Vertical profile of dissolved oxygen in the eastern Japan Basin, Yamato Basin, and Tsushima Basin of the Japan Sea in 2016

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The Japan Sea is a semi-closed marginal sea in the North Pacific Ocean. Dissolved oxygen concentration in deep water of the Japan Sea, however, is higher than that of the adjacent North Pacific Ocean due to its independent deep-ventilation. Gamo (1999) found that dissolved oxygen in bottom water deeper than 2000 m depth in the eastern Japan and Yamato Basins continuously decreased during the last 50 years at about 0.8 μmol/kg/year of consumption rate. This long-term trend of decrease could be derived from stagnation in the deep ventilation which associates with warming in the northern part of the Japan Sea including coastal area of Siberia. Kumamoto et al. (2008) found temporary increases on the long-term decrease trend and proposed a hypothesis: “Dissolved oxygen is supplied to the bottom water in the western Japan Basin due to new bottom water formation only in severe winters. Oxygen-rich new bottom water is transported to the Yamato and eastern Japan Basins within a few years along an anti-clockwise deep current in the Japan Sea. Without the oxygen supply the concentration in the bottom water decreases due to consumption for decomposition of organic matter”. Based on this hypothesis, Kumamoto (2010) speculated that “true” consumption rate of dissolved oxygen in the bottom water is about 2 μmol/kg/year and the bottom water of the Japan Sea will become anoxic within 100 years. Here we measured vertical profile of dissolved oxygen in the eastern Japan Basin, Yamato Basin, and Tsushima Basin of the Japan Sea in 2016 and discussed temporal change in oxygen concentration in the bottom water in the past several years. During research cruises of Oshoro-maru-26th (July 2016), KIOST-Eardo (September 2016), and Nagasaki-maru-447th (October 2016), dissolved oxygen concentration from surface to bottom was measured on board using modified Winkler method. Uncertainty in oxygen measurement was estimated to be about 0.2 μmol/kg from replicate measurements. The vertical profiles of dissolved oxygen observed in 2016 were compared with those measured in 2010. Between 2010 and 2016, dissolved oxygen concentration in the bottom water of the three basins decreased about 5 μmol/kg in average and consumption rate was calculated to be about 0.8 μmol/kg/year, which agrees with that observed during the last 50 years. According to Kumamoto (2010), during the past six years dissolved oxygen concentration in the bottom water should decrease more than 10 μmol/kg if there was no oxygen supply due to formation of new bottom water. Although these observational results imply supply of dissolved oxygen into the bottom water between 2010 and 2016, dissolved oxygen concentration in the bottom water in the eastern Japan Basin monotonously decreased from 2010 and 2016 (JMA, 2016). This discrepancy could be resolved by decrease in organic matter flux from surface to bottom waters and/or increase in circulation rate of the deep current of Japan Sea. We will continue observations, including primary production and direct measurement of the deep current, in the Japan Sea in 2017 and 2018 and discuss further these results. This work was supported by Environment Research and Technology Development Fund (ERTDF), the Ministry of the Environment, No. A-1002 “Mechanism elucidation and future forecast on the decreasing trend of dissolved oxygen concentrations in the deep water of the Japan Sea (2010-2012)” and No. 2-1604 “Global warming impacts on thermohaline circulation and subsequent biogeochemical change in the Japan Sea (2016-2018)”.

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