

Climate Proxies and the Ice Ages

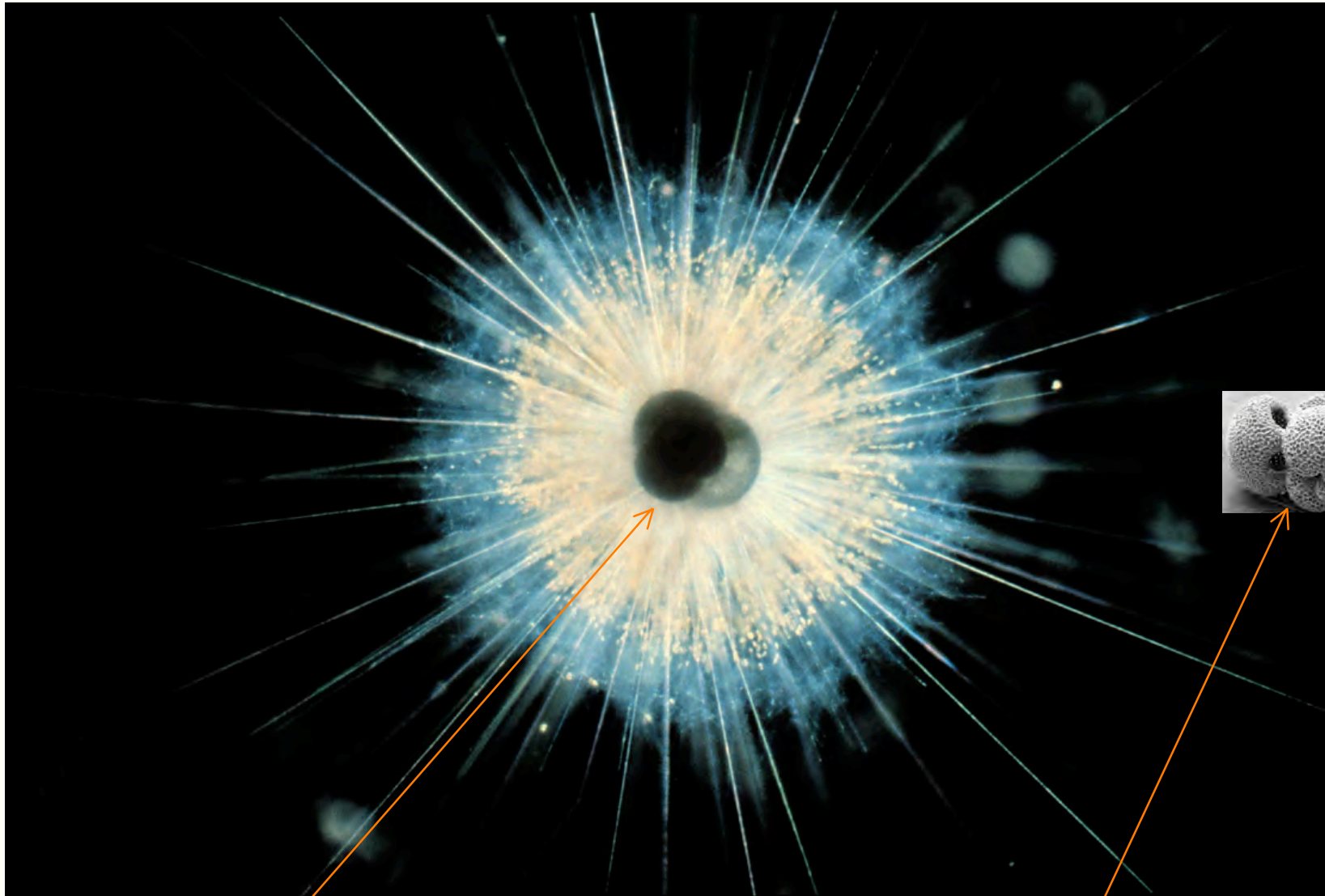
David Lea, Department of Earth Science,
University of California, Santa Barbara

Collaborators: D. Pak, M. Medina-Elizalde, S. Medley, S. Weldeab, UCSB;
H. Spero, UCD; L. Peterson, Miami; R. Thunell, USC; D. Black, SUNY-SB; T.
Guilderson, LLNL; Z. Jian, Tongji U., Shanghai, PRC; R. Toggweiler, GFDL

