THE EFFECTS OF REDOX CONDITIONS ON FERRIC IRON IN $CaTiO_3$-PEROVSKITE FROM KIMBERLITIC MAGMAS

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Kimberlites are volcanic rocks which reflect the nature mantle source region, but they are also modified during their ascent to the surface and altered subsequent to eruption. Kimberlites often contain diamonds, graphite and/or carbonate, and the stability of these minerals is directly influenced by the oxygen fugacity (fO_2) of the magma during its ascent. It is well known that kimberlites experience multiple stages of crystallization under changing conditions during ascent and it has been suggested that natural perovskites may be used to unravel parts of the magmatic history of these rocks. Perovskite ($CaTiO_3$) is an accessory phase in undersaturated, alkaline igneous rocks and very common in the groundmass of kimberlites. In Brazil, a volcanic kimberlite pipe found in the region of Rosário do Sul - Rio Grande do Sul, presents a unique opportunity to investigate $CaTiO_3$-perovskite, which is found in the matrix of this kimberlitic rock. Data from literature suggested that the kimberlite pipe with the highest fO_2 has the highest proportion of highly absorbed diamonds, whereas pipes with lower estimated fO_2 have lower proportions of highly resorbed diamonds. In this way, they proposed that perovskite oxybarometers may have the potential to predict the diamond quality and, therefore, the value of a kimberlite pipe. In order to examine relative oxygen fugacities of naturally occurring kimberlite magmas, we equilibrated perovskites with different kimberlitic melts at high pressures, high temperatures, and different fO_2. The initial experiments were performed at temperatures of around 1250°C and a pressure of 2GPa, with durations of 24 hours, in an end-loaded piston cylinder. Further experiments were carried out using a 1000 ton Walker type multi anvil apparatus, and the conditions used were a temperature of 1350°C and a pressure of 6GPa, with durations of 24 hours. The experiments were conducted under different redox conditions using a variety of solid-state buffer assemblies: Re-ReO_2 buffers for relatively oxidizing conditions and CCO buffers for more reducing conditions. Microprobe analyses of perosvkites were carried out to measure the iron content of perovskite at different oxygen fugacities, pressures and temperatures. The results indicate that the Fe-concentrations in perovskite in kimberlite critically depends on fO_2, temperature and bulk composition. The experimental results of this work, in conjunction with literature data, are used to calibrate an improved geo-oxybarometer for perovskite in kimberlite melts.

KEYWORDS: PEROVSKITE, OXYGEN FUGACITY, IRON CONCENTRATION