

Geochemical and Temporal Variability of Hydrothermal Activity at the Semenov Hydrothermal Field, Mid-Atlantic Ridge

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The Semenov hydrothermal field is located at an oceanic core complex at 13°30'N on the Mid-Atlantic Ridge. It is composed of five hydrothermal sites of varying size and representing various stages of hydrothermal activity (from active to extinct). To better understand the history of hydrothermal activity at Semenov, we have collected a series of sediment cores from two extinct hydrothermal sites (Semenov-1 and Semenov-4) situated at different blocks of the detachment fault and hosted by distinct host lithologies.

The contrasting character between Semenov-1 and Semenov-4 resulted into diverse hydrothermal processes reflected in the different visual characteristics and geochemical composition of the sediments. Pelagic background sediments are light brown to beige, foraminifera-rich sediments and exhibit high Ca/Ti ratios. In contrast, hydrothermal layers are characterized by red-orange to dark brown sediments and have higher Fe/Ti ratios. Hydrothermal layers formed by plume fallout exhibit Mn peaks and typically show inversely proportional Ca/Ti and Fe/Ti ratios. Mass wasting-derived hydrothermal sediments, on the other hand, are coarse-grained and are characterised by enrichments in Cu, Ba, and S, representing sulphide and barite grains transported from close-by extinct seafloor massive sulphide mounds.

Sediments collected from both hydrothermal sites record a mass wasting event which preceded fallout of plume particulate matter. At Semenov-1, more than one layer with plume fallout was identified, and pelagic sediment layers occur in between these events, suggesting episodic hydrothermal venting. Sediments from Semenov-4, on the other hand, are dominantly hydrothermal in nature with nearly absent pelagic sediments which could indicate continuous seafloor hydrothermal activity.

Initial oxygen isotope data indicate that collected sediments date back until marine isotope stage (MIS) 6. At Semenov-1, hydrothermal layers coincide at specific time intervals from MIS-2 to MIS-5, revealing older age estimates compared to previously reported ages from sulphides. Hydrothermal activity at Semenov-4, on the other hand, occurred throughout MIS-1 to MIS-5.

The variations in the hydrothermal history between Semenov-1 and Semenov-4 likely reflect the interplay of magmatic controls, such as differences in heat source and host lithology,