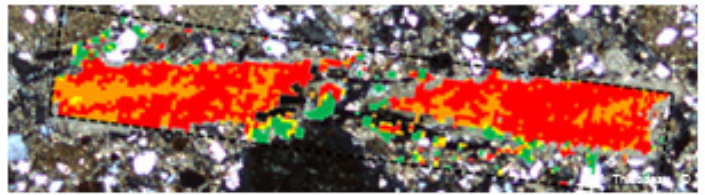


8th Developing International Geoarchaeology Conference



Simon Fraser University, Canada - June 17th - 21st, 2019

ORGANIZING COMMITTEE

Francesco Berna, PhD, Associate Professor, Simon Fraser University

Candice Koopowitz, MA, Graduate Student, Simon Fraser University

Peter Locher, MA, Technologist, Simon Fraser University

Brandi MacDonald, PhD, Assistant Research Professor, University of Missouri

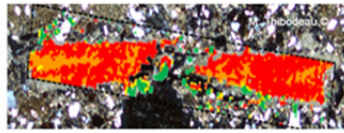
Rudy Reimer, PhD, Associate Professor, Simon Fraser University

Lucy Wilson, PhD, Professor, University of New Brunswick

Abstracts

Authors Affiliations

Email Addresses



Keynote

Charles French [University of Cambridge]

Title: *Chronicling resilience of valley systems in semi-arid landscapes of southern Peru and East Africa*

Abstract: A series of geoarchaeological studies that I have been involved with colleagues in southern Peru and East Africa have repeatedly demonstrated the importance of hydrology, soil movement and capture in the success or failure of agricultural exploitation in these semi-arid landscapes. A combination of archaeological, ethnographic, hydrological and soil-sediment evidence will be presented for the Ica valley of southern Peru and the East African landscapes of Aksum and Konso in Ethiopia, Tot in Kenya and Engaruka in Tanzania. In each case study, the success or failure of the farming system represents a balancing act between a number of climatic, hydrological, soil, erosional and human factors. Throughout, the resilience of captured alluvial material appears to be key. These studies also provide resonances for understanding the longevity of present day landscapes.

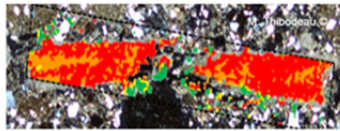
Invited Presentation

Ximena Suarez Villagran [Universidade de São Paulo]

Co-Authors: Gelvam Hartmann, Mareike Stahlschmidt, Susan Heinrich, Bertrand Ligouis, and Éric Böeda

Title: *On the evidence of hearths at Serra da Capivara (Brazil), the oldest human settlements in South America*

Abstract: Undisputable evidence for a Pleistocene human presence in South America is still subject of debate. The most accepted chronology comes from the site of Monte Verde II (Chile) where stone artifacts and domestic structures were dated to c. 14,5 kyr BP. The archaeological sites at Serra da Capivara, northeastern Brazil, have the oldest and most controversial evidence for a Pleistocene human presence in South America. Stone artifacts belonging to a pebble industry have been found in numerous locations associated with charcoal fragments and sediments dated to c. 20 kyr BP. Many researchers have questioned the anthropogenic origin of the pebble industry, which resembles naturally flaked stones. Well-preserved hearths have never been properly documented or studied, despite being commonly mentioned in the publications. Human-made fires, in the form of hearths or other combustion features, would be unquestionable proofs that humans were at Serra da Capivara during the Last Glacial Maximum, despite the ambiguity ascribed to the pebble industry. In this presentation, we discuss the latest micro-contextual study of ancient combustion features from South America, with data from two sites at Serra da Capivara (Vale da Pedra and Sítio do Meio). This study combines micromorphology with complementary techniques, such as organic petrology, FTIR (Fourier transform infrared spectroscopy), micro-FTIR and magnetic analyses. Macroscopic evidence and microarchaeological data will be compared and discussed to evaluate whether the qualitatively described hearths are indeed human-made fires.



Podium and Poster Presentations

Aviad Agam [Tel-Aviv University] – (Podium Presentation)

Co-Authors: Lucy Wilson, Avi Gopher, Ran Barkai

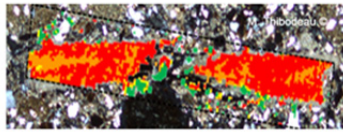
Title: *Identifying geologic origins of flint at Acheulo-Yabrudian Qesem cave, Israel: Results of an integrated study*

Abstract: We present the results of a study aimed at identifying the geologic origins of flint at the Acheulo-Yabrudian site Qesem Cave (QC) (420-200 kya), combining a geologic survey with visual, petrographic, and geochemical analyses. Twelve lithic assemblages from QC were classified to flint types, based on visual traits. Potential flint sources were located, and petrographic thin sections of archaeological and geologic samples were produced and compared. Also, a geochemical analysis, using both ICP-MS (Inductively coupled plasma mass spectrometry) and ICP-AES (Inductively coupled plasma atomic emission spectroscopy), was performed to detect major elements, trace elements and rare-earth elements, and to establish a chemical signature. In total, 42 potential sources were identified: 21 Turonian (Upper Cretaceous), up to 8 km from the site; two Upper Cenomanian-Turonian sources (~12 km north of QC); six sources of Cenomanian or Turonian age (12-13 km north of QC); nine Campanian (also Upper Cretaceous) sources (~18 km south of QC); and four Eocene sources (18-30 km south of QC). The combination of petrographic and macroscopic data permitted the assignment of flint types to sources on three levels of certainty: certain, likely and tentative. Flint types of Eocene origin, for example, were securely assigned to their geologic age based on the presence of nummulites. Campanian flint is also securely identifiable by its brecciated texture and the presence of bulimina foraminifera. The geochemical analysis provided some clues concerning potential paths for future investigations. Campanian samples, for example, were characterized by high values of uranium. Generally, while QC is located within rich flint-bearing Turonian limestone, which was often used by the cave inhabitants, flint from other, potentially more distant, geologic origins was also used in note-worthy proportions.

