



Origin and age of an ongoing radioactive contamination of soils near La Hague reprocessing plant based on $^{239+240}\text{Pu}/^{238}\text{Pu}$ and $^{241}\text{Am}/^{241}\text{Pu}$ current ratios and ^{90}Sr and Ln(III) soil contents

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HIGHLIGHTS

- Determination of elevated actinides and ^{90}Sr activities near the La Hague nuclear reprocessing plant.
- Isotopic ratios show that the contamination is coming from old burnt fuel.
- The $^{241}\text{Am}/^{241}\text{Pu}$ dating method yields a contamination date close to 1983.
- Elevated levels of cold light Ln(III) confirm the presence of old burnt fuel.
- The La Hague reprocessing plant operator decided to remove the contamination.

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ABSTRACT

Nuclear reprocessing plants are sources of environmental contamination by gaseous or liquid discharges. Numerous radionuclides are of concern, with actinides and ^{90}Sr being the most radiotoxic. Environmental radioactivity survey programs mostly use γ -spectrometry to track contaminations because γ -spectrometry is very cost effective and can be carried out on raw samples. On the other hand, the determination of β - or α -emitting radionuclides in environmental samples requires rather sophisticated analytical methods, and are thus dedicated to specific goals. However, measuring radionuclides such as Pu , Am , and Sr often provides more information about the presence of a current or prior contamination and on its origin, based on the isotopic composition of the samples. We found that the analysis of ^{241}Pu , $^{239+240}\text{Pu}$, ^{241}Am , and ^{90}Sr of a few selected soil samples taken near the nuclear reprocessing plant of La Hague, France, revealed the presence of a previous environmental contamination originating from several incidents in La Hague site involving atmospheric transfer and leaks in flooded waste pits. The $^{241}\text{Am}/^{241}\text{Pu}$ dating method indicated a contamination period prior to 1983. The presence of elevated levels of light non-radioactive lanthanides and yttrium in the soil samples confirmed the involvement of cold fuel. Our results demonstrate how long-lived actinides are likely to reveal a long-term contamination of the environment by spent fuel. Our study indicates that there is a requirement to use more sophisticated tools than γ -spectrometry when surveying the environments surrounding industrial plants for nuclear power and nuclear reprocessing with a potential for the accidental release of radioactivity into the environment.

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1. Introduction

Nuclear reprocessing plants are facilities that treat nuclear-burnt fuel in order to: re-use some of the radionuclides for new fuel rods (Darcousse et al., 2008) (e.g. MOX fuel), separate long-lived radionuclides from short-lived radionuclides, and shape

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Radioactive Contamination Of Soils Pla

Christian Drosten



Radioactive Contamination Of Soils Pla:

The Effects of Radiation and Radioisotopes on the Life Processes Charles M. Pierce, U.S. Atomic Energy Commission, 1963 **The Effects of Radiation and Radioisotopes on the Life Processes: Index**, 1963 The Nature of Radioactive Fallout and Its Effects on Man: May 27-29, June 3, 1957. 1008 p United States. Congress. Joint Committee on Atomic Energy. Special Subcommittee on Radiation, 1957 **The Nature of Radioactive Fallout and Its Effects on Man** United States. Congress. Joint Committee on Atomic Energy, 1957 The Nature of Radioactive Fallout and Its Effects on Man United States. Congress. Joint Committee on Atomic Energy. Special Subcommittee on Radiation, 1957 *Soviet Soil Science*, 1968 Public Health Service Publication, 1967 **Bibliography of Agriculture**, 1976 Scientific Basis for Soil Protection in the European Community H. Barth, P. L'Hermite, 2012-12-06 PH BOURDEAU Directorate General Science Research and Development Commission of the European Communities Brussels Belgium We are living on a unique planet the only one in the solar system where life exists The very existence of life has modified the physical and chemical environment of the earth its atmosphere and oceans in a way that makes life sustainable This system with its complex cybernetic mechanisms has been named GAIA by Lovelock Man has always interfered with it on a more or less limited scale This interference is now reaching global proportions such as climate modifications resulting from CO and trace gas 2 accumulation in the atmosphere or the destruction of stratospheric ozone not to speak of global radioactive contamination GAIA will probably prevail as a living system but it probably does not give much importance to man s survival as such and it is man that has to take care of his own survival In the ecosystem of Planet Earth soils are the thin interface between lithosphere and atmosphere which constitutes the essential substrate for the terrestrial biosphere the productivity of which far exceeds that of the oceans even though the latter cover a much larger area than the continents Soils themselves are complex systems They develop through weathering of minerals are colonised by living organisms which in turn modify their substrate making it suitable for other organisms This induces a primary ecological succession which eventually reaches a climax in equilibrium between climate soil and the biological communities **Combined Subject and Author Indexes to Radiobiology Bibliographies** U.S. Atomic Energy Commission. Division of Technical Information, 1967 *Environmental Protection Research Catalog: Indexes* Smithsonian Science Information Exchange, 1972 *KWIC Index to the Journal of the Health Physics Society*, 1958 **U.S. Environmental Protection Agency Library System Book Catalog** United States. Environmental Protection Agency. Library Systems Branch, 1975 **Hearings and Reports on Atomic Energy** United States. Congress. Joint Committee on Atomic Energy, 1957 **Nuclear Science Abstracts**, 1976 **Climate Change and Soil Microorganisms for Environmental Sustainability** Meenu Saraf, *Annual Report to Congress of the Atomic Energy Commission* U.S. Atomic Energy Commission, 1972 **Toxicology Research Projects Directory**, 1980-04 *Bibliography of Agriculture*, 1973 **Soil Water Measurement** J. David Cooper, 2016-03-21 This book is written for all

those involved in measurement of soil water phenomena whether they be environmental scientists field technicians agronomists meteorologists hydrogeologists foresters physical geographers civil or water engineers or students in these subjects It contains a comprehensive description of all the major methods used for measurement of soil water content and potential solute concentration transport and balance of water and solutes including recharge to groundwater aquifers The emphasis is firmly on techniques which can be applied in the field or on samples obtained from the field The theory and practice of the workings of the main instruments and methods available is described along with practical tips on surmounting some of the main difficulties and explanations of many commonly encountered jargon words

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