

Different sources of hydrocarbon pollution in surface sediments of the Campeche Sound, Gulf of Mexico, revealed by biomarker analysis

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The Campeche Sound in the Gulf of Mexico is the largest oil field in Mexico. Oil production, refinery activities, heavy ship traffic as well as natural petroleum seeps are potential sources of pollution of water and sediment in the area (García-Cuéllar *et al.*, 2004). Embedded in a grid system of a long term environmental monitoring program (e.g., Vázquez and Virender, 2004) surface sediments from the shelf area of the Campeche Sound and also from the adjacent abyssal plain further west were studied. The nonaromatic hydrocarbon biomarkers in these surface sediments, several crude oils and drill cuttings samples were investigated by GC-MS.

The overlapping fossil hydrocarbon envelopes indicate multiple sources like discharged drilling fluids, the heavy ship traffic or land run-off. Samples taken close to known asphalt seeps exhibit biomarker patterns virtually identical to those of the reference crude oils, and thus have apparently escaped from petroleum reservoirs with fractured cap rocks. These sediments and the asphalts both lack of angiosperm biomarker oleanane (cf. Moldowan *et al.*, 1994) as expected for crude oils from a Jurassic source rock. Other surface sediments, superimposed on the fossil hydrocarbons, contain biomarkers neither typical of mature fossil fuels nor of typical immature organic matter in marine surface sediments. Their origin from drill cuttings recovered from Tertiary to Cretaceous deposits and disposed of into the sea would be a reasonable explanation. The regional distribution of indicative biomarkers will be shown and discussed.

References

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The timescale of the Earth's accretion and volatile loss: New constraints from Pd-Ag systematics

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The extinct radionuclide ¹⁰⁷Pd decays to ¹⁰⁷Ag with a half-life of 6.5 Myr and is a useful chronometer to study early solar system processes [1]. It provides constraints for the accretion and subsequent chemical differentiation of planetary bodies in a similar way as the ¹⁸²Hf-¹⁸²W system. In contrast to the refractory elements Hf and W, there is a distinct difference in volatility between the more refractory element Pd and moderately volatile Ag. Thus the Pd-Ag system can be used to study accretion and core formation but also volatile depletion.

In particular, the Pd-Ag decay system has been successfully applied to study the formation and differentiation of iron meteorites [1]. Internal isochrons determined for these meteorites generally yield initial ¹⁰⁷Pd/¹⁰⁸Pd ratios in the range of 1.5 – 2.5 x 10⁻⁵ [1]. Combined with recent results for carbonaceous chondrites, this suggests that the initial ¹⁰⁷Pd/¹⁰⁸Pd ratio of the solar system may be in the range of 6 x 10⁻⁵ [2].

Here we report new high precision Ag isotope data for a variety of terrestrial basalts from different geological settings. The data indicate an ε¹⁰⁷Ag of 2.1 ± 0.6 for the Ag isotopic composition of bulk silicate Earth relative to the NIST SRM 978a Ag standard. In contrast, the CV3 chondrite Allende has a well-constrained ε¹⁰⁷Ag of -0.4 ± 0.5. Assuming that the Earth accreted from material with similar volatile depletion as the CV3 chondrites and that Ag isotopes are not significantly affected by stable isotope fractionation, it is possible to model the Earth accretion and core formation. A simple two-stage model suggests that the last complete metal-silicate equilibration took place no longer than 15 Myr after the start of the solar system. This is at odds with the results of the well-investigated Hf-W system, where the same model yields a time of ~30 Myr. Different scenarios can be considered to reconcile the apparent discrepancy: (1) the Earth accreted from material having greater volatile depletion than CV3 chondrites (Pd/Ag > 20). Some ordinary chondrites feature such high Pd/Ag ratios. (2) Metal-silicate equilibration was incomplete and affected the Pd-Ag and Hf-W system differently. (3) Significant volatile depletion took place prior to the giant impact, for example during the accretion of the Earth.

References

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