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Editorial

Korean Arctic Ocean expeditions (K-PORT) in the Northern Chukchi Sea

The Chukchi Sea, as the only conduit of inflowing water to the Arctic Ocean, is among the most productive regions in the world's oceans and very important to be monitored because environmental changes in the Chukchi Sea can be directly linked to Arctic marine ecosystems (Sambrotto et al., 1984; Springer et al., 1989; Springer and McRoy, 1993; Grebmeier et al., 2006a; Lee et al., 2007). Recently, the Northern Chukchi Sea has experienced a rapid decline of sea-ice extent and variable environmental changes during summer (Overland and Stabeno, 2004; Grebmeier et al., 2006b; Bluhm and Gradinger, 2008; Grebmeier, 2012). During our Arctic expeditions, the Arctic sea-ice extent was at the minimum record (3.4×10^6 km^2) in 2012 in relation to routine satellite observations since 1979 (Parkinson and Comiso, 2013). This enormous loss of sea ice was most evident in the Northern Chukchi and Beaufort seas where the sea-ice edge retreated beyond 80°N (Parkinson and Comiso, 2013; Hwang et al., 2015). These recent environmental changes have greatly affected the physiological status, community structure, and primary production of phytoplankton (Kim et al., 2015-a,-b; Yun et al., 2015-a), and could consequently alter seasonal distributions and nutritional status of upper trophic levels such as zooplankton (Nelson et al., 2009; Dolan et al., 2014; Yun et al., 2015-b).

Based on satellite ocean-color data, large increases in annual net primary production by phytoplankton were observed particularly on the continental shelves of the Chukchi Sea as well as the East Siberian, Laptev, and Kara seas (Pabi et al., 2008). However, recent *in situ* field-measured rates of primary production were up to 3 times lower than those previously reported from the shelf of the Chukchi Sea (Lee et al., 2007, 2013; Yun et al., 2014). Consistently, significant decreases of 30–50% in nutrients and approximately 40% in integrated chlorophyll concentration have been observed in recent years based on long-term field measurements from various programs since the 1980's in BERPAC (USA/USSR Bering and Chukchi Seas research program), ISHTAR (Inner Shelf Transfer and Recycling in the Bering and Chukchi Seas), CHOEX/ICE 90 and RUSALCA (Russian–American Long-term Census of the Arctic) (Whitledge and Lee, unpublished data). At this point, whether climate and environmental changes enhance or reduce the overall rates of primary production in the Chukchi Sea remains controversial.

Using the first Korean research Icebreaker 'RV Araon', the Korean Arctic Ocean research program (Korea-Polar Ocean in Rapid Transition; K-PORT) was executed intensively in the Northern Chukchi Sea from 2010 to 2014 to understand rapid environmental changes and to conduct multidisciplinary survey and mapping of water-column and sediment processes over both temporal and spatial scales. The papers in this special issue report various results from a multi-disciplinary study of biological, chemical, physical, and geological surveys in the Northern Chukchi Sea in this rapid transition of sea-ice change and provides a better understanding of both the sea-ice and marine ecosystems as they respond to ongoing environmental changes. For sea-ice physics, Hwang et al. (2015) improve our current understanding of how sea-ice deformation occurs at very small, sub-km scales, and how such deformation is related to large-scale wind forcing that results in significant sea-ice deformation. Several floe fracture event records were analyzed from an array of GPS-equipped ice-anchored buoys deployed on a single sea-ice floe in the Arctic Ocean over the nine-month period. Kim et al. (2015-b), using a mooring array on a drifting sea ice, reveal the mixing and entrainment mechanisms sustaining suspended particulate matter within the upper mixed layer of the marginal ice zone after completion of the under-ice bloom. In terms of the sea-ice ecosystem, Lee et al. (2015) present detailed results on the role of particulate organic carbon (POC) as a potential food source to higher trophic levels such as microzooplankton in various environments from two different Arctic sea-ice floes in the Northern Chukchi Sea.

For water-column studies, Zhao et al. (2015) describe the optical attenuation coefficient, attenuation depth and optical thickness in the study region and suggest two subsurface water masses: cold shelf water transported by a subsurface current along the East Siberian Slope and warmer water from the Pacific Ocean input flow through Bering Strait, based on both the optical attenuation property and the physical features of the water. Using traditional ocean observations and bacterial biogeography based on a pyrosequencing method, Han et al. (2015) introduce population dynamics of major taxa in bacterial communities to understand the effects of the hydrographic features on the marine bacterial diversity within the Arctic Ocean. They show that Arctic marine bacteria have certain biogeographic patterns over the Chukchi Borderland and that the Arctic bacterial biogeography is related to oceanographic traits, such as sea-ice dynamics and current circulation. Yun et al. (2015-a) provide valuable information on primary and nitrogen productivity in the Chukchi Sea-Canada Basin region, based on results from 19 ship-board primary productivity stations. This paper indicates that freshwater balance, vorticity in the Beaufort Gyre, and eddy activity can play important roles in the regional productivity. Kim et al. (2015-a) report on the biochemical compositions (lipids, proteins, and carbohydrates) of particulate organic matter as a potential food source in the Northern Chukchi Sea in order to improve our understanding on physiological status of phytoplankton, determine important controlling factors, and estimate the energetic contents of POM. Yun

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et al. (2015-b) reveal the relationship between macromolecular compositions (proteins, lipids, and carbohydrates) of phytoplankton and major biochemical compositions (water, proteins, lipids, and ash) of zooplankton to evaluate the nutritional status of zooplankton community. Yang et al. (2015) describe the microzooplankton community and its grazing impact on major phytoplankton groups investigated in the Chukchi Sea and the Western Canada Basin. They find that the spatial distribution of microzooplankton biomass and its composition are related to differences in phytoplankton biomass and composition in the water column, with microzooplankton grazing identified as an important process controlling phytoplankton biomass and composition. Jiang et al. (2015) provide basic information on vertical variation in ciliate communities to understand how pelagic ciliates are structured in the water column under a summer sea-ice reduction regime. Lastly, La et al. (2015) describe the variation of the sound-scattering layer dominated by Arctic copepods observed around Northwind Ridge. The sound-scattering layer (SSL) was primarily distributed in the upper most 100 m of the Pacific Summer Water (PSW), which provided a desirable habitat for Arctic copepods due to high nutrients and phytoplankton biomass. Notably, the highest density SSL was observed in the eddy-like structure of the PSW coincident with high nutrients and chlorophyll *a*.

This special volume is dedicated to the Korean Chief Scientist in 2010 and 2011, Dr. Kyung Ho Chung, who passed away suddenly in December, 25, 2012. All the papers in this volume are in loving memory of him who largely contributed to developing the Korean Arctic programs over the past 10 years.

Finally, we would like to take this opportunity to acknowledge the Korean Ministry of Oceans and Fisheries for the financial support to the K-PORT programs (PM13020 and PM14040). We are also grateful to Professor J.D. Milliman for his great guidance in preparation for publication of this Korean Arctic Expeditions in the Northern Chukchi Sea as a special issue of Deep-Sea Research II. We are especially indebted to all reviewers for providing their valuable review comments for individual articles of this volume.

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Sang Heon Lee*
Department of Oceanography, Pusan National University, Busan 609-735, South Korea
E-mail address: sanglee@pusan.ac.kr

Jacqueline M. Grebmeier
Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science, Solomons, MD, USA

Sung-Ho Kang
Division of Polar Ocean Environment, Korea Polar Research Institute, Incheon 406-840, South Korea

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* Corresponding author.