Geochemistry, physics, and dispersion of a Gakkel Ridge hydrothermal plume, 87°N, 55°30'E

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During the 2016 RV Polarstern expedition exploring the axial volcanic Gakkel Ridge, we employed CTD casts to identify the source and dispersion characteristics of a hydrothermal plume at 87°N, 55°30'E, first identified by the 2001 AMORE expedition. We collected buoyant plume water samples characterized by pronounced Eh and potential temperature anomalies, devoid of high turbidity, and containing nearly equimolar dissolved CH_4 (365 nM) and H_2 (289 nM). We predict that a clear, intermediate temperature (~300 °C) source fluid likely originates within a 200 m radius of our closest-approach cast. This source does not contain sufficient Fe and/or dissolved sulfide to promote immediate formation of solid polymetallic sulfides. Non-buoyant plume signals had comparatively lower Eh and temperature anomalies and higher turbidity, consistent with Fe oxidation and particle ingrowth during plume dispersion. A positive linear relationship between potential temperature anomaly and CH_4 abundance in all samples affirms that plume waters derive from a single source fluid. A closest-approach $\delta^{13}CH_4$ value of -13.1‰ was determined via shipboard cavity ringdown spectrometry and shore-based IRMS analysis. Geochemical results and limited sediment cover point to a likely ultramafic influence on venting fluids. However, plume waters also contain significant SiO_2 enrichments, implicating an additional effect of basaltic water-rock reaction, in accordance with OFOS camera imagery of abundant pillow lavas. Confirmation awaits comparison with ongoing analyses of He isotope signatures and Fe and Mn abundances.