Re-Os geochronology of shungite: A 2.05 Ga fossil oil field in Karelia

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Voluminous deposits of C-rich shungite (fossilized hydrocarbons) near Shunga, Karelia, represent one of Earth's earliest major accumulations of organic material. Re-Os geochronology pins the depositional age, constraining models for the emergence of biological activity in oxygenated environments. Shungite in the Paleoproterozoic platform succession of the Fennoscandian shield occurs as *in situ* stratified layers (metamorphosed oil shales), veins and diapirs (migrated hydrocarbons), and brecciated or clastic forms (resedimented bitumen or fossilized oil spills). The organic material occurs as nano-scale globular structures analogous to fullerenes. Shungite has variable C concentrations, from <1% to >50% in *in situ* layers, to as high as 98% in migrated shungite. H and O concentrations are extremely low. The age of the shungite was previoulsy loosely bracketed by a Pb-Pb age of 2090 ± 70 Ma [1] for underlying dolostones, and a Sm-Nd age of 1980 ± 27 Ma [2] for a cross-cutting gabbro.

Re-Os isotope chemistry was done at AIRIE by Carius tube dissolution in inverse *aqua regia*, followed by chemical purification and NTIMS analysis. Re (50 to 223 ppb) and Os (2 to 8 ppb) concentrations are an order of magnitude higher than ranges typical of C-rich shales. Four splits from two samples of *in situ* shungite yield a precise age of ~2050 Ma. Results for two additional samples (remobilized and resedimented shungite) plot slightly above the isochron defined by *in situ* shungite, consistent with migration and isotopic equilibration 20-30 m.y. after deposition, following ingrowth of ^{187}Os. A systematic study is underway to (1) test the coherence of data from discrete, stratigraphically ordered layers containing *in situ* shungite, and (2) determine the variability and integrity of Re-Os systematics in migrated shungites.

[1] Puchtel *et al.* (1992) *Trans. Russ. Acad. Sci.* **326**, 706-711.
[2] Vasil'eva *et al.* (2000) Abstracts on Precambrian Subdivision, Kola Science Centre, Apatity, Russia, 53-54.

Experimental analysis of supercritical CO_2-brine-rock interactions using a flow-through reactor

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Geologic storage of CO_2 by injection into deep brine aquifers is currently viewed as a promising avenue for sequestering CO_2 due to large potential storage space, general proximity to significant point sources of CO_2, and mean porosities and permeabilities favorable to injection. However, commonly utilized geochemical models may not accurately represent the relevant subsurface conditions and rock-water -supercritical CO_2 reactions. Experimental testing of reservoir rock cores to supercritical CO_2 challenge under controlled laboratory conditions provides baseline data for determining likely subsurface geochemical reactions and reaction rates.

We have developed a flow-through reactor in which rock cores are flooded with supercritical CO_2 and reproduced formation waters under typical reservoir conditions to simulate the effects of subsurface CO_2 injection. The reactor system has capabilities for continuous monitoring of key geochemical parameters, pH and EC, during the experiment. We report on the geochemical evolution of brines and changes in the rock-core properties, as a result of CO_2-brine-rock interactions.