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## EFFECT OF REDOX STATE ON THE REDOX SENSITIVE ELEMENT RETENTION BY APTIAN SANDS

*Esra Orucoglu*<sup>1\*</sup>, Sylvain Grangeon<sup>1\*</sup>, Myriam Agnel<sup>2</sup>, Benoît Madé<sup>3</sup>, Mathieu Debure<sup>1</sup>,

<sup>1</sup>BRGM, Orléans, France.

<sup>2</sup>ANDRA, Centre de Meuse/Haute-Marne, Bure, France

<sup>3</sup>ANDRA, R&D Division, Châtenay-Malabry, France

Corresponding authors: [E.Orucoglu@brgm.fr](mailto:E.Orucoglu@brgm.fr) & [S.Grangeon@brgm.fr](mailto:S.Grangeon@brgm.fr)

Interactions between waste components and the surrounding geological formation must be identified and quantified in the perspective of long-term safety assessment of, for example, (rad)waste disposal. The potential mobility of the waste components (chemical toxic elements, metals, radionuclides) in the host geological formation could be anticipated with detection of the retention mechanisms and of the relevant minerals phases in the formation that controls the retention.

In France, low and intermediate-level short-lived radioactive waste, coming not only from the nuclear power sector but also from non-nuclear activities (hospitals, research laboratories or other industrial activities), are disposed of in the Aube disposal facility (CSA). In the present work, As and Sb retention capacities of Aptian sands and effect of redox state on these retentions were examined. Sand samples were collected from capillary zone ( $S_{CFr}$ ) and saturated zone ( $S_{Sat}$ ), representing oxidative and reductive redox conditions at the facility site. As (III & V) and Sb (III & V) sorption experiments were conducted with these two sand samples. Based on Rietveld refinement of X-Ray diffraction patterns (XRD) and scanning transmission electron microscopy (STEM) analyses, sand samples are dominated by quartz (~95%) with accompanying minor mineral phases including microcline, glauconite, kaolinite and trace amounts of smectite clays. The iron oxide content of the sand samples (<1.9%) indicates the presence of iron mineral phases. 10-20% of total iron content of sand samples are extractable iron-oxides (crystalline and amorphous) that may have a significant role in the retention of chemically toxic elements, especially redox sensitive elements. The organic carbon content of the sand samples are below 0.1 w%. Groundwater samples were found to be slightly acidic (pH ~6), have low alkalinity (~1mM) and low ionic strength. Synthetic water representing groundwater conditions were used in the batch experiments having 7 and 30 days contact time.

As(III) retention capacity of  $S_{Sat}$  is higher than its As(V) retention capacity, on the other hand oxidation state of As do not significantly affect the retention capacity of the  $S_{CFr}$  sand (Figure 1). Although both sand samples have about the same quantity of mineralogical phases capable of oxidizing or reducing As(III)/As(V), mineralogical difference between  $S_{Sat}$  and  $S_{CFr}$  sands could influence sorption at low concentrations.

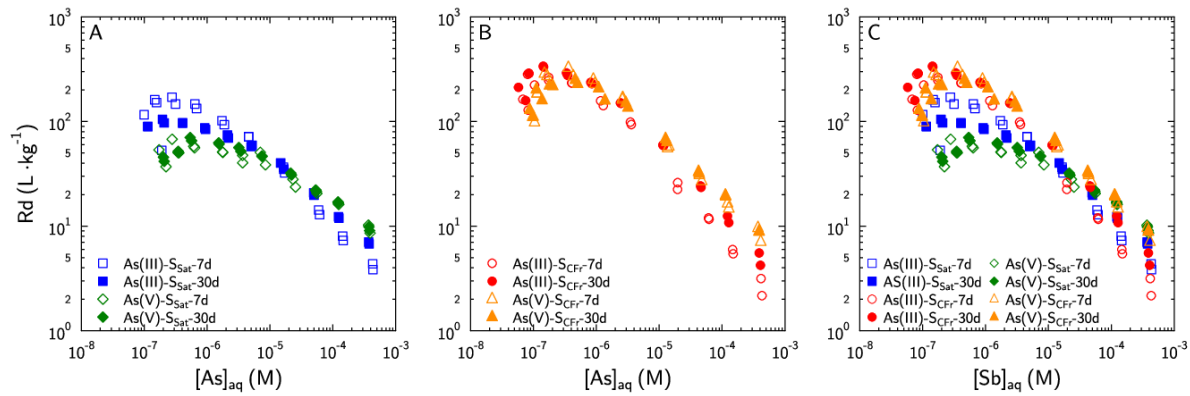


Figure 1: As(III) and As(V) retention capacities of  $S_{Sat}$  and  $S_{CFr}$  sands 7- and 30-day contact time

Sb(III) retention capacity of  $S_{Sat}$  is approximately two order of higher than its Sb(V) retention capacity, on the other hand oxidation state of Sb do not significantly affect the retention capacity of the  $S_{CFr}$  sand at low concentrations but at higher concentrations retention capacity of the sand is one order of magnitude higher in Sb(III) than in Sb(V) (Figure 2).

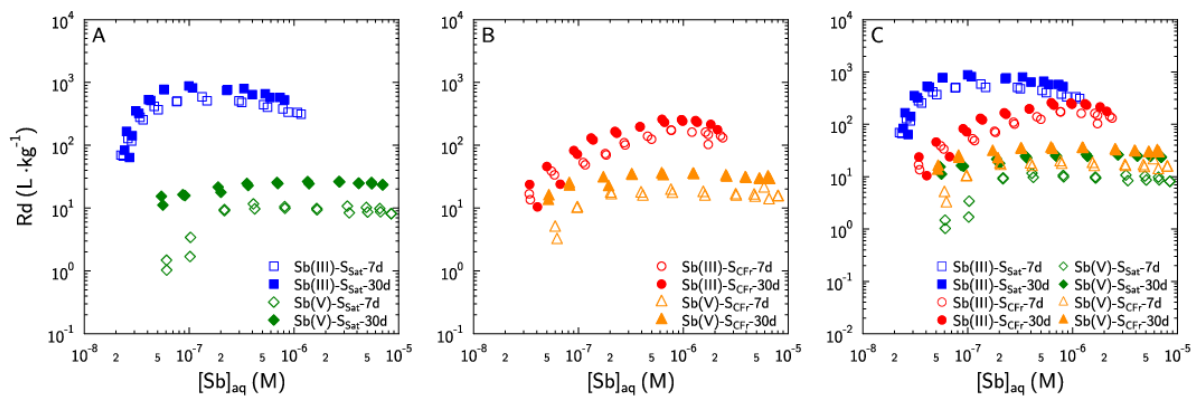


Figure 2: Sb(III) and Sb(V) retention capacities of  $S_{Sat}$  and  $S_{CFr}$  sands 7- and 30-days contact time

Results from experiments conducted here demonstrate that the retention of the redox sensitive elements is influenced by the redox conditions, precisely redox state of the element, redox capacity of the sand samples and the interaction time (7d, 30d). Determining the retention mechanisms of As and Sb as a function of the oxidation state of the elements, the mineralogy of the sand, including the oxidation state of Fe, and the contact time will undoubtedly contribute to a quantitative understanding of the retention of redox-sensitive elements and therefore of their potential mobility in the natural environment.

**Keywords:** Sorption; Aptian sands; Redox; Arsenic; Antimony.