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Eight glacial cycles of deep-water temperature and ice volume from the SW Pacific: Ocean – ice comparisons

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The relative contributions of temperature and ice volume to oxygen isotopic composition (δ^{18}O) of deep ocean foraminifera are not well known. Benthic δ^{18}O reflects some combination of local to regional water mass properties (largely deep-water temperature) as well as global changes in seawater δ^{18}O ($\delta^{18}O_{sw}$) resulting from ice-sheet fluctuation. An independent measure of temperature is thus highly desirable. Benthic foraminiferal Mg/Ca may be useful in reconstructing deep-water temperature changes, but there are unresolved problems, related to the calibration for Mg/Ca at the coldest temperatures. Here we present deep-sea Mg/Ca and δ^{18}O records for the past eight glacial cycles in benthic foraminiferal (*Uvigerina* spp.) calcite from a marine sediment core recovered in the mid Southern latitudes. Ocean Drilling Program Site 1123 on Chatham Rise, east of New Zealand in the Southwest Pacific Ocean (3290 m water depth), lies under the Deep Western Boundary Current (DWBC) that flows into the Pacific Ocean, and supplies most of the deep water in that ocean. DWBC strength and water mass properties are directly related to processes occurring around Antarctica. Temperatures and $\delta^{18}O_{sw}$ derived via pore fluid modelling of the last glacial maximum are available from Site 1123, helping to constrain deep-water temperature estimates using Mg/Ca. Selected time slices have B/Ca ratios in *Uvigerina* to indicate deep-water carbonate saturation state, and also Mg/Ca and B/Ca on planktonic species, which also provide evidence on surface temperature and carbonate saturation. These results permit preliminary discussion of the magnitude of the deep-water temperature changes during glacial/interglacial transitions and the interglacials them-

selves. In particular, our deep-water temperature estimates confirm that interglacials before 430 ka were cooler - at least in the deeper southern Pacific - than those of the past four climatic cycles, a pattern observed in the δD record from EPICA Dome C. We examine the relative contributions of deep-water temperature and ice volume to the benthic δ^{18}O signal. The phase relationship between the two signals is tentatively assessed for the middle/late Pleistocene, when different patterns of climate variability have been inferred from marine and ice core records.