Availability of nutrient sources for bacterial development in deep clay environments

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It is now acknowledged that highly adapted bacteria are present in deep environments and will probably play a very important role in geochemical cycles. The avaibility of nutrients and energetic sources able to be used by deep biosphere is a key point to understand microbial subsurface life. However the introduction of nuclear waste in a deep geological disposal will lead to a new inventory of nutrients and energetic sources for microbial activity in this particular environment [1]). An inventory of nutrients, energetic sources and possible thermodynamically reactions has been realised in the case of the specific french geological disposal of nuclear waste based on a multibarrier system involving a host rock: argillite. Different reservoirs of nutrients have been identified to be able to support bacterial activity. That is to say: minerals of the host rock, organic matter of the host rock, nutrients of the interstitial water of argillite and hydrogen. H_2 is known as one of the most energetic substrates for deep terrestrial subsurface environments [2]. High amount of H_2 gas will be produced within nuclear deep waste repository (originated from radiolysis or corrosion processes of metallic components in anoxic conditions) and consequently will improved microbial activity in this specific environment. It is known that bacteria developed processes such as complexation, acidification or oxydo-reduction reactions, to access to nutrients contained in minerals [3].

In such a context, we considered in a first step the biological redox reactions using H_2 and Fe (III), and we try to answer the question: are hydrogenotrophic microorganisms able to use structural Fe (III) of the clayey host-rock as electron acceptor?

Kinetic studies of redox metabolism of the iron-reducing bacteria '*Shewanella putrefaciens* strain MR-1' using H_2 as electron donor show availability of Fe (III) as electron acceptor in the studied clayey environment. The use of cristallochemistry tools allow to observe a structural modification of argillite due to this bacterial activity.

The bioavaibility of other nutrients in the host-rock will be also discussed in the presentation

IRSN contribution to this work is gratefully acknowledged.

[1] Lin *et al.* (2005) *Geochimica et Cosmochimica Acta* **69**, 893-903. [2] Stroes-Gascoyne *et al.* (1998) *Environmental Science & Technology* **32,** 317-326. [3] Berthelin *et al.* (2000) *Environmental Mineralogy* **2**, 7-25.

Mineralogy and geochemistry of Neogene mudrocks from Khuzam and Durri formations in southern Egypt

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Mineralogy and geochemistry of the Neogene mudrocks of the Khuzam and Durri formations at Southern Wadi Qena area have been investigated. X-ray diffraction analysis of the bulk samples for Khuzam and Durri Neogene mudrocks revealed the presence of clay (smectite, mica "illite" and kaolinite) and non-clay (quartz, calcite, dolomite, feldspar, anhydrite, halite and hematite) minerals. Little variation in the amount of these clay minerals throughtout the Khuzam and Durri Formations proved that the mudstone beds are thought to have derived essentially from same sources at Red Sea High Hills. Kaolinite and illite may have neoformed after smectite, the main clay mineral in the area, contemporaneously with accumulation of Qena lake sediments. Both major oxides and trace elements were analyzed for 40 mudrock samples from the studied area. The unstandarised discriminant function scores, F1 and F1 for major elements of the Neogene sediments under study were calculated according to Roser and Korch (1988) method. They were plotted on the diagram, following the boundaries (P1- P4) proposed by those authors. Plotting of the studied samples revealed that the intermediate igneous rocks were the main source of these mudrocks that were derived mainly from the Red Sea mountains. The study revealed also that the trace elements exhibit no vertical and/or lateral variations, indicating monotonous source.