MARINE ISOTOPE STAGE 31 (1.07 MA): AN EXTREME INTERGLACIAL IN THE ANTARCTIC NEARSHORE ZONE

R. Scherer (1), S. Bohaty (2), D. Harwood (3), A. Roberts (4), and M. Taviani (5)
(1) Northern Illinois University, USA (reed@geol.niu.edu), (2) University of California, Santa Cruz, USA, (3) University of Nebraska, USA, (4) University of Southampton, UK, (5) Istituto di Geologia Marina, Bologna, IT

As global end-member environments, the polar regions are the bellwether of global climate change. Climate modelling suggests that the polar regions are more profoundly impacted by global warming than low latitude regions, and recent warming documented in Arctic and Antarctic environments might be a result of this polar amplification process. It is not yet clear that the short-term records of recent warming represent the start of a long-term trend, however, stratigraphic records of past significant high latitude warm events likely reflect changes not limited to regional or local perturbation, but ones of global significance. Sea-ice plays an especially important role in climate, by influencing albedo, bottom water formation, biologic productivity, and heat, moisture and CO2 exchange between the ocean and the atmosphere. As such, proxy records such as diatom assemblages that indicate dramatic shifts in the presence, duration and extent of sea-ice are of special significance for climate model development and validation.

The Cape Roberts Project, a stratigraphic drilling project in McMurdo Sound, Antarctica, recovered a two meters thick unconsolidated biogenic carbonate unit that was deposited on the flank of a deep water carbonate bank (CRP-1 drillhole, Lithologic Unit 3.1). The deposit is dated by diatom biostratigraphy, 87Sr/86Sr ratios in biogenic carbonate, and 40Ar/39Ar dating of an ice-rafted volcanic clast as between 1.13 and 0.79 Ma. A Reversed-to-Normal magnetic polarity transition is recognized within this stratigraphic unit, indicating the base of the Jaramillo (Chron C1r.1n), 1.07 Ma.
which directly corresponds with Marine Isotope Stage 31 (MIS-31). Precise dating allows confident correlation of Unit 3.1 with any well-dated deep-sea record.

Hemipelagic deposition includes abundant and diverse diatoms and calcareous plankton. The diatom floras are almost entirely pelagic and include many taxa that commonly occur only north of the polar front. Most significant is the near absence of sea-ice related diatoms. These and other observations indicate that surface waters were notably warmer than present, and that sea-ice was drastically reduced during this interglacial stage. Such conditions likely signify partial or complete retreat West Antarctic Ice Sheet and significant modification in bottom water production.

Although MIS-31 has received little prior attention as a key climate event, there is sufficient evidence from both low and high latitude records to indicate significant ocean circulation and ice volume changes during that interglacial, including relatively warm sea surface temperatures and strong North Atlantic Deep Water production. MIS-31 plays an important role in the transition from 41 kyr to 100 kyr climate cycles, and calculated orbital northern hemisphere summer insolation values for MIS-31 are among the highest of the last 5 Ma.

High latitude stratigraphic records such as CRP-1, Unit 3.1 contain critical evidence of past climate extremes. We contend that such events provide evidence of past polar amplification during warm interglacials. There is continuing need for new drilling efforts along the Antarctic continental margin to recover additional records of past climate change that, like CRP-1, Unit 3.1, are proximal to the ice sheet.