Estimating the degree of compactional thinning of fine-grained clastic rock based on ichnological observation

*Kentaro Izumi[1], Ryota Suzuki[2], Mutsuko Inui[3]

1. Faculty & Graduate School of Education, Chiba University, 2. Arima Junior High School, 3. School of Science and Engineering, Kokushikan University

This study proposed the empirical relationship between the degree of compactional thinning and geochemical composition for fully consolidated fine-grained clastic rocks. New data were provided by sedimentological, ichnological, and geochemical analyses of the mudrock samples from the Eocene Naharigawa Formation, Muroto-Hanto Group, Kochi Prefecture, Japan. Based on these analyses, the degree of compaction of the Naharigawa mudstones as a percentage of shortening (C_{ms}) was calculated as 83.01 %. To quantitatively estimate the empirical relationship, the C_{ms} values for various fine-grained clastic rocks, whose geochemical compositions are available by previous studies, were further calculated and compiled. As a result of the compilation, a significant and strong negative correlation between the C_{ms} values and CaO abundances ($r = -0.75$; $p < 0.05$) was recognized. Furthermore, the C_{ms} values show negative correlation between Ca concentrations normalized to terrigenous material (CaO/Al_2O_3, CaO/TiO_2) that are considered as proxies for relative contribution of non-terrigenous (i.e. biogenic) carbonates, although the recognized correlations are not statistically significant. These lines of evidence strongly suggest that the degree of physical compaction of fine-grained clastic sediments is affected by carbonate contents. Although the obtained relationship may hold only for fully consolidated fine-grained clastic rocks of the Paleogene or older ages, it is very helpful for quantitatively estimating the degree of compactional thinning for any fine-grained clastic rock-dominated succession, as long as the major element composition of the sediments is determined.
Furthermore, a geological example of application of the proposed empirical relationship to consolidated mudstone-dominated succession is also discussed.

Keywords: Fine-grained clastic rocks, Compaction, Trace fossils

