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Supporting Information for

Southward migration of Arctic Ocean species during the Last Glacial Period

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Introduction

This supporting information provides the figures about the location of the studied sediment core YSZK-1 and related core sites, lithologic log of core YSZK-1 showing sample positions, ostracod faunal variability in YSZK-1, and visualization of sea surface and bottom water temperature and salinity (annual mean, summer mean, and winter mean) of the NW Pacific Ocean. Tables in this supporting information include AMS ^{14}C dates results and OSL dating results for samples from YSZK-1 and autoecology summary of studied ostracod species. Table S3 is uploaded separately.

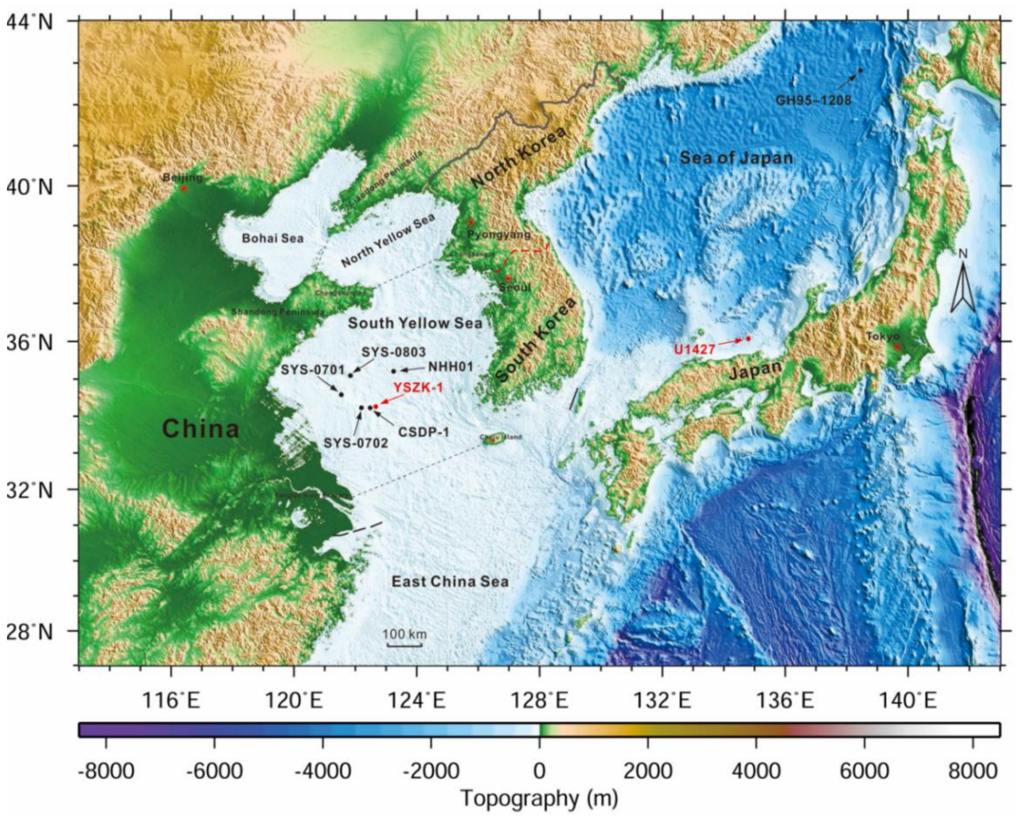

Figure S1. Map showing the location of the studied sediment core YSZK-1 (35°5.1055'N, 122°31.4515'E, water depth: 68 m) and related core sites CSDP-1 (34°18'N, 122°22'E, water depth: 52.4 m), SYS-0701 (34°39.7535'N, 121°27'E, water depth: 33 m), SYS-0702 (34°18.0919'N, 122°05.7459'E, water depth: 32 m), SYS-0803 (35°02'N, 121°45'E, water depth: 49 m), NHH01 (35°13'N, 123°13'E, water depth: 73 m), GH95-1208 (43°46'N, 138°50'E, water depth: 3435 m) and U1427 (35°57.9200'N, 134°26.0604'E, water depth: 330 m). Details of these core sites are from Ikehara & Itaki (2007), Liu et al. (2010), Zhao et al. (2014), Liu et al. (2018), and Sagawa et al. (2018). Additional ostracod data were obtained from five adjacent Yellow Sea cores (SYS-0701, SYS-0702, SYS-0803, NHH01, and CSDP-1) and one IODP core from the Sea of Japan (IODP-U1427). Data from the Yellow Sea cores SYS-0803, SYS-0701, and SYS-0702 were obtained from the study of Liu et al. (2010), NHH01 data were obtained from that of Zhao et al. (2014) and CSDP-1 data were obtained from that of Liu et al. (2018). Ostracod data from IODP Site U1427 were obtained from the work of Huang et al. (2018). IRD data were obtained from core GH95–1208 in the northern Sea of Japan (Ikehara & Itaki, 2007).

