XAS assessment of Cr release from Sukinda mining overburden

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The Sukinda Valley of Jajpur district (Orissa, India) comprises of ~98% of India's Cr ore reserve. The open cast mining activities in this region generate annually ~7.6 million tons of solid wastes in the form of rejected minerals, overburden materials, waste rocks and low-grade ore. This activity is extremely polluting since it exposes fresh powdered rocks to outdoor conditions, resulting in the oxidation of Cr by weathering processes. As a consequence, the flux of Cr(VI) species mobilized into the nearby water bodies is estimated at 11.7 tons per year released to the Sukinda valley surroundings. However, the dynamics of Cr remobilization subsequent to the mining activity is not well understood and mitigates our understanding of the Cr pollution dynamics. Thus, the elucidation of Cr speciation evolution in this system is necessary to better understand the dynamics of Cr(VI) released in the mine surroundings.

One fresh tailing was collected in May 2017 immediately after mining processing, and a second one at 40 cm deep in an "old" tailing. Extractible Cr(VI) was quantified after K_2HPO_4 extractions, and shows a significant decrease in Cr(VI) content with depth in the "old tailing" core, that suggests an important remobilization of soluble Cr(VI), or the reduction of Cr(VI) into Cr(III) during aging. Tailing blocks were resin-embedded for µSXRF mapping and µ-XANES measurements were conducted to determine Cr and Mn speciation. Results show mainly the presence of Cr(III), in residual chromite or Fe-oxides. However, at some specific locations, Cr(VI) was present. The fresh tailing shows a higher Cr(VI)/Cr(III) ratio than the aged one. Given the vicinity between Mn containing phases and Cr(VI) hotspots, Cr oxidation process might be strongly linked to Mn presence as already proposed for other systems. The gathered results are greatly complementing the information already collected on these samples (XRD, XRF, and SEM observations) and allow a general better understanding of the mining activities impacts on the toxic Cr(VI) release.