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DATING OF ROCK IMAGES IN WARDAMAN COUNTRY, NORTHERN TERRITORY, AUSTRALIA

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Abstract: The Victoria River District contains many rockshelters with abundant paintings and petroglyphs, most of which are relatively young. The weak nature of the rock and its vulnerability to weathering and erosion have controlled the preservation of the rock art to such an extent that much older images are apparently no longer preserved, if they were present initially. Pigment compositions range from haematite, gypsum, huntite, kaolinite and oxalate salts, and thin films containing oxalate, gypsum, quartz and clay encrust some rock carvings. Radiocarbon age determinations confirm field observations supporting the view that the visible rock art is no older than mid-Holocene.

Introduction

The Top End of the Northern Territory is a region famously rich in rock art with a strong relative chronology linked to a number of archaeological sequences. This relative time frame is underpinned by the beginnings of a strong absolute chronology derived from 'bridging' from the rock art sequence to the parallel archaeological and palaeo-ecological history of the region (Chippindale and Taçon 1998). In addition there is now a mass of absolute dates for beeswax figures — a scarce but distinctive form of rock art superbly suited for direct radiocarbon dating. (There are about 150 dates for beeswax figures from Arnhem Land and Tabletop Range in the Northern Territory — Nelson et al. 2000; similar work by Michael Morwood is in hand in Western Australia.) Other rock images lacking beeswax are much more difficult to date reliably, but much progress has been made (e.g. Watchman and Cole 1993; Roberts et al. 1997). Knowledge is accumulating of the pigments used in painting (e.g. Watchman et al. 1993; Ward et al. 2001), and of surface geology and geochemistry. Understanding the composition and behaviour of rock surfaces and pigments is crucial to dating and to long-term conservation of the art, which in so many places is visibly weathering and wearing away.

The research reported in this paper has focussed on the eastern Victoria River District (VRD) of the Northern Territory (Fig. 1). This region lies between Arnhem Land and the Kimberley. Growing research knowledge makes it ever clearer that the sequences in those two regions have much in common, in the presence of beeswax art, in the petro-glyphs, especially the tradition of cupules (pecked cup-like depressions), and in the paintings. The small anthropomor-phous 'Dynamic' or 'Mimi' figures of Arnhem Land (Chaloupka 1988–89) resemble 'Bradshaw figures' (Walsh 1994, 2000) of the Kimberley; as do later distinct manners of painting in each region's art. It may be then that there is a single large, northern Kimberley-Arnhem Land 'Province' of art traditions extending from Derby to Groote Eylandt. The Kimberley-Arnhem Land rock art shows some strong uniting similarities, particularly in their earliest images, but these are apparently absent from the land in-between.

The Victoria River region lies between the Katherine area, south-western limit of classic Arnhem Land rock art, and the Kununurra area, eastern limit of classic Kimberley art. Paintings and petroglyphs are scattered throughout this intervening region but have been only patchily recorded and studied (e.g. Tabletop Range, partly now in Litchfield Park (unpublished records, except for the beeswax figures); Dead Man Pocket, on the Laurie Creek portion of Fitzmau-rice River drainage (unpublished records); Victoria River region (Lewis and Rose 1988); Keep River National Park (Watchman et al. 2000a); and Wardaman country (e.g. Flood and David 1994; David et al. 1990, 1994, 1995; Flood 1997), subject of current work. Other promising zones such as the Gregory National Park (Ray Reser, work in progress) and in the Port Keats-Fitzmaurice River region (Mark Crocombe, Ken Mulvaney, Graeme Ward and Alan Watchman, work in progress) remain to be reported on.

The purpose of the present paper is to summarise new field observations, and the systematic records and laboratory analyses that we have made from Wardaman country, which enlarge and strengthen knowledge already reported and provide implications for the whole 'Kimberley-Arnhem Land' province. This paper focuses on:

- characterising rock paints,
- making field observations regarding chronology of the art,
- recording relative age relationships, and
- determining direct ages for paintings and petroglyphs.

Archaeology of rock images in Wardaman country

Traditional Aboriginal art took many forms but rock art is the only one that leaves a long-term, immovable record in the landscape. In Australia rock art researchers have the

