RADIOCARBON IN THE ENVIRONMENT – AN INTRODUCTION

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Radiocarbon analysis has been largely seen as a chronological tool since its inception in the mid-20th century. However, its use in environmental analysis has diversified with the development of novel techniques in radiocarbon analysis. After discussions at the 21st Radiocarbon Conference in Paris, we decided to provide a setting for the presentation of research utilizing radiocarbon and stable isotopes at the Inaugural Radiocarbon in the Environment conference. Another motivation behind the conference themes was to bring ecologists and paleoecologists together to highlight the high-quality isotope research available.

The conference was held in Queen's University Belfast in August 2014 with the help of co-organizers Dr Philippa Ascough (Glasgow University) and Dr Jesper Olsen (Aarhus University) (Figure 1) and a number of session convenors. The plenary speaker at the conference was Professor Ingeborg Levin, who summarized 50 years of atmospheric and oceanic bomb-radiocarbon analyses, concentrating on the use of radiocarbon to describe dynamic processes in the earth system.



Figure 1 Radiocarbon in the Environment Conference organizers, from left to right: Evelyn Keaveney, Jesper Olsen, Philippa Ascough, and Paula Reimer.

Natural abundance and enriched radiocarbon have been successfully used in many fields and some of the research presented at the conference is included in this special issue under the umbrellas of atmospheric, terrestrial, marine and freshwater radiocarbon analyses.

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Tracing anthropogenic inputs to the atmosphere and ocean allows analysis of the global carbon cycle and monitoring of pollution sources. Turnbull et al. demonstrated the ways in which the precision of $^{14}CO_2$ measurement can be increased to target coordination between labs assessing atmospheric radiocarbon. Radiocarbon can also be used to track the impact of fossil fuels on the natural environment. Baydoun et al. investigated the influence of pollution on the natural environment by measuring ^{14}C from plants and tree leaves in Lebanon as did Beramendi-Orosco et al. in Mexico. Lujanienė et al. used a multiproxy approach to investigate hydrocarbon contamination and possible leakage of chemical warfare agents in the Baltic Sea.

Radiocarbon has been used successfully in the monitoring of nuclear and industrial facilities, as demonstrated by two papers in this issue by Muir et al. investigating the temporal trend in transfer of Sellafield-derived ^{14}C to the carbonate component of NE Irish Sea sediment, and ^{14}C enrichment in the Eastern U.K. coastal environment. Povinec et al. presented 25 yr of monitoring the atmosphere near the Bohunice nuclear power plant. In a more unusual application of ^{14}C and stable isotope analysis, Cook et al. presented a case study determining the age of human remains to assist the Greater Manchester Police, as well as using $\delta^{13}C$ and $\delta^{15}N$ stable isotopes to elicit the contribution of marine resources to the diet.

Marine reservoir offsets have been measured in many places around the world. Facorellis and Vardala-Theodorou investigated changes in the Aegean Sea reservoir offset in the past using paired marine and terrestrial samples. Carvalho et al. demonstrated the potential of archaeological snail samples for determining local marine reservoir offsets in Brazil. Radiocarbon can, however, also be a valuable tool in ecology, augmenting stable isotope studies of food webs. Hadden presented a local reservoir offset from marine gastropod shells in the Florida Panhandle, USA, but demonstrated that variability was due to biological factors such as the mobility and feeding preferences in addition to localized inputs of ^{14}C-depleted freshwater. Holmquist et al. examined interspecies, latitudinal, and interannual variability in reservoir effects in Southern California estuaries.

Keaveney et al. used ^{14}C to demonstrate seasonal use of terrestrial carbon by invertebrates in a humic and alkaline lake in Northern Ireland. Terrestrial carbon supported the highest trophic levels of the food web, information that was not made clear with the use of stable isotopes alone. A second paper by Keaveney et al. also demonstrated the utility of the radiocarbon method in tracing terrestrial carbon through carbon pools in the water, and used stepped combustion to show the fractions of detrital/labile carbon buried in sediment. Also in the terrestrial realm, Carmi et al. presented work on the isotopic composition of dissolved inorganic carbon (DIC) in a semi-arid, unsaturated zone and Ishikawa et al. looked into the sources of DIC in streams with different bedrock geology.

The utility of the radiocarbon method in fields beyond chronology and its application in global atmospheric, terrestrial, marine or freshwater carbon cycles is increasing. We were pleased to provide the forum for such research and hope with the continuation of the conference series that the value of radiocarbon analyses in the living environment will be recognized and its use in climate and ecological studies will proliferate.

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