interpreted as deposits of a submarine channel-levee system. The lower part of the Izaki Olistolith consists of the mudstone dominated levee deposits and is overlain by the sandstone dominated channel-fill depoisits. A total of 22 ichnogenera and 24 ichnospecies occurred from the Izaki Olistolith. According to recent quantitative evaluation of ichnodiversity, the ichnodiversity in the channel-fill deposits was 1.74 times higher than that in the levee deposits (Kikuchi et al., 2018). The stratigraphic changes of bioturbation intensity and ichnodiversity were estimated by application of the image-resampling method proposed by Kikuchi et al. (2018). In addition, geochemical analysis was also examined in the Izaki Olistolith. The total organic carbon (TOC) and total nitrogen (TN) contents in 77 mudstone samples were measured with the element analyzer FLASH 2000 (Thermo Fisher Scientific).

Detailed analysis of ichnodiversity for each 1 m thick interval showed that the ichnodiversity in the Izaki Olistolith increased upward associated with paleoenvironmental changes from levee to channel environments and subsequent filling of the channel. In contrast, bioturbation intensity was constantly low, showing no significant trend in vertical changes. The TOC values range from 0.38 to 0.52wt.%. The mean values of TOC and TN were 0.46wt.% and 0.08wt.%, respectively. Both of TOC and TN values slightly increased upward.
The test of correlation suggested a significant positive correlation between the ichnodiversity and the mean of TOC for each 1 m thick interval. This implies that the variation of ichnodiversity in submarine fan deposits can be an indicator of organic matter input, especially under the condition of relatively low amount of input (0.3–0.5wt.%). In future work, it is necessary to analyze the deposits that have higher organic matter contents and investigate how bioturbation intensity and ichnodiversity change under the

high organic matter input.

Keywords: ichnofossil, ichnodiversity, bioturbation intensity, total organic carbon