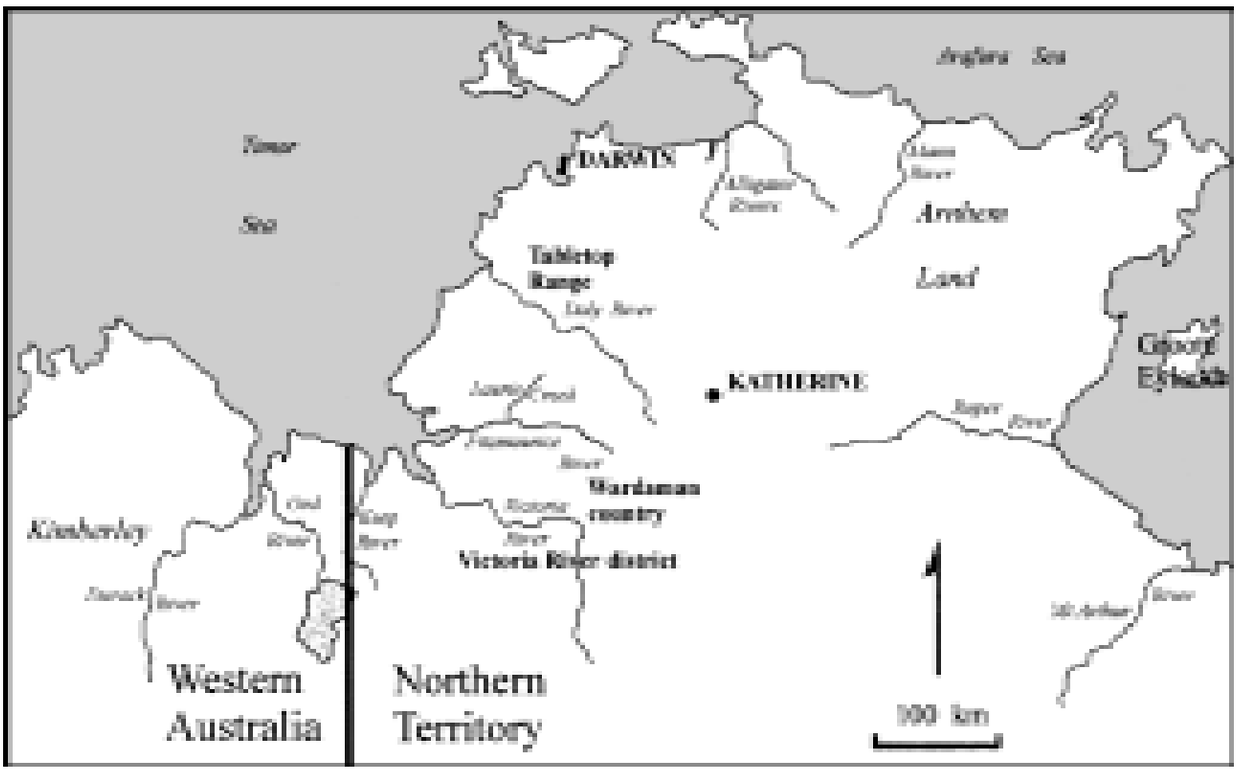

Figure 1. *The study area: the Top End of the Northern Territory, Australia.*

great advantage that Aboriginal art is a living tradition. Whilst most of this art is now expressed not on rock but in other mediums, in remote northern Australia rock art is integral to contemporary Aboriginal communities. Some elderly Aboriginal people can still explain the meanings of rock art and also practise the re-touching of rock paintings. In September1999 in Wardaman country Flood and Chippindale had the memorable experience of coming across a fresh rock carving, so newly made that the rock dust was still in the abraded grooves.

Wardaman country lies east of the Victoria River and west of the town of Katherine in the Northern Territory (131ºE 15º 25'S). Most of current Wardaman traditional territory is encompassed within the cattle stations of Willeroo, Delamere and Innesvale. (A 1990s campaign to purchase the latter for the Wardaman people was successful and Innesvale is now Aboriginal land and has been re-named Menngen, meaning white cockatoo.) The traditional tribal territory of Wardaman-speaking people took in about 7700 square kilometres (2800 square miles) of country extending south of the upper Flora River, west to the Victoria River, east to Willeroo and south to Jasper Gorge. (Boundaries were never precise and have changed over the centuries and especially in post-contact times (Tindale 1974: 237; Merlan 1989). The term Wardaman country is used here to refer to the cattle properties of Willeroo, Delamere and Innesvale — now Menngen, where our fieldwork took place.)

Rock art still plays a meaningful role in this contemporary group whose parents or grandparents were hunter-gatherers and who, sixty years ago, camped in rockshelters that their ancestors had decorated. In the Victoria River region soft sandstone formations have eroded into many rockshel-ters containing thousands of paintings and petroglyphs. There are also a few open-air petroglyph sites on rock slabs or 'pavements'. Flood's thorough field survey and recording program (funded by Earthwatch) over five seasons, 1988–92, recorded in Wardaman country more than 200 rock art sites containing some 5000 individual paintings and 45 000 petroglyphs, mainly abraded grooves and animal tracks. Most sites were visited with the traditional owners, who were keen to record their knowledge. Frances-ca Merlan (Merlan 1989, 1994) has recorded in the Warda-man language stories about the sites. This work was continued by Flood and Chippindale in 1998 (self-funded) and continued in 1999 by Flood, Chippindale and Watchman (funded by a grant from the Australian Institute of Aboriginal and Torres Strait Islander Studies).

The primary aims of the 1999 fieldwork reported here were investigations into the location, development and chronology of rock art in the eastern Victoria River region, together with further expeditions with traditional owners to find 'lost sites' — remote sites known to exist but un-visited for so long that their location had been almost forgotten.

Distribution of rock art

Explanation of the location of rock art both across Wardaman country and on the small, inter- and intra-site scale was one of the objects of this project. Much of the region is relatively flat and featureless land covered with savannah woodland with no rockshelters and hence no rock paintings. To find rock paintings one has to find rockshel-ters, for paintings were always done under overhangs, we were told by Wardaman people, so 'that they will last'.

