

II International Conference on Radioecological Concentration Processes (50 years later)

Seville, 6th-9th November 2016

Editorial

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Abstract

In this editorial a summary of the main contributions and outcomes of the conference celebrated in Seville about Radioecological Concentration processes during six intense sessions is given. It was quite remarkable in addition to the good quality of the communications presented, the active participation of the delegates and the good working atmosphere created during the conference as well as the participation of a good set of young researchers that will construct the future of the radioecology. In addition, it was possible to obtain as a main conclusion of the conference that the radioecology is in good health with a set of emerging new topics under development.

Introduction

From the 6th to the 9th of November 2016, in the meeting hall of Centro Nacional de Aceleradores (University of Seville, Seville, Spain) took place the “II International Conference on Radioecological Concentration Processes (50 years later)” under the joint organization of the Universities of Seville (Spain) and Gothenburg (Sweden). With this event, the organization try to commemorate the fifty years anniversary of the first Radioecological Concentration Processes Conference hold in Stockholm, which is recognized as an extremely important event which contributed to the birth of the modern radioecology: In the pioneer 1966 conference, more than 100 communications were presented and a good number of participants played afterwards an essential role in the development and growing of the radioecology as scientific discipline.

The first conference had as a main motivation the dissemination of the radioecological studies appearing at that time associated to the nuclear weapon tests performed by USA and the former USSR at the end of the 1950s or beginning of the 1960s. Since then, a lot of anthropogenic emissions of radioactivity (provoked or accidental) have occurred, being remarkable at the dates of this II edition the 30 years passed since the Chernobyl accident and the 5 years passed from the Fukushima accident. In addition, the emergence of new analytical techniques has made possible to extend the radioecological studies to new radionuclides and environmental compartments.

With this II edition of the Conference, the promoters have tried to obtain information about the actual status of the radioecology over the world, to evaluate the advances reached during the last years and to plan the development of some priority research lines to be followed along the first half of the XXI century. Just thinking in the future of the radioecology, special efforts were devoted to stimulate the active participation, through presentation of communications, of young researchers.

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The response of the radioecology community to the conference can be qualified as very positive. A total of 152 delegates coming from 35 different countries participated in the conference in a very active way because more than 160 communications were presented, distributed in 6 intense sessions. A total of 6 invited lectures, 40 oral presentations and 120 poster communications formed the scientific program of the conference.



The scientific content of the Conference

Between the invited lectures presented we can start the presentation of the scientific content of the conference by highlighting two of them. The first one was given by professor Elis Holm (Sweden) presenting an evaluation of the radioecological studies performed at the time of the first edition of the conference, 50 years ago, and remarking some pioneer radioecological studies performed at these dates, while the second one was given by Professor Francois Brechignac (France), secretary of the International Union of Radioecology (IUR), which exposed the perspectives and priority lines to be followed by the Radioecology in the XXI century: The past and the future of the radioecology was then exposed, immersed in a huge number of communications that have allowed to obtain a well-defined picture of the actual status of this scientific discipline.

As anecdotic information, we can indicate that in this II edition have participated two delegates that attended and presented communications in the Ist edition: Professors Rudolph Alexakhin (Russia) and Bertil Persson (Sweden). Both delegates, in several speeches distributed along the conference, transmitted to the participants, and based in their experience, their vision about the actual situation of the radioecology and the main problems that have this discipline nowadays.

The communications presented at the conference can be classified in different sections according with their thematic, doing easier their exposition and discussion. In each section the more representative communications (from the point of view of the authors of this document) will be shown, trying to remark emerging research lines existing nowadays.

Obviously in the conference were presented communications that can be put in the frame of historically well-defined lines of research in radioecology: Works analyzing radionuclides transfer soil-plant in ecosystems or contaminant situations not well analyzed until now, works analyzing transfers to the trophic chain and to the wildlife, etc were presented and the main contributions are compiled in Table 1.

