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Determination of picomolar Fe(II) in seawater using an automated in-situ flow analyzer

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In the open ocean, iron is widely recognized as an essential element for the phytoplankton growth. Since the bioavailability of iron depends on its chemical form in seawater, many of iron studies in the ocean now focus on the chemical speciation of iron. Regardless of increasing interests in iron speciation in the ocean, marine biogeochemical process of Fe(II) is not fully investigated. In oxic conditions, Fe(II) is rapidly oxidized to Fe(III), which makes it difficult for us to determine Fe(II) in seawaters. To prevent the Fe(II) oxidation after sampling, we developed an in-situ flow analytical method of Fe(II) in seawater.

The in-situ analyzer was composed of an acrylic, oil- and water-filled, pressure-compensated vessel containing a flow through analyzing system, an aluminum pressure housing for electronic modules, a battery for the power supply. The Al pressure housing can hold a CPU for system control, a photomultiplier detector with amplifiers, an AD converter, and a flash memory for data logging. Highly sensitive luminol chemiluminescence detection, previously used for the onboard Fe(II) determination in oceanic waters, was applied for the flow through analytical system. In this study, we examined the optimal conditions for the chemiluminescence detection and adopted the conditions to this system. We also developed a system for the in-situ calibration of Fe(II) concentration during the hydrographic cast for vertical measurement. The detection limit was low enough to apply for Fe(II) determination in the open ocean.

By using the in-situ analyzer, we obtained 1000m vertical profiles of Fe(II) in the western North Pacific and eastern South Pacific during the research cruise KH-10-2 and KH-11-10 with R.V. Hakuho-maru.

Keywords: In-situ autoanalyzer, seawater, Fe(II), Pacific Ocean