Evaluation of atmospheric transport as source of biogenic and anthropogenic organic compounds in marine sediment of Eastern Meediterranean

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Several classes of lipid biomarkers, and anthropogenic compounds (PAHs) have been determined in in aerosol and marine sediment at a central location of Eastern Mediterranean. Aerosol samples (gas and particle phases) have been collected at the marine background station of ECPL, Finokalia on the island of Crete. Sediment samples have been collected from different transects across the continental self and slope (100 to 1500 m) in the oligotrophic Cretan Sea. Seawater samples and additional sediment and aerosol samples were collected at six sampling stations distant from pollutant point sources. All sediment samples were analyzed to determine their organic carbon and (for most of them) their black carbon content.

Specific compound concentrations indicated that atmospheric transport of terrestrial carbon to Eastern Mediterranean is not episodic. Back air mass trajectory analysis indicated that air parcels from north, northeast and northwest contain higher amounts of higher plant lipids and PAHs.

Organic carbon content varied from 2 up to 22 mg/g and black carbon from 0.3 up to 5.6 mg/g. The analysis of marine sediments has shown that the terrestrial signal is an important fraction (34-62%) of total lipids in this oligotrophic area. Marine sediment concentrations of most biomarkers of both marine and terrestrial origin were attenuated with depth and with increasing distance from land. The relative abundance of terrestrially derived lipids has shown an increase from the shallow station of the continental shelf (41%) to the deep basin station (61%), indicating their more persistent character in comparison to the marine derived components.

Seawater and aerosol gas-phase analysis provided strong evidence that air-seawater exchange flux is an important process of atmospheric PAHs input to pristine marine sediments. In addition, the significant correlation found between the PAHs and the organic and black carbon content further suggests the importance of atmospheric input of PAHs to the sediments.

Inorganic geochemistry and mineralogy of tobacco: Changes on combustion with health implications

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Composition of tobacco

Up to 8 weight% of tobacco in commercial brands is mineral, with whewellite and weddellite sometimes accounting for 5%. These biominerals may have an intra-cellular origin and/or grow on the leaf surface during fungal decay. Silicate and oxide minerals in atmospheric dust are trapped by trichomes and their viscous exudates on the leaf surface. Others minerals are derived from fertilisers, industrial pollutants and manufacturers' processes.

There is a very strong correlation between the concentrations of high valence trace elements (normally considered relatively immobile) in tobacco and the concentration of the same elements in average upper continental crust. Enrichment of heavy metals by the tobacco plant can increase their concentration by up to two orders of magnitude (or more in the case of Cd).

Minerals, tobacco combustion and human health

The behaviour of minerals and trace elements during cigarette combustion (400-950°C) is not well characterised, nor are the mechanisms by which trace elements might be transferred from the burning cigarette to the lungs. We have analysed the mineralogy and trace element concentrations in raw tobacco and ash formed at various temperatures in the smoking range to estimate partitioning between smoke and ash phases. The data suggest that light elements ($Z<15$) are strongly partitioned into smoke, possibly as silicate mineral particles, elements $Z=15$ to $Z=25$ and some heavy metals such as Cd, Sn and Pb slightly favour the smoke phase, whereas most other elements from $Z=26$ to $Z=58$ partition into the ash.

The data suggest that unless combustion activates the surfaces of silicate minerals (notably quartz), for example by the formation of free radicals, then these phases are unlikely to pose a significant health hazard. The oxalate phases are involved in decomposition reactions and may be hazardous by contributing significantly to the carbon monoxide budget. Of the heavier metals that partition into smoke, Cd is the most likely hazard to health, being a known human carcinogen with a long half-life in the body.

We conclude that minerals and inorganic trace elements in tobacco possibly have a significant role in diseases attributed to smoking, in particular those minerals that decompose on combustion or heavy metals that partition into smoke. Respirable particles are normally <10 microns so the characteristics of minerals and heavy metals that are transported in smoke require to be determined.