Organic geochemical analysis of the impact of cadaver burial on soil

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A comparative study of soil lipids collected from eleven crime scenes across Malaysia, with different post-depositional intervals (PDI) of cadavers, was conducted. A laboratory degradation study of porcine flesh in soil was also carried out in parallel. The overall premise for this work was that organic molecular components in soil will be useful in determining the provenance of a cadaver and/or calculation of its post-mortem interval (PMI).

The results from the Malaysian samples show that the concentrations of palmitic (C16:0) and stearic (C18:0) acids are higher in the cases with a low PMI, In addition, their unsaturated analogues, palmitoleic (C16:1) and oleic (C18:1) acids are also present at high concentration. The higher concentration of cholest-5-en-3β-ol (cholesterol) in the cases with low PMIs indicates that this component is most likely derived from the decomposing body. The cases with longer PDI demonstrate a large shift towards plant-derived organic material. Differences observed are presumably due to the transformation of the cadaver derived lipids and can be associated with PMI and/or PDI.

Subsequently, porcine flesh was degraded in aerobic and anaerobic soil mesocosms, representative of tropical and temperate climates, for a year. Mesocosms were sampled throughout the experiment and target analytes were chosen to provide information about both materials derived from the flesh and the response of the microbial community to its presence in the soil environment. Initial results reveal that flesh derived triacylglycerol components degrade within the first 120 days resulting in a corresponding increase in concentration of free fatty acids, i.e. palmitic and stearic acids. Similar patterns of degradation are observed under both aerobic and anaerobic conditions. Preliminary analysis of phospholipid fatty acid distributions, derived from the soils, reveals a concentration increase in the region of 180-400% for soils incubated with porcine flesh after 121 days, with a currently unidentified C18:1 fatty acid moiety becoming the dominant component in the latter samples.

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Role of acid mobilization in association of smaller particle size with higher iron solubility

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Iron (Fe) is an essential nutrient for phytoplankton. Iron-containing soil dust mobilized from arid regions supplies the majority of iron to the oceans, but primarily presents in an insoluble form. Since most aquatic organisms can take up iron only in the dissolved form, a key flux is the amount of soluble iron in terms of the biogeochemical response to atmospheric deposition. Atmospheric processing of mineral aerosols by anthropogenic pollutants may transform insoluble iron into soluble forms. We discuss the effect of the acid mobilization on a relationship between aerosol iron solubility and mineral particle size in an aerosol chemistry transport model [1]. The iron solubility from onboard cruise measurements [2, 3] over the Atlantic and Pacific Oceans in 2001 is used to evaluate the model performance in simulating soluble iron.

The association of smaller size with higher solubility as a role of the acid mobilization considerably improves the results of soluble iron in terms of ratio of fine to total particles, compared to constant iron solubility. The improvement of model-observation agreement provides strong evidence for faster iron dissolution in fine particles by anthropogenic pollutants. Accurate simulation of the ratio of fine to total aerosols of soluble iron has important implications with regards to the ocean fertilization because of a longer residence time of smaller particles, which supply nutrients to more remote ocean biome. The model reveals higher concentration of soluble iron in the coarse mode than that in the fine mode over the Southern Ocean except downwind regions of Australian dust, in contrast to the Northern Ocean. These results suggest that dust does not efficiently transport soluble iron to significant portions of the Southern Ocean. This corroborates hypothesis that phytoplankton blooms are not sustained by the supply of iron to surface waters from dust deposition in the Southern Ocean [4] except the Australian sector [5].

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