In the tropical, monsoonal north of Australia the primary use of rockshelters was for habitation and shelter from rain and fierce sun in the summer-wet season. Wardaman country has year-round high temperatures, no frost and markedly seasonal rainfall. Annual average rainfall is 500–600 mm, almost all of which falls between November and April. The slightly cooler months of May to September are virtually rain-free. Annual evaporation significantly exceeds rainfall, and by the end of the dry season all except permanent water sources such as springs and large waterholes have dried up. In the dry season occupation focussed on permanent waterholes and their rich aquatic food resources. People tended to camp in the sandy riverbeds or on the banks where large paperbark trees provided shade. The main use of rockshelters was in the wet season, to give shelter from tropical downpours and shade from hot summer sun.

Available rockshelters were intensively used, and decorated, in the wet season when rain falls daily, often as heavy downpours. Flooding and the boggy mud of the black soil plains make travel difficult, and in the two wettest months, January and February, people tended to stay in one place, where large shady rockshelters were available and food such as fruits and yams were plentiful. The need to camp in rockshelters for at least part of the year explains the presence of both occupational debris and rock art in the vast majority of rockshelters, but by no means every rockshelter in Wardaman country contains rock art. Small shelters high on escarpments and far from water seldom have been either occupied or decorated.

We found that the occurrence of decorated shelters could be predicted from the geological map (Sweet 1972). Whilst the whole region is sandstone, there is one particular variety of sandstone that produces large rockshelters and expanses of smooth wall ideal for rock art. Small rockshelters with some minor rock art do occur in other types of sandstone and on conglomerate rock but the major site complexes (groups of sites) are on cross-bedded quartz sandstone of the Antrim Plateau Volcanics, which lies in beds up to 150 metres thick trending from north-west to south-east in a series of mesas or massive exposures containing dozens of rockshelters, for example Garnawala, Yingalarri, Jalijbang and Yiwarlarlay.

This cross-bedded sandstone also produces striking landforms such as high pillars or mushroom-shaped balancing rocks. All these are named, story places. Some have little or no rock art because of their lack of overhangs; for example a high pillar or 'stack' at Garnawala has no art but is a sacred mythological site. Dramatic anthropomorphous or zoomorphic rock formations sometimes lead to decoration of nearby rockshelters which otherwise might not have been selected for use because of their uncomfortable, rocky floors or lack of space. For instance, near Wynbarra Rockhole some irregular-shaped, stone columns of dark orange-red conglomerate give the impression of discs piled unevenly on top of each other. On some the topmost disk is the largest, resembling the comb on a cockatoo's head. These columns are said to be menngen, sulphur-crested white cockatoos transformed into rock. Nearby rockshelters are small with generally rocky floors, but all bear paintings and petroglyphs relating to the white cockatoo dreaming. Another group of 27 art sites in the outcrop of Jigaigarn relates to a spectacular rock on the skyline balancing on a tiny base. This is a grasshopper dreaming and a large but boulder-strewn rockshelter below (known as Gordolya) is a major art and occupation site dominated by a huge striped figure — an ancestral grasshopper. (Various Wardaman traditional owners have given various interpretations of this site — this is the most recent one that we recorded from Bill Harney in 1999.) Part of the floor was excavated in 1991, and charcoal from 11 centimetres above the base of the occupational deposit gave an age of 10 060 ± 110 BP (David et al. 1995).

Some fifty rock art sites at Garnawala (= Mt Hogarth) are located on two adjacent outcrops stretching over a kilometre, but they are all considered as one entity. At Yingalarri (= Ingaladdi) the eighty art sites are in separate outcrops with a kilometre or more between them and have various different names — Nimji, Murning and Garnyi-warnyirr — and a different major site in each complex. Within each group of sites the largest, shadiest rockshelter with a soft earth floor generally contains the most occupational debris and the greatest quantity of rock art. Such shelters also usually have the oldest occupation and the oldest art (see below).

So close is the link between Aboriginal religion and everyday life that there is little or no distinction between sacred and secular sites. This means that major camping places are also often major galleries of rock art. Secular sites contain paintings that appear to be more casual. According to traditional owners, some recorded a visit to a site or illustrated a story whilst others involved love magic or sorcery. Where rockshelters occur in groups on an outcrop or along a cliff line, the largest habitable rockshelter is usually both the major campsite and the main Dreaming site.

Large figures dominate the major sites and many images of animals, humans and other motifs, some secular and some Ancestral Beings 'made in the Dreamtime' surround these. A centrally placed (or pair of) anthropomor-phous figure(s), more than human-life-size, generally distinguishes the art in the major sites. It is usually finely painted with elaborate internal polychrome decoration and with certain supernatural characteristics, and is regarded as an Ancestral Being. Within rockshelters the main figure or figures are normally located in the central prime position. They often fill the main available space, stretching from top to bottom of a high rock panel or from end to end of a wide wall. Painted Dreaming figures are placed in the protection of overhangs so that they would last forever, with the help of regular re-touching. Wardaman people believe that the paintings have always been there since Dreaming Beings painted themselves on the wall after they had finished their creative deeds. Some large slabs of rock in the open air, unprotected from the elements, are decorated with equally large engraved human and animal figures.

