The composition of noble gases in the solar wind as collected by Genesis: A proxy for solar nebula composition.

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Genesis, a NASA sample return mission, collected solar wind (SW) in space for 2.5 years for precise elemental and isotopic analyses. SW matter originates from the photosphere and outer convective zone of the Sun and serves as a proxy of solar nebula composition. One major objective of Genesis was to determine solar abundances and isotopic composition of volatile elements. The solar composition of noble gases is difficult to determine as they are depleted in primitive meteorites and also not detectable in the photospheric spectrum due to their high excitation energies.

SW is known to be slightly fractionated relative to photospheric composition, as detected mainly by spacecraft measurements. Ionisation of solar matter enhances elements with low first ionisation potential (FIP). Noble gases are high FIP elements, nevertheless, Kr and Xe enrichments relative to Ar similar as low FIP elements were detected in SW extracted from lunar samples [2]. However, enrichments are expressed relative to solar abundances which recently changed significantly [e.g. 3]. Light elements are also affected by isotopic fractionation presumably upon acceleration of the SW ions. For example Genesis data revealed that ^{3}He/^{4}He is 6% different between two distinct SW velocity regimes and Ne varies by ~1%/amu [1]. The magnitude of isotope fractionation decreases with atomic mass and is probably negligible for elements heavier than Ar (Ar fractionation is ~0.3%/amu). Thus, the isotopic composition of Kr and Xe in the SW are probably equal to photospheric values.

Here, we present abundances and isotopic composition for all five stable noble gases in the SW as collected by Genesis [1,4,5] and compare them with estimates of solar abundances (derived otherwise) and other primitive solar system objects (Jupiter atmosphere, comets, etc.). We discuss how our values compare with existing SW fractionation models and how we can extract solar abundances from the SW data obtained from Genesis.

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Structural incorporation of Neptunyl(V) into calcite – Interfacial reactions

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In this experimental study a wide range of methods has been used to investigate processes leading to incorporation of neptunyl(V) (NpO_2^+) cations into the calcite structure.

As part of the investigation calcite surface properties were characterized over a wide range of pH and p(CO_2) conditions using zetapotential and *in situ* crystal truncation rod measurements. A detailed picture of surface charging phenomena and the corresponding molecular surface arrangement under varying solution conditions could be gained.

The NpO_2^+ adsorption species on the calcite surface were investigated by means of room temperature and low temperature (15 K) EXAFS spectroscopy. NpO_2^+ seems to adsorb at the calcite surface as an innersphere complex. Adsorption kinetic and desorption experiments indicate that even under equilibrium conditions NpO_2^+ becomes incorporated into the calcite structure.

Upon coprecipitation from calcite supersaturated solutions NpO_2^+ is readily incorporated into the calcite structure. Incorporation species were investigated using room temperature, low temperature (70 K), and polarization dependent EXAFS measurements, together with conventional powder XRD, NIR and Raman spectroscopy. The linear NpO_2^+ molecule seems to substitute one calcium ion and two adjacent carbonate ions in the calcite structure. It is hence coordinated by four monodentate bound carbonate ions in the equatorial plane. Polarization dependent EXAFS measurements indicate, in agreement with NIR spectroscopic results, that the coordination polyhedron is a distorted tetragonal bipyramid. Powder XRD data indicates that NpO_2^+ incorporation causes local distortion in the calcite lattice.