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U-Nb-Sc-Ce-Yb-Ti in Zircons and H_2O in Zircon Melt Inclusions: Insights into the Tectono-Magmatic Origin of 2,736 Ma Volcanics from the Superior Province

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Zircon trace and rare earth element (TREE) contents, O and Hf isotopes, along with H_2O contents in melt inclusions in zircon (MIZs) can provide valuable insights into the tectono-magmatic origin of zircon-forming magmas. We studied zircons and re-homogenized MIZs from a 2,736±2.5Ma lava dome breccia and rhyolite from the Sturgeon Lake volcanic complex, Superior Province, Canada (Davis et al. 1985). The zircons were annealed at 1100ºC and 4kbar for 6hr in a rapid-quench internally heated pressure vessel; 45 homogeneous and glassy MIZs were simultaneously exposed following casting, grinding and polishing to expose zircon interiors. MIZs range in diameter from 5-20µm. We measured the MIZ & host zircon $\delta^{18}O$ and MIZ H_2O contents by SIMS and MIZ major element composition by EPMA. Measurements of TREEs in zircon hosts follow the methods of Blum et al. (this meeting), and involve the automated analysis of 26 TREEs, including Nb and Sc. TREEs were calibrated against zircons 91500 and MAD-559.

The ^{18}O of all host zircons are constant and mantle-like (5.4±0.4‰(2SD)). Most MIZs have ^{18}O=8.0±1.0‰ and $\Delta^{18}O_{MIZ\text{-}Zrn}$=+2.6±1.1‰, consistent with the predicted melt-zircon equilibrium (Lackey et al. 2008). These MIZs show 74.6±3.1wt% SiO_2 and total alkali of 5.7±1.0wt% that agree well with the whole rock data (Davis et al. 1985). Their average H_2O content is 2.8±1.1wt%. The U/Nb(18±9), Sc/Yb(0.16±0.10), and U/Yb(0.25±0.13) ratios of the host zircons overlap with those of oceanic and continental arc/undepleted mantle type zircons (Grimes et al. 2015). The slightly enriched εHf of a host zircon +1.8 (Davis et al. 2005) can be consistent with either of these zircon types. However, the $\Delta\log fO_2$ (FMQ)=–1±0.8 (zircon oxybarometer of Loucks et al. 2020) suggests zircon formation from a relatively reduced magma that contrasts with the modern day oceanic and continental arcs. The MIZ H_2O contents of 2.8±1.1wt% can be obtained through fractional crystallization of a magma that is relatively low in H_2O content. Taken together, these results are more consistent with host zircon formation from a relatively undepleted mantle derived magma than an arc mantle derived magma.