It has emerged from our research that engraving did not precede painting, but the two techniques were used

Colour	Major mineral phases	Minor mineral phases	Contamination
White	Huntite (Mg3Ca(CO3)4) Magnesium oxalate hydrate (MgC2O4.H2O) Quartz (SiO2) Gypsum (Ca(SO4)(H2O)2)	Whewellite (CaC2O4.H2O) Weddellite (CaC2O4.2H2O) Ca-feldspar (CaAlSi3O8) Kaolinite Magnesium chloride hydroxide Fe-phosphate Spinel Anatase	Haematite (Fe2O3) Melanterite (FeSO4(H2O)7) Siderite
Cream	Huntite		Haematite Melanterite
Red	Haematite Magnesium oxalate hydrate Quartz	Gypsum Whewellite Goethite Kaolinite Albite Alunite (KAl3(SO4)2(OH)6	
Red - black	Haematite Magnesium oxalate hydrate Whewellite Quartz	Gypsum Potassium Iron Oxalate (K3Fe(C2O4)3.3H2O)	
Black	Haematite Quartz	Ca-feldspar K-feldspar Whewellite Gibbsite (Al(OH)3) Gypsum Kaolinite Melanterite Boehmite (Al2(OOH)2 Microcline Weddellite	
Yellow	Gypsum Quartz Kaolinite Melanterite	Haematite Goethite Whewellite Fe-phosphate Microcline	Huntite Magnesium oxalate hydrate
Orange	Gypsum Haematite Whewellite	Quartz Kaolinite Microcline	Huntite Magnesium oxalate hydrate

Table 1. *Summary of the major, minor and contaminating phases in paints from rock art sites in the VRD.*

contemporaneously in different locations. Patination on engraved marks such as abraded grooves and animal and human tracks varies from very thick to non-existent, and they appear to span the whole period of rock art production (see below). Cupules, however, are associated with hard, stable rock surfaces and seem to belong primarily to the archaic rather than later carving tradition. Similarly, a correlation exists between hard, stable, well-protected rock surfaces and the presence of rare engraved frontal human faces (e.g. Gongonmaya 1, Yingalarri 66, Jalijbang 1).

Further study was devoted to the question of the antiquity of rock surfaces and the possibility of survival of rock art of a similar age to the earliest art of Arnhem Land and the Kimberley. Occupation of the Victoria River region had begun by 10 000 years ago, the age of the basal occupational debris in the rockshelters of Gordolya and Garnawala 2 (Hawk Dreaming). Evidence excavated at Yingalarri 1 suggests a similar antiquity for both occupation and rock art, for John Mulvaney found a carved bird track and abraded grooves on rock fragments in a pre-5000-year-old context (Flood 1997: 303).

If rock art ten or more millennia old ever existed in Wardaman country, then it has not survived tropical weathering as our dating assays attest. No representations have yet been found of extinct animals such as the thylacine, whereas there are dozens of paintings of thylacines in early art of Arnhem Land and the Kimberley, and petroglyphs of the same distinctively striped creature on open sites in the Pilbara. Nor have any paintings or petroglyphs been discovered in the eastern Victoria River region resembling

classic Bradshaw (Gwion) or Dynamic figures. The nearest to the east are those of western Arnhem Land. To the west a few small, crude human figures bearing a vague stylistic resemblance to the Bradshaw type were identified by Darrell Lewis (1984) on Coolibah Station in the region of the Victoria River Crossing. Similar figures occur near the Fitzmaurice River gorge (AW pers. obs. 2003), and in the Keep River region (Taçon et al. 1998).

Paint compositions

In September 1999 samples of paints and rock surface coatings were collected by Watchman as part of combined fieldwork in the Yingalarri and Innesvale areas. Subsequent analyses in the laboratory at James Cook University provided information about the chemistry and mineralogy of the major paint components (Table 1). White, cream, red, red-black, black, yellow and orange paints were examined using an x-ray diffraction system (GADDS) and software was used to match the diffracted patterns with standard mineral spectra.

White paints consist mostly of huntite ($CaMg_3(CO_3)_4$), gypsum ($CaSO_4.2H_2O$) and the oxalate minerals whewellite ($CaC_2O_4.H_2O$) and weddellite ($CaC_2O_4.2H_2O$). Minor minerals, such as the two red minerals, haematite (Fe_2O_3) and melanterite ($FeSO_4.7H_2O$), and white kaolinite ($Al_2Si_2O_5(OH)_4$) and quartz (SiO_2) are probably contaminants associated with underlying or adjacent red and yellow paints. This is evident in the cream paint where huntite, haematite and melanterite are all present as major components, and in the field it was apparent that the white paint had smeared the underlying red paint. Huntite is preserved as a major white paint mineral without the presence of oxalate at Yingalarri-1, -21, and -73 and Gongonmaya-1, and with oxalate at Yingalarri-1, -21, -22, -55. Only at Jalijbang-12 was huntite not found as a white paint; oxalate was the main white paint component. Further investigation of huntite is therefore warranted because its presence could be a result of selective preservation where microbiological activity has not converted it into oxalate. In addition to obtaining huntite from local deposits it could have been traded in from the Kimberley, where it was widely used for Wandjina paintings (Clarke 1976; Ford et al. 1994; Ward et al. 2001). The oxalate salts also require further investigation because they have potential for being used in the radiocarbon analysis of the paintings.

