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Geoarchaeological research in the humid tropics: A global perspective

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ABSTRACT

Geoarchaeological research is now commonly undertaken as an integral component of archaeological investigations across much of the world. However, in humid tropical regions there is a relative shortfall of this Earth-Science approach to understanding archaeological records. In these regions, where hot and humid conditions prevail for significant parts of the year, sedimentological records are prone to high levels of diagenesis, bioturbation and weathering. This means that understanding and quantifying archaeological site formation processes can be very challenging because we may have not have sufficient existing data with which to decipher the stratigraphic (and microstratigraphic) features recorded in these sequences. In this paper we introduce a special issue of *Journal of Archaeological Science* in which we showcase a selection of geoarchaeological research from across the equatorial regions of five continents, highlighting the types of stratigraphic sequences and sedimentological features that are likely to be encountered, and evaluating the tools that can be employed to maximise the geoarchaeological potential of these unique records. Additionally, we use this opportunity to review geoarchaeology in the humid tropics from a global perspective, outlining the main problems that geoarchaeologists face working in these environments and the techniques available to mitigate them.

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1. Introduction: geoarchaeology in the humid tropics

The environments of the humid tropics are unique, posing major challenges for both archaeologists working in these regions today, and the human populations that have inhabited these climatic zones on and off over the past 200,000 years or so. These hot and humid environments are unforgiving testing grounds for geoarchaeologists working to interpret cultural and sedimentary records as they are wholly uncondusive to the preservation of a wide range of archaeologically important materials (e.g. bone, organics, biomarkers, minerals such as calcium carbonate). However, geoarchaeological science is in a perfect position to tackle the problem of reconstructing archaeological site formation processes that are likely to be specific to these humid tropical environments. The remit of geoarchaeological science is wide-ranging and multi-disciplinary, but here we boil it down to crystallize two primary goals: i) the multi-scalar reconstruction of past environments with which human populations have interacted, and ii) the identification and evaluation of processes that form and preserve an

archaeological site. Both of these goals are pertinent in interpreting the archaeological record of humid tropical environments, as well as the sedimentary matrix from which this cultural information is recovered.

This special issue of *Journal of Archaeological Science* showcases a wide range—both chronologically and geographically—of geoarchaeological research from the fascinating and often demanding environments of the humid tropics and adjacent sub-tropical, climatically transitional zones. What draws this collection of papers together is the ever more apparent need to assess the modes and tempo of site formation processes in these environments, and how they differ—if at all—from those recorded in non-tropical or arid tropical regions, both of which have received much attention in the archaeological and geoarchaeological literature (see e.g. Goldberg and Macphail, 2006, and references therein). As such, regionally specific mechanisms of sedimentation need to be carefully assessed along with the geoarchaeological signatures that characterise these atypical and often extreme environments. The research featured in this volume provides valuable insights into a range of these issues, highlighting the depositional and post-depositional environments that are likely to be encountered, and the methods that can best be employed to identify diagnostic signatures and mitigate for the often-aggressive degradation

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processes operating in humid tropical regions.

The humid tropics cover a significant proportion of the Earth's terrestrial surface (Tricart, 1972; Thomas, 1974), including areas that are particularly important in our understanding of human evolution and the rise and fall of early civilizations (e.g. equatorial Africa, Southeast Asia, South America). However, despite the ubiquity of these wet, tropical landscapes we know surprisingly little about the geomorphological processes and mechanisms that shape them (Gupta, 1993, 2011). As one of the primary goals of geoarchaeology is to reconstruct the environmental conditions under which archaeological sites are formed, modified and preserved, site formation processes operating in the humid tropics are therefore similarly poorly understood (Stephens et al., 2005; Kourampas et al., 2009; Morley, in press). The research presented in this volume has wide-ranging global relevance, originating as it does from the tropical (and in some cases marginal sub-tropical) regions of five continents: South America (Brazil), North America (Belize), Africa (Tanzania and Malawi), Asia (Myanmar, Malaysian Borneo, Flores and Timor Leste), and Australasia (Papua New Guinea and Northwest Australia). What links these spatially disparate regions are the hot and humid climates that prevail today, and that have done so episodically throughout the Quaternary (Douglas and Spencer, 1985). The theme that links these studies, outside of the site-specific research questions that they address, is the reconstruction of the depositional and post-depositional histories of the sites in this climatic zone using state-of-the-art geoarchaeological science techniques applied to stratigraphic sequences.

