Interdisciplinary collaboration between the Humanities and Sciences. Fifteen years of Geo- and Bioarchaeology teaching and research at the Vrije Universiteit Amsterdam

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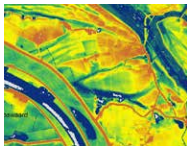



INTERDISCIPLINARITY BETWEEN HUMANITIES AND SCIENCE

A FESTSCHRIFT IN HONOUR OF PROF. DR. HENK KARS

editors
Sjoerd Kluiving, Lisette Kootker
& Rita Hermans

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IGBA VU
Institute for Geo- and Bioarchaeology

Contents

Interdisciplinary collaboration between the Humanities and Sciences

Fifteen years of Geo- and Bioarchaeology teaching and research at the Vrije Universiteit Amsterdam

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Introduction

In 1999 the Faculty of Earth and Life Sciences of the Vrije Universiteit in Amsterdam founded the Institute for Geo- and Bioarchaeology for Research (IGBA). At the same time, the Institute founded an interdisciplinary study program entitled 'geo- and bioarchaeology', which was developed by Professor Henk Kars, attracting and inspiring a modest number of bachelor and master students, as well as PhD students from both the Netherlands and abroad.

Now, fifteen years later, in response to low student numbers, the study program has been cancelled by a faculty wishing to economize, thereby reducing research opportunities (Kluiving & Kars, 2014). In this paper, delivered on the retirement of Prof. Dr. Henk Kars, a) we review what has been accomplished in the fifteen years of research collaboration between geology and archaeology at the VU, b) we introduce ten papers between science and humanities that form the backbone and introduction of this Festschrift to Prof. Dr. Henk Kars, and c) we discuss what future prospects exist for research and teaching geo- and bioarchaeology in the Netherlands and beyond.

Almost half a century ago Colin Renfrew declared that "every archaeological problem starts as a problem in geoarchaeology" (Renfrew, 1976). Geoarchaeology has developed in the current and pre-last decennium internationally, shown by

the growth of interdisciplinary sessions between culture and nature at various large conferences. The department of Geo- and Bioarchaeology (AGBA) of the Vrije Universiteit has organised a significant number of international conferences and symposia, and has manifested itself as the university where interdisciplinary research is executed at the interface of geology and archaeology: the 33st *International Symposium on Archaeometry* (ISA, 2002; Kars & Burke, 2005), the 1st *International Symposium on Biomolecular Archaeology* (ISBA, 2004), the 3rd conference *Preservation of Archaeological Remains In Situ* (PARIS, 2006; Kars & van Heeringen, 2008), and the 1st and 3rd international *Landscape Archaeology Conferences* (LAC2010, LAC2014). Moreover, we have been guest editors of five special volumes dedicated to themes of Landscape Archaeology, Geoarchaeology, and Soil as a Record of the Past (Quaternary International, 2012, 2015; Catena, 2015, 2016; SoilD, 2016).

What is geoarchaeology?

Definitions that have often been cited in the literature suggest that geoarchaeology addresses archaeological research questions using methods and techniques from the earth sciences (Butzer, 1973; Engel and Brückner, 2014). In the early days of this emerging interdisciplinary research field the focus was on understanding the physical environment and landscape setting of the archaeological remains and the (pre-) historic landscape.

Nowadays the original definition of geoarchaeology has been widened with the application of earth sciences going beyond simply the reconstruction of the archaeological-historical landscape. Furthermore, archaeological knowledge is now being used to inform questions addressing earth science research and the relationship between natural processes and human influence. Over the past fifteen years, the AGBA Institute has contributed in many ways to academic debates in geoarchaeology. The following list of themes, research questions and publications of staff, PhD and MSc students illustrate the multi-faceted role of the IGBA in contributing to the interaction of earth sciences and archaeology (for a more complete description see Kluiving & Kars, 2014).

Geoarchaeological prospection and Geo-ICT applications

Identification and geoprospection of the remains of past settlements and graveyards can be undertaken by coring and through remote sensing analysis (Sueur, 2006; Waldus & Van der Velde, 2006). Magnetometry has been successfully applied to map archaeological features including ditches and hollows, as well as iron-rich anomalies within the soil caused by metalliferous objects and high temperature alteration caused by other processes such as burning (Kattenberg, 2008). Novel geochemical techniques have also been used to detect organic residues associated with settlement, such as proteins derived through the decay of human and animal material (Oonk, 2010).

