GEOLOGY OF AUSTRALIAN NATIONAL PARKS 1

A GEOLOGICAL STUDY OF STONE ARTIFACTS IN THE COLLECTION OF THE KAKADU NATIONAL PARK HEADQUARTERS

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FOREWORD

The outstanding biological diversity and scenic beauty of Australian national parks owes much to their geological foundation. This controls, to a significant degree, the character of their striking landforms and exerts an important control on the style and distribution of natural ecosystems. The distinctive character of these parks has evolved through processes involving the intimate interaction of rocks, soil, climate, fauna and flora over millions of years. An understanding of the geology is essential to an appreciation of this evolutionary process. Such an understanding, focussing on the long-term history of wilderness, must serve to enrich the experience of those who visit these areas.

The need for geological understanding of our prominent national landmarks is recognized in the criteria for World Heritage nominations. Article 2 of the World Heritage Convention indicates that properties nominated for listing should (i) 'be outstanding examples representing the major stages of earth's evolutionary history' and (ii) 'be outstanding examples representing significant ongoing geological processes'.

The importance accorded to geology in this context has not been matched by the information available to the Australian public on the geological aspects of our wilderness areas. This is particularly striking for a park such as Uluru, where, to a large extent, the rocks are the park. Nor has there been a great deal of emphasis placed on geology in park management. The earth science community in Australia has perhaps been slow in bringing to the attention of both park managers and the general public the large body of information it holds on basic scientific aspects of these important areas.

The Environmental Geoscience group within BMR is attempting, through Project 242.04, The Geology of Australian National Parks, to remedy this deficiency. That project is undertaking the production of explanatory material - maps, brochures and posters - designed to heighten public awareness of the geological framework of our major parks. There is a great deal of information available from which this educational material will be drawn. Much of it is of a specialist nature and may be of interest to park managers and to a range of research workers. This current series of BMR Records is designed to provide the means of making this information rapidly available.

Elizabeth M Truswell
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2 November 1990

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SUMMARY

The artefact collection held by the Australian National Parks and Wildlife Service at Kakadu National Park Headquarters comprises mostly stone tools constructed from a variety of rock types.

These are in order of predominance, quartzite, dolerite, tuff, vein quartz, chert, rhyolite, silicified siltstone/claystone, basalt, granite, dacite, chalcedony, greywacke.

The differing hardness and fabric of these lithologies gives them different qualities which suit different styles of usage in stone tool manufacture, particularly in their fracturing characteristics. This is clearly reflected in the preferred use of particular rock types for different types of tool. Flakes are made mainly from quartzite, tuff and chert, points from fine quartzite and tuff, scrapers from tuff, hatchets from dolerite, pestles grinders and hammers from quartzite and dolerite cobbles, and mortars and anvils from quartzite or dolerite.

All of the rock material is derived from the Kakadu region and surrounds. However, although most tools were sourced from within 40 km of collection sites, more than 20% have been transported at least 80 km, and 5% for more than 140 km.

INTRODUCTION

The artefact collection at Kakadu National Park Headquarters was examined in July 1990, during a field visit to Kakadu by RS Needham undertaken as part of BMR's Environmental Geoscience Program. The examination was undertaken as part of the objective to provide geological information to Park staff to assist in interpretation of the natural environment for use by Park managers and visitors, and to provide educational material. Other aspects of this project are to be reported separately.

About 200 stone items were examined, and a short description of the rock type provided for each one, or for each group if the numbered specimen contained more than one rock type (refer Appendix). A short rock name was given, and where possible the name of the geological formation to which the rock belongs, was listed. The likely provenance area for the rock material was also suggested.

Examination was purely visual and the artefacts were not scratched or chipped. This restricted the ability to identify some more weathered, polished or encrusted specimens as accurately as the "fresher" artefacts.

Descriptions of the type of tool shown in the Appendix were taken directly from the ANPWS catalogue of the collection. The collection sites shown on Figure 2 were also taken from the catalogue.

DESCRIPTION OF ARTEFACT ROCK TYPES

The rock types from which the stone tools are made are described in order of abundance in the collection.

QUARTZITE/SILICIFIED SANDSTONE

Quartzite is the commonest material in the collection. It is also the rock type used for the widest range of tool forms. This reflects the broad range of characterisitics that quartzite possesses, depending on the degree of silicilication, grain size, and fabric (the rock's internal structure determined by the arrangement of mineral grains), which all determine its strength, hardness, and fracture style.

To a significant degree, these characteristics relate to the different geological formations from which the rock was derived. The geological formation for many samples can be determined through examining the metamorphic grade of the rock (e.g. whether the rock is foliated like a gneiss, or composed of individual sand grains as in its parent sandstone rock type); the shape and degree of sorting of the quartz grains, and the degree of alteration (mainly silicification).

In this way, it is possible to show that the quartzite artefacts were probably obtained from several different geological formations - Kombolgie Formation, Mundogie Sandstone, Munmarlary Quartzite, Petrel Formation, Acacia Gap Quartzite. For details on

the geology of Kakadu and surrounding regions refer to Needham et al 1980, and Needham 1988.

The characteristics which allow discrimination between geological formations are best examined microscopically, particularly in respect of grain shapes, and the style of silicification (e.g. as overgrowths on original clastic quartz grains). Therefore to be more certain of the origin of the quartzite artefacts would require thin sectioning of the specimens, with consequent damage to the specimens in the collection.

The visual classification suggests that the most suitable quartzite type for the manufacture of flakes, points and scrapers is fine grained, highly silicified quartzite. The degree of silicification, and generally fine grain size, produce a fair conchoidal fracture style which can be readily utilised by the artisan to make these sharp-edged tools.

This type of quartzite most probably came from silicified zones along faults and joints in the Kombolgie Formation, in the plateau and outlier country. However, it is also possible that many artefacts from this group came from the silicified caps on the Mesozoic Petrel Formation sandstone in the far south of Kakadu, for example from the very large stone quarry about 7 km southeast of the Mary River Rangers' Station (GR 5370-125973). This question could only be answered by microscopic examination of the specimens as described above.

Quartzite is also used to make pestles, grinders, hammers, mortars and anvils. In this type of tool, fracture style is unimportant, and indeed a massive, poorly fissile rock suits the purpose better. Hence most of these tools are made either from cobbles which were clasts (i.e. river cobbles derived from older rock sequences) in the Kombolgie Formation or Mundogie Sandstone, or from massive, commonly coarse grained and foliated gneissic quartzite from the Mundogie Sandstone, Munmarlary Quartzite, or Mount Basedow Gneiss.

DOLERITE

Dolerite is the second most common rock type in the collection. The rock is hard, dense, heavy and massive, and is commonly used for pestles, grinders, hammers, mortars and anvils, and is used exclusively in this collection for hatchets and axes, many of which are edge-ground. There are two main types of dolerite, each distinctive of a particular geological formation.

Material from the Zamu Dolerite predominates, probably because small outcrops occur throughout Kakadu, even in places on the plains relatively close to the coast. This heavy, black or greenish black rock grades from slightly foliated in the south, e.g. Graveside Gorge area, to strongly foliated in the north, associated with a change in mineralogy from equidimensional hornblende to needle-like amphibole. These changes relate to the change in metamorphic grade of rocks of this age (i.e. older than the Kombolgie Formation) from lower in the south and west to higher in the northeast, and make it possible to estimate the provenance area of the rock material within an accuracy of 20 - 40 km.

The Oenpelli Dolerite crops out mostly east of Kakadu in Arhnem Land, particularly east of Oenpelli, near Tin Camp Creek, east of Ranger, and in Deaf Adder Gorge. It is always non-foliated (because it post-dates the metamorphism which affected the Zamu Dolerite), green and commonly with cream or white feldspar crystals up to a centimetre or so across. The outcrop of this formation is usually strewn with numerous cobble-sized boulders, and most artefacts were probably fashioned from these. Because of this mode of occurrence, it is possible that the cobbles were often carried away from their provenance and shaped and ground elsewhere.

Dacite is a similar rock to dolerite, and is used in one mortar artefact. This rock type only occurs in the South Alligator Valley southeast from Shovel Billabong, within the South Alligator Group of geological formations.

