ELSEVIER

Deep-Sea Research II 52 (2005) 2240–2274

DEEP-SEA RESEARCH
PART II

www.elsevier.com/locate/dsr2

Temporal and spatial flux changes of radiolarians in the northwestern Pacific Ocean during 1997–2000

Yusuke Okazaki[a,*], Kozo Takahashi[b], Jonaotaro Onodera[b], Makio C. Honda[c]

[a]*Ocean Research Institute, University of Tokyo, Minamidai 1-15-1, Nakano-ku, Tokyo 164-8639, Japan*
[b]*Department of Earth and Planetary Sciences, Graduate School of Science, Kyushu University, Hakozaki 6-10-1, Fukuoka 812-8581, Japan*
[c]*Japan Agency for Marine-Earth Science and Technology, Natsushima 2-15, Yokosuka 237-0061, Japan*

Received 30 September 2003; accepted 28 July 2005
Available online 20 October 2005

Abstract

In order to examine the radiolarian fluxes and evaluate their relationship to the physical and biological environments, time-series sediment traps were deployed at three stations (Stations 50N, KNOT, and 40N) in the northwestern North Pacific from 1997 to 2000. Station 50N (50°N, 165°E, 3260 m) is located in the center of Western Subarctic Gyre (WSAG); Station KNOT (44°N, 155°E, 2957 m) is located toward the margin of WSAG; and Station 40N (40°N, 165°E, 2986 m) is located in the Subarctic Boundary. Total radiolaria fluxes at Station 40N showed higher values than those at the other two stations, and were mainly attributed to the influence of relatively high-temperature and high-salinity subtropical gyre waters. Correlation coefficients between total mass fluxes (mainly composed of diatoms) and radiolarian fluxes at three stations were relatively low. This is primarily because of the wide vertical distribution of radiolarians and various trophic patterns corresponding to their niche. Radiolarian species were classified according to their geographic water mass and vertical distributions based on previous studies using sediment samples. As a result, seasonal changes of radiolarian fluxes in each water mass showed patterns corresponding to particular controlling factors such as physical hydrography and food conditions. Among these patterns, temporal changes in radiolarian taxonomic composition in the upper layer (0–100 m) seemed to reflect well the sea-surface temperature anomaly (SSTA) changes, affected by El Niño and La Niña events, at Station 40N. Therefore, radiolarian assemblages can be used to reconstruct past SSTA changes and to understand the past El Niño and La Niña teleconnection in the Kuroshio-Oyashio Extension region.

Keywords: Radiolaria; Sediment trap; Temporal flux variation; Western Subarctic Gyre; Subarctic Boundary; El Niño; La Niña

1. Introduction

Microplankton shells and skeletons have been used as various proxies to reconstruct past climate change and ecological environment. Therefore, a better knowledge of the present relationship between the ecology of microplankton and the physical and biological environmental conditions will improve our understanding of both paleoceanography and present-day oceanography. Radiolaria are siliceous microzooplankton with high diversity that dwell in a wide range of depth zones from the surface water down to several thousand

*Corresponding author at: Institute of Observational Research for Global Change, Japan Agency for Marine-Earth Science and Technology, 2-15 Natsushima-cho, Yokosuka 237-0061, Japan. Tel.: +81 46 867 9515; fax: +81 46 867 9455.
E-mail address: okazakiy@jamstec.go.jp (Y. Okazaki).

0967-0645/$ - see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.dsr2.2005.07.006

meters. Thus, they have a potential to be a proxy of various vertical water masses.

