Guest Editorial

Geoarchaeology: A toolbox of approaches applied in a multidisciplinary research discipline

1. Introduction and scope of this special volume

This special issue of Quaternary International presents an integrated set of papers on Geoarchaeology and the interaction between humans and palaeoenvironment. The papers arise from session 34 – Geoarchaeology: Palaeoenvironment and Human interactions organised during the XVIII INQUA congress held in July 2011 in Bern, Switzerland. The session was supported by the INQUA commission for Humans and the Biosphere (Habcom) and the International Working Group on Geoarchaeology of the International Association of Geomorphologists (IAG). This session was extremely successful with 30 oral presentations and 50 poster presentations, reflecting the growing importance of the research discipline. Geoarchaeology as a field is growing as more and more techniques more typically used in earth and environmental sciences are shown to have uses in interpreting the archaeological. This volume includes 26 papers reflecting a diversity of approaches applied in the research discipline ‘geoarchaeology’. The papers are diverse in their spatial as well as topical scales and reflect the rapid growing toolbox of approaches and methods (e.g. geospatial analyses in GIS, improved dating techniques, modelling of geomorphological systems, advanced analytical techniques in sedimentology, geochemistry etc.) applied in the discipline. A multidisciplinary discipline receiving more and more significance in a changing world where environmental and climate change influences our human habitat and our resources (e.g. water).

2. A toolbox of approaches

First, Jones (this special issue) focusses on water availability, one of the most important resources of humans, to highlight issues in geoarchaeology and some of the challenges involved in ensuring investigations are undertaken sufficiently rigorously to enhance academic knowledge and debate.

Following on from this, Bellin et al. (this special issue) considers aridification in the Western Mediterranean Basin. While noting that most of the severe aridification phases were climatically induced not human-driven and well correlated with a large dataset of palaeoenvironmental records from the Western Mediterranean Basin and North Atlantic Ocean, they will have doubtless impacted on human cultural development in the region. Tang et al. (this special issue) considers the prehistoric civilization in the hyperarid Tarim Basin as a case study to evaluate the influences of environmental change and found that the prehistoric cultural materials are only encountered in the record during relatively wet periods; again showing the importance of environmental change to civilizations. Crombe et al. (this special issue) studied the Final Palaeolithic and Early Mesolithic human occupation around the Moervaart palaeolake (Belgium) and presents a paleoreconstruction of the landscape.

Sinha et al. (this issue) show how Harappan civilisation archaeological sites are co-located along a palaeochannel of the Ghaggar-Hakra river, hereby demonstrating the importance of the presence of watercourses for civilizations. The authors mainly used electrical resistivity soundings to map the large-scale geometry and architecture of the palaeochannel system.

The use of satellite imagery becomes more important in disambiguating the archaeological past. In this special issue Balbo et al. (this special issue) present a study set on the South West margin of the Thar Desert, in North Gujarat, an ecotone sensitive to the slightest shifts in precipitation patterns (Indian Summer Monsoon). Their results constitute the first step towards the full multi-scaler integration of landscape architectures, stratified archaeological sites and surface sediments at regional and local levels using data collected from satellite imagery and field exploration.

Chang et al. (this issue) look at the spatial arrangements of the complicated and diverse sets of cultural features in the region around the East Sea/Sea of Japan, including the Korean peninsula, Japanese archipelago and maritime regions. The style and distribution of cultural materials is considered and patterns of human migration inferred. In particular it is indicated that the emergence of the Late Paleolithic in Japan was very likely influenced by the Late Paleolithic in Korea.

Bottari et al. (this issue) considered the seismic record in Umbria and shows how the archaeological site at Carsulae was not abruptly abandoned because of earthquakes or landslides, but rather, it suffered progressive impoverishment of the groundwater table which will have affected the whole town. Fujiwara et al. (this special issue) study the influence of a palaeohazard event on a harbour by integrating sedimentological and historical data. They document the sudden decline of a famous port town, Hashimoto (Japan), formerly flourishing along the Hamana River due to the closing of a water route connecting Hashimoto with the Pacific Ocean by tsunami-genetic deposits.

This leads us into a series of papers reporting research where sedimentary logging and analysis techniques continue to play an important role. According to Ward et al. (this special issue), the islands of the Dampier Archipelago preserve a probable 30,000 year archaeological record that reflects the change from a
continental to an island environment following post-glacial sea-level rise. They use first-order geomorphological principles to assess key Late Pleistocene and Holocene sediment bodies that may preserve archaeological deposits. Haessler et al. (this special issue) consider the sedimentary record of the Etiloko Lagoon, Aetolia, Western Greece together with a series of geochemical and isotopic techniques in an attempt to disentangle natural and anthropogenic imprints in the sedimentary record. Meylemanns et al. (this special issue) apply detailed sedimentological and palaeoecological analysis together with radiocarbon and OSL to reconstruct Late Glacial and Holocene landscape changes along the river Scheldt in Belgium. This is of primary importance for the understanding ‘preservation potential’ of archaeoological structures and finds from the Final Palaeolithic up to the Medieval period in this area.

Tisdall et al. (this special issue) continues in this theme using radiocarbon and OSL dating to identify periods of minerogenic and organic sediment accumulation to carry out palaeoenvironmental analyses of an exposed sequence of interbedded sand and peat overlying glacial till on Stronsay, Orkney.

