Self-assembly in natural organic matter: Lipid and amphiphilic components

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Recent work has demonstrated that natural organic matter (NOM) in soils and sediments has a hierarchical or "structure within a structure" architecture [1,2]. The first-order structure results from the self-assembly of amphiphilic and lipid components to form a nanostructured composite material. The second-order structure is formed by the self-assembly of this composite with additional but nonamphiphilic components. The objective of this study is to investigate the dependence of NOM self-assembly on the concentration and nature of components in the first-order level of organization, which is assumed to initiate and control the final NOM structure. Composite materials isolated from four different environmental samples were analyzed by differential scanning calorimetry and multidimensional solid-state NMR spectroscopy. Variation of the excess heat capacity and the mobility and domain structures of composite materials with their composition was used to assess structural organization of these materials.

[1] Chilom & Rice (2009) *Langmuir* **25**, 9012-9015. [2] Chilom *et al.* (2009) *Org. Geochem.* **40**, 455-460.

Emplacement of passive margin sediments into deep crustal hot zones of continental arcs: Interplay of tectonic and magmatic thickening in the formation of continental crust

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Both magmatic and tectonic processes cause thickening of continental arc lithosphere. In western USA, increased Farallon-North American plate convergence during the Cretaceous was accompanied by lithospheric thickening due to enhanced magmatism and tectonic shortening. Here, we use lower crustal metaquartzite (80% SiO_2) xenoliths in late Miocene basalts in the central Sierra Nevada Batholith, California to constrain how arc lithosphere thickens and matures. The xenoliths are equigranular in texture and contain >50% qtz, ~10% gt, <40% pl, trace TiO_2, Al_2SiO_5, and biot. High qtz mode, abundant detrital zircons, and oriented graphites suggest a supracrustal sedimentary protolith. However, last equilibration T using TitaniQ are 700-800°C. Thermodynamic modelling shows that coexistence of gt and pl for these bulk compositions limits equilibration P's to 0.6-1.6 GPa with GASP barometer giving 0.9-1.3 GPa. These P-T constraints indicate equilibration of the metaquartzites within a hot lower crust (18-45 km). All zircons have discordant U-Pb with variable upper intercept ages (1.7, 2.7, 3.3 Ga; consistent with Hf model ages) and common lower intercept age (100 Ma). Collectively, the above indicate that protoliths of the metaquartzites were Proterozoic to Paleozoic passive margin sediments of N. American affinity and that they were transported to lower crustal depths at ~100 Ma during the peak of Cretaceous arc magmatism. Underthrusting of N. American lithosphere beneath the arc could have transported these sediments to high P, but underthrusting alone cannot explain the xenoliths' high final temperatures. An extra heat source, imparted by deep lithosphere magmatic "hot" zones, is needed. Our results thus suggest a complex interplay between tectonics and magmatism that drives vertical growth and compositional evolution of continental arcs. Despite the common view that magmatic differentiation drives lower crust to become mafic and upper crust felsic, underthrusting can introduce felsic rocks into lower crust. Local density, rheologic and seismic inversions are thus expected.