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Methodological considerations of integrating portable digital technologies in the analysis and management of complex superimposed Californian pictographs: From spectroscopy and spectral imaging to 3-D scanning

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ABSTRACT

How can the utilization of newly developed advanced portable technologies give us greater understandings of the most complex of prehistoric rock art? This is the questions driving The Gordian Knot project analysing the polychrome Californian site known as Pleito. New small transportable devices allow detailed on-site analyses of rock art. These non-destructive portable technologies can use X-ray and Raman technology to determine the chemical elements used to make the pigment that makes the painting; they can use imaging techniques such as Highlight Reflective Transformation Imaging and dStretch© to enhance their visibility; they can use digital imagery to disentangle complex superimposed paintings; and they can use portable laser instruments to analyse the micro-topography of the rock surface and integrate these technologies into a 3-D environment. This paper outlines a robust methodology and preliminary results to show how an integration of different portable technologies can serve rock art research and management.

1. Introduction

How can utilizing newly developed advanced portable technologies give us greater understandings of the most complex prehistoric rock art found across the globe? This is the central research question driving our research under the title of 'The Gordian Knot'. Rock art was part of the repertoire of the earliest anatomically modern humans (Pike et al., 2012), was subsequently made in every time period, and is found on every continent save Antarctica: understanding rock art thus is fundamental to understanding human environmental and social interactions worldwide. Rock art is studied by researchers across disciplinary spectrums, so developing techniques to better analyse rock art will clearly benefit researchers across multiple disciplines. As Chippindale and Nash (2004: 7) succinctly pointed out, rock art's great strength is the fact that it is fixed in place. However, this strength is ironically the central problem confronting rock art research: its lack of portability limits laboratory analyses to understand the material component comprising the art, thereby limiting interpretation of the art. Fortunately, recent advances in portable technologies have greatly increased the ability to analyse *in situ* rock art. This project aims to directly tackle the problem of fixity with the question posed above: we aim to develop a methodology that integrates new but proven portable technologies to analyse the most important, compelling, and complex rock-art confronting researchers rock art that is are made up of multiple superimposed paintings and utilizing multiple colours. Such an approach ultimately allows a far deeper probing of the materiality of pigments comprising the paintings than previously possible. The use of pigments far predates any known rock art itself (Barham, 2002), and has been a fundamental form of material culture ever since. The application of pigments on artefacts, walls, canvases, rock and other surfaces is of high interest across a wide multiplicity of

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Fig. 1. View of the mouth of the Main Cave, Pleito, California. Photo by David Robinson.

Fig. 2. The conjoined panels of A/G/H, known as the 'Gordian Knot'. Photo by David Robinson.

disciplines, so scientific studies of pigments that link interpretative approaches will have wide reaching applicability. Research here thus sets out to establish a methodology that allows for deeper quantitative and qualitative interpretations of complex surface-applied pigments not only on rock, but other surfaces.

To achieve this requires a focussed study on an accessible, world class, highly complex painted site. Fortunately, we have access to such a site. The site is called Pleito, located on the Wind Wolves Preserve in South-Central California in an area attributed to the native group known as the Emigdiano Chumash. Grant (1978: 532) described the site as the "finest example of prehistoric rock art in the United States." This is probably because the pictographs at Pleito have one of the widest colour palettes of any site in the world, with multiple variants of red, black, white, cream, yellow, orange, green, and blue (see Bury et al., 2003). Within the Main Cave of the site, there are 12 polychrome panels comprising hundreds of individual elements (Fig. 1). These panels also likely have the greatest intensity of superimposed painting of any other pictograph site on the North American continent.

The conjoined Panels A/G/H are contiguous; during documentation of the site in 2003, Dan Reeves called these panels the 'Gordian Knot' due to the sheer complexity of paintings located there (Fig. 2). In total, the Gordian Knot paintings form one of the most complex prehistoric panels found anywhere in the world.

This site is thus ideal for applying, and integrating, a range of portable technologies including portable X-Ray Fluorescence, portable Raman Spectroscopy, portable digital laser scanning, dStretch©, and Highlight Reflectance Transformation Imaging. We therefore have launched a new AHRC funded project called "Unravelling the Gordian Knot". The Gordian Knot project is a collaboration between academic researchers at the University of Central Lancashire, University of Strathclyde, California State University, Channel Islands, plus professional collaborators such as the Rock Art Documentation Group based in Santa Barbara and B&W Tech based in New Jersey as well as the Wildlands Conservancy who are the landowners of the Wind Wolves Preserve. The project sets out to disentangle the superimposed painted events using imaging techniques, use a technique called Layer Separation to establish a sequence for all the panels, and to analyse the material components used in the making of the pigments through seriated time. An experimental study will complement this research by providing comparative data to interpret some of the spectral results. The project aims to establish a replicable and robust methodology of integrating portable technologies that can be utilized in the analysis of similarly complex superimpositions anywhere else in the world. In turn, the data will allow multiple and nuanced questions to be addressed concerning pigment recipes and change through time while opening new theoretical vistas to rethink ethnographic and other theoretical notions of pigment as a form of material culture. Furthermore, located on the Wind Wolves Preserve in the heart of South-Central California near the large urban population centres, the site is continually under pressure from human visitation, either in the form of research, tours, or even trespass. The project aims to provide information to the Preserve for its management of the site, as well as create a website which may be used to provide an alternative means of experiencing the site as a complement or alternative to actual site visitation. The Gordian Knot project will conduct this research over the next several years. This paper details the methodology behind this project, and presents the initial findings from a pilot project, including a case study from panel C in the Main Cave.

2. Background and methodology

Previous work has focussed on Geographic Information Systems approaches to Pleito and its relationship to land-use, viewshed, and movement (Robinson, 2006, 2010a; Wienhold, 2014), issues of pigment composition (Lee, 1979; Reeves et al., 2009; Scott et al., 2002) or interpretative approaches considering indigenous ethnography and ontology (Robinson, 2007, 2010b, 2013a, 2013b). The site is located on either side of a perennial stream in a rich riparian environment with oak woodlands in all directions (Fig. 3).

The sandstone formations on the eastern side of the creek contain at least five pictograph loci, plus nine bedrock mortar stations with 61 bedrock mortars, and over 100 cupules (Robinson, 2006: 219). Middens are located on terraces on either side of the stream. Grasse (2005) has conducted excavations of the Lower Midden in front of a rock art locus known as Boulder Cave: the midden is over 2 m in depth with finds of lithic debitage, projectile points, ground stone material, charcoal, animal bone, ochre, and beads: various strands of dating evidence suggest occupation since