Evaluation of plant-fragment concentration system in the turbiditic sequence by terrigenous biomarker analysis of sediments from the Kawabata Formation, Yubari area, central Hokkaido, Japan.

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Kawabata Formation distributed in Yubari area, central Hokkaido, is formed by basin-filled and slope-apron turbidite systems, and sandstone and mudstone are mainly predominated by turbiditic sequences. Distinctive plant-fragment (PF) concentrated sandstones were found in the Kawabata Formation, and their sedimentological and biomarker analyses suggests that these sediments were deposited by hyperpycnal flow (Furota et al., 2014). In the present study, we conducted biomarker analysis of sandstone and mudstone characterized as several turbidite type sequences from the Kawabata Formation to evaluate sedimentological processes and to compare with the plant-fragment concentrated sandstones in hyperpycnite.

The sandstones and mudstones analyzed were collected from the outcrops of the Takinoue Park, Yubari, central Hokkaido. For the biomarker analysis, lipids were extracted with dichloromethane/methanol, and separated to aliphatic, aromatic and polar fractions. These lipids were identified and quantified by GC-MS.

Three consecutive turbiditic sequences analyzed are two Bouma type sequences (ca. 60 cm and 25 cm thick) and a distinctive ‘PF-concentrated’ type sequence (ca. 34 cm thick), in which the sandstone layer is characterized by abundant plant fragments and particles as reported by Furota et al. (2014). Sedimentary layer in the Bouma type sequences equivalent to Ta units consists of medium - to fine sands with tiny black PFs. Tb unit consists of fine sands with parallel laminations containing the concentrated PFs. Tc unit also consists of fine sands about 1-2cm thick without cross laminations, and the concentrated PFs are observed as many black bands in this unit. Te unit is massive sediment that consists of very fine sands to silty muds without PFs. In the ‘PF-concentrated’ type sequence, a sandstone layer consists of medium to fine sands containing the large plant-derived blackish particles with diameters of ca. 5-10 cm, and many PF thin layers. The mudstone layer, corresponding to the Te unit, is a massive sediment that consists of very fine sands to silty muds without PFs as the Bouma type sequence.

The *n*-alkane concentrations in the turbiditic sequence are of minimal values in the Ta units. The concentrations increase in Tb and Tc, and then decrease in Te units. This trend is also shown in variations in the concentrations of plant-derived terpenoids. The *n*-alkane concentrations are lower than the turbiditic sandstone unit than the mudstone unit. Pristane / phytane ratio (Pr/Ph) of the mudstone unit is 2.12 while the lower and upper layer of the sandstone unit exhibits a strong oxic and terrigenous matter-abundant character at 5.18 and 9.98 respectively. In addition, a peak of higher branched isoprenoid (HBI) alkane, known to be derived from specific diatoms, was found in the mudstone sample. The C27/C29 sterane ratios, which are indicators of marine / terrigenous sources of organic matter, is 0.41 in the mudstone unit, and less than 0.21 in the sandstone units. These results suggest that the organic matter was mainly of terrestrial origin. Triterpenoid compositions are mostly dominated by lupane and oleanane (derived from angiosperms) in both the mudstone and sandstone layers. However, the

sandstone layers had a remarkably higher concentration of the triterpenoids, including A-ring degraded triterpenoid (*des*-A- triterpenoids) such as *des*-A-oleanane, *des*-A-lupane as well as monoaromatic and diaromatic *des*-A-triterpenoids. The *des*-A-triterpenoids are thought to be generated by microbial degradation during early diagenesis. The *des*-A- triterpenoid compositions are also nearly constant as the results of diterpenoids and non-degraded triterpenoids. However, the ratios of *des* -A-triterpenoid/pentacyclic (non-degraded) triterpenoid are higher throughout the turbiditic sequence, especially Tb and Tc units of the Bouma type sequences and sandstone units of the 'PF-concentrated' type sequence. Furota et al. (2014) reported that the *des*-A/pentacyclic triterpenoid ratios in sandstone units were clearly lower than mudstone units in the hyperpycnite, suggesting that more fresh terrigenous organic matter was rapidly transported by the hyperpycnal flow. Our results imply that the organic matter in the current study is mostly of terrestrial origin and rapidly transported by an efficient delivering system.

Keywords: Turbidite, Biomarker, Terpenoids, Hokkaido, Miocene

