Messages in Paint
An archaeometric analysis of pigment use in Aboriginal Australia focusing on the production of rock art

Jillian A. Huntley
BA (Hons) Australian National University

This thesis is submitted for the Degree of Doctor of Philosophy of the University of New England

December 2014
I certify that any help received in the preparing this thesis and all sources used have been acknowledged herein.

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

Jillian A. Huntley
December 2014

Archaeology
School of Humanities
University of New England
For Fred, Astro-Charlie and Bella Bug.

With thanks to the Mikes (Smith and Morwood) for helping engage the ‘big picture’.
# Table of Contents

Acknowledgements for Graphics  m  
List of Tables  o  
List of Figures  q  
Abstract  i  
Acknowledgements  ii  
Statement of Authorship  v  
Forward  vi  
A Note on Nomenclature  vii  
List of Abbreviations  viii  

## Chapter One - Introduction  1  
  1.1 Archaeological Investigations of Ochre  4  
  1.1.1 Australian Ochre studies  10  
  1.2 Re-examining the Provenance Postulate  19  
  1.2.1 Previously Unseen:  
      Geochemical Evidence of Cultural Context in Rock Art Production  21  
  1.2.2 Issues of Scale  23  
  1.3 pXRF in Archaeology  24  
  1.3.1 pXRF and Rock Art Research  26  
  1.4 Research Aims and Regional Context  28  
  1.4.1 The Rock Art Assemblages  30  
  1.4.1.1 The Sydney Basin  31  
  1.4.1.2 The Northwest Kimberley  31  
  1.4.2 Archaeological History:  
      Geochemical and Archaeological Implications  38  
  1.4.3 Regional Environment  39  
  1.4.3.1 The Sydney Basin  40  
  1.4.3.2 The Northwest Kimberley  43  
  1.4.4 Geochemical and Archaeological Implications  
      of Regional Palaeogeographies  47  
  1.5 Research Aims  49  
  1.5.1 Thesis Structure and Case Study Specific Research Aims  50
PART I
Chapter Two
Huntley, J. (2012). Taphonomy or Paint Recipe: In situ portable X-ray fluorescence analysis of two anthropomorphic motifs from the Woronora Plateau, New South Wales. Australian Archaeology, 75 (December), 78-94. ISSN: 0312-2417

Preface to the article 57
Abstract 57
2.1 Introduction 58
2.2 Complex Physical Interactions –
Some Issues Associated with in situ pXRF Analysis of Rock Art 59
2.3 Orientation - Browns Road 29 62
2.3.1 Taphonomic Context of Rock Art at BR29 65
2.4 Application of in situ pXRF at BR29 (Research Aims) 68
2.5 Methodology 66
2.6 Results and Discussion 71
2.6.1 Trends in Overall Compositional Data 71
2.6.2 Trends in Indicator Elements 76
2.6.3 'Visibility' of Indicator Elements with pXRF 81
2.6.4 Archaeological Implications of Geochemical Data from pXRF Analysis at BR29 82
2.7 Summary 82
Acknowledgements 82

Chapter Three

Preface to the book chapter 87
Abstract 87
3.1 Introduction 88
3.2 pXRF: background, example and evaluation 90
3.2.1 pXRF methodology 91
3.22 Case study: evidence for geomorphic processes (chemical weathering) in sandstone shelters containing rock art; pXRF as a novel conservation and management tool 92
3.2.3 Evaluating pXRF for rock art and associated material science applications 97
3.3 μCT: background, examples and evaluation 98
3.3.1 μ-CT methodology 99
3.3.2 Case study: structure of ochres and mineral accretions; integration of μ-CT in the analysis of rock art materiality 100
3.3.3 Evaluating μ-CT for rock art and associated material science applications 104
3.4 Community-driven material science 104
3.4.1 Future prospects for non-invasive x-ray techniques in Aboriginal-directed programs 105
3.5 Summary 106
Acknowledgements 106

Chapter Four

Preface to the Article 111
Abstract 111
Graphic Abstract 112
4.1 Introduction 112
4.2 Materials and Methods 115
5.3 Results 118
4.4 Discussion 121
4.5 Conclusions 123
Acknowledgements 123
PART II
Chapter Five
ISBN: 0813- 0426