TUFF

Along with fine grained highly siliceous quartzite, tuff dominates in the manufacture of sharp-edged stone tools. This is because the tuff is a very fine grained (microcrystalline) siliceous rock largely devoid of any internal structure. It therefore produces a good and predictable conchoidal fracture, and can be worked very delicately by spalling off tiny conchoidal fragments to form fine points with less likelihood of failure than with other rock types.

Tuff is a volcanic rock, formed from ash settling on the ground or in bodies of water following an eruption. The tuff in the artefacts is at times spotted, laminated or massive, but these variations occur throughout the areas of outcrop of the tuff beds and by and large cannot be used to narrow down the provenance area.

The tuff is restricted to two geological formations, both in the South Alligator Group. The Gerowie Tuff and Mount Bonnie Formation extend west from the South Alligator River to Batchelor in a long meandering belt of low ridges commonly strewn with angular rubble fragments suitable for stone tool manufacture. Particularly good areas are along the Mary River south of Annaburroo homestead, where the tuff is pale grey and in places strikingly laminated, near Mount Douglas where the tuff forms unusually thick and massive beds up to 1 m thick, and around Shovel Billabong where there is extensive rubbly exposure.

QUARTZ AND QUARTZ BRECCIA

Quartz is the second most common rock used to make flakes, and most cores in the collection are also of quartz. Two points are also made from quartz. The quartz comes from quartz-filled fault zones which form the most common outcrop on the lowland plains of Kakadu. Even when all the surrounding rocks are weathered away, quartz "blows" often remain as evidence of a fault line cutting through those rocks. A good example is along the walking trail to Nangalour Art Site, where lines of quartz blows form low ridges rising above the sand plains. The original fault may be only a

few metres across, but the quartz rubble commonly spreads for several tens of metres either side.

Usually the quartz is massive silica and can be subdivided on the basis of colour into milky quartz (white), quartz crystal (clear), etc. A number of tools from one collection site near Koongarra are composed of amethystine quartz, which probably formed as quartz crystals growing into a void in the strongly fractured Koongarra Fault, which runs along the southeastern edge of the Mount Brockman Massif.

In some fault zones, the "wall rock" is laced with numerous quartz veins and itself becomes silicified. There are several fault zones like this between Cooinda and Nourlangie Camp, which are the probable provenance of several pink and white quartz breccia flakes from collection sites along the South Alligator River.

CHERT

Chert has similar properties to tuff, as it also is a very fine grained (cryptocrystalline) massive siliceous rock. However, its fracturing style is usually hackly, in that fracture shapes and direction are less predictable. Although sharp edges can be readily produced, it is difficult to make accurate shapes such as points. This is reflected in the absence of any chert points or scrapers in the collection; all chert tools are classified in the ANPWS catalogue as flakes.

The closest occurrence of chert is in the Koolpin Formation, near Shovel Billabong. In this area some chert bands are pink to red and may be classified as jasper. Some of the chert artefacts are grey-red, supporting this area as the likely provenance.

One nodule of chert in the collection has a devitrified coating of powdery white material which, according to the catalogue, may have been used for ochre. This coating is not seen on Koolpin Formation chert. It is possible that the nodule came from the Katherine area, where chert nodules in the Cambrian Tindall Limestone commonly have these white rims.

CHALCEDONY

Chalcedony is a mixture of cryptocrystalline fibrous quartz and chert, and is the material which forms "thunder eggs" and agate in voids in volcanic rocks. One flake and one core in the collection are made from this material, which has properties similar to chert but which is much more brittle and commonly has an uneven fracture owing to its fibrous microcrystalline texture. Therefore when hit it is likely to shatter, and so is an inferior material for stone tool manufacture.

The two closest volcanic units are the Nungbalgarri Volcanic Member of the Kombolgie Formation within Arnhem Land, and the Plum Tree Creek Volcanics near Mount Callanan. Chalcedony is more common in the Plum Tree Creek Volcanics, so it is more probable that the source of this material was in the southern area of Kakadu.

RHYOLITE/IGNIMBRITE

Two flakes and one scraper are made from a fine grained pink to red-grey quartz-rich volcanic rock. Square to lath shaped pink to white feldspar crystals can be seen in the coarser grained varieties, along with greenish irregular shaped "xenoliths" (fragments of older rock broken up and incorporated in the volcanic magma), and occasional black flecks of biotite mica. This rock formed from debris ejected from the volcano as a dense hot cloud, which welded together, still hot, when it fell to the ground. The rock name is ignimbrite, although the term rhyolite is used when the rock is very fine grained and looks glassy.

This rock breaks off readily as relatively coarse conchoidal fragments. Owing to its fine grain size and homogeneous texture, quite sharp edges can be fashioned from it.

The rock belongs to the Plum Tree Creek Volcanics, and likely provenances for these tools would be near Mount Callanan, or between Turnoff Creek and Mount Lambell in the Katherine River catchment in the far southeast of Kakadu.

SILTSTONE

Silicified siltstone was used in the manufacture of one scraper and one flake, and one specimen of hematitic siltstone was also used as a source of red ochre. Highly silicified siltstone can produce a homogeneous, hard rock with a regular conchoidal fracture very suitable for tool manufacture. The scarcity of silicified siltstone through most of Kakadu however is reflected in the low number of tools in the collection made from this material.

Potential sources for the siltstone in the collection are the Wildman Siltstone west of Kakadu, Mesozoic siltstone from Cobourg Peninsula or from the Bloomfield Springs area in the south, and rare siltstone beds in the Kombolgie Formation such as those near Katherine Gorge south of Kakadu.

BASALT

Basalt is a black, fine grained, dense volcanic rock (extruded as lava flows from fissures probably along the "Bulman Fault Zone" which largely controls the course of the East Alligator River), and is used in two flakes in the collection. Basalt outcrop is widespread in Arnhem Land in the plateau country northeast of Magela Creek headwaters, but its use in Kakadu is overshadowed by other materials capable of producing better quality edges more easily. Basalt is less brittle than tuff and quartzite and harder to fracture, therefore it require mores effort to produce a less predictable result.

GNEISS

White gneiss composed of quartz and feldspar has been used to make a hammer which formed part of the artefact collection from the South Alligator Rangers' Station. The gneiss is a strong, coarsely foliated rock, and pieces with no weaknesses related to

jointing, veining etc. can be shocked repeatedly with little danger of breaking up. The gneiss comes from the Nanambu Complex, which forms low white rounded outcrops in places along the eastern bank of the South Alligator River, and underlies the Kombolgie Formation at Granite Hill 4 km south of Jabiluka and southwest of Gulung-gul.

GRANITE

One flake from the Jim Jim Rangers' Station is made from the distinctive coarse grained pink-grey "Mount Bundey Granite". This is the same rock type now used in Kakadu for the construction of rock embankments and rock bars across gullies for erosion control. Presumably the artefact was manufactured long before transport of granite boulders by truck 100 km into Kakadu began a few years ago.

The use of such coarse granite as a flake is surprising owing to the texture of the rock and the consequent difficulty in forming a sharp edge. It may be possible that some tools were traded on the basis of their appearance rather than on their performance alone. Therefore perhaps this tool may have had some aesthetic value to its owner.

GREYWACKE

Greywacke is a sandstone-like sedimentary rock with a high percentage of lithic (small rock fragments rather than individual mineral grains) material, usually derived from volcanic activity taking place at the same time as sedimentation. It is a widespread and common rock type west of the Mary River and south of Mount Bundey, and also between Moline and Katherine. It occurs mostly in the Mount Bonnie, Burrell Creek, and Tollis Formations.

The rock is in places quite highly siliceous and dense, and long conchoidal spalls can be easily split off. The only piece in the collection is a core, so the actual type of tool manufactured is not readily apparent. Where greywacke is near the contact zone with granite (for example near Pine Creek), it is metamorphosed to a very hard and dense hornfels which was quarried extensively by aboriginals in that region for stone tool manufacture. However, no tools made from hornfels are present in the Kakadu collection.