Hassan Ahmadi Karvigh [University of Tehran] – (Podium Presentation)

Title: *Zoroaster's time based on new geoarchaeological findings in Seistan*

Abstract: Despite the countless number of different theories on the Zoroaster's time, the date of Zoroaster remains controversial. The aim of this article is to determine, for the first time, the Zoroaster's date based on analysis of geographical references of the *Avesta* and comparison with new Geoarchaeology findings in the Seistân region, located on the eastern Iranian plateau. The direct Avestan references to the geography of ancient Seistan, include 39 passages from the *Vendidâd* and *Yashts* of the *Young Avesta* and 12 passages of the *Bundahis*. It has been shown that these passages provide detailed consistency and correlation with the description of the historical geography of prehistoric Seistân that they could not be interpreted as mythical. The historical geography of Seistân has been studied by two decades of field work, and maps of comparative geography of the region have been prepared to provide a chronological framework for the time of Zoroaster. My study shows that the most ancient channel of the Helmand River in Seistân is the Pudâi River, which precedes the earliest traces of human presence in the region.



This study also proves that the Helmand River used to flow to the northern delta of Seistân during the periods 3,200 to 1,800 BCE and 1,400 to 200 BCE, and to the southern delta during 1,800 to 1,400 BCE. I demonstrate that the Avestan river Zarenumaitî or Dâityâ refer to the ancient channel named Trâkun River, the Avestan river Nâvtâk or Vâtâeni refer to the Shile River and the three countries of Airyana Vaejah, Haêtumant and Urva, mentioned in the first chapter of *Vendidâd* are identified with the southern, northern and Pudâi deltas of the Seistân, respectively. It thus appears that the natural course shift of the Helmand channel from the southern to the northern delta of Seistân occurred circa 1,400 BCE and provides a secure basis for chronology of later specific events. Using this basis, I conclude with $1,350 \pm 15$ BCE as the date of Zoroaster's first arrival to the Vishtâspa's court.

Aleš Bajer [Mendel University in Brno] – (Poster Presentation)

Co-Author: Lenka Lisá

Title: *Archaeological Dark Earth as a marker of past landscape cultivation; case study from Moravia, Czech Republic*

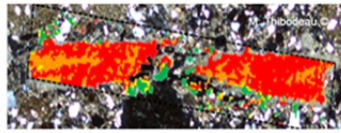
Abstract: Geodiversity is often understood as the main factor predicting the way the Holocene soil cover and the landscape morphology look like. On the other hand, the human role is also undisputed. One of the ways to understand the human action in the past soil development is to study the geochemistry and micromorphology of buried soils connected with human occupation. One of the typical soils of this type is called Archaeological Dark Earth. To date this type of soil has been poorly understood as cultivation and past human landscape marker in Czech lands. During the last few years our team studied a set of Archaeological Dark Earth formed in different morphological contexts of Moravia, the south east part of the Czech Republic. The sites selected include morphology buried under a Roman rampart, Slavic tell-like accumulations on sandy dunes, and soils buried under the alluvial plain. An Archaeological Dark Earth is usually characterized (but not necessarily) by dark (black) colour, increased Corg, TN, P, Mn and magnetic susceptibility and by the content of different ecofacts. The formation of these soils is often correlated to the content of charred material and biomass as well as to the different types of past agricultural practices. The morphological appearance of these soils reveals not only information on past geomorphology, but also the ecological strategies of past human societies. In light of current global problems with organic matter, CO₂ and water shortage, we trust that a better understanding of the nature and formation processes of Archaeological Dark Earth has the potential to improve landscape management in the future.

Francesco Berna [Simon Fraser University] – (Podium Presentation)

Co-Authors: Michael Toffolo and Morgan Ritchie

Title: *Microstratigraphic study of combustion features from short-lived intermittent occupation at a 1300- year-old Coast Salish rock shelter, British Columbia*

Abstract: Coast Salish people are the Indigenous populations that have lived in southwestern British Columbia and northern Washington State for over 12,000 years. Archaeological investigations indicate that from at least 3,500 years ago, Coast Salish people's subsistence



