

Enhanced phytoplankton productivity induced by anthropogenic nutrient enrichment and iron fluxes in the coastal water of Alang, Gujarat

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Alang (21°24'43"N and 72°12'10"E) ship breaking yard (14.3 km) established in 1982 dismantles around 200 ships every year resulting in a significantly high iron concentration (11.2 ± 5.7 %) in the intertidal sediments. The tidal flushing with high waves cause Fe transport from intertidal sediments and enrich subtidal sediments (14.7056 ± 9.49 %) in the comparison of the values recorded from the offshore sediments (5.96 ± 2.55 %). High levels of pH (8.15 ± 0.14), dissolved oxygen (4.31 ± 1.29 mg/l) and nutrients in terms of NO_3^- -N (33.72 ± 7.46 $\mu\text{mol/l}$), NO_2^- -N (0.67 ± 0.21 $\mu\text{mol/l}$), NH_4^+ -N (1.60 ± 1.42 $\mu\text{mol/l}$) and PO_4^{3-} -P (2.71 ± 1.15 $\mu\text{mol/l}$) in the overlying water associated with iron fluxes from enriched intertidal sediments to subtidal sediments triggered a massive phytoplankton bloom ($277.24 \pm 378.2 \times 10^3/\text{l}$ cells) with significantly high concentration of chlorophyll *a* (4.22 ± 6.66 mg/m³) and phaeophytin (1.17 ± 0.59 mg/m³). This fertilized water with enhanced concentration of NO_3^- -N was preferred by *Navicula distans*, *Thalassionema balticum* and *Peridinium sp.* for excessive proliferation at some locations contributing 96%, 30.9% and 40%, respectively, of the total percentage composition in the community structure. A similar enhanced level of nutrients in the offshore water could not increase phytoplankton pigments viz. chlorophyll *a* (0.8 ± 0.37 mg/m³), suggesting the persistence of high nitrate low chlorophyll (HNLC) condition. Thus, significantly declined phytoplankton population ($13.8 \pm 8.78 \times 10^3/\text{l}$ cells) associated with high nutrients and low Fe, suggested that availability of Fe has a potential to enhance phytoplankton productivity in nearshore waters than in offshore regions.

Chemistry of newly-discovered hydrothermal vents in the East Scotia Sea

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Seafloor spreading at the East Scotia Ridge (ESR) was initiated >15 Ma ago and is presently proceeding at a rate of ~70mm/yr. The ESR is a backarc spreading centre that consists of 9 second-order ridge segments (E1 to E9), separated by non-transform discontinuities. Evidence of hydrothermal signals in the water column was first reported in segments E2 and E9 by German *et al.* [1], and a more recent cruise by ourselves to this area in January 2009 detected high levels of particulate material and dissolved iron and manganese in the water column at E2 and E9 [2]. On further investigation, as part of that study, a towed camera system also observed black smoker chimneys at E2.

As part of a study to investigate the chemosynthetic environments south of the Polar Front, we returned to the ESR this year (January-February 2010) with the RRS *James Cook*, equipped with the UK ROV *Isis*. Focused and diffuse vent fluids were observed and sampled for the first time at both segments E2 and E9. The maximum recorded temperatures of the fluids are, respectively, 353 and 383°C, and the chemical compositions of the endmember fluids are distinctly different. The hydrothermal endmember at E2 has a chloride concentration ([Cl⁻]) that is similar to ambient seawater, while at E9, [Cl⁻] is distinctly lower than seawater and is ~100 mM.

In addition, we have observed hydrothermal activity at a submarine volcano located to the south of the South Sandwich Islands. Fluids vent from friable chimney structures at temperatures of up to 212°C; preliminary analyses indicate that these fluids have exceptionally high levels of hydrogen sulphide (>40 mM), and [Cl⁻] is lower than seawater.

Further analyses will be conducted on all samples when we return to shore, and will be reported at the meeting.

[1] German *et al.* (2000) *Earth Planet. Sci. Lett.* **184**, 241–250. [2] Connelly *et al.* (2010) *Earth Planet. Sci. Lett.* submitted.