



Calcium Isotope Analysis by Mass Spectrometry

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The variations in the isotopic composition of calcium caused by fractionation in heterogeneous systems and by nuclear reactions can provide insight into numerous biological, geological, and cosmic processes. Calcium isotopic analysis is therefore widely applied across a spectrum of cosmo- and geochemistry, paleoclimatic, nutritional, and biomedical studies. The measurement of calcium isotopic abundances in natural samples has challenged analysts for more than three decades. Practically all Ca isotopes are subject to significant isobaric interferences, and the low-abundant Ca isotopes can be particularly affected by peak tailing effects from the neighboring major isotopes. The extent of natural variations of these stable isotopes appears to be relatively limited, and therefore highly precise mass spectrometric techniques are required to resolve isotopic effects. Isotope fractionation during sample preparation and measurements and instrumental mass bias can significantly exceed the natural isotope abundance variations in samples. Not surprisingly, a TIMS procedure developed by Russell et al. (Russell et al., 1978. *Geochim Cosmochim Acta* 42: 1075–1090) for Ca isotope measurements was considered as revolutionary for isotopic measurements in general, and that approach is commonly used (with small modifications) for practically all isotopic systems and with different mass spectrometric techniques. Nevertheless, despite several decades of calcium research and corresponding development of mass spectrometers, the available precision and accuracy is still not sufficient to achieve all of the challenging goals. This presentation discusses figures of merit of presently used analytical methods and instrumentation, and attempts to critically assess their limitations. Additionally, the availability of Ca isotope reference materials will be discussed.