

## AMS Dates and Phytolith Data from Mud Wasp and Bird Nests at Carpenter's Gap 1, Northern Australia

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Roberts et al. (1997) recently reported the results of a pilot study analysing mud wasp nests collected from archaeological rockshelters in the Kimberley region. Using optically stimulated luminescence (OSL) dating of quartz grains and AMS radiocarbon dating of pollen they produced ages for a small number of nests, between 100 BP to 23,800 BP (Roberts et al. 1997:697). These age estimates are argued to date the approximate time of each nests' construction and provide minimal estimates for Aboriginal rock art located beneath some of the nests. In addition to the dating, some of the nests were examined for their pollen and phytolith content, including one argued to be 17,500 years old. While the study was limited in extent, Roberts et al. (1997) concluded such nests can serve as useful sources of palaeoecological and chronological data for the reconstruction of late Quaternary environments around the world, as well as developing absolute chronologies for rock art. A major collaborative research project led by Dr Richard (Bert) Roberts addressing these issues in northern Australia is currently underway, having received financial support through the Australian Research Council (Bert Roberts pers. comm.).

This paper reports a small suite of AMS radiocarbon dates and phytolith data derived from mud nests collected at the Carpenter's Gap 1 rockshelter in the

southwest Kimberley (Fig. 1), a site which has a 40,000 year old human occupation sequence (O'Connor 1995). These results were obtained during the course of more general research focused on the investigation of late Quaternary environmental change and archaeology in the semi-arid tropics of northern Australia (see Wallis 2000, 2001). Examination of mud nests from Carpenter's Gap 1 was undertaken in order to supplement the palaeoecological database of the site and help develop a better understanding of issues of phytolith movement, taphonomy and site deposit formation processes in relation to the accumulation of phytoliths in archaeological rockshelter deposits; however, logistical constraints and the novelty of the approach meant this research was designed to be exploratory in nature, rather than exhaustive.

### Description of samples, collection and laboratory procedures

A total of six mud nests adhering to the walls and roof of the Carpenter's Gap 1 rockshelter were collected for analysis. Nests numbered 1–5 were mud wasp nests (probably of the wasp *Sceliphron* sp.; Ian Naumann pers. comm.), whilst the final nest (No. 6) was constructed by an unknown species of swallow-like small bird. The latter was included in the study to test the proposition of

Roberts et al. (1997:699) that non-wasp sediment accumulations, such as those created by birds or termites, might also serve as palaeoecological information traps.

There were no apparent macroscopic morphological differences observed between the mud wasp nests, with all five nests being a uniform deep red-orange in colour and somewhat coarse grained (Fig. 2). The bird nest was less homogenous in colour, with some grey pigmentation apparent; however, it too had retained a general orange colouration (Fig. 3). A distinctive feature of the bird nest was the appearance of larger, relative to the wasp nests, 'clumps' of mud used in its construction. This characteristic might have implications for later interpretations of this sample and is discussed where relevant below.

Since it was not known at the time of collection whether sufficient pollen would be preserved to allow AMS radiocarbon dating, the nests were collected in a manner so as to permit OSL dating if required, i.e. at night using a red-filtered light source (following discussions with Bert Roberts and Nigel Spooner). Each nest was carefully prised from the rock surface using an

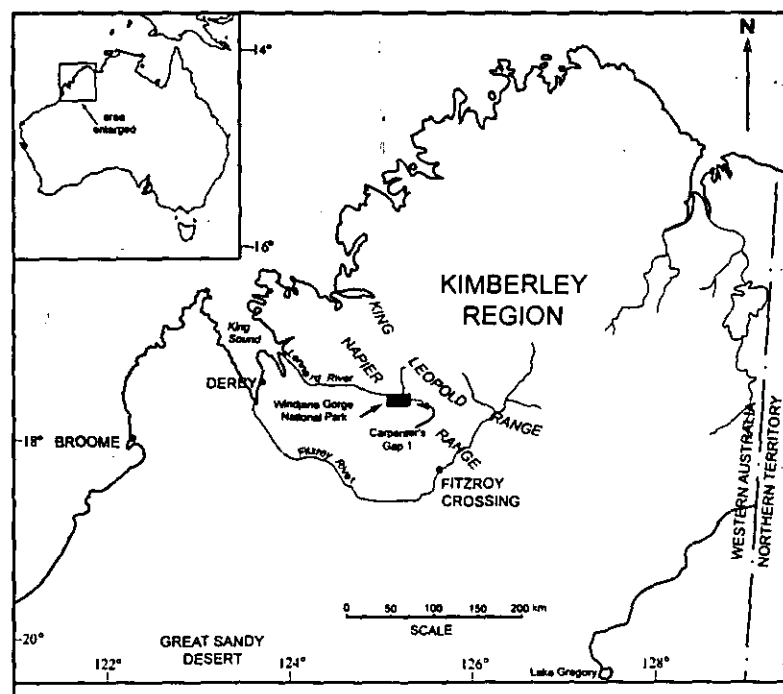


Figure 1 Map showing the location of the Carpenter's Gap 1 rockshelter, southwest Kimberley.

excavation trowel, wrapped in a double layer of bubble and thick black plastic, and labelled prior to transportation back to Canberra for analysis. Although the initial study by Roberts et al. (1997) aimed to use dated nests to provide minimum/maximum ages for rock art, this was not a consideration in the current study and subsequently none of the nests were collected from situations under- or overlying rock art.



