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Settling in Sahul: Investigating environmental and human history interactions through micromorphological analyses in tropical semi-arid north-west Australia

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ABSTRACT

The Pleistocene continent of Sahul was first settled by people who arrived by watercraft from Island South East Asia about 50,000 years ago. Some of the oldest archaeological sites in Sahul are located in the southern Kimberley, in northwest Australia. This area lies within the southern zone of influence of the tropical monsoon and thus has always been highly sensitive to changes in monsoon dynamics over time. How these climatic changes have affected the colonisation and occupation of Australia is an important research theme in Australian archaeology. This paper illustrates the contribution and challenges of micromorphology in deciphering palaeoenvironmental and anthropogenic markers in a still largely unexplored Australian context. Micromorphological analysis of two archaeological sequences in the Napier Range (Carpenters Gap 1 and 3) provides a complementary and comprehensive reconstruction of the human-climate history in this area spanning nearly 50,000 years of Australian human presence. The results demonstrate an opportunistic use of sites by people through time, surprisingly independent of local climatic variation, suggesting highly flexible subsistence strategies.

1. Introduction

The Pleistocene continent of Sahul was first settled by people who arrived by watercraft from Island South East Asia, most probably about 50,000 years ago (O'Connell and Allen, 2015). Rapid dispersal across the continent is indicated by an overall distribution of Pleistocene sites older than 40 ka across the Sahul landmass (Balme, 2013; Allen and O'Connell, 2014; O'Connell and Allen, 2015). To move from tropical Wallacea, an area rich in marine resources, to varied continental Sahul environments (Fig. 1), the colonisers had to be economically, technologically and socially flexible (Balme et al., 2009; Balme and O'Connor, 2014). Despite this apparent flexibility many sites, particularly in the northwest coast and arid centre of Australia, appear to have a lower density of occupation over the Last Glacial Maximum (LGM) – a period generally marked by cooler and more arid conditions (Hope, 2005; Turney et al., 2006; Williams et al., 2009). The relationship between human history and environmental forcing is an important research theme in Australian archaeology that has been investigated by many authors (Veth, 1989; Hiscock and Kershaw, 1992; Morwood and Hobbs, 1995; Lourandos and David, 1998; O'Connor et al., 1999; O'Connor and Veth, 2006; Smith et al., 2008; Williams et al., 2010, 2015; Smith, 2013). The complexity of responses to environmental changes in regional northern Australia was drawn to attention by O'Connor and Veth (2006:35) who refer in particular to two sites in the southern Kimberley, Carpenters Gap 1 (CG1) and Carpenters Gap 3 (CG3) which, although only three kilometres apart, present very different archaeostratigraphical sequences. The location of these two sites (Fig. 1) is of particular interest because, although the Kimberley region today has a tropical monsoon climate (Waples, 2007; Pepper and Keogh, 2014), the southern part of the Kimberley is an area of fluctuating transition between the tropical zone and the more arid centre of Australia and it has always been highly sensitive to changes in the Indonesian-Australian summer monsoon dynamics (Kershaw et al., 2003; Kershaw and van der Kaars, 2012; Reeves et al., 2013b). During the LGM, both of the sites would have been within the expanded arid zone (Hesse et al., 2004; Fitzsimmons et al., 2013; Smith, 2013) and it may have

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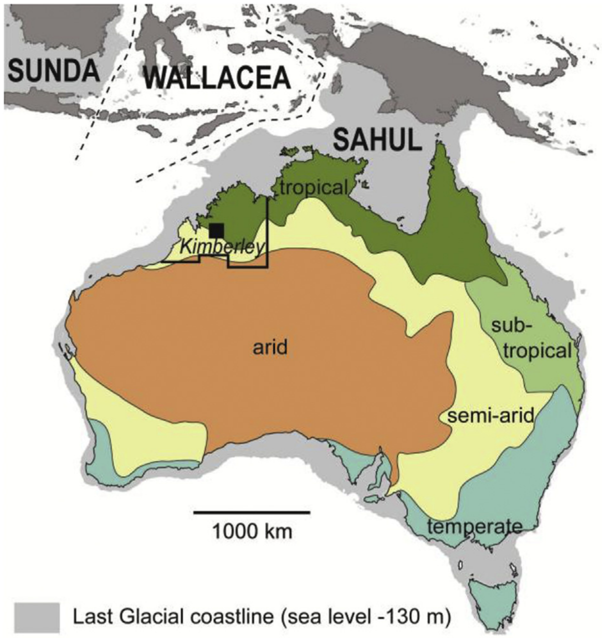

Fig. 1. Map of modern Australia in relation to Last Glacial Sahul, Wallacea and Sunda areas. The study area is located in the Kimberley region (Western Australia), at the transition between the tropical and semi-arid modern climate zones (modified from Williams et al., 2015).

been a more challenging environment in which to live. It has been suggested that the establishment of arid conditions may explain the sparse evidence for occupation in CG1 and CG3 throughout the Pleistocene and in particular during the LGM (McConnell and O'Connor, 1997; O'Connor and Veth, 2006; O'Connor et al., 2014). However, these observations were not made with the benefit of a geoarchaeological analysis that can provide a more detailed understanding of site formation history, help reveal discrete anthropogenic signatures and provide information on local palaeoenvironmental history (Goldberg and Sherwood, 2006). No micromorphological analyses of archaeological sequences has ever been undertaken in this area of Australia and only very few across Australia as a whole.

