

# DIG 2009

DEVELOPING INTERNATIONAL GEOARCHAEOLOGY  
AVANCES EN GÉOARCHÉOLOGIE INTERNATIONALE

Conference and Geochemical  
Characterization in Archaeology Workshop  
May 24-28, 2009



Department of  
Anthropology

School of Geography and  
Earth Sciences



# Conference Overview

## **Monday May 26th, 2009**

DIG INAA Workshop 8:45AM – 4pm

Location: Nuclear Reactor Building *Please meet in Main Lobby at 8:45am*  
*lunch, coffee and snacks will be provided*

## **Tuesday May 27th, 2009**

DIG INAA Workshop 9:00am – 4:30pm

Location: Nuclear Reactor Building  
*lunch, coffee and snacks will be provided*

7:00pm 8:30pm - Guest Speaker: Mark Jaroszewicz, Ontario College of Art and Design

Location: Togo Salmon Hall 114

## **Wednesday May 27th, 2009**

DIG INAA Workshop 9:00am – 4:00pm

Location: Nuclear Reactor Building  
*lunch, coffee and snacks will be provided*

## **Welcoming Reception and Conference Registration 7:00pm – 10:00pm**

Location: University Club, Great Hall

*Sponsored By Hamilton Chapter, Ontario Archaeological Association*

## **Thursday May 28th, 2009**

DIG Conference Presentations

Location: CIBC Hall, McMaster University Student Centre (MUSC), 3<sup>rd</sup> Floor

Registration 8am-12pm outside CIBC Hall

9:20 Oral presentations

10:20 Coffee break *Sponsored by Archaeological Services, Inc.*

10:40 Oral presentations

11:40 Lunch

1:20 Poster Session and student poster presentation judging *Prizes sponsored by the Canadian Geological Foundation*

2:40 Coffee break *Sponsored by The Canadian Archaeological Association*

3:00 Oral Presentations

## Conference Overview

### Friday May 29th, 2009

DIG Conference Presentations

Location: CIBC Hall, McMaster University Student Centre (MUSC), 3<sup>rd</sup> Floor

Registration 8am-12pm outside CIBC Hall

9:00 Oral Presentations

10:20 Coffee break *Sponsored by Bartington Instruments*

10:40 Oral Presentations

12:00 Lunch

1:20 Oral Presentations

2:40 Coffee break *Sponsored by The Canadian Museum of Civilization*

3:00 Oral Presentations

4:20 Keynote speaker

### DIG Banquet and Closing Reception 6:30pm-11pm

6:30 Cocktails

7:30 Banquet dinner

Location: Great Hall, University Club

## Campus Information

McMaster University telephone number: 905-525-9140

Hospitality Services x. 24422

Conference Services x. 24781

Department of Anthropology x. 24423

School of Geography and Earth Sciences x. 24535

## Dining on Campus (McMaster University Student Centre)

La Piazza Mon-Thurs 8am-6pm, Friday 8am-4pm

Teriyaki Experience Mon-Thurs 11am-5pm, Friday 11am-4pm

Tim Horton's Mon-Fri 7:30am-3pm

Williams Coffee Pub Mon-Fri 8am-4pm

## Keynote Speaker

### **Dr. Ron Hancock**

#### **BIOGRAPHY**

The Keynote Speaker for this event is Dr. Ronald G.V. Hancock from the Department of Medical Physics and Applied Radiation Sciences and the Department of Anthropology, McMaster University. Dr. Hancock's scientific contributions to Archaeology span almost four decades. After earning his B.Sc. and M.Sc. in Chemistry at the University of Auckland, New Zealand, he came to Canada to pursue his Ph.D. in Analytical Chemistry at McMaster University, in Hamilton Ontario. He was immediately hired as the Slowpoke Reactor Supervisor at the University of Toronto in 1971, where he remained until the reactor's closing in 1998, having being the nuclear reactor's director for almost a decade. He continues to be actively involved in the world of archaeological sciences, although he officially retired in 1998. He is still serving on the committees of MA and PhD Anthropology students at McMaster University. He is a driving force behind the creation of dedicated facilities and procedures for Archaeometric studies at the McMaster Nuclear Reactor-Centre for Neutron Activation Analysis.

Dr. Hancock has used his expertise in chemistry to examine a multitude of archaeological materials (glass objects, ceramics, plasters, beads, stone tools and copper implements, as well as soils, teeth and bone samples, to name a few) from a wide variety of regions from around the world (North and South America, Europe, Near east, Asia, Australia and Africa), spanning both prehistoric and historic time periods. He has published more than 400 peer reviewed papers and book chapters. His research has contributed to answering questions that have varied from the technological capabilities of the Neanderthals, to questions of trade and exchange between Europeans and First Nations communities in Canada, to understanding ancient diets through the use of trace elemental contents in archaeological bone samples. Below is the title and abstract for his keynote address.

## Keynote Address

### **How good are our archaeometric data? A reassessment and reinterpretation of a published data set of shell tempered pottery**

Caution must be used to ensure that a newly-produced ceramic data set is of the highest reliability possible, prior to data analysis. Since we match the elemental concentration fingerprints of samples to sort them into groups, miss-analyses or miss-recordings of elemental concentration data tend to produce chemical outliers whose elemental concentration fingerprints do not match others as they should.

Ceramics that produce chemical outliers are potentially interesting, since they may indicate some sort of trans-regional trade or exchange. When they occur singly, outliers are often rejected from further discussion and interpretation. But, when several appear they may be clumped together, if appropriate, to form a new chemical grouping.

For shell tempered pottery, care must be taken in the way we remove the effect of shell tempering. While the current method of correction, based on the measured Ca concentrations, works relatively well, it falls short when there are missing Ca data. A better approach might be to estimate the maximum Sc concentration in the data set and normalise the data set to this Sc concentration.

A shell-corrected data set from the literature is used to illustrate the above points. Data are corrected using combinations of bivariate plots, and prayer.

Inspection of the corrected data shows that it is possible that minor geochemical differences among wares from a small geographic region may be used to separate them using a small number of elements.

## Presentation Schedule

Oral presentations will be allotted 20 minutes each, including 5 minutes for questions. Please bring presentations on a flash/usb drive or CD. We will provide a laptop.

Please submit your presentation upon registration at the Opening Reception (evening of Wednesday 27th), or at the registration desk at 8:30am the morning of your presentation.

Posters can be up to 3 x 4 feet. Poster boards and pins will be provided. Delegates will be responsible for affixing and removing their poster(s). Posters can be affixed on Thursday May 28 at 12pm and must be removed by Friday May 29 at 12pm.

### Thursday May 28th

Oral Presentations 9:20am – 12:00pm, 3:00pm – 4:20pm

Lunch: 11:40pm-1:20pm

Poster Session 1:20pm-2:40pm

Location: CIBC Hall, McMaster University Student Centre, 3<sup>rd</sup> Floor

**9:20-9:40**      ***J.V. Owen, R. Hunter, R. Jellicoe and M. Zierden***

Morphological and melt compositional evolution of phosphatic porcelain from sintering to vitrification: evidence from sherds excavated in Charleston, South Carolina

**9:40-10:00**      ***B. Lailson Tinoco, P. Schaaf, L. Manzanilla, G. Solis-Pichardo, and T. Hernandez***

Applying Strontium Isotopes to the Study of Pre-Hispanic Human Migration: the Case of Teopancazco, Teotihuacan

**10:00-10:20**      ***J. Thompson, W.J. Rink, and M. Dominguez Rodrigo***

EPR dating of thorium-contaminated teeth

**10:20-10:40**      **Coffee break sponsored by Archaeological Services, Inc.**

**10:40-11:00**      ***D. Lubell, J. Feathers, J-L. Schwenninger, M. Faber, C. Yapp, J. Shipp, and A.M. Rosen***

Using OSL, stable isotopes and phytoliths to reassess the chronology of a Capsian escargotière in eastern Algeria: implications for Holocene settlement in the Maghreb

**11:00-11:2**      ***J. Morin***

Trade and Exchange of Nephrite Jade Celts in the Pacific Northwest

**11:20-11:40**      ***G.H. Bondar***

Elementary, My Dear Holmes: Characterization by INAA of Metarhyolite from Holmes' South Mountain Quarry

**11:40-1:20 Lunch 3<sup>rd</sup> floor MUSC (Provided)**

**1:20-2:40 Poster Session**

***F. Cattin***

Lead Isotope Analysis and the Provenance of Copper: Two Case Studies from the Alpine Area and Northeastern North America

***N. Roy, N. Bhiry, J. Woollett***

Paleoenvironmental evolution and human occupation at Dog Island in the north of Labrador, Canada

***C. McNamee, H. Cyr, A. Freeman and L. Amundson***

A Geoarchaeological Examination of the St. Louis Site: Reconstructing Environment and Vegetation through Multiple Proxy Indicators

***C. McNamee, H. Cyr, and P. Dawson***

Site Formation Processes of Sub Arctic Pit Houses, Ikirahaq Island, Nunavut

***A. L. Burke and G. Gauthier***

The Effects of Surface Weathering on the Geochemical Analysis of Archaeological Lithic Samples using Non-Destructive XRF

***K.C. Seramur and E.A. Cowan***

A Model for Burial of Holocene Archaeology Sites by Aeolian Sedimentation in the Sandhills of the Southeastern U.S.A.