Red paint is predominantly haematite with minor amounts of gypsum, quartz, whewellite and goethite. Oxalate minerals and haematite are the major components in the red-black paint. The black paint does not appear to contain charcoal or manganese dioxide (the two most common black pigments found elsewhere), but haematite with various mixtures of kaolinite, oxalate, goethite, feldspar, gibbsite ($Al(OH_3)$) and boehmite ($Al_2(OOH)_2$). The iron in haematite can occur in different states of oxidation and element co-ordination, and these factors effect its colour. X-ray diffraction analyses of the haematite were not able to determine whether the oxidation state of iron in the black mineral was different to that in red haematite. The yellow paint is a mixture of melanterite, kaolinite, haematite, gypsum and goethite. Orange paint consists of gypsum, haematite, whewellite and feldspar.

The oxalate minerals in the paints are not unusual as they have been found associated with paints in the Kimberley where they are thought to be the product of the microbiological alteration of huntite and calcite that were used as primary white pigments (Ford et al. 1994). Oxalate minerals are also found in laminated rock surface coatings associated with rock carvings in the VRD (see dating section), and these minerals are produced by natural microbiological accumulation in northern Australian rockshelters (Watchman and Jones 1998).

Importantly, jarosite ($KFe_3(SO_4)_2(OH)_6$) was not found in any of the red, orange and yellow paints in the VRD, unlike the mulberry-coloured 'Bradshaw' paintings in the Kimberley region (Ward et al. 2001; Watchman 1997; Walsh 2000: 62). It would therefore seem that sources of jarosite are not available in the VRD and that trade in jarosite between the Kimberley and the VRD did not take place.

Field observations on chronology

Rock art can only be made where there is rock. It is only archaeologically visible when it then survives on rock from when it was made into present times. So the distribution of rock art depends critically on the distribution of rock, and on how that rock reacts to long-term exposure to weathering and erosion. In the Kimberley-Arnhem Land province two large areas have a great deal of archaic rock art and both these areas largely comprise metamorphosed sandstones. These are often fractured such that the collapse of ceiling slabs has produced shelters which, when protected by a comparatively modest overhang, bear rock art. Many are of no great height, but some are tens of metres high. The colour and appearance of these exposed rock surfaces is also often distinctive, as they are mainly grey or cream in colour, and have well defined horizontal bedding planes. It is on these kinds of surfaces that the older rock art is found, nearly always taking the form of faded paintings in red haematite pigments. Sometimes, the pigment is in the strong red of ochre; often, it takes a different and distinctive tint, which appears to have blue in it, and therefore is pink rather than red when pale, or a striking purple colour when dark that Walsh (1994, 2000) has well termed 'mulberry'. Watchman (1997) and Ward et al. (2001) have identified the coloured mineral on some of these blue-red surfaces as jarosite, not the usual haematite of the abundant red tones. Where the archaic rock art is red the recent paintings are in varied colours — principally red, yellow and white.

Other regions of the Province do not have these kinds of surfaces. In the Tabletop Range, for instance, the exposed rock surfaces are not great because of the smaller formations of a different kind of sandstone. Often more red-brown in colour, it forms fewer overhangs, and the much smaller overhangs within the protected surface are more often sculpted by cavernous weathering. Tabletop Range is of a geological nature and has exposures that are more affected by erosion than in western Arnhem Land, and so offer fewer opportunities to make rock art

on protected surfaces. Strikingly, and consistent with this, not many surfaces in the Tabletop Range bear painted rock art, and the paintings on those surfaces are in varied colours — red, yellow and white — sometimes combined in a solitary bichrome or polychrome image. All these traits are consistent with its being comparatively young. This seeming absence of older rock art could arise in three ways. Either rock surfaces had not stabilised during archaic times into their present form, but were actively weathering and were not suitable for painting or carving. Or there was older rock art, but the surfaces on which it was made have since weathered and eroded, to the point where none of that rock art survives. Or there was not older rock art; none has survived because none was made.

Dead Man Pocket, on the Laurie Creek tributary of the Fitzmaurice River, is instructive in this respect. Rock art has been found in two distinct 'pockets', in areas where the valley widens each side of the creek-bed and in shelters along a low cliff-line. Between the two pockets the valley narrows into a 'squeeze' with waterfalls. The lower pocket is of softer and generally darker rock of the Saddle Creek Formation, which forms shelters of varying depth. It has quite a number of varied polychrome paintings, evidently recent. It also has petroglyphs on soft surfaces, unpatinated, and the motifs are those of recent petroglyphs in the region. On other surfaces there are petroglyphs of very different character, motifs archaic in character on boulders in well-protected places that are heavily patinated with a gypsum-oxalate mineral skin.

The upper pocket of the distinctive pale grey sandstones and siltstone (Loy et al. 1990: 113), mentioned above, has a number of the characteristic near-vertical surfaces under a modest protective overhang — rather than full shelters. On some of those surfaces there are paintings in the pale, pink variant of the red-blue tone characteristic of older rock painting in the province. The motifs, which are not numerous, share key characteristics with archaic western Arnhem Land and Kimberley paintings.

