X-Ray Microprobe Analysis of A Mineral Crystal

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Introduction

To evaluate the abilities of the PNC Microprobe and illustrate its capabilities for mineralogical analysis, a reference crystal of the mantle mineral olivene was analyzed. Of interest in mineralogical investigations, in addition to the gross composition, is the trace element distribution and, in particular, the chemical speciation of these trace elements in the mineral because of the import of such data to mineral petrogenesis.

Methods and Materials

This experiment was performed with the KB focussing mirror pair installed which provided about 5 micrometer spatial resolution, The multielement EDX analyzer was used to collect the data. To avoid swamping the detector with the Fe signal, the exciting radiation was set just below the Fe K-edge.

Results and Discussion

The area on the crystal (Figure 1) was mapped and as illustrations the Mn and Cr element distributions are plotted (figures 2 and 3). Signal heights are arbitrary as the detector response has not been calibrated. This particular sample has been analyzed previously by means of the electron microprobe and it will be of interest to ascertain how the results delivered by the long-standing method of electron excitation analysis compare to those determined by means of X-ray excitation technology. The latter is much less damaging to the sample, potentially offers higher sensitivity and, in addition, the X-ray technique allows the use of XANES to determine the chemical valence state, a parameter of critical importance to the analysis of minerals. The latter is not readily provided by the electron microprobe. These very preliminary results illustrate the power of the X-ray microprobe. Clearly Cr and Mn are found in the region of the crack in the sample and it is clear that the Mn lies along the crack and the Cr is found at the outer end of the crack and also on an area outside of the crack zone. XANES scans of the Mn and Cr signals were performed and calibrated against the metal edges with the result that the Mn was identified as Mn(II) and the Cr as Cr(III).

Acknowledgments

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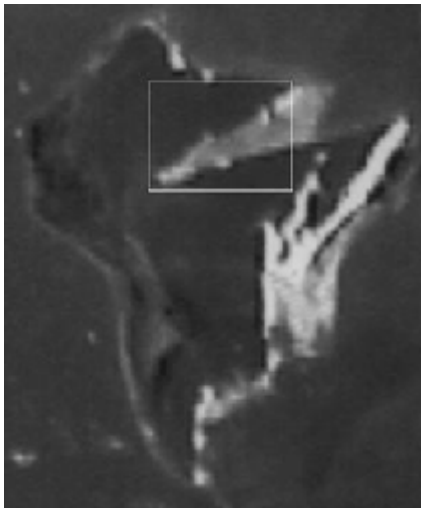

Figure 1: The Crystal showing the Area Analyzed.

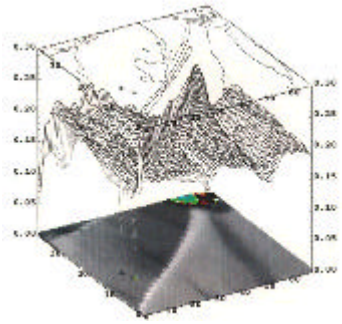

Figure 2: Distribution of Manganese. The XANES trace shows Mn(II).

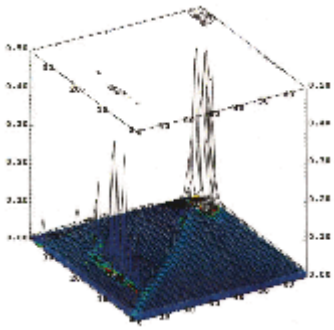

Figure 3: Distribution of Chromium. The XANES trace shows Cr(III).