Preface to the article 126
Abstract 126
5.1 Introduction 127
5.1.1 Dingo and Horned Anthropomorph 129
5.1.2 Yengo 1 130
5.1.3 Other Relevant Background 131
5.4 Methodology 134
5.4.1 Instrument Parameters 134
5.4.2 Data Collection Protocol 135
5.4.3 Data Analysis and Chemometrics 136
5.5 Results and Interpretations 137
5.6 Discussion 142
5.6.1 Taphonomic Implications 143
5.6.2 Chronological Implications 144
5.6.3 Behavioural Implications 144
5.7 Conclusions 145
Acknowledgements: 146
Supplementary Material 146

Chapter Six

Preface to the article: 149
Abstract 150
6.1 Introduction 150
6.1.1 The Kimberley Study Area 152
6.1.2 Previous Mulberry Pigment Characterisation in the Kimberley 154
Chapter Seven - Summary

7.1.1 Archaeological implications: the Sydney Basin 175
7.1.2 Archaeological implications: the northwest Kimberley 176
7.2 Evaluation of pXRF for Archaeology and Rock Art Research 176
7.3 Caveats for in situ pXRF Analysis of Rock Art 178
7.3.1 Selecting Analyte Locations 178
7.3.2 Instrument Parameters 179
7.3.3 Data Processing 180
7.4 Novel methods for in situ pXRF analysis of Rock Art 180
7.5 The Future for Archaeological Pigment Studies in Australia 181
7.6 Conclusion 183

References Cited 185

Appendix A 209
Protocol of in situ pXRF analysis using a Bruker Tracer III-V spectrometer

Appendix B 211
Publication offprints of Chapters Two and Six:

and

Appendix C
Publication offprint of:
Preface to the article: 253

Appendix D
Publication offprint of:
Preface to the article: 269

Appendix E 279
Supplementary online material for the journal article presented as *Chapter Five* (now hosted at http://www.ifrao.com/auranet-library/).
List of Tables

Table 1.1  Cage determinations obtained for the Kimberley rock art ...........................................33

Table 1.2  OSL dating of mud wasp nests in Brremangrey, Upper Lawley and Lower Mitchell Falls site complexes, northwest Kimberley .................................................................33

Table 2.1.  Summary of geochemical trends ..........................................................................................72

Table 2.2.  Net Peak Area (NPA) values .................................................................................................73

Table 3.1.  pXRF Net peak area data ......................................................................................................95

Table 3.2.  Evaluation of pXRF .............................................................................................................97

Table 3.3.  μ-CT scan parameters ..........................................................................................................99

Table 3.4.  Evaluation of μ-CT ..............................................................................................................104

Table 4.1.  XRF irradiation conditions ..................................................................................................118

Table 4.2:  Raw pOSL counts ..............................................................................................................119

Table 5.1.  Provenance of excavated pigments, Dingo and Horned Anthropomorph ..........................130

Table 5.2.  Subsurface ochres from Yengo 1, Square 4A after McDonald 2008:98 .............................131

Table 6.1.  Compounds of minerals discussed in the text ......................................................................155

Table 6.2.  Summary of samples analysed ............................................................................................160

Table 6.3.  Net Peak Area pXRF Data ..................................................................................................163
List of Figures

Figure 1.1. Watercolour painting by Thomas Bock, 1837 'Manalargenna'. Top right: close up of the Toolburnner ochre quarry Tasmanian. Bottom: Overview of the Gog Range Tasmanian, the location of the Toolburnner ochre quarry................................................................. 7

Figure 1.2. Overview of Sahul showing sites mentioned in the text.........................................................11

Figure 1.3 Case study locations with rock art..........................................................................................30

Figure 1.4. Overview of mud-wasp nest dated using OSL.........................................................................34

Figure 1.5 Case study locations with landscape overviews......................................................................40

Figure 1.6 Ochre quarries in Booderee National Park, NSW.................................................................42

Figure 1.7 Kaolin seam on the Frenleigh Track, Newcastle, NSW..........................................................42

Figure 1.8 Examples of geological weathering, northwest Kimberley, WA...........................................44

