An Insight into [244]Pu abundance in Interstellar Matter

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The steady-state deposition of Interstellar Matter (ISM) on Earth and its accumulation in Earth reservoirs such as deep-sea sediments and ferromanganese nodules may be investigated by searching for short-lived nuclides ($T_{1/2} < 100$ Myrs), extinct in the present Solar System. Such nuclides are known to have been extant in the Early-Solar System and are expected to reach steady-state abundances in the ISM. We investigated the case of [244]Pu using accelerator mass spectrometry (AMS) for its high sensitivity to actinides and determined the [244]Pu content of the Pu fraction separated from 1 kg of North-Pacific deep-sea sediment. The distribution of Pu isotopes (A=239,240,241,242,244) is consistent with that expected from nuclear fallout and sets a limit of < 0.2 atoms cm^{-2} yr^{-1} (90% conf. level) for [244]Pu ISM deposition. Using recent data on Earth accretion of large ISM grains (m > 3×10^{-7} gram) and assuming an Early-Solar U abundance in ISM, we derive a limit of $(^{244}Pu/U)_{ISM} < 1 \times 10^{-3}$, smaller but not very far from the adopted Early-Solar value of 0.007. We are pursuing our measurements with the separation of Pu, Cm and Hf from a deep-sea sediment core clean of nuclear fallout (sediment depth 2-230 cm).
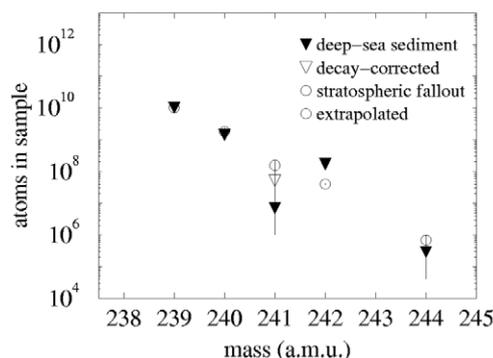
Vanadium (III, IV and V) sorption onto goethite α-FeOOH

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The sorption of vanadium onto colloidal oxyhydroxides and clay minerals is an important control on the fate of vanadium in seawater, soils and groundwater. Vanadium occurs in the +3, +4 and +5 oxidation states under aqueous conditions; incorporated V in minerals might serve as a palaeoredox indicator. We measured the sorption of V (3+, 4+ and 5+) onto goethite under controlled atmospheric conditions. V-FeOOH surface complexes were determined using EXAFS spectroscopy.

The sorption of V(V) onto goethite (Fig.1) has a concentration dependence that reflects the formation of polynuclear complexes in solution when [V] > 3 ppm.

V(V) adsorbs as the mononuclear vanadate $(VO_4)^{3-}$ ion (or its conjugate acids) on the FeOOH surface via an inner-sphere complex. V(IV) adsorbs onto goethite as the $(VO)^{2+}$ ion which appears to form a monodentate Fe-O-VO complex. We find no evidence for V(IV) oxidation to V(V).

The surface of goethite oxidises adsorbed V(III) to V(IV) (Fig.2). Our results disagree with the proposal of Schwertmann and Pfab (1994) that V(III) can be incorporated into FeOOH via substitution of V^{3+} for Fe^{3+}.

References

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