

## **Solving the iron quantification problem in low-kV EPMA: An essential step toward improved analytical spatial resolution in electron probe microanalysis—Fe-sulfides**

**AURÉLIEN MOY<sup>1,\*</sup>, ANETTE VON DER HANDT<sup>2</sup>, AND JOHN FOURNELLE<sup>1,†</sup>**

<sup>1</sup>Department of Geoscience, University of Wisconsin, Madison, Wisconsin 53706, U.S.A.

<sup>2</sup>Department of Earth Sciences, University of Minnesota, Minneapolis, Minnesota 55455, U.S.A.

### **ABSTRACT**

The use of the field emission gun in scanning electron microscopy permits the imaging of sub-micrometer-size features. However, achieving sub-micrometer analytical spatial resolution in electron probe microanalysis (EPMA) requires both reducing the electron beam size and reducing the accelerating voltage to achieve the desired sub-micrometer interaction volume. The resulting quantification of the first-row transition metals at low accelerating voltage, i.e., below 7–8 kV, is problematic as the main characteristic X-ray lines ( $K\alpha$ ) cannot be excited at these conditions. Furthermore, the use of the  $L\alpha$  and  $L\beta$  soft X-ray lines for quantification is complicated by bonding and self-absorption effects resulting in not-yet-determined mass absorption coefficients and hence in the failure of the traditional matrix correction procedure. We propose two methods to circumvent these low-kilovolt (low-kV) analysis limitations: using the non-traditional  $FeL\ell$  line and using universal calibration curves for the more traditional  $FeL\alpha$  and  $L\beta$  lines. These methods were successfully applied to Fe-sulfide minerals showing accurate quantification results by EPMA at reduced kV, necessary for accurate quantification of sub-micrometer sulfide grains.

**Keywords:** EPMA, sulfides, low kV, iron, microprobe, SXES, EMPA, X-ray