Analysis of Hydrothermal Alteration in Abyssal Peridotites from the Gakkel Ridge

Sierra N. Patterson, Kendra J. Lynn, Cécile Prigent, Jessica M. Warren

Department of Geological Sciences, University of Delaware, Newark, DE, USA

Hydrothermal alteration of abyssal peridotites occurs over a wide range of conditions (temperature, pressure, fluid composition). Despite the presence of secondary alteration phases in most seafloor samples, a systematic characterization of the extent of alteration and inventory of mineral phases has yet to be conducted. By examining the alteration history of peridotites from the Arctic Gakkel Ridge, we can better describe the fluid-rock interaction processes at ultra-slow spreading ridge axes. We conducted a petrographic analysis of 50 peridotite samples from 20 dredges along the Gakkel Ridge to assign a rank of 1-5 in 0.5 step intervals in order of progressive alteration based on the Birner et al. (2016) scheme. Forearc peridotites exposed on the Pacific Tonga Trench (n=45; Birner et al., 2016) were also recharacterized to provide comparison with Gakkel samples in this study. Gakkel peridotites span the entire alteration scale, from 1 (nearly pristine) to 5 (completely altered with exception of spinel). The samples have a unimodal asymmetric distribution with a peak at 4 (serpentine dominates over silicate minerals) whereas Tonga samples are bimodal with peaks at 1 (nearly pristine) and 3-3.5 (amount altered is equal to the remaining silicate). These distributions show that Gakkel peridotites have overall higher degrees of alteration compared to Tonga. The magnitude of alteration in Gakkel peridotites varies along the ridge. Samples on the western end represent the full range of the alteration scale but only highly altered samples (e.g., ≥3) are found on the eastern side of the ridge. Serpentinization dominates alteration for both Gakkel and Tonga peridotites. Amphibole is also present as an alteration phase in veins and reaction rims of primary minerals in both localities. Energy Dispersive X-Ray Spectroscopy analyses show that Gakkel amphibole has a tremolite or magnesio-hornblende composition, indicative of both melt-rock and fluid-rock interactions up to more than 700°C. Amphibole

bearing samples are found in more than 20% of Gakkel peridotites throughout the ridge. This suggests that high temperature alteration is a common process at this ultra-slow spreading center.