High-precision measurement of 36 SF 5 + signal using the MAT 253 Ultra isotope-ratio mass spectrometer

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Abstract

Rationale: The Δ ^{36}S standard deviation (SD) measured in a conventional isotope-ratio mass spectrometer (IRMS) such as MAT 253 is at *c.a.* 0.1difficult to resolve the origin of non-mass-dependent sulfur (NMD-S) isotope fractionation in the tropospheric sulfate aerosol and in Martian meteorites or small deviations from the canonical mass-dependent fractionation laws. Interfering ions (originated from fluorination and/or mass spectrometer ion source itself) with m/z at 131 of $^{36}SF_5^+$ by the community as the cause of the poor precision, but the exact ion species has not been identified or confirmed. **Methods:** Here we examined the potential interfering ions by using the Thermo Scientific MAT 253 Ultra, a high-resolution (mass resolving powers up to 40,000) stable isotope-ratio mass spectrometer, to measure the SF_6 working gas and SF_6 gases converted from IAEA-S1 Ag_2S reference materials via a fluorination system. **Results:** We found that there is a resolvable peak to the right of the $^{36}SF_5^+$ peak for both the SF_6 working gas and SF_6 generated by the fluorination system. The peak is identified as the $^{12}C_3F_5^+$ ion, generated inside the instrument during the ionization process. By minimizing the presence of carbon-bearing compounds (e.g., organic matter in sample or helium gas, glue or o-ring in sample tubes, or carbon-bearing gases inside the mass spectrometer), we were able to achieve a Δ ^{36}S SD of 0.046SF_6 zero-enrichment and 0.069measurement start from sliver sulfide IAEA-S1. **Conclusions:** Minimizing the presence of carbon-bearing compounds and avoiding the interfering signals from $^{36}SF_5^+$ via MAT 253 Ultra high-resolution isotope-ratio mass spectrometer, we can improve Δ ^{36}S measurement precision by 2 to 5 folds, which helps to open new territories for research using quadruple sulfur isotope composition.

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