PREFERRED ROCK TYPES FOR DIFFERENT TOOLS

Cutting-type tools (flakes, points and scrapers) are mostly made from quartzite, tuff, chert and vein quartz, owing to the fracturing properties of these rocks and their ability to readily produce a sharp edge upon splitting (figure 1). The more definitive shapes required to produce points and scrapers result in the use of the rock types with more predictable fracturing characteristics; hence vein quartz and chert, with irregular fracture, are only rarely used in these tool types.

The **hammering and grinding-type tools** demand different characteristics from the cutting-type tools. The rocks used for pestles,

grinders, hammers and hatchets must be strong and difficult to fracture so that the tool does not break up during use. Dolerite, and some types of quartzite different from the quartzite used in the cutting-type tools, are used almost exclusively for this purpose.

Several of the dolerite tools appear to have been manufactured from appropriately shaped cobbles, small boulders, or spalls collected from areas of dolerite outcrop, or from water-worn cobbles collected from nearby creeks.

It is apparent from the texture, shape, hardness and colour of the quartzites used for this type of stone tool, that they were cobbles collected most probably from the Kombolgie Formation or Mundogie Sandstone. These cobbles were "reworked", that is they were originally eroded from older rock sequences and deposited as pebbles in conglomerate beds within the sandstones of these two geological formations. The hardness and durability of these cobbles therefore are not only reflected in their use for this type of stone tool, but also in their ability to survive reworking through a complete geological cycle (i.e. rock formation - erosion - transport - deposition - rock formation), and further erosion to release them from the enclosing sandstone to be collected for use as tools.

Ground edge tools are made almost exclusively from dolerite, reflecting that although the rock is dense and strong, it is less hard than quartz and quartz-rich rocks such as sandstone and quartzite against which the dolerite has been ground to produce the required edge. Whereas quartz has a hardness of 7 on Moh's scale, the constituent minerals of dolerite (feldspar, hornblende, olivine), have hardnesses of 6-6.5, 5-6, and 6.5-7 respectively. Quartzite is unsuitable because it cannot be ground to an edge against rocks of the same hardness.

PROVENANCE OF ARTEFACTS

The collection site for each artefact in the collection is plotted on Figure 2 for those where the collection site is recorded in the ANPWS catalogue. The closest suitable possible provenance for each artefact is also indicated. The lines connecting the collection site with the possible provenance are not intended to represent transport routes.

Most of the provenance areas lie within Kakadu, but a small number of artefacts are sourced from areas in Arnhem Land (mainly basalt), and is areas west and south of the Park (tuff, greywacke, granite, siltstone, chert nodule). Although most artefacts are locally sourced, there is strong evidence for transport and therefore trading of rock material or tools over distances commonly greater than 100 km.

The frequency distribution of possible artefact transport distances is plotted in Figure 3. The peak between 40 and 60 kilometres reflects the position of most of the collection sites on the plains about this far from the escarpment country or the hills and ridges terrain of southern Kakadu. As one might expect, above

this distance there is a direct negative relationship between distance and the number of artefacts. This suggests all suitable local material was exploited for tool manufacture in preference to reliance on trading links to import higher quality material from elsewhere. This is also supported by the use of local quartzite over tuff generally over 50 km away for points, where tuff is inherently easier to fashion and produces a tool of better quality.

REFERENCES

Needham, R.S., Crick, I.H., & Stuart-Smith, P.G., 1980 - Regional geology of the Pine Creek Geosyncline in Ferguson, J., & Goleby, A.B. (editors) - URANIUM IN THE PINE CREEK GEOSYNCLINE. Proceedings Series, International Atomic Energy Agency, Vienna. pp 1-22.

Needham, R.S., 1988 - Geology of the Alligator Rivers Uranium Field, Northern Territory. Bureau of Mineral Resources, Australia, Bulletin 224. 96pp.

APPENDIX: GEOLOGICAL DESCRIPTIONS OF ARTEFACTS IN KNP H/Q COLLECTION, JULY 1989. S. Needham BMR

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
1	Flake	Quartzite	Very fine grained, limonite stained, thoroughly silicified quartz sandstone	Munmarlary Quartzite Mundogie Sandstone, or Kombolgie Formation	Munmarlary area, KAPALGA, N MUNDOGIE
2	Retouched Point	Tuff	Spotted very fine grained black tuff (welded volcanic ash). Pale grey devitrified skin	Gerowie Tuff	MUNDOGIE, MCKINLAY
3	Retouched Point	Quartzite	Very fine grained white quartzite with pale mauve banding	Possibly Mesozoic-from silcrete cap	Only currently known locality is 10 km SE of Mary R Ranger Station in RANFORD HILL
4	Not geological material - metal strap				
5	Core	Quartz	Vein quartz pebble	Water worn pebble from Kombolgie Formation	Plateau and outlier country
6	Core	Quartzite	Pale pink very fine banded recrystallised quartzite	Water worn pebble from Kombolgie Formation	Plateau and outlier country
7	Hatchet	Dolerite	Porphyritic olivine dolerite. Phenocrysts of pale green feldspar < 7 mm dark plates of olivine < 3 mm	Oenpelli Dolerite	Within 250 m W of Nangalour Art Site (Nanguluwur)
8	Unidenti-fied	Hematitised siltstone	Dark red/brown layered (bedded) heavily hematised sedimentary rock-siltstone	?Kombolgie Formation	Plateau and outlier country
9	Glass - not geological				
10	Red ochre fragment	Sandstone	Exfoliated sandstone fragment with encrustation of ochre or mineral salts	Kombolgie Formation	Plateau and outlier country
11	Glass - not geological				

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
12	Ochre Pieces	Hematite	Specular hematite, massive and fine grained. One fragment facetted, indicating having been ground for ochre	Various formations	Widespread
13	Flake	Quartzite	White, pink and grey flakes of fine thoroughly silicified quartz sandstone	Probably Kombolgie Formation, silicified fracture zones	Plateau and outlier country
13/02	Flake	Quartzite	Buff-grey fine grained even grained strongly silicified quartz sandstone	Kombolgie Formation	Plateau and outlier country
13/04	Flake	Volcanic	Fine grained grey-pink crystalline igneous rock, probably volcanic	Probably, Nungbalgarri Volcanic Member of Kombolgie Formation	Plateau country
14	Not geological material				
15	As #13				
16/02	Ochre	Hematite	Very fine grained silty hematite	Possibly siltstone bed in Kombolgie Formation	Plateau and outlier country
17	Hatchet	?Dolerite	Heavily limonite coated weathered fine grained rock. Possibly very fine acicular texture suggests igneous-dolerite?	?Zamu Dolerite	JIM JIM, CAHILL
18/1,3	Tools & Flakes	Quartzite	White fine grained thoroughly silicified quartz sandstone	?Kombolgie Fm/Mundogie Sst	CAHILL, MUNDOGIE plateau & outlier areas
18/2	Tools & Flakes	Tuff	Cryptocrystalline dark grey tuff, with pale grey devitrified weathered surface	Gerowie Tuff	MUNDOGIE, MCKINLAY RIVER

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
18/4,7,10	Tools & Flakes	Quartz	Glassy and milky vein quartz	Quartz blows in fractures cutting Kombolgie Fm and older rock formations	Plateau, outlier and ridge country
18/5*	Tools & Flakes	Quartzite	Red/orange, colour banded, hematite/ilmenite stained, strongly silicified fine even grained quartz sandstone	Kombolgie Formation	Iron stained and silicified joints and faults, plateau and outlier country
18/6	Tools & Flakes	Quartzite	White ill sorted medium to coarse grained quartzite cut by finer quartz vein	Mundogie Sandstone	KAPALGA, MUNDOGIE
18/9*	Tools & Flakes	Tuff	Weakly laminated finely spotted light to dark grey tuff (volcanic ash)	Gerowie Tuff	MUNDOGIE/MCKINLAY RIVER /MARY RIVER
18/11	Tools & Flakes	Granite	Porphyritic pink/black granite. Zoned plagio-clase phenocrysts < 2 cm	Mount Bundey Granite	Mount Bundey area, MARY RIVER
18/12	Tools & Flakes	?Basalt	Dark grey-pink igneous rock-dyke or basaltic flow rock	?Nungbulgarri Volcanic Member, Kombolgie Formation	Plateau country
20*	Scraper	Rhyolite	Fine grained red, siliceous massive rhyolite. Very fine grained glassy quartz grains, greenish tuff fragments to 7 mm.	?Plum Tree Creek Volcanics	STOW/RANFORD HILL
21	Flake	Dolerite	Fine grey dolerite, fine ophitic texture	Zamu Dolerite	CAHILL, JIM JIM, MUNDOGIE
22/4-10	Tools & Flakes	Quartz	Glassy, pink, & white vein quartz	as 18/4 etc	
22/3	Tools & Flakes	Quartzite	Very fine white highly silicified quartz sandstone	as 18/1,3	

