Beta dosimetry of potassium feldspar extracts using imaging microprobe analysis and small sample gas flow beta counting

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We provide a comparison of two independent methods used to determine the absolute K content of potassium feldspar extracts from sand-sized lacustrine, colluvial and aeolian sediments. The methods used were gas flow beta counting and imaging microprobe x-ray fluorescence analysis.

Imaging analysis demonstrated that the proportion of potassium feldspar grains in a nominally pure K-feldspar extract varied from a low of 7% to a high of 84%. All extracts included a significant proportion of quartz, and some also contained a few plagioclase feldspar grains. However, the absolute K_2O content in individual potassium feldspar grains of all eight extracts examined was within the range of 15.5 = B10.7% K_2O by weight. The K_2O contents in four of five extracts, measured using gas flow beta counting, were significantly lower than this value. This reflects the dilution effect of significant amounts of non-K bearing grains in these extracts. This difference can result in up to an 80% underestimate in the internal beta dose rate of a potassium feldspar grain. A 14% underestimate in the total dose rate to potassium feldspar grains, and therefore a 14% overestimate in sediment ages determined by luminescence dating of nominally pure potassium feldspar extracts is thus possible.

We suggest that gas flow beta counting is suitable for the determination of K contents of bulk sediments and therefore the external beta dose rate, but that internal beta dosimetry is best performed by imaging microprobe x-ray analysis. An alternative, inexpensive approach would be to assume a 15.5 = B10.7% K_2O content for all nominal K-feldspar extracts separated using a heavy liquid with specific gravity of 2.58, and use this value to determine the internal beta dose rate. Dose rate errors incurred with this approach are expected to be significantly less than those incurred by the small sample gas flow beta counting method.