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Observation of Mass-Independent Fractionation in MC-ICPMS and its Implication for Accurate Isotope Ratio Measurements

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Today, MC-ICPMS has become a powerful research tool for the high precision isotope ratio measurements with over five-hundred papers published annually in the past several years$^{1-2}$. However, MC-ICPMS suffers approximately tenfold larger bias (up to 25 % for lithium^{3}) in isotope amount ratio measurements as compared to thermal ionization mass spectrometry (TIMS). This bias needs to be properly corrected in order to obtain accurate isotope amount ratio measurements.

The choice of the fractionation law to calibrate (correct) measured isotope ratios is crucial in isotope science. Over the last decades, the Russell law mass bias correction model (Eq. 1)^{4} which is applicable only for mass-dependent fractionation and assumes identical mass bias for both the calibrator and measurand elements, has become a standard curriculum in isotope ratio measurements. However, it has been reported that not only mass bias is different for different elements but also that the mass bias is different for different isotope pairs of a same element$^{5-6}$. Mass-independent fractionation in MC-ICPMS has been observed for elements such as Nd, W and Cd$^{5-7}$.

$R_{i,j} = r_{i,j}(m_i/m_j)^{-f}$ (1)

Here $R_{i,j} = n(^{i}\mathrm{E})/n(^{j}\mathrm{E})$, $r_{i,j}$ is the measured (uncorrected) isotope ratio and E is the element of interest, f is the fractionation function and m_i,m_j are the nuclide masses.

In this talk, recent research results on MIF observed for Ge, Hg and Pb in MC-MCP in our group^{8} will be presented and its implication for Russell law mass bias correction for isotope amount ratio measurements will be presented and discussed.

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