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Anomalous magmatism at 40°S on the Pacific Antarctic Ridge during the penultimate deglaciation

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Ice sheet growth and falling sea level may promote submarine volcanism by releasing pressure on mid-ocean ridges and enhancing melt production in the upper mantle [1-2]. Records of ridge flank bathymetry display Milankovitch-scale periodicities in abyssal hill spacing [3, 4] but interpretation of the bathymetry data remains controversial [5, 6]. Alternative proxies are therefore necessary to assess whether sea level modulates mid-ocean ridge magmatism. Sediment records from 1°N to 11°S on the East Pacific Rise (EPR) show that hydrothermal particle flux increased during the last two deglaciations (Terminations 1 and 2) [7]. Here we present two additional records, one from 20°S on EPR and one from 40°S on the Pacific Antarctic Ridge (PAR). At 20°S, ^{3}He-normalized fluxes of Fe, Mn, and As increased 10-fold at ~20 kyr BP, remained elevated until 15 kyr BP and returned to background values by 10 kyr BP. The temporal pattern is consistent with published results from the EPR [7] but the magnitude of the signal is 3-4x larger. In the PAR core there is a 10 cm thick layer of basaltic glass shards that coincides with Termination 2 (T2). The shards are MORB composition and have angular and curved fluidal morphologies that are typical of pyroclastic deposits created by explosive submarine volcanism [8]. The distance of the core site from the PAR axis during deposition (8 km) implies that anomalous volcanic activity created a buoyant seawater plume which lofted pyroclastic debris high into the water column with subsequent fallout to distal ridge flank locations. Because the ash layer is interspersed with foraminifera that document the oxygen isotopic transition from a glacial to interglacial state, it is likely the product of multiple eruptions over ~10 kyr rather than a single event subsequently altered through bioturbation. The necessary plume height to create an ash layer 8 km from the ridge axis will be discussed in the context of laboratory-based volcaniclastic settling rates and ARGO float derived current velocities for the deep Southeast Pacific.

[1] Lund and Asimow (2011) *G-cubed* **12**. [2] Huybers and Langmuir (2009) *EPSL* **286**, 479. [3] Crowley et al. (2015) *Science* **347**, 1237. [4] Tolstoy (2015) *Geophys. Res. Lett.* **42**. [5] Olive et al. (2016) *Science* **350**, 310. [6] Goff (2016) *Science* **349**, 1065a. [7] Lund et al. (2016) *Science* **351**, 478. [8] Clague et al. (2009) *J. Volcan. Geo. Res.* **180**, 171.