NERC Research Experience Placement Scheme (3)

Project: Fingerprinting environmental releases from nuclear facilities.

Supervisors: Professor Phil Warwick, Professor Andy Cundy (both GAU-Radioanalytical, University of Southampton), Professor Andy Milton (Ocean and Earth Science ICP-MS facility).

Summary:

Identifying the source of nuclear materials in the environment rapidly and with minimal sample processing is a key objective in the field of nuclear forensics. Characterisation of these materials is essential in the responsive management and risk assessment of both authorised and accidental (or deliberate) discharges of radioactive materials to the environment. Rapid techniques for the identification and characterisation of so-called “hot particles” (microscopic pieces of radioactive material that can deliver a concentrated dose of radiation to a small area) in environmental materials is of fundamental importance to this objective. Laser ablation techniques offer significant potential for the analysis of elemental distribution in these particles at the sub-mm scale. However, they are limited to being semi-quantitative due to material-related variability in ablation efficiencies. This project focuses on developing laser ablation mass spectrometry techniques (laser ablation inductively coupled mass spectrometry, and laser enabled time of flight inductively coupled mass spectrometry) for the rapid characterization of particles released from nuclear facilities, and from uranium mining and processing facilities. The project aims to develop effective approaches to correct for variable ablation efficiency across diverse materials, and order to more effectively fingerprint these materials (in terms of their source), and their stability and/or environmental risk. Working closely with staff in the University’s Geochemistry group and the research and commercial consultancy group GAU-Radioanalytical, and with access to a comprehensive archive of materials, the project will explore new methods for the rapid elemental and isotopic analysis of fuel and fuel cladding debris (and other “hot” particles), high temperature glasses and composites, and uranium-rich particulates, and demonstrate their application in a nuclear forensics or risk management context.

This project will link closely to ongoing work with the National Physical Laboratory and with European Union partners in the EU Horizon SURRI project (https://cordis.europa.eu/project/id/101079345), and skills developed will include laser ablation mass spectrometry data collection, processing and analysis skills, and nuclear forensics assessment.