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
22/2	Tools & Flakes	Chert	Pink-grey cryptocrystalline banded siliceous rock-chert	?Koolpin Formation	MUNDOGIE
22/1	Tools & Flakes	Breccia	Brecciated hematite-stained quartz. Angular vein quartz fragments cemented with hematite stained siliceous matrix	Faults in Nanambu Complex	Cooinda-Nourlangie Camp area
23 (21, 16, 7, 20, 15, 28, 23, 14, 29, 27, 13)	Tools, Core, Flake	Quartz	Facetted (ie. fragments of large crystals of quartz) and broken fragments of vein quartz, as quartz-crystal and milky quartz	Vein quartz infill of fracture zones, Kombolgie Formation and older units	Plateau, outlier and ridge country
23 (6, 9, 19, 2, 17, 26, 22, 12, 25, 8, 18)	Tools, Core, Flake	Quartzite	Pink, white and grey fine strongly silicified quartz sandstone	Kombolgie Formation silicified fractures, or Mundogie Sandstone	Plateau and outlier country; or MUNDOGIE NW JIM JIM
23 (2, 5, 11)	Tools, Core, Flake	Sandstone	Weakly silicified fine to medium grained quartz sandstone. One with quartz crystal growths (in vein)	Kombolgie Formation	Plateau and outlier country
23/1	Tools, Core, Flake	Breccia	Hematitic infill to quartz breccia. One vein quartz fragment < 1 cm	Fault zone	Cooinda-Nourlangie Camp area
23/4, 10	Tools, Core, Flake	Siliceous siltstone	Very fine, finely layered, dark grey/brown siliceous rock-sediment. Possibly contact metamorphosed (ie. hornfels)		?MARY RIVER, MCKINLAY RIVER, MUNDOGIE or farther south
24	Ochre	Hematite	Massive hematite, specular hematite encrustation, minor limonite coating	Koolpin Formation or Wildman Siltstone	MUNDOGIE, MCKINLAY RIVER, PINE CREEK, MARY RIVER

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
25	Pestle	Dolerite	Weathered, weakly foliated, porphyritic metadolerite. Spongy (weathered) surface. Amphibole laths < 6 mm, plagioclase phenocrysts to 4 mm	Zamu Dolerite	JIM JIM, CAHILL, MUNDOGIE, OENPELLI
26	Pestle	Dolerite	Fine ophitic dolerite, speckled cream weathered surface	Zamu Dolerite	JIM JIM, MUNDOGIE
27	Pestle	Dolerite	Fresh speckled black/white fine foliated dolerite	Zamu Dolerite	JIM JIM, MUNDOGIE, CAHILL
28	Pestle	Dolerite	Medium grained green/grey dolerite, ophitic texture	Zamu Dolerite	JIM JIM, MUNDOGIE
29*	Mortar	Quartzite	Foliated fine grained chlorite-muscovite metaquartzite	Mundogie Sandstone, Cahill Formation, Munmarlary Quartzite	CAHILL, EAST ALLIGATOR MUNDOGIE
50	Scraper	Silicified claystone	Very fine grained white silicified claystone	Mesozoic Bathurst Island Formation	Cobourg Peninsula and islands
51	Flakes	Dolerite	Fine grained grey-green ophitic dolerite	Zamu Dolerite	Between Rum Jungle and South Alligator River
52	Scraper	Gabbro	Coarse grained black feldspar amphibole gabbro	Oenpelli Dolerite	2 km N of Leichhardt Billabong
53	Flake	Dolerite	Altered pale grey-green medium-grained feldspar amphibole dolerite	?Zamu Dolerite	Between Rum Jungle and South Alligator River
54	Unidenti-fied	Dolerite	Medium to coarse grained feldspar amphibole dolerite, feldspar euhedra to 5 mm, Limonite staining	Zamu Dolerite	Between Rum Jungle and South Alligator River

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
55	Unidenti-fied	Dolerite	Medium grained altered (creamy white feldspars) quartz dolerite	Oenpelli Dolerite	Between Cooinda and 2 km N of Leichhardt Billabong
56	Flake	Dolerite	Medium grained feldspar dolerite. Minor limonite staining, feldspars altered to creamy white	Zamu Dolerite	Between Rum Jungle and South Alligator River
57	Scraper Flake	Tuff	Massive to finely laminated, very fine grained to crypto-crystalline, grey to dark grey cherty tuff. Devitri-fied pale grey skin on smaller flake	Gerowie Tuff	MUNDOGIE, MCKINLAY, MARY RIVER
58	Flakes	Chert	Very fine grained brownish grey hackly siliceous chert. Pale grey partly devitrified weathered surface	Possibly from chert nodule or band in Mesozoic rocks from Cobourg Peninsula & islands, or from limestones in Daly River area, or Gerowie Tuff or Koolpin Formation	?
59	Flake	Cherty quartzite	Very fine grained, flaky to conchoidal fracture, grey massive siliceous quartzite	?Acacia Gap Quartzite	Rum Jungle to Adelaide River
60	Flake	Tuff	Very fine grained spotted dark grey tuff (volcanic ash) with white/cream devitrified skin	Gerowie Tuff	MUNDOGIE/MCKINLAY RIVER/ MARY RIVER/NOONAMAH
61	Flake	Chert	Red-brown fine siliceous fractured chert, altered to white/cream in and around some fractures. Hackly fracture	?Koolpin Formation	MUNDOGIE/MCKINLAY RIVER/ MARY RIVER

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
62	Flake	Tuff	Very fine grained black spotted tuff, devitrified pale cream skin. Finely laminated layering of spots	Gerowie Tuff	MUNDOGIE/MCKINLAY RIVER/ MARY RIVER/NOONAMAH
63	Flake	Quartz	Fragment of water-worn pebble (originally about 8 cm across) of milky vein quartz	Pebble from creek bed or clast from Early or Middle Proterozoic conglomerate or pebbly sandstone unit	Plateau, outlier, southern hills, or sand plains country
64/1-2	Ochre	Hematite	Very finely crystalline specular hematite. 1. Is fragment of water worn pebble. 2. Is possibly the same or worn by rubbing	Probably Koolpin Formation	KAPALGA/MUNDOGIE MCKINLAY RIVER/MARY RIVER
64/3	Flake	Chert	as for #61		
65	Broken point	Silicified sandstone	Hematite-stained fine grained well sorted quartz sandstone, strongly silicified	Kombolgie Formation or Petrel Formation	Plateau/outlier stone country, or Mesozoic cliffs in RANFORD HILL
66 as #65					
67	Outcrop material not artefact	Dolerite	Fine grained weathered ophitic grey dolerite, hematite/limonite rind and fracture coatings	Zamu Dolerite	Cooinda to Black Jungle Range
68	Flake	Silicified sandstone	Red, hematite-stained, moderately (68/1) to strongly (68/2) silicified fine to very fine grained quartz sandstone. 68/1 is a pebble fragment, therefore unlikely to be from the Mesozoic	Kombolgie Formation	Plateau and outlier country

