

***Hydrographic CO₂ Data
during JAMSTEC Cruises at
Station KNOT and K2***

Version 202303

March 2023

***Mutsu Institute for Oceanography
Japan Agency for Marine-Earth Science and Technology***

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1. Introduction

Anthropogenic CO₂ was taken up by the global ocean at a rate of $2.2 \pm 0.4 \text{ Pg C yr}^{-1}$ during the 1990s (Denman et al., 2007). The most fundamental and reliable approach to the direct detection of the CO₂ uptake rate and its variation is to make more accurate and longer time-series observations at fixed stations, for example, station ALOHA in the subtropical North Pacific Ocean (e.g., Dore et al., 2003), BATS in the subtropical western North Atlantic Ocean (e.g., Bates et al., 2002), ESTOC in the subtropical eastern North Atlantic Ocean (e.g., Santana-Casiano et al., 2007), Ocean Station Papa (OSP) in the subarctic eastern North Pacific (e.g., Wong and Chan, 1991), and stations KNOT (Kyodo western North Pacific Ocean Time-series (Kyodo means "collaborative" in Japanese); 44°N, 155°E) (e.g., Tsurushima et al., 2002) and K2 (47°N, 160°E) (e.g., Honda et al., 2006) in the subarctic western North Pacific Ocean (Fig. 1). Time-series observations are essential to understanding temporal variation of dissolved inorganic carbon (DIC) in the ocean.

At least annually since 1997, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) has conducted hydrographic observations at KNOT or K2 in the subarctic western North Pacific (Fig. 1). Station KNOT is located in the western subarctic gyre and just north of the Subpolar Front (Fig. 1) and has been a Japanese JGOFS time-series station since June 1998 (e.g., Tsurushima et al., 2002). Hydrographic studies in this region were also conducted by other organizations since 1992 (e.g., Tsurushima et al., 2002, Wakita et al., 2005, Wakita et al., 2010, Wakita et al., 2013, Wakita et al., 2016, Wakita et al., 2017).

In this report, we compile data obtained at station KNOT and K2 by JAMSTEC cruise in order to investigate the temporal variation of DIC and related properties (total alkalinity (TA), temperature, salinity, oxygen, and nutrients (silicate, nitrate, nitrite, ammonium, and phosphate), dissolved organic carbon (DOC)) in the subarctic western North Pacific.

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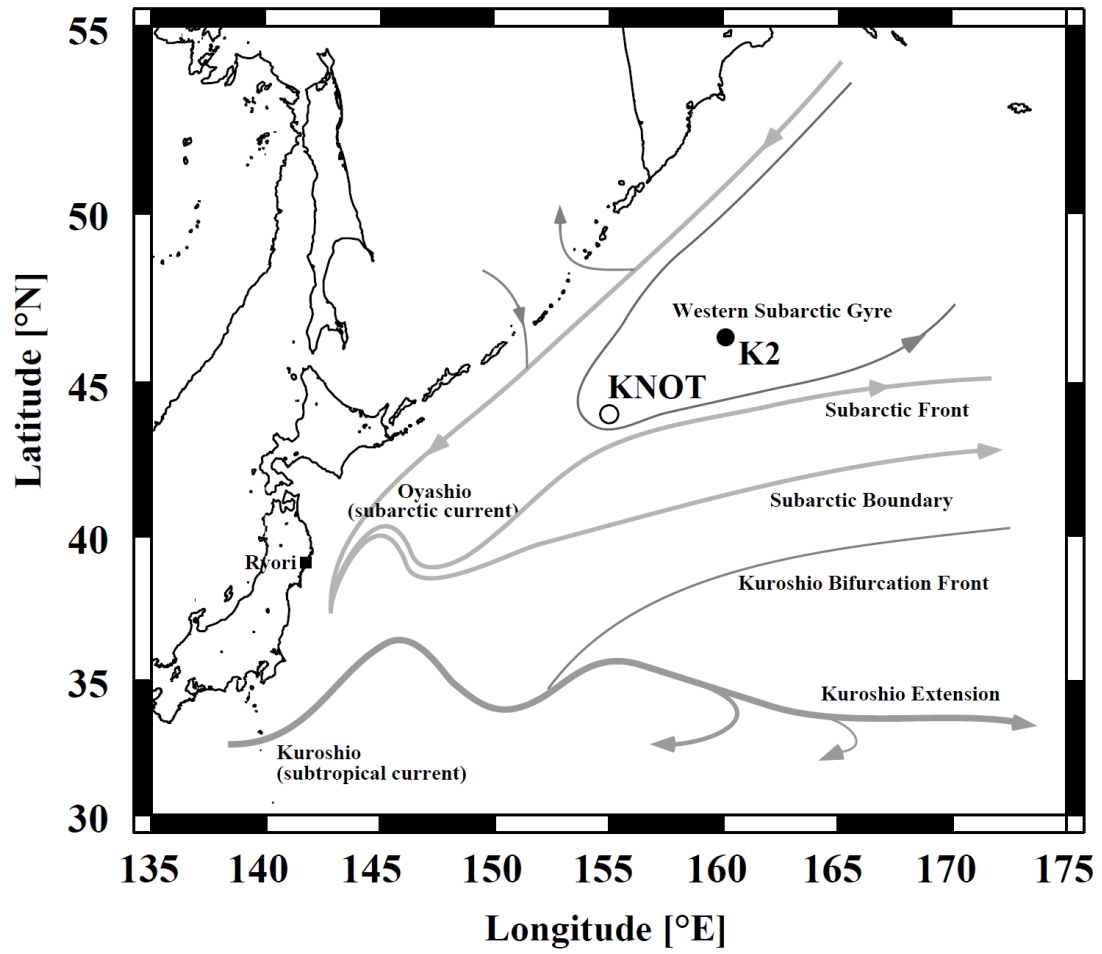