Tabla 1	First Author
Analysis and modelling of radioecological concentration processes in the food chain lichen - reindeer – man	Bertil Persson (Sweden)
Comparison of radiocesium root uptake by leguminous and non-leguminous herbaceous plants	Shigeo Uchida (Japan)
Transfer parameters for ICRP'S reference animals and plants in terrestrial mediterranean ecosystems	F.Javier Guillén (Spain)
TJØTTA – ICRP reference site in Norway	H.Torring (Norway)
Assessment of anthropogenic radionuclides in tundra of high arctic environment	A.Cwanek (Poland)
Caesium-137 in norwegian reindeer and sámi herders – 50 years of studies	L. Skuterud (Norway)
Radionuclides accumulation in antarctic birds	K.M. Szufa (Poland)
Organ distribution of ²¹⁰Po and ¹³⁷Cs in lynx (<i>Lynx lynx</i>), wolverine (<i>Gulogulo</i>) and wolves (<i>Canis lupus</i>)	R. Gjesvik (Norway)
Concentration of radionuclides in marine organisms	F.P.Carvalho (Portugal)

In this section can be located also the elevated number of communications presented in association with the Fukushima accident. Within this frame about 30 communications (the majority lead by the 20 Japanese scientists attending to the conference) were presented with contributions in the fields of terrestrial and marine radioecology as well as evaluating the impact of the accident in the wildlife. Some of these works are compiled in Table 2.

Table 2	Main Author
Land use, Controls Fate and Transport of Radionuclides in Fukushima in the terrestrial environment	Y. Onda (Japan)
Radioactive and stable cesium isotopes in Fukushima forests	V. Yoshenko (Japan)
Effective half-lives of radiocesium in different Japanese tree species	K. Tagami (Japan)
Radiostrontium isotopes in Japan after the Fukushima nuclear accident	N. Kavasi (Japan)
The impact of recent releases from the Fukushima nuclear accident on the marine environment	N. Casuberta (Switzerland)
Reconstruction of radiocesium levels in Fukushima coastal organisms: best practice for planning emergency monitoring	Y. Tateda (Japan)
Bioaccumulation of radiocesium in marine fish; pre- and post- Fukushima data records	M. Johanssen (Australia)
Distribution of ²³⁹⁺²⁴⁰Pu concentrations and ²⁴⁰Pu/²³⁹Pu atom ratios in surface seawaters of the North Pacific Ocean	M. Yamada (Japan)
Concentration ratios of radionuclide in marine organisms around Japan	T. Aono (Japan)
Behaviour of radiocesium from arthropods in different trophic levels after the Fukushima power plant accident: chronological changes from 2012 to 2015	S. Tanaka (Japan)
Dosimetry method of animals affected by Fukushima Nuclear Plant accident	G. Hayashi (Japan)

The radioecological studies associated to ecosystems affected by nuclear accidents or contaminated by weapon tests were not only centered in the previously detailed, associated to the Fukushima accident. They were also presented, for example, studies in areas affected by the weapon tests carried out in the Pacific by USA in the years 1950-60 and in zones affected by British nuclear weapon tests in Australia, as well as it was presented the evaluation of the impact generated in their surroundings by a nuclear submarine dumped in the Arctic Ocean. Some of these works are compiled in Table 3.

In this Table are also compiled 3 or the 15 presented radioecological works carried out in Semipalatinsk (Kazakhstan), region where the former Soviet Union carried out an elevated number of atmospheric and underground weapon tests. In the conference a complete description of the radiological works carried out by Institute of Radiation Safety and Ecology, Kurchatov, Kazakhstan (led by Prof. Lukshenko) was disseminated being presented for the first time for example hundreds of results concerning transfer soil to plant in Semipalatinsk and the results obtained in the same area about the distribution of the antropogenic contamination remaining in the soils of the contaminated area as a function of the grain size.

Table 3	Main autor
A Comparison of remediation strategies after the Kyshtym, Chernobyl and Fukushima Daiichi accidents	S. Fesenko (IAEA)
Pacific proving grounds imprint in the Indonesian throughflow sediments	D. Pittauer (germany)
Health and environmental risk assessment of the dumped Russian submarine K-27 in Arctic	A.Hosseini (Norway)
Distribution of artificial radionuclides in particle-size fractions of soil on fallout plumes of nuclear explosions	Kabdyrakova (Kazajistan)
Transfer of radionuclides to plants of natural ecosystems at the Semipalatinsk Test Site	Larionova (Kazajistán)
Parameters of radionuclides transfer into bodies of wild animals inhabiting nuclear weapons testing venues	Panitskiy (Kazajistán)

During the conference, on the other hand, it has been evidenced clearly the existence of a series of emerging working lines in the field of radioecology. These emerging lines are the following:

a) Radioecology and NORM. Once the dosimetric studies designed and performed to evaluate the occupational and public doses associated to the extraction (mining) or the processing (industries) of NORM materials (materials enriched in natural radionuclides) have been established, are growing the studies devoted to the evaluation of the radioactive impact due to the mentioned mining and industrial activities in their surrounding environmental compartments. The existence in these cases of a radioactive contamination source that can be quite well characterized, is allowing to gain much information about the behavior of several natural radionuclides in the environment.

