

## Modified hydrothermal diamond-anvil cell for the study of C-H-O-S fluids near the Moho

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The conventional hydrothermal diamond-anvil cell (HDAC) [1] has been modified for routine experiments at the pressure (P)-temperature (T) conditions near the Moho (~2.5 GPa and ~1000°C). The modifications include: (a) replacing the WC seats with Si<sub>3</sub>N<sub>4</sub> seats minimizes electrical and thermal conductivity thus improving the stability of the automatic T controlling system up to 900°C; and (b) reducing the size of the collar surrounding the sample to ~3 cm dia. [2] minimizes the amount of H<sub>2</sub>-Ar gas flow needed to prevent oxidation of the diamonds and shields the driver screws and posts from high temperatures as they now reside outside of the collar. This prevents damage, facilitates opening the cell, and makes preparing the next sample much easier.

In their study of the structure of synthetic subduction-zone fluids (KAlSi<sub>3</sub>O<sub>8</sub> – H<sub>2</sub>O system) at T up to 900°C and P up to 2.3 GPa, Mibe *et al.* [3] reported that near this maximum P-T condition, corundum was stable with a supercritical fluid for the sample containing ~60 wt% of water. On the other hand, Raman spectroscopic identification of carbonate- and sulfate-bearing primary melt inclusions in corundum megacrysts, from Change basalts in China, indicates the presence of C and S in the fluids from which the corundum crystallized [4]. In similar corundum deposits worldwide, most researchers agree that corundum occurs as xenoliths, rather than phenocrysts, in alkali basalts, but the origin of corundum remains controversial [5, 6]. The modified HDAC has the potential for solving this problem by adding C and S into the synthetic subduction-zone fluids, so that their effects on the stability of corundum can be identified in the simulated experiments, and also for collecting data related to the physicochemical properties of these fluids at well-controlled P-T conditions.

[1] Bassett *et al.* (1993) *Rev. Sci. Instr.* **64**, 2340–2345. [2] Anderson *et al.* (in press) CCSC-2010, Toronto, Canada, April 25–28, 2010. [3] Mibe *et al.* (2008) *J. Geophys. Res.* **113**. B0428. doi:10.1029/2007JB005179, 2008. [4] Song & Hu (2009) *Acta Petrol. Mineral.* **28**, 349–363. [5] Guo *et al.* (1996) *Contrib. Mineral. Petrol.* **122**, 368–386. [6] Levinson & Cook (1994) *Gems & Gemol.* **30**, 253–262.

## Are CFCs conservative tracers in subsurface environments?

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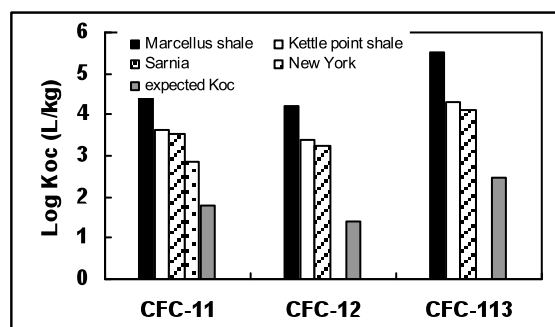
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Sorption is known as relatively unimportant process for CFC transport in most groundwater environments with low organic carbon contents (foc) [1]. Particular types of carbonaceous matter (CM, e.g. black carbon) have great sorption capacities for CFCs [2].

We focus on the sorption potential of CFCs to subsurface sediments along with CM types and amounts. For this study, Marcellus and Kettle point shales are selected for high foc (5–8%), and New York and Sarnia for aquifer and aquitard materials with low foc (0.05–0.5%), respectively.

The isolated CM is predominantly kerogen/black carbon fraction (>90% of the foc) in the Sarnia and New York samples. Type II kerogen is most abundant CM in shale samples [3]. The sorption isotherms are slightly nonlinear, and the organic carbon partition coefficients (Koc) are >1 order of magnitude greater at the measured concentrations than the expected Koc for all samples. These results suggest that CFCs can be significantly retarded by sorption process even in low foc groundwater environments.



**Figure 1.** The measured Koc for CFCs at Cw/S=1e-6 (solubility-normalized concentration).

[1] Plummer & Busenberg (1999) 'Chlorofluorocarbons' in *Environmental Tracers In Subsurface Hydrology*, p.441. [2] Choung & Allen-King (2007) *Eos Trans. AGU*, **88**(52) Fall Meet. Suppl. Abstract H33D-1626. [3] Obermajer *et al.* (1997) *Org. Geochem.* **26**, 229–246.