Lab Support: G. Paradis, L. Hamady, K. Steger, J. King

Support: NSF Earth System History Program

Living foraminifera: *Globigerinoides ruber*

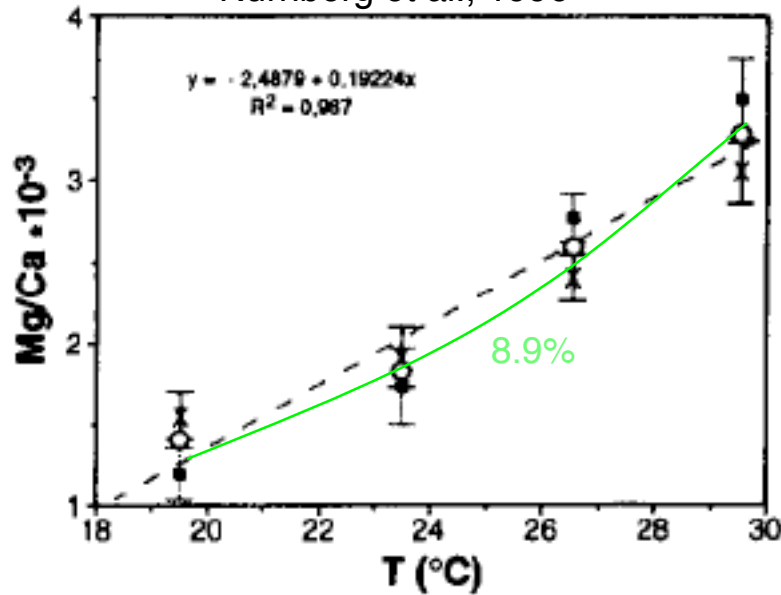


Shell produced by living foram

↔
0.25 mm

Shell preserved in marine sediment

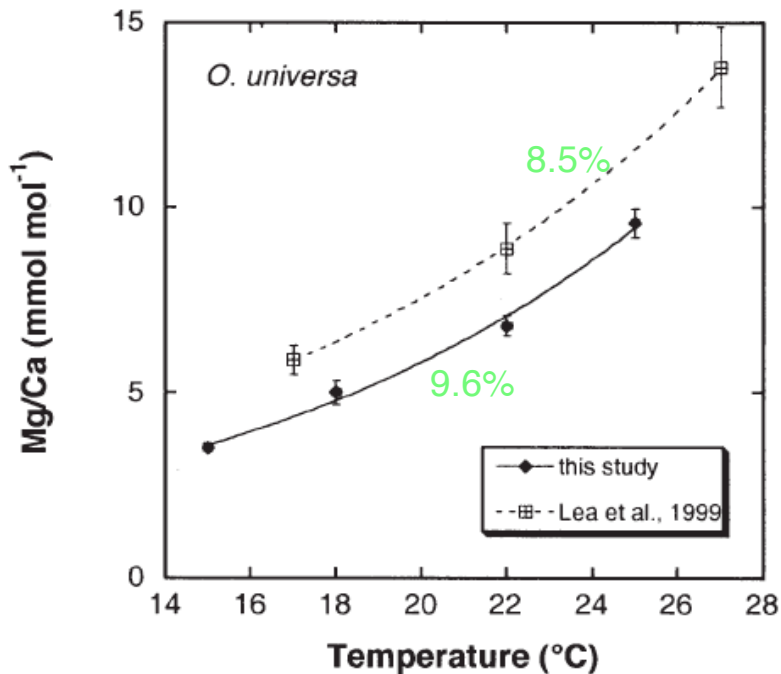
Nürnberg et al., 1996



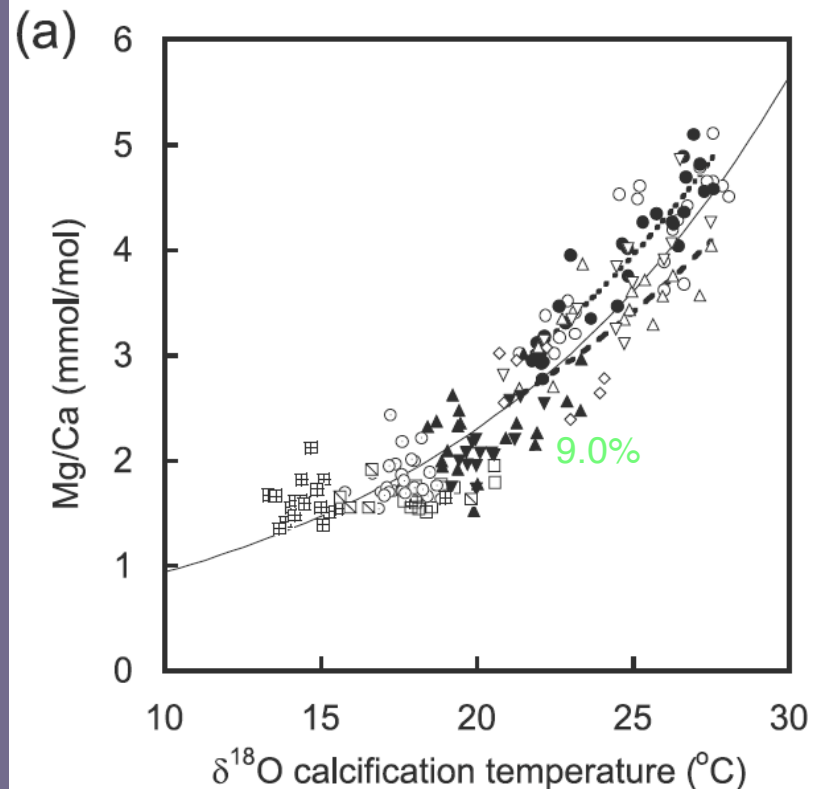
Culturing (left) and sediment trap work (below) establishes that foram Mg/Ca increases by $9 \pm 1\%$ per °C: i.e.,

