Mineralogical and trace element characteristics of noble gas carrier phases of interplanetary dust particles and impact debris in a Central Pacific sediment core

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We examine mineralogy, trace element and noble gas chemistry of deep ocean sediments from LL-44 GPC-3 including Cretaceous/Tertiary (K/T) and Eocene/Oligocene (E/O) boundaries. Bulk sediment and magnetic isolate extractions were analyzed by noble gas-MS, SEM, and cryogenic LA-ICP-MS (CLA-ICP-MS). Noble gas analysis reveals ET He and Ne throughout the entire sampling interval. $^{3}He/^{4}He$ ratios of $3.1x10^{-4}$ and $^{2}°Ne/^{22}Ne$ ratios of 9.96-12.62 are consistent with the SEP signatures in c. Pacific zero-age magnetic grains and stratospheric IDPs. Magnetic extracts typically constitute <1% of the bulk sample while accounting for 3-10% of total ^{3}He. The magnetic isolates reveal no significant differences of $^{3}He/^{4}He$, $^{2}°Ne/^{22}Ne$, or $(^{3}He/^{2}°Ne)_{solar}$ from bulk GPC-3 sediments or Z-MAG grains. SEM and CLA-ICP-MS analysis determine the mineralogy and trace element signatures of the magnetic isolates respectively, to distinguish between the carrier phases of the continuous flux of IDPs and the flux associated with major impact events. SEM reveals stark contrasts in composition and morphology of (K/T) and (E/O) boundary samples. It remains unclear if these grains are capable of retaining ET noble gases, but do provide a resilient method of locating impact boundaries in deep ocean sediments. Identifiable ET grains are not observed in a survey of ``background'' samples leading to a less certain mode for the mineralogical carrier phase of the continual flux of IDPs. We report trace element and mineralogical markers for individual grains, magnetic and bulk separates, which provide insights into the carrier phases of ET noble gas from the continuous flux of IDPs in non-impact boundary related samples.

Aromatic carboxylic acids are anaerobically transformed in Guaymas basin sediments

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Guaymas Basin in the Gulf of California is a geologically active region characterized by thick layers of sediment, through which hydrothermal fluids percolate and pyrolyze organic material to form petroleum hydrocarbons. We hypothesize that natural *in situ* exposure will enable enrichment of microorganisms from Guaymas Basin sediments that are able to degrade hydrocarbons, such as naphthalene, under sulfate-reducing conditions. Hydrocarbon-laden sediments were sampled from 2000 m below the sea surface and were used as inocula to establish anaerobic sulfate-reducing enrichments. While there was little sulfate loss in cultures amended with naphthalene, there was activity in cultures supplemented with an anaerobic metabolite of naphthalene in the form of 2-naphthoic acid. There was significant sulfate loss in active cultures incubated at 30°C as compared to unamended background controls, but sulfate disappearance occurred more rapidly in cultures incubated 60°C. Disappearance continued over several transfers and amendments with new substrate.

DNA was extracted from both frozen, unenriched sediment samples and active cultures, and then probed for functional genes. A clone library was produced from unenriched sediment for dissimilatory sulfite reductase genes (*dsrAB)*, and is being compared to those sequences obtained from active cultures. Cultures were also screened for benzylsuccinate synthase (*bssA*), a gene involved in the anaerobic degradation pathway of many hydrocarbons. Primers were used to amplify DNA from 2-naphthoic acid-degrading cultures incubated at 30°C, and the resulting product had sequence similarity to the related gene naphthylmethylsuccinate synthase (*nmsA*). Primers that target *nmsA* are being used to screen DNA extracts from active enrichment cultures. Further analysis, including nucleotide sequence analysis of clones from active cultures, as well as HPLC measurements of 2-naphthoic acid and sulfate concentrations, can support that the reduction of sulfate coincides with the disappearance of substrate.