Enhanced hydrothermal activity along the East Pacific Rise during the last two glacial terminations

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Mid-ocean ridge magmatism is driven by seafloor spreading and decompression melting of the upper mantle. Scaling estimates [1] [2] and model results [3] [4] indicate that glacial-interglacial changes in sea level should modulate melt production at mid-ocean ridges, an idea that has been confirmed with detailed surveys of ridge bathymetry [4] [5]. The nature and timing of associated changes in hydrothermal activity have remained unknown, however, precluding a clear understanding of whether ridge magmatism can act as a negative feedback on ice sheet size. Here we present multiple records of hydrothermal sedimentation spanning 1300 km of the East Pacific Rise (EPR). At each location, the carbonate-free concentration of Fe, Mn, and As increased beginning at ~25 kyr BP, reached maximum values by 15 kyr BP, and then decreased into the Holocene. ^{3}He-normalized fluxes confirm that input of hydrothermal metals to ridge-crest sediments increased during Termination I. Lateral sediment focusing is an unlikely explanation given the similar signal in multiple cores and the lack of evidence for anomalous horizontal transport in ^{3}He-based focusing factors. Coherent variations in Fe, Mn, and As suggest that diagenetic overprinting is not the primary driver of the down core signal. Elevated metal concentrations also occur during Termination II. The time series of hydrothermal sedimentation bear a strong resemblance to a record of seafloor bathymetry from 17ºS [5], suggesting that both have a common driver. The simplest explanation is glacial-interglacial variations in sea level, which apparently modulates sub-ridge melting, crustal thickness, and hydrothermal activity at the EPR. Our results imply that geothermal heat flux from ridges increases during the last two glacial terminations, which should act to erode the deep ocean stratification, enhance the abyssal circulation, and transmit excess heat to the Southern Ocean, thereby setting the stage for deglaciation.

[1] Lund and Asimow (2008) *AGU Fall Meeting, Abstract #PP11D-08*. [2] Huybers and Langmuir (2009) *Earth and Planetary Science Letters* **286**, 479-491. [3] Lund and Asimow (2011) *G-cubed* **12**, Q12009. [4] Crowley et al. (2015) *Science* **347**, 1237-1240. [5] Tolstoy (2015) *Geophys. Res. Lett.* **42**.