***S. D. Kaushik***

The Pleistocene Record of the Central Narmada Valley: Archaeology and Palaeoenvironment

***K. Michelaki, R. Hancock, A. Pidruczny, B. L. MacDonald, and P. Woodley***

Using Instrumental Neutron Activation Analysis (INAA) to test the validity of current field methods of chert identification in archaeological projects

***B. L. MacDonald, J. Palka, B. Ramdoo, W. Matysiak, D. Thirugnanasampanthan, R. Reimer, F. McNeill and E. Desouza***

Multi-Component Analysis of a Copper Artifact from a Rockshelter Site (EaRu-5) in Coastal British Columbia

***G.M. Krezoski, J.I. Boyce, E.G. Reinhardt, J. Gabriel, H. Erkanal, and V. Sahoglu***

Paleogeographic reconstruction of submerged prehistoric shorelines and coastal environments at Liman Tepe, western Turkey

**2:40-3:00 Coffee Break Sponsored by The Canadian Archaeological Association**

**3:00-3:20 *E.C. Robertson and R. Blyth***

Characterizing Heat Treatment of Archaeological Tool Stone Using Synchrotron Science

**3:20-3:40 *T. Carter, F-X. Le Bourdonnec, M. Kartal, G. Poupeau and P. Moretto***

Early Days: Sourcing Obsidian from the Öküzini Cave (SW Turkey)

**3:40-4:00 L. Wilson**

Raw material economics in their environmental context: An example from the Middle Palaeolithic of southern France

**4:00-4:20 E.P. Sonnenburg, J.I. Boyce, and E.G. Reinhardt**

Holocene water-level fluctuations and the implications for Paleoindian Archaeology in Southern Ontario, Canada.

## Friday May 29

Oral Presentations 9:00am – 12:00pm, 3:00pm – 4:20pm

Lunch: 12pm-1:20pm

Keynote Address: 4:20pm

Location: CIBC Hall, McMaster University Student Centre, 3<sup>rd</sup> Floor

**9:00-9:20 R.I. MacDonald**

Reconstructing the Pre-contact Vegetation of Southern Ontario: Developing a Paleoenvironmental Baseline with GIS-based Substrate and Historic Vegetation Data

**9:20-9:40 M.J. Thornbush and J.R. Desloges**

Fluvial stability and site formation processes at the lower Nottawasaga River, southern Ontario, Canada

**9:40-10:00 M.W. Gregg and G.F. Slater**

Assessment of the efficacy of stable carbon isotopes in categorizing organic residues surviving in early archaeological pottery from the Middle East and Europe

**10:00-10:20 T. Bell, R. Quinn, K. Westley, R. Plets, W. Forsythe and M.A.P. Renouf**

A Landscape approach to the investigation of prehistoric marine archaeology off Newfoundland and Northern Ireland

### 10:20-10:40 Coffee break sponsored by Bartington Instruments

**10:40-11:00 S.D. Kaushik**

The Pleistocene record of the Central Narmada Valley: Archaeology and Palaeoenvironment

**11:00-11:20 R. Inglis**

Human Occupation and Changing Environments at the Middle-Upper Palaeolithic Transition: Soil Micromorphology at the Haua Fteah, Libya

**11:20-11:40 T. Orchard**

Sea Levels and mid- to late-Holocene Human Occupation in southern Haida Gwaii, Northern Northwest Coast

**11:40-12:00 M. Burchell, N. Hallmann, B.R. Schöne, and H.P. Schwarcz**

Improving the precision of seasonality estimates in bivalves using high-resolution sclerochronology and oxygen isotope analysis: A case study from the Pacific Northwest Coast

**12:00-1:20    BBQ Lunch on the MUSC terrace**

**1:20-1:40        *K.A. Adelsberger and J. R. Smith***  
Accretionary Desert Pavements as Taphonomic Surfaces

**1:40-2:00        *C. French***  
Living with landscape change in the Durrington Walls to Stonehenge landscape

**2:00-2:20        *M.G. Canti***  
Silbury Hill, Wiltshire, UK: geoarchaeological studies of the old ground surface

**2:20-2:40        *C.M. Fadem, J.R. Smith, A. Moore and M. Mendusic***  
Matrix of Change: The Geoarchaeology of Early European Agriculture

**2:40-3:00        Coffee Break Sponsored by The Canadian Museum of  
Civilization**

**3:00-3:20        *A-M. Lemieux, N. Bhiry and P.M. Desrosiers***  
Geoarchaeology and traditional knowledge of Subterranean Winter Sod Houses in Eastern Hudson Bay, Canadian Arctic

**3:20-3:40        *A. DeGagne***  
Socializing Hunter-Gatherer Space: Understanding Palaeo-Eskimo Inland occupations through GIS visualization of a structure at the Mingo Lake Site, Interior Baffin Island, NU

**3:40-4:00        *S.M. Mentzer***  
Micromorphology and Geoarchaeology of Ucagizli II, Hatay, Turkey

**4:00-4:20        *K. Milek***  
The uses and limitation of multi-element soil analyses for the interpretation of site activity areas

**4:20                *Keynote Address: R.G.V. Hancock***

**How good are our archaeometric data? A reassessment and reinterpretation of a published data set of shell tempered pottery**

## Presentation Abstracts

(organized alphabetically)

### **Accretionary Desert Pavements as Taphonomic Surfaces**

*K. A. Adelsberger<sup>1</sup> and J. R. Smith<sup>2</sup>*

<sup>1</sup>Environmental Studies, Knox College

<sup>2</sup>Department of Earth and Planetary Sciences, Washington University

The identification of potential taphonomic effects on cultural materials is particularly essential when the materials in question come from surface contexts. On the eastern Libyan Plateau of central Egypt, accretionary desert pavement surfaces provide a uniquely stable surface for the recovery of Paleolithic assemblages. The lack of aligned clasts at the surface suggests minimal effects of slope-wash or other orienting processes on clasts. Combined with the presence of refitting knapped materials within small recovery areas, the lack of evidence for overland flow or other reworking events supports lateral stability across this landscape since the deposition of Paleolithic materials. However, lateral stability does not preclude the vertical movement of debitage or other artifactual materials into the soil column. Accretionary pavement formation involves the maintenance of coarse materials at the surface, overlying a continually accumulating layer of wind-blown silts. Given typical accretion rates for desert pavements, the original depositional surface relevant to Paleolithic archaeological materials lies a minimum of several centimeters beneath the modern surface. Smaller clasts are more susceptible to loss below the surface during wetting and drying cycles, trampling, or other pedogenic events. The taphonomic effects of an accretionary pavement surface are therefore likely minimal for those coarser clasts maintained at the surface, and more significant for smaller clasts such as lithic debitage. This taphonomic signature may inform site formation investigations in arid areas, and would likely prevent complete refitting and debitage analysis of stone tool assemblages recovered from accretionary pavement surfaces

### **A landscape approach to the investigation of prehistoric marine archaeology off Newfoundland and Northern Ireland**

*T. Bell<sup>1</sup>, R. Quinn<sup>2</sup>, K. Westley<sup>2</sup>, R. Plets<sup>2</sup>, W. Forsythe<sup>2</sup>, M.A.P. Renouf<sup>3</sup>*

<sup>1</sup>Department of Geography, Memorial University

<sup>2</sup>Centre for Maritime Archaeology, University of Ulster

<sup>3</sup>Archaeology Unit, Memorial University

Recent coastal archaeological and palaeogeographical studies have established that significant sea-level rise has submerged ancient European/North American coastlines since the last Ice Age. Important technological developments in marine geophysics and geodynamic modeling have for the first time created an opportunity to predict, locate and precisely map the locations of these ancient coastlines. The *Submerged Landscapes Archaeological Network* (SLAN) was created to take advantage of this cutting-edge technology for the benefit of North Atlantic archaeology and palaeoenvironmental research. The network utilizes a landscape approach to the investigation of these drowned coastlines, initially focusing on the reconstruction of their configuration and the identification of landscape features preferred by past humans for settlement, such as river valleys, lake basins and sheltered lagoons. Our analysis incorporates three data sets: a computer-modeled simulation of relative sea-level (RSL) changes that predicts the depth of submerged shorelines at specified time intervals; a high resolution seafloor

map, which in combination with the RSL data generates a series of reconstructed shorelines charting the prehistoric evolution of the coast; and targeted sub-bottom profiler surveys to map the geophysical signatures of palaeo 'land-surfaces' (eg. lake basins, beaches, and terraces). Two current projects illustrate the SLAN approach. In Newfoundland, early Maritime Archaic Indian sites are believed to be located on 6000 to 9000-year-old shorelines that are now submerged on the seabed in 10-30 m water depth, whereas along the north coast of Ireland sea levels were lowered by 5-30 m during the earliest known Mesolithic, extending the terrestrial environment onto emergent shelves.

### **Improving the precision of seasonality estimates in bivalves using high-resolution sclerochronology and oxygen isotope analysis: A case study from the Pacific Northwest Coast**

*M. Burchell<sup>1</sup>, N. Hallmann<sup>2</sup>, B. R. Schöne<sup>2</sup> and H. P. Schwarcz<sup>3</sup>*

<sup>1</sup>Department of Anthropology, McMaster University

<sup>2</sup>Geosciences, University of Mainz

<sup>3</sup>School of Geography and Earth Sciences, McMaster University

The season of shellfish procurement is a central question for many archaeological studies in coastal environments. The methods commonly used to identify seasonality, such as shell growth colouration or growth increment analysis often produce ambiguous results and are not precise estimators of seasonal collection patterns. Sclerochronology has been widely used in the geosciences to refine paleotemperature estimates and confirm the relationship between oxygen stable isotopes and seasonal patterns of growth in mollusk shells. Sclerochronology can improve the precision of seasonality estimates in archaeological shells by identifying the timing of shell growth line formation on an annual and daily time scale, and the date of shell collection can be identified with a high degree of accuracy to the nearest fortnightly cycle. By comparing micro-increment formation and local tidal patterns, it is also possible to interpret the relative position in the intertidal zone where the shells were collected.