Figure 2 Photograph showing the inner and outer surfaces of a mud wasp nest (Sample No. 1).

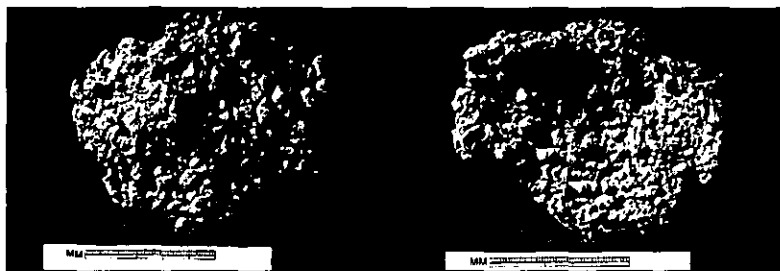


Figure 3 Photograph showing the inner and outer surfaces of a portion of the bird nest (Sample No. 6). Note the much larger clumps of mud used in the construction of this nest as compared with those in Figure 2.

In the laboratory each nest was broken into smaller pieces and two sub-samples (each containing a cross-section of the nest) were weighed into separate containers. The first of these sub-samples was used to recover pollen, using the standard protocol employed in the Pollen Laboratory, Department of Archaeology and Natural History, Research School of Pacific and Asian Studies, Australian National University. The pollen was then dated using the AMS radiocarbon technique to produce an estimate of the age of construction for each nest. The second sub-sample was processed to recover phytoliths. Following an initial coarse crushing using a mortar and pestle, each sample was subjected to an extended immersion period (6 hrs) in an ultrasonic bath to aid disaggregation. After this initial processing, phytolith extraction techniques followed a standard protocol for extraction from sediments [adapted from Bowdery (1998:Appendix 14.1)]. Phytolith residues were mounted in Eukitt for light microscopy viewing and 1000 phytoliths were counted for each sample so as to determine the

percentage of each type as a contribution to the overall assemblage. Other microfossils encountered during phytolith counting (sponge spicules, carbonised particles, starch grains and diatoms) were simply recorded as a number of fragments observed whilst counting. No attempts were made to pursue further identification or analysis of any of these particles.

## Results

The pollen recovered from the nests was abundant and in excellent condition and was well suited to the task of obtaining radiocarbon dates condition (Ewan Lawson pers. comm.). Hence, AMS dates were obtained on pollen from four of the five mud wasp nests collected, as well as the single bird nest. As outlined in Table 1, all dated nests were apparently formed within the last 1000 years. The other wasp nest (Sample No. 1) was not dated owing to financial constraints, but for reasons outlined in the discussion below it is thought also to be late Holocene in age.

Table 2 shows the percentage by dry weight of phytoliths recovered from each nest. As is evident, phytolith fraction weights are very low, generally comprising less than 0.5% by weight of the original nest sampled, with the exception of the bird nest sample (Sample No. 6). These results are the same general order of magnitude as phytolith percentages in modern sediments associated with savannah grassland, swamp, sand-dune and pindan contexts in the wider study region

(Wallis 2000:231).

Figure 4 displays the phytolith and other microfossil assemblage data for each examined nest. Unfortunately, owing to the absence of a suitable reference collection for the Kimberley region, the pollen grains have not been analysed. As shown, the greater proportion of phytoliths in each sample are dominated by grasses and elongate types, the latter of which probably derive from a wide range of plant species including grasses. The majority of phytolith types are represented by only very rare occurrences, often only in one or two of the nests, for example echinate and verrucate spheres (the former coming from palms and the latter from a vine thicket tree, probably *Celtis philippensis*). In general, there is a relatively low level of specific identifications possible.

Lab number	Sample number	Material dated	Measured delta <sup>13</sup> C per mil	Conventional <sup>14</sup> C age (uncalibrated) years BP
OZD 933	2	pollen	-23.02	150±45
OZD 934	3	pollen	-20.67	520±50
OZD 935	4	pollen	-25.18	740±45
OZD 936	5	pollen	-24.86	340±50
OZD 937	6	pollen	-15.64	570±50

Table 1 AMS radiocarbon ages for pollen recovered from nests, Carpenter's Gap 1.

In all samples, with the exception of the bird nest, the grass spectra are dominated by spheroids, a type derived from spinifex. Spinifex is the dominant local vegetation type, occurring in abundance on the talus slope in front of the rockshelter.