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
69	Ochre	Hematite/ quartz	Crystalline quartz growths in very finely crystalline specular hematite. Shape indicates rubbing for ochre	?	Virtually anywhere in NT
70	Rock sample	Laterite	Fragments of laminated to vermicular hematite/ limonite laterite	Cainozoic laterite capping	Extensive on sand plain country
71	as #65 and #68				
72	Unidenti-fied	Rhyolite	Fragments of pebbles of weathered pink, finely porphyritic (euhedral laths of white feldspar and "square" glassy quartz) volcanic rock, probably rhyolite or ignimbrite	Plum Tree Creek Volcanics or Coronation Sandstone	STOW, RANFORD HILL (Stage 3 area)
73	Rock sample	Dolerite	Very fine grained ophitic dark grey-green dolerite, white to brown ferruginous weathered rind	Zamu Dolerite	Cooinda to Black Jungle Range
74	Flake	Silicified sandstone	Very fine, strongly silici-fied, sandstone, limonite and hematite stained in patches and along fractures	Kombolgie Formation or Petrel Formation	Plateau/outlier country or southern Mesozoic cliffs
75	Unidenti-fied	Quartzite	Coarse-grained white metamorphic quartzite. Angular grains, rock weakly foliated.	Mundogie Sandstone or Munmarlary Quartzite	FIELD ISLAND/KAPALGA/ EAST ALLIGATOR/CAHILL
76	Rock sample	Vein quartz	Fractured milky vein quartz	Quartz blows widespread in region	Almost anywhere along quartz-filled fault zones

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
77	Unidenti-fied	Silicified siltstone	Iron-stained red-grey silicified siltstone. Pale yellow-brown limonitic weathered rind	?Wildman Siltstone	FIELD ISLAND/POINT STUART/ KOOLPINYAH
78	Scrapers	Tuff	Massive to finely laminated tuff (78/3, crystal tuff) 78/1 has devitrified weathered rind	Gerowie Tuff	MUNDOGIE/MCKINLAY RIVER MARY RIVER/NOONAMAH
79 as #78					
80	Ochre	Quartz hematite rock	Coarsely crystalline specular hematite with quartz intergrowths	Hematite and quartz-filled fault zone	Widespread, along some fault zones mainly on sandy plains and in southern hills
81	Rock sample	Hematite	Amorphous dark red-brown hematite, in flaky frag-ments with irregular patches of vein quartz and some small fragments (apparently as clasts in amorphous groundmass) of specular hematite	Probably hematite-rich cap on laterite from on or near fault zone	Widespread mainly on sand plains country
82	Microcore	Chert	Red chert with uneven to conchoidal fracture. Silicified siltstone/ claystone	Possible silcrete over Mesozoic strata	Cobourg Peninsula, islands, southern Mesozoic cliffs
83	Scraper	Quartzite/ crystal tuff?	Dark grey fine to very fine highly silicified quartz sandstone. Probably originally a water worn pebble from creek bed, or clast in pebbly sandstone or con-glomerate. Devitrified white rind. Or may be crystal tuff.	Clast from Mundogie Sandstone/Crater Formation; or Gerowie Tuff	Rum Jungle to South Alligator River & north of 13° 30'S

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
84	Scraper	Tuff	Laminated light to medium grey amorphous to finely spotted tuff.	Gerowie Tuff	MARY RIVER (e.g. Annaburroo)
85	Flake	Tuff	Very finely laminated black very fine grained tuff. White devitrified weathered rind.	Gerowie Tuff	MUNDOGIE/MCKINLAY RIVER/ MARY RIVER
86/2	Broken point	Quartzite	Very fine grained white even grained highly silicified quartz sandstone	Mundogie Sandstone or Petrel Formation	MUNDOGIE, or RANFORD HILL (Mesozoic cliffs)
87	Hatchet	Amphibolite	Very fine grained, green-grey moderately foliated amphibolite (metamorphosed fine-grained dolerite)	Zamu Dolerite	CAHILL/EAST ALLIGATOR/ OENPELLI
87*	Hatchet	Amphibolite	Very fine grained, green-grey, moderately foliated amphibolite (metamorphosed fine-grained dolerite)	Zamu Dolerite	CAHILL/EAST ALLIGATOR/ OENPELLI
88	Grinder	Dolerite/ Gabbro	Medium grained dark-green olivine feldspar hornblende dolerite. Massive	Oenpelli Dolerite	OENPELLI/GILRUTH/ JIM JIM
89	Grinder	Sandstone	Poorly sorted, medium to coarse grained quartz sandstone. Angular quartz grains. Probably a rounded creek boulder	Kombolgie Formation or Mount Basedow Gneiss	Plateau/outlier country or Mount Basedow area
90	Hammer	Sandstone	Poorly sorted, medium to coarse grained quartz sandstone. Angular quartz grains. Probably a rounded creek boulder	Kombolgie Formation or Mount Basedow Gneiss	Plateau/outlier country or Mount Basedow area

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
91	Hatchet	Metadolerite	Fine grained green-grey altered chloritic dolerite/ amphibolite	Zamu Dolerite	CAHILL/EAST ALLIGATOR/ JIM JIM
92	Broken point	Quartzite	Pale brown fine grained and well sorted strongly silicified quartz sand-stone .	Kombolgie Formation	Plateau/outlier country along fault zones
93	Hammer	Quartzite	Brown very fine grained and well sorted silici-fied quartz sandstone. Rod-shaped river pebble.	Kombolgie Formation	Plateau/outlier country
94	Not rock material (bone)				
95	Rock fragment/ ochre	Porcellanite	Hard (greater than 7) amorphous white nodule with powdery white coating with minor-hexagonal cracking, also with patchy brown limonite staining	Chert nodule in Cambrian limestone?	Possibly Katherine area
96	Grinding stone	Dolerite	Medium grained massive green feldspar amphibole dolerite	Oenpelli Dolerite	OENPELLI/GILRUTH/ JIM JIM
97	Ochre	Sandstone	Sandstone pebble, medium grained with brown matrix, encrusted with limonite/ hematite skin.	Kombolgie Formation	Plateau/sandstone country
98	Not rock material (glass)				
99	Flake	Vein quartz	Milky vein quartz with limonite staining on irregular to hackly fracture surfaces	Quartz blows on fault zones	Anywhere on sand plain country

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
100	Core	Chalcedony	Fragment of siliceous void filling from a volcanic flow, i.e., "Thunder egg"	Probably Antrim Plateau Volcanics or Plum Tree Creek Volcanics or Nungbalgarri Volcanic Member	Katherine area or STOW/ RANFORD HILL or Goomadeer River area
101	Laterite	Hematitic siltstone	Laminated highly hematitic very fine siltstone. Thin layers to 2 mm of pale grey coarser silty bands. Patchy limonite coating.	Wildman Siltstone	MARY RIVER/MCKINLAY RIVER
102	Hammer	Gneiss	Crenulated medium-grained pale-grey muscovite feldspar quartz gneiss	Nanambu Complex	EAST ALLIGATOR, CAHILL
103	Axe	Altered Gabbro	Dark green fine grained altered gabbro. Strongly chloritised irregular patches to 1.5 cm of glassy pale brown patches (quartz?) with dark brown facetted crystals to 1.5 mm at centre (garnet?)	?Oenpelli Dolerite	Widespread in plateau country, mainly OENPELLI, GILRUTH
104	Flake	Quartzite	Dark grey fine grained metaquartzite	?Munmarlary Quartzite	Munmarlary area
105	Rock sample	Tuff	Laminated pale to dark grey tuff, fractured with limonite and hematite coatings and a filling of an amorphous white material-product of devitrification?	Gerowie Tuff	MARY RIVER/MCKINLAY RIVER
106	Ochre	Hematite	Red to black finely crystalline specular hematite. Botroyoidal growths in vugs-goethite?	Koolpin Formation or Wildman Siltstone	MUNDOGIE/MCKINLAY RIVER/ PINE CREEK

