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Sulfide undersaturated melts at the ultraslow spreading Gakkel ridge in the Arctic Ocean

MARIANNE RICHTER[1,2], OLIVER NEBEL[2], JUNG-WOO PARK[3], JAMES DOTTIN III[4,5], ANDREW TOMKINS[2], REID R. KEAYS[2], JAMES FARQUHAR[5] AND HENRY J B DICK[6]

[1]Instituto Andaluz de Ciencias de la Tierra (IACT)
[2]Monash University
[3]Seoul National University
[4]Carnegie Institution for Science
[5]University of Maryland
[6]Woods Hole Oceanographic Institutuion

Presenting Author: marianne.richter@csic.es

Ocean floor lavas from fast spreading ridges are considered to be S-saturated [1,2]. Sulfide saturation in mantle-derived melts is dependent on partial melting reactions, pressure, temperature and chemistry of the mantle source [3] and has long been proposed to be affected by magmatic differentiation. A recent study showed that primitive basalts from a fast-spreading ridge leave the mantle sulfide saturated but enter the magma chamber below the ridge sulfide undersaturated through pressure loss [4]. Here, we test this hypothesis for ultra-slow spreading ridges by determining platinum-group element (PGE) concentrations and S-isotopes from sixteen basalts from the ultraslow spreading Gakkel Ridge ranging MgO from 9.4 to 6.6 wt.%. The data are combined with existing trace element concentration and Fe isotope data to further constrain magmatic evolution. Our data show that the concentration of PGE in near-primitive melt increases until MgO=8.5 wt.% and then decreases, coincidental with a sharp drop in Cu concentration. Primitive melts above the MgO threshold of 8.5 wt.% are sulfide undersaturated with the increase in PGE concentration possibly attributed to dissolution of mantle monosulfides *en route* to the surface. More evolved erupting lavas reached S saturation, likely through S incubation in a magma chamber, which is monitored by the segregation of Cu-sulfide phases at S saturation. Our results confirm that primitive magmas leave the mantle S saturated and become S undersaturated *en route* to surface. At the ultraslow spreading ridges, sulfide saturation through magmatic differentiation occurs at lower MgO compared to fast spreading ridges, proving the existence of at least small magmatic reservoirs in these settings.

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