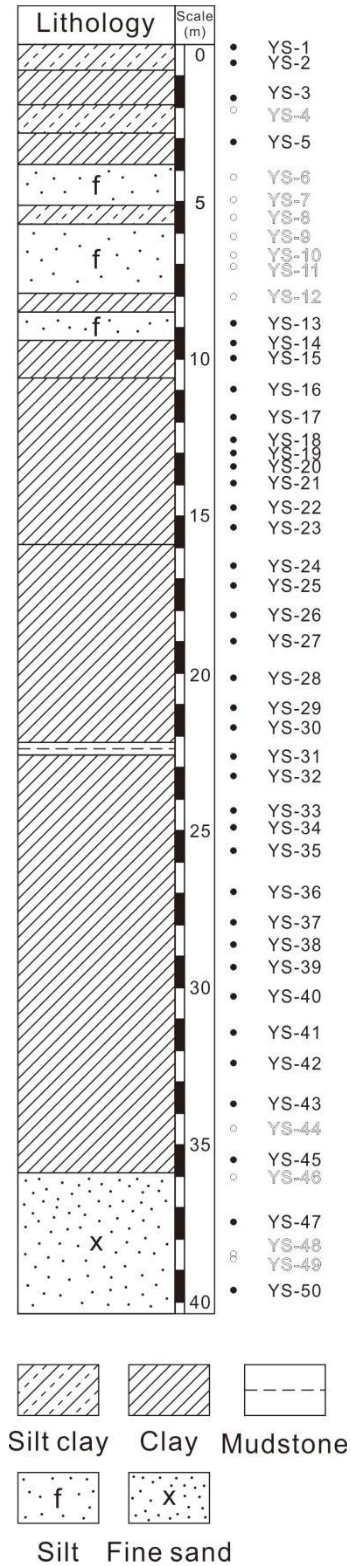

Figure S2. Lithologic log of core YSZK-1 showing sample positions. White circles represent samples without ostracods, and black circles represent samples with ostracods.