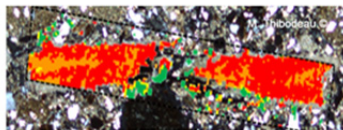
involved diversified pursuits, including intensive fishing, shellfish harvesting, plant cultivation, and hunting and gathering. Social hierarchy, technological sophistication, landscape management, and labour organization enabled the Coast Salish people, like other Northwest Coast groups, to amass impressive food surpluses. These surpluses supported populations larger than many agricultural societies and were the basis for elaborate feasts and grand displays of wealth, rituals, and building of monumental architecture. The Coast Salish peoples lived in permanent settlements along the coast and at the confluence of major rivers in British Columbia. In addition, during hunting and harvesting trips they exploited seasonal resources in the interior, especially the forested belts above valley bottoms and below sub-alpine zones. There, evidence of human presence at ephemeral sites is less apparent and mostly confined to rock shelters in the form of combustion features and stone tools scatter. To retrieve information on the timing and quality of the activities that took place in these ephemeral locations, a micro-archaeology approach is required. Here we present the protocol used and the results obtained at the DjRr-4 rock shelter, a Coast Salish short-lived occupation in the Indian River valley in southwestern British Columbia. The study of the formation and post-depositional processes of a series of combustion features by soil micromorphology, phytolith and diatom analysis, paleoethnobotany, zooarchaeology, lithic analysis, and radiocarbon dating shows that this rock shelter was used for short-lived, intermittent occupations that took place during the early 8th, early 12th, and 17th c. CE. The chronology in agreement with existing evidence of increase population expansion in the region and the archaeological record (especially the large proportion of terrestrial mammal remains consistent with the adoption of the bow and arrow by Coast Salish peoples starting from the second half of the 7th century CE) suggest that the DjRr-4 rock shelter was used as a temporary campsite during hunting trips and is an example of the intermittent intensification of this practice in the region.

Emma Betz [University of Oxford] – (Poster Presentation)

Co-Author: Matthew McCarty

Title: *Stylistic and Scientific Analysis of a Fortuna Statuette*

Abstract: Archaeological museum collections around the world receive donations from individuals who purchased objects while on vacation. These objects' authenticities are often questioned since they have no provenience. Many museums recognize that there are possible fakes and replicas within their collection but that does not stop some from displaying them alongside genuine objects. Most museums rely on art historical connoisseurship to determine authenticity which on its own may be misleading. Non-destructive analysis methods are becoming increasingly popular and help to provide an increased degree of robustness to the overall analysis. The Molnar collection was donated by Dennis Molnar to the Museum of Anthropology (MOA) at the University of British Columbia in 2010. This collection comprises 72 various items coming from Greek, Roman, Egyptian, Near Eastern, and South American cultures. Of these 72 items, there are around 30 statuettes described as bronze including a figurine depicting the Roman goddess Fortuna with attributes of the Egyptian goddess Isis. This statuette was chosen as a sample piece to investigate because not only was scientific analysis (pXRF) possible but stylistic analysis was also viable. Stylistically, it is a very unique piece which might indicate that it is not of Roman origin. However, the elemental composition is within the common percentages of Roman statuettes which indicated Roman origin. This study



emphasizes the value of complementary, non-destructive analysis for objects in a museum setting, particularly when a unique iconography could indicate a more recent origin. The rapid, and easily obtained pXRF results prompts further investigations into the Molnar and other MOA collections.

Christopher Carey [University of Brighton] – (Podium Presentation)

Co-Authors: Kim Hunnisett, Lee Bray, and Richard Macphail

Title: *A geoarchaeological analysis of a Bronze Age roundhouse and reave system on Dartmoor, UK*

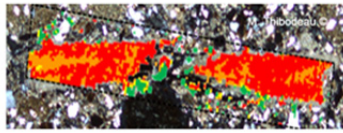
Abstract: The granite uplands of Dartmoor, UK, contains a rich prehistoric archaeological record, including the remains of numerous stone circles, roundhouses, and associated land and field divisions, with the land divisions known as reaves. Many of these roundhouses had been the subject of ‘early archaeological’ excavations, and whilst of their time, had left significant questions about their use and chronology unresolved. The reaves in comparison, have been the subject of more recent archaeological fieldwork, with a Middle Bronze Age date generally accepted for their construction. However, an excavation funded and led by Dartmoor National Park Authority, provided the opportunity to apply a suite of geoarchaeological techniques to the excavation of a seemingly isolated roundhouse and an associated reave system. The analytical programme utilised a multi-method approach, integrating sediment quantification, geochemical analysis and thin section analysis, to investigate the pre-reave landscape and the interior of the roundhouse. The results demonstrate a landscape that had witnessed significant soil erosion and colluviation prior to the establishment of the reave system in this locale, recognising the start of the transformation of this landscape, into what would later become a Raised mire with a Podzolic soil. The excavation of the roundhouse revealed a stone structure built onto the wall of roundhouse, partially incorporating a presumed Neolithic standing stone. This structure featured an opening, into which had been set a hearth. Although the hearth had been largely removed and then sealed in prehistory by a large stone, the geochemical analysis demonstrated this hearth to be associated with the use of metals (Bronze). The interpretation of this data suggests a local smith, living away from his local community, but still tied to the wider Bronze Age society through the reave system.

Valentina Caruso [Università degli Studi di Milano] – (Poster Presentation)

Co-Authors: Nicoletta Marinoni, Luca Trombino, Cristina Cattaneo, Francesco Berna

Title: *Microstructural and chemical degradation of archaeological and modern human bones: a new application of synchrotron radiation μ CT and FT-IR spectroscopy*

Abstract: Human bone is composed by an intimate association of mineral and organic components. It, thus, undergoes complex and variable changes after death. In fact, the human body do not decay in a predictable way due to many intrinsic and extrinsic factors. Here we comparatively present microstructural and chemical data obtained from archaeological skeletal remains from contexts dating to 3rd and 17th century and from contemporaneous remains from the Milan area (Italy). The histological morphology of pristine and altered bone was visualized