Figure 1.9. Rock art panels in the northwest Kimberley showing the complexity of precipitate accretions........................................................................................................................................46

Figure 2.1. Illustration of critical depth penetration with light element optimised pXRF ..................60

Figure 2.2. Location of BR 29 (AHIMS 52-2-1643)...............................................................................62

Figure 2.3. Plan and section drawing of Browns Road 29.......................................................................63

Figure 2.4. Overview of rock art panel showing the location of pXRF spectra........................................64

Figure 2.5. Detail of the rock art panel....................................................................................................64

Figure 2.6. Hawkesbury Sandstone Control Block.....................................................................................70

Figure 2.7. Dendrogram of pXRF analysis ..............................................................................................75

Figure 2.8. PCA Plots - 3 projections of the first three components..........................................................76

Figure 2.9. Cavernous Weathering Indicator Elements...........................................................................77

Figure 2.10. Clay Indicator Elements.....................................................................................................79
Figure 2.11. Precipitous Mineral Indicator Elements

Figure 3.1. Overview of non-invasive x-ray techniques

Figure 3.2. Location of the Kimberley and Sydney Basins showing the case study areas

Figure 3.3. Overview of yellow and black bichrome rock art panel at Browns Rd 29 showing the location of pXRF analysis

Figure 3.4. pXRF NPA data for cavernous weathering indicator elements, BR29

Figure 3.5. μ-CT ‘fast scan’ of ochre surface finds

Figure 3.6. spectral overlay of red ochre nodule (light grey) and mulberry ochre quarry (dark grey)

Figure 3.7. μ-CT ‘fast scan’ (four projections), mineral accretion from Kangaroo Shelter, northwest Kimberley

Figure 4.1 - The portable units utilized in this study

Figure 4.2 The materials tested

Figure 4.3 Results: (a) Increased luminescence counts for loose quartz grains. (b) A similar plot on a reduced scale to provide more detail for materials with lower OSL counts. (c) Bleaching of quartz grains after pXRF

Figure 5.7. Location of Dingo and Horned Anthropomorph and Yengo 1

Figure 5.2. Montage of archaeological pigments examined

Figure 5.3. Excavation profile southern overhang excavation, Dingo and Horned Anthropomorph

Figure 5.4. Unweathered Hawkesbury sandstone control block

Figure 5.5. Multivariate projections, light element profiles

Figure 5.6. Multivariate projections, heavy element profiles

Figure Pref 6.1 Portable Raman spectra, K1 sample (the location of the exfoliated panel is illustrated in the Graphic Abstract of Chapter Five)
Figure 6.1. Sites sampled, northwest Kimberley, Western Australia .................................................. 152

Figure 6.2. Detail of rock art sampled .................................................................................................. 153

Figure 6.3. Plan of LMR01a showing the location of RRS and other archaeological features... 159

Figure 6.4. Sample KSMA .............................................................................................................. 160

Figure 6.5. PXRF spectral overlay, MM20 (left) and K1 (right)......................................................... 162

Figure 6.6. SEM secondary electron images cross-sections K1 (left) and RRS ......................... 164

Figure 6.7. SEM, Secondary Electron Images of RRS Zircons.........................................................164

Figure 6.8. Element Maps: K1 motif and rock shelter substrate (left); KSMA (right)................. 166

Figure 7.1. Location of pervious projects. Red text shows studies funded by the AIATSIS Rock Art Protection Program.................................................................................................................. 182
Abstract:

Anthropogenically modified pigments are held to be some of the earliest, most unambiguous and persistent evidence for behavioural modernity, frequently (and often tenuously) invoked as material expression of symbolic thought and action. Recent finds, increases in the sophistication of analytic techniques and theoretical frameworks have renewed interest in ochre, reflected by a spike in actualistic studies, investigations of pigment morphology and geochemistry. Archaeological studies continue a bias towards Pleistocene pigments, while archaeological research continues to focus on ochre from known source locations, and in Australia, ethnographically documented mines. Here I take a different tack, targeting Holocene ochres, focusing on pigments with at least one known, indisputably symbolic function—the production of rock art. As part of the physical and metaphorical (cultural) landscape, rock art offers a unique pigment archive as it remains in the location in which it was created.

