

## Mechanism of uranium accumulation in a mining-impacted acidic peatbog

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Uranium can accumulate in peatbogs from both natural and anthropogenic sources [1, 2]. An acidic peatbog located in central France was affected by historical uranium mining activities as well as by continued uranium leaching from granite rocks. As a result, this site displays areas, referred to as hotspots, in which uranium concentration can reach up to 4,000 mg/kg [3]. The first-order question for this site is the mechanism leading to this remarkable accumulation. Microbially-driven reductive immobilization is a possible route but so is the complexation of U(VI) by solid phase organic matter that is abundant in the peat soil.

In order to unravel this mechanism and to evaluate the impact of proposed remediation strategies, extensive depth-resolved sampling of soil and porewater have been carried out at hotspots as well as at U-free background areas. Core samples were analyzed for chemical composition, mineralogy and uranium speciation using a combination of x-ray diffraction, gamma spectrometry, sequential chemical extractions, electron microscopy of petrographic sections, cryo electron microscopy of plunge-frozen samples and bulk and micro-scale X-ray absorption spectroscopy. Moreover, the microbial community present in the soil was characterized phylogenetically and probed for its metabolic potential for U(VI) reduction. Additionally, porewater physico-chemical parameters (e.g., pH, Eh, DO, Fe(II),  $\text{SO}_4^{2-}$ , sulfide, U, Mn(II), major inorganic cations and anions, TOC, TIC) were obtained from the same spots to allow correlation of the water and soil characteristics as a function of depth. This approach is the basis for a delineation of the redox transition from oxic to anoxic and the corresponding microbial activity in each redox zone and provides the information needed to understand the mechanism of accumulation of U in this site.

[1] Krachler and Shotyk (2004). *J Environ Monit* **6**, 418-426.

[2] Regenspurg *et al.* (2010). *Geochim Cosmochim Acta* **74**, 2082-2098. [3] Moulin (2008). PhD, Ecole Centrale de Paris.

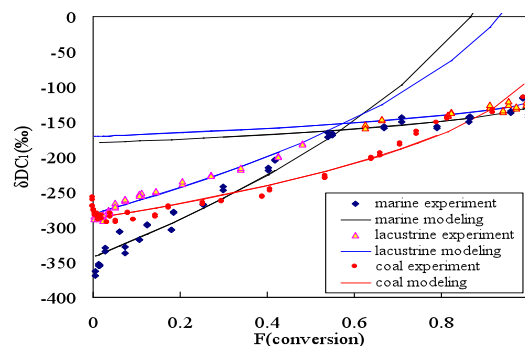
## Modeling hydrogen and carbon isotopes of thermogenic gases from different kerogens in closed system

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For better characterizing the hydrogen and carbon isotopes of thermogenic gases, we studied three selected lacustrine, marine and terrigenous kerogen (coal) samples using gold-tube closed system. We found the obvious fractionation mutation of hydrogen isotope at higher conversion rate for lacustrine and marine kerogen. How to model the isotopic variation is a key issue. Here, we take Rayleigh's method proposed by Rooney (1995) [1], and the isotopic variation was modeled by using two Rayleigh's functions and the results are showing in Fig. 1. In Rayleigh's function, we fitted the experimental results through adjusting the initial isotope compositions of the gas precursors ( $\delta_0$ ) and fractionation factors ( $\epsilon=1000(\alpha-1)$ ,  $\alpha$  is the ratio of reaction rates of isotopes). It is clear that there exist variations for evolution trend of lacustrine and marine kerogen while conversion rate (F) reaches around 0.6, but the variation is not obvious for coal in comparison. Figure 1 suggests that the initial isotope and fractionation factor changed for type I/II kerogen. Inspecting the generation and cracking record, we found these variations are corresponding to the onset temperature of massive secondary cracking of heavy hydrocarbons to methane. This study implies that the secondary cracking of oil in closed system will change the hydrogen and carbon isotopes of thermogenic gases.



**Figure 1:** The experimental and modeling results

[1] Rooney *et al.* (1995) *Chem. Geology*. **126**, 219-232.