The geographical distribution of sanctuaries on the hill tops of Crete, Greece, including sight lines and other spatial characteristics, have been systematically analysed in GIS (Soetens, 2001). 3D-modelling of the geological and cultural

Figure 1. Landscape reconstruction in the Fayum Oasis, Egypt: PhD student Annelies Koopman investigates the dynamic landscape of the northern shore of Lake Quarun using sediment-stratigraphic methods. Below the surface of the contemporary desert, a hidden landscape has been revealed comprising past lake shorelines Aeolian, Wadi, and deep and shallow lake deposits as well as charcoal hearths (Koopman et al., 2015).

Figure 2. Investigation of storm layers in the Late Medieval clays of Schokland: correlation of geological and historical data (Van de Biggelaar et al., 2014; photo: Hege Hollund).

setting of the city of Bergen, Norway, demonstrates its significant heritage value (De Beer *et al.*, 2012). Using stratigraphic modelling, the relationship between high densities of artefacts and the spatial variability of non-erosive, stable surfaces has been established (Gkouma *et al.*, 2011). Statistical analyses have produced probability maps explaining surface structures and indicate the preferential location for settlement in a landscape (Fernandes *et al.*, 2012).

The archaeological-historical landscape

What was the landscape like at a particular archaeological period and locality in question, and how did people use this landscape? The natural landscape can vary considerably in shape and over time at any given place, influenced by the dynamics of sedimentation and erosion, soil formation, as well as volcanic, tectonic and other processes. How do cultures relate to these natural forces in terms of land use and experience? Under the banner of landscape archaeology the AGBA has carried out many research projects in diverse Mediterranean regions, including Italy, Greece, Turkey and Egypt (Kluiving *et al.,* 2011, 2016; Groenhuizen *et al.*, 2015; Kluiving, 2015; Koopman *et al.*, 2015: Fig. 1). Within a geoarchaeological PhD project in Flevoland, The Netherlands, four discrete time windows of human history within the past 250.000 years demonstrate highly variable landscape conditions influencing as well as determining cultural history (Van den Biggelaar *et al.*, 2014, 2015; Van den Biggelaar & Kluiving, 2015; see also Van den Biggelaar *et al.*, this volume). In order to reconstruct the paleo-landscape and to investigate whether evidence of Roman waterworks could be detected, geoarchaeological coring campaigns were carried out to gain insights into the sedimentology, chronology, stratigraphy and geoarchaeology of the eastern Netherlands river area (Verhagen *et al.*, 2016).

Studies of human-induced 'natural' disasters in the south-western Netherlands have included the reconstruction of flooding of an entire Medieval landscape, and has provided insights which have allowed advice to be given to designers recreating cultural landscapes for future development (Kluiving *et al.*, 2006; De Kraker & Kluiving, 2010). Novel approaches include a) palaeoclimate reconstructions based on historical documents such as crop yield records that can be correlated to past monthly temperatures (De Kraker & Fernandes, 2013), b) potential of correlating temperature fluctuations and trends with historical storm episodes to inform storm potential under scenarios of future climate change (De Kraker, 2006), c) to establish insights in historical land use in polder areas to sustainable coastal management given rising sea levels (De Kraker, 2011). It is significant to note that the last 3000 years of sea level rise in NW Europe cannot be constrained by geological data, but by archaeological and historical data instead (Kluiving *et al.*, 2013).

Which natural resources have been used in the past?

How did humans obtain minerals, rocks and ore, for direct use as well as for the production of ceramics, metals and glass? An MSc student of Archaeometry undertook an analysis of *La Tene* bracelet fragments found in The Netherlands, which demonstrated that the rough glass had its provenance in Egypt (Van der

Figure 3. Landscape archaeological research in eastern Flevoland: MSc student Mark Groenhuijzen is coring into Pleistocene sands, a project related to the 'Nieuwland Erfgoedcentrum' PhD research 'Biography of the New Land' (photo: Don van de Biggelaar).