A decade since the first published application of portable X-ray Fluorescence (pXRF) to rock art there has been an absence of critical scrutiny and methodological development. Aiming to redress this, I use conventional and Synchrotron X-ray Diffraction, Micro Computed Tomography and Scanning Electron Microscopy to explain and evaluate pXRF. I develop novel methods of using geochemical data to identify paint mineralogy (including differentiating between paints of the same colour), recognise the chemical signatures of taphonomy and compare ochres from excavated contexts with rock art. Interpreting the resultant elemental profiles relies on understanding the complex taphonomy of pigments and the chemical expression of non-cultural phenomena, something not adequately addressed previously. This work therefore offers a non-invasive means by which large scale studies of archaeological pigments can be undertaken.

By expressly separating characterisation from the assignment of provenance, I describe and interpret pigment geochemistry within the frameworks of object biography and intentionality. I demonstrate how pigment characterisations make available additional strands of chronological and behavioural evidence within regional prehistories. In the Sydney Basin, I report the first archaeological identification of calcite rock art paint at Yengo 1 shelter, where I show calcite pigments are present from 1,500 BP. I provide the first archaeological description of a mulberry ochre quarry in northern Australia—showing these pigments are available locally within the King Leopold formation of the northwest Kimberley and that ochre quarries occur in sites with large rock art assemblages. Ultimately, this work demonstrates that it is not always the highest resolution scientific data that produces the most insightful archaeological findings.

**KEYWORDS:** pigment characterisation; geochemical analysis; rock art; ochre; mineral pigment; pXRF; Sydney Basin; Northwest Kimberley

**ANZSRC FOR:** 210102 Archaeological Science 45% - 210101 Aboriginal and Torres Strait Islander Archaeology 25% - 030101 Analytical Spectrometry 10% - 040202 Inorganic Geochemistry 10% - 210202 Heritage and Cultural Conservation 10%

**ANZSRC SEO:** 950503 Understanding Australia’s Past 90% - 950302 Conserving Aboriginal and Torres Strait Islander Heritage 10%
Acknowledgements

They say it takes a village to raise a child. Based on my experience, it takes an academic community to facilitate the completion of a successful PhD. From inception, either knowingly or unwittingly, a large number of the discipline's community help to shape the project. This research has been influenced by the disciplines of Archaeometry, Australian Archaeology, Rock Art Research, Conservation Science and Analytical Chemistry. Acknowledging every individual who has inspired and influenced the project would be a thesis in itself and I mean no offence by omission. I have received support and encouragement from many people since April 2009 when this all began (especially as I have had two children in that time). I have singled out those who have had the greatest overt affect on the work chronicled, but point out that the very act of becoming part of a vibrant academic community continually informs and inspires my evolving research practice. The journal articles and book chapter that form part of this document (Chapters Three to Six, Appendices C and D) contain additional, specific acknowledgements.

I would like to thank supervisor June Ross for inviting me to participate in the research program in the northwest Kimberley. I appreciate June's support, encouragement, logistical guidance and candour. Perhaps the most critical role of a PhD supervisor is advocacy within the academy and associated spheres. I have had a supportive advocate in June and I would like to express my gratitude for the opportunities she has help create for me and her efforts in disseminating my research. I have no doubt that June has performed countless acts of advocacy on my behalf, of which I have no firsthand knowledge, that have had, and will continue to have, beneficial consequences for me beyond my PhD project. June’s influence on my scholarship (particularly my writing) has been warmly welcomed. I am not the easiest student to have supervised. I thank June for meeting my fierce independence with patience.

I would like to thank supervisor (and mate) Maxime Aubert for sharing his technical, academic and bureaucratic knowledge, answering my thousands of questions with honesty and humour. Max’s has provided tutelage in scientific techniques and methods, archaeometric practice and earth science culture. Working with Max has made me a better scientist and a more comprehensive researcher. Association with sections of Max’s own dynamic projects have provided me many opportunities and he too has been a strong advocate of my research and burgeoning expertise as a rock art/ochre analyst.

