In the past 200 years, the appearance of the populated part of the continent has changed significantly due to land clearance and grazing, resulting in erosion and the transport of a large amount of sediment. Optical dating of fluvial sediments is enabling the impact of these changes on the fluvial system to be assessed.

Reading the sands of time

A new technique for dating young sedimentary deposits, developed by scientists at CSIRO Land and Water, has begun to chronicle the affects on Australian landscapes of European settlement.

The technique uses tiny quartz grains from river (fluvial) sediments as indicators of how long ago they were deposited. Once their age has been established, the chemistry of the sediments offers a record of land-use practices at the time. For example, increased levels of phosphorus in the sediments might reflect a period of increased fertiliser use.

Stratigraphy is the name given to the study of sediments and CSIRO geomorphologists Dr Jon Olley and Gary Caitcheon are specialists in this field.

'Tiny grains of quartz from the sediments act as a clock, which begins to "tick" as soon as the grains are sealed away from daylight,' Olley says. 'Radiation naturally present in the surrounding soil causes electrons to become trapped at imperfections in the crystal. This has the effect of winding up the quartz clock.

'Before we can read the time on the clock, we need to determine at what speed it was ticking. This is achieved by measuring the "energy field" or the strength of radiation contained in material surrounding the quartz grains. Gamma and alpha spectrometry are used to take these measurements.'

A technique called optically-stimulated luminescence (OSL) is used to read the clock itself. First, a sample is taken from the site of interest. This involves hammering a hollow rod horizontally into sediment and digging it out so that sand grains are not exposed to light. The sample is then taken to a 'red light' room to separate out and clean the quartz grains.

There the grains are exposed to a strong light which kicks the electrons out of their traps, allowing them to be trapped elsewhere in the crystal. As they are re-trapped they emit a violet or ultraviolet glow that can be detected. The more light emitted by the sand grains, the longer the time elapsed since they were sealed away from sunlight. This information, combined with a measure of the natural radiation surrounding the quartz, indicates how long ago the sediments were deposited.

The advantage of OSL dating is that it can be used to date sediment deposits containing relatively small quantities of quartz sand, which means it is applicable in virtually all Australian fluvial sedimentary environments. This enables recent environmental change to be examined, such as the impact of European urban and rural land use. No other single method can determine the age of sediment deposited during the past 500 years.

CSIRO has dated sediment deposited at the junction of the Barwon and Namoi rivers in western New South Wales to show that on the Barwon River, sediment associated phosphorus concentrations have not changed in the last 50-200 years. On the Namoi River there is a slight increase in phosphorus concentrations in about the last 30 years, but more measurements are needed to determine its significance.

The dating technique is not confined only to the sediments. Earlier this year, Olley dated ancient rock paintings with Dr Richard (Bert) Roberts of La Trobe University, Dr Andrew Murray and Dr Ian Naumann of CSIRO, rock art authority Mr Grahame Walsh and scientists from the Australian National University, University of New England and Australian Nuclear Science and Technology Organisation. The team dated a painting of a human figure and hand stencil at a Kimberley rock shelter in north-western Australia, showing it was created during or before the last Ice Age, more than 17 000 years ago.

Mud wasps are common worldwide and their nests may last thousands of years. Quartz grains from mud wasp nests were used to bracket the age of the paintings. Rock art lying beneath a wasp's nest is older than the nest. Where paint is superimposed on the nest's remains, the painting is younger.

The OSL technique can date sand grains buried more than 300 000 years ago, and archaeologists hope it will help fill in many blanks in the record during the period in which modern humans were emerging, ultimately shedding light on when Australia was first inhabited. Scientist also hope that because the technique can also be applied to young sediments that it will better enable us to understand the impact European settlement had on this island continent.

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