$$\text{Mg/Ca} = b \cdot e^{(0.09 \pm 0.01 \cdot T)}$$

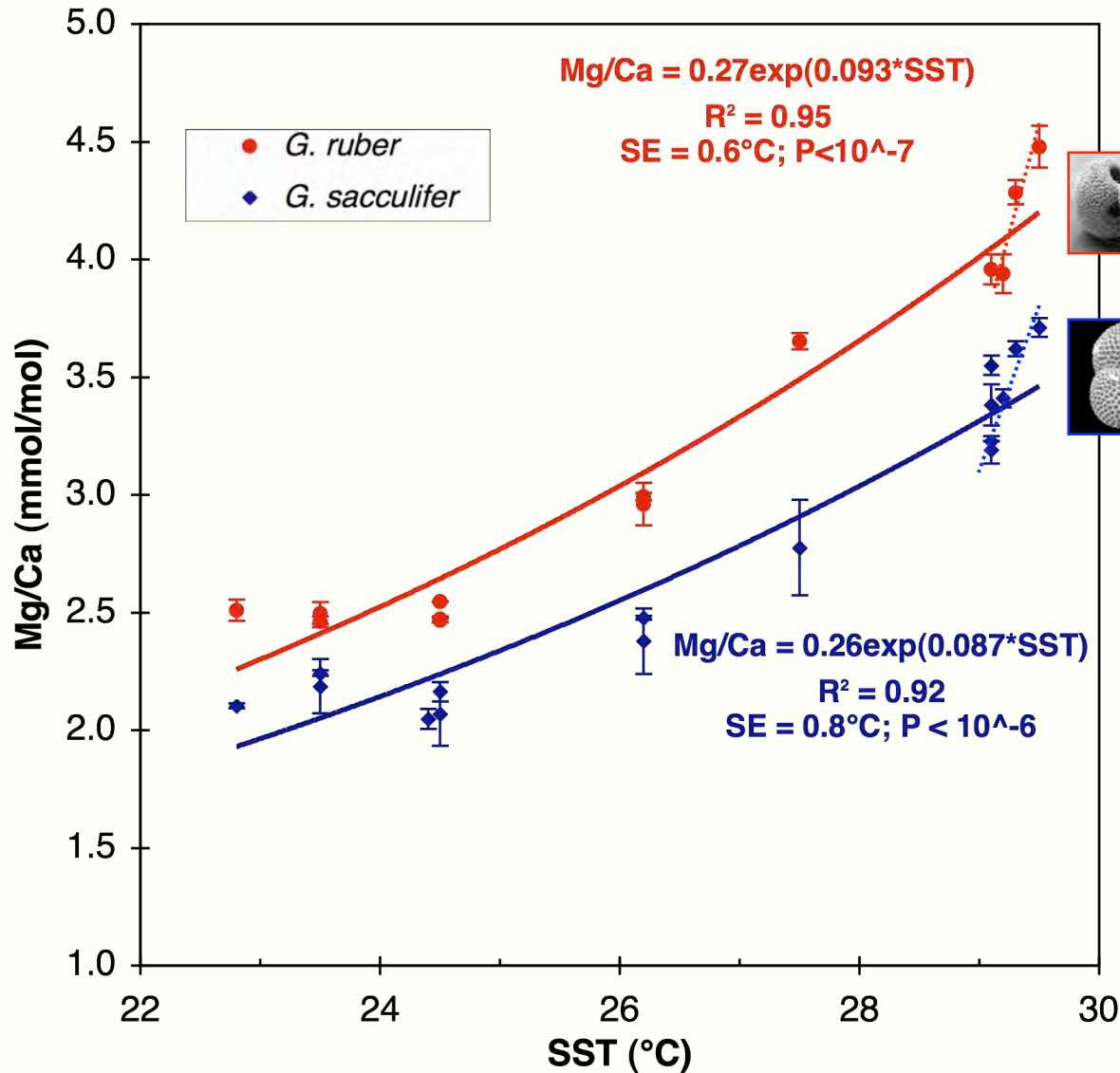
Lea et al., 1999; Russell et al., 2004



Anand et al., 2003



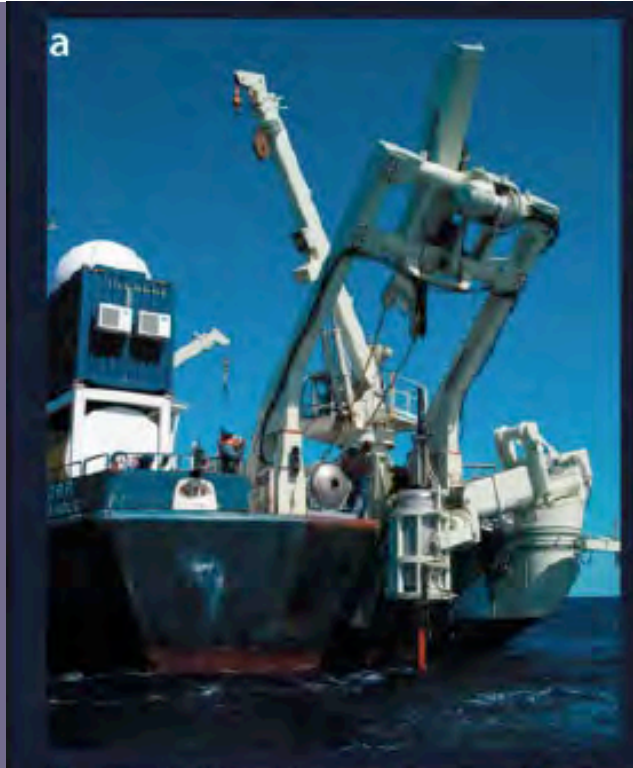
Equatorial Pacific core-top calibration



The grouping of points at 29°C reflects the influence of post-depositional dissolution along a depth transect.

Water depths between 1625-3200m (*G. ruber*) and 1625-4445m (*G. sacculifer*).

