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Dynamics in Holocene Northwest Pacific Intermediate Water Ventilation: Interactions with the Southeast Asian Monsoon System

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The Okhotsk Sea is one of only a few regions in the world ocean where active ventilation of intermediate depth water masses is happening. This ventilation mechanism, and subsequent mixing processes, are largely responsible for providing oxygen to the mid-depth North Pacific. Formation rates and ventilation patterns of the Okhotsk Sea Intermediate Water (OSIW) may be also crucial factors for the intermittent development of Oxygen Minimum Zones at large parts of the NE Pacific continental margin during the last deglaciation and parts of the Holocene. However, few if any well-dated records are available so far that track the evolution of OSIW formation and ventilation through these critical deglacial and Holocene time intervals with sufficient temporal resolution.
We present results from several radiocarbon-dated sediment cores that we recovered from core layer depths (600-1000 m) of the OSIW formation regions within the Okhotsk Sea. By using stable carbon and oxygen isotopes of planktic and benthic foraminifera in connection with bulk sediment nutrient proxies, we reconstruct the history of ventilation patterns and hydrographic variability of OSIW for the last 15,000 years with an average sample resolution of 20-100 years. We observe short-term variability in mixed layer and bottom water masses.
Better ventilated OSIW than today during the late glacial is contrasted by reduced or lacking ventilation during the deglaciation with minimum carbon isotope values during the Boelling-Alleroed and earliest part of the Holocene. At the Sakhalin margin, the occurrence of laminated sections in a deeper core attest to the short-term development of an Oxygen Minimum Zone during these time intervals.
The mid-Holocene time interval is less well ventilated than today and we suppose that formation of OSIW is diminished and sometimes ceases during this interval. From ca. 4 to 5 kyr onwards, increased OSIW ventilation coincides with changes to more unstable and colder climatic situations in adjacent Siberia and SE Asia, expressed in a weakening of the SE Asian summer and a strengthening of the winter monsoon that today precondition the near-shore shelf regions for OSIW formation by brine rejection and enhanced winter mixing.
On a hemispheric scale, principal centennial to millennial-scale variability of temperature and OSIW ventilation coincides with reported changes in NADW production through the Holocene.