Uranyl nitrate adsorption by Eucalyptus bark: A column experiment

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Organic matter (OM) is increasingly found to have high impact on the fate and behaviour of mobilised uranium (U) [1]. The phase of the OM, whether aqueous or solid, has different effects on U mobility. For example, humic acids cause a decrease in the extent of U adsorption to mineral surfaces [2]. Studies using solid OM are limited, but suggest that U is adsorbs strongly to OM [3, 4]. This sorption behaviour is consistent with U concentrating in organic-rich wetlands and sediments [5]. We conducted column experiments using 100 ppm uranyl nitrate solution to demonstrate the effect of solid OM on U mobility. Tree bark (TB) from *Eucalyptus globulus* was selected as the solid OM for its high abundance of aromatic functional groups. U was eluted through columns of either TB and quartz sand or sand only. Breakthrough curves were obtained via electrical conductivity and total U in collected aqueous fractions. The spatial distribution of U within columns and its oxidation state were determined by synchrotron-X-ray fluorescence microscopy (XFM) and X-ray absorption spectroscopy (XAS).Our results show that U was retarded, but released, in sand only columns compared to the salt tracer. However, U was almost completely retained in the TB-sand columns with only μgL^{-1} levels of U detected. XFM elemental maps reveal that the U retention occurred within the first half of the TB-sand column, whereas U was distributed evenly in the sand-only column. Scanning electron microscope images showed U preferentially absorbing to TB over sand. There was no change in U oxidation state in either column (XAS data), demonstrating that reduction of U(VI) to U(IV) does not readily occur in OM and that a reduced U(IV) is not vital for stability. Thus, we show that eucalyptus tree bark is an effective, low-cost, highly available, medium for adsorbing U, with applications for contaminated land management.

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