1.1. Study area and regional setting

Both sites are located on the northern side of the Napier Range, in Windjana Gorge National Park (Fig. 2). The range is part of an extensive Devonian limestone reef system built around 350 million years ago (Playford et al., 2009). Erosion has exposed the limestone and created caves, tunnels and gorges across the range where some perennial rivers flow (such as the Lennard River through Windjana Gorge, Fig. 2). Both sites are located on an outcrop of the range, only a short walking distance from the Lennard River. The landscape surrounding the two sites is composed of low hills overlooking large floodplains covered by savannah woodland, dominated by Eucalyptus spp. and boab trees (Adansonia gregorii) with spinifex and tussock grasses (Payne and Schoknecht, 2011). The tropical semi-arid monsoonal climate in the Kimberley consists of a hot, wet season from November until April and a warm, dry season from May until October. In the southern Kimberley annual rainfall is approximately 600–800 mm, almost all of which falls during the wet season when there are regular floods (McKenzie and May, 2003; Bureau of Meteorology (2015)). Geologically, the range in this area is composed of successive sedimentary beds grading from fine limestone, siltstone to sandstone and conglomeratic facies, the coarser facies being more easily eroded, resulting in the formation of numerous overhangs and caves (Playford et al., 2009: 337). Both CG1 shelter and CG3 cave have formed at the sedimentary unconformity within a Pillara limestone platform facies (Dp, Fig. 2).

1.2. Materials and methods

Micromorphological and sediment samples were collected from excavations within CG3 cave in August 2012 and from CG1 shelter during April 2014. Oriented sediment samples were extracted from the section profile using plaster bandages (Goldberg and Macphail, 2003, 2005a; see Fig. 4, Fig. 5, Fig. 13, Fig. 14). Resin impregnation of the undisturbed sediment monoliths was undertaken at the geotechnical facilities of the School of Earth and Environment at the University of Western Australia. Standard fabrication processes for

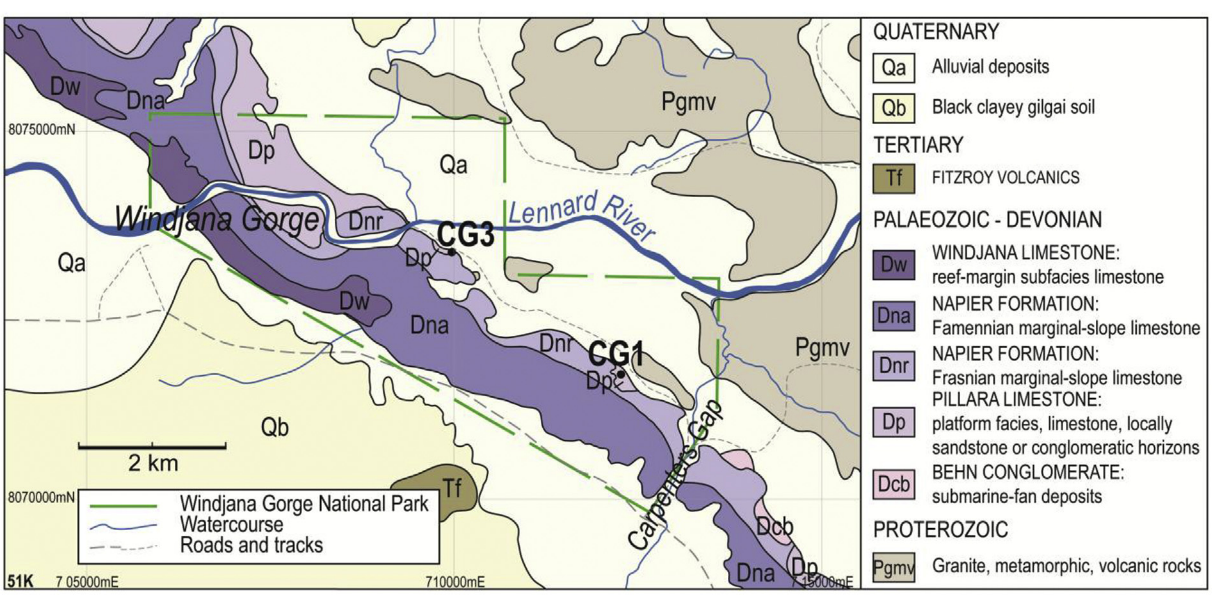

Fig. 2. Geological setting of Carpenters Gap 3 cave and Carpenters Gap 1 shelter (modified from Playford et al., 2009).