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
107	Scraper	Tuff	Black cryptocrystalline tuff, massive, conchoidal fracture. Grey devitrified weathered rind.	Gerowie Tuff	MCKINLAY RIVER
109	Core	Vein quartz	Glassy vein quartz, fractured	Quartz blows over fault zones	Widespread over sand plain country
111	Axe	Dolerite	Fine ophitic grey dolerite, rare feldspar euhedra to 4 mm	Zamu Dolerite	KAPALGA, MUNDOGIE
112	Anvil	Quartzite	White, coarse, moderately sorted, quartz veined, silicified meta-sandstone	Mundogie Sandstone or Munmarlary Quartzite	Mount Partridge Range-Mundogie Hill area, or Munmarlary area
113	Core	Vein quartz	as #109		
115	Cyclon	Quartzite	White to pale pink coarse grained foliated feldspar quartz gneiss-metamorphosed arkose. Fragments angular.	Munmarlary Quartzite	Munmarlary area
116	Core	Quartz vein in meta-arkose	Fractured glassy pale grey quartz vein 6 cm wide cuts coarse, ill sorted (angular to subangular fragments) meta-arkose.	Munmarlary Quartzite	Munmarlary area
117	Core	Greywacke	Fine grained pale grey-brown muscovitic massive greywacke	Fisher Creek Siltstone	Between McKinlay and Adelaide Rivers or Moline-Katherine area
118	Axe	Dolerite	Fine grained, green-grey altered chloritic massive olivine dolerite	Zamu Dolerite	KAPALGA, MUNDOGIE, MCKINLAY RIVER, BATCHELOR

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
119	Grinder	Quartzite	Fine grained, pale grey-brown foliated metamorphic quartzite. Possibly a pebble clast. Ground smooth on one broad curved face	Munmarlary Quartzite or clast from Mundogie Sandstone	FIELD ISLAND, KAPALGA, Munmarlary area
121	Scraper	Quartzite	Fine grained silicified even grained quartz sandstone, pale brown iron staining	Kombolgie Formation	Silicified zone in sandstone of Arnhem Land Plateau/ outliers
122	Scraper	Quartzite	fine grained silicified even grained quartz sandstone, pale brown iron staining	Kombolgie Formation	Silicified zone in sandstone of Arnhem Land Plateau/ outliers
123	Flake	Rhyolite	Cryptocrystalline red siliceous rhyolite (welded volcanic glass)	Plum Tree Creek Volcanics	RANFORD HILL, STOW, KATHERINE, probably within 10 km of El Sherana turnoff on Kakadu Highway or Turnoff Creek area 10 km S of Sleisbeck
124	Cyclon	Dolerite	Fine ophitic grey dolerite, iron-stained reddish weathered surface	Zamu Dolerite	JIM JIM, MUNDOGIE, STOW
125	Axe	Dolerite	Medium grained ophitic dolerite, weathered to pale grey with brown limonite patches	Zamu Dolerite	JIM JIM, MUNDOGIE, STOW
126	Anvil	Dolerite	Weathered grey fine grained metadolerite	Zamu Dolerite	JIM JIM, CAHILL, KAPALGA, MUNDOGIE
127	Axe	Dolerite	Pale grey-green fine grained metadolerite	Zamu Dolerite	JIM JIM, CAHILL, KAPALGA MUNDOGIE

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
128	Grinder	Sandstone	Silicified salmon pink, fine and even-grained quartz sandstone	River worn pebble clast from, probably, Kombolgie Fm sandstone	Anwhere in the plateau and escarpment country
129	Scraper	Tuff	Black vitreous tuff (welded volcanic ash), conchoidal fracture, grey devitrified weathered surface.	Gerowie Tuff	MUNDOGIE, MCKINLAY RIVER
130	Rock sample	Quartzite	Meta-arkose, very coarse to gritty grain size, angular glassy quartz and white weathered feldspar grains	Munmarlary Quartzite	Near Munmarlary homestead
131	Flake	Tuff	Very fine grained black tuff (welded volcanic ash)	Gerowie Tuff	MUNDOGIE, MCKINLAY RIVER
132	Scraper	Spotted tuff	Very fine grained black tuff (welded volcanic ash)	Gerowie Tuff	MUNDOGIE, MCKINLAY RIVER
133	Grinder	Quartzite	Pink fine, even grained silicified quartz sandstone. (Slight hematite staining).	Water worn pebble clast from Kombolgie Formation sandstone	Anywhere in plateau/ outlier country
134	Grinder	Quartzite	Cream, fine and even grained, silicified quartz sandstone	Water worn pebble clast from Kombolgie Formation sandstone	Anwhere in plateau/ outlier country
135	Core	Chert	Black chert, hackly to conchoidal fracture. Hint of bedding/layering. Microfractured.	Water worn pebble clast origin unknown	?
136	Hammer	Sandstone	Coarse, saccharoidal white quartz sandstone, hematite/ limonite staining.	Mundogie Sandstone	MUNDOGIE, KAPALGA, FIELD ISLAND

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
137	Hammerstone grinder	Quartzite	Fine grained, even grained pink-grey silicified quartz sandstone	Water worn pebble from ?Kombolgie Fm, ?Mundogie Sst	?
138	Rock sample	Dolerite	Coarse olivine dolerite. Olivine crystals stand out as green euhedral knobs on weathered surface	Oenpelli Dolerite	Within 200 m W of Nanguluwur Art Site
139	Flake	Tuff	Black vitreous tuff (welded volcanic ash), conchoidal fracture	Gerowie Tuff	MUNDOGIE/MCKINLAY RIVER
140	Axe	Dolerite	Fine grained green-grey metadolerite	Zamu Dolerite	MUNDOGIE or KAPALGA or JIM JIM
141	Anvil	Dolerite	Fine grained grey-green ophitic metadolerite	Zamu Dolerite	MUNDOGIE or KAPALGA or JIM JIM
142	Hammerstone	Quartzite	Oblate river worn pebble 9x6x4 cm. White fine grained quartzite, non-foliated	Probably a clast from Mundogie Sandstone	Widespread in FIELD ISLAND, KAPALGA, MUNDOGIE
143	Axe	Dolerite	Fine grained green-grey metadolerite	Zamu Dolerite	MUNDOGIE/KAPALGA or STOW/ JIM JIM
144	Anvil	Dacite	Porphyritic medium grained dacite; phenocrysts of white sub-euhedral plagio-clase feldspar up to 1 cm across in a green matrix of plagioclase and augite	Un-named dacite body between Shovel Billabong and UDP	Around and SW of Shovel B'bong, MUNDOGIE
145	Not rock material				
146*	Scraper	Tuff	Fresh massive black spotted tuff, very thin rind of devitrified spots/weathered feldspar	Gerowie Tuff	MUNDOGIE/MCKINLAY RIVER

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
148	Point	Tuff	White devitrified (ie. weathered) tuff (welded volcanic ash). Very fine grained	Gerowie Tuff	SW of S All River in MUNDOGIE. Also possibly from MCKINLAY RIVER
149	Point	Quartz	Glassy vein quartz	Vein quartz blows wide-spread in lowland and ridgeland areas of Kakadu	Anwhere in lowland/ ridgeland Kakadu
150	Point	Tuff	White devitrified (ie. weathered) tuff, fine grained	Gerowie Tuff	SW of S Alligator R in MUNDOGIE. Also MCKINLAY RIVER
151	Flake	Quartz	Glassy vein quartz	Widespread quartz blows	Lowland and ridgeland areas of Kakadu
152	Point	Tuff	Pale green/grey very fine grained devitrified tuff with fine quartz vein	Gerowie Tuff	SW of S Alligator R in MUNDOGIE. Also MCKINLAY RIVER
153	Point	Tuff	Pale white/cream very fine grained devitrified tuff	Gerowie Tuff	SW of S Alligator R in MUNDOGIE. Also MCKINLAY RIVER
154	Hatchet	Dolerite	Weathered green-grey fine ophitic metadolerite	Zamu Dolerite	JIM JIM/MUNDOGIE/KAPALGA
157	Scraper	Quartzite	White fine grained strongly silicified quartzite	?Kombolgie Formation or ?Munmarlary Quartzite or ?Mundogie Sandstone	Munmarlary area or Spring Peak area or silicified zones anywhere on Arnhem Land Plateau
158	Flake	Chalcedony	Red cherty chalcedony with hackly, glass-like fracture. Devitrified to white material on weathered edge	Koolpin Formation	MUNDOGIE. Probably within 10 km S of Long Billabong and W of Shovel B/bong

