

Pb isotope analysis using Tl and a ^{207}Pb - ^{204}Pb spike on a double focusing MC-ICPMS

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A comparative study of the use of Tl and a Pb double spike (DS) to correct for mass bias during Pb isotopic analysis on a single focusing MC-ICPMS showed that Tl-doping procedures do not always yield highly precise or accurate Pb isotope ratios (Thirlwall, 2002). We have carried out a similar investigation on our double focusing MC-ICPMS. Standards and samples were analysed with a desolvating nebuliser coupled to an Axiom MC-ICPMS. Solutions were analysed unspiked with Tl (Tl/Pb = 0.05-0.2), and re-analysed (consuming < 20 ng Pb) after addition of a ^{207}Pb - ^{204}Pb DS calibrated with respect to SRM982. Tail corrections to isotopic data were not required and ^{204}Pb ratios calculated with three different Hg corrections agree to < 20 ppm in standards and samples.

SRM981 data are corrected for mass bias by normalisation to: (a) $^{208}\text{Pb}/^{206}\text{Pb} = 2.1677$; (b) $^{205}\text{Tl}/^{203}\text{Tl} = 2.3889$, or; (c) using a DS correction. Using (a), reproducible ratios identical (<< 100 ppm) to those obtained by Thirlwall (2002) were obtained. Method (b) yields imprecise Pb isotopic ratios (± 250 ppm/amu) e.g., $^{206}\text{Pb}/^{204}\text{Pb} = 19.925 - 16.950$. Despite the large range in Pb isotopic ratios obtained by (b), DS-corrected data for *all* these runs yield reproducible Pb isotope ratios (± 100 ppm 2 rsd; $n > 50$) within 30 ppm of those reported by Thirlwall (2002).

Samples display similar behaviour to the standards, with DS-corrected data often (but not always) different from the Tl-corrected data. Moreover, within a single day the offset between Tl- and DS-corrected Pb isotopic ratios observed for SRM981 is not the same as for samples, precluding the use of the standard to adjust the Tl-corrected sample data. The cause of the difference in Tl- and DS-corrected Pb isotope ratios observed for standards and samples is not yet clear. However, in part, it is related to sample uptake - a complex function of instrument set-up, nebuliser condition, and the physical and chemical properties of the aspirated solution. We will also report on a similar study using a conventional glass nebuliser to see if these effects are restricted to the Aridus desolvating nebuliser.

Thus, the vagaries of Tl-normalisation described by Thirlwall (2002) are *not* confined to a single type of MC-ICPMS instrument - only use of a double or triple Pb spike can demonstrate that an instrument produces highly precise and accurate Pb isotopic data. However, MC-ICPMS analysis does enable rapid Pb isotopic analysis (6-8 analyses/hour) and optimal spiking for the DS run - making Pb DS analysis by MC-ICPMS a routine procedure.

References

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The oxygen isotopic composition of water extracted from CV carbonaceous chondrites

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Introduction. The oxygen triple-isotopic composition of water extracted from hydrated minerals in primitive carbonaceous chondritic meteorites can contribute significantly to our understanding of the evolution of the corresponding parent bodies. Analysis of examples of both CI and CM meteorites (1) provide evidence that a portion of the water is representative of that present at the final stages of aqueous alteration. The experimental method used (2), which incorporates stepped pyrolysis in conjunction with high sensitivity $^{18}\text{O}/^{16}\text{O}$ and $^{17}\text{O}/^{16}\text{O}$ measurements, has now been applied to a suite of CV carbonaceous chondrites, with the objective of constraining further the role of parent body water. CV chondrites, unlike CI and CM chondrites, have experienced high temperature processing, as reflected by the attendant mineralogy (3), and reduction in the overall water content. However, hydrated minerals remain, providing evidence of past aqueous alteration. These form the focus of the present study.

Results. Although yields from CV samples are only about 10 % of those from CI and CMs, incremental pyrolysis of 5-10 mg samples still releases sufficient water to permit 12-15 heating steps, with concomitant isotopic analyses. The release profiles from CV chondrites exhibit two major peaks. The first of these occurs at between 50 and 450°C, but varies greatly in magnitude between meteorite samples. The second release, in contrast, is centred at ~750 °C.

Saponite, the dominant hydrated phase in Kaba (4) and other CVs is a smectite-type mineral that incorporates water between structural lattice layers. That such interlayer water readily exchanges with surrounding reservoirs is accurately reflected by the isotopic data with water from low temperature steps being characterised by a terrestrial $\Delta^{17}\text{O}$ signature of ~0‰. In contrast the second release is of water indigenous to the meteorite, probably originating from structural O-H groups within minerals. This water possesses a distinct isotopic composition with $\Delta^{17}\text{O}$ close to -0.7 ‰, which is similar to that of the indigenous water extracted from some CM meteorites. The implications of these results will be discussed at the meeting.

References

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