Geomorphological studies are used in conjunction with micro-palaeoontological studies by Pavlopoulos et al. (this special issue) who reconstructs the palaeoecography using palaeo-environmental data from foraminifers and sea-level changes, providing archeological data about the presence of a potential harbour in the area. Another palaeoontological study is carried out by Li (00084) who assesses the potential impact of increased temperature by looking at fossil charcoal records from the mid-Holocene archaeological sites at Xishanping and Dadiwan. They reconstruct the vegetation and plant diversity between 5200 and 4300 cal yr BP, which was a warm period for the region. Li (00178) considers the archaeoological sedimentary profile from Tanjialing, Hubei Province, by examining for pollen-TOC-TN-δ13Corg Content.

The radiogenic and stable isotopes of carbon are particularly powerful in studies of events in the Holocene and Peng et al. (this issue) advances the current research by cross-checking the reliability of 14C dating of collagen and integrating the work with a stable isotopic reanalysis on the sample (δ13C). Stable and radiogenic isotopes can become more and more commonly used in studies due to their versatility. Bicho et al. (this special issue) revisits the Muge shellmiddens which have been investigated for some 150 years and yet have proven problematic; they present new radiocarbon dates together with a complete and detailed new view of the chronology of one of the most important shellmiddens as well as to the time of settlement of Mesolithic complex hunter-gatherers in the region and the following reuse of the shellmiddens by Neolithic populations. Roeke et al. (this issue) continues the use of radiocarbon dating in the landscape to date charcoal layers in soils and mining heaps in Austria and to reconstruct phases of pasture and mining activity stretching as far back as the Early Bronze Age. Pena-Monne et al. (this issue) combined radiocarbon dating of organic material and thermoluminescence dating volcanic ash from Argentina to elucidate the evolution of peopling in the southern Mendoza province during the Holocene.

Stable isotopes can also be used to reconstruct palaeoclimates which can then provide useful information for analysis of human–landscape interactions. Wang et al. (this issue) reconstructed seasonal-scale climate conditions using high-resolution oxygen isotopes, ratios (δ18O) of archaeological shells (Mercenaria campechiensis) and otoliths (Ariopsis felis) and found that the climate reconstructions agree with archaeological observations and are partially coherent with the history of sea-level change. Paul et al. (this issue) also used the stable isotope compositions of carbon (δ13C values), together with those of oxygen, in modern and archaeological adult snail shell carbonates to indicate the dietary plants at the time and comment on a progressively wetter climate over the period in question. Niemann et al. (this issue) used a range of techniques including stable isotope analysis of carbon together with organic and inorganic chemical analyses to investigate palaeoenvironmental changes in southern Ecuador over the last ca. 1400 years and comment on plants and other changes brought about by invaders since the Spanish colonisation.

A chemical study of cultural materials (Roman Glass) was carried out by Petit-Dominguez (this issue) who analysed a full suite of elements and used statistical analyses to recognise patterns in the data.

Finally, Kisielene et al. (this issue) presents the results of multi-disciplinary investigations including sedimentological, chronological (14C and thermo-luminescence (TL)), geochemical reconstruct the palaeoenvironmental conditions and peculiarities of the population history at the Skomantai archaeological site, W Lithuania. This multidisciplinary approach reinforces the collaborative efforts being undertaken in much modern research to better understand the archaeological past.

3. New challenges for geoarchaeology in a changing world

Geoarchaeology is a growing and evolving research discipline at the intersection between geomorphology, environmental history and archaeology (Butzer, 2008). The term geoarchaeology was one of the first times used by Karl Butzer (1973). During its short existence, geoarchaeology as a research discipline has evolved from a speciality approach employed in exceptional circumstances to an essential aspect of a growing share of field-based archaeological research applying a huge variety of approaches and proxies. The research discipline gains more and importance as is reflected by its formal recognition by professional associations e.g. International association of geomorphology, Geological Society of America, INQUA commission for Humans and the Biosphere etc. and the increased number of geoarchaeology sessions at international meetings.

In a changing world where climate change causes violent impact on the human habitat geoarchaeological research receives new significance. The (comparative) analysis of past cultures’ adaption strategies to environmental changes provide important insights to develop effective approaches to design scenarios of human reactions on expected environmental changes. The concurrent assessment of different landscapes’ resilience processes to human impact and natural phenomena provide important insights to develop effective approaches to solve present and future environmental problems. However, this requires a deep understanding of the physical processes shaping Earth surface including natural and anthropogenic triggers. To understand – and finally to control – the ‘anthropogenic’ triggers human have to be dealt as actors and not only as factors. Against this background, surprisingly only few scientists have seized the chance to work on these challenging topics along the interface of natural sciences and social/historic sciences. Rather, the strong geomorphological and sedimentological approaches in geoarchaeological studies frequently lack the integration of archaeological research. Moreover, archaeologists in many cases still find it difficult to study a landscape or an excavation site considering geological and geomorphological data. Based on this observation it seems that the earth sciences and archaeologists are sometimes missing the chance to cover a challenging research field with high potentials to find answers for future problems of human–environment interactions. It would be eligible when in future more earth scientists are courage and do real inter- and transdisciplinary research – to
develop effective approaches to solve present and future problems of human-environment-interactions and give impulse to new research themes as palaeohazard research in a geoarchaeological context.

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