Seawater temperature anomaly in the NW Pacific accompanied with accelerated deep water formation during the late Cretaceous

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Oxygen isotope records, obtained from extraordinarily well preserved (glassy) foraminiferal shells, reveal Anomalously high sea surface water temperatures (SSTs) and upper water temperatures (UWTs) in the late Cretaceous north western Pacific. These are induced by increased heat transport from the equator to northern high latitudes, with acceleration of a deep water formation rate in the northern Pacific. We obtained planktic and benthic foraminiferal specimens from impermeable mudstones of the Yezo Group distributed in Hokkaido, Japan. The Yezo Group in the study area is composed, in ascending order, of upper slope proximal turbidite, outer shelf mudstones, inner shelf sandy mudstones, deltaic sandstones, and outer shelf mudstones. The geological age of the Yezo Group is assigned to the late Turonian -- early Campanian. Paleolatitude and paleodepth of the basin are estimated as 40 degree N and 300 -- 350 m depth, respectively. Based on sccanning electron microscopic observations of foraminiferal test fragments, and elemantel analyses of diagenetic calcites and foramniferal tests, it is revealed that all analyzed foraminiferal tests represent original isotopic records. The calculated SSTs from planktic foraminifers (27, 28, and 26 degree C for the late Turonin, Coniacian, and ealy Campanian, respectively) are much higher than the present north western Pacific mid-latitude SSTs. UWTs estimated from benthic foraminifer isotopic records are 16 -- 18 degree C. This thermal structure is comparable to that of the present subtropical north western Pacific. Comparing these results to other isotopic records obtained from south England chalk sequences and deep sea sediments from the north Atlantic (ODP Site 1050), the equatorial Pacific (DSDP Site 463), and the southern Indian Ocean (ODP Site 763), oxygen isotopic compositions in the north western Pacific remain constant from the late Turonian to the early Campanian, while the other records show uniformly increasing oxygen isotopes during this period, regardless of their possible diagenetic offset. Moreover, leaf margin analyses (LMA) and climate leaf analysis multivariate program (CLAMP) of land plant fossils show mean annual air temperatures decreasing from the Turonian to the Campanian in the high latitude Northern Hemisphere. In addition, atmospheric CO2 concentration, calculated by carbon isotopic compositions of pedogenic carbonates, was also reduced from the Turonian to the Campanian. Therefore, all these indices, except for the north western Pacific seawater temperatures, are considered to represent a global temperature decreasing trend from the Turonian to the Campanian. On the other hand, general circulation models of the late Cretaceous climate indicate intensification of a deep water formation rate in the northern Pacific with reduction of atmospheric pCO2, which is accompanied by northward invasion of western boundary warm currents. As a consequence, SSTs and UWTs in the north western Pacific do not show a coincidental decrease with global cooling.