ABSTRACT

TITLE:	Chemical Signatures of Perovskite in Katungite Dikes of the Navajo Volcanic Field: Implications for Magma Sources and Conditions
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ABSTRACT: A series of west-trending ultramafic and ultrapotassic dikes (katungite) are exposed in the west-central part of the Navajo volcanic field. These katungite dikes contain high concentrations (up to 5% volume) of perovskite along with associated olivine, phlogopite, mellilite, and apatite. Perovksite in these rocks occurs as euhedral to subhedral crystals with complex growth and chemical-zonation patterns. The perovksite forms either as isolated rounded to pyramid-shaped crystals, "flower" aggregates, and "necklaces" around earlier formed phenocrysts of olivine. A study of the chemical signatures of perovskite in the NVF katungite samples reveals that they mostly consist of the end member perovksite $CaTiO_3$(96-98 mol. %). The perovskite crystals have extremely elevated abundances of rare-earth elements with LREE enriched 10,000 to 30,000 times chondrite with 0.1 to 0.7 weight percent of Nb_2O_3, La_2O_3, Ce_2O_3, Pr_2O_3, Nd_2O_3, and SrO. Overall, however, the perovskite in the katungite samples tends to be more ceroan, and exhibit elevated concentrations of U (40 to 100 ppm) and Th (300-2000 ppm). Prominent zonation in perovskite indicates a complex history of crystallization during magma explacement in which LREE oxides tend to show a decrease in concentration from core to rim whereas SrO show an increase. According to the oxygen barometer of Bellis & Canil (2007), the NVF katungite samples span a wide range of oxygen fugacities relative to the Ni-NiO buffer, ranging from -4 to 0 with DNNO increasing with increasing Fe_2O_3. The DNNO values tend to become more negative from the cores to rims of individual crystals. This suggests that the magmas associated with these rocks were in a moderately to slightly reduced state during emplacement and were buffered by a C-H-O volatile phase that increased with crystallization. Most elements show an increase in concentration with higher Fe_2O_3 and higher DNNO. This hints that the distribution of most elements in the perovksite is closely allied to the oxidation state of the magma. We interpret the DNNO data as evidence the magmas for the NVF katungite dikes were generated by melting of a deeper mantle source than NVF minettes. A variety of geochemical trends indicate that the minettes were generated by partial melting of metasomatized lithospheric mantle.