

Late Campanian–Early Maastrichtian heteromorph dominated ammonite fauna of the Northwestern Pacific region: an example from the Nakaminato Group (Hitachinaka, central Honshu, Japan)

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Late Campanian to Early Maastrichtian ammonite fauna in the Northwestern Pacific region has known to be dominated by such characteristic heteromorphs as *Didymoceras*, *Pravitoceras*, *Diplomoceras*, *Baculites*, etc., occurring from some of offshore mudstone strata (Izumi, Sotoizumi, Yezo and Nakaminato groups) around Japan. Among those strata, the Nakaminato Group is suitable to demonstrate their stratigraphic succession as well as other molluscan fauna, because of continuously exposed strata observed along the Pacific coast, though fossils are not so prolific in occurrence. We report the faunal components and their succession in addition to the lithostratigraphy and sedimentary environments of the Nakaminato Group as basic information for reconstructing their habitat and ecological significance.

The Nakaminato Group crops out only 4 km north-southward on wave-cut benches along the Pacific coast in Hitachinaka City, Ibaraki Prefecture, central Honshu. The homoclinal (30 to 40° NE) strata provide a continuous lithostratigraphic succession of the Upper Campanian to the Lower Maastrichtian about 1,900 m thick. The Nakaminato Group is subdivided into the offshore mudstone-dominated Hiraiso, and sandstone- and sandy turbidite-dominated Isoai formations in ascending order.

Didymoceras sp. occurred from massive mudstone of the lowermost part of the Hiraiso Formation. *Didymoceras awajiense* and *Diplomoceras* sp. co-occurred from siltstone frequently intercalated with thin, fine to very fine sandstone of the lower part of the Hiraiso Formation. *D. awajiense* shows a wide range of variation in modes of coiling and shell ornamentation. It commonly occurs also from other upper Upper Campanian strata in Japan: Izumi Group and Toyajo Formation of Sotoizumi Group in Southwest Japan. However, the co-occurrence with *Diplomoceras* has not been known in other areas in Japan at all. In having coarser ribs, *Didymoceras* sp. morphologically differs from *D. awajiense* and also *D. hidakense*. *Pravitoceras*, a possible descendant of *Didymoceras*, has not discovered yet, though the equivalent horizon seems to exist within this group. *Baculites* sp. with an indeterminate large nostoceratid occurred from mudstone of the upper part of the Isoai Formation. Based on inoceramid ("*Inoceramus*" *kusiroensis*) and U-Pb age of detrital zircons in sandstone, the age of the upper part of the Isoai Formation is assigned as Early Maastrichtian.

On the basis of a few fragmentary specimens of *Diplomoceras* sp. from the Nakaminato Group, preserving early to middle growth stages, the entire shell form of a world-wide genus *Diplomoceras* can be reconstructed especially for initial and late to final stages, by referring to the previous good records from the Yezo Group, Japan, France and Antarctica. Our reconstruction suggests that the adult shell of *Diplomoceras* is composed of nine shafts and eight U-shaped turned shells. Its length will exceed 1.6 m. It reminds us *Diplomoceras* was one of the largest giant heteromorphs with mostly benthic mode of life.