Examination of surface features on kimberlitic iron-titanium oxide minerals

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Oxide minerals, including chromite and ilmenite, are found in abundance in kimberlite deposits, brought to the surface during the eruption of a kimberlitic magma from the upper mantle. Previous studies have shown that the dissolution of these oxide minerals reflects magma chemistry and fluids present, which also cause the dissolution of diamonds. The goal of this study is to establish a connection between surface features and reaction products occurring on kimberlite oxide minerals and the dissolution found on diamonds from the same kimberlite pipe. This study will also address the specific chemical and fluid interactions that result in the features seen on the examined grains.

Chromite and ilmenite grains from two kimberlite bodies were examined for distinct dissolution features and imaged using a Scanning Electron Microscope. The chromite grains from both kimberlites display consistent regular polygonal, stepping, and triangular pitted features on the grain surface. The ilmenite grain surfaces are predominantly covered by reaction products, primarily perovskite and titanite, and in some cases by kimberlitic groundmass. Several grains were cleaned in hydrochloric acid in an attempt to reveal the ilmenite grain surface beneath the carbonaceous groundmass. This procedure yielded some unique surface features unlike those seen on the chromite grains, mainly circular pitting. Following imaging, the chemistry and zonation of selected grains were analysed through wavelength dispersive spectroscopy and elemental X-ray mapping methods. Several ilmenite grains were found to show complex zonation, as well as an abundance of reaction products on the surface. The chromite grains, however, display only a very thin ring of zonation, as well as some minor pitting around the very edge of the grains. The eventual aim is for the possible prediction of preserved quality diamonds in a kimberlite through examination of the more abundant oxide minerals.

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