A hydrogen rich Early Earth?

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V.N. Larin (1993) [1] proposed that the chemical differentiation in the solar system was driven by the magnetic field of the Protosun, which induced a magnetic zoning of the ionized solar nebula matter. This hypothesis is geochemically supported by a correlation between the Log of the chemical element abundances of the Earth outer geospheres relative to the Sun, and the first ionization potential of these elements.

The observed correlation is theoretically reappraised in the present paper and is interpreted as a Boltzmann distribution, which is proportional to the distance to the Protosun. The model is succesfully tested for the observed solar normalized chemical compositions of the Earth, Mars and chondrites; poorly convincing results are obtained for Venus in absence of reliable data for low abundance elements.

The comparison of the abundance of a given element in the Earth's crust with the average abundance predicted from the proposed model is further interpreted as reflecting the geochemical radial differentiation of the Earth. Using a simple thermochemical model, we propose that the radial distribution of hydrogen on Earth is a function of the chemical affinities of major Earth forming elements with hydrogen.

This model provides insights for hydrogen abundance on Earth. Notably, the inner Earth would have been and still could be hydrogen rich. Although most of this hydrogen have escaped to atmosphere and space through the thorough degassing of the mantle, it is reasonable to suggest, in the perspective given by our model, that very large amounts still reside in the core.

[1] V.N. Larin (1993) *Hydridic Earth*. Ed. C. W. Hunt. Polar Publishing. 247 p.

Anions in clay materials: A case study for multi-scale modeling approaches

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Swelling property in water endows clay materials with a very low hydraulic conductivity and transport of water and solutes in these media is mainly diffusive, with diffusion coefficients that are much smaller than in bulk water. As a consequence, clay materials are recognized as efficient barriers for waste confinements. For instance, bentonites are already used by solid-waste-disposal operators in the form of compact and/or geosynthetic clay liners while engineered bentonite barriers and natural clay formations are foreseen for radioactive waste confinement in deep geological repositories. Clay material physical and chemical properties result from their small size (typically $< 2\mu$m) and structural specificities. Recent developments of computationnal and spectrometric techniques enabled to probe these properties down to the molecular scale, providing accurate descriptions of processes taking place at the solid/water interface. However, for engineering applications, clay properties must be characterised at a large spatial scale (1m-100m) using macroscopic descriptions and often empirical parameters enabling predictive modelling on extended timescales (typically 100 000 years for radwaste repositories). Making the link between these spatial and temporal scales is of paramount importance to assess the robustness of long term predictive modelling results through a detailed justification for the necessary modelling simplifications.

The present talk will focus on anions distribution and mobility in montmorillonite and illite clay materials that are representative of natural clay formation mineralogy. Illite and montmorillonite structures have an excess of negative charge that is compensated by cations adsorption in their interlayer space and on their outer surface. Conversely, anions undergo weak or no specific adsorption and are repelled from the negative surface, a phenomenon called anion exclusion. While this process can be adequately predicted by theoretical models on simple static systems (e.g. clay suspension in 1:1 electrolytes), its quantitive prediction on complex systems (compact clay material, multispecies electrolytes) remains problematic as well as its impact on macroscopic anion diffusion parameters. We will review models available from the nano- to the macroscopic scale in order to (i) highlights recent improvements in our understanding of anion distribution and mobility in clay materials and (ii) to identify remaining gaps to be elucidated.