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Geochemical and Petrologic Insights into Alkaline Magma Generation from Mount Waesche, Marie Byrd Land, Antarctica

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Preliminary $^{40}Ar/^{39}Ar$ eruption ages from Mount Waesche, a young stratovolcano (426-96 ka) in the Executive Committee Range in Marie Byrd Land, West Antarctica, indicate the volcano erupts more frequently during interglacial periods. We conducted a detailed petrologic study on thirteen magmas that erupted in the last interglacial period (~100-135 ka) and six magmas that erupted during the recent glacial period to evaluate changes to the magmatic system as a function of the ice load. Samples from Mount Waesche are generally alkaline (Na_2O+K_2O = 4.16-9.69 wt%; basalt to benmoreite) and contain plagioclase + oxides ± clinopyroxene ± olivine, with total crystallinities (phenocrysts + microphenocrysts) ranging from ~3 to 35%. Several samples have crystal clots and individual olivine xenocrysts with fayalitic cores and pyroxenes with aegirine cores. Clinopyroxene and olivine compositions in basalts and hawaiites range from $Wo_{45-48}En_{33-43}Fs_{10-20}$ and Fo_{58-78}, and those measured in phonotephrite range from $Wo_{45-47}En_{33-41}Fs_{10-18}$ and Fo_{59-79}. Olivines in are unzoned or have weak normal-zoning. Clinopyroxenes have weak normal zoning in all samples. Clinopyroxene thermobarometery [1] reveals temperatures ranging from 995±13(±1 sigma) to 1121±10ºC and pressures from 3.9±2 to 9.6±0.3 kb, where the most Mg-rich samples typically record the highest temperatures and highest pressures. Whole rock chemistries show a depletion in the middle rare earth elements (MREE) suggestive of hornblende fractionation; however, the pre-eruptive temperatures generally exceed that of hornblende stability [2]. Crystallization models fail to reproduce the depletions in the MREE, when using mineral assemblages grown in experiments on alkali-rich compositions at temperatures and pressures comparable to those of the natural samples. Assimilation-fractional-crystallization models generate the observed patterns in MREE using primitive compositions from Mt. Waesche and a granosyenite from Marie Byrd Land [3]. The current dataset suggests that the temperatures, pressures, and processes required to generate lavas from Mt. Waesche do not differ significantly between glacial and interglacial periods. For future work, we will examine the dataset for patterns in age and estimates of erupted volume.

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[3] Tkacheva, D.A. et al. (2018), Geochem. Int. 56, 628-650.