We present the results of a high-resolution sclerochronological and oxygen isotope analysis of modern and archaeological specimens of the estuarine bivalve, *Saxidomus gigantea* (Butter clam) to demonstrate the utility of this technique. Environmental and biological controls on estuarine mollusks are discussed, specifically the influence of seasonal variations in freshwater influx, and the implications for interpreting paleoseasonality and paleoclimate from oxygen isotope data. By combining geochemical and biological data from mollusks within a broader context of a site's archaeofauna data, it possible to produce a nuanced understanding of the role, and significance of shellfish gathering in settlement-subsistence economies.

### **Elementary, My Dear Holmes: Characterization by INAA of Metarhyolite from Holmes' South Mountain Quarry**

*G. H. Bondar*

Department of Anthropology, Penn State – Greater Allegheny Campus

As part of his nascent lithic studies in the early 1890's, American archaeologist William Henry Holmes of the Smithsonian Institution identified a metarhyolite quarry in the Blue Ridge mountains thought to be the source of Archaic Period artefacts found near Washington, D. C. Revisiting this quarry in 2006, this research reports on the geochemical characterization of this material by INAA, and integrates it into the author's

database of samples from 32 other metarhyolite quarries across eastern North America. To these data are then compared approximately 100 artefacts from the Terminal Archaic Period providing insights into the distribution of this material approximately 4,000 years ago.

### **The Effects of Surface Weathering on the Geochemical Analysis of Archaeological Lithic Samples using Non-Destructive XRF**

*A. L. Burke<sup>1</sup> and G. Gauthier<sup>2</sup>*

<sup>1</sup>Département d'anthropologie, Université de Montréal

<sup>2</sup>Département de Chimie, Université de Montréal

Evaluating the geochemical effects of weathering for archaeological provenance studies of lithics based on data obtained from non-destructive and surface dependant techniques such as X-ray Fluorescence (XRF) is critical. The effects of weathering will vary with rock type (mineralogy) and are non-linear for the range of elements usually reported for XRF analyses. Lighter elements with greater ionic radii and lower electronegativities (greater mobility) should be the most affected by natural weathering processes. In the case of hornfels, this issue becomes critical since hornfels weathers quickly and deeply in archaeological contexts. Hornfels is a general term used to refer to contact metamorphic rocks. Rocks identified as hornfels were occasionally used during the prehistory of the northeastern North America to manufacture chipped stone tools. We present data on cut and polished (fresh, unweathered surfaces) of geological and archaeological samples from quarries in Quebec and New Hampshire and compare these to weathered archaeological samples from quarries and sites in the Northeast region. In our study we find that the major elements are indeed significantly affected by weathering. On the other hand, some of the trace elements such as the lanthanides and the high field strength elements seem robust and may therefore provide greater reliability for the chemical characterization of weathered archaeological artifacts. Finally, some hornfels artifacts appear to be so deeply weathered due to the mineralogy of the protolith (original rock prior to metamorphism) that even the trace element chemistry of these artifacts may not be reliable in identifying a bedrock source.

### **Silbury Hill, Wiltshire,UK: geoarchaeological studies of the old ground surface**

*M.G. Canti*

English Heritage

Internal collapse within the 45m high prehistoric mound of Silbury Hill, Wiltshire, UK led to re-opening and refilling of the existing tunnels, as reported at the last DIG conference in Cambridge UK, 2007. The repair work also entailed a full archaeological recording and sampling program that showed the remarkable state of the old ground surface beneath the hill. In most exposures, the buried soil is not simply a compressed or degraded version of the expected local profile. Rather, it is an artefact in itself, showing elements of extensive truncation, sorting and possible re-deposition, which suggest that unusual activities were going on there before mound building began. An experimental site has been initiated on a similar soil/slope nearby in order to try and recreate the Silbury buried surface by simple processes such as trampling and erosion. This paper will show examples of the old land surface and report on the analyses so far undertaken on samples, as well as presenting the latest results from the experimental site.

## **Lead Isotope Analysis and the Provenance of Copper: Two Case Studies from the Alpine Area and Northeastern North America**

*F. Cattin*

Département d'anthropologie - Université de Montréal

The question of the materials provenance benefits from increasing powerful methods in the field of archaeometry. Lead isotope analysis is a meaningful way of tracing the provenance of metal artifacts. Lead is present in trace amount in metal ores. Its isotopic composition is controlled by the geological evolution of the ore-bodies, and therefore potentially provides a characteristic fingerprint of each individual mining district.

Our doctoral research project, conducted at the University of Geneva (Laboratory of Prehistoric Archaeology and Human Peopling History, Department of Anthropology and Ecology), Switzerland, was based on copper provenance in the Alps during the Late Neolithic, the Bell Beaker period and the Early Bronze Age. On the basis of metallic compositions (lead isotope analysis and chemical element composition), our research showed changes in copper supply. Moreover, some copper sources have been proposed by comparison with an ore database covering Europe.

Within our ongoing project, conducted at the University of Montreal in Montreal (Department of Anthropology) under the supervision of Prof. Adrian Burke, we want to apply lead isotope analysis to native copper in Northeastern North America. We aim to qualify the variability of copper sources in Prehistory, by studying the collections from two Late Archaic archaeological sites in the Ottawa Valley of Quebec and Ontario: Île aux Allumettes and Île Morrison. In a second phase, a comparison with geological sources is planned.

This research is funded by a post-doctoral fellowship from the Swiss National Science Foundation (PBGEP1-123575) and the Fonds Constantin Topali (year 2008-2009).

### **Early Days: Sourcing Obsidian from the Öküzini Cave (SW Turkey)**

*T. Carter<sup>1</sup>, F-X. Le Bourdonnec<sup>2</sup>, M. Kartal<sup>3</sup>, G. Poupeau<sup>4</sup> and P. Moretto<sup>5</sup>.*

<sup>1</sup>Department of Anthropology, McMaster University

<sup>2</sup>IRAMAT-CRP2A, UMR 5060 CNRS-Université Bordeaux 3

<sup>3</sup>Department of Archaeology, Faculty of Letters, Ankara University

<sup>4</sup>UMR 5198 CNRS-Museum National d'Histoire Naturelle, Département de Préhistoire, Musée de l'Homme

<sup>5</sup>Centre d'Etude Nucléaire de Bordeaux-Gradignan, UMR 5797, CNRS-Université Bordeaux 1

Tiny quantities of obsidian have been recovered from Epi-Palaeolithic to Chalcolithic strata at the Öküzini Cave in the Antalya region of SW Turkey, whose dates span the later 17<sup>th</sup> / early 16<sup>th</sup> – 4<sup>th</sup> millennia cal BC, the former thus representing the earliest evidence for the long-distance movement of obsidian in the Eastern Mediterranean. Obsidian was an exotic resource to the cave's occupants, the nearest sources being in the Aegean (300 km to the west), and Cappadocia (380 km to the north-east).

In 2007 our team elementally characterised the site's entire obsidian assemblage (n=56) using particle induced x-ray emission [PIXE] at the *Centre d'Etude Nucléaire de Bordeaux-Gradignan*, Bordeaux. This paper details the results of these analyses in the broader context of hunter-gatherer mobility, inter-regional contacts and the 'origins of obsidian exchange' in Anatolia / the Near East.

## **Socializing Hunter-Gatherer Space: Understanding Palaeo-Eskimo Inland occupations through GIS visualization of a structure at the Mingo Lake Site, Interior Baffin Island, NU**

A. DeGagne

Department of Anthropology, McMaster University

This paper explores the potential for using high-resolution distributional analyses in domestic space to better understand the social realm of highly mobile societies. The excavation of a single Palaeo-Eskimo structure from the Mingo Lake site (LdFa-1), Interior Baffin Island, NU provides data for a case study investigating the organization of activities in short-term domestic occupations, and exploring the social implications behind spatial distributions.

Geographic Information Systems (GIS) were used to visualize the lithic debitage distributions recovered from in and around a heavily constructed Palaeo-Eskimo structure from the Mingo Lake site. Inverse Distance Weighting was used to create a continuous surface of debitage distributions, while formal artifacts were visualized by point-plotting proveniences recorded during excavation. A qualitative evaluation of these distributions was undertaken to understand how activities were organized in an Interior Palaeo-Eskimo structure.

This distributional analysis set out to determine if a conceptualized division of space could be distinguished from the archaeological remains, not to define the activities that took place within and around this specific structure. Through the application of social spatial theory, the social structure of this Palaeo-Eskimo household was interpreted from the distribution pattern identified. This knowledge was used to further explain the conceptualization of space, inter-personal interactions, and day-to-day functioning of these early Arctic inhabitants in a unique interior context.

## **Matrix of Change: The Geoarchaeology of Early European Agriculture**

C. M. Fadem<sup>1</sup>, J. R. Smith, A. Moore<sup>2</sup>, and M. Mendušić<sup>3</sup>

<sup>1</sup>Department of Earth and Planetary Sciences, Washington University

<sup>2</sup>Rochester Institute of Technology

<sup>3</sup>Prehistoric Archaeology, Cultural Museum, Šibenik, HRV

Excavations at the Danilo Bitinj and Pokrovnik sites are part of an interdisciplinary effort toward understanding the origins of European agriculture. The Neolithic record here is biased toward upland storage locales. Our work on the Early Farming in Dalmatia Project is now in its fifth year. We focus on the soil matrix as a physical and chemical archive, and possible ceramic source material. As our open lowland sites preserve the landscape context of earliest farming, site-specific geoarchaeological study presents a unique opportunity to inform this record.

