Formation and growth mechanisms of natural nanotubes: Imogolites

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A distinctive feature of certain volcanic soils is the presence of short range ordered aluminosilicates imogolite and allophanes. Due to their high surface area and reactivity, these nanosized phases are an important factor affecting soil dynamics (carbon sequestration, pollutant mobility...). The structure of imogolite is well established: nanotubes with a diameter of ca. 2 nm and several hundreds of nm in length consisting of a curved gibbsite layer with isolated Si tetrahedra inside the tube. However, very little is known about the formation mechanisms of these nanotubes. In the present study, we synthesized these phases and examined the systems from the initial mixing of the reagents to the final products using a variety of analytical techniques (XRD, TEM, EXAFS, NMR and SAXS). Our results demonstrate that the precursors of the nanotubes are not a circular structure but roof tile shaped particules with sizes up 5 nm and varying curvatures. These precursors assemble to form short nanotubes or doughnuts. The final products are obtained by end-to-end assembly of these short nanotubes.

An integrated inorganic and organic geochemical study to evaluate the origin/age of crude oils

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Selected trace elements (e.g. V, Mo, Fe and Zn) in oils have been previously used for oil-oil and oil-source rock correlations [1, 2]. Trace element contents may predict crude oil origin, maturity, migration pathways and establish sources of heavily biodegraded petroleum samples. A novel rapid, reliable and accurate method of determination of major and trace element contents of crude oils has been developed based on Laser Ablation Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS) [3]. For the first time this method has been applied to a series of petroleum samples for analysis of Fe, Mg, Zn, Cu, Cr, Ni, Co, V, As, Mo and Se at trace levels, with little or no sample pre-treatment.

Bulk stable carbon isotopic analyses of saturate and aromatic fractions of crude oil have been previously used to differentiate marine from non-marine sources, however, Australian crude oils do not appear to follow this trend [4]. Carrying out $\delta^{13}C/\delta D$ of individual hydrocarbons (of known origin- non-marine and marine) in a systematic manner may provide a better understanding on the origins of crude oils in Australian petroleum systems. Oils analysed include a series from Australian and Western Canadian basins of different geological age (e.g. Jurassic, Cretaceous, Ordovician, and Devonian). The application of linear discriminant analysis of the stable carbon and hydrogen isotope ratios and trace element concentrations has allowed the classification of crude oils to their geographical (or basinal) sources and age. The use of complimentary inorganic and organic isotope techniques for the petroleum samples may provide a new highly discriminant tool for petroleum exploration.

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