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Characterisation of the localisation and speciation of radionuclides at the former nuclear weapons testing site of Maralinga, South Australia.

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In the 1950s-60s the Maralinga Lands were used by the British/Australian governments for the testing and development of nuclear weapons. Four clean-up programs have been undertaken at Maralinga with the last, concluding in 2000, having the objective to release the former nuclear test sites for use by the traditional owners. As part of a wider scientific program examining soil-to-animal radionuclide transfer, the localisation and speciation of radionuclides in the soils were investigated by XFM and XAS. In samples from atomic bomb detonation sites, Sr-90 was mostly localised in 'fused' sand formed during the explosions. Its distribution within the silicate melt particles was extremely heterogeneous, however, XANES imaging demonstrated that its speciation was homogeneous and EXAFS analyses confirmed it to be similar to Sr incorporated into hydrous silicate glasses. At a site where about 8 tonnes of natural/depleted uranium were exploded, uranium was found to be heterogeneously distributed as discrete micron-sized particles. XFM revealed that no other heavy elements were associated with these particles and XANES imaging demonstrated that uranium was solely present in the particles as U(VI) in uranyl geometry. EXAFS analyses confirmed the XANES imaging results, but due to significant scattering from the 2nd coordination shell, the chemical speciation of uranium was not unequivocally identified. Whilst identification of these particles' mineralogy is on-going, these results have demonstrated that the soil-to-animal transfer of these radionuclides through inhalation, the dominant uptake process in mammals, will be minimal.

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