Recent AMS ^{14}C Applications in Environmental and Climate Research

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After a short discussion on recent technical developments in accelerator mass spectrometry (AMS) radiocarbon (or ^{14}C) analysis at ANSTO, this paper focuses on the applications of radiocarbon in environmental and climate studies through the illustration of several applications in the field, which have been carried out at ANSTO.

With the recent installation of two new machines from NEC, the Centre for Accelerator Science at ANSTO now has four tandem accelerators (10 MV ANTARES, 2 MV STAR, 1 MV VEGA and 6 MV SIRIUS), which are capable of measuring a range of long-lived radioisotopes including ^{14}C, ^{10}Be, ^{26}Al, ^{129}I, ^{36}Cl, ^{236}U and ^{239}Pu by AMS for various applications in earth, environmental and climate research. Three of the four accelerators are currently used for ^{14}C analysis. In addition, there have been improvements in AMS ^{14}C target preparation, especially for microgram-sized samples. Samples containing as little as 10-20 μg of carbon can now be reliably prepared and analysed at ANSTO [1-2]. This has opened up opportunities for radiocarbon analysis of new materials such as single grains of specific skeletal components of carbonate sediments (eg, single foraminifera) and gas species (CO, CH_4) trapped in ice cores.

Radiocarbon is one of the most common and important cosmogenic radionuclides for building reliable chronologies for various materials and archives for the study of environmental and climatic changes for the Holocene and late Pleistocene. Radiocarbon is also employed as a powerful tracer of the carbon cycle, climatic systems and environmental processes. In this paper, several case studies will be discussed to show the breath of radiocarbon applications in these scientific areas. They include dating of recent Antarctic mosses for the study of biological effects of climate change [3], study of soil carbon dynamics using radiocarbon in deep soil carbon [4], investigation of CH_4 sources during the Last Glacial Termination through $^{14}CH_4$ measurements in ancient polar ice [5], and investigation of spatial and temporal variations in surface ocean ^{14}C using paired measurements of U/Th and ^{14}C on corals for better understanding of past climate variability and ocean circulation changes [6].

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