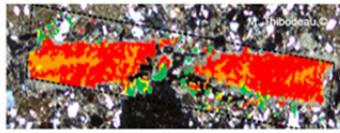
in 3D and measured by SR- μ CT at the Elettra Synchrotron Facility (Trieste, Italy). This analytical approach allows visualization and quantitative information on bone architecture with an extraordinary level of detail of the ultrastructural bone features. In addition, to quantitatively inter-characterize the different degree of alteration of mineral and organic phases and to gain insights on diagenetic processes that may have occurred over time, the infrared absorptions of collagen (ν 1Amide I), phosphate (ν 3PO₄ and ν 4PO₄) and carbonate (ν 2CO₃) and their relative intensities were analyzed by FT-IR. The mean bone mineral crystal length and the Infrared splitting factor (IRSF) were also measured for each sample. The results prove that the total bone porosity of archaeological bones appeared mostly caused by the degradation of organic and mineral phases, which were linked with an inverse relationship, since if the bone components degrade the diagenetic bone porosity increases. However, this increase does not follow a linear trend over time, suggesting that the perimortem and depositional environment conditions played an important role in bone alteration. Finally, the degradation of bone mineral leads to a recrystallization of the biogenic carbonate hydroxyapatite into a diagenetic more thermodynamic stable form of carbonate hydroxyapatite.

G eraldine Fiers [Ghent University] – (Podium Presentation)

Co-Authors:  va Halbrucker, Tim De Kock, Philippe Cromb  and Veerle Cnudde

Title: *Experimental alteration of flint used on prehistoric sites in NW Belgium*

Abstract: Archaeological lithic assemblages often contain a considerable amount of altered artefacts due to post-depositional surface-modifying processes. These alteration features on lithic tools especially complicate functional analysis, as these features can partially or completely obscure prehistoric use-wear traces. However, to evaluate the impact of alteration processes on the preservation of such traces, a good understanding of these processes from a geochemical and physical point of view is required. Therefore, alteration experiments are performed on experimental flint tools, made from various flint raw materials used on prehistoric sites in the Scheldt Valley, northwestern Belgium. The focus will be given on two frequently occurring alteration processes, i.e. burning and patination. For the first, controlled heating experiments were carried out with a selection of the experimental tools both in laboratory (furnace) and open-air setting (fire hearth). For the second, the patination was reproduced on another selection of experimental tools by chemical treatment in both alkaline and acidic environments in laboratory. The possible chemical and physical changes of altered flint were investigated with optical microscopy and high-resolution X-ray computed tomography (micro-CT). In addition, the eventual different alteration behavior of various flint variants was studied. These results will be coupled to the study of flint raw materials used on prehistoric sites in our study area. That study resulted in the development of a database consisting of mineralogical, geochemical and structural information of each flint raw material variant. This way, the relation between the properties of flint raw materials and their alteration behavior will be investigated. Finally, these resulting insights will be considered in the study of altered lithic artefact assemblages from selected prehistoric sites dating to the Mesolithic-Neolithic transition (5th millennium cal BC) in the Scheldt Valley.



Beatrice Fletcher [McMaster University] – (Podium Presentation)

Co-Authors: Aubrey Cannon and Eduard Reinhardt

Title: *Systematic Investigation of Anthropogenic Chemical Signatures at a 17th Century Huron-Wendat Village*

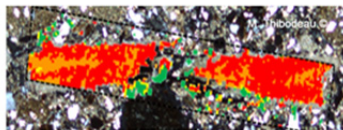
Abstract: Chemical identification of anthropogenic signatures has been promoted as a method with significant potential for minimally invasive site surveying, prospection, and mapping. Chemical analysis has also been presented as a method that might yield insights into past human behaviour that enrich other archaeological datasets. In this vein, many researchers have advocated the use of multi-element analysis as a means of differentiating between human activities and for generating maps of past occupations. Our study investigates human occupation at the Ahatsistari site (BeGx-76), a 17th century Huron-Wendat Village in Ontario. For our study, we employed an Itrax™ core scanner, an automated high-resolution x-ray fluorescence scanner originally designed for the non-destructive analysis of environmental cores. This method allowed for the capture of over 60 separate chemical concentrations and the collection of over 20 independent measurements per 1cm³ sample. We coupled this unprecedented measurement resolution with sampling at 25cm intervals across a central portion of the village. Our 274 sampled locations present the highly variable reality of soil chemical distributions. Though it is clear that human occupations have identifiable impacts of the chemical makeup of the soil, the variability of key elements such as phosphorus or calcium seems to be far more complex than has been previously suggested. Our paper explores the nuances of the intensely occupied landscape at the Ahatsistari village site while also presenting emerging questions in the field of archaeological soil chemistry.

Krista Gilliland [Western Heritage] – (Podium Presentation)

Co-Author: Robin Woywitka

Title: *Illuminated from the Ground Up: An evaluation of luminescence dating methods for building a cultural chronology in Canada's north*

Abstract: Archaeological sites in the boreal forest are notoriously difficult to interpret, in part because there is a scarcity of datable or diagnostic artifacts to support age estimates. Other problems that are inherent when working in the north typically include shallow and undifferentiated archaeological deposits and the high potential for disturbance (cryoturbation, bioturbation) at these sites. Compounding these difficulties is the fact that most of the archaeological studies undertaken in northern Canada are conducted within a cultural resources management (CRM) context. Together, these issues often result in an incomplete understanding of the timing of human occupation of the north, with the consequence that heritage resources in the boreal forest can be undervalued. In areas that are under high developmental pressure, such as Alberta's north, this presents a considerable challenge to effective heritage resource management. Previous research in other regions has demonstrated that optically-stimulated luminescence (OSL) measurements can be used for obtaining not only chronometric ages for archaeological sites, but can also illuminate sediment depositional histories, site formation processes, and relative ages. To that end, samples for portable OSL analysis were collected while conducting CRM-based studies in northwestern Alberta during the past five years. Here, we



present our preliminary results within a broader geomorphological context and suggest that, despite the methodological and logistical challenges ingrained in this approach, OSL techniques can appreciably increase understanding of the chronology of occupation of the boreal forest. We also provide recommendations for the next steps to be taken in order to establish a regional, relative chronology for archaeological sites in northwestern Alberta. This work has the potential to contribute to reconciliatory efforts by documenting the deep history of human occupation of the boreal forest. It also has wider resonance within the broader fields of geomorphology, pedology, and chronometric dating in boreal forest settings.

