East Asia GEOTRACES Workshop: Trace Element and Isotope (TEI) study in the Northwestern Pacific and its marginal seas

PLENARY TALK ABSTRACTS

2018 US GEOTRACES Pacific Meridional Transect: studying inputs and internal cycling across a wide variety of coastal to oceanic regimes

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In summer 2018 the US GEOTRACES Program will conduct a meridional transect in the central Pacific along 152°W from Alaska to Tahiti, GEOTRACES Cruise GP15. The justifications for this transect are very compelling since it would sample: strong margin fluxes, sub-Arctic HNLC waters, Pacific intermediate waters that have their origins in the western Pacific, the oldest deep water in the world's oceans, the distal ends of hydrothermal plumes from the Juan de Fuca Ridge and East Pacific Rise as well as oxygen minimum zones, equatorial upwelling, and some of the most oligotrophic waters in the world's oceans in the South Pacific gyre at 20°S. The cruise would also allow temporal variability to be addressed since it will be along the CLIVAR/Repeat Hydrography P16 line, and near existing time series stations and sites of previous TEI studies. Moreover, there is evidence of atmospheric inputs of contaminant elements like Ag, Hg, and Se derived from Asian fossil fuel combustion reaching these waters; surface and aerosol sampling will directly address this potential input. In terms of intercalibration, it will occupy a crossover station with the Japanese GP02 cruise, linking the two programs.

Trace metal cycling in the Atlantic Ocean. Inputs, distributions and biogeochemical effects

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The (sub-)tropical North Atlantic receives high Saharan dust inputs and features an oxygen minimum zone, which impact trace metal biogeochemistry. The dust inputs deliver Fe to the ocean, which subsequently controls N2 fixation. The dust deposition to the North Atlantic diminishes with latitude, and the waters of the subpolar gyre consequently become Fe limited following the spring bloom. The Fe supply to surface waters is therefore primarily determined through deep winter mixing, which also includes Fe from hydrothermal sources of the Mid-Atlantic Ridge. The Fe to nitrate ratios supplied by winter mixing are unfavourable to sustain phytoplankton growth throughout the summer.

The South Atlantic does not feature strong dust inputs, and areas of high productivity along the SW African coast and the 40°S zonal band are considered to be sustained by upwelling and benthic Fe supply, respectively. The control of ocean productivity with distance from biogenic trace element sources is determined by removal and recycling processes, and features co-limitation of micro and macronutrients.

In this presentation, a range of UK and German GEOTRACES related cruise activities in the Atlantic Ocean are presented. Overall, the strong link between biogenic trace element supply and ocean productivity is emphasised, which constitutes a major outcome of the International GEOTRACES programme.

The distribution of particle concentration and composition in GEOTRACES: effects on scavenging

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The GEOTRACES program is revolutionizing our understanding of the distribution of trace elements and isotopes in the ocean. In my lab, we are also measuring the distribution of size-fractionated particle concentration and composition. The combination of trace element and particle measurements in full ocean depth GEOTRACES sections puts us in an ideal position to revisit Karl Turekian's "Great Particle Conspiracy" and examine the controls on scavenging removal of trace elements and isotopes. I will present particle results from the first two US GEOTRACES cruises and what we are learning about scavenging of trace elements and isotopes.

Section cruises and Intercalibration in GEOTRACES Japan

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Trace elements and their isotopes (TEIs) in seawater are key parameters for modern marine biogeochemical studies. For these studies, the clean seawater sampling method for contamination-prone trace metals is a crucial issue. Since 2009, GEOTRACES-Japan had several GEOTRACES section cruises, such as KH-09-5 (6 Nov., 2009 – 10 Jan., 2010) in the Indian Ocean, KH-12-4 in the subarctic North Pacific (23 Aug. - 3 Oct., 2012), KH-14-6 in the western South Pacific (2 Dec., 2014 - 26 Feb., 2015). During the GEOTRACES section cruises, we examined some clean seawater sampling methods using Kevlar wire, Ti-wire, Ti-armored cable and Vecrtan cable, which indicated that we need to be careful especially for some trace metals like Fe and Zn. Here, I'll indicate the results on the comparison of sampling methods and make some recommendations for the clean seawater sampling.

In the international GEOTRACES project, it is also important to ensure the data quality of TEIs via the intercalibration activities. Some Japanese groups joined the US GEOTRACES intercalibration cruise in 2008 and the international intercalibration activities before the section cruises. In this presentation, I'll introduce the intercalibration activities in Japan and the collaboration with other countries. Without these kinds of collaborations, we cannot carry out the intercalibration activities. I hope this workshop will be the first step for the collaborative studies in the East Asia.

Data Management and GEOTRACES Intermediate Data Product: from the global to the Asian marginal seas

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GEOTRACES is an international study with expeditions conducted throughout the world ocean basins. The program will run for decades and now involves more than 35 nations. Data management, including data submission and publishing, is a very essential issue. In February 2014, four years after the launch of the GEOTRACES program, the first GEOTRACES Intermediate Data Product 2014 (IDP2014) was released in two parts: 1) the digital data package and 2) the eGEOTRACES Electronic Atlas. This IDP 2014 aimed to release a data product early in the program, strengthen the collaboration within the project by sharing data and attract scientists from other communities (e.g. physical and biological oceanography, modelling). Now, the second Intermediate Data Product 2017 (IDP2017) is in production and will be published this August at the 2018 Goldschmidt Conference in Paris.

GEOTRACES takes interest in the theme "continental run off", the material transport from the land to the open ocean, particularly with understanding of geochemical TEIs. However, marginal seas in the western North Pacific and western boundary current area are rich in the variability of bottom character and bathymetry, constantly or intermittently exchanging energy and materials between land and open ocean. As these marginal seas play a decisive role in the

sustainable development and environmental adaptation/protection necessitated by global/regional climate changes, it is urgently necessary to establish a framework for cooperative studies to improve our common understanding of the status and impact of materials exchange in marginal seas. In this presentation, current biogeochemical cruises covering the various marginal seas connecting to the western North Pacific will be introduced. Related results will strengthen the cooperation of the Asian-GEOTRACES program and serve to benefit of Asian regional marine biogeochemical and ocean/environmental sciences community.