Pilbara petroglyphs dated

By ROBERT G. BEDNARIK

Recently I have reported the discovery of Historical petroglyphs in the eastern Pilbara, Western Australia (Bednarik 2000). This find (which has since led to the discovery of an even earlier 18th century inscription in Western Australia) occurred in the course of a systematic search for Historical inscriptions to facilitate the establishment of a calibration curve for microerosion dating of Pilbara Aboriginal petroglyphs. This search began in 1988, when in the company of the late Howard McNickle I found the first dated inscriptions at one of the many Spear Hill sites.

I have been engaged in trying to establish the age of Pilbara rock art since the 1960s, when I discovered the huge petroglyph concentration on Burrup Peninsula as well as many inland petroglyph sites (Bednarik 1973; for a history of rock art research in the Pilbara, see Bednarik 2002). Having anticipated for many years that such scientific dating would succeed via micro-geomorphic methods (Bednarik 1979), and having developed the microerosion method in 1989 (Bednarik 1992), I had decided that the most promising approach would be to secure a series of microerosion calibration readings from Historical inscriptions with dates. Australia unfortunately lacks the multitude of rock surfaces of historically known ages particularly common in Eurasia (monu-ments, bridges, gravestones, quarries, glacial abrasions etc.). The calibration curve for crystalline quartz in the Pilbara, the first in Australia, has now been completed. It incorporates engraved dates ranging from 1881 to 1997 (the purported 1771 date was unsuitable for analysis as it occurs on dolerite).

In contrast to all other currently used methods of estimating the age of rock art, microerosion analysis addresses the 'target event' of Dunnell and Readhead (1988); it seeks to estimate the actual age of petroglyphs rather than that of a phenomenon associated with them physically. The microerosion method by micro-wane measurement has been used on petroglyphs in six blind tests now, in Russia, Italy and Bolivia (Bednarik 1992, 1995, 1997). Archaeological expectations were matched in all cases except one, where, however, results matched those of other scientific analyses (Bednarik 1995; Watchman 1995, 1996). Calibration curves are now available from Lake Onega (Russia), Vila Real (Portugal), Grosio (Italy), Qinghai (China; Tang 2000) and eastern Pilbara (Australia), and the technique has also been applied in India, South Africa, at several Bolivian sites and on petroglyph-making stone hammers. The method's practical time range on crystalline quartz, from the present to perhaps 50 000 years BP, renders it particularly suitable for rock art, because very little rock art can be expected to be outside that range, and the perhaps most effective range (from around 1000 years to about 10 000 years) coincides with the presumed age range of most surviving petroglyphs.

The precision of the method is probably poor at this early stage in its development, because it depends entirely on the number and precision of calibration points. The principal potential variables in the solution processes responsible for microerosion are temperature, pH and moisture availability. The first two are regarded as unimportant. Variations in mean annual temperatures, even as far back as glacial peaks of the Pleistocene, are not thought to have been of a magnitude that would have affected solution rates appreciably. Variations in pH can be assumed to have taken place through time, but they are just as unlikely to have influenced solution rates. In the case of both amorphous silica and crystalline quartz, there is almost no change in solubility below pH 9, and higher values would certainly not have been experienced in nearly every natural environment. For alumina the effect is negligible in the central region of the pH scale, which coincides with most natural conditions. Precipitation certainly varied in the past, and this is the one variable to be considered further. But significant changes in moisture availability affect component minerals differently, and should thus be detectable by calibration of more than one component mineral. Therefore it is preferable to apply the method to two different component minerals of the same surface, such as quartz and feldspar.

While microerosion analysis is not thought to provide great accuracy, it is probably more reliable than most alternative methods of dating petroglyphs (Bednarik 2001a), and it is certainly cheaper, simpler and more robust than most. It requires no laboratory backing, and results can be determined in the field, which may save considerable effort necessitated by the need to return to a perhaps very remote site to obtain supplementary data. The method provides not single results, but clusters of age-related values that can be converted into various statistical expressions — a luxury not available to all other dating methods currently used. Moreover, it is the only such method offering a means of internal checking — that is, of checking the validity of the result without recourse to another method (although luminescence dating has a limited feature of this type, i.e. the possibility of checking whether the uranium and thorium decay chains are in equilibrium, and multiple targeted AMS ^{14}C analyses of laminated accretions provide good reliability; cf. Campbell 2000; Watchman 2000). Finally, microerosion analysis involves no removal of samples, or even contact with the rock art, being a purely optical method.

Motif	Wanes	Min. A	Max. A	Mean A	Age, years	Tolerance
Female SH7	No measurements taken				**c. E350**	-
Male 65B	10	1	4	2.00	**E425**	+426, -212
Anthropomorph SH9	12	3	5	4.25	**E904**	+160, -266
Female 65B	Micro-wanes range from 10-15 microns				**E2127-3191**	-
Impact scar 65B	20	10	30	17.25	**E3670**	+2713, -1543
Circle 65B	14	75	125	91.07	**E19 376**	+7219, -3419
Circle 65B	14	110	180	125.74	**E26 753**	+11 545, -3349

Table 1: *Quartz microerosion data from seven petroglyphs, sites 65B and Spear Hill, eastern Pilbara. Micro-wane dimensions in microns.*

Having secured a calibration curve for the Pilbara at the Spear Hill Complex (McNickle 1985) I applied it to several selected petroglyphs in the region, at three granite boulder piles: Woodstock 65B, Spear Hill 7 and Spear Hill 9. Woodstock site 65B is located near the long abandoned Abydos station, on AGM granite, a fine to coarse, even-grained biotite adamellite, biotite granodiosite and, less commonly, biotite tonalite, well foliated and often gneissic. Both Spear Hill sites are of AGL granite, a well foliated, fine to medium-grained biotite adamellite representing remobilised older granitic rocks. Seven motifs were analysed: four anthropomorphs (including three Woodstock figures), two circles, and a 'vandalistic' impact scar spatially related to the younger of the two circles (Table 1; for full details please refer to Bednarik 2002).