Magnus M. Haaland [University of Bergen] – (Podium Presentation)

Co-Authors: Ole Fredrik Unhammer, Christopher E. Miller, Susan Mentzer, Christopher S. Henshilwood.

Title: *What's in that black layer? A report on a 85 000 year old dark sedimentary feature in Blombos Cave, South Africa*

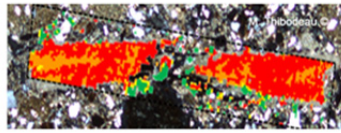
Abstract: Blombos Cave (BBC) is located on the southern Cape coastline of South Africa. Inside the cave, a more than 3 m deep and laminated sequence of unconsolidated quartz- and calcareous-rich sandy deposits has been exposed. The lower part of this sequence dates to the Middle Stone Age (MSA; 101-70 ka) and contains numerous archaeological remains after prehistoric occupation, including lithic and bone artefacts, shellfish and faunal remains, organic-rich lenses, hearths and combustion features. Here, we report on the current investigation of an unusually complex and dark sedimentary feature dated to ca. 85 ka BP. This feature, which consists of multiple micro-stratigraphic layers, is between 5 and 20 cm thick and extends for more than 6 square meters across the central area of the cave floor. Compared to the general MSA sequence, it stands out as a unique type of deposit, both by its overall shape, morphology and colour, as well by its content and microstructure. It has previously been difficult for field archaeologists to understand the formation processes behind these dark sediments by using strictly macroscopic methods. As such, this has hindered progress in assessing whether it is or how it may be associated with past human activity. By combining archaeological micromorphology and microspectroscopy with three-dimensional, high-resolution field documentation, in this presentation, we aim to unravel the depositional and post-depositional history of this highly distinct and intricate deposit and to discuss its archaeological significance.

Éva Halbrucker [Ghent University] – (Podium Presentation)

Co-Authors: Géraldine Fiers, Tim De Kock, Philippe Crombé and Veerle Cnudde.

Title: *The impact of post depositional alterations on the preservation of microwear traces*

Abstract: Microwear analysis is an important part of lithic studies as it gives insights into the use of stone tools and indirectly into the activities performed by prehistoric people. However, its success depends on the preservation degree of the archaeological artefacts. Alteration features on lithic tools complicate functional analysis, as these features partially or completely obscure microwear traces. Therefore, altered lithic artefacts are often discarded from analysis which causes a potential information loss. In order to gain a better understanding of the intensity of



alterations that makes microwear traces difficult or not interpretable, these processes are investigated in experimental set-ups. The focus is on two different alterations, i.e. patination and burning, since in the archaeological collections of our research area, the Scheldt Basin (Belgium), we predominantly encounter these alterations on Mesolithic lithics. Tool replicas are used in experiments mimicking forager activities, such as the processing of plant (wood, reed, nettles) and animal material (bone, hide, antler, meat). After these experiments, microwear traces are analyzed and registered. Afterward, sets of experimental tools are subjected to different experimental alteration processes, i.e. either burnt in a furnace or open hearth, or patinated in alkaline or acidic lab-environment. Finally, the microwear analysis is repeated and traces before and after alteration are compared. It is hoped that the results of this project will allow a better integration of altered artefacts in future microwear studies.

Ailidh Hathway [Simon Fraser University] – (Podium Presentation)

Co-Author: Francesco Berna

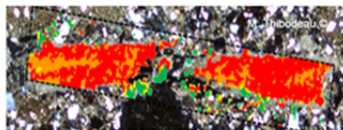
Title: *A Microsedimentological Approach to Wetland Reconstruction: A Preliminary Case Study of Wonderwerk Cave, South Africa*

Abstract: New high-resolution research is leading scholars to refine our understanding of the role played by ecosystem diversity in the evolution and adaptability of the Genus *Homo*. It is now hypothesized that hominin high adaptability was inherited from the highly biodiverse mosaic environment that existed in Eastern Africa 3 to 0.5 Ma ago. The mosaic environment hypothesis challenges the notion that hominin high adaptability was triggered by rapidly changing landscape conditions. To date there have been limited opportunities to test the two competing models in Southern Africa. The archaeological site of Wonderwerk Cave, South Africa, offers this kind of opportunity as it preserves a continuous record of the environment outside the cave over the last two million years. Soil micromorphological analyses of the sediment trapped inside Wonderwerk Cave reveal evidence for a playa-lake system as a major component of the landscape throughout the Earlier Stone Age and into the Middle Stone Age. Here we present our methodological approach to study the evolution of the Wonderwerk Cave playa-lake system using microsedimentological analysis to identify different phases of the playa-lake and their chronological sequence. Sedimentological parameters such as particle composition, grain size distribution, grain roundness and deposit diagenesis are measured from petrographic thin sections processed from intact sediment blocks. This research provides the foundations to synchronize the hydrological phases of the playa-lake with the different cultural phases of the Earlier Stone Age and early Middle Stone Age at Wonderwerk Cave. Furthermore, it explores the validity of the mosaic environment hypothesis in southern African contexts.