Radiolaria are classified into two taxonomic groups: Polycystina and Phaeodaria. The skeletons of polycystine radiolarians are often preserved in the sediments, whereas phaeodarian radiolarians are easily dissolved in the water column because of their skeletal constitution and thus are rarely preserved in the sediments (Takahashi et al., 1983). Recently, the importance of the oscillation in the intermediate-water production rate during the Quaternary climate change has been recognized (e.g., Talley, 1999). Ganopolski et al. (1998) indicated the expansion of the North Pacific Intermediate Water (NPIW) formation in the north during the Last Glacial Maximum (LGM) and the oscillations in the production of NPIW during the late Quaternary might have been influenced by the major climatic changes (Kennett et al., 2002). A part of the NPIW originates in the Okhotsk Sea today (e.g., Talley, 1991; Freeland et al., 1998; Wong et al., 1998), and the NPIW is distributed mainly between 300 and 700 m in the northwestern North Pacific (Talley, 1993). However, paleoceanographic knowledge in this region is still meager mainly because of the carbonate dissolution caused by the shallow carbonate compensation depth (CCD).

The northwestern Pacific Ocean is characterized by high primary production attributed to diatoms. Therefore, the efficiency of the biological pump in this region is significantly high (Honda et al., 2002) and thus, important for the global carbon cycle. There have been some previous taxon-quantitative works on radiolarian flux in the subarctic North Pacific using time-series sediment traps: the Alaskan Gyre (Stations PAPA and C: Takahashi, 1987, 1997), and the central subarctic Pacific (Station SA: Fukumura and Takahashi, 2000). In the northwestern Pacific, Bernstein et al. (1990) reported the radiolarian fluxes at seven stations. However, they used free-drifting sediment traps and their sampling durations were only for ca. 24 h.

In this study we present the modern seasonal changes in the time-series radiolarian flux over a 2-year period in the northwestern North Pacific and evaluate their relationships to the physical and

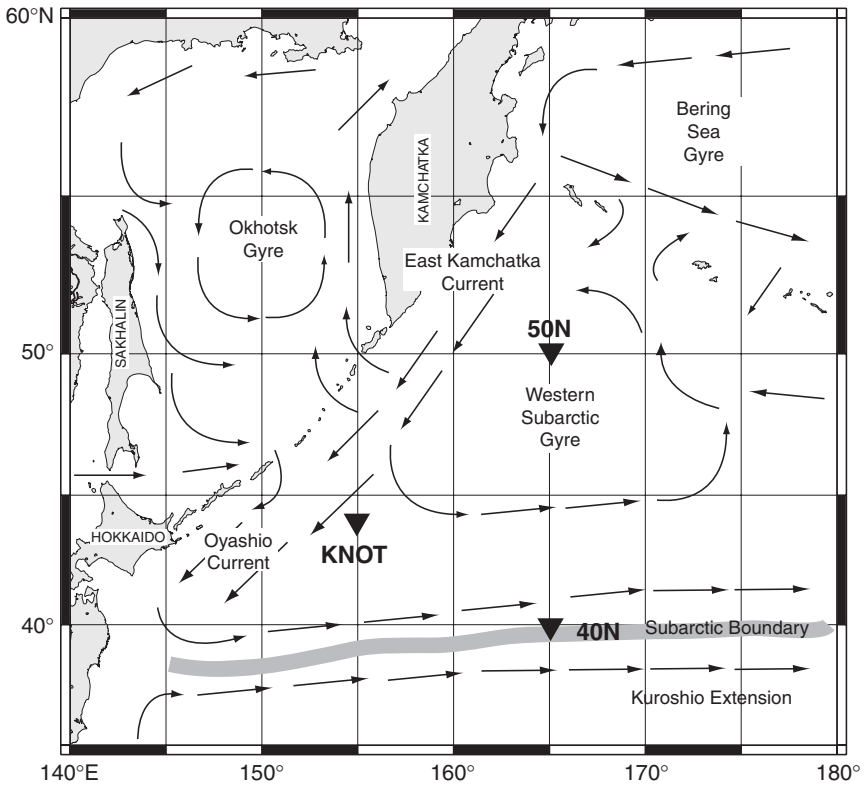

Fig. 1. Map showing the locations of the three sediment trap stations in the northwestern North Pacific. General circulation patterns are also shown (Map drawn by "Online Map Creation").