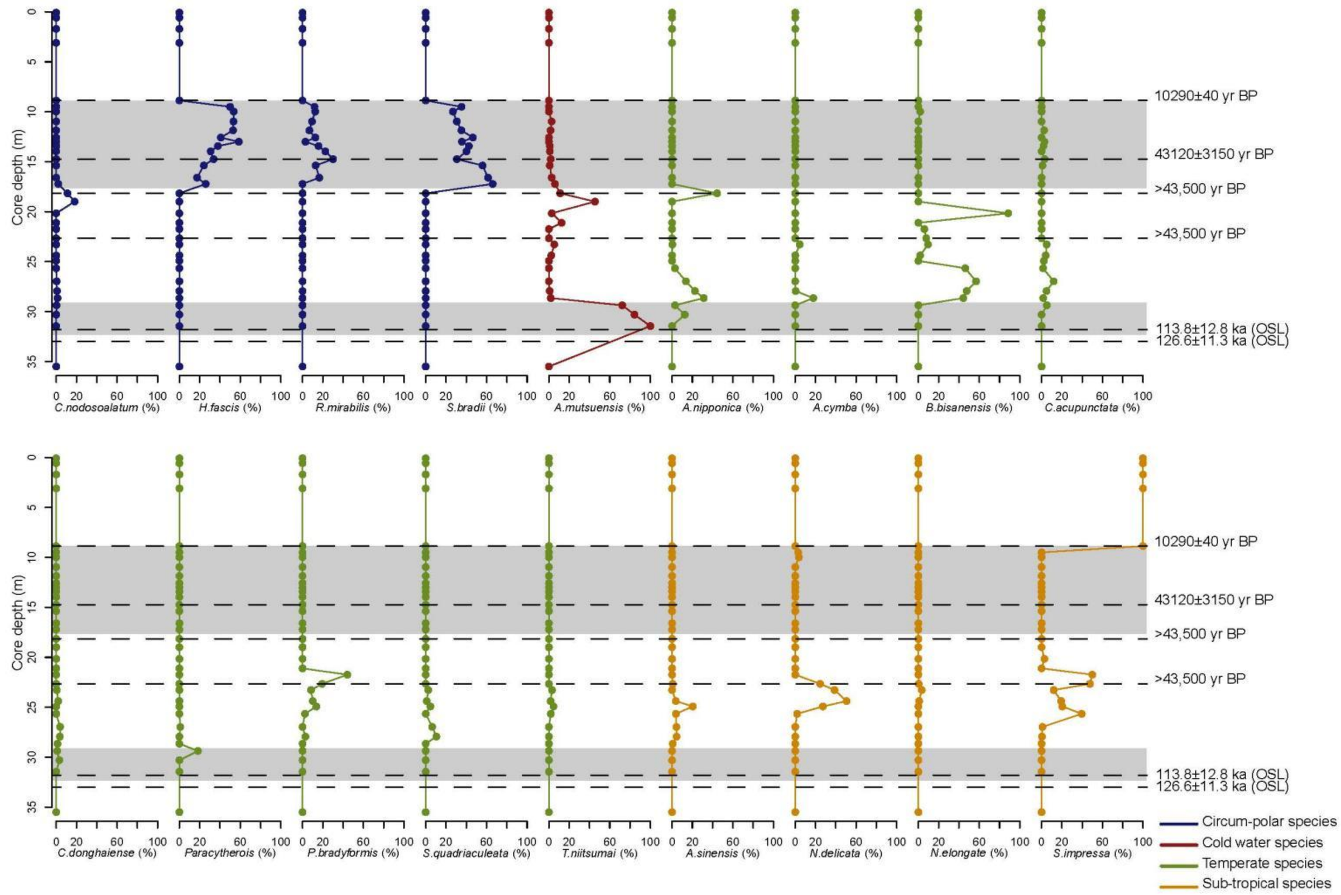

Figure S3. Ostracode faunal variability in YSZK-1. Eighteen panels show the downcore relative abundances (%) of five circumpolar species (blue), one cold-water species (red), eight temperate species (green), and four sub-tropical species (orange). Four AMS 14C dates and two OSL dates have been obtained from YSZK-1 and are listed on the far right of the chart. Gray shadings highlight two intervals dominated by circumpolar and cold-water species.

