Geophysical Research Abstracts
Vol. 14, EGU2012-5923, 2012
EGU General Assembly 2012

$^{87}Sr/^{86}Sr$ Isotope Ratio Measurements of Calcium-rich matrices by (Laser Ablation)-Multiple Collector Inductively Coupled Plasma Mass Spectrometry: A Survey on Mass Discrimination and Matrix-Induced Interferences

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The use of $^{87}Sr/^{86}Sr$ ratios is a powerful tool in anthropological and biological research for the investigation of migration, mobility and movement due to its outstanding properties of regional difference and Sr abundance in nature. Laser ablation coupled to multiple collector - inductively coupled plasma mass spectrometry (LA-MC-ICPMS) stands out due to its attributes as a semi-invasive means for the fast and direct investigation of Sr isotope ratios and marginal sample preparation required. However, direct $^{87}Sr/^{86}Sr$ ratio measurements in calcium phosphates and carbonates suffer from significant matrix-related interferences such as molecular ions, e.g. $(^{40}Ca\text{-}^{31}P\text{-}^{16}O)^+$, $(^{40}Ar\text{-}^{31}P\text{–}^{16}O)^+$, $(^{43}Ca\text{-}^{44}Ca)^+$ as well as in many cases concomitant atomic ions, e.g. $^{87}Rb^+$, $^{174}Hf^{2+}$. Interferences on Sr isotopes analyzed by LA-MC-ICPMS have been subject to numerous debates and discussions among users during the last couple of years. Interpretations of generated data are highly diverse regarding the trustworthiness of LA-MC-ICPMS, as corrections are approached in different ways and diverse sources of interferences are presumed. The major part of observations report trends towards higher $^{87}Sr/^{86}Sr$ for LA-MC-ICPMS compared to solution-nebulisation based MC-ICPMS when analyzing apatite matrices and lower ratios in case of calcium carbonate samples. This study is dedicated to the systematic investigation of the effect of interferences and instrumental mass discrimination on Sr isotopic investigations using LA-MC-ICPMS. The major focus was set on analyzing human tooth samples, fish hard parts and geological carbonates. Laser ablation data and corresponding data established using solution nebulisation based approaches were compared and potential sources of interferences identified by e.g. using high resolution ICPMS. The combined corrections of interferences and adequate mass bias correction procedures lead to accurate data even though increased uncertainties have to be taken into account. The obtained results are discussed along with coexisting approaches for data correction in laser ablation analysis.