EGU21-10154
https://doi.org/10.5194/egusphere-egu21-10154
EGU General Assembly 2021

Controls on the distribution and behaviour of metals in sub-surface metalliferous seamount sediments from the Molloy Ridge system, Arctic Ocean

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Sub-surface sampling of marine sediments allows investigation of paleo-depositional conditions and subsequent modification by post-depositional geochemical processes. This sedimentary record can encompass many thousands of years and record discrete events where proximal and distal material is incorporated into the pelagic sediment column. The Arctic Ocean is the world's smallest ocean, however evidence from sedimentary records show it has a pivotal role in the regulation of many oceanographic and physiographic processes. Despite this, there are only limited studies on the distribution and geochemical behaviour of metals within sub-surface marine sediments of the Arctic Ocean basin. This study presents a detailed geochemical investigation for two sediment piston cores to a maximum of 5.7 metres depth and spanning at least 44,000 years BP, from two seamounts bordering the western flanks of the Molloy Hole in the Fram Strait.

Comparison to other studies of sub-surface ridge sediments below 60°S on the Mid-Atlantic Ridge reveals these piston cores contain elevated metal concentrations, particularly for Mn, Co, and Ni. Distinct variability is observed within, and between the cores; particularly the interplay between Fe and Mn, the two most common authigenic elements in marine pelagic sediments. Within the Molloy Ridge neovolcanic zone, in the upper half of the easternmost core (PC127/79), Fe and Mn are decoupled and metal distribution is controlled by redox front migration. Decoupling occurs as Mn is more readily dissolved compared to Fe, and Fe in solution is more reactive and precipitates quicker during remobilisation. In PC127/79, Mn is strongly associated with other redox-sensitive metals (e.g., Co, Ni, Mo, U) likely in Mn-oxide dominated horizons, and Fe is strongly associated with V and As. Towards the base of the core, Fe and Mn are coupled, but are not associated with a distinct discrete metalliferous signature of Co, Ni, Cd and Ti. These metals are also negatively associated with major rock-forming elements such as Si, Al, Mg, and Ca. In the western core (PC127/80), Fe and Mn are coupled, are positively associated with the majority of metals and the major rock forming elements, and negatively correlated with common clay-derived components.

Investigation of pelagic versus hydrothermal component indices indicate that the distinct metalliferous signature towards the base of PC127/79 may have a hydrothermal origin. Hydrothermal activity associated with ultramafic oceanic core complexes is known on superslow-

spreading ridges to the north and south of the Molloy Ridge, however contributions of metals from ice-rafted debris or past mass wasting events off the Spitsbergen margin cannot be ruled out.