Episodic methane release events from Last Glacial marginal-sea sediments in the Northwest Pacific Ocean

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According to recent observations of anomalous bottom-simulating reflections (BSR), the Northwest Pacific marginal sediments around Japan main islands bear large abundances of methane hydrate[Satoh, 2002]. During the Last Glacial, direct and indirect evidences accumulated from geochemical data suggest that methane episodically released from hydrate trapped in the seafloor sediments[Dickens, 1995; Hinrichs et al., 2003; Kennett et al., 2000]. Here we show that marginal sediments from the Northwest Pacific contain a hopanoid (diploptene) derived from the activity of methanotrophic bacteria in water column and/or surface sediment during the Last Glacial warming periods (Interstadials 1, 3 and Preboreal warming). The carbon isotopic compositions of diploptene range between -41.0 per mil and -27.9 per mil (relative to PDB). In the same horizons indicative of a contribution of methanotrophic bacteria, foraminiferal isotope signals were also found with highly depleted 13C compositions of planktonic foraminifera (-1.9 per mil, PDB) and benthic foraminifera (-0.8 per mil, PDB), suggesting that indirect records of enhanced incorporation of 13C-depleted CO2 formed by methanotrophic process that use methane as their main source of carbon. From combined isotopic data of diploptene and foraminifera, the most prominent signal of methane release was detected in the sediments deposited at 25,380 to 25,490 cal. yr BP (ca. 100 years time span), corresponding to the Interstadial 3. This is the first evidence of methane hydrate instability in the open Northwest Pacific during the Last Glacial. Considering the Glacial-Interglacilal hydrographic conditions in this region, the instability of methane hydrate may be modulated by intermediate water warming and/or the lowering of sea level. Our results suggest that the Northwest Pacific marginal regions had a profound effect on rapid global warming climate changes during the Last Glacial.