Reconstructing Hydrothermal Activity on the Juan de Fuca Ridge Over the Past 25ka

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Hydrothermal activity on mid-ocean ridges plays a unique role in biogeochemical cycles in the ocean. Hydrothermal vents are a significant source of dissolved Fe, a critical micronutrient in the ocean that supports primary productivity and can modulate the carbon cycle. Little is known about hydrothermal activity in the Last Glacial Maximum (LGM), but new evidence suggests lower sea levels may generate enhanced hydrothermal activity. If hydrothermal activity was higher during the LGM, an Fe fertilized biological pump could have contributed to lower atmospheric CO_2 levels. In this study we investigate sediment cores from the Juan de Fuca Ridge (JdFR) to reconstruct hydrothermal activity over the past 25 ka. Five multicores were examined from a spatial array, covering a depth transect along the ridge flank and crest, with a temporal resolution of between 500 and 1000 years. Fe and Cu concentrations were measured by flux fusion, corrected for lithogenic inputs, and normalized to ^{230}Th to calculate hydrothermal fluxes. Hydrothermal flux of Fe and Cu was observed at all times from all sites, suggesting persistent hydrothermal activity on the JdFR. Furthermore, Fe flux into the sediment increases with proximity to the ridge, consistent with a hydrothermal source. The sediment record indicates a stable flux of Fe during the Holocene, compared to flux variations that change by up to 100% between 15 and 20ka. Averaged over 5-7kyr time slices, Cu flux is greater in all 5 records during the LGM than during the Holocene, but in contrast, Fe flux overall appears slightly lower during the LGM than the Holocene. These are the first records from the JdFR to cover the last deglaciation at millennial timescales, and they suggest a more complicated hydrothermal response to glacial sea level changes than observed at other mid-ocean ridges.