Stratigraphy and sedimentary facies of the Nakanosawa to Koyamada formations of the Somanakamura Group in Fukushima Prefecture: Paleoenvironmental changes from Late Jurassic to Early Cretaceous

*Hisao Ando[1]

1. Department of Earth Sciences, College of Science, Ibaraki University

The Somanakamura Group, distributed along the Futaba Fault in the eastern margin of the Abukuma Mountains from Minami-soma City to Soma City, Fukushima Prefecture, is the Middle Jurassic to lowest Cretaceous strata. Among the contemporaneous strata in Japan, the group composed of alternating shallow marine and nonmarine strata, is one of important and infrequent well-exposed continuous successions across the Jurassic/Cretaceous (J/K) boundary horizon in Japan. The upper half of the Somanakamura Group, namely the uppermost Tochikubo (non-marine: Oxfordian), Nakanosawa (marine: Kimmeridgian–early Tithonian), Tomizawa (non-marine: late Tithonian), and Koyamada (marine: Berriasian–Valanginian) formations have been studied on their stratigraphy, sedimentary and biofacies for a few years. This paper summarizes their results and consider the paleoenvironmental changes among the late Jurassic to early Cretaceous in Japan (Figure).

The Tatenosawa Sandstone Member of the lower Nakanosawa Formation, Somanakamura Group, is a series of regressive sandy deposits that lies above a basal transgressive lag facies that was deposited on a wave-ravinement surface overlying the quartzose well-sorted sandstone of the fluvial Tochikubo Formation. It shows a shallowing-upward facies succession, from open shallow marine to inner bay-lagoon sedimentary environments. The member was formed by the repeated progradation of siliciclastic depositional systems during a slow relative sea-level rise with several small-scale oscillations.

The Koike Limestone Member formed a carbonate platform over several kilometers wide (E–W) and 10 km long (N–S) as carbonate barrier–lagoon systems were established after the siliciclastics supply ceased due to dominant arid climate in hinterland. Five fining-upward facies successions (FFS: < a dozen meter thick) can be well identified across the entire study area. They were formed by five regressions and transgressions driven by small-scale relative sea-level changes, each of which caused the sedimentary environment to change from foreshoal through oncoid shoal and backshoal to lagoon environments. The Koike Limestone itself suggests subtropical marine climate during Late Jurassic Greenhouse condition. The deposition of the Nakanosawa Formation reflects the third-order sea-level cycles during the second order highstand from the Kimmeridgian to early Tithonian.

The fluvial Tomizawa Formation unconformably overlying the Koike Limestone with a subaerially erosional and undulated surface at least 40 m deep is dominated by thick quartzose sandstone especially in the lower part. A large amount of quartz detritus was provided from a provenance due to rapid weathering of granitic rocks in hinterland. The lower member (25–50 m) of the Koyamada Formation (maximum thickness: about 175 m) consists of shallow-water (inner shelf–upper shoreface) sandstone overlying the Tomizawa Formation with a wave ravinement surface, and the upper acidic tuff and tuffaceous sandstone. The upper member is an outer shelf–shelf slope facies composed of homogeneous dark gray siltstone. The formation shows a transgressive-upward trend, though the lower member constitutes at least three upward-coarsening facies successions suggesting small-scale sea-level oscillations. The sedimentary age of the Koyamada Formation designated as Berriasian–early Valanginian should be reexamined based on a comparison with recently reported U-Pb radiometric ages of tuff and global sea-level change curves.

References

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