

Cretaceous-Paleogene stratigraphy in Northwest Pacific and its significance for paleoenvironmental study

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The Cretaceous – Paleogene period is known as the latest Greenhouse climate in the history of earth. In order to understand ocean – climate system during past Greenhouse climate, numerous attempt has long been made for the marine sequences in the Atlantic and Southern oceans and the Tethyas Sea. The Pacific Ocean was the outstandingly largest ocean during Cretaceous – Paleogene, and it may have played important roles in Earth's ocean – climate system. Despite its importance, very little work has been done to establish detailed paleo-oceanographic changes during Cretaceous – Paleogene. This is largely because most of the Cretaceous – Paleogene Pacific oceanic crusts have subducted under continents, and bad recoveries of Cretaceous – Paleogene sediments of the ODP and DSDP cores from the Pacific sites have prevented researchers from studying paleoenvironmental changes of the Pacific Ocean.

First, we establish the detailed integrated stratigraphy (planktic foraminiferal and dinoflagellate cyst biostratigraphy, carbon isotope stratigraphy and U-Pb dating of tuff beds) of the Cretaceous – Paleogene marine sequences exposed in Hokkaido Japan because the resolution of international stratigraphic correlation of these strata is not enough to identify important climatic and/or extinction events such as the OAEs, K/Pg, PETM and others. The strata used in this study is as follows; the Yezo Group (early Aptian – early Campanian: 125 – 75 Ma), the Nemuro Group (Campanian?– early Eocene: 75?– 53 Ma), the Poronai Formation (late Eocene: 42 – 35 Ma) and the Onbetsu Formation (late Eocene – early Oligocene: 34 – 32 Ma). Our integrated stratigraphy enables to identify the exact horizons of following climatic and extinction events. The Cretaceous Oceanic Anoxic Events (OAEs) of the OAE1a (125.5 – 124 Ma), Leenhadlt Level of OAE1b (110 Ma), OAE1c (107 Ma), OAE1d (101 Ma), OAE 2(94 – 93.5 Ma) are identified in the Yezo Group exposed in Oyubari and Tomamae areas. Although no so-called black shales were found in these horizons, evidences of oxygen depletion were identified from the most of these horizon based on the analyses of benthic foraminifera, degree of pyritization and sedimentary structure such as degree of bioturbation. The horizons of the K/Pg (66 Ma) and PETM (Paleocene Eocene Thermal Maximum; 56 Ma) in the Nemuro Group and Late Eocene Warming (37 Ma) in the Poronai Formation exhibit no obvious differences in lithology. Especially, the strata across the K/Pg boundary in the Shiranuka Hill consists of massive mudstone and a few intercalations of thin felsic tuff and turbidite sandstone. The middle – late Eocene cooling (40 – 39 Ma) is characterized by abundant occurrences of glendonites and buliminids (benthic foraminifera) in the middle part of the Poronai Formation, which indicates that cooling and eutrophication of surface water occurred in the northwest Pacific. The prominent positive excursion of oxygen isotope around Eocene/Oligocene boundary (34 – 33.6 Ma) is placed at the top of the Urahoro Group. The overlying Onbetsu Formation includes Oi-1a and Oi-1b of early Oligocene. Flood occurrence of buliminids in the lower part of the Onbetsu Formation suggest that surface water eutrophication occurred in response to global cooling after the Oi-1 glaciation.

The horizons of climatic and extinction in Hokkaido have continuous outcrop without significant hiatus and faults. High resolution analyses of these horizons will improve our understanding of climatic and environmental changes in northwest Pacific during the latest greenhouse period.

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