Figure 4. Groundwater level, flow and chemical composition, especially the oxygen content, determine the preservation potential of invisible heritage within the subsurface. Groundwater monitoring is needed to identify changes in hydrological parameters, caused by e.g. construction and the potential impacts of reduced groundwater on the conservation of archaeological deposits.

Laan, 2013). The economic significance of iron extracted from bog iron on two Dutch push moraines on the Veluwe has also been indicated by Moerman (1928). Recent estimates based on the number of iron slags suggest production of around 55.000 tonnes of crude iron ore, indicating the largest early medieval iron production centre in North-West Europe. The early historic iron production process involved winning of solid iron by using small charcoal heated ovens that reached temperatures of 1200 °C, facilitating the conversion of iron oxide to metallic iron (Laban *et al.*, 1988; Joosten, 2004). Since Roman times salt recovery from peat in the Lowlands has been an almost daily practice. During the Middle Ages, as a result of increasing urbanisation, the peat was not only an important fuel source, but continued to be exploited for salt with excavation and extraction having a major impact on the landscape (De Kraker & Borger, 2007).

Our soil as a repository of invisible heritage

Conservation of archaeological remains *in-situ*, demanded by many statutory governing institutions, urges questions to be addressed related to the physical preservation status within soils and sediments. Knowledge of the mechanisms of degradation and decay of materials such as bone, wood, and metal is essential and the processes operating within the soils and sediments, including the geochemical and hydrological regimes and groundwater movements, which all influence conservation capacities considerably (Huisman, 2009). Conservation should not be considered static, but as a dynamic process, at which in spatial design the conservation of cultural heritage is preserved in nature development projects. Next to contributions from the earth sciences, historical geography is also important (Bloemers *et al.,* 2010).

Bioarchaeology

While in the past the degradation of bone was not considered to be a big problem, nowadays this view has changed due to the rapid developments of research in ancient DNA that demands good preservation. Two PhD projects within the Institute have studied degradation mechanisms in a variety of bone types and soil conditions across a range of European countries (Jans, 2005; Hollund, 2013; see also Kootker & Davies (this volume) for more references on bioarchaeology and bone analysis). A separate research theme related to bioarchaeology considered human evolution, in particular, Neanderthal behaviour. The evolution of cognitive development using archaeological data from the Early- and Mid-Palaeolithic contexts has proved more promising, following the so called bottom-up approach (Langbroek, 2012).

Archaeology contributing to earth science

Archeo-seismology is a good example of where archaeological knowledge is a key component of earth science research. Archaeological find spots in tectonically active areas like the Mediterranean can provide important clues about timing and intensity of earthquakes in prehistory, when historical sources are scarce and

Figure 5. Archaeologists and senior field technicians take the course Soil Science and Geology for archaeologists (www.scholingarcheologie.nl) on the location of the Wekeromse Zand, central Netherlands.

measuring instruments were not available. Internal structural deformation of the Roman theatre of Pinara, Southern Turkey, have been captured and visualised using laser altimetry, providing a measure for the extent and intensity of earthquakes that originated along the local fault zone (Yerli, 2011).

Many other examples illustrate that where the results of radiometric dating of geological deposits are lacking or scarce, relative dating of archaeological remains can provide a chronological framework for landscape evolution across a variety of research projects (*e.g.*, Kluiving *et al.,* 2013, 2016; Kranendonk *et al.,* 2015; Vos *et al.,* 2015; Verhagen *et al.*, 2016).

Interdisciplinary research

Within the relationship between earth sciences and archaeology the landscape is centre stage. For earth science practitioners the term landscape is almost self-evident in terms of meaning 'natural'; for archaeologists, landscape has a different, wider meaning that is equally as valid. Cultural landscape features comprise anthropogenic phenomena such as infrastructure and housing, but can also include intangible and invisible elements that contribute to the perception of the landscape (Kluiving *et al.,* 2012; Kluiving & Guttman, 2012; Bloemers *et al.*, 2010). Both visions of landscape can contribute to each other, so consequently many projects now take a multidisciplinary approach. The challenge for the future is to develop increasingly larger scale projects between geology and archaeology that

are truly interdisciplinary. Key to achieving this aim is that the research questions considered should be posed by both disciplines, which goes beyond traditional approaches where one is only an auxiliary discipline for the other. An example of such an overarching research question is undoubtedly related to the fact that we are currently moving beyond the 'natural' climate of the Holocene interglacial and have moved into the Anthropocene (Kaplan *et al.,* 2009; Ruddiman *et al.*, 2008; Ruddiman, 2013; Smith & Zeder, 2013). Human impact on the environment has increasingly outweighed the flow of natural processes interacting with the earth's lithosphere, atmosphere, biosphere and hydrosphere (Waters *et al.*, 2016).

