



RESEARCH INTO AUSTRALIAN RAINFALL RECORDS BASED ON CAVE DEPOSITS

- Nicholas White

On 23 January 2008 Drs Henk Heijnis and Ed Hodge of the Australian Nuclear Science and Technology Organisation (ANSTO) hosted a seminar to examine progress on understanding the variability in Australia's rainfall and the part that speleothem studies can play in understanding this variation of past climates to better understand the present and perhaps predict future patterns and extremes.

This was a very timely meeting with about 70 attendees from Universities, consulting firms, water authorities and both ACKMA and ASF. The attendance of cave managers and cavers was in response to the opportunity to hear of the latest studies and also because of a concern that there was an insatiable demand for more and more speleothems for analysis *for climate data*.

Henk Heijnis (ANSTO) and Russell Drysdale (Newcastle U.) started discussions with the background of the various patterns influencing weather and climate in Australia. Of real interest were the El Nino-La Nina variability and other patterns which involve longer cycles; 'the Pacific Decadal Oscillation' and much longer cycles such as climate change and human induced climate change.

Various samples can be analysed to calibrate the cycles and as well as tree rings, ice cores and deep sea coring, coral growth and speleothem growth can be used to calibrate when and how much rainfall occurred at various times. These rely on such samples having sufficient radioactive material so that the decay can be measured.

For instance the uranium-thorium series has been the most common for speleothem dating, however some shorter lived isotopes can be used for shorter periods. Thus C^{14} and Th^{230} are useful for century studies. Other isotopes are good for decade changes (Cs^{137} , C^{14} and Th^{230}). Ra^{226} and Pb^{210} are useful for years. O^{18} is good for studies of weeks or seasons.

Drysdale particularly put in context the importance of speleothems to understanding past climates and put into context the advances in methodology which had allowed much better results from much smaller samples. These need expensive equipment such as laser ablation mass spectrometry but there are a series of other instruments applicable in various situations.

Janece McDonald (Newcastle Uni) emphasised the importance of cave monitoring and sampling of drip waters which can lead to a much more informed

actual speleothem sampling program. The studies illustrated differences in which cations are enriched during wet and which during dry periods at Wombeyan.

Pauline Treble (ANU) illustrated how some of the methodological changes had allowed smaller samples to be used and stressed that seasonal changes can be measured with these newer methods. For some purposes such as tropical cyclone histories, high speleothem growth rates are needed as well as adequate natural uranium content.

It is now possible to use straw stalactites for such studies, these were never used previously as they did not fulfil one of the standard requirements of such work that the part of the speleothem being measured needs to represent the original deposited material. Conventionally this required calcite deposition which was sealed by later deposits.

A very interesting sample was a speleothem which had grown on timber which was installed during the original Moondyne Cave development; a sample with a known history. So for Managers' quite apart from a speleothem which has grown on your fence, path, and installation and is used by guides to illustrate growth rates, it may be immensely valuable to scientists in calibrating and elucidating past climate history.

Ed Hodge (ANSTO) gave examples of the possibility of using the accelerator mass spectrometer for C^{14} to match rainfall records with speleothem records. Some of this relies on the isotopes released during atmospheric nuclear testing which started in 1954 and peaked in 1975.

Danielle Verdon (SKM and Newcastle Uni) illustrated the importance of better informed research studies for planning new infrastructure. In particular she referred to the IPO which is the 'interdecadal pacific oscillation' which is now the subject of a lot of research investigation.

Pauline Treble (ANU) illustrated some her work from Margaret River where she used O-18 with the Moondyne sample to construct a rainfall record from 1911 to 1992. She was able to construct a 700 year record for a speleothem from Golgotha Cave. She emphasised that the WA samples were from dune calcrenites and did not have some of the same constraints as for example samples from Wombeyan.

This longer time range allowed her to illustrate the wet and dry periods in Australia and how long each one is. These were referred to as the IPO of which the 20th century started as dry which continued to the 1940's when it became wet and it reverted to a dryer period in the 1970's and is still dry. Thus we had one and a half cycles in 100 years or a change from wet to dry and vice versa every 30-40 years. Refined studies of this periodicity will help future planning in all sorts of ways.



Pauline Treble with her 'drip catchers' at Naracoorte. Photos: Steve Bourne



The seminar finished with a group discussion. People were agreed that cooperation and sharing resources would prove valuable. There was discussion about the need for a review article on current Australian work. Susan White and Janece McDonald agreed to set up a database about existing samples. There is already information in an AQUA dataset. Some managers expressed concern about ensuring responsible sampling. Ian Household (Tas), Steven Bourne and Liz Reed (Naracoorte) had sampling questionnaires to aid in the initial requests for samples.

The seminar was very successful in bringing researchers, managers, cavers and water managers together to understand the contribution which cave deposits can play in furthering knowledge of climate history.