Old and stable rock-surfaces occur on this branch of the Fitzmaurice River and on those surfaces there are both old and new paintings, and old and new petroglyphs of forms strikingly consistent with those elsewhere in the Province.

The region of the present study, Wardaman country, is another key intermediate zone, to the south-east of Laurie Creek. The numerous paintings and petroglyphs were mostly on the kinds of surfaces, softer and darker sandstone, which weather more rapidly, much like those on Tabletop Range. Consistent with this, the paintings recorded were polychrome and of the recent tradition. The petroglyphs, for the most part abraded grooves, were again nearly all characteristic of the recent tradition. No paintings or petroglyphs of diagnostically older form had been reported.

New observations in the new fieldwork complete the Wardaman picture. First, a number of surfaces were observed of the characteristic stable type: vertical cliffs of the grey-cream rock, often many metres high, and with only a slight ledge of protruding stone as a protective surface. Most of these bore no art, but their existence indicates that old surfaces might exist, and it is likely that if art were made on them in archaic times, then that art would possibly survive in protected situations.

Second, one of these surfaces is a high painted panel on an extremely well protected ceiling under a large overhang (Jalijbang 2). The ceiling bears a number of faded red grass-prints, similar to those found both in western Arnhem Land and Kimberley, and which are considered one of the most distinctive features of the archaic painting tradition. This is only one surface, but one which demonstrates that archaic paintings may exist there.

Third, on another of these surfaces on the wall of a rockshelter (Gongonmaya 1) is a mass of cupules, the petroglyph form that is demonstrably a component of the ancient petroglyph tradition in the Province. Although in a protected position, they are much weathered and heavily repatinated; these are not recent but archaic. Archaic petroglyphs, older than about 4000 years, exist alongside the archaic paintings. Another major engraved surface was found (at Jalijbang 12) and recorded with a mass of weathered cupules; however, its geological context is less reliably diagnostic of its long-term stability.

Fourth, Watchman, who is very experienced in the geological contexts of rock art in the Province, made new field observations in 1999 at several previously known sites. On these surfaces are petroglyphs that are not, by their form, diagnostically ancient. In Wardaman country the oldest petroglyphs are of circles and animal and bird tracks whereas younger ones are more figurative such as human and animal figures, although cupules, tracks and abraded grooves are found throughout the sequence. From his knowledge, Watchman considers these surfaces are indeed ancient, and so will be the weathered and repatinated petroglyphs on them. Some samples were taken for radiocarbon dating that may or may not be possible to date, according to the geochemistry of the materials.

To summarise, field observations in 1999 confirm that in Wardaman country there are:

- alongside many surfaces of soft rock which is susceptible to weathering are a number of surfaces of hard rock resistant to weathering of the kind bearing archaic rock art elsewhere in the Province,
- adjacent to the many recent paintings are a few of distinct archaic type such as grass prints on those resistant surfaces, and
- near the many recent petroglyphs are a few of distinct archaic type such as cupules on those resistant surfaces, and other figurative petroglyphs, not of distinct archaic type that show such signs of extensive weathering and patination.

Regional context

Setting Wardaman country into the wider Province a strong pattern can be seen across this immense zone. In the Kimberley and in western Arnhem Land there are many resistant surfaces bearing both archaic and recent petro-glyphs and paintings. In western Arnhem Land, there are also many recent and reliably radiocarbon-dated beeswax figures, and a few archaic beeswax figures.

Sampe descrption, ste name	Sampe ab. number	AMS ^{14}C age (radiocarbon years BP)
Current VRD research, carved human foot, Yingaarri 1	YE3, CAMS65343	730 ± 40
Crust layer beneath paint, Yingarri 66	TC4, CAMS65346	930 ± 40
Crust deposit directly over carved macropod foot, Yingaarri 66	TC8, CAMS65344	1120 ± 180
Base layer of encrustation over carved human foot, Jajbang 12	MD2, CAMS65345	2090 ± 40
Previous regional research base layer of crust over carved macropod track, Yiwararay B	YIW3, OZD454	3160 ± 60
Base layer of crust, off-art surface	YIW4, CAMS45675	4080 ± 50
Youngest layer in crust over cupue, J	KR1.2, CAMS45666	1470 ± 50
Average age of coating, J	KR1, Average	2925 ± 65
dest ayer, J	KR1.3, OxA7369	5840 ± 65
Base of crust over cupue, Granipi	KR24, CAMS44349	4560 ± 50
Base of crust, off-art, G	KR24, CAMS45670	8520 ± 60

Table 2. *Summary of current and previous age determinations using the carbon in oxalate for AMS ^{14}C dating of encrustations associated with paintings and petroglyphs in the VRD (including Yiwarlarlay) and Keep River (Jinmium, Granilpi) areas, N.T. (Previous results are from Watchman et al. 2000a, 2000b).*