Danilo soils are well-structured and variable in depth. They commonly contain large clasts which were clearly deposited, rather than produced through *in situ* bedrock weathering. Laboratory tests show the soil to be organic carbon-poor and sodic, conditions normally resulting in infertility. X-ray diffraction analysis reveals the Danilo soil parent material to be volcanic in nature, explaining mutual sodicity and long-term fertility. Soil organic matter  $\delta^{13}\text{C}$  analysis reveals a dominance of  $\text{C}_3$  plants – and, therefore, the predominance of moist, tolerable conditions – throughout the life of the solum.

We have begun comparable analyses for the Pokrovnik site. Comparison of this inland locale with the near-coast Danilo site will help us understand regional variation in paleoclimate, site formation processes, and landscape evolution. Petrologic and x-ray diffraction analyses indicate ceramic raw materials may have been sourced on-site. We use both appearance in thin section, bulk mineralogy, and elemental analysis to compare natural and cultural materials, and to construct a typology for the Early and Middle Neolithic ceramic assemblages.

### **Living with landscape change in the Durrington Walls to Stonehenge landscape**

*C. French*

Department of Archaeology, University of Cambridge

Large scale multi-disciplinary investigations of the Durrington Walls to Stonehenge landscape in Wiltshire, southern England, have revealed dramatic landscape and land-use change in the early-mid-Holocene. Geoarchaeological study of this landscape has indicated that this process commenced in the Mesolithic with the first inroads into the deciduous woodland, was intensive and swift in the earlier Neolithic, such that by the later Neolithic the whole landscape was essentially open managed grassland. Soil type change was fast and variable, as were erosion signatures and their timing. Captured within this dynamic landscape are a series of late Neolithic structures associated with the eastern entranceway Durrington Walls henge, whose discovery and construction features are unique in England.

### **Human Occupation and Changing Environments at the Middle-Upper Palaeolithic Transition: Soil Micromorphology at the Haua Fteah, Libya**

*R. Inglis*

Department of Archaeology, University of Cambridge

The environmental contexts of late Pleistocene occupations in North Africa are potentially key to dispersals of Anatomically Modern Humans (AMHs). Shifting environments controlled the movements of the late Middle and Upper Palaeolithic populations via corridors through the now hyper-arid Sahara. The archaeological sequence at the Haua Fteah, Libya, lies at a crossroads in these corridors between the Nile, the Maghreb, and Saharan routes. Excavated in the 1950s, and currently undergoing re-excavation by the Cyrenaica Prehistory Project, the 14m deep stratigraphy encompasses a sequence from the 'Libyan Pre-Aurignacian' to modern-day stabling deposits, representing, according to present chronologies, between 80,000 and 200,000 years of sedimentation.

Cave and rockshelter sediments, similar to those at the Haua Fteah (a semi-collapsed doline), result from complex interplay between anthropogenic and 'natural' influences, and contain high-resolution histories of cultural and environmental change. Stratigraphic sequences may appear to result from relatively continuous deposition, yet contain hiatuses, truncated units and changing sedimentation rates. Through the application of soil micromorphology, and associated physical and chemical analyses, a detailed site formation history can be developed which includes these variances and hiatuses. An understanding of these formation processes is fundamental to the cultural and environmental chronologies built upon such sequences.

This paper presents the initial results of ongoing doctoral research into the microstratigraphy of the Middle-Upper Palaeolithic layers at the Haua Fteah. A preliminary sedimentological history for this key North African site will be outlined, together with its potential environmental and cultural significance to debates surrounding the dispersal of AMHs in North Africa.

### **Assessment of the efficacy of stable carbon isotopes in categorizing organic residues surviving in early archaeological pottery from the Middle East and Europe**

*M. W. Gregg<sup>1</sup> and G. F. Slater<sup>2</sup>*

<sup>1</sup>Department of Anthropology, University of Toronto

<sup>2</sup>School of Geography and Earth Sciences, McMaster University

This paper will present molecular and isotopic evidence demonstrating that  $\delta^{13}\text{C}$  values previously used to identify animal fats in archaeological pottery from northern Europe have limited applicability in categorizing organic residues from early ceramic horizons in central Europe or the Middle East. Overlapping and contradictory values have been observed in modern ruminant dairy and carcass fats from animals pastured northern and central Europe and exclusively fed  $\text{C}_3$  forage grasses. In light of our analysis of organic residues from pottery fragments recovered from nine Neolithic sites in the Fertile Crescent, we will outline the physiological and anthropogenic factors affecting the fractionation of stable carbon in fatty acid synthesis and the preparation and storage of foods for human consumption, and put forward a series of measures allowing for more confident categorization of organic residues recovered from early pottery vessels.

### **Geoarchaeological characterisation and interpretation of the fluvial terraces of selected outcrops in the region of Mação, Vila Nova da Barquinha and Chamusca areas of Middle Portuguese Tejo River, with special reference to the terraces associated with Prehistoric human occupation**

*S. D. Kaushik*

Département de Préhistoire, Institut de Paléontologie Humaine Muséum National d'Histoire Naturelle

Alto Ribatejo is a region of central Portugal that extends along the Middle Portuguese Tejo. The Lower Tejo sedimentary basin has the "Estremenho" Limestone Massif (Mesozoic) to the North and West, and the Schist-metamorphic Complex (Pre-Cambrian and Palaeozoic) to the East, while to the South it is contiguous with the Sado Basin.

Six river terraces have been recognised for the Tejo River in the Portuguese sector. The earliest human occupation is recorded from the T4 terrace. The aim of the present research was to record the fluvial potential of the river at the lower terraces (T6/alluvial plain) and the middle terrace (T4), as well as to discover the archaeological potential in these sites. The study area comprises three municipalities (Mação, Vila Nova da Barquinha and Chamusca) in the Alto Ribatejo province of central Portugal.

The present study brings very interesting results. Five main stratigraphical units were identified in the lower terraces; the second unit, which comprises boulders, cobbles, pebbles and some lithic artifacts, is identified as terrace T6. This terrace may belong to a late phase of the Upper Pleistocene. Three main stratigraphical units have been

identified in T4. T4 is extremely significant, because it contains the earliest records of human occupation, which are dated to OIS 7 – 9. The sedimentological analysis evidenced that T4 was deposited during the temperate climatic conditions.

The archaeological artifacts are divided into three categories on the basis of geological context. The first category groups the Lower Palaeolithic artifacts from the T4 terrace, at different localities. The second category is made of the lithic artifacts which were recorded from the T6 at Outeiro du Pedro, thought to belong to the Upper Pleistocene. The third category is constituted of artifacts which were recorded as surface finds at various localities. Typologically and morphologically, they are very similar to artifacts from the Middle/Lower Palaeolithic and the Bronze Age.

### **The Pleistocene Record of the Central Narmada Valley: Archaeology and Palaeoenvironment**

*S. D. Kaushik*

Département de Préhistoire, Institut de Paléontologie Humaine Muséum National d'Histoire Naturelle

The present paper and poster describes the study of geoarchaeological, sedimentological and palaeoenvironmental processes, associated with Middle and Late Pleistocene sediments, in the Hoshangabad and Sehore Districts of Madhya Pradesh in the Central Narmada Valley (India). The alluvial deposits, spanning from the Lower Pleistocene to the Holocene, have yielded evidence of vertebrate, lithic industries and associated palaeoenvironmental data. The stratigraphical sequence reveals distinct units such as Dhansi formation, Surajkund formation and Benata formations. Analyses of collected stone tools revealed a general continuity of the Acheulian industry in this region. Numerous vertebrate fossil specimens, including teeth and bones, contribute to revise the Quaternary bio-chronology. The occurrence of several flakes in the Dhansi formation (which is overlain by the Surajkund formation at the Bikori Budhani section) if confirmed, may extend the antiquity of human occupation to slightly earlier than the Brunhes-Matuyama boundary.

### **Paleogeographic reconstruction of submerged prehistoric shorelines and coastal environments at Liman Tepe, western Turkey**

*G.M. Krezoski<sup>1</sup>, J.I. Boyce<sup>1</sup>, E.G. Reinhardt<sup>1</sup>, J. Gabriel<sup>1</sup>, H. Erkanal<sup>2</sup>, and V. Sahoglu<sup>2</sup>*

<sup>1</sup>School of Geography and Earth Sciences, McMaster University, Hamilton, ON

<sup>2</sup>Department of Humanities, Ankara University, Ankara, Turkey

Changing Holocene sea levels significantly altered coastal environments worldwide and had a major influence on the settlement patterns of prehistoric peoples. At Liman Tepe, a long-occupied prehistoric coastal settlement in western Turkey, the configurations of submerged mid-Holocene (ca. 5-6 Ka) coastlines were investigated to guide the search for underwater Neolithic archaeological sites. Shoreline features were mapped on the shallow shelf area (4 km<sup>2</sup>) using a single-beam (200 kHz) echosounder and chirp (18-24 kHz) sub-bottom seismic profiler. Changes in the coastal paleoenvironments were determined by detailed sedimentologic (lithofacies, grain size, magnetic susceptibility) and micropaleontologic analyses of 5 marine sediment cores.

