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A simple empirical method for high-quality electron microprobe analysis of fluorine at trace levels in Fe-bearing minerals and glasses

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ABSTRACT

We present a new, high-quality electron microprobe method for analyzing F in Fe-bearing minerals and glasses down to trace levels (<1000 ppm F). This method is empirically based and corrects for the problem of overlap of the F$K\alpha$ peak onto the "shoulder" of the Fe$L\alpha_1$ peak that arises when using synthetic multi-layered diffraction crystals. It also achieves high precision and accuracy while maintaining low detection limits and a small beam diameter. Analytical conditions for F using the new method and a synthetic W/Si diffraction crystal are: 10 kV accelerating voltage, 180 nA beam current, 8 μm beam diameter, and 400 second total peak count time. An iterative beam exposure method is employed to minimize potential damage to the sample due to beam heating. The method presented here can be used to address problems related to degassing of F at active volcanoes, the reservoirs of F in the mantle, and the partitioning of F between minerals and silicate liquid.