My mate Alice Storey has been a source of academic support and archaeometric inspiration/commiseration. I am grateful to have found a kindred spirit who not only understands, but celebrates with me the ‘science geek’ that lurks inside some archaeologists (’90s rock chicks).

I acknowledge June Ross’ co-chief investigators for the Change & Continuity: Chronology, Archaeology and Art in the North Kimberley, Northwest Australia project, ARC Grant No. LP0991845 (hereafter C&C); Mike Morwood and Kira Westaway. I am grateful to have participated in such an
exciting project. I especially thank Mike for his encouragement and support, and for facilitating my research in the broader Kimberley region (Appendix D).

Thanks to my C&C cohort: Kim Newman, Brent (Shark Bait) Koppel, Dean (only the best people study ochre) Fleming, Yinnika Perston, Meg Travers, Deb Holt, Di England and Isabel Blazer. Iz especially has been a constant support and amusement.

I acknowledge Primary Investigator Mark Moore for his collegiality and collaboration, and for inspiring me, through his own research, to consider overarching theoretical questions relevant to the engagement of Australia and broader Southeast Asian region in the debates about human modernity and symbolic behaviour.

Thanks to my pXRF cohort: Jess Walker for her support in the early days and Nicky Forster; for everything. Thanks also to Mary-Jean Sutton— we external students must stick together. Cheers to Emma St Pierre for helping me figure out what the hell a thesis by publication looks like.

For their generosity in sharing conversations, ideas, ideology and a general passion for archaeology thanks to Duncan Wright, Jaun Lopez, Paul Tacon, Rebbecca Parkes and Iain Davidson. I also thank Iain (and Helen) for giving me the opportunity to work on consultancy projects in northwest central QLD during the latter stages of my candidacy. Without these opportunities I would not have had the financial means to complete my doctorate.

I appreciate the conversations about my project that I have been able to have at the indulgence of some of Australian archaeology's 'big picture' guys. Mike Smith, Mike Morwood, Iain Davidson, Ian Crawford, Kim Akerman and Val Attenbrow particularly. The minutia of the analytics and chemometrics I have worked with during this project might have distorted my perception of their archaeological implications had these archaeologists not reminded me of the larger human story artefacts tell. I am particularly indebted to the Mikes (Smith and Morwood) for encouraging me to 'go big', where it was warranted.

Conservation scientists Kalle Kasi, Ian Macleod, Phil Haydock, and Bruce Ford have generosity facilitated access to laboratory facilities, unpublished data and laboratory equipment at the Western Australian Museum.

Mike Donaldson, Mark More and Iain Davidson provided insightful comments on an early version of Chapter One.

PhD projects are a war of attrition. This is a battle I could not have won without the support of my family, foremost my husband Lucas and daughters Charlie and Bella. My parents-in-law deserve special mention for their assisting when I travelled - heartfelt thanks Julie, David and Phil. In the final months of writing Jason Kemp helped out, creating time amounting to extra invaluable weeks and Daniel and Narrell Ricardo provided me with workspace.
Excluding the previously published chapters and appendices, this thesis was proof read by Julie Taylor, David Hume and Phillip Huntley. Julie Taylor and David Hume provided formatting assistance. Typesetting and graphic elements for the forward and title pages were undertaken by Lucas Huntley.

This research project has been supported financially by an Australia Post Graduate Award and a University of New England ‘Strategic Top-Up’ stipend. The School of Humanities, UNE also provided additional funding at times to facilitate conference travel – specific thanks to Lynda Garland and Claire Girvin. Laboratory and field expenses for the Sydney Basin case study was funded by the Australian Geographic Society (project grant: Rock art and Ray Guns, JH sole investigator) and laboratory works for the northwest Kimberley case study was supplemented by the Kimberley Foundation of Australia (Stage 1 project: Messages in Paint, JH sole investigator). I was supported for fieldwork and some laboratory costs by the C&C ARC Linkage project and I thank the chief and primary investigators.