Hannah Herrick [Simon Fraser University] – (Podium Presentation)

Title: *Best practices for analyzing archaeological lime production*

Abstract: Lime production is one of the earliest human forays into the creation of synthetic materials. As such, a considerable amount of effort has been directed towards understanding the creation and use of lime through time and space. Several methods from the earth sciences are useful in lime analysis. However, there is little consensus in the optimal suite of analytical



techniques necessary for yielding both holistic and thorough interpretations of lime technology. An overview of common methods in lime production analysis will be reviewed, and a proposed set of best practices will be presented through current and future research at the Bronze Age site of Kalavassos Ayios-Dhimitrios, Cyprus.

Jayde Hirniak [Arizona State University] – (Podium Presentation)

Co-Authors: Eugene Smith, Racheal Johnsen, Shelby Fitch and Minghua Ren

Title: *Discovery of cryptotephra at Middle-Upper Paleolithic sites Arma Veirana and Riparo Bombrini, Italy: A new link for broader geographic correlations*

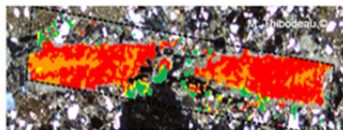
Abstract: Chemical characterization of cryptotephra is critical for temporally linking archaeological sites across vast geographic areas. Here, we describe cryptotephra investigations of two Middle to Upper Paleolithic sites from northwest Italy, Arma Veirana and Riparo Bombrini. Results show that cryptotephra are present as small (<100 micron) glass shards at both sites, with geochemical signatures rare for volcanoes in the Mediterranean region. One cryptotephra bearing deposit (population one) from Arma Veirana contains shards of a high silica rhyolite (>75 wt. %) with low FeO (<1 wt. %) and a $K_2O/Na_2O > 1$ and the second deposit (population two) contains a high silica rhyolite (>75 wt. %) but with high FeO (2.33-2.65 wt. %). Shards at Riparo Bombrini (population three) are also a high silica rhyolite (>75 wt. %) with low FeO (<1 wt. %). Trace element analysis by LA-ICP-MS shows depletions in Ba, Sr, and Eu and an enrichment in Th, U and Pb. These results suggest that shards from population one at Arma Veirana are potentially the same shards as population three at Riparo Bombrini. Potential source volcanoes are from Anatolia; however, the exact eruption is not yet determined. The age of the potential eruptions (Kirka-Phrigan, Acigöl Complex) does not agree with chronological evidence at both sites. However, these results highlight how cryptotephra can benefit archaeology, even without a source eruption determined, by providing a distinct link between deposits throughout the Mediterranean.

Candice Koopowitz [Simon Fraser University] – (Podium Presentation)

Co-Author: Francesco Berna

Title: *Evaluating the infrared 630cm^{-1} O-H libration band in bone mineral as evidence of burning: an application to the Oldowan Fauna of Wonderwerk Cave*

Abstract: FTIR spectroscopy has played an important role in recent attempts to understand the use of fire in prehistory. It has been used in the identification of heat altered sediment and bone. For the latter, the presence of the OH libration band at ca. 630cm^{-1} in the FTIR spectrum of an archaeological bone has been assumed to be indicative of fire-altered bone. However, no ad-hoc research has explored whether this FTIR band could result from other ambient temperature diagenetic processes, or what the effects of heating variables may be on the appearance of this band. Here, we present a study designed to address this lacuna, and apply our results to the analysis of fauna from the Oldowan context at Wonderwerk Cave, South Africa. Using samples of cortical bone from micro- and macrofauna, a series of heating experiments to explore the change in FTIR spectra depending on temperature and duration of exposure to heat will be



presented. Results demonstrate that the 630cm^{-1} peak is indeed diagnostic of burning bone above 537°C , due to the formation of pure hydroxyapatite. Our results also show that microfauna bones are particularly sensitive indicators of burning when subjected to FTIR analysis. According to our findings, the large majority of the micro- and macrofauna bone specimens associated with the Oldowan assemblage from a limited area at Wonderwerk Cave were burnt above 537°C .

Andrew Latimer [Simon Fraser University] – (Podium Presentation)

Co-Author: Rudy Reimer Yumks

Title: *How Skwxwú7mesh (Squamish) Transformer Sites Convey and Encode Cultural and Geological Knowledge*

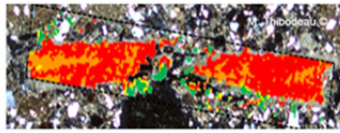
Abstract: Transformer sites are locations that are connected to Coast Salish stories of supernatural beings that travelled through the land, transforming people and animals in order to show moral lessons and create the resources that became vital for the lives of Coast Salish peoples. My research concerns Transformer sites and associated stories in the Salish Sea area, and it will use a multifaceted approach that incorporates ethnographic accounts of Coast Salish sites and stories. First, spatial mapping of Transformer sites across the Salish Sea gives an understanding of the landscape and general geology of the area. Second, a viewshed analysis qualifies how transformer sites were seen on different points on the landscape, particularly along waterways. Third, field observations qualify the distinctiveness of transformer sites from perspectives of travel, evaluating them based on phenomenological factors such as size, colour, composition, and shape. Fourth, the frequency and quantity of archaeological sites and ethnographic reports associated with transformer sites gives an indication of the human activities associated with them. Together, these methods provide a greater understanding for how travel through the physical landscape corresponds with the oral traditions and cultural landscape of people in the past. Understanding transformer sites means recognizing the significance they have to Indigenous peoples, and they represent an aspect of spiritual land use that must be considered in ongoing negotiations between these nations and the Canadian government. Within the story of legendary figures and mythical items are truths and practical knowledge about how past peoples understood their surrounding landscape.

