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In situ measurements of calcium isotopes by ion microprobe in carbonates and application to foraminifera

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An analytical procedure has been developed for the in situ measurement of calcium isotope composition of carbonates with a spatial resolution of 15-20 μm on a Caméca IMS 1270 ion microprobe in Nancy (France). By using two Faraday cup detectors, the ^{40}Ca and ^{44}Ca can be measured simultaneously, improving the internal reproducibility. Instrumental mass fractionation (IMF) of calcium isotopes was observed to be independent of primary ion beam intensity and of the Mg content of the carbonate, but can depend on vacuum conditions. Three calcite reference materials were used in this study (ENS 0, MEX and BRET105E) and their δ^{44}Ca values relative to NIST915a were reproducible within a typical 1s standard deviation of $\approx$0.15 permil. Also, for these three standards, δ^{44}Ca measured by ion micorprobe are equal, within errors, to the values obtained by TIMS. This analytical procedure was applied to planktonic foraminifera, *Globorotalia inflata*, dated at 2.8 Ma from Shatsky Rise (ODP Leg 198). The range of measured δ^{44}Ca within a single test is 1.7 permil. This intratest variation can be attributed to several processes such as temperature variation, ontogenic effects or differences between primary and secondary calcite (i.e. calcite precipitated by different biomineralization processes).