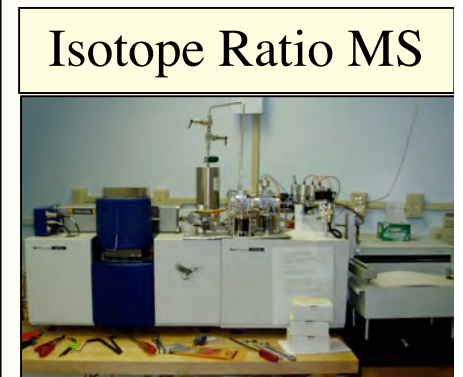
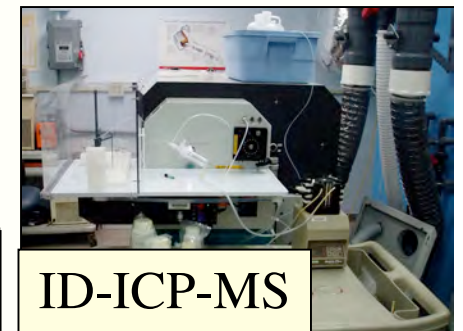
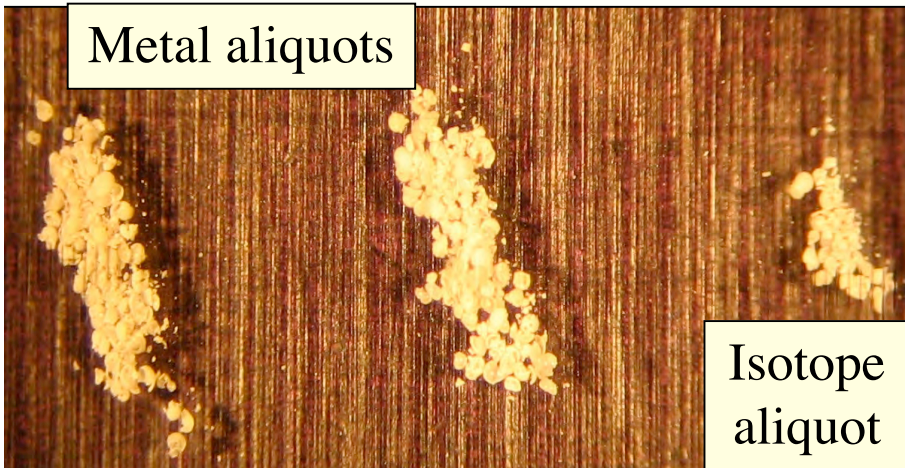
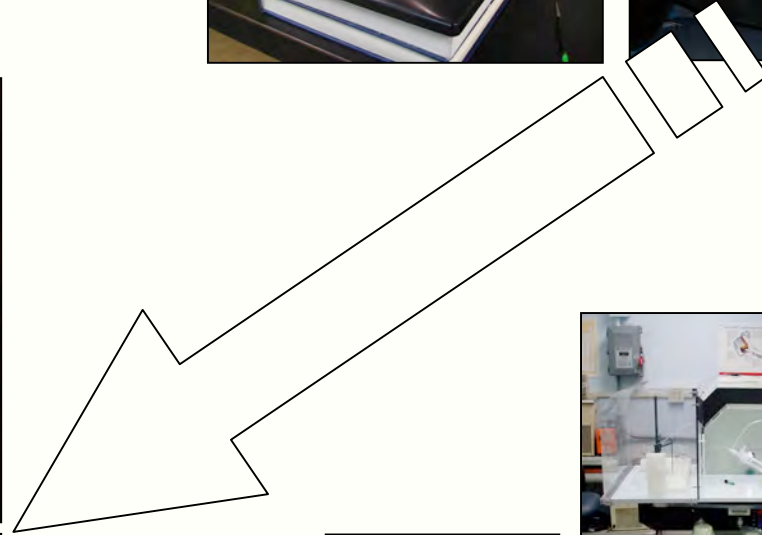
