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Quantitative analysis of ammonium in biotite using infrared spectroscopy

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ABSTRACT

The present paper provides a calibration of the Beer-Lambert law allowing the determination of the ammonium (NH_4) content of biotite using infrared (IR) spectroscopy. Single biotite crystals were analyzed by Fourier Transform Infrared spectroscopy. Using a linear correlation between the NH_4 infrared absorption band intensity and the NH_4 content as determined by vacuum techniques, the NH_4 molar absorption coefficient at 1430 cm^{-1} was found to be 441 ± 31 L/mol·cm. After having calibrated the biotite thickness to Si-O absorption band, the NH_4 content of biotite can be calculated directly from its IR spectrum by the relation:

$$[NH_4^+] \text{ (ppm)} = 1044.3 \times \frac{A^{1430} - A^{2395}}{A^{1249} - A^{2395}} - 320$$

where A^{1249}, A^{1430}, and A^{2395} are absorbances corresponding to wavenumbers 1249 cm^{-1} (Si-O vibration peak), 1430 cm^{-1} (NH_4 bending), and 2395 cm^{-1} (spectrum baseline), respectively. The analysis of biotites having different chemical compositions suggests that, to a first approximation, the calibration is independent of biotite chemical composition. An infrared determination of NH_4 partitioning between muscovite and biotite coexisting in the same rocks shows good agreement with results of previous studies and further validates the method.