

# Carbon-14 ( $^{14}\text{C}$ ) Analysis of DIC in Groundwater Using Accelerator Mass Spectrometry (AMS)



The main advantage of  $^{14}\text{C}$  dating of groundwater using AMS over other methods of  $^{14}\text{C}$  dating is that there are no special sampling procedures and only 1-5L of water needs to be sent to the laboratory for analysis. An added advantage is that the precision of analysis is considerably better than that using direct absorption and there is a lower level of detection. The disadvantage is that it is more expensive than the Direct Absorption (DA) method of  $^{14}\text{C}$  analysis.

## Sampling and Submitting Samples

The amount of water required is dependent on the dissolved inorganic carbon (DIC) concentration of the water. We suggest sending 5 L because often the DIC concentration is unknown and it is better to have too much sample than not enough. If the DIC concentration is known to be high, less sample can be submitted. There are no special requirements for collection of the water samples other than ensuring that the bore is pumped for a sufficient time prior to sampling and that the jerry cans are filled with water and well sealed. The water does not need to be filtered in the field before filling the containers. Occasionally, difficulties may occur if the pH of the water is  $<6$  because, for these waters, much of the inorganic carbon is in the form of dissolved  $\text{CO}_2$  and this may be lost during transport to the laboratory. Please discuss with laboratory staff if this is likely to be the case with groundwater samples being submitted.

## Analysis Methodology

For samples sent to the CLW laboratory for AMS  $^{14}\text{C}$  analysis, the first stage is conversion of the DIC to  $\text{CO}_2$ . This is undertaken at the CLW laboratory. The  $\text{CO}_2$  samples are then sent to a laboratory with a suitable accelerator mass spectrometer where the analysis is completed. Currently, we use the AMS capability at ANU, Canberra, Australia.

$^{13}\text{C}/^{12}\text{C}$  analyses are provided for each sample submitted for  $^{14}\text{C}$  laboratory at no additional charge.

## Precision and Level of Detection

The Single-Stage AMS at The ANU provides an average precision of  $\sim 4\%$  (around 40 years at 10,000 years) and currently has a limit of detection of  $\sim 45,000$  years. Using the 14UD AMS at The ANU the limit of detection is the  $\sim 60,000$  years with  $\sim 5\%$  precision.

---

### CSIRO Land and water

Contact	Fred Leaney, Principal Research Scientist
Phone	+61 8 8303 8728
Fax	+61 8 8303 8750
Email	Fred.Leaney@csiro.au