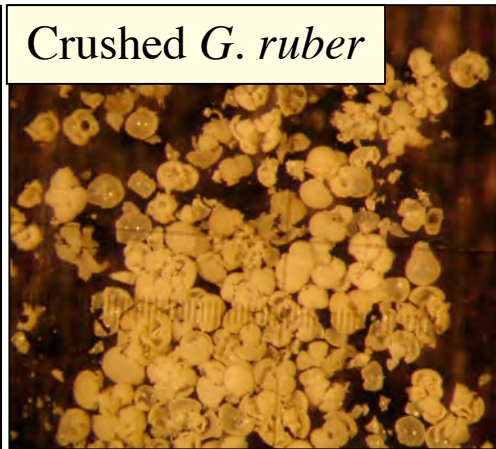
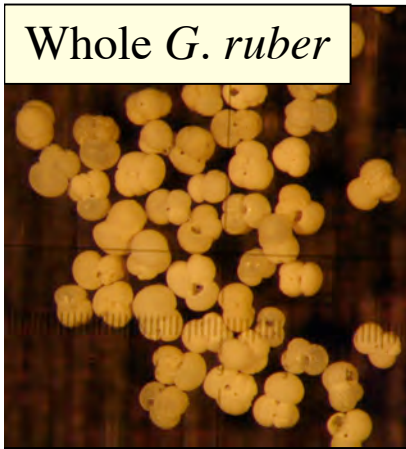
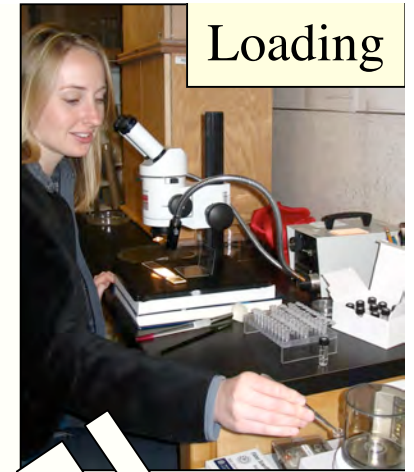
Data from Dekens et al., 2002, G³ and Lea, unpublished data, 2003