Although Pilbara petroglyphs have attracted the interest of Europeans for at least 160 years, and have long been thought to be of great antiquity, until now their age has remained entirely conjectural. Lorblanchet's (1983, 1992) claimed 18 500-year stylistic chronology of a Burrup Holocene site is baseless (it rests on a single doubtful date from a shell found on the surface, unrelated to any rock art). My own quest to determine the age of the region's abundant rock art, commenced in 1967, has now led to the development of a procedure capable of routinely yielding consistently credible age estimates for this corpus. This development was greatly facilitated by three factors. First and foremost was my early appreciation of the need to break out of the archaeological habit of inventing stylistic sequences and then attempting their correlation with perceived lithic traditions, which I replaced with attempts to exploit geochemistry and micro-geomorphology, thereby initiating 'direct dating' of rock art. The second factor was my development of the theory of micro-wane formation in 1989. Thirdly, my discovery of numerous Historical engraved dates made it possible to create the first microerosion calibration curve for any region of Australia.

These three stages have now led to the development of a standardised method for routine age estimation of individual motifs in the Australian Pilbara, particularly in the granite-dominated eastern Pilbara. It is capable of yielding age estimations of about one hundred petroglyphs per week of field work. However, bearing in mind the tendency of archaeologists to misinterpret or over-interpret direct-dating evidence (Bednarik 1994, 1996, 2001a; Watchman 1999), it is important that a number of qualifications and considerations concerning the data presented here are clearly enunciated:

1. These data do not constitute secure and precise datings. Substantial tolerance values are attached to them, reflecting the spread of the primary data. There is no finite guarantee that the true age of a figure must necessarily lie between the tolerance margins, although this is highly probable.
2. The reliability of each result is largely dependent on the number of micro-wane determinations made.
3. The calibration curve the estimates are based on is tentative, and may need to be refined. There is, however, very little prospect for such refinement in Australia, and it may come in the form of comparative data from similar arid

regions on other continents.

4. In reliable microerosion analysis the use of two or more parallel calibration curves (from two or more component minerals) is desirable and has already been demonstrated elsewhere. In the present case it is recommended that a calibration curve for feldspar be established to render results more reliable.
5. Crystalline quartz occurs in different forms, and while it is not expected that their presently untested solution characteristics differ sufficiently to affect the rather coarse resolution this method supports, for the sake of rigour it is desirable to test this assumption through analyses targeting surfaces of historically known ages of different quartz types.
6. A large part of Pilbara rock art occurs on plutonic or extrusive igneous rocks such as gabbro, dolerite and basalt, which renders the development of expertise in the microerosion behaviour of such minerals as pyroxene, augite and olivine very useful for an expansion of the dating program now begun. It is planned to attempt this in due course.
7. These preliminary dates provide no basis for archaeological interpretations of traditions, occupation duration, or any of the other types of misleading archaeological constructs often extracted from rock art. Much older dates are expected to be secured from the region in due course, for instance from cupules, and the few present determinations tell us nothing about population densities, artistic trends, 'styles' or any such interpretations.

Nevertheless, there is a realistic possibility that the adverse climatic conditions introduced by the Last Glacial Maximum around 18 000 years ago effected de-population of economically marginal regions, such as much of the Pilbara. This does appear to be reflected in the region's rock art, which provides indications of a lengthy period of very little, or even a complete absence of, petroglyph production. This seems to coincide with the final Pleistocene, or the period from the Last Glacial Maximum to the arrival of the coastline near its present level, in the early Holocene. Naturally this hypothesis requires extensive testing, both through excavation and rock art dating. The few age estimates presented here are certainly most inadequate to test such speculations, although they might well support such a scenario. It is most desirable to acquire some few hundred randomly derived dates from the rock art, and with the development of a standardised procedure of securing fairly reliable age estimations routinely there is now no impediment to such a strategy.

One issue clearly addressed by the current work is the presence of Pleistocene rock art in the Pilbara. Indeed, it suggests that petroglyphs of such antiquity occur most commonly in the region, because the type of deeply repatinated, non-iconographic motifs dominated by cupules and certain linear arrangements account for at least twenty per cent of the region's rock art. The ubiquity of Pleistocene rock art had been suspected by me since the 1960s, and other researchers have had similar vibes, but until now these remained purely speculative. Bearing in mind that the number of petroglyph motifs in the region is believed to be over a million, and quite possibly a few millions, it becomes apparent that the Pilbara comprises not only the largest regional concentration of petroglyphs, it apparently also possesses the world's largest surviving corpus of Ice Age art. This body is many times the size of the legendary Pleistocene rock art in the caves of south-western Europe, it is older than any rock art known in the Americas or Africa, and while older rock art does occur in Asia, very little is known there about its extent. In Australia Pleistocene rock art does occur elsewhere, especially in the caves along the southern coast and in various northern and central regions, but numerically these occurrences are not likely to rival those of the Pilbara. At this stage it is realistic to expect that Pilbara rock art will be shown to be the world's largest concentration of Ice Age art. Another definite finding of the project as it currently stands is that the characteristic and highly sacred Woodstock figures are surprisingly recent — certainly more recent than I expected them to be (the two youngest motifs sampled are Woodstock figures). Conversely, rock paintings do occur in the region, but they are rare and none I have seen is likely to be of the Pleistocene.

NOTE: This short report will be followed by two major technical papers about the project, currently in press (Bednarik 2001b, 2002).

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