Emma Lowther [Simon Fraser University] – (Poster Presentation)

Co-Authors: Farid Rahemtulla and Francesco Berna

Title: *Micro-stratigraphy of an anthropogenic island, Lake Babine, British Columbia*

Abstract: Ongoing work on Smokehouse Island in Babine Lake, north-central British Columbia is challenging the notion that Pre-Contact First Nations peoples reacted passively to resource rich environments but, in fact, as in coastal areas they were actively shaping their landscapes to improve access to targeted resources such as shell fish and berries. Smokehouse Island is strategically located to harvest exceptionally abundant yearly salmon runs and is historically documented to had weirs and smokehouses. Excavations from 2014-2017 have uncovered a 50 cm thick deposit of anthropogenic material accumulated in extremely rapid time on a riverine island. Here we present the soil micromorphology work conducted to investigate if this deposit



was accumulated at once (i.e., dumped) to raise the island permanently above the flood level or if it was deposited as the result of very intensive and continuous activity repeated over the years. Our analysis shows that the anthropogenic material is composed of angular, unsorted chaotically distributed fire cracked gravel and pebbles dispersed on an organic rich soil matrix. With the exception of the modern top soil horizon, and some deep alternation of anthropogenic and flood deposits, no evidence of buried top soil horizons, in situ combustion features or trampling surfaces have been observed in the top most 50cm of the many excavation units sampled. Based on these preliminary results, we hypothesize that the ancestors of Lake Babine First Nations landscaped the surface of the little island either by transporting or redistributing large quantity of material derived from activities such as pit ovens and smoke houses, probably in order to raise the level of the island above flood levels and provide a larger, more stable surface upon which they could have better harvest and process large quantity of salmon. In fact, no evidence of major floods has been documented on top this anthropogenic layer.

Brandi Lee MacDonald [University of Missouri] – (Podium Presentation)

Co-Authors: Ramiro Barberena, María Fernández, Agustina Rughini and Michael Glascock

Title: *Geoarchaeological and Geochemical Approaches to Obsidian Source Distribution in Northwestern Patagonia*

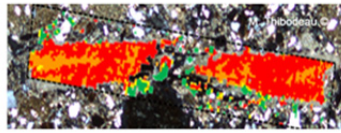
Abstract: Northwestern Patagonia is located in a tectonically active part of the southern Andes (Argentina), which has facilitated the formation of obsidian, including pyroclastic deposits that have been affected by geomorphic processes, resulting in a complex obsidian landscape. Until recently the geomorphic relocation of obsidian across this landscape was poorly understood, limiting our understanding of prehistoric human mobility during the late Holocene. We present a current assessment of regional availability of different obsidian types, combining geoarchaeological survey and geochemical characterization (XRF and NAA) to understand the distribution and chemical properties of obsidian. This robust “source-scape” provides the foundation for reconstructing patterns of lithic provisioning and discard. We compared new results on obsidian source distribution to a database of 1,109 artifacts, and this reassessment has enabled new insights into seasonal mobility and access to high altitude sources. Our results suggest that interpretations of obsidian availability and procurement are more nuanced than previous understanding.

Peter Mears [University of New Brunswick Saint John] – (Podium Presentation)

Co-Authors: Lucy Wilson and Constance L. Browne

Title: *Weight versus the number of pieces: Do our interpretations of raw material use vary depending upon how we quantify use? A case study from the Middle Palaeolithic in the Vaucluse, southern France.*

Abstract: Using a dataset of over 15,000 pieces from 11 archaeological layers at a Middle Palaeolithic site in southern France, the Bau de l’Aubesier, we expand upon previously published models and discuss lithic raw material selection strategies in the Vaucluse region. Our previously used resource selection function showed a significant positive relationship between the



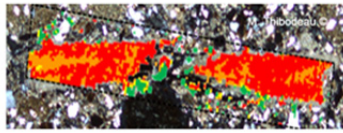
attractiveness of local lithic sources and the number of stone tools found at the site, with raw material quality becoming increasingly important as a variable to determine use in the upper layers. However, the upper layers include more knapping debris, with a lower proportion of typologically-identified pieces. This study quantifies use from the perspective of collected stone tool weights, irrespective of their frequency or typologies, using a Generalized Linear Model to assess which variables are driving the selection of raw material sources. Raw material of a range of sizes is abundant in the Vaucluse and a wide variety of tool weights are observed at the Bau de l'Aubesier. So, if many small stone tools happen to weigh less than a single larger one, should we reconsider how previous models have been used to interpret the prehistoric economic behaviour and raw material procurement strategies of Middle Palaeolithic hominins in the Vaucluse?