Diatoms occur in very low quantities in five of the six samples, whilst no sponge spicules were observed in any nest.

Sample number	Original sample weight (g)	Phytolith fraction weight (g)	Percentage phytoliths
1	7.202	0.029	0.40
2	6.365	0.031	0.49
3	7.181	0.028	0.39
4	5.804	0.019	0.33
5	5.778	0.021	0.36
6	7.569	0.123	1.63

**Table 2** Information relating to percentage by weight of phytolith component in mud nest samples, Carpenter's Gap 1.

## Discussion

Unfortunately, owing to the restricted temporal and spatial nature of the samples the phytolith data are relatively limited in what they actually reveal about palaeovegetation. The phytolith spectra observed in the nests predominantly provide information relating to the grassland vegetation in the immediate site vicinity, and ultimately reflect the presence of plants similar to those growing around the site today. It is expected that, when it becomes available, the pollen in the nests will provide a complementary suite of data relating primarily to local flowering trees and/or shrubs, although it is acknowledged that this data-set will be somewhat restricted in scope owing to the nature of formation of the nests and potential opportunities for incorporation of pollen (Mike Macphail pers. comm.).

Possibly the data from the mud nest study is more useful for what it adds to our understanding of phytolith taphonomy and preservation issues, rather than for the reconstruction it allows of late Holocene vegetation. Presumably the materials in such nests can be separated into those introduced by one of three primary mechanisms:

- 1) those imported by the animal vectors as part of the nest construction process (i.e. in the sediments collected by the bird or mud wasp with which they construct the nest);
- 2) those imported by animal vectors secondary to nest construction (e.g. stockpiled for food or in faecal pellets deposits in the nest itself); or
- 3) those introduced through incidental wind transportation.

Pollen in the wasp nests is probably introduced as a direct result of the wasps visiting flowering plants to gather nectar as a food resource (Riek 1970:881, 937; Roberts et al. 1997), but may also be equally likely introduced incidentally by wind. Phytoliths derived from recently decayed vegetation amongst sediments used for nest construction may be introduced via the

animal vector or by wind. It should also be noted that where sediments are used for nest construction, it is possible that reworked phytoliths and/or pollen from earlier time periods may also be incorporated into the nest, although in reality the likelihood of this affecting results is minimal.

Ian Naumann (pers. comm.) advises that mud wasps typically construct their nests using materials collected from within a 50m (or much less) radius, owing to their small size and consequentially limited supply of energy. Presumably the collection range for mud nest building birds is much greater, in proportion to their larger size and longer flight capabilities. The dominance of spheroids in the five mud wasp nests reflects the immediate dominant vegetation type, this being spinifex

on the talus slopes of the range in front of the shelter. That spheroids are almost entirely absent from the bird nest sample is probably a reflection of differences in the construction strategies of birds and wasps, supporting the premise that the source material for the bird nest is derived from further afield.

Consideration of the nest construction habits of birds versus wasps raises issues relating to the suitability of nests for dating and vegetation reconstruction and interpretations thereof. In the specific case of bird nest construction, the use of large 'clumps' of mud (see Fig. 3) may affect attempts to use OSL dating techniques if not all quartz grains are adequately exposed to sunlight during the nest construction period. Since such techniques were not employed in this study this problem is not of direct relevance, but it is worth noting for future studies of such materials.

The earlier study of mud wasp nests (Roberts et al. 1997) revealed the presence of isolated sponge spicules and an absence of diatoms. In contrast, in the present study a few diatom fragments were encountered, although no sponge spicules were seen. The sponge spicules are obviously not in a primary depositional context and therefore must have been introduced into the nest from elsewhere during construction, via either wind or animal transportation. Similarly, although some diatom species can survive in relatively dry, even dark, cave locations, it is highly unlikely that they have formed *in situ*. Subsequently, they are also probably present as a result of introduction in sediments or water from elsewhere during nest construction. In any case, that both such microfossils can occur in mud nests has been demonstrated and is of importance when considering phytolith assemblage formation processes in associated rockshelter deposits, such as at Carpenter's Gap 1. *In situ* deterioration of mud nests may result in these sorts of microfossils being introduced to the site deposits, although the evidence suggests this



immediate area today. It is highly probable that older nests in this shelter have undergone physical deterioration since their formation, thereby contributing material to the site deposits. However, if the quantity and composition of contemporary nests on the shelter walls can be used as a guide, it is unlikely that such breakdown of nests will have contributed significant quantities of materials to the deposit. While the results of this study support the statement by Roberts et al. (1997) that mud wasp nests may provide useful chronological and palaeoenvironmental 'snap-shots', they also indicate extensive sampling (in both a spatial and chronological sense) will be required in order to use the data in this manner. However, their amenability to AMS radiocarbon dating suggests they will no doubt become a particularly useful means by which to date overlying or underlying rock art with limited technical involvement on behalf of the investigator.

#### Acknowledgments

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