Geophysical Research Abstracts
Vol. 13, EGU2011-9518, 2011
EGU General Assembly 2011

Sub-decadal records of surface water properties recorded in deep-sea corals spanning the last millennium from the Gulf of Mexico

Nancy Grumet Prouty (1), Brendan Roark (2), and Alan Koening (3)

(1) US Geological Survey, 400 Natural Bridges Drive Santa Cruz, CA 95060 USA (nprouty@usgs.gov), (2) Department of Geography, Texas A&M University, College Station, TX 77843 USA (broark@geos.tamu.edu), (3) US Geological Survey, MS 973 Denver Federal Center Denver, CO 80225 USA (akoenig@usgs.gov)

Results from this study represent the first comprehensive investigation of growth rates and age distributions of black coral in the Gulf of Mexico and provide the qualitative background to assess negative impacts. Results from this work highlight the fact that these species in particular are the slowest growing deep-sea corals and exhibit extreme longevities. Radiocarbon analysis of deep-sea black corals in the Gulf of Mexico indicated that these animals have been growing continuously for at least the last two millennia, with growth rates ranging from 8 to 22 μm yr-1. Visual growth-ring counts based on SEM images were in good agreement with the 14C-derived ages, suggesting annual ring formation. The presence of bomb-derived 14C in the outermost samples confirms sinking particulate organic matter (POM) as the dominant carbon source and suggests a link between the deep-sea and surface ocean. There was a high degree of reproducibility found between multiple discs cut from the base of each specimen, as well as within duplicate subsamples. Robust 14C-derived chronologies and known surface ocean 14C reservoir age constraints in the Gulf of Mexico provided reliable calendar ages with future application to the development of proxy records of surface water variability and climate change. Reliable age models can be applied to multi-decadal paleoclimate reconstructions derived from the skeletal geochemistry.

The geochemical composition of deep-sea corals offers a continuous, and long-lived, record of surrounding seawater conditions. Geochemical analysis of the coral skeleton included discrete sampling for stable isotope variability and high-resolution, continuous sampling via laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). As part of this study, a suitable reference material for calibration of LA-ICP-MS analyses for black corals was developed using trace-element-doped oil mixed in a polymer. The material is homogeneous for a large suite of trace-element composition at high-resolution sampling (i.e. < 50-100 microns). Changes in the geochemical records are interpreted to reflect changes in the surface water environment. Paleoindicators of eutrophication and oxygen levels include: V, Mo, U, Re, Cu and I. These metals explain over 40% of the total variance in the high-resolution (laser) time-series. Enrichment in redox-sensitive trace elements during the most recent 2-3 centuries was consistently observed in the geochemical records from two different sites in the Gulf of Mexico. Covariance of these redox-sensitive metals suggests both naturally occurring and anthropogenic changes in oxygen levels. Corresponding changes of I, Re, Mo, U and V suggest that these redox- sensitive elements may be paleoindicators of naturally occurring eutrophication and oxygen conditions in the Gulf of Mexico. Furthermore, LA-ICP-MS results are in agreement with the solution analysis documenting an increase in the paleoindicators of low-oxygen conditions. These records can be used to infer changes in surface water conditions related to nutrient loading, eutrophication, and hypoxia in the Gulf of Mexico over the last millennium.