The sediment cores revealed a sequence of poorly-sorted pebbly shoreface deposits containing abundant shell and coralline fragments (Unit E shell hash) overlain by marine muds and silts (Units D-B) deposited in low-energy shallow marine and lagoonal/wetland

environments. The contact between the pebbly sands and mud sequence is represented in seismic profiles by a high amplitude reflection that is continuous basin-wide. The reflector surface (top of Unit E) shows a number of northwest-trending ridges and terrace features that are interpreted as buried paleoshorelines.  $^{14}\text{C}$  dating of shell materials from uppermost buried beach ridge yielded a Late Neolithic age of 3860 +/- 120 cal BC. The laminated mud sequence (Unit C, D) overlying the beach deposits record the development of a shallow back-barrier lagoon. The lagoonal sediments transition at 60-80 cm in the core to sandy, organic-rich muds containing abundant organic fragments (Unit D). Organic materials from just below Unit D yielded a  $^{14}\text{C}$  dated at 450 +/- 70 cal BC. The transition is interpreted as the onset of construction of the Alexander causeway (334 BC) connecting the mainland with Karantina Island. Following the causeway construction the shoreline on the east side of the island prograded rapidly covering older barrier/lagoonal sequences with a > 1 m mud drape.

### **Applying Strontium Isotopes to the Study of Pre-Hispanic Human Migration: the Case of Teopancazco, Teotihuacan**

*B. Lailson Tinoco<sup>1</sup>, P. Schaaf<sup>2</sup>, L. Manzanilla<sup>3</sup>, G. Solís-Pichardo<sup>4</sup> and T. Hernández<sup>2</sup>*

<sup>1</sup>Earth Sciences Graduate Program, Universidad Nacional Autónoma de México

<sup>2</sup>Institute of Geophysics, Universidad Nacional Autónoma de México

<sup>3</sup>Institute for Anthropological Research, Universidad Nacional Autónoma de México

<sup>4</sup>Institute of Geology, Universidad Nacional Autónoma de México

Archaeology requires interdisciplinary support from other areas in order to enrich the acquisition of precise information for understanding past human behavior. Earth Sciences play an important role in the analysis of evidence of the human past by offering a variety of useful concepts and techniques.

The application of strontium (Sr) isotopes as a geochemical tracer is a useful tool for helping to resolve archeological questions about human migration. This technique is carried out by comparing the  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios of human molars and bones with the  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios in the soil of a specific region. These ratios are affected by the mobility of the individuals during their lifetime because the strontium present in soil and plants is introduced into the human organism, where it is substituted for calcium within the minerals of bone tissue. The  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios in dental enamel indicate the place of childhood residence, while the same ratios in bone mark where the individuals spent the last years of life. Strontium isotopes were analyzed in more than 50 samples of bone, dental enamel, soil and plants from modern and archaeological contexts in Teotihuacan and the regions of Veracruz, Puebla and Tlaxcala, Mexico. This study compared the  $^{87}\text{Sr}/^{86}\text{Sr}$  isotopic ratios of the individuals with the available edaphologic information from probable places of origin, shedding important light on migration patterns.

### **Geoarchaeology and traditional knowledge of Subterranean Winter Sod Houses in Eastern Hudson Bay, Canadian Arctic**

*A.-M. Lemieux<sup>1</sup>, N. Bhiry<sup>1</sup> and P. M. Desrosiers<sup>2</sup>*

<sup>1</sup>Département de géographie, Université Laval

<sup>2</sup>Avataq Cultural Institute

Subterranean Inuit houses were the initial focus of archaeological research in the Arctic in the 1920's, largely because they are easily visible in coastal areas. However, they were often built with sod blocks containing artefacts of previous occupations (i.e., Palaeoeskimo occupations). This mixture produced an inverse stratigraphy that

confused the original archaeologists who were investigating cultural history. Despite those problems, geoarchaeology has not been very popular among Arctic archaeologists until recently. During the summers of 2007 and 2008 and as part of the International Polar Year, we documented site formation processes during the excavation of a sod house. In addition to studying the structure itself, the study focussed on soils analysis as well as the paleoecology and paleogeography of the surrounding area. This research allowed us to evaluate sediment sources and the processes involved in site formation as well as the effects of the climate. Furthermore, the discovery of preserved elements from a wood roof structure was a pleasant surprise that allowed us to better document the construction technique. In addition, the traditional knowledge of the Inuit and an understanding of their special relationship with the natural environment provide resources that assist in the interpretation of land use. We conducted interviews with the elders of Inukjuak who provided greater insight into how the land was used and their ancestors' way of life. Given the preliminary stage of the research, we focus our attention on the methodology and discuss its anthropological implications

### **Using OSL, stable isotopes and phytoliths to reassess the chronology of a Capsian escargotièrre in eastern Algeria: implications for Holocene settlement in the Maghreb**

*D. Lubell<sup>1</sup>, J. Feathers<sup>2</sup>, J-L Schwenninger<sup>3</sup>, M. Faber<sup>4</sup>, C. Yapp<sup>4</sup>, J. Shipp and A.M. Rosen<sup>5</sup>*

<sup>1</sup>Department of Anthropology, University of Waterloo

<sup>2</sup> Department of Anthropology, University of Washington

<sup>3</sup> Research Laboratory for Archaeology and the History of Art, University of Oxford

<sup>4</sup>Huffington Department of Earth Sciences, Southern Methodist University

<sup>5</sup>Institute of Archaeology, University College London

The 1973-6 excavations at Aïn Misteheyia revealed an archaeological sequence dated between 9500 and 6000 calBP with evidence for technological and subsistence change coeval with what we now know to be the 8200 event (Jackes and Lubell 2008; Lubell *et al.* 1976). A human burial (Meiklejohn *et al.* 1979) from the lowest levels at the site which are dated on land snail shell to at least 9000 calBP, is dated twice on collagen, run 30 years apart by different labs using different methods, to 5000 calBP. New OSL dates on ceramic fragments and sand grains from land snail shell fillings from the upper 50cm of the deposits, show that this burial is contemporaneous with those upper levels and is therefore intrusive, despite any stratigraphic proof. The burial provides clear evidence for post-Capsian use of the site and for previously undocumented mid-Holocene (Neolithic?) settlement in the region. To further understand the implications, we use new data from phytolith analyses of bulk samples collected during excavation, stable isotope analyses of land snail shells from the site, and palynological analysis of a core from a nearby marsh (Ritchie 1984), to reassess the geoarchaeology of the site and the implications of the cultural sequence for the history of human occupation in the eastern Maghreb.

## **Reconstructing the Pre-contact Vegetation of Southern Ontario: Developing a Paleoenvironmental Baseline with GIS-based Substrate and Historic Vegetation Data**

*R. I. MacDonald*

Archaeological Services, Inc.

Inventories of standing timber, compiled in the course of the earliest cadastral land surveys in the late eighteenth and early nineteenth centuries, have been used for several decades by researchers interested in creating maps of southern Ontario's vegetation as it was immediately prior to European land clearance. Other researchers have investigated the phytosociology of native trees and correlations between vegetation and various substrates and edaphic conditions. Still other researchers have employed proxy data, such as pollen, to understand forest distributions and dynamics over time. All of these information sources have been used by environmental archaeologists interested in reconstructing the pre-contact vegetation of southern Ontario and its on-going development since deglaciation at the end of the Pleistocene. Geographical information systems (GIS) technology now gives us a powerful tool for overlaying these data sets in order to investigate trends, both quantitatively and qualitatively, that can lead us to new insights into the paleoecology of southern Ontario and the wider Great Lakes region. This paper reviews how this process has been developed by the author in the context of site potential modelling for archaeological master plans and highlights a promising first attempt at correlating historic vegetation with substrate data.

## **Multi-Component Analysis of a Copper Artifact from a Rockshelter Site (EaRu-5) in Coastal British Columbia**

*B. L. MacDonald*<sup>1,2</sup>, *J. Palka*<sup>2</sup>, *B. Ramdoo*<sup>3</sup>, *W. Matysiak*<sup>3</sup>, *D. Thirugnanasampanthan*<sup>3</sup>, *R. Reimer*<sup>4</sup>, *F. McNeill*<sup>3</sup> and *E. Desouza*<sup>3</sup>

<sup>1</sup> Department of Anthropology, McMaster University

<sup>2</sup> McMaster Nuclear Reactor, McMaster University

<sup>3</sup> Department of Medical Physics and Applied Radiation Sciences, McMaster University

<sup>4</sup> Department of First Nations Studies, Simon Fraser University

Geochemical characterization of artifact copper has emerged as an area of interest to archaeologists primarily for the purpose of determining if the raw materials are of European or North American origin. By determining the source origins of artifact copper, archaeologists are able to map the nature and extent of trade relations within and between

Indigenous and European groups during early-contact periods, and potentially, to gain broader understandings of Indigenous resource use in North America. In some contexts the distinction between Native and European copper will act as a unique temporal marker that provides the opportunity to refine occupational chronologies. The analysis of a copper point from a rockshelter site (EaRu-5) located in traditional Squamish Territory (British Columbia), has illustrated the utility of copper artifact characterization for determining the origins of its raw material, and for further refining the occupational chronology of the site during pre- and post-contact periods. The results of this analysis provide a rare and unique example of how copper artifacts can provide multiple forms of contextual information to archaeologists.

## **Site Formation Processes of Sub Arctic Pit Houses, Ikirahaq Island, Nunavut**

*C. McNamee, H. Cyr, and P. Dawson*

Department of Archaeology, University of Calgary

This study presents the results from a geoarchaeological examination of two late Holocene pit house structures on Ikirahaq Island near the Inuit community of Arviat, in the Kivalliq region of Nunavut. This research contributes to an International Polar Year project entitled “Dynamic Inuit Societies in Arctic History” led by Dr. Peter Dawson of the University of Calgary. The geoarchaeological component of this project has three primary objectives: (1) to examine the site formation processes affecting the two Arctic pit house structures on Ikirahaq island; (2) to document the effects of cryoturbation and sod formation on the integrity of these two structures; and (3) to understand the environmental conditions both during and following periods of human occupation. In order to meet these objectives, bulk sediment and micromorphic samples were collected from stratigraphic levels within and outside the pit house features. Soil texture, organic matter, and microstratigraphic analysis are utilized to understand site formation processes and the effects of cryoturbation and sod formation on archaeological features. Phytoliths, diatoms, and stable oxygen isotope analyses provide proxy data to interpret past environmental conditions.