The initial impetus sparking the inception of this volume was provided by positive feedback and fruitful discussions following a paper presented by one of us (MWM) on this topic at the Australian Archaeology Association's (AAA) 2014 annual meeting in Cairns, in the tropical Australian north. It became apparent then that geoarchaeologists working in tropical northern Australia and Southeast Asia felt that they were working with sedimentological records with insufficient comparable analogues available in the relatively copious published geoarchaeological literature, generated primarily from supra-humid tropical regions (e.g. temperate Europe and North America; semi-arid Southern Africa; arid to hyper-arid Southwest Asia). The general feeling was that whilst archaeological sites (and cultural material) located in the wet tropics were exposed to an unusually vigorous combination of the elements characteristic of these harsh environments, there lacked a concerted drive to assess the potentially atypical site formation processes at work, and the diagnostic signatures that might help recognise these physical and chemical environments.

Despite some of the most important archaeological stories of the present day—understanding the global dispersal of *Homo sapiens*; reconstructing the early civilizations of the Americas; elucidating the origins of agriculture outside SW Asia, to name just three—bringing these regions into focus, we currently have limited understanding about how these environments might influence the archaeological record, and the potential limitations of techniques at the geoarchaeologist's disposal. Nonetheless, there are some exceptions to this general rule. Over the past few decades a small number of geoarchaeologists and archaeological scientists have endeavoured to reconstruct archaeological site formation processes in humid tropical environments (e.g. Glover, 1979; Gillieson, 1986; Mercader, 2002; Mercader et al., 2003; Gilbertson et al., 2005; Stephens et al., 2005; Lewis, 2007; Araujo et al., 2008; Kourampas et al., 2009, 2015; Mijares and Lewis, 2009; Rabett et al., 2011, 2016). Whilst this list is not exhaustive, by no means would a more comprehensive catalogue be significantly weightier. We hope that this special issue not only expands on this relatively slender body of work, but also stimulates further discussion and helps focus research agendas in this field over the coming years and decades.

2. The papers: a selection of geoarchaeological research from the humid tropical regions of the world

In presenting the papers that form this volume, it seems appropriate to set them out geographically, and we have done this by traversing from the far west (relative to the Europe-centric Mercator map projection), from South and Central America (Villagran et al., in press and Macphail et al., in press; respectively), through to Africa (Sulas et al., in press; Wright et al., in press), and on to Asia (Morley, in press; Marwick et al., in press; Stephens et al., in press; Morley et al., in press; O'Connor et al., in press), before finally moving into Australasia (Denham and Grono, in press; Vannieuwenhuysse et al., in press) (Fig. 1).

We would like to note that there are important chronological and geographical gaps in this selection of papers. The timing of volumes such as these is rarely perfect, and there are regions in which contributions would have been welcome, but the timing of projects and publication schedules simply did not synchronise. We do not claim that these papers span all of the areas in which humid tropical geoarchaeological research is being undertaken, and regions under-represented (e.g. Northwest South America, Equatorial Africa, South Asia) in this volume, therefore, do not reflect a shortfall of research occurring there, but more our lack of space to publish them or the asynchrony of publication schedules.

We start our tour of the humid tropics in central Brazil, where Villagran and colleagues investigate early Holocene sediments from Lapa do Santo—a rockshelter rich in human remains associated with complex funerary practices. Through the combination of micromorphology, μ FTIR, and organic petrology, they identify both *in situ* hearths and reworked combustion products (most likely relating to housekeeping), shedding new light on the complexity of these practices and the identification of features diagnostic to specific activities. These results are bolstered by the use of experimental work, using observations made during the heating of modern day soils and sediments. Interestingly, they also identify the use of termite mound fragments, possibly as part of the combustion process serving as heat retainers. The close spatial association of the intensive fire-use to the human graves shows multi-functional zones of the cave, where combustion by-products were excavated to accommodate the interments. They were also able to identify clay aggregates that are likely pedogenic material inwashed from outside the site, potentially linking the external geomorphic system with the internal karst system. This study highlights the use of multiple datasets to address questions of both site formation and human activities occurring at a site, a justifiably recurring theme in the volume.

Moving north to Belize, Central America, Macphail et al. (in press) investigate sediments at the Mayan site, Marco Gonzalez, using micromorphology and other geochemical and sedimentological techniques to identify a type of Dark Earth that differs from the intensively-studied Amazonian Dark Earths (ADE's, or *terra preta*). The recognition of these anthropogenically-enhanced soils in a Mayan context raises interesting questions about localised human-driven environmental change, both contemporary with the occupation of the site, and contributing to the soil characteristics today. They utilise a range of chemical, physical and mineral magnetic datasets to strengthen their interpretation of the stratigraphy, revealing a series of ground raising deposits that they correlate with over 500 years of industrial activity (salt production), prepared floor construction, and the accumulation of both industrial and domestic waste. Magnetic susceptibility measurements proved especially useful in revealing strong tropical weathering. Interestingly, in terms of catchment-wide environmental change, they show that the site was latterly covered with a layer of beach sand relating to a marine incursion, ultimately reclaimed and sealed

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