Finally, and most importantly, I acknowledge the Aboriginal peoples of the lands in which I have worked – the traditional owners of the northwest Kimberley and the Aboriginal stakeholders of the Sydney Basin including the Woronora Plateau, Yengo National Park and MacPherson State Forest (Mangrove Creek Catchment). The continuing cultural traditions of the Warnabul, Dharawal, Wanaru, Darugh, and Darkagin peoples are represented in the archaeological materials studied and I thank the Kandiwal Aboriginal Community, Warnanbul Gunmbera Aboriginal Corporation, the Kimberley Land Council, and the Illawarra, Metro, Mindaribba, Wanaruha and Darkinjung Local Aboriginal Land Councils as well as the Wonaruha Nation Aboriginal Corporation for their time in considering and reviewing my research methods and outputs. It has been a privilege to have been allowed to work with the rock art and ochres discussed in this thesis and I am grateful to the indigenous custodians who have shared their knowledge with me in this endeavour, in turn allowing me to share my results a broad scientific and general audience.
Statement of Authorship:

This thesis is composed of my original research. The nature of scientific enterprise such that it is, often takes many people to pull together a successful program of archaeometric investigation. Consequently, a number of the published chapters in this thesis required the input of various colleagues involved in the C&C Project. Credit, in the form of co-authorship and/or acknowledgement has been given where credit is due. Two forms appear at the end of co-authored chapters (Chapters Two to Six). One contains a statement of originality, the other a statement of contribution by others (quantifying the contribution of co-authors).

Unless otherwise stated in the form of co-authorship, citations and acknowledgements contained within this thesis, authorship is entirely my own. As the primary author of all published materials I accept responsibility for any errors or omission (if contained) within.

The content of this thesis (including the appendices) result from work I have carried out since the commencement of my research higher degree candidature at UNE. None of the material presented has been previously submitted (in whole nor part) for a degree at this, or any other, institution. I have clearly stated which parts of this thesis have drawn on published data from research submitted for my previous qualification (BA Hons, Australia National University – c.f. in Chapter Two and Chapter Five, published data is presented as Appendix C).

Jillian Huntley
December 2014
Forward

‘nani gigantum humeris insidentes’

I have felt the presence of an ANU/UNE academic heritage through my short research career. This is particularly evident to me in the work of Isabel McBryde and Mike Smith. Here I want to single out the two key papers that have shaped my understanding of archaeological pigment use, long distance trade and exchange, and the material expression of cultural landscape. These articles have been an anchor whenever I have felt like I am drowning in the complexity of archaeological ochre use. Their conceptual richness and depth of narrative exemplify why the analytical effort required in investigating archaeological ochres is so worthwhile:

‘The cultural landscapes of Aboriginal long distance exchange systems: can they be confined within our heritage registers?’ (McBryde, 1997a)
The theoretical concepts woven into this manuscript have been the single biggest influence on my conceptualisation of the behavioural implications of archaeological ochre use. McBryde’s work humanised the provenance postulate for me, articulating the archaeological value of understanding trade and exchange and perhaps more importantly, how we might recognise archaeological expression of conceptual spaces such as cultural landscapes.

‘The Changing Provenance of Red Ochre at Puritjarra Rock Shelter, Central Australia: Late Pleistocene to Present’ (Smith et al., 1998)
This seminal paper has rippled throughout archaeometric ochre research globally because of its clarity in not only demonstrating, but also clearly communicating, the archaeological importance of ochre research. This study was the first to prove the potential outlined by Mulvaney (1976) in regards to accessing insights from the material indices of trade and exchange. That Smith could draw such a well reasoned narrative from the archaeometric analysis of just 4% of the Puritjarra ochre assemblage is a testament to the central place of archaeology within this style of research. The reach and longevity of this paper, its continued global impact, speaks to the fact that the strength of its archaeological stance is yet to be replicated.
A Note on Nomenclature:

The nomenclature of rock art styles, specific graphic motif forms, sites, site complexes and landscapes used in this thesis is the end product of consultation with the Aboriginal stakeholders of the Sydney Basin and the Traditional Owners in the northwest Kimberley. Aboriginal custodians of the respective case study regions have reviewed and approved all publication outputs prior to their submission.

The terminology adopted for the northwest Kimberley is in accordance with the Memorandum of Understanding between members of the *Change & Continuity: Chronology, Archaeology and Art in the Northwest Kimberley, Northwest Australia* (ARC Linkage Grant No. LP0991845) project team and the Wunambal Gaambera Aboriginal Corporation.