Figure 1. Time-series stations and main ocean currents in the subarctic western North Pacific. The Kuroshio and Oyashio are the subtropical and subarctic western boundary currents in this region, respectively.

2. Data sources and analyses

We prepared a set of data to investigate long-term climate change in the subarctic western North Pacific. All data were collected from the observations at stations KNOT (42 CTD casts) and K2 (87 CTD casts) from 1997 to 2020. These cruises were made by 4 research vessels: R/V *Mirai*, R/V *Hakuho Maru*, R/V *Natsushima* and R/V *Yokosuka*. These cruise reports are available from the JAMSTEC data web site (https://www.godac.jamstec.go.jp/cr_catalog/view/base?lang=en). DIC and TA were measured by using coulometric and potentiometric techniques, respectively. Measurement of TA since 2007 was made using a spectrophotometric system. The precision of both DIC and TA was $\pm 0.1\%$ or better from duplicate determinations. The DIC and TA values were determined with calibration against certified reference material provided by Prof. A. G. Dickson (Scripps Institution of Oceanography). The dissolved oxygen (DO) and nutrient concentrations were measured with an automatic photometric titrator and a continuous flow analyzer, respectively. Based on replicate samples, the precisions of the DO measurements were smaller than 0.4 mmol/kg. The precisions for silicate, nitrate, and phosphate at the maximal concentrations of working standard solutions (~ 170 , ~ 60 , and ~ 3.5 mmol/kg) were smaller than 0.2, 0.2, and 0.4%, respectively.

Seawater samples for DOC measurements were taken from Niskin bottles after filtration through a pre-combusted (450 °C for 4 h) 47-mm GF/F filter (Farmer and Hansell 2007). The samples were frozen upright and preserved at about -20 °C before analysis. After a sample had been returned to room temperature for analysis, it was acidified to pH <2 with hydrochloric acid and bubbled with carrier gas (high-purity air) to remove DIC. The DOC concentration was determined by using a total organic carbon analyzer (TOC-V (2006~2014) or TOC-L (2015~), Shimadzu Co., Kyoto, Japan) following the analytical method of Ogawa et al. (2003). The values were calibrated against consensus reference material provided by Prof. D. A. Hansell (Miami University) and the deep water (>3000 dbar) collected at K2. The precision for the DOC concentrations was ± 1.0 μM , where the number indicates the average of the absolute values of the differences between duplicate samples.

3. Future update of data and contact persons

These update data will be opened on the JAMSTEC data web site in future.

Contact Persons

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5. Acknowledgements

We acknowledge the staff of Mutsu Institute for Oceanography, JAMSTEC and the captains and crews of the R/V Mirai, R/V Natsushima, R/V Yokosuka, and R/V Hakuho Maru for their kind cooperation. We thank the staff of Marine Works Japan Co., Ltd. who worked as marine technicians onboard.