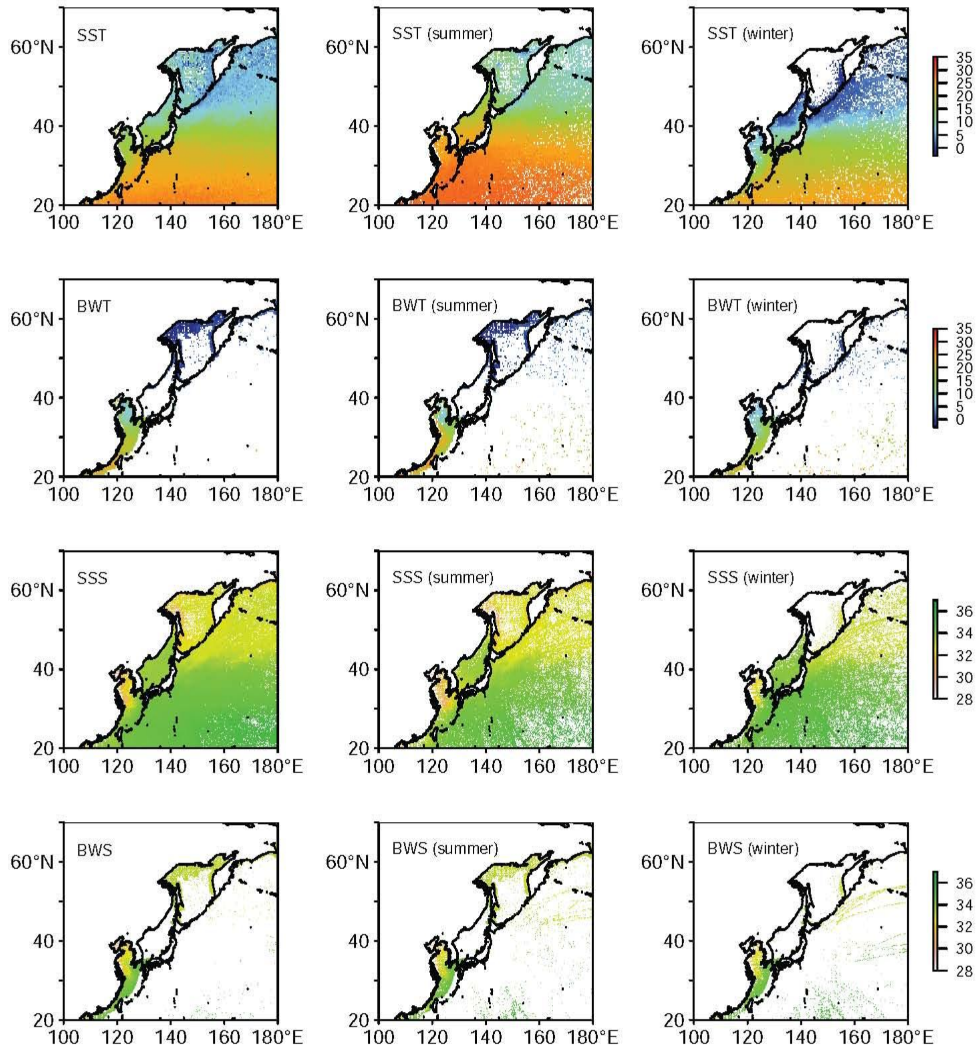

Figure S4. Visualization of sea surface and bottom water temperature and salinity (annual mean, summer mean, and winter mean) of the NW Pacific Ocean. Data are sourced from World Ocean Atlas 2018 (Locarnini et al., 2018; Zweng et al., 2018). From top to bottom rows are sea surface temperature (SST), bottom water temperature (BWT), sea surface salinity (SSS), and bottom water salinity (BWS). From left to right in each row are the annual mean, summer mean, and winter mean of the variable. The bottom water plots only show the areas with seafloor water depths <200 m.

Table S1. AMS ^{14}C dates results for samples from YSZK-1.

Sample	Depth	Conventional Radiocarbon Age (BP)	Calendar Calibrated Results: 95.4 % Probability	High Probability Density Range Method	DeltaR
YS-13	8.87 m	10290±40	9334–9133 cal BC	11283–11082 cal BP	100±20
YS-22	14.74 m	43120±3150 BP	greater than 39629 cal B	greater than 41580 cal BP	100±20
YS-26	18.16 m	>43500 BP			
YS-31	22.66 m	>43500 BP			

Table S2. OSL dating results for samples from YSZK-1.

Sample	Depth	K (%)	Th (ppm)	U (ppm)	Water Content (%)	Dose Rate（Gy/Ka）	De (Gy)	OSL Age (ka)
OSL-1	31.8 m	2.41±0.04	12.86±0.70	2.11±0.30	14±5	3.22±0.24	366.0±31.1	113.8±12.8
OSL-2	33.0 m	2.58±0.04	13.19±0.80	2.83±0.40	11±5	3.95±0.31	500.3±21.8	126.6±11.3

Table S3. Known ostracod taxa from YSZK-1.

Table S4. Autoecology summary of studied ostracod species.

Species	Autoecology	References
Sarsicytheridea bradi	mesohaline to enhaline (>6.5‰), thermoeuryplastic (-2, 2–19℃) and shallow to deep water	Frenzel et al., 2010
Cytheropteron nodosoalatum	euhaline, deep-water and open sea species	Stepanova et al., 2019
Heterocyprideis fascis	euryhaline shallow (neritic) and cold water	Gemery et al., 2017a
Rabilimis mirabilis	relatively shallow (<200 m) water depths, a range of salinities with a modern circum-Arctic distribution	Gemery et al., 2017b
Rabilimis septentrionalis	common in the shallow (<20 m) nearshore marine environments with seasonal sea ice and seasonal temperature and salinity fluctuations	Pushkar et al., 1999
Acanthocythereis mutsuensis	cold ostracod species, mainly know from the Sea of Japan, occur in the central and deeper part of the Yellow Sea (beyond the 50 m isobath)	Zhao & Wang, 1988; Ikeya & Cronin, 1993
Acanthocythereis dunelmensis	middle- to outer-shelf species occurring in the polyhaline to euhaline environments with temperature from (-2–13℃)	Frenzel et al., 2010; Gemery et al., 2017a
Neomonoceratina delicata	nearshore species abundant at depths less than 30 m at relatively high salinities (>30 psu), widely distribute in the nearshore and estuary environments including northern coast of Vietnam, inlets and bays of the Ryukyu Islands, the coast of China and the Jason Bay on the Malay Peninsula	Hong et al., 2019; Zhao and Wang, 1990
Pistocythereis bradyformis	prefer salinity values above 25 psu and water depths of 20–50 m, widely distribute in the coastal areas along Japan, China, Indonesia and Malaysia	Hou and Gou, 2007; Wang et al., 2018
Sinocytheridea impressa	coastal and estuarine areas in <20 m of water along the coastline of China and also from the supralittoral to sublittoral zones within their ranges of salinity (oligohaline to euhaline), largely inhabit the muddy and silty bottoms in lagoon-type environments, a wide distribution along the coast of the eastern margin of Eurasia (Japan, China and northern Vietnam)	Tanaka et al., 2019
Bicornucythere bisanensis	commonly in brackish water (salinity: 20–30 psu) with water depth less than 10 m along the coasts of China and Japan	Irizuki et al., 2009