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An experimental study of storage (P, T, X-H2O, fO2) conditions beneath Krafla Central Volcano (Iceland)

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Rhyolite accounts for about 10% of Iceland's volcanic products, providing insights into silicic magmatism in basalt-dominated oceanic settings. However, the phase relations and storage conditions (P-T-fO_2-XH_2O) of these magmas are poorly understood due to a lack of experimental studies on Fe-rich but Ca- and K-poor rhyolites such as the rift zone rhyolites of Iceland. To address this, we used an Internally Heated Pressure Vessel (IHPV) to conduct phase equilibria experiments on rhyolite from Krafla volcano. Because rhyolite magma was unexpectedly encountered at shallow depth (2.1 km) during recent drilling of the IDDP-1 geothermal well, Krafla represents an opportune target for this work, providing a unique opportunity to compare experimental results with natural phase assemblages where pressure conditions are known a priori. Preliminary results show good agreement between the phase assemblages and mineral compositions of the natural Krafla rhyolites and our experimental samples at 850-875 °C and 50 MPa, including the presence of augite at low (1-3 vol%) crystallinity and presence of fayalite at $fO_2 < \Delta NNO = -2$. Our results imply that relatively hot (>800-850°C) and shallow ($\leq$ ~50 MPa) storage conditions are typical of most rift-related Icelandic rhyolites, and are consistent with the view that the low to moderate H_2O contents of on-rift rhyolites reflect H_2O saturation at low pressures. They also highlight an especially strong influence of fO_2 on the stability of ferromagesian phases in these magmas, reflecting their Fe-rich melt compositions (~3 wt% FeO^T). Our experiments offer new perspectives on the enigmatic origins of Iceland’s rift zone rhyolites, and provide important temperature and fO_2 constraints that support developing plans to study the active IDDP-1 magma body via targeted drilling.