## **A Geoarchaeological Examination of the St. Louis Site: Reconstructing Environment and Vegetation through Multiple Proxy Indicators**

*C. McNamee<sup>1</sup>, H. Cyr<sup>1</sup>, A. Freeman<sup>1</sup> and L. Amundson<sup>2</sup>*

<sup>1</sup>Department of Archaeology, University of Calgary

<sup>2</sup>Stantec Consulting

The St. Louis site, located along the South Saskatchewan River, in central Saskatchewan, Canada, is a multiple component site consisting of stratified weakly developed soils marking periods of reduced deposition, episodic stability, and human occupation. The human occupation at the St. Louis site spans the Paleoindian to Middle Prehistoric periods (10,000 – 5,000 BP), a time poorly represented archaeologically on the Northern Plains. The dearth of early-middle Holocene archaeological sites is often attributed to reduced inhabitability of the Northern Plains during the Hypsithermal, a period of maximum aridity and limited water availability. Environmental conditions, often reconstructed through the study of vegetation, fauna, and isotope data collected from lake sediments, are not well documented in paleoenvironmental research of the Northern Plains due to the lack of lake data from the early to middle Holocene. This study employs stable isotope and phytolith evidence from buried soils to reconstruct the local prehistoric vegetation and environment during this little understood time period.

## **Micromorphology and Geoarchaeology of Uçağızlı II, Hatay, Turkey**

*S.M. Mentzer*

Department of Anthropology, University of Arizona

Uçağızlı II is a Middle Paleolithic cave site located on the Mediterranean coast of Turkey. The site contains a two-meter sequence of archaeological sediments overlying a beach deposit that correlates with a local Pleistocene high stand. Geoarchaeological study of the site and surrounding landscape was initiated in conjunction with salvage excavations that began in 2005. A test trench uncovered numerous cemented combustion features, faunal remains, and a Mousterian lithic sequence.

Micromorphological analyses of the test trench sediments support the initial division of the geologic stratigraphy into three layers. The sediments contain abundant ashes, burned and unburned bone fragments, charcoal and lithic debitage. The ratio of charcoal to ash varies throughout the excavated layers. Geogenic sediments are rare and include aggregates of rubified clay, speleothem fragments, and sand-sized mineral grains. Biogenic components include insect fecal pellets and phosphatized bone fragments that likely source from coprolites. Post-depositional processes include bioturbation, occupation of the site by carnivores, decalcification, secondary carbonate precipitation, and faulting of cemented features. Study of the local landscape reveals that the excavated area occupies a side-chamber that once adjoined a larger karstic cavity. This cavity has collapsed, leaving isolated, brecciated remnants of a more extensive archaeological deposit.

Uçağızlı II represents the older segment of a longer sequence for this locality. The nearby cave site of Uçağızlı I contains Early Upper Paleolithic materials, and the two sites provide an opportunity to compare combustion feature morphology, occupation intensity, and hominid exploitation of a coastal environment across the Middle-to-Upper Paleolithic transition.

### **Using Instrumental Neutron Activation Analysis (INAA) to test the validity of current field methods of chert identification in archaeological projects**

*K. Michelaki<sup>1</sup>, R. Hancock<sup>1,2</sup>, A. Pidruczny<sup>3</sup>, B. L. MacDonald<sup>1,3</sup>, and P. Woodley<sup>4</sup>*

<sup>1</sup>Department of Anthropology, McMaster University

<sup>2</sup>Department of Medical Physics and Applied Radiation Sciences, McMaster University

<sup>3</sup>McMaster Nuclear Reactor, McMaster University

<sup>4</sup>New Directions Archaeology, Ltd.

In Ontario, stone tools are ubiquitous in archaeological sites, and at these sites, chert is the predominant raw material for the manufacture of tools such as projectile points, bifaces, drills, scrapers or wedges. Understanding the sources of cherts found archaeologically has been paramount in attempts to understand how First Nations groups used the resources in their natural environment, as well as how far they were willing to travel for them, and whether they engaged in long-distance exchange with other groups to acquire such materials. Currently, the assignment of archaeological chert tools to different chert sources is based primarily on the macroscopic consideration of the tools' colours and textures. Two assumptions underlie this method: 1) that cherts with the same colour/texture come from the same source, and 2) that cherts with different colour/texture come from different sources. These assumptions have not been tested systematically. The colours of rocks and minerals are determined to a great degree by their chemical composition. We used Instrumental Neutron Activation Analysis (INAA) to chemically fingerprint specimens from chert sources to test whether the assumptions behind archaeological analytical techniques are valid and, thus, whether the techniques and the interpretations drawn from the data collected using such techniques, are reliable. The purpose of the present project is threefold: 1) To test whether cherts from different known local (and neighbouring) sources, which are often cited in the archaeological literature as the sources of archaeological material, can be chemically distinguished; 2) To test whether cherts from the same known source are more similar to each other than to cherts from other known sources; and 3) To test whether the archaeological grouping of cherts based on a consideration of colour/texture coincides with their chemical grouping, based on INAA.

## **The uses and limitations of multi-element soil analyses for the interpretation of site activity areas**

*K. Milek*

Department of Archaeology, University of Aberdeen

Excavations at the medieval site of Quoygrew, on Westray, in the Orkney Isles, included an intensive geoarchaeological program designed to enhance the understanding of the activities that took place at the site and their environmental context. This paper focuses on the results of the spatial analysis of five superimposed buildings at Quoygrew, which represent a continuous occupation sequence from the eleventh to sixteenth centuries. A total of 550 samples taken from the floor sediments of each major occupation phase using a systematic 0.5 m grid were analyzed using ICP-AES, LOI, and magnetic susceptibility, and the results were mapped over the plan of each phase using ArcView GIS. Magnetic susceptibility, organic matter content as estimated by LOI, and most elements showed clear spatial patterning, with high and low concentrations clustered in different parts of structures, often related to features and layers that had been defined in the field. The results demonstrated that all three techniques were suitable for supporting interpretations about the locations of activity areas or revealing the locations of new activity areas that had not been identified in the field. However, the increasingly popular trend of interpreting how activity areas were used based solely on multi-element distributions is highly problematic because each element has a number of possible sources. In addition to having adequate local reference samples, the study demonstrated that it is essential to overlay multi-element data with other datasets that can contribute additional information about the possible sources of elements, including soil micromorphology whenever possible.

## **Trade and Exchange of Nephrite Jade Celts in the Pacific Northwest**

*J. Morin*

Department of Anthropology, University of British Columbia

Over the past 3000 years in the Pacific Northwest nephrite jade celts appear to have been widely exchanged among indigenous peoples from a limited number of raw material source locations. Archaeologists in the region have commonly misidentified many artifacts of being made nephrite when in fact they are made of other materials such as serpentine. To overcome this problem, I am using a near-infrared spectrometer and associated software to accurately identify the mineralogy of over 2000 artifacts. This technique is completely non-destructive and provides results in a matter of seconds. This method will allow me to characterize the mineralogy of a very large sample of celts and production debris and develop an inventory of the spatial and temporal distribution of celts made of nephrite and other rocks. Through developing an inventory of nephrite celts and production debris I intend to identify zones of tool production and acquisition and attempt to discern the exchange relationships that best account for such distributions. This analysis will also include detailed contextual comparisons of the distribution of nephrite tools and manufacturing debris from large villages and mortuary contexts. I suggest that small nephrite celts were largely exchanged in 'down-the-line' systems and were desirable for their functional characteristics in woodworking, while large nephrite celts were exchanged between elites to cement social relationships and debt obligations.

## **Sea Levels and mid- to late-Holocene Human Occupation in southern Haida Gwaii, Northern Northwest Coast**

*T. J. Orchard*

Department of Social Sciences, University of Toronto at Scarborough

Recent research in Gwaii Haanas (Southern Haida Gwaii, British Columbia) has highlighted a 1200 BP shift from generalized subsistence economies to economies demonstrating an intensified focus on salmon. This transition occurs much later in Gwaii Haanas than it does elsewhere on the Northwest Coast (NWC), and thus has implications for understanding variability in NWC developments. Our ability to further address these developments in the Haida context is hindered by poor archaeological visibility of the mid-Holocene in Gwaii Haanas, largely due to sea level change throughout the Holocene that has left early- through mid-Holocene cultural deposits stranded on raised landforms some distance from current shorelines. The period after 5000 BP represents a constant, gradual decline in sea levels from a high of 15 metres down to present levels. These persistent sea level changes have raised suggestions that locations of cultural activity were constantly shifting, and thus archaeological remains may be ephemeral and difficult to locate. The results of preliminary fieldwork in 2007, along with re-consideration of existing data, indicate that mid-Holocene archaeological remains do exist in the region. Furthermore, these results support the utility of using the reconstructed sea level curve as a basis for guiding survey work aimed at targeting specific time periods. Overall, these results are in line with patterns described elsewhere on the coast of British Columbia, which point to a close relationship between site locations and sea level histories, and reveal long-term continuity in the use of local areas in the face of this dynamic environment.