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
159 Glass-man made					
160	Point	Tuff	Black spotted tuff (welded volcanic ash)	Gerowie Tuff	MUNDOGIE, MCKINLAY RIVER
167	Anvil	Dolerite	Fine grained green-grey ophitic dolerite	Zamu Dolerite	JIM JIM, STOW, MUNDOGIE
168	Chopper	Dolerite	Very fine green-grey dolerite/metadolerite, limonitic coated weathered surface in places	Zamu Dolerite	JIM JIM, STOW, MUNDOGIE
169*	Point	Tuff	Green, very finely spotted massive cherty tuff	Gerowie Tuff	MUNDOGIE/MCKINLAY RIVER/ MARY RIVER
171	Stone tool	Quartzite	Pink thoroughly silicified medium grained quartz sandstone	Kombolgie Formation silicified zone	Plateau/outlier country
172	Stone tool	Quartzite	Pink thoroughly silicified medium grained quartz sandstone	Kombolgie Formation silicified zone	Plateau/outlier country
173	Stone tool	Quartzite	Pale mauve thoroughly silicified fine grained sandstone	Kombolgie Formation silicified zone	Plateau/outlier country
174	Stone tool	Chalcedony	Dark red/grey cherty chalcedony, fine (< 2mm) specular hematite veinlets	Koolpin Formation	MUNDOGIE, within 10 km S of Long Billabong
175	Stone tool	Chalcedony	ditto more cherty, red-grey, no hematite veins	Koolpin Formation	MUNDOGIE, within 10 km S of Long Billabong
177 as for #171					

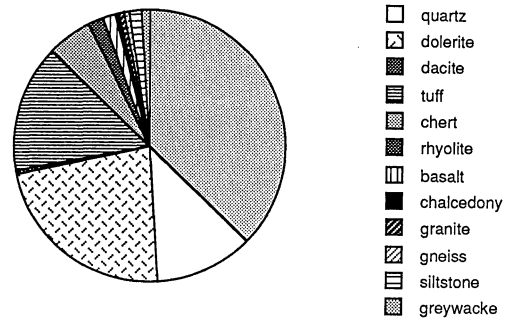
Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
178	Core	Amethyst	Crystalline amethystine quartz	Quartz filling voids along faults and fractures in Kombolgie Formation sandstone and all older rocks	Near Koongarra
179 as for #171					
180	Flake	Amethyst	As for #178		
181	Point	Quartzite	White strongly silicified quartz sandstone/ quartzite	Mundogie Sandstone or Munmarlary Quartzite	NE MUNDOGIE/NW JIM JIM, or MUNMARLARY area
182	Point	Quartzite	Grey/pale mauve thoroughly silicified quartz sandstone/ quartzite	Kombolgie Formation or Mundogie Sandstone	Plateau/outlier country or NE MUNDOGIE/NW JIM JIM
183	Point	Quartzite	Grey/pale mauve thoroughly silicified quartz sandstone/ quartzite (white)	Kombolgie Formation or Mundogie Sandstone	Plateau/outlier country; or NE MUNDOGIE/NW JIM JIM
184 as for #178					
185 as for #178					
186 as for #178					
187	Flake	Chalcedony	Grey/red conchoidal fractured cherty chalcedony	Koolpin Formation	Within 10 km S Long Billabong
188	Flake	Chalcedony	As for # 187 with specular hematite veining on one surface	Koolpin Formation	Within 10 km S Long Billabong
189	Flake	Quartz	Rock crystal (ie. high quality vein quartz free of discolouration and other impurities)	Any quartz-filled fault or fracture zone in all rocks of Kombolgie Fm age or older	Plateau, outlier and ridge country, sand plains

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
191	Point	Quartz	Milky vein quartz	Any quartz-filled fault or fracture zone in all rocks of Kombolgie Fm age or older	Plateau, outlier and ridge country, sand plains
192	Flake	Hematitic quartz breccia	Hematite-stained siliceous material, brecciated and veined by greyish milky quartz. Quartz crystal terminations on one face indicate quartz growth into void.	Fault zone	Plateau, outlier and ridge country, sand plains (eg. between Cooinda and Nourlangie Camp)
193	Hatchet	Dolerite	Medium grained green-grey dolerite. Hornblende weathers out as dark acicular crystals on surface. These are aligned, indicating metamorphism ie. the rock is properly termed a 'meta-dolerite'.	Zamu Dolerite	JIM JIM/CAHILL
194	Hatchet	Dolerite	Porphyritic coarse dolerite, cream feldspar phenocrysts to 7 mm	Oenpelli Dolerite	JIM JIM (Deaf Adder Gorge area) or OENPELLI
195	Mortar	Quartzite	Medium grained silicified quartz sandstone with occasional vein quartz pebbles < 7 mm	Water worn pebble from Kombolgie Formation	Plateau and outlier country
196	Hatchet	Dolerite	Medium to fine grained green-grey dolerite, deeply weathered surface, chloritic veinlets < 1 mm	Zamu Dolerite	JIM JIM/CAHILL/MUNDOGIE
197	Hatchet	Gabbro	Medium grained black gabbro, tight acicular ophitic fabric	Oenpelli Dolerite	JIM JIM (Deaf Adder area) or OENPELLI

Catalogue No. (*indicates in training collection)	Artefact Type	Short Rock Name	Short Rock Description	Geological Formation	Possible Provenance (capitals indicate standard 1:100 000 sheet names)
198	Chopper	Dolerite	Weathered surface precludes detailed description. Probably medium grained grey-green metadolerite	?Zamu Dolerite	?CAHILL/JIM JIM/MUNDOGIE
202	Point	Quartzite	Silicified white, very fine and even grained, quartz sandstone. Wavy amorphous silica zones and zones of limonite staining	Petrel Formation	Southern Mesozoic cliffs
208	Ochre stone	Specular hematite	Massive, fine grained specular hematite. Striated facets indicate grinding for ochre	Koolpin Formation	STOW, MUNDOGIE, MCKINLAY RIVER
209	Spear	Quartzite	Silicified white, very fine and even grained, quartz sandstone	Petrel Formation or Kombolgie Formation	Southern Mesozoic cliffs or plateau and outlier country
5471P1047	Rock sample	Rock Crystal	Glassy vein quartz. Flat brown pitted face is vein wall against country rock. Specular hematite inclusions parallel to vein wall display free form finely dendritic crystal growths. Minor pinkish red amorphous irregular inclusions - probably hematite along quartz crystal boundaries	Vein quartz blows along fault zones	Widespread in sand plains country, also plateau, outlier and ridge country

Figure 1. Preference for the use of certain rock types for different types of artefact

TOTAL ARTEFACTS n=153



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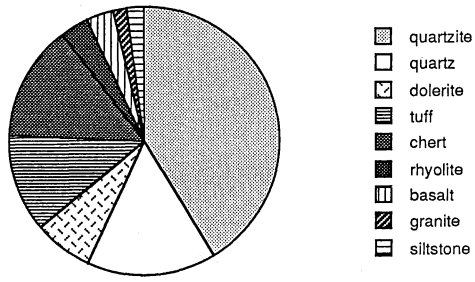

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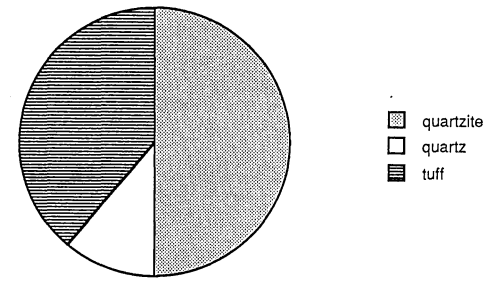
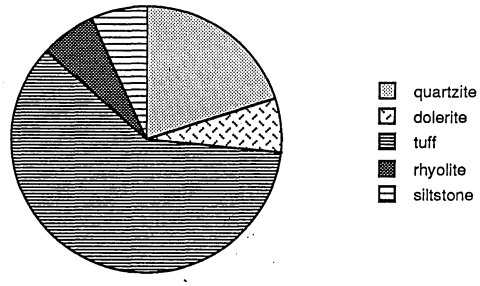
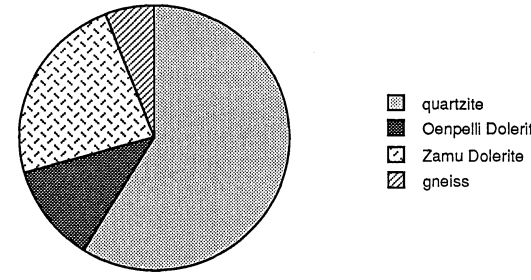


