Tellurium isotopes and the origin of the solar system

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^{126}Sn decays to ^{126}Te with a half-life of 0.235 Myrs. ^{126}Sn cannot be produced in significant amounts by the s-process; it is an r-process nuclide that is probably formed in a supernova environment. The discovery of ^{126}Te excesses that correlate with Sn/Te in meteorites would thus provide powerful confirmation of the theory that a supernova injected freshly synthesised nuclides into the molecular cloud from which our solar system formed, providing evidence of a trigger.

Tellurium is of additional interest because it has eight stable nuclides that are well suited for the study of nucleosynthetic isotope anomalies. The nuclides $^{122\text{-}124}$Te are produced only by the s-process, $^{128, 130}$Te only by the r-process, ^{120}Te only by the p-process, whereas $^{125, 126}$Te are produced by the r- and s-process. Recently, ε-level Mo isotope anomalies have been reported in bulk meteorites (Dauphas et al., 2002; Yin et al., 2002). These anomalies were inferred to be of nucleosynthetic origin because they mirrored the s- and r-process anomalies that were identified in presolar grains. Previous studies have also reported large (100%-level) Te isotope anomalies in acid-etched residues of Allende (Richter et al., 1998; Maas et al., 2001). Thus bulk carbonaceous chondrites may also display nucleosynthetic Te isotope anomalies.

In the present study, we analyzed bulk samples of the carbonacous chondrites Orgueil (CI), Murchison (CM), ALH3100 (CM), Allende (CV) and ALH84028 (CV) for their Te isotope composition. All measurements were conducted by MC-ICPMS. The data are normalized to ^{125}Te/^{128}Te=0.22204 with the exponential law. Results are expressed in ε-units relative to a JMC Te solution. The reproducibility (2s) of the isotopic measurements for 100 ng samples of Te is typically ±4500 ppm for ^{120}Te/^{128}Te, ±140 ppm for ^{122}Te/^{128}Te, ±100 ppm for ^{124}Te/^{128}Te, ±30 ppm for ^{126}Te/^{128}Te and ±60 ppm for ^{130}Te/^{128}Te.

The Te isotopic compositions of all chondrites were within error identical to the JMC standard. Bulk chondrites thus preserve no resolvable evidence of the nucleosynthic isotope anomalies found in presolar grains. Any ^{126}Te anomalies due to decay of ^{126}Sn are furthermore either too small to be resolvable or absent. This indicates that the initial abundance of ^{126}Sn was either very small or that Sn/Te fractionation occurred too late. The Te isotopic composition of the silicate Earth is probably dominated by the late veneer (Yi et al., 2000) and is therefore unrelated to the bulk earth Sn/Te. However, assuming the bulk Sn/Te ratios of carbonaceous chondrites reflect variable early volatile element depletions during condensation in the nebular that represent their parent bodies, we can calculate a maximum initial ^{126}Sn/^{118}Sn of $1x10^{-4}$.

Low pH protonation of bacterial cell walls: New data for *Bacillus subtilis*

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Previous potentiometric studies of the charging behavior of bacterial cell walls have focussed primarily on pH conditions higher than approximately 3.5. However, recent bulk metal adsorption and X-ray absorption spectroscopy data suggest that cell wall functional groups can be proton active below pH 3.5, and that surface complexes involving these functional groups can remain important under higher pH conditions. To provide constraints on the speciation of the bacterial cell wall under low pH conditions, we have conducted potentiometric titrations using the Gram-positive aerobic species *Bacillus subtilis*, covering the pH range 1.5 to 10.5.

Titration experiments were conducted using an auto-titrator assembly, with the bacteria suspended in 0.1 m $NaClO_4$. A thorough wash procedure was used to ensure that the cell walls were free of growth media components, and the electrolyte used was purged of dissolved CO_2 by bubbling N_2 gas through it for 60 minutes prior to the titration. The titrations were conducted in a N_2 atmosphere. Both down-pH and up-pH titrations were conducted, and full reversibility of the protonation reactions was observed over the entire pH range of the experiments.

The titration curves above pH 3.5 are consistent with those from previous studies over this pH range. However, we observed significant adsorption of protons under low pH conditions. In fact, this proton adsorption continued to the lowest pH values examined, indicating that proton saturation did not occur under any of the conditions of the experiments. Zeta potential measurements indicate that the cell wall remains negatively charged, even under the lowest pH conditions studied, and EXAFS data suggest that the low pH-active functional group is a phosphoryl site. We model our titration data using a range of electrostatic models, solving for the acidity constant and site concentration of the functional group that is active under low pH conditions. This study indicates that the cell wall of *B. subtilis* can interact with protons and metals under extremely low pH conditions, and that the nature of the surface phosphoryl sites is likely more complex than has been previously envisioned.