Oral presentation

Distribution of the carbonate species off the coast of Mozambique and Tanzania.

Mr Mutshutshu Tsanwani (Presenter)
Department of Environmental Affairs
P.O. Box 52126
V&A Waterfront
Cape Town
8002
mitsanwani@environment.gov.za

Mr Baxolele W. Mdokwana
Department of Environmental Affairs
P.O. Box 52126
V&A Waterfront
Cape Town
8002
bmdokwana@environment.gov.za

Mr Khaya. Siswana
Department of Environmental Affairs
P.O. Box 52126
V&A Waterfront
Cape Town
8002
ksiswana@environment.gov.za

Background
The carbonate system is one of the most important systems in the ocean, primarily because of the role it plays in maintaining the pH of seawater within a narrow range. It plays the key role of acting as a buffer for the acidity of seawater and controlling atmospheric CO$_2$. The rapid increase in atmospheric CO$_2$ comes with unintended consequences for the global oceans. About 30% of CO$_2$ released into the atmosphere by humans is taken up by the oceans. As a result, the carbonate chemistry of the upper ocean is going through a considerable change. The pH has dropped by about 0.1 unit since the beginning of industrialisation in a process commonly referred to as ocean acidification. Ocean acidification is posing a huge threat to marine calcifying organisms since their calcium carbonate shells or skeletons are potentially susceptible to dissolution in acidic waters.

Method
Here we studied the distribution of the carbonate chemistry off the coast of Mozambique during the November 2017 IIoE-2 cruise and Tanzania during the June 2018 IIoE-2 cruise, with the aim of providing the spatial variability and its link to ocean acidification. The measurements of DIC and TA were performed on-board the SA Agulhas II using a VINDTA 3C (Versatile Instrument for the Determination of Total Alkalinity) from Marianda coupled to a CO$_2$ model 5012 coulometer. The carbonate species were calculated from DIC and TA using a CO2Sys_v2.1, in which the temperature, salinity and stoichiometric equilibrium constants for carbonic acid of Lueker et al. 2000, KHSO$_4$ of Dickson 1990, pH total scale
(mol/kg-SW) and boron concentration from Lee et al. 2010 were used. DIC and TA were normalised to a salinity of 35.

Results
The results show that DIC (Fig. 1) ranged from 1960-2090 µmol/kg in the surface layers off the coast of Mozambique whereas the pCO$_2$ ranged from 350-750 ppm, pH ranged from 7.8-8.1 and Ωarag ranged from 2.39-3.65. DIC in the surface layers off the coast of Tanzania ranged from 1950-2154 µmol/kg whereas the pCO$_2$ ranged from 365-960 ppm, pH ranged from 7.7-8.1 and Ωarag ranged from 1.94-3.75. DIC off the coasts of both Mozambique and Tanzania increased sharply offshore in the thermocline region and exceeded 2250 µmol/kg below 1000 m depth. Aragonite saturation state offshore was under-saturated (Ωarag < 1) below 1000 m whereas the pH fell below 7.8. The lowest pH found in offshore bottom waters off the coast of Mozambique and Tanzania was 7.6 and 7.7 whereas the lowest Ωarag was 0.79 and 0.58, respectively. Low Ωarag below 1000 m poses a threat to calcareous organism’s growth and survival.

Figure 1. Vertical distribution of Total Alkalinity (AT), dissolved inorganic carbon (DIC), pH and aragonite saturation state (Ωarag) (Line 4) off the coast of Mozambique and Tanzania.

Conclusion
High Ωarag on the shelf indicate that the Mozambique and Tanzanian’s coasts were suitable habitat for calcareous organisms. Low Ωarag below 1000m poses a threat to calcareous organism’s growth and survival. Upward migration of aragonite saturation horizon may occur in the future due to accumulation of anthropogenic CO$_2$. 