## **Morphological and melt compositional evolution of phosphatic porcelain from sintering to vitrification: evidence from sherds excavated in Charleston, South Carolina.**

*J. V. Owen<sup>1</sup>, R. Hunter<sup>2</sup>, R. Jellicoe<sup>3</sup>, and M. Zierden<sup>4</sup>*

<sup>1</sup>Department of Geology, St. Mary's University

<sup>2</sup>Ceramics in America

<sup>3</sup>Antique English Porcelain and Ceramics

<sup>4</sup>Charleston Museum

Eight phosphatic porcelain sherds recovered from various historical sites in Charleston were analysed by electron microprobe. Five of the sherds contain sulphur (2.8-3.7 wt.% SO<sub>4</sub>); three are essentially devoid of this component. The degree of vitrification is highly variable, particularly among the SO<sub>4</sub>-poor samples. Collectively, the sherds contain silica polymorphs (quartz and tridymite or cristobalite), a tricalcium phosphate (TCP) phase(s), a glassy matrix (melt phase), and/or plagioclase or a ternary feldspar. Sulphate has selectively partitioned into TCP; the melt phase is strongly enriched in incompatible elements (Ti, Fe, Na, K). The TCP phase in sintered to incipiently vitrified samples remains porous, or only some pores are filled with melt. With increasing degrees of vitrification, the melt blebs in this phase increase in size and begin to coalesce, ultimately forming ameboid patches up to ~10 µm in diameter. In the most vitrified samples, the melt in the TCP begins to leak into the matrix, leaving behind TCP grains essentially devoid of either pores or melt. Melt compositions vary with contiguous mineralogy, showing that equilibrium was not achieved; none have a composition corresponding to the thermal minimum in the anorthite-TCP-silica system. The most silicious matrix melts, for example, occur in the most highly vitrified sherds, where this

phase has conspicuously resorbed quartz. Bulk compositional and aesthetic criteria are used to constrain the origin of these sherds.

### **Characterizing Heat Treatment of Archaeological Tool Stone Using Synchrotron Science**

*E. C. Robertson<sup>1</sup> and R. Blyth<sup>2</sup>*

<sup>1</sup>Department of Archaeology and Anthropology, University of Saskatchewan

<sup>2</sup>Canadian Light Source, Inc.

Recent research at the Canadian Light Source, Canada's national synchrotron facility, has revealed that synchrotron-based analysis offers new insights on the effects of heat treatment on rock types used to produce flaked stone tools. Specifically, we have used CLS's capacity for x-ray absorption near edge structure analysis (XANES) to look at samples of Beaver River Sandstone (BRS), a tool stone that was important to the precontact groups of northern Alberta and Saskatchewan. BRS's relatively low quality and the frequent appearance of reddening on archaeological specimens suggest that it was frequently heat treated; however, due to problems with the definitive identification of heat treatment in lithic material, this issue remains the subject of debate. XANES is a powerful technique not merely because it informs on the elemental composition of sample material; it also reveals shifts in the chemical coordination of these elements, making it possible to detect molecular changes associated with processes such as heat treatment. Our work to date has involved exposing BRS samples to archaeologically realistic heat treatment procedures that do not exceed 500°C. Subsequent XANES analysis has shown that these procedures do not affect the silica which dominates BRS's composition, an expected result, given that silica only shifts between its polymorphs at higher temperatures. However, the trace quantities of iron, titanium and calcium characteristic of BRS show distinctive patterns of chemical migration and alteration; despite the very low proportions of these trace elements in BRS, these changes appear to be responsible for significantly improved workability of heat-treated samples.

### **Paleoenvironmental evolution and human occupation at Dog Island in the north of Labrador, Canada**

*N. Roy<sup>1</sup>, N. Bhiry<sup>2</sup>, J. Woollett<sup>3</sup>*

<sup>1</sup>Northern Studies Centre, Département de géographie, Université Laval

<sup>2</sup>Département de géographie, Université Laval

<sup>3</sup>Département d'histoire, Université Laval

In order to document the impact of climate changes on Thule and Inuit activities along the northern coast of Labrador, Canada, geomorphological and paleoecological investigations were undertaken at the Oakes Bay 1 site located on Dog Island. The island is about 40 km from Nain in the Labrador Sea. The Oakes Bay 1 site consists of seven semi-subterranean sod houses located in a boggy terrace on the north shore of Oakes Bay. The archeological data indicate that the site was occupied by Thule people at about 400 years BP and by the Inuit after that (Woollett, 2003). The principal goals of this study were: 1) to document the paleogeography of Oakes Bay at Dog Island, 2) to reconstitute the local and the regional vegetation to detect climate fluctuations in the past and 3) to compare environmental and archeological data to evaluate the impact of climate on Thule and Inuit activities between the 16<sup>th</sup> and 19<sup>th</sup> centuries. The hypothesis of the study is that climate variation has been a significant cause of change in the ecosystems and the human occupation in the Dog Island area.

The paleogeography of the surrounding site (Oakes bay) was assessed through geomorphology, stratigraphy and by examining sediments in the laboratory (i.e., particle size, quartz exoscopy and mineralogy). The pollen analysis was used to retrace the evolution of the regional vegetation while macrofossil and soil analyses helped to evaluate local hydrological changes. Paleoenvironmental reconstructions show that climate change associated with the Little Ice Age had a significant impact on hydrological and ecological processes (principally on the local scale).

### **A Model for Burial of Holocene Archaeology Sites by Aeolian Sedimentation in the Sandhills of the Southeastern U.S.A.**

*K.C. Seramur and E.A. Cowan*

Department of Geology, Appalachian State University

We propose a geomorphic model for burial of archaeology sites by Holocene aeolian sedimentation in the southeastern U.S.A. These sites occur in the “Sandhills”, an area along the fall line between the Piedmont and Coastal Plain physiographic provinces where Cretaceous marine deltas are being reworked by fluvial and aeolian processes. Our work shows evidence of aeolian landforms reworked into a discontinuous sand sheet that buried archaeology sites preserving stratigraphic and cultural context.

During the cold, dry Late Glacial Maximum (LGM) the Sandhills was an eroded hummocky landscape with little vegetation. There are many published examples of LGM aeolian sedimentation and dune migration within large fluvial drainages of the southeastern U.S.A. Vegetation density increased with the onset of warmer and wetter climatic conditions at the end of the Pleistocene. It has been argued that aeolian sedimentation in the southeastern U.S.A. ended with the onset of this wetter climate. However, evidence of episodic aeolian sedimentation indicates that dryer climatic periods occurred throughout the Holocene. We hypothesize that vegetation adjacent to aeolian landforms acted as a sediment trap with up to a meter of sand being deposited in localized areas within this eroded landscape. OSL and radiometric dates, sedimentology, soil chemistry and buried occupation surfaces are used as lines of evidence to support our model of localized Holocene aeolian activity.

### **EPR dating of thorium-contaminated teeth**

*J.W. Thompson<sup>1</sup>, W.J. Rink<sup>2</sup> and M. Domínguez Rodrigo<sup>3</sup>*

<sup>1</sup>Medical Physics and Applied Radiation Department, McMaster University

<sup>2</sup>Department of Geography and Earth Sciences, McMaster University

<sup>3</sup>Departamento de Prehistoria, Universidad Complutense

Fossil tooth enamel was recovered from an archaeological site at Lake Eyasi (Tanzania), and ages were determined with both electron paramagnetic resonance (EPR) and <sup>230</sup>Th/<sup>234</sup>U (U-series) dating. The startling presence of exogenous thorium in the dental tissues necessitated the development of a novel approach to the age calculations, which resulted in tentative—but consistent—model age estimates for both EPR and U-series techniques. The problem of thorium contamination will be discussed, and our model will be presented in a qualitative fashion. The technique may be applicable at similar sites and potentially may allow the dating of samples which would otherwise be excluded from further study.

## **Fluvial stability and site formation processes at the lower Nottawasaga River, southern Ontario, Canada**

*M. J. Thornbush<sup>1</sup> and J. R. Desloges<sup>2</sup>*

<sup>1</sup>Department of Geography, Lakehead University, Orillia Campus

<sup>2</sup>Department of Geography and Planning, University of Toronto, St. George Campus

A geoarchaeological approach to site formation processes considers the implications of the landscape-specific context that shapes the archaeological record. Fluvial instability occurred in past riverine environments that were undergoing climatically-forced landscape change. A river system experiences non-uniform change in stability that can be widespread along the river course. This is evident at the lower Nottawasaga River, as a lowland meandering river situated in southern Ontario, Canada. Climatic change in the Great Lakes region, endorsed especially by fluctuations in the precipitation regime during the Holocene, affected upstream morphometry and the integrity of the archaeological record. Geomorphological investigations at the river-scale have suggested that the lower Nottawasaga River eroded vertically and laterally, pending on water levels in the Great Lakes. A long core from an oxbow, Doran Lake, provides reach-scale details of that environmental change, which transformed river morphodynamics. Findings have shown that episodes of coarse-grain accumulation are associated with periods of erosion, when fluvial aggradation could have buried sites at this location. As a meander cutoff, Doran Lake formed over 7,000 years ago in the mid-Holocene when water levels in the Lake Huron basin increased and led to fluvial instability from meander migration during a period of enhanced flow. Meander-loop migration due to fluvial instability, where there was an increased discharge through the topographically raised Edenvale Moraine section, would have displaced archaeological evidence and destroyed context, establishing unconformities in the sedimentological record

## **Holocene water-level fluctuations and the implications for Paleoindian Archaeology in Southern Ontario, Canada**

*E.P. Sonnenburg, J.I. Boyce and E.G. Reinhardt*

School of Geography and Earth Sciences, McMaster University

Post-glacial and climate-driven water level fluctuations during the Holocene had a dramatic effect on shoreline positions in the Great Lakes basins. In Rice Lake, in southern Ontario, low water levels occurring after the draining of glacial Lake Iroquois (ca 11,000 YBP) allowed for a large area of the lake plain to be inhabited by early Paleoindian peoples. It has been previously proposed that subsequent rising water levels have likely inundated many small Paleoindian sites, however, there has been no detailed systematic survey within the lake to test this hypothesis.

