High resolution coral records of reactive and micronutrient trace metals: Monitoring biological responses to flood plumes.

Tim Wyndham, Malcolm McCulloch, and Eric DeCarlo[1]

The influences of flood plumes on the coastal ocean are difficult to investigate because they are intermittent, transient and highly variable in nature. The application of trace metals in coral carbonates as proxy recorders of marine environmental conditions has been demonstrated to be an excellent method for overcoming these difficulties. Coral records of trace metals have been widely used to provide historical records of the physical impacts of flood plumes, including changes in salinity ($\delta^{18}O$), sediment load (Ba), and anthropogenic inputs such as heavy metal pollution (eg. Pb, Cd). In contrast, the use of coral records to monitor the biologic responses to these changing environmental conditions has proved more difficult. However, with improvements in analytical techniques, it is now possible to investigate coral records of reactive (rare earth elements) and micronutrient (eg Mn, Zn and Cu) trace metals, which can be used to more widely explore the biogeochemical impact of flood plumes on the coastal ocean.

We have obtained high resolution temporal records of rare earth elements, Cu, Zn, Mn and Sn, from corals from two locations; (1) near Townsville on the Great Barrier Reef (GBR), and (2) Kaneohe Bay on Oahu, Hawaii. Both locations often display large phytoplankton blooms following flood events, and therefore provide a good opportunity to test the idea that coral records can be used to monitor the biological response to flood plumes. These coral records show significant responses to flood plumes that can only be attributed to biogeochemical cycling that occurs as a result of the flood plume influence, rather than the flood plume itself. Thus a mechanism for exploring the biological response to flood plumes is provided. It has generally proven difficult, however, to interpret these coral records without a good understanding of the coastal processes. Therefore we have also directly measured the influence of trace metal concentration of a coastal *Trichodesmium* bloom on the GBR and have been investigating the relationship between phytoplankton abundance and trace metal concentrations in Kaneohe Bay. It is hoped that combining these pieces of evidence will make it possible to reconstruct historical records of biologic responses to changing environmental conditions.

1. Department of Oceanography, University of Hawaii

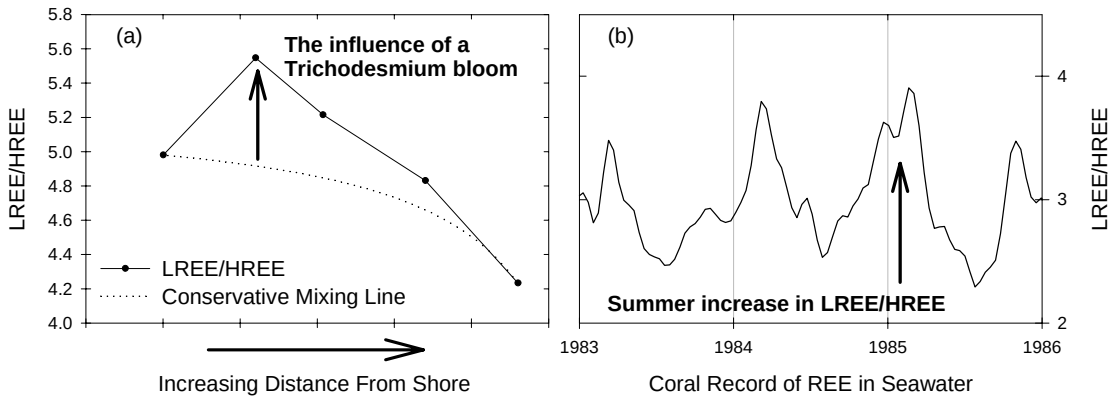

Figure 1. (a) HREE scavenging by a Trichodesmium bloom on the Inner Great Barrier Reef results in an increase in the LREE/HREE ratio. (b) A coral record of REE seawater composition at the same study area shows an annual summer increase in the LREE/HREE that can be attributed to similar processes.