Ten research papers in this Festschrift

In this Festschrift we present ten research papers written by former colleagues, post-doctoral and PhD students that encapsulate all the themes discussed previously. The papers range from pure archaeometry, to bioarchaeology, landscape archaeology and historical geography and illustrate the width and strength of geo- and bioarchaeology.

Jan Kolen & Barbara (chapter 2) discuss the true enigma of European landscape archaeology and summarize findings and common opinions that may re-activate the debate about the nature and origins of the cultural landscape among scholars of prehistoric hunters and gatherers. They conclude that the evidence is far from complete and coherent, proposing a new systemic and focused approach and research strategy while calling on the assistance of Henk himself.

Guus Borger & Sjoerd Kluiving (chapter 3) describe and reconsider the most relevant historical and geological data pertaining to the discharge and supply of water to the 'Wet Heart' of the Netherlands during the past millennia. Based on data such as the evidence for the earliest peatland cultivation and reclamation they date the outlet of the Almeer to the Wadden Sea, developed as a tidal channel, to the 8th century AD, almost a millennium later than the latest geological interpretation (Vos, 2015).

Kootker & Davies (chapter 4) review the current state of human bioarchaeological isotope geochemistry research in The Netherlands. With examples of many case studies in the Netherlands they comment on the on-going methodological developments in isotope research that are improving our understanding of the archaeological record. Many of the on-going developments are allowing smaller samples to be analysed, resulting in either less sample destruction or the capability to analyse new sample types.

Marco Langbroek (chapter 5) describes the recent find of a Neolithic polished axe made of quartzite from the Naarder Eng (Huizen, the Netherlands) and the implications of this find for the so-called 'Quartzite Palaeolithic' of the Naarder Eng. Field observations reported here suggest that the site is situated on a localized outcrop of quartzite cobbles originally derived from the ice-pushed deposits at this locality. This quartzite procurement site may well have been in use during the Neolithic, i.e. during the mid-Holocene.

Adrie de Kraker (chapter 6) discusses strategic inundations during the Eighty Year's War and how archaeology is preserved after reclamation of the landscape in Zeeuws-Vlaanderen (southern Netherlands). The author combines history, historical geography, physical geography, archaeology and aerial photography to reconstruct late medieval landscape, its settlements and main infrastructure.

Ineke Joosten and Maarten van Bommel (chapter 7) report on archaeometric analyses using ultra-high performance liquid chromatography and scanning electron microscopy to determine colorants and the condition of fibres and the possible use of a mordant. Bog finds from the Bronze Age and late Iron Age were compared to pieces of fabric from the sandy soil of a large Early Medieval cemetery of Rhenen and a piece of cloth from a 17th century shipwreck found in the sea near Texel.

Dauven *et al.* (chapter 8) study the variation in $\delta^{13}C$ and $\delta^{15}N$ ratios in collagen from a single human femur, and between different bones of the same skeleton, in order to estimate the range of isotopic variation in archaeological isotope studies. Results show that the choice of sampling position is significant and important, with implications for the use of a subdivided femur as an international standard for isotopic measurements. Measuring a wider range of skeletal elements of the same individual, and plotting them as standardized isotopic scores, potentially gives considerably more insight into individual life histories than rib-femur spacing.

Don van de Biggelaar *et al.* (chapter 9) discuss the landscape development and evidence for hominin activity in Flevoland (central Netherlands). It is demonstrated that the area consists of a stacked stratigraphic sequence of different landscapes with (possible) traces of hominin activity dating back to the period 220-170 ka (MIS 7/early MIS 6). During each of these four time periods the study area was characterised by a different environmental setting and specific evidence of hominin activity.