In order to gain a better understanding of the water-level fluctuations in Rice Lake and its archaeological potential, a detailed geophysical survey and sediment coring program was initiated in 2007. Cores extracted from a bay (water depth 2.5 m) in Rice Lake adjacent to a well-documented terrestrial Archaic archaeological site provide evidence that human occupation extended into areas that are now submerged. Microdebitage was used to identify potential areas of archaeological interest, and small microscopic quartz and chert flakes (<1 mm) were identified in three cores using a SEM and high-resolution grain-size analysis. Radiocarbon dates of the microdebitage layer indicate that these flakes were deposited in the Paleoindian period. Paleoenvironmental reconstruction using microfossil analysis (thecamoebians), and magnetic susceptibility provide further

insights into the extent and timing of post-glacial low water levels that allowed Paleoindian peoples to exploit the now inundated landscape.

### **Raw material economics in their environmental context: An example from the Middle Palaeolithic of southern France**

*L. Wilson*

Department of Geology, University of New Brunswick

The environment offers both challenges and opportunities to any human group. In the Vaucluse region of southern France during the Middle Palaeolithic, the challenges included a periglacial climate, and physical barriers to travel (mountainous terrain and deep gorges). The opportunities lay in the variety of food resources and shelter offered by that terrain, and in the presence of lithic raw material sources and water, all of which were irregularly distributed across the region. The raw materials used for the lithic assemblage of one very rich layer (layer IV) within one major site, the Bau de l'Aubesier, provide an insight into how prehistoric groups behaved.

The proportions of raw materials used show that materials from different geographic areas were used in different ways. This appears, for instance, in the ratio of knapping by-products (chips) to larger flakes and tools. The raw material types that have the highest proportion of chips, and thus were extensively knapped on site, are those that were available within a few hundred metres of the site. However, distance to source is evidently not the only factor that influences the chip ratio of other raw material types. This study evaluates the economic attractiveness of source areas, by taking into account the quality of the raw material, the extent of the source, the size and abundance of the nodules, and the difficulty of the terrain, in order to demonstrate how the Neandertal groups that created the assemblage interacted with their physical environment.



# Canadian Archaeological Association l'Association canadienne d'archéologie



Museum of \_\_\_\_\_  
Ontario Archaeology

AN AFFILIATE OF THE UNIVERSITY OF WESTERN ONTARIO



Archaeological  
Services  
Inc.



MUSÉE CANADIEN DES CIVILISATIONS  
CANADIAN MUSEUM OF CIVILIZATION



The organizing committee thanks our sponsors for their contribution to

DIG 2009  
DEVELOPING INTERNATIONAL GEOARCHAEOLOGY  
AVANCES EN GÉOARCHÉOLOGIE INTERNATIONALE

## DIG 2009 Sponsorship and Exhibitor Information

Department of Anthropology  
 McMaster University  
 1280 Main Street West  
 Hamilton, Ontario, Canada, L8S 4L9  
 Phone: (905) 525-9140 ext. 24423

Archaeological Services, Inc.  
 528 Bathurst Street  
 Toronto, Ontario, M5S 2P9  
 Phone:(416) 966-1069  
 Web:<http://www.iasi.to>  
 E-mail:[info@iasi.to](mailto:info@iasi.to)

Bartington Instruments  
 5 & 10 Thorney Leys Business Park  
 Witney, Oxford, England OX28 4GE  
 T +44 1993 706565  
 F +44 1993 774813  
 E [sales@bartington.com](mailto:sales@bartington.com)  
[www.bartington.com](http://www.bartington.com)

Brockhouse Institute for Materials Research  
 McMaster University  
 Arthur Bourns Building  
 1280 Main Street West  
 Hamilton, Ontario, Canada L8S 4M1  
 Phone: (905) 525-9140 ext. 24683  
[bimr@mcmaster.ca](mailto:bimr@mcmaster.ca)

Canadian Archaeological Association  
<http://www.canadianarchaeology.com/home.lasso>

Canadian Geological Foundation  
 Mineral Resources Branch  
 Nova Scotia Department of Natural Resources  
 1701 Hollis Street, P.O. Box 698  
 Halifax, NS, Canada B3J 2T9  
 Tel: (902)-424-7943  
 Email: [hsswinde@gov.ns.ca](mailto:hsswinde@gov.ns.ca)

Canadian Museum of Civilization  
 100 Laurier Street  
 Gatineau, Quebec K1A 0M8  
[web@civilization.ca](mailto:web@civilization.ca)  
 819 776-7000 or 1 800 555-5621  
 TTY: 819 776-7003

School of Geography and Earth Sciences  
 McMaster University  
 General Science Building  
 1280 Main Street West  
 Hamilton, ON, Canada L8S 4K1  
 Phone: (905)525-9140 ext. 24535

Museum of Ontario Archaeology  
 1600 Attawandaron Road  
 London, Ontario N6G 3M6  
 Tel:(519) 473-1360  
<http://www.uwo.ca/museum/>

McMaster Nuclear Reactor  
 Nuclear Research Building  
 McMaster University  
 1280 Main Street West,  
 Hamilton, Ontario, Canada L8S 4K1

## DIG 2009 Sponsorship and Exhibitor Information

Ontario Archaeological Society  
Hamilton Chapter  
64 Sulphur Spring Road  
Ancaster, Ontario, Canada L9G 1L8  
Phone: (866)243-7028  
<http://www.hwcn.org/link/hcoas/>

Faculty of Science  
McMaster University  
1280 Main Street West  
Hamilton, Ontario L8S 4K1  
Fax 905-546-9995  
Phone 905-525-9140 Ext. 22615

Faculty of Social Science  
McMaster University  
1280 Main Street West  
Hamilton, Ontario L8S 4M4  
Phone: (905) 525-9140 ext. 23772

Scholarly Book Services Inc.  
289 Bridgeland Ave., Unit 105  
Toronto, Ontario, Canada M6A 1Z6  
1-800-847-9736  
Fax 1-800-220-9895

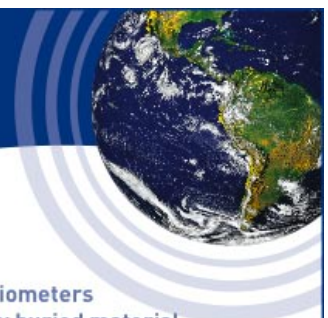
Thermo Fisher Scientific  
900 Middlesex Turnpike, Building 8  
Billerica, MA 01821 USA  
Tel: 800-875-1578  
Tel: +1 978-670-7460  
Email: [niton@thermofisher.com](mailto:niton@thermofisher.com)  
[www.thermo.com/niton](http://www.thermo.com/niton)

VWR International  
2360 Argentia Road  
Mississauga, ON L5N 5Z7  
Orders: 1-800-932-5000  
<http://www.vwrcanlab.com/index.cgi>

Tourism Hamilton  
34 James Street South  
Hamilton, Ontario, Canada L8P 2X8  
Phone: 905-546-2666 or 1-800-263-8590  
E-mail: [tourism@hamilton.ca](mailto:tourism@hamilton.ca)  
Web: [www.tourismhamilton.com](http://www.tourismhamilton.com)

Wiley-Blackwell  
Phone: 781-388-8545  
[www.wiley-blackwell.com](http://www.wiley-blackwell.com)

# World leaders in high precision magnetic measurements



**MS2**  
Magnetic susceptibility measurements  
For field and laboratory applications  
- Susceptibility to  $2 \times 10^{-6}$  SI resolution



**Grad601**  
Single axis fluxgate gradiometers  
For detection of shallowly buried material  
- Easy electronic adjustment of the sensors



Bartington Instruments Limited  
5 & 10 Thorney Leys Business Park  
Witney, Oxford, OX28 4GE, England.

T: +44 1993 706565  
F: +44 1993 774813  
E: sales@bartington.com

[www.bartington.com](http://www.bartington.com)

**Bartington**  
Instruments

## McMaster University DIG 2009 Conference Committee

### DIG 2009 Co-Chairs

Brandi Lee MacDonald, Department of Anthropology  
macdonbl@mcmaster.ca

Lisa Sonnenburg, School of Geography and Earth Science  
sonnenep@mcmaster.ca

### Faculty Advisors

Dr. Aubrey Cannon, Chair and Professor, Department of Anthropology

Dr. David Chettle, Professor, Department of Medical Physics and Applied Radiation Sciences

Dr. Ron Hancock, Adjunct Professor, Department of Medical Physics and Applied Radiation Sciences

Dr. Pavlos Kanaroglous, Director and Professor, School of Geography and Earth Sciences

Dr. Kostalena Michelaki, Assistant Professor, Department of Anthropology

Dr. J.S. Preston, Professor, Department of Engineering Physics

### Conference Services

Wendy Read

### Titles Bookstore

Stacey Gabbitous

### Media Production [cover, website design and photo credits]

Matthew J. Seguin

mjseguin@gmail.com

### Program

Meghan Burchell, Department of Anthropology

burcheme@mcmaster.ca

### Volunteers

Eliza Brandy, Miranda Brunton, Ani Cheniér, Katherine Cook, Nadia Densmore, Gloria Lopez, Deane Maynard, and Jessica Pilarczyk

### Thank You

Gerald Beirling, Instructional Assistant, Departments of Anthropology and Sociology

Dr. Christopher Heysel, Director, Nuclear Operations and Facilities

Rosita Jordan, Administrator, Department of Anthropology

Judy Major-Girardin, Associate Professor, School of the Arts

Alice Pidruczny, Lab Manager, Centre for Neutron Activation Analysis