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Editorial

Military and, to a certain extent, the non-military use of Depleted Uranium (DU) has been a subject of considerable concern in the domain of Radiation Protection and Radioecology over the past fifteen years. Enhanced public awareness with regard to the health hazards arising from exposure to ionising radiation, especially in the aftermath of the Chernobyl accident in 1986, has also lead to increased efforts by the scientific community to assess the true effects of DU usage. Depleted uranium has been the topic of several scientific conferences (e.g., *Expert Meeting on "Depleted Uranium in Kosovo: Radiation Protection, Public Health and Environmental Aspects"*, Bad Honnef, Germany, 19–22 June 2001) and extensive environmental studies (most notably the UNEP study *Depleted Uranium in Kosovo. Post-Conflict Environmental Assessment*, 2001), as well as the subject of ad hoc investigations published in the scientific literature. Thus, the decision of the Editors of the *Journal of Environmental Radioactivity* to dedicate a special issue on the effects of and practices for the detection of DU was most welcome.

Depleted uranium is the by-product of the industrial process used to enrich natural uranium ore for use in nuclear reactors and nuclear weapons. It is an extremely dense, hard, autopyrophoric metal, which makes it ideal for application in armour-piercing munitions and enhanced armour protection. Civilian use is limited primarily to the construction of stabilizers for airplanes and boats. It is estimated that at present approximately 600,000 tons of DU have been amassed in the USA alone. About 320 tons of DU was dispersed into the environment during the Gulf War in the early 1990s; about 15 tons of DU was released a few years later in the Balkans.

Contrary to public misconception, the main health hazard from DU arises not from radioactivity, but, as with other heavy metals, from its chemical toxicity, with the kidneys being the main target organs. Depleted uranium is slightly radioactive (about 40% less radioactive than natural uranium) and decays primarily by the emission of alpha and beta particles, which do not penetrate the garments and skin. Thus, the radiation hazard from external exposure to DU is minimal. However, adverse health effects may result from the inhalation or digestion of aerosols or particles, which are produced by the ignition of DU in a missile or armour during impact or penetration of fragments into soil and other surfaces. In general, radionuclides may be inhaled in different forms, including gaseous compounds, aerosols and particles, all of which will have different physical–chemical characteristics and therefore different transfer, absorption or residence times in the lungs. The size of the particles associated with radionuclides is especially important: large particles (diameter 5 to 30 μm) are

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usually deposited in the upper parts of the respiratory tract, whereas small particles (diameter 1 μm) can reach the lower parts of the pulmonary system, where, if deposited in the alveoli, they can lead to a high local dose in the surrounding cells and tissue. Small DU particles of less than 2.5 μm may therefore reside in the lungs for a long period of time, exposing lung tissue to irradiation and ultimately transferring into the circulatory compartment with a biological half-life of approximately one year.

As mentioned above, several studies concerning both the health effects arising from exposure to DU, and the methodology for detecting DU in human excreta and the environment, have been published in the scientific literature during the past ten years. The most comprehensive study is an ongoing follow-up medical evaluation of 33 friendly fire survivors of the Gulf War, conducted since 1993 by the US Department of Defense. The subjects of this study, most of whom have embedded DU fragments, have not developed any abnormalities due to uranium chemical toxicity (e.g., kidney malfunction) or radio-toxicity (e.g., leukaemia, bone or lung cancer), although above-normal urine uranium levels are still measured. However, it is generally accepted that such studies are far from conclusive or representative as far as long-term health effects are concerned. Therefore, both the follow-up observation of Gulf War veterans as well as basic, medical and environmental research must be continued.

The papers included in this special issue refer to several aspects of DU. In a Letter to the Editor, the ICRP opinion and advice on DU is presented. The issue contains a general overview of the use and health effects of depleted uranium and the civil uses of DU. A number of ensuing papers present data on the properties, chemical state and composition of DU detected in environmental samples. The details of a method for detecting DU in environmental samples using gamma-ray spectroscopy are presented and a model of uranium migration from embedded DU fragments is described. Finally, health and biological aspects of population exposure to DU are investigated.

I am indebted to the numerous referees who scrutinised the papers submitted to this special issue through the process of peer review, thus contributing to the high scientific standard finally achieved. I would like to thank the Founding Editor of the *Journal of Environmental Radioactivity*, Professor Murdoch S. Baxter, for his valuable help and direction during the initial stages and the Associate Editor and very good friend, Dr Gabrielle Voigt, who provided advice and support in all phases of this endeavour. Finally, thanks are due to Dr Elisabeth Johnson, whose considerable efforts as a scientific English language editor contributed to the clarity and accuracy of the material published in the following pages.

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