Raman Spectroscopy as Analytical Tool for Alkali Feldspars

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This contribution reports calibrations of Raman band positions for the determination of the Na/K ratio in ordered and disordered alkali feldspar solid solutions along the join $KAlSi_3O_8$ - $NaAlSi_3O_8$. Crystals along the ordered series microcline – albite and the disordered series sanidine - analbite were synthesised in steps of 10 mol% by ion exchange from natural albite (Iveland, Norway) or sanidine (Volkesfeld, Eifel, Germany) following the method of Kroll et al. (1986) and were analysed by X-ray diffraction and electron microprobe. Calibrations were made for the positions of several Raman bands in the wavenumber region 100 – 850 cm^{-1}.

The data show that for the disordered series sanidine – analbite a band between 120 - 142 cm^{-1} yield the best results, enabling the determination of K/(Na+K) with an accuracy of better than $\pm$0.04 for the synthetic series. The application of this calibration to natural samples was tested by analysing a series of alkali feldspars (K/(Na+K) = 0.28 – 0.86) from various volcanic rocks. These data suggest that the calibration can be used to estimate the K/(Na+K) ratio in natural disordered alkali feldspars with an accuracy of better than 0.1. The accuracy in K/(Na+K) can be further improved to $\pm$0.03 (synthetic samples) and $\pm$0.07 (natural samples) by using the Raman shift difference between the most intense Raman band at about 512 cm^{-1} and the band at 120 to 142 cm^{-1}.

For the ordered series microcline – albite, a Raman band ranging between 748 and 764 cm^{-1} seem to be most suited for a correlation with composition. The current data set allows an estimation of K/(Na+K) with an accuracy of about $\pm$0.1 for the synthetic series. However, it must be noted that the available solid solution series was plagued by chemical inhomogeneity due to incomplete Na/K exchange during sample synthesis, thus leading to a large analytical error. Further work is in progress to prepare homogenous samples of the microcline – albite solid solution in order to improve the calibration.

References

Kroll H, Schmiemann I, von Cölln G (1986) Feldspar solid solutions. Am Mineral 71: 1-16.

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