

## The vapour-brine partitioning of uranium in boiling ore systems

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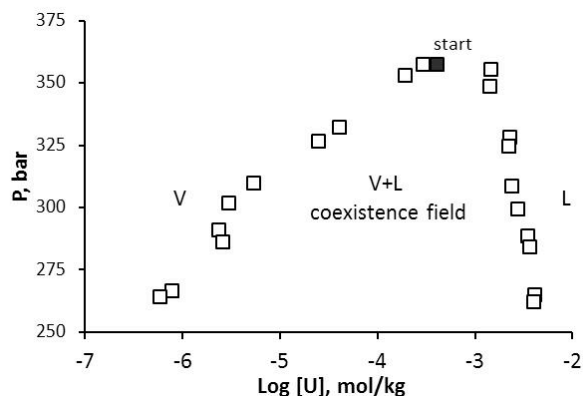
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Uranium is found in ore systems associated with high-temperature H<sub>2</sub>O-CO<sub>2</sub> fluids of probable magmatic origin, such as skarns and iron oxide-Cu-Au-U deposits. At P-T-X conditions of vapour-liquid (V-L) coexistence, the exsolved magmatic fluids undergo boiling, so uranium mobility in the ore fluid is dependent on its partitioning between V and L. In an experiment using a pressure vessel equipped with dual sampling lines, we have determined the partition coefficients ( $D_{V/L}$ ) for U at 400°C between coexisting CO<sub>2</sub>-rich vapour and NaCl brine.  $D_{V/L}$  increases linearly from  $1.5 \times 10^{-4}$  to  $2.0 \times 10^{-1}$ , with increasing P from 263-356 bar.



**Figure:** Uranium concentrations in vapour and liquid sample pairs taken at equivalent P, from a starting P-T-X of 356 bar, 400°C, and bulk composition of  $4.2 \times 10^{-4}$  m (100 ppm) U, 2.3 m CO<sub>2</sub> and 0.5 m NaCl (filled square).

The results of this study suggest that boiling may be instrumental to the production of zoned uranium orebodies, as the majority of U is carried in the denser brine rather than in the coexisting CO<sub>2</sub>-rich vapour. However, at conditions approaching the critical curve, increasing concentrations of U are partitioned into the vapour (e.g., 1% of the total U at 325 bar, rising to 20% at 357 bar). This study presents the first experimental data on the V-L partitioning of U and its mobility in H<sub>2</sub>O-CO<sub>2</sub> vapour.

## Different D-rich organic reservoirs in unequilibrated ordinary and carbonaceous chondrites

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Insoluble organic matter (IOM) contained in chondrites is known to host large D-enrichments [1]. The distribution of D in carbonaceous chondrites (CC) appears to be heterogeneous at the sample, micrometer and molecular scales [1-3]. The isotopic signature is influenced by primary (pre-accretional) processes, including low temperature chemistry occurring in the outer protosolar nebula or in the parent molecular cloud [4] and secondary processes during the evolution of the parent body [1]. On the other hand, the distribution of D in the IOM of ordinary chondrites (OC) remains cryptic. Most of the OC have been subjected to thermal metamorphism. Surprisingly, the D-content of IOM in OC and CC exhibit an opposite evolution with increasing temperature of the parent body [1]. While more high temperature CC have a lower D/H compared to pristine or hydrated CC, the D/H ratio of OC IOM increases with increasing temperature.

To better understand this striking observation, we have subjected the IOM of Orgueil (CC) and GRO 95502 (OC) to thermal heating without oxygen (pyrolysis). Then, we have evaluated the evolution of each IOM upon heating by NanoSIMS (to assess the D/H distribution), STXM (molecular structure) and Raman (organization degree). In CC, the D-content decreases, while in the meantime the IOM undergoes the carbonization process (loss of heteroatoms and formation of larger aromatic structures). In OC, the D/H ratio increases likely due to the loss of a D-depleted organic component.

We conclude that in CC the D-rich organic component is thermally sensitive whereas in OC it is thermally refractory. This clearly indicates different organic moieties that may have distinct origins. Organic radicals were suggested to be the carrier of the D-excess in CC [3]. In OC, another organic component, yet unidentified has to be invoked. It might have been formed in the interstellar medium [4]. The opposite behavior of the organic D-rich component in CC and OC may induce distinct evolutions of the D/H of their IOM upon thermal metamorphism.

[1] Alexander *et al.* 2010 *GCA*, **74**, 4417-4437. [2] Remusat *et al.* 2006 *EPSL*, **243**, 15-25. [3] Remusat *et al.* 2009 *ApJ*, **698**, 2087-2092. [4] Aléon 2010 *ApJ*, **722**, 1342.