

## Temperature and Hydrological Changes in the Western Caribbean During the Last Glacial Cycle

M. W. SCHMIDT<sup>1</sup>, H. J. SPERO<sup>1</sup>, AND D. W. LEA<sup>2</sup>

<sup>1</sup>University of California, Department of Geology, Davis (schmidt@geology.ucdavis.edu)

<sup>2</sup>University of California, Department of Geological Sciences, Santa Barbara (lea@geol.ucsb.edu)

Today, the Caribbean has a profound effect on the sea surface temperature (SST) and sea surface salinity (SSS) of waters that eventually flow into the Florida Current and become part of the Atlantic's northward-flowing component of the 'global-conveyor belt.' Thus, changes in Caribbean SST and SSS over the last glacial cycle may be intimately linked to changes in the magnitude of oceanic heat and salt transported to the North Atlantic.

Stable oxygen isotope ( $\delta^{18}\text{O}$ ) and Mg/Ca ratios from planktonic foraminifera *Globigerinoides ruber s.s.* (white variety) were measured at ~ 1.25 kyr. resolution through the last glacial cycle from core ODP 999A (sed. rate ~5 cm/kyr), Colombian Basin, western Caribbean. Calculated SSTs, based on a published core top calibration, were combined with *G. ruber*  $\delta^{18}\text{O}$  to estimate past seawater  $\delta^{18}\text{O}_{\text{water}}$  ( $\delta^{18}\text{O}_w$ ) using a laboratory calibrated  $\delta^{18}\text{O}$ -temperature relationship.

Late Holocene Mg/Ca (4.09 mmol/mol) yield SSTs in agreement with the average modern SST of 28.5°C. Glacial Mg/Ca (3.41 mmol/mol) suggest the western Caribbean was 2.5°C cooler during the last glacial maximum (LGM). Deconvolved  $\delta^{18}\text{O}_w$  values for the Late Holocene of the Colombian Basin average 0.9‰, in agreement with modern  $\delta^{18}\text{O}_w$  values. The structure of the  $\delta^{18}\text{O}_w$  reconstruction reflects regional hydrographic changes during the last glacial cycle, superimposed on the longer-term variations in continental ice volume. In order to remove the ice volume effect, a recently published  $\delta^{18}\text{O}_w$  reconstruction from eastern equatorial Pacific core TR163-19, thought to contain a continuous record of ice volume and sea level changes, was subtracted from that in ODP 999A. The resulting excess  $\delta^{18}\text{O}_w$  record ( $\Delta\delta^{18}\text{O}_w$ ) for Caribbean surface waters reflects regional salinity variations. These data suggest large positive Caribbean  $\delta^{18}\text{O}_w$  anomalies during the LGM ( $\Delta\delta^{18}\text{O}_w=+0.7\text{‰}$ ), MIS 4 ( $\Delta\delta^{18}\text{O}_w=+0.6\text{‰}$ ), and MIS 6 ( $\Delta\delta^{18}\text{O}_w=+0.5\text{‰}$ ), and modern or slightly lower salinities during MIS 3 and 5.

A comparison of the Caribbean  $\Delta\delta^{18}\text{O}_w$  record to June solar insolation variability at 60°N shows a clear correlation between minimum insolation and high  $\Delta\delta^{18}\text{O}_w$  in the Caribbean. Furthermore, comparison of a previously published benthic  $\delta^{13}\text{C}$  proxy used to gauge variability in the formation of North Atlantic Deep Water (NADW) with  $\Delta\delta^{18}\text{O}_w$  from the Caribbean indicate that as NADW production slows, the SSS in the Caribbean increases. These correlations suggest that elevated Caribbean salinities are associated with the early phases of NADW weakening and North Atlantic thermohaline circulation shut down.

## In-situ determination of mineral solubilities in fluids using a diamond-anvil cell and SR-XRF

C. SCHMIDT<sup>1</sup> AND K. RICKERS<sup>2,1</sup>

<sup>1</sup>GeoForschungsZentrum Potsdam, Telegrafenberg, Potsdam 14473, Germany (hokie@gfz-potsdam.de)

<sup>2</sup>Hamburger Synchrotronstrahlungslabor HASYLAB at Deutsches Elektronensynchrotron DESY, Hamburg 22603, Germany (rickers@mail.desy.de)

A hydrothermal diamond-anvil cell has been designed for the in-situ analysis of the concentration of elements in fluids using synchrotron radiation XRF. This technique permits determination of the solubility of minerals in fluids at high pressures and temperatures (tested to 1.1 GPa and 800°C) and is applicable for sparingly soluble compounds, congruent or incongruent dissolution, and studies of dissolution kinetics.

Test experiments were conducted at beamline L at HASYLAB using white synchrotron light of a second-generation source. The solubility of AgCl(s) in water was determined at 300 to 450°C and pressures to 760 MPa. The observed Ag concentration in the aqueous fluid ranged from 100 to 1580 µg/g (detection limit 10 to 15 µg/g). The chlorargyrite solubility in water showed a strong increase with temperature, but only a slight or insignificant decrease with pressure. The molality of Ag in the fluid was obtained from density corrected K $\alpha$  peak areas by calibration to the known solubility at 300 °C and 8.6 MPa and, standardless, by comparison with Monte-Carlo simulated spectra. The results from both methods were internally consistent and in good agreement with literature data at comparable P-T conditions (Figure 1). From these data, we estimate an analytical precision in the solubilities determined in this study of better than  $\pm 25\%$ .

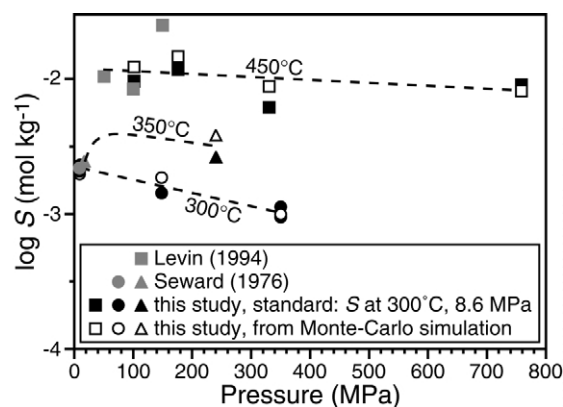


Figure 1: Comparison of experimental data for the solubility of AgCl(s) in water.

### References

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