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Ultradiffuse venting in aging SMS mounds of the TAG hydrothermal field

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The Trans-Atlantic Geotraverse (TAG) hydrothermal field is one of the most well-studied hydrothermal system to date. It hosts numerous seafloor massive sulfides (SMS) deposits representing relics of past hydrothermal activity. These SMS deposits located beyond the actively venting high-temperature (~360°C) mound have remained largely unexplored and were generally assumed to be devoid of fluid circulation. Recent targeted submersible sampling and high-resolution acoustic surveys have provided new insights into the nature and the timing of these past hydrothermal processes (Pelleter et al., 2024).

These investigations crucially reveal that several relic deposits still host hydrothermal activity, in the form of ultra-diffuse venting, with fluid temperatures ranging from 3 to ~30°C. These fluids are variably enriched in trace metals (*e.g.* Fe <30 µM, Mn <20 µM) and Si (<0.4 mM), reflecting ongoing water-rock interactions. For some of these mounds, these fluids also exhibit a 1:1 sulfate-to-Ca^{2+} enrichment trend, consistent with extensive subsurface anhydrite dissolution and providing important constraints regarding the interruption of high-temperature hydrothermal activity associated with the formation of these mounds. By combining $^{87}Sr/^{86}Sr$ systematics together with Ge/Si and Mn/Si concentration ratios and alkali metals (Li, K, Rb) we examine whether the chemistry of these ultra-diffuse fluids primarily results from low-temperature hydrothermal alteration or result from high extent of seawater mixing with deep-seated high-temperature fluid similar to those at the active TAG mound.

Overall, this discovery is crucial for better defining the boundary between activity and inactivity in SMS deposits and, importantly, offers a unique opportunity to investigate the mechanisms governing fluid chemistry at the waning stage of hydrothermal activity.

Pelleter et al., (2024). Diversity, spatial distribution and evolution of inactive and weakly active hydrothermal deposits in the TAG hydrothermal field. *Frontiers in Earth Science*, *12*, 1304993.