In this emerging research line an elevated number of communications have been presented. Some of the most representative ones are compiled in Table 4. These studies have not been limited exclusively to evaluate the environmental radioactive impact generated by the traditional mining of uranium, being also analyzed the environmental radioactive impact due to some non-uranium NORM industries such as the devoted ones to the production of phosphoric acid or to the extraction and processing of oil and gas . In addition it has been also analyzed the environmental radioactive impact due to the performance of big civil constructions (a traffic tunnel for example) in an area enriched in natural radionuclides.

Table 4	Main Author
Environmental behaviour of radionuclides from uranium mining and milling activities	Oliveira (Portugal)
Uptake of natural radionuclides to edible vegetables from contaminated soil	Smodis (Slovenia)
Dispersion and Transfer of NORM & metals due to construction in U-bearing minerals	Skipperud (Norway)
A review on the natural radionuclides behaviour in an estuary affected by mining activities and fertilizers industries; the case of "Ría de Huelva"	Bolivar (Spain)
Environmental impact of some NORM industries in Mexico	Mandujano (Mexico)
Radioecological and Environmental impact of produced water discharged from a shallow water offshore petroleum field	Kpeglo (Ghana)

b) Radioecology and hot-particles: It is well known by the scientific community working in radioecology the fact that in defined zones of the world affected by nuclear accidents, controlled releases or weapon tests, the existing radioactive contamination is present mostly in particulate form. In many cases, these particles have a refractory behavior being inhibited the transfer of radionuclides to the surrounding environmental compartments.

A proper evaluation of the radioecological behavior of this form of radioactive contamination needs of a detailed knowledge of the composition, morphology and chemical state of these particles, known commonly as "hot particles". These particles can be found in areas affected by the Chernobyl accident, in areas affected by nuclear weapon tests (Semipalatinsk, Nevada, Maralinga, etc), in areas affected by the accidental dispersion of Pu due to aircrafts accidents (Palomares, Thule), in releases from nuclear reprocessing plants (Sellafield, Dounreay, Mayak, etc) and even in some releases of NORM industries.



In this conference have been presented several communications related to radioactive particles, being the most representative ones compiled in Table 5. Between them, we can highlight, a) the invited lecture given by Prof. Brit Salbu (Norway) where the challenges associated to the presence of radioactive particles in the environment were presented and discussed, and b) the communication presented by Dr. Ole-Christian Lind (Norway) about the impact in biota of these particles, in particular when are incorporated by ingestion.

Table 5	Main author
Challenges associated with radioactive particles in the environment	Salbu (Norway)
Particles as concentrated sources related to uptake and radiological dose in mammals	Johansen (Australia)
Retention of particle associated radionuclides in biota	Lind (Norway)
Hot particles studies by ion beam analysis (IBA) techniques and accelerator mass spectrometry (AMS) at CAN	Jimenez-Ramos (Spain)
Characterization of radionuclides in uranium mine tailings with synchrotron based hard X-ray microprobe techniques	Mihok (Canada)

C) Radioecology, new analytical techniques and new radionuclides: The consolidation of two mass spectrometric techniques, the accelerator (AMS) and the high resolution inductively coupled (ICPMS-HR) mass spectrometric techniques have allowed to reach limits of detection so low than new anthropogenic radionuclides with very long half-lives can be evaluated with high precision in several environmental compartment, opening new research lines in radioecology. Communications centered in the determination of radionuclides such as I-129, U-236, Np-237, etc in several environmental compartments have been presented in the conference, and are compiled in Table 6. Radionuclides as I-129 and U-236 are starting to play a relevant role in fields such as Oceanography due to its conservative behavior and because their main sources are known with enough detail.

In this subject, we can highlight the communication presented by Prof. García-León (University of Seville). In this communication it was performed a detail evaluation of the role of the Accelerator Mass Spectrometry Technique (AMS) in Radioecology, showing as examples some relevant works done recently in Radioecology with basis in the use of AMS.

