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Paleoenvironmental Constraints on Pleistocene Ice Sheets from Glacio-Volcanic Deposits in Northeast Iceland

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A growing body of research suggests that deglaciation can lead to increased eruption rates by destabilizing existing magma bodies and even prompting new magma generation. Given its high rate of magma production and periodic glaciations through the Pleistocene, Iceland is the ideal locality on Earth to study volcano-ice interactions as much of its landscape is dominated by glacio-volcanic landforms such as tuyas. One of the main products from magma-ice interactions is volcanic glass, which locally contains dissolved volatiles such as H_2O, CO_2, and SO_3. The pressure-dependence of volatile solubility in magmas allows estimation of the ice thickness at the time of eruption by measuring the volatile content of glassy eruption products such as pillow lava rims. Here we use volatile estimates from samples of three volcanoes (Gæsafjöll [65.77], Bláfjall [65.55 N], Búrfell [65.44 N]) to test the hypothesis that in northeastern Iceland the Pleistocene ice sheets thickened southwards towards the present day location of Vatnajökull ice cap. Major element and sulfur concentrations of the glasses were analyzed by electron microprobe at the University of Wisconsin-Madison, and major element concentrations are basaltic for all three tuyas (SiO_2=46.99–51.22 wt. %; MgO=4.11–9.06 wt. %; CaO 8.90–13.88 wt. %; FeO=9.40–16.48 wt. %). Gæsfjöll and Bláfjall have similar major element concentrations, whereas Búrfell is relatively enriched in FeO and depleted in MgO and CaO. Glass (n=102) SO_3 contents, which are proxies for water, range between 100 ppm and 3,100 ppm for all three edifices with SO_3 contents generally increasing towards the south (Gæsafjöll=199.1 ppm–1,864.9 ppm; Bláfjall=130.4 ppm–2,356.3 ppm; Búrfell=163.3 ppm–3,001.8 ppm). Thus, our preliminary data support the idea that the Pleistocene ice bodies through which these three volcanoes erupted thickened to the south. Future work will include FTIR measurements of H_2O and CO_2 to further test this hypothesis.