The lack of resistant surfaces in the Tabletop Range means that there is no archaic art, but there are recent paintings and beeswax figures. This is in contrast to western Arnhem Land (Watchman and Jones 2002; Watchman, this volume), near the Mann River of central Arnhem Land (Taçon 1993), on Laurie Creek, in Wardaman country, and in the Keep River region (Watchman et al. 2000b) where there are both resistant and soft rock surfaces, although the resistant surfaces may be rare. Here there are recent paintings (Mann River, Laurie Creek, Wardaman country, Keep River) and recent petroglyphs (again in all four areas), and there may be recent beeswax figures (Mann River). Here there are also ancient paintings (again in all four areas), and ancient carvings (again in all four areas; Birdingal et al. in prep.); in most of these areas, the ancient figures are rare, in correspondence with the rarity of surviving resistant rock surfaces. The lack of the pigment jarosite in Wardaman country may also be a factor, since this mulberry-coloured paint seems to be less durable than haematite. Both are more long lasting than yellow and white pigments.

In defining this Kimberley-Arnhem Land Province of rock art (above), the chief reason to bring this huge region, traditionally treated as distinct areas, into a single entity was the strong similarities in the early rock art of the Kimberley and western Arnhem Land, especially large irregular-infilled animal figures and small Bradshaw and Dynamic hunters holding boomerangs and spears. These regions also share strong similarities in their geology and in the kind of enduring rock surfaces it creates. The one region without archaic elements, the Tabletop Range, is explicable in response to its geology, as it lacks the resistant surfaces. The new observations in Wardaman country make possible this broad survey of the 'land in-between'. It shows that archaic paintings and petroglyphs exist across the Province, albeit in small numbers, and that those paintings and petroglyphs have a broad consistency. The recent paintings and petroglyphs are also consistent across the region in their characteristic images of animals and people in red, white, yellow and black.

Direct dating

Previous chronological work in the eastern Victoria River region was on rock art at Yiwarlarlay (Lightning Brothers site) on Delamere, approximately 100 km south of the current work area (Watchman et al. 2000a). That report described the dating of calcium oxalate salt on the encrusted surfaces within the shelter that had both paintings and petroglyphs. An age for the onset of formation of the oxalate on those surfaces was estimated at 4080 years BP (see Table 2). As a carved macropod track was covered by oxalate that was dated at 3160 ± 60 radiocarbon years ago, it confirmed evidence from excavation for the late use of that site for occupation.

In the Keep River (Jinmium and Granilpi) area, more than 200 km west of Wardaman country, the ages of oxalate minerals covering pecked cupules have also been determined (Watchman et al. 2000b). There the oldest oxalate minerals in cupules were measured at 5840 ± 65 radiocarbon years BP (Table 2). Most other coatings in cupules were between 1430 and 5280 years old. The indication from these two previous studies and particularly from work done at the Carpenter's Gap site in the southern Kimberley region (Watchman et al. 2001) is that oxalate coatings have formed as a result of microbiological processes that require stable rock substrates. The implication from these age determinations is that the measurement of age on oxalate is a good approximation to the time that the petroglyph was made or at least re-engraved. The results also show that, in the Top End the mid-Holocene was a period of increased rock surface stability and increased rock painting and engraving activity, presumably because climatic conditions were more favourable. Those conditions also favoured oxalate formation.

The results of the new work in the research area indicate a period of painting and engraving in the late Holocene, from approximately 2000 to 700 years ago. The tradition of engraving human feet has endured for more than two millennia because petroglyphs of feet and a ship with similar degrees of patination are recent compared with the encrusted foot at Jalijbang 12. Combined with previous work the age determinations reflect a consistent pattern of rock painting and engraving throughout the mid-Holocene until recent times.

Absolute dating of rock art in Australia (e.g. Ward and Tuniz 2000) and elsewhere (e.g. Russ et al. 1992) is a lively research field with, so far, mixed results. Our understanding of the varied and complex transformations of rock surfaces remains slight, and so therefore does our understanding of the pathways that carbon takes on rock surfaces. Radiocarbon determinations can, often but not always, be made for the material on rock surfaces (e.g. Loy et al. 1990) but it may not be certain that the carbon whose age is so determined does derive from the painting on the surface we wish to date (Nelson 1993; Gillespie 1997). The carbon in oxalate has been shown to be a reliable source for the AMS ^{14}C analysis of age of encrusted paintings and petroglyphs as attested by independent age determinations of oxalate minerals and their covering sediments at Carpenter's Gap, Western Australia (Watchman et al. in press).

Relative dating is the essential complement to absolute dating. First, it is a good control for novel methods of uncertain reliability. If robust and well-based relative chronologies are created, then the match between those and absolute chronologies will be a useful guide to reliability. Second, further relative dating better defines the cultural units within Australian rock art, so that when reliable absolute dating exists for a single figure, panel, site or small area, there is a good understanding of what the entities are which have been dated, and therefore of what is the broad story beyond the particulars of the precise material dated.