Tabla 6	Main Author
Accelerator mass Spectrometry (AMS) in Radioecology	García-León (Spain)
¹²⁹I concentrations in the south hemisphere: North Atlantic versus Southern Ocean	Lopez-Gutierrez (Spain)
Analysis of Pu isotopes and Np-237 in seawater by AMS	Levy (IAEA)
Iodine-129 in soil from Korea	Kim (South Korea)
First results of Uranium-236 in the South-Atlantic Ocean	Lopez-Lora Spain)
¹³⁵Cs activity and ¹³⁵Cs/¹³⁷Cs atomic ratio in Japanese environmental samples before and after the Fukushima Daiichi Nuclear Power Plant accident	Yang (Japan)
Measurement of ²³⁶U at the Geotraces East Pacific Zonal Transect	Villa (Spain)

On the other hand, in the conference were presented communications related with the use of natural and/or artificial radionuclides in sedimentological studies and in the estimation of erosion rates. ²¹⁰Pb, ¹³⁷Cs and ²³⁹⁺²⁴⁰Pu profiles in lacustrine and marine sediment cores have been used as essential tools to establish sedimentation rates in the analyzed ecosystems and to evaluate for example in them the evolution of contaminants such as metals and pesticides during the last 50-100 years, while determinations of artificial radionuclides with different sources (fallout, Chernobyl, Fukushima) in various terrestrial systems have allowed to show the utility of these radionuclides to

evaluate erosion rates and redistribution of particulate matter. Representative communications in this research line have been compiled in Table 7, together with other communications showing the role of different natural and artificial radionuclides as tracers of atmospheric processes.

Table 7	Main Author
Depth distributions of bomb-derived and Chernobyl-derived radiocesium in sediment sinks and their application in reconstructing changes in erosion rates	Golosov (Russia)
Cesium-137 wash-off associated with soil erosion on various land uses in Fukushima	Wakiyama (Japan)
Factors influencing the distribution of weapon-test plutonium alpha emitters on the whole basin of a lake	Vioque (Spain)
Records of plutonium fallout in tropical coastal marine sediments	Corcho (Switzerland)
Atmospheric Deposition Flux of radioisotopes in Krakow, southern Poland during years 2005-2015.	Nalichowska (Poland)
⁷Be activity concentration during heatwave events in Spain	Hernandez (EU)
Events affecting levels of gross alpha and gross beta activities and heavy metals composition of airborne particulate samples	Liger (Spain)
Winter extremes of beryllium-7 surface concentrations in Northern Europe	Ajtic (Serbia)

We will finish indicating that a big fraction of the experimental work carried out in Radioecology are focused to obtain parameters, transfer coefficients and concentration factors to be implemented in models which are developed to study the dispersion, behavior and routes followed by the radionuclides in different environmental compartments. For that reason, a conference in Radioecology cannot be considered complete if there are not included communications devoted to show the advances in modeling and the results obtained through their application. Some communications compiled under the epigraph of Modeling are indicate in Table 8, being particularly interesting to highlight the work presented by Dr. Periañez summarising the results obtained in the implementation of various radioecological models developed by the scientific community for studying the dispersion of contaminants in the marine environment. The results obtained through the application of these models to the study of the dispersión of ¹³⁷Cs in the Pacific due to the Fukushima accident has shown the necessity to increase the efforts in an improvement and validation of the models, and to enhance the coordination between the modelers and experimentalists.

Table 8	Main Author
Overview of marine modelling activities in IAEA Modaria Program: Lessons learn from the Baltic Sea and Fukushima Scenarios	Periañez (Spain)
Implementation of a food chain sub-module into a model for radioecological assessments in the coastal waters around Iceland: effects on kinetic modelling of bioaccumulation processes.	Iojspe (Norway)
Considerations of application of ecological thermodynamics to radionuclide transfer parameters	Ikonen (Finland)
Modelling of Cs-137 input into the sediment and its vertical distribution within the sediment of a shallow eutrophic lake.	Putyrskaya (Germany)

Dissemination of the communications presented in the Conference

Once the conference has finished, the promoters have had in front of them one final task: the dissemination of the main results and works presented in the conference.

The book of proceedings that the reader has now in his hands is the first product generated. This book is edited by the University of Seville, Department of Physics, in paper and electronic versions, being formed for around 100 extended abstracts (maximum 8 pages including tables and figures)

In addition, a special issue devoted to the conference will be published in the international journal more representative in radioecology: *Journal of Environmental Radioactivity* (Elsevier). This special issue will be formed by near 20 papers corresponding to different communications presented in the conference. With this special issue, we pretend to transmit to the scientific community and to future generations a picture about the status of the Radioecology 50 years after the celebration of the pioneer first edition of the Radioecological Concentration Processes Conference.

Acknowledgements: The authors of this communication acknowledge deeply the work of I.Vioque, I.Diaz y J. Galván (University of Seville) and, J.Mantero, M.Isaksson and T. Rimón (University of Gothenburg) in the organization of the Conference.