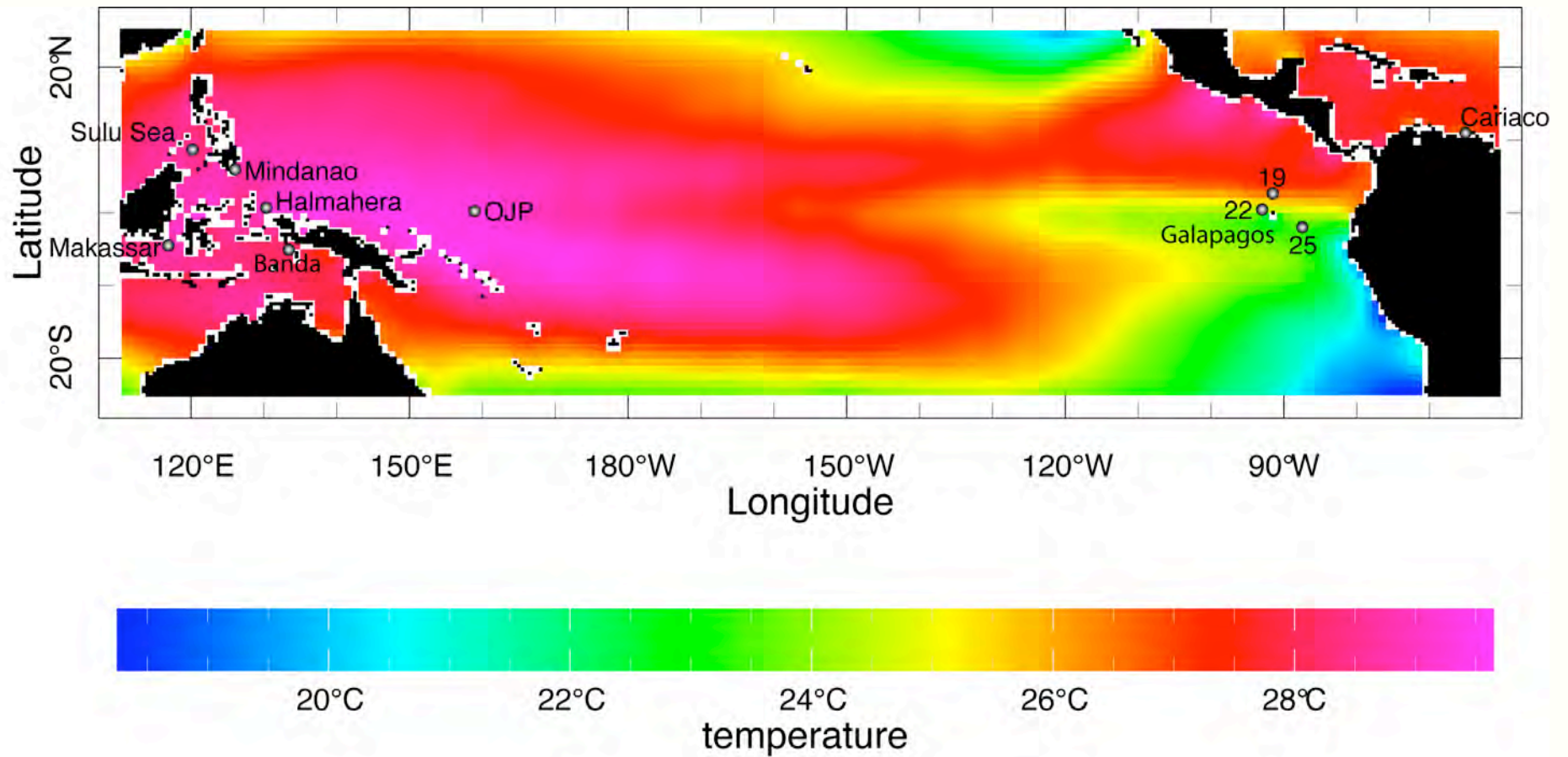
Left: long piston coring facility on the R/V Knorr, undergoing seagoing trials in late 2007.