Conclusions

All occupational material and petroglyphs so far dated in the VRD belong to the Holocene period or the last 10 000 years. Was there earlier occupation and earlier rock art? Possibly, but if so it has not yet been found in the relatively large sample of excavated rockshelters (eight) and recorded rock images (>50 000). A small amount of the rock art in Wardaman country contains elements that have been found in early contexts in the Kimberley and Arnhem Land. For example, one or two panels of heavily-patinated pecked cupules, grass prints on one well-protected ceiling, large red hand prints and hand stencils and a few dark red, large, naturalistic animals comparable to those in the 'irregular infill' style of Walsh's earliest period rock art in the Kimberley (Walsh 2000: 412, 413, 418). The latter figures occur in the vicinity of the Victoria River with its rich aquatic resources that may have been the magnet that first attracted people into the region. Walsh (2000: 424) considers that pecked cupule panels, object imprints, handprint and stencil forms, large macropod themes and irregular infill brush techniques 'strongly indicate regional forms of a widespread and general culture'. It may be fragmentary traces of this early, pan-Australian culture that have survived in the VRD, but all these rock art elements continue throughout the region's rock art tradition, and therefore could equally well be Holocene as Pleistocene.

The only exclusively archaic elements of the Kimberley-Arnhem Land province are classic 'Bradshaw' (Gwion) and Dynamic figures, but these are absent from Wardaman country. Is their absence due to weathering or cultural factors? In spite of the scarcity of hard, stable rock surfaces and durable paint such as jarosite, it seems unlikely that among 50 000 rock art images there would be not a single trace of a small, anthropomorph of Bradshaw or Dynamic type, or of the distinctively archaic but not identical form found on the Fitzmaurice River. Nor is it likely that over-painting would have obscured all earlier figures if they had existed, for this did not happen in the equally prolific art traditions of Arnhem Land or the Kimberley.

The age of 'Bradshaw' and Dynamic figures is still a matter of debate, but whether their antiquity is Pleistocene or Holocene, they seem to have been genuinely absent from Wardaman country. This 'land in-between' would always have been a less attractive human habitat than the Kimberley or Arnhem Land. Apart from the resources of the Victoria River and a few permanent large waterholes and springs, the VRD is relatively lacking in food resources compared with the large rivers and richer environments of Arnhem Land, and the Kimberley. It has also always been much farther from the seashore — the arrival points of the first Australians. Today Wardaman country is some 200 kilometres inland, but Pleistocene low sea level would have increased distance from the shore five-fold and made the environment much more arid. The relatively richer environments and closer proximity to the seaboard of the Kimberley and Arnhem Land make it likely that the highly distinctive nature of Bradshaw and Dynamic art styles were confined to those regions and never diffused to the 'land in-between'.

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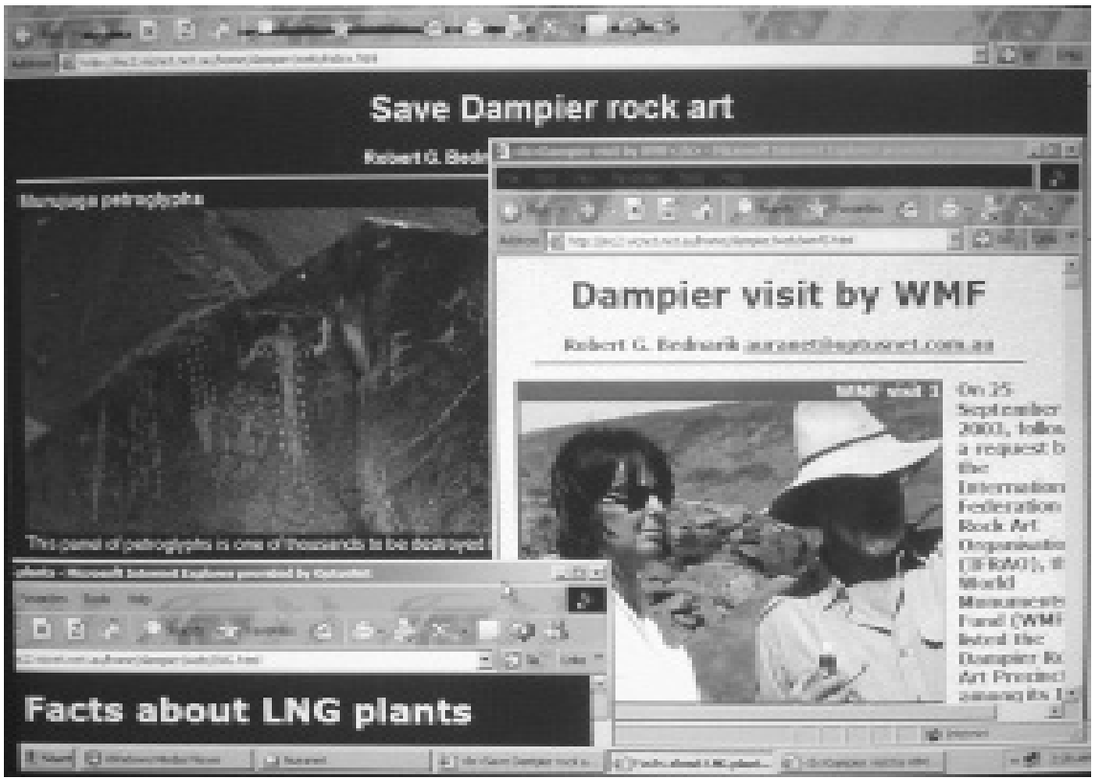

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