Jan Verhagen *et al.* (chapter 10) report on the Linge, a water body in the central Netherlands, comprising a western part which is a natural branch of the Rhine delta, and an eastern part which is largely artificial. Analysis of data from historical maps, oral history, other documentary sources and Digital Elevation Model maps reconstructs how the natural water course and drainage channels developed in the area from late medieval times until the present. It is assessed whether the Linge channel originated near Lobith or that this possibility should be rejected.

Merriman *et al.* (chapter 11) suspect that the mineral corrosion products which form on the surface of archaeological copper alloy objects might provide a suitable locus for the preservation of organic residues. This may offer new insights into the ritual or mundane use of copper vessels. Results of this study have the potential to open up the possibility of extending the study of the use of vessels via the identification of organic residues to include metal forms.

Does geoarchaeology have a future in The Netherlands and beyond?

The scientific legacy of fifteen years of Geo- and Bioarchaeology teaching and research at the Vrije Universiteit has had an important impact in the Netherlands and the demise of both the Institute and its study programme clearly exposes the

future ability of the country to undertake multi- and interdisciplinary research bridging the sciences and humanities. The Institute created a huge synergy between research and teaching, which has delivered a vast quantity of knowledge, which was not possible following traditional research frameworks (Kars & Burke, 2015; Kars & van Heeringen, 2008). Future interdisciplinary research is strongly embedded in CLUE+, such as the LAC conference series (Kluiving *et al.*, 2012, Kluiving & Guttmann, 2012, Bebermeier *et al.*, 2012, 2013), as well as the International Association of Landscape Archaeology (www.iala-lac.org), and interdisciplinary research sessions at the European Geosciences Union (Kluiving *et al.*, 2015a, 2015b, 2016; Kluiving & Borger, 2015). The reforming structural bachelor, master and doctoral training developed by the Institute will continue after AGBA's closure as seen in:

a. regular geoarchaeology Erasmus+ courses for (R)MA and PhD students archaeology in the ARCHON research school (www.archonline.nl);
b. the start of an interdisciplinary intra-university bachelor minor in Geoarchaeology at the Vrije Universiteit in the academic year 2016/2017: www.vu.nl/minorgeo);
c. the emergence of Science and Geoarchaeology in the ACASA (UvA/VU) bachelor and master programmes;
d. post-academic training of geology, historical geography and soil science to practitioners and professionals working at the nature-culture interface (www.scholingarcheologie.nl) (Figure 5);
e. geoarchaeology Master's research projects at the Faculty of Earth and Life Sciences;
f. interdisciplinary PhD and Master's projects in the Research School of Humanities, and
g. Geo- and bioarchaeology are embedded within the CLUE+ research cluster combining top researchers from a wide variety of academic disciplines to jointly investigate central concerns of contemporary society, of relevance to all social domains and at all geographical scales (www.clue.vu.nl).

Now, at the culmination of Henk Kars's career we conclude that fifteen years of geo- and bioarchaeology at the Vrije Universiteit have delivered a sustainable synergy between training and research in the interdisciplinary field between geology, archaeology, biology and historical geography. We have demonstrated that investments in interdisciplinary collaborations between the humanities and the sciences in this period clearly support tracks to future developments in this field in the Netherlands and beyond.

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INTERDISCIPLINARITY BETWEEN HUMANITIES AND SCIENCE

Henk Kars was appointed as first Chair of Archaeometry in The Netherlands in 1994. From 2002 he was full time professor at the Vrije Universiteit Amsterdam, interim Director of CLUE, and founder and Managing Director of the Institute for Geo- and Bioarchaeology. This festschrift volume incorporates original publications in the field straddling the Sciences and Humanities produced by various former PhD-students, post-docs and colleagues.

Landscape archaeology is described in the first cultural landscapes of Europe as a mysterious outcome, while the historical record of surface water flow of the central Netherlands is reviewed. The south-western Netherlands are historically analysed since military inundations during the Eighty Year's War. The palaeolandscapes of the eastern Netherlands are reconstructed to locate the origins of the river Linge. The long time scale is considered in a 220.000 year overview of landscape development and habitation history in Flevoland.

Bioarchaeology is represented in a review of the current state of isotope research in The Netherlands and a correlation between bio- and geochemistry meets an analysis of organic residues in copper corrosion products. Archaeometry reveals the colour of Dutch archaeological textures. The relevance of a quartzite Neolithic axe found near to Huizen, The Netherlands is described.

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