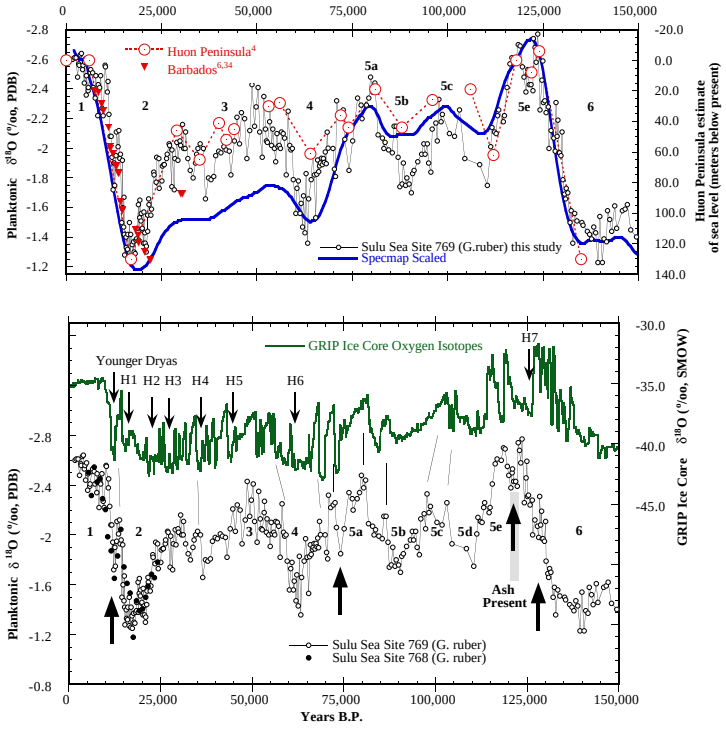
Oxygen-isotope record of sea level and climatic variations in the Sulu Sea over the past 150,000 years

Braddock K. Linsley, Department of Earth and Atmospheric Sciences, University at Albany, State University of New York

As knowledge of variations in the Earth's climate has grown, concern over the origin and distribution of past "abrupt" climatic events and their potential future impact has also risen. The oxygen isotope ($\delta^{18}O$) composition of planktonic foraminifera recovered from marine sediments cored at ODP Site 769 in the shallowly silled Sulu Sea on the edge of the western Pacific warm pool has yielded new clues to past millennial-scale climatic variations and possibly longer term sea level changes in this important region [*Linsley and Thunell,* 1990; *Linsley,* 1996]. The glacial-interglacial $\delta^{18}O$ amplitude in this record is only 1.3 °/oo, almost equaling the 1.3 °/oo [*Fairbanks,* 1989] to 1.0 °/oo [*Schrag et al.,* 1996] planetary glacial-interglacial ice volume signal. This suggests that at most 0.3 °/oo of the long-term $\delta^{18}O$ signal is attributed to temperature or salinity change. Several abrupt climatic events usually associated with higher latitudes are also recorded in the Sulu Sea at ~11,000 years B.P. (Younger Dryas), ~75,000 years B.P., and ~120,000 years B.P (lower panel). The Younger Dryas is now thought to be a global deglacial event originating at higher latitudes. The origin of the older events remains uncertain as is the absence of pronounced millennial-scale Dansgaard-Oschger events in isotope stage 3 (an interglacial period 23,000 to 58,999 years ago). However, the mid-Eemian abrupt event adds support for the presence of last interglacial climatic instability as suggested by ice core records.

On time scales of around 10,000 years, the Sulu Sea oxygen isotope record closely matches changes in sea level deduced from coral terraces on the Huon peninsula [*Chappell and Shackleton;* 1986], particularly during isotope stage 3 (see top panel) where the Sulu Sea oxygen-isotope record deviates from the SPECMAP deep-ocean oxygen isotope record and indicates that sea level at this time was only 40-50 meters below present levels. A recent revision of the Huon peninsula terrace record [*Chappell et al.,* 1996], indicates lower sea levels during stage 3 adding to the controversy around stage 3 sea levels. If the conclusion of higher stage 3 sea levels can be substantiated it implies that the subsequent rate of increase in continental ice volume during the return to full glacial conditions was correspondingly faster than previously thought.



Upper Panel: ODP site 769 planktonic $\delta^{18}O$ results (thin solid black line with open circles) compared to a scaled version of the SPECMAP deep ocean $\delta^{18}O$ record (bold solid blue line), and past sea level estimated from the Huon Peninsula (large open red circles) and Barbados (solid red triangles). Numbers indicate isotope stages. Note the close correspondence between the Huon Peninsula sea level record and Site 769 $\delta^{18}O$, in particular during stage 3 when the SPECMAP record is ~0.5°/oo less negative.

Lower Panel: Oxygen isotopic ($\delta^{18}O$) analyses from Sites 769 (open black circles) and 768 (filled black circles). Large arrows mark locations of "abrupt" climatic events discussed in the text. (Upper Curve); GRIP Greenland summit ice core $\delta^{18}O$ results spanning the last 150,000 years. The temporal position of the Younger Dryas and Heinrich events H1 - H6 are marked by small arrows.

References:

Chappell, J., and N.J. Shackleton, Oxygen isotopes and sea level, *Nature, 324,* 137-140, 1986.

Chappell, J., A. Omura, T. Esat, M. McCulloch, J. Pandolfi, Y. Ota, and B. Pillans, Reconciliation of late Quaternary sea levels derived from coral terraces at Huon Peninsula with deep sea oxygen isotope records, *Earth and Planetary Science Letters, 141,* 227-236, 1996.

Fairbanks, R.G., A 17,000-year glacio-eustatic sea level record: Influence of glacial melting rates on the Younger Dryas event and deep ocean circulation, *Nature, 342,* 637-642, 1989.

Linsley, B.K., Oxygen isotope evidence of sea level and climatic variations in the Sulu Sea over the past 150,000 years, *Nature,* vol 380, p234-237, 1996.

Linsley, B.K., and Thunell, R.C., The record of deglaciation in the Sulu Sea: Evidence for the Younger Dryas event in the tropical western Pacific. *in* J.P. Kennett, ed., *Paleoceanography,* Special Issue on the Younger Dryas, 5, no. 6, 1025-1039, 1990.

Schrag, D.P., G. Hampt, and D.W. Murray; The temperature and oxygen isotopic composition of the glacial ocean; *Science, 272,* 1930-1931, 1996.