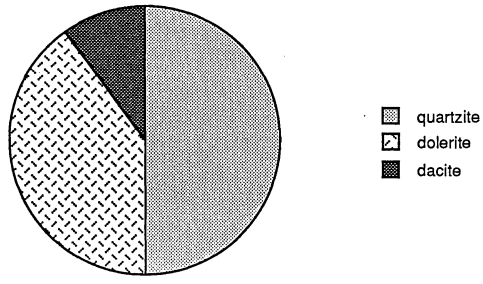
SCRAPERS n=15



PESTLES/GRINDERS/HAMMERS n=17



MORTARS/ANVILS n=10



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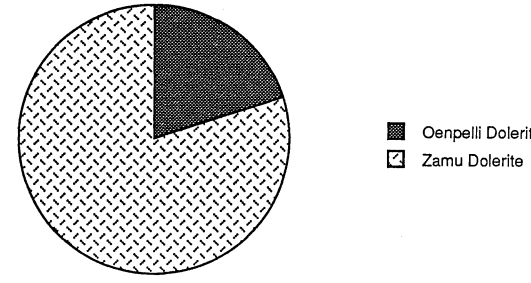

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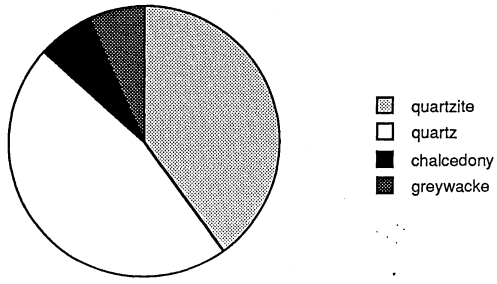


OCHRE STONES n=11

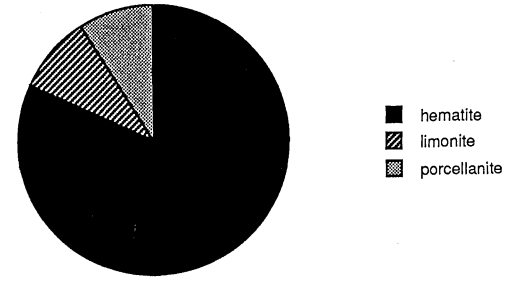
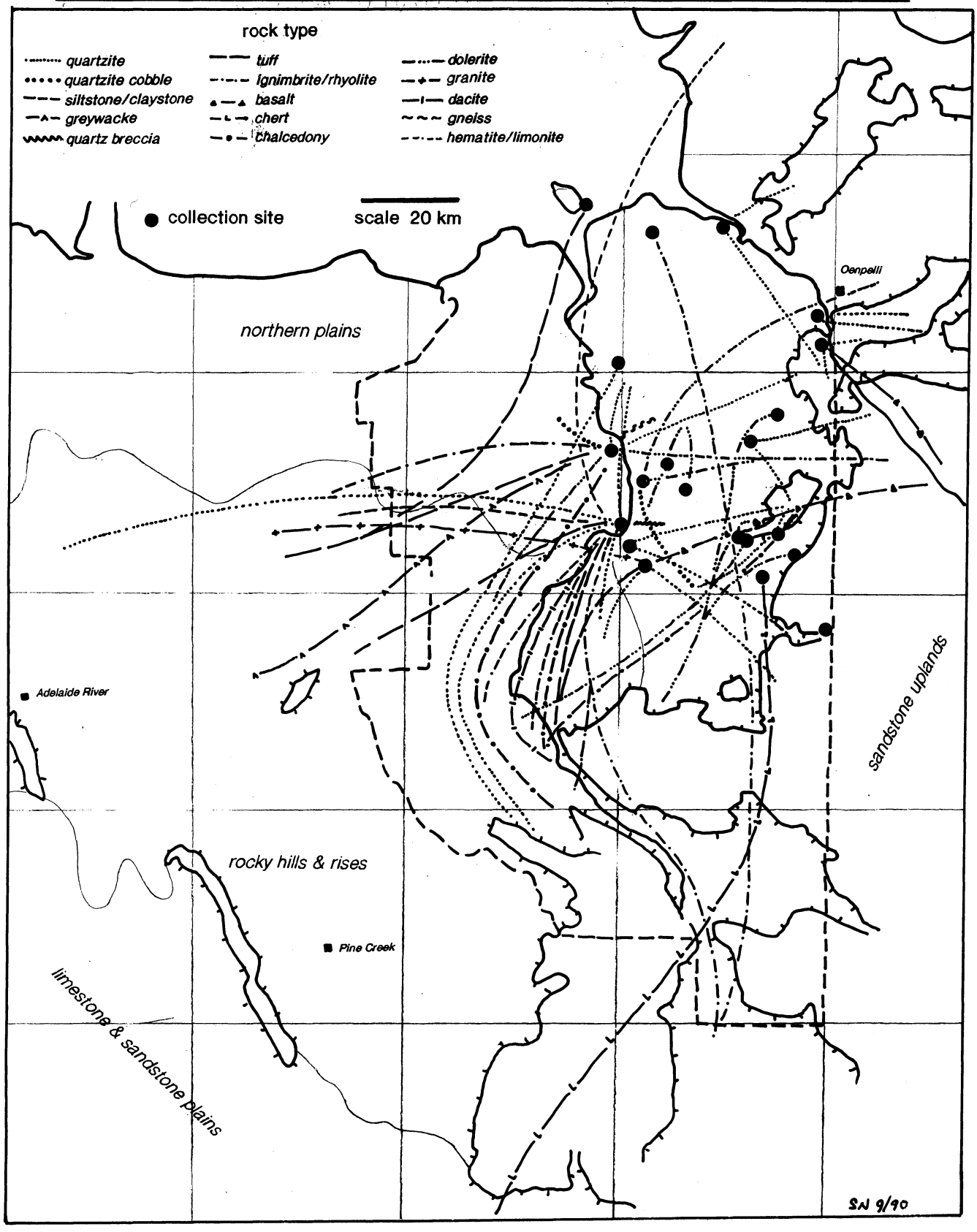


Figure 2.

PROVENANCE OF STONE ARTEFACTS IN THE KAKADU NATIONAL PARK HEADQUARTERS COLLECTION



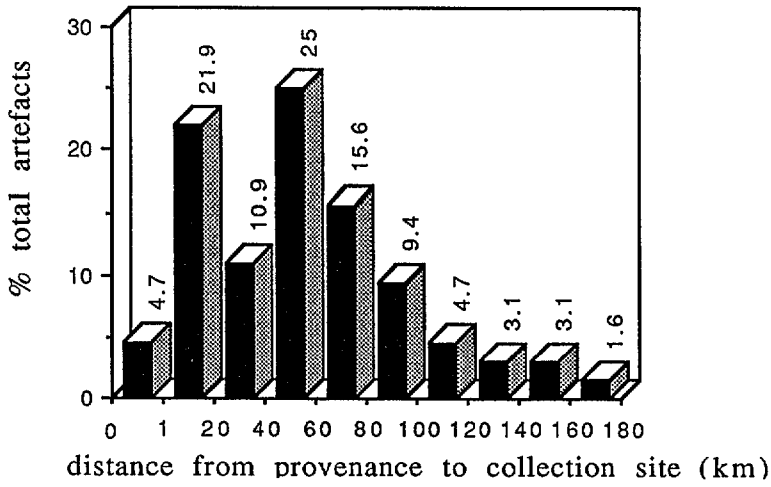


Figure 3. Distance between collection site and likely provenance