Effects of sea level change on the deep-sea hydrothermal flux of transition metals to the ocean

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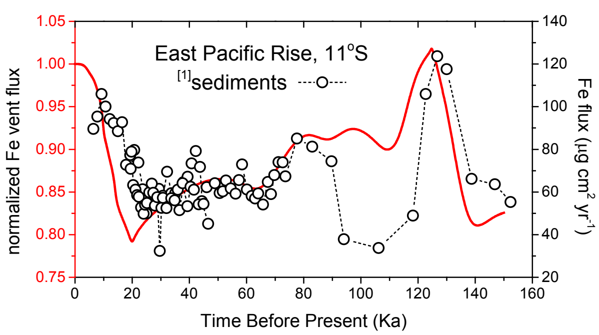
The effect of glaciation on magmatism in fast-spreading mid-ocean ridges is a contested topic, with one hypothesis being the decreased hydrostatic load (lower sea level) increases magmatic activity, which consequently increases the hydrothermal flux of transition metals [1]. However, feedbacks associated with the physical chemistry of hydrothermal solutions must also be considered. The solubility and transport of Fe (and Mn) is foremost a function of *T* in MOR systems, increasing 600-fold from 300 to 450 °C. During hydrothermal circulation, *T* maxima for any local *P* should be limited by the two-phase boundary (critical curve) of NaCl solutions, an idea supported by the chemistry of modern vent fluids. Neglecting other potential feedbacks, a decrease in hydrostatic *P* due to glaciation would therefore lower the *T* at which hydrothermal fluids become positively buoyant, and should serve to decrease the metal flux accordingly. Assuming these constraints, I calculate how historic changes in sea level might have affected the Fe flux from vents typical of the EPR (solid curve). The relative changes compare well to Fe flux estimates from EPR, 11°S



sediments [1], although the magnitudes differ by ~50%. This physicochemical response to sea level fluctuation would affect metal fluxes on an effectively instantaneous timescale compared to that required for melt migration to enhance magmatic activity. Another associated feedback to consider is that changes in sea level should affect the efficiency of hydrothermal heat extraction from MORs.

[1] Lund et al. (2016) *Science*, 351, 478-482.