$CaCO_3$ burial records from the eastern South Pacific over the last 140 kyrs

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The Southern Ocean has been suggested to play a key role in the 80-100 ppm decreases in atmospheric carbon dioxide concentration ($pCO_{2,atm}$) in the glacial intervals compared to the interglacial through enhanced salinity stratification, dust-borne iron fertilization, and carbonate compensation. In particular, ocean alkalinity increase resulting from $CaCO_3$ dissolution in the glacial Southern Ocean seafloor might have significantly contributed to lowering $pCO_{2,atm}$. However, the lack of sedimentary $CaCO_3$ record from the Pacific sector of the Southern Ocean prevents comprehensive understanding of the $CaCO_3$ dissolution effect on the decrease of $pCO_{2,atm}$. Here, we present new $CaCO_3$ burial records from MR16-09 PC3 and International Ocean Discovery Program Site U1543, derived from off Chile, the eastern South Pacific, which cover the past 140 kyr. We measured the bulk $CaCO_3$ contents and the sieve-based weight (SBW) of a planktic foraminiferal species *Globorotalia inflata* and conducted scanning electron microscope observation of *Globigerina bulloides*. We further calculated the mass accumulation rate (MAR) of $CaCO_3$. The $CaCO_3$ contents and the MAR showed pronounced orbital scale changes, i.e., the burial increased during the interglacial periods in Marine Isotope Stage (MIS) 5 and 1. In contrast, there was no preservation during the glacial intervals in MIS 6 and 4-2. In MIS 5d, 5b, and 5/4 boundary, bulk $CaCO_3$ contents and the SBW of *G. inflata* showed significant decreases. Simultaneously, the *G. bulloides* shells frequently showed cracked surfaces and broadened pores, i.e., ultrastructure breakdown. These changes suggest $CaCO_3$ dissolution events occurred on the suborbital scale, during the three cold periods of MIS 5. These dissolution events were probably caused by the undersaturation with respect to calcite in the sediment porewater or the bottom water. Sedimentary bromine (Br) is a proxy of total organic carbon, which increases respiration CO_2 in the sediment porewater and leads to the $CaCO_3$ dissolution. The X-ray fluorescence (XRF) scanned Br records in the two core sites, MR16-09 PC3 and U1543, exhibited inconsistent patterns suggesting the undersaturated porewater was not the principal reason for the $CaCO_3$ dissolution events. Therefore, it is more likely that corrosive bottom-water intrusion into the eastern South Pacific was the primary factor controlling the events.

Keywords: Southern Ocean, carbonate compensation, carbon cycle, CaCO3, off Chile