Bottom: core MD98-2162, 32.5 to 33 m core depth, ~125,000 yrs BP.





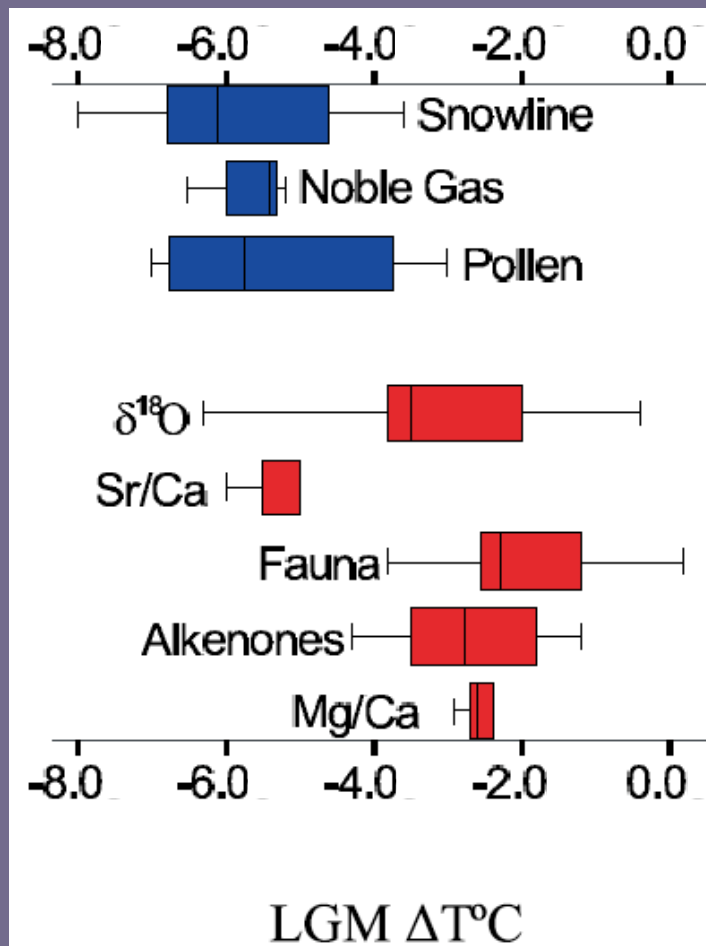
Tropical Pacific SST & Core Sites



Meta-analysis of tropical surface temperatures during the Last Glacial Maximum

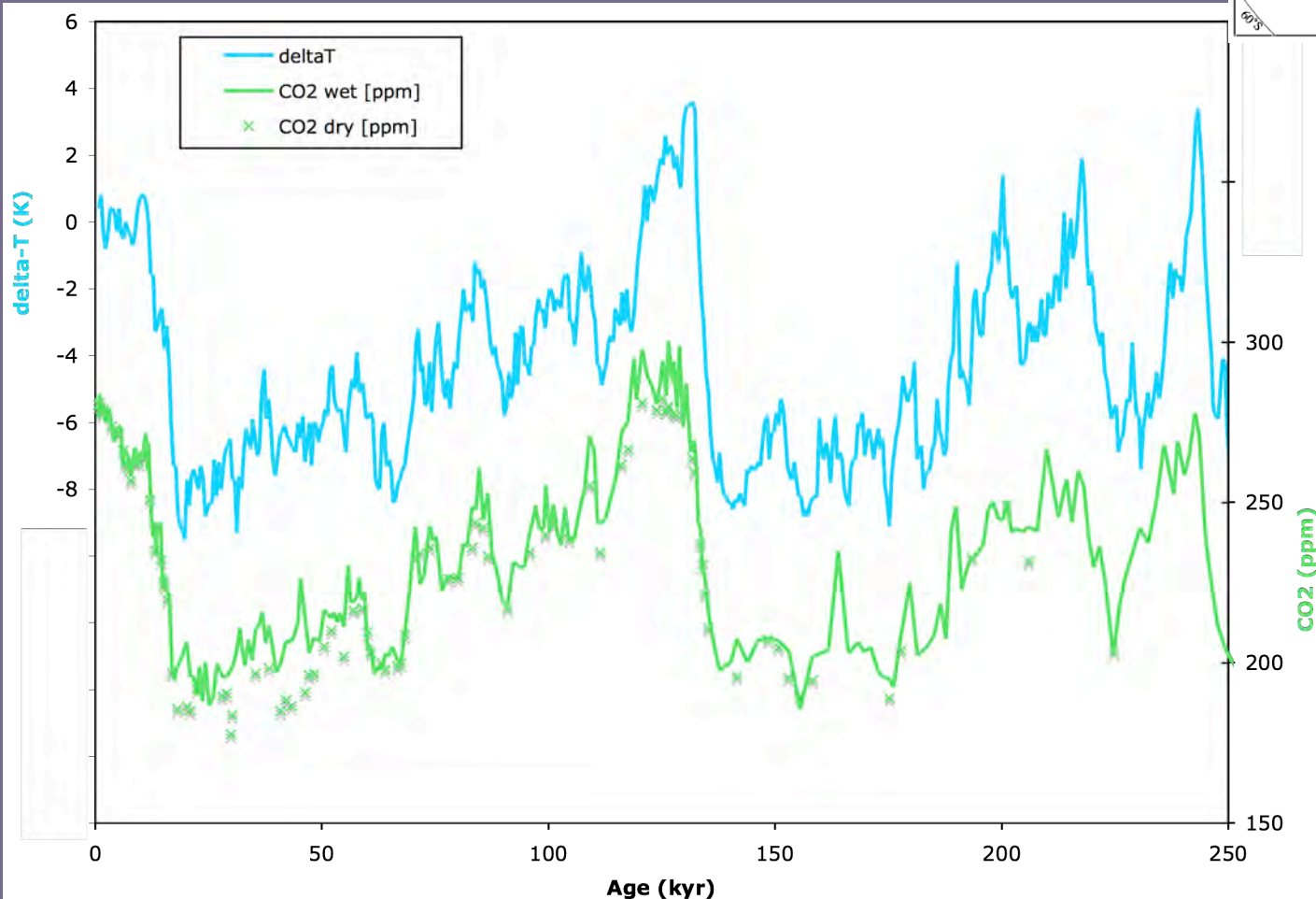
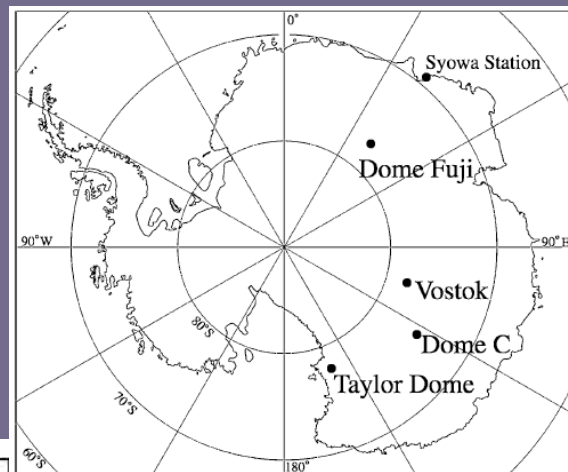
A. P. Ballantyne,¹ M. Lavine,² T. J. Crowley,¹ J. Liu,¹ and P. B. Baker¹

Using a Bayesian spatial interpolation scheme, we estimate a mean cooling of LGM tropical sea surface temperatures of $-2.7 \pm 0.5^\circ\text{C}$ ($\pm\sigma$) and surface air temperatures of $-5.4 \pm 0.3^\circ\text{C}$ ($\pm\sigma$).



Northern Hemisphere forcing of climatic cycles in Antarctica over the past 360,000 years

Kenji Kawamura^{1,2,†}, Frédéric Parrenin³, Lorraine Lisiecki⁴, Ryu Uemura⁵, Françoise Vimeux^{6,7}, Jeffrey P. Severinghaus², Manuel A. Hutterli⁸, Takakiyo Nakazawa¹, Shuji Aoki¹, Jean Jouzel⁷, Maureen E. Raymo⁴, Koji Matsumoto^{1,†}, Hisakazu Nakata^{1,†}, Hideaki Motoyama⁵, Shuji Fujita⁵, Kumiko Goto-Azuma⁵, Yoshiyuki Fujii⁵ & Okitsugu Watanabe⁵



Antarctic Dome Fuji ice core - an independent chronology based on O_2/N_2 fractionation in firn air as controlled by local insolation.