I thank the Kandiwal Aboriginal Corporation, the Native Title Group at Kalumburu and the Wunambal Gaambera Aboriginal Corporation for their guidance. I am indebted to Chief Investigators: the late Michael J. Morwood and June Ross for initiating and coordinating the Aboriginal consultation. I owe June particular thanks for her continued management of all consultation for the project.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Archaic Period</td>
<td>Irregular Infill Animal</td>
<td>Irregular Infill Animal</td>
</tr>
<tr>
<td>Tasselled Figures</td>
<td>Tassel Bradshaws</td>
<td>Mambi Gwion</td>
</tr>
<tr>
<td>Bent Knee Figures</td>
<td>Sash Bradshaw</td>
<td>Yowna Gwion</td>
</tr>
<tr>
<td>Dynamic Figures</td>
<td>Elegant Action Figures</td>
<td>Dynamic Gwion</td>
</tr>
<tr>
<td>Straight Part Figures</td>
<td>Clothes Peg Figures</td>
<td>Wararrajai Gwion</td>
</tr>
<tr>
<td>Painted Hands</td>
<td>Clawed Hands</td>
<td>Painted Hands</td>
</tr>
<tr>
<td>Wandjina</td>
<td>Wandjina</td>
<td>Wanjina</td>
</tr>
<tr>
<td>Contact Period</td>
<td>-</td>
<td>Contact Period</td>
</tr>
</tbody>
</table>
List of Abbreviations:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AINSE</td>
<td>Australian Institute of Nuclear Science and Engineering</td>
</tr>
<tr>
<td>AIATSIS</td>
<td>Australian Institute of Aboriginal and Torres Strait Islander Study</td>
</tr>
<tr>
<td>ANSTO</td>
<td>Australian Nuclear Science and Technology Organisation</td>
</tr>
<tr>
<td>C&amp;C</td>
<td>Change and Continuity Project (ARC LP LP0991845)</td>
</tr>
<tr>
<td>D&amp;HA</td>
<td>Dingo and Horned Anthropomorph Rockshelter</td>
</tr>
<tr>
<td>ENSO</td>
<td>El Niño-Southern Oscillation</td>
</tr>
<tr>
<td>FTIR</td>
<td>Fourier Transform Infrared spectrometry</td>
</tr>
<tr>
<td>LA-ICPMS</td>
<td>Laser Ablation-ICPMS</td>
</tr>
<tr>
<td>LGM</td>
<td>Last Glacial Maximum</td>
</tr>
<tr>
<td>ICPMS</td>
<td>Inductively Coupled Plasma Mass Spectrometry</td>
</tr>
<tr>
<td>µCT</td>
<td>micro-Computed Tomography</td>
</tr>
<tr>
<td>MURR</td>
<td>Missouri Nuclear Reactor, University of Missouri</td>
</tr>
<tr>
<td>NAA</td>
<td>Neutron Activation Analysis</td>
</tr>
<tr>
<td>NPA</td>
<td>Neat Peak Area (Relative Abundance)</td>
</tr>
<tr>
<td>MSA</td>
<td>Metropolitan Special Area (Chapter Two)</td>
</tr>
<tr>
<td>PCA</td>
<td>Principle Components Analysis</td>
</tr>
<tr>
<td>PIXE/PIGE</td>
<td>Particle Induced X-Ray Emission/Particle Induced Gamma-Ray Emission Analysis</td>
</tr>
<tr>
<td>PD</td>
<td>Powder Diffraction</td>
</tr>
<tr>
<td>pXRF</td>
<td>portable X-Ray Fluorescence spectrometry</td>
</tr>
<tr>
<td>SEM-EDXA</td>
<td>Scanning Electron Microscopy-Energy Dispersive X-Ray Analysis</td>
</tr>
<tr>
<td>XRD</td>
<td>X-Ray Diffraction</td>
</tr>
<tr>
<td>XRF</td>
<td>X-Ray Fluorescence spectrometry</td>
</tr>
<tr>
<td>Y1</td>
<td>Yengo 1 Rockshelter</td>
</tr>
</tbody>
</table>