

NENIMF: Cameca IMS 3f

Trace and rare earth elements in silicate minerals and glasses

The Cameca IMS 3f instrument has a realistic limit of detection for most elements in the range of 1 to 100 ppb with a typical spatial resolution of 10 to 30 micrometers in glasses and common silicate minerals. Li, Be, B, Sc, Ti, V, Cr, Rb, Sr, Y, Zr, Nb, Ba and REE (La, Ce, \pm Pr, Nd, Sm, Eu, \pm Gd, \pm Tb, Dy, \pm Ho, Er, \pm Tm, Yb, \pm Lu) represent a list of routinely analyzed trace elements. The REEs are usually analyzed separately from other trace elements, applying different high-energy offsets of -60 V and -90 V, respectively. Examples of REE working curves can be obtained from my article in "Modern Analytical Geochemistry".

Analytical Conditions:

- Primary O⁻ beam: ca. 10 to 30 μ m in diameter at 8 to 12.5 kV accelerating voltage and 1-20 nA of beam current;
- Secondary optics setup: 4.5 kV of secondary ion extraction potential, 150 μ m field of view, and $M/M = 300$ at fully open entrance and exit slits;
- High voltage energy offset is usually set to -60 to -90 V to be able to suppress isobaric molecular interferences. These are mostly monoxides; ¹³⁵BaO and ¹³⁷BaO interfere with ¹⁵¹Eu and ¹⁵⁴Eu, respectively, ¹⁶⁷Er with ¹⁵¹EuO, ¹⁵⁸GdO and ¹⁵⁸DyO with ¹⁷⁴Yb or ¹⁴⁷SmO with ¹⁶³Dy etc. (Zinner and Crozaz, 1986);
- Energy window is centered and opened to 40-60 V (i.e., \pm 20-30 V).

References:

[1] Zinner E, Crozaz G (1986) A method for the quantitative measurement of rare earth elements in the ion microprobe. Int J Mass Spectr Ion Proc 69, 17-38.

Sr/Ca and Mg/Ca ratios in reef corals and planktonic foraminifera

A variety of the energy filtering-based approach to carbonates has made an important contribution to ocean sciences in the form of paleo-climate proxy development, particularly from the point of view of biomineralization, based on Mg/Ca, Sr/Ca, Ba/Ca measurements in corals and foraminifera. Standardization for these measurements used the same carbonate standards as in the 1280-based method described above. The only difference, as compared to IMS 1280, is that an energy offset of -80 v was used to successfully suppress molecular ion interferences. At the conditions given below, replicate analyses of a reference carbonate material (*OKA carbonate standard*) within a single analytical session yield a precision of ca. 0.2-0.5%.

Analytical Conditions:

- Primary O⁻ beam of ca. 10 μ m in diameter at 8 to 12.5 kV accelerating voltage and 1-6 nA of beam current;
- Secondary optics setup: 4.5 kV of secondary ion extraction potential, 150 μ m field of view, $M/M = 300$ at fully open entrance and exit slits;
- High voltage energy offset: -70 to -80 V to suppress isobaric interferences (e.g. ²³NaH⁺ or ⁴⁸Ca⁺⁺ on ²⁴Mg⁺);
- Energy window is centered and opened to 40-60 V (i.e., \pm 20-30 V).

References:

[1] Allison N (1996) Comparative determinations of trace and minor elements in coral aragonite by ion microprobe analysis, with preliminary results from Phuket, South Thailand. Geochim Cosmochim Acta 60, 3457-3470; [2] Bice KL, Layne G and Dahl K (2005) The application of SIMS for measuring Mg/Ca in rare, delicate or altered planktonic foraminifera: examples from the Holocene, Paleogene and Cretaceous. Geochim Geophys Geosyst 6, doi:10.1029/2005GC000974; [3] Cohen AL, Layne GD, Hart SR and Lobel PS (2001) Kinetic control of skeletal Sr/Ca in a symbiotic coral: implications for the paleotemperature proxy. Paleoceanography 16, 20-26; [4] Cohen AL, Owens KE, Layne GD and Shimizu N (2002) The effect of algal symbiosis on the accuracy of Sr/Ca paleotemperatures from coral. Science 296, 331-333.

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