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Pleistocene Deep Sea ostracods from the Bering Sea (IODP expedition 323)

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ABSTRACT

The study presents the first Pleistocene (0–1.9 Ma) record of Deep Sea ostracods from the Bering Sea, derived primarily from Integrated Ocean Drilling Program Expedition 323, Site U1344 (59°3.0′N, 179°12.2′W, 3171 m of water depth). Deep Sea ostracod abundances in the Bering Sea sediments are some of the lowest that have been recorded in bathyal and abyssal marine environments (<1 specimen per sediment gram). In comparison, benthic foraminifera are several orders of magnitude more abundant in the same samples. The humble ostracod assemblage at Site U1344 is predominantly composed of deep water species *Krithe sawanensis*, *Fallacihowella* sp. A, *Cytheropteron* spp., *Eucytherura* sp., *Argilloecia toyamaensis*, and *Bradleya mesembrina*. Less abundant taxa include *Munseyella melzeri*, *Munseyella ristveti*, *Cluthia* sp., *Robertsonites hanaii*, and *Microcythere mediostriata*. Some of these taxa (e.g. *Fallacihowella* sp. A, *Bradleya mesembrina, Microcythere mediostriata*) are reported for the first time in the North Pacific. The predominance of the genera *Krithe*, *Fallacihowella*, *Cytheropteron* and *Argilloecia* indicates cold, ventilated bottom waters. The deep Bering Sea ostracod assemblage shares many common and closely related species with continental slope faunas from the Gulf of Alaska, the Okhotsk Sea, the Arctic Ocean, and even the subpolar North Atlantic. A few continental shelf ostracods, such as species of *Munseyella* and *Robertsonites*, are present at Sites U1344 and U1343, in the northern slope of the Aleutian Basin. The presence of shallow water ostracods at the Bering Sea slope sites is possibly explained by sea ice rafting. Exceptionally low ostracod abundance in the U1344 record did not permit evaluating links between ostracod faunas and paleoceanographic conditions; however, an increase in ostracod occurrences throughout the middle Pleistocene at Site U1344 appears to correlate with general sea ice expansion in the Bering Sea. High primary surface productivity, high food flux and high sedimentation rates are considered to be the main factors diluting or suppressing Deep Sea ostracods in the Bering Sea, suggesting that ostracods may prefer living in more oligotrophic deep water environments with well oxygenated waters and moderate food supply.

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1. Introduction

The majority of the ostracod studies from high latitude North Pacific marginal seas have focused on Miocene to Pleistocene sequences in and around Japan, the Japan Sea (e.g., Okada, 1979; Cronin and Ikeya, 1987; Ikeya et al., 1992; Ikeya and Cronin, 1993; Ozawa, 2003; Ozawa et al., 2004; Ozawa and Kamiya, 2005; Ozawa, 2009; Irizuki et al., 2007, 2009; Iwatani et al., 2012; Yamada et al., 2002), modern sediments in the Okhotsk Sea (Ozawa, 2004; Ozawa and Tsukawaki, 2008), and Quaternary sediments in the Gulf of Alaska (Brouwers, 1988, 1990, 1993, 1994). Yet, with the exception of a recent study of modern benthic ostracods from the northern Bering and Chukchi Sea shelves (Gemery et al., 2013), very little is known about ostracods from the Bering Sea, in particular bathyal and abyssal faunas. One potential reason for the lack of information on Deep Sea ostracods from this region is their very low abundance in biosiliceous-rich sediments that characterize the North Pacific Ocean. Sediment in the deep Bering Sea generally lacks abundant carbonate microfossils because the seafloor is below the carbonate compensation depth (CCD) in most regions. The lysocline and the CCD over the continental slope of the Bering Sea are documented at depths of 2000 and 3800 m, respectively (Chen et al., 2005). This study uses core samples derived from sites drilled during Integrated Ocean Drilling Program (IODP) Expedition 323 to examine and document the abundance, taxonomic composition, and paleoenvironmental significance of Deep Sea ostracod assemblages from the Bering Sea.

IODP Expedition 323 sailed into the Bering Sea in 2009 with the aim at studying for the first time the sedimentary and paleoceanographic history of this marginal sea over the past 5 Ma. Seven sites (U1339 to U1345) distributed on a depth transect ranging from 819 to 3173 and covering three different regions (Umnak Plateau, Bowers Ridge, and the Bering slope region) were successfully drilled during the expedition (Fig. 1, Table 1) (Takahashi et al., 2011).

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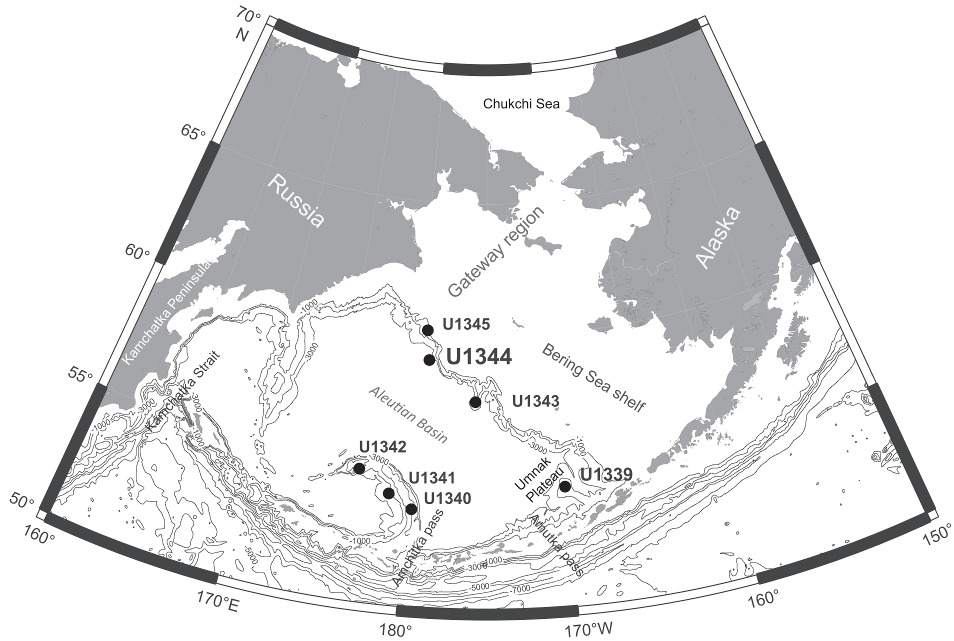

Fig. 1. Location of IODP Expedition 323 sites in the Bering Sea.

Table 1
Drilling results summary for Expedition 323 sites.

IODP Site	Coordinates	Water depth (m)	Penetration depth (m)	Age (Ma)	Average sedimentation rate (cm/ky)
Bering Slope					
U1344	59°03.00′N, 179°12.20′W	3171	745	0–1.9	45
U1343	55°33.39′N, 175°48.95′W	1950	744	0–2.4	31
Umnak Plateau					
U1339	54°40.20′N, 169°58.90′W	1868	200	0–0.8	28
Bowers Ridge					
U1340	53°24.00′N, 179°31.29′W	1294	604	0–5	12
U1341	54°24.00′N, 179°00.49′E	2139	600	0–4.3	14
U1342	54°49.70′N, 176°55.02′E	818	47.3	0-∼1	3.6

IODP: Integrated Ocean Drilling Program.

The cored sedimentary sequences at the Bering Sea sites are composed of terrigenous, glaciomarine, and biogenic components that capture the spatial and temporal evolution of the Bering Sea through the Pliocene and Pleistocene (Takahashi et al., 2011). Terrigenous sediment are mostly made up of angular siliciclastics and volcaniclastics, whereas biogenic sediment predominantly contain siliceous microfossils (diatoms, radiolarians, silicoflagellates, ebridians), and a much lower amount of organic (dinoflagellates), and calcareous microfossils (nannofossils, planktonic and benthic foraminifers, and ostracods) (Takahashi et al., 2011).

2. Study area

The Bering Sea is the third largest marginal sea in the world and one of the world's most productive regions, supporting high seasonal primary productivity exceeding 1 gC m^{-2} d^{-1} during the spring bloom (Brown et al., 2011; Springer et al., 1996), and exhibiting sediment with profuse siliceous microfossils, and very high sedimentation rates (Takahashi et al., 2011; Aiello and Ravelo, 2012). Approximately one half of the Bering Sea is a shallow (0–200 m) neritic environment, with the majority of the continental shelf spanning the eastern side of the basin off Alaska from Bristol Bay to the Bering Strait (Fig. 1). The northern continental shelf is seasonally ice covered, and little ice forms over the deep southwest areas. In addition to the shelf regions, two significant topographic highs have better carbonate preservation than the deep basins: Shirshov Ridge, which extends south of the Koryak Range in Eastern Siberia; and Bowers Ridge, which extends 300 km northwest from the Aleutian Island arc. To the south of the Bering Sea is the Aleutian Basin, a vast plain ∼3850 m deep, with occasional gradually sloping depressions as deep as 4150 m (Hood, 1983).

Three major rivers flow into the Bering Sea: the Kuskokwim and Yukon rivers drain central Alaska, and the Anadyr River drains parts of eastern Siberia. Surface water circulation in the Bering Sea is dominated by an anticlockwise gyre (the Bering Sea Gyre) along the Bering Slope, contributing to the main flow of the Bering Slope Current (BSC, Stabeno et al., 1999). Water exchange between the Bering Sea and the North Pacific Ocean takes place along the several paths between the Aleutian Islands (generally between 1 and 4 km water depth).

3. Materials and methods

3.1. Site U1344

This study focuses on IODP Site U1344 in the center of the northern Bering Sea slope margin, but also examines selected