Cornel Pop [Max Planck Institute for Evolutionary Anthropology] – (Podium Presentation)

Co-Authors: Lucy Wilson and Constance L. Browne

Title: *Evaluating landscape knowledge and lithic resource selection at the French Middle Palaeolithic site of Bau de l'Aubesier*

Abstract: We report on the application of a novel approach to exploring the degree of landscape knowledge and the nature of decision-making processes reflected in the utilization of stone resources in the French Middle Palaeolithic. Specifically, we use data from Bau de l'Aubesier to explore the reasons why a majority of the 350 sources catalogued in the region surrounding the site appear not to have been utilized, including several located near Bau and yielding high-quality materials. Indeed, most of the nearly 16,000 provenanced lithics at Bau appear to have been collected from sources requiring considerable travel time (1+ hours) and suggest a NE-SW procurement corridor. We depart from previous efforts in focusing on the spatial relationships between sources as an explanatory variable, operationalized in terms of minimum travel times. Using GIS and a generalized linear model of resource selection derived from the Bau assemblages, we compute individual source utilization probabilities for each possible landscape location throughout the region (~1,200 km² at 90m resolution), factoring in the intrinsic characteristics (e.g. quality) of, and time required to reach, each source on the way to the Bau. We find that in most cases seemingly viable sources were likely not exploited simply because the minimum cost path leading back to Bau passes through, or requires only minimal deviations to reach, higher quality sources. More generally, we find that throughout the entire region a cost/benefit analysis of competing sources favours those from areas known to have been utilized. Virtually all the available information on lithic procurement at Bau is consistent with a model of relatively uniform landscape utilization premised on detailed knowledge of a very large area, an ability to accurately estimate travel times between all locations, and a pragmatic strategy of stone resource exploitation based on minimizing costs (travel and search times) and maximizing utility.



Emily Purcell [Simon Fraser University] – (Poster Presentation)

Co-Authors: Rosa M. Albert, Francesco Berna and Morgan Ritchie

Title: *Using biogenic Silica Microremains to understand Anthropogenic Deposits in Sts'ailes Territory, British Columbia*

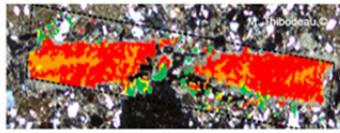
Abstract: Biological microremains, like phytoliths, diatoms and sponge spicules, are increasingly used as proxies for paleoenvironmental interpretation around the world. These microremains can be used as to make inferences about paleoenvironments as they can provide space and time specific data; this can be applied to understanding anthropogenic changes to the landscape. While the benefits of using biological microremains are well understood, their full potential has yet to be explored in the Pacific Northwest of North America. In this project we aim to establish the potential and limitations of microremain analysis in British Columbia. Our research compares microremains from pre- and post-occupied contexts at an archaeological site in the traditional territory of the Sts'ailes, along the Harrison River in southwestern BC. Through analysis of the deposition and taphonomy of biological microremains, we will address the unique composition of microremains in anthropogenic contexts, and the way they differ from the riverine deposits at the same site.

Farid Rahemtulla [University of Northern British Columbia] – (Podium Presentation)

Co-Authors: Emma Lowther and Francesco Berna

Title: *Smokehouse Island: an indigenous terra formed island on the Babine River, North Central British Columbia*

Abstract: Smokehouse Island is located on the Babine River in north central B.C. and historically, indigenous peoples erected sophisticated wooden fish weirs and smokehouses here to harvest and process large volumes of Pacific salmon returning annually to their spawning grounds. Archaeological work on the island was initiated in 2014 as part of the Babine Archaeology Project, a community-engaged partnership. Sub-surface the site consists of an unusually high density of chipped stone tools, fire cracked rock, charcoal, and other organic debris. Early in the project history it became apparent that the island was “formed” largely via accumulation of cultural materials deposited by humans, with lesser contribution from natural processes. At question is whether this terra forming was intentional (planned) on the part of the indigenous peoples, or was it the unintentional consequence of repeated, intensive use of the same location? To investigate further intact sediment block samples were collected for soil micromorphology analysis from several excavation units. The soil micromorphology analysis shows that across the island the top 40-50cm of the stratigraphic column is indeed composed of anthropogenic material chaotically accumulated in what appears to be a single depositional event. These finds are consistent with dumping or redistributing large quantities of material altered by pre-contact traditional activities such as stone boiling, cooking, roasting and salmon smoking. The microstratigraphy analysis shows that this last depositional event follows periods of alternating flood deposits and in situ pyrotechnological activities. Thus, it appears that starting a few hundred years before contact, the ancestors of the Lake Babine Nation landscaped part of the island, probably to extend its permanent surface above flood level due to the need of processing larger quantities of salmon. The presentation consists of two parts: first, overview of



excavations, stratigraphy, radiocarbon chronology, and significant material culture, and second, preliminary results from soil micromorphology.

Rudy Reimer Yumks [Simon Fraser University] – (Podium Presentation)

Title: *Sourcing pre-contact lithic materials in British Columbia: integrating traditional knowledge and geochemistry*

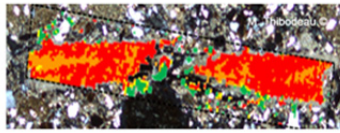
Abstract: Lithic provenance studies have a long history of finely detailed scientific practice. Numerous studies have demonstrated the use of various materials over time, their distribution over landscapes and inform archaeologists about their use and value. Yet, select few studies offer careful integration of Indigenous knowledge regarding the location of lithic sources, their names and associated oral history and traditions. This paper offers insight into the value of integrating Indigenous traditional knowledge regarding lithic sources of British Columbia and geochemical analysis.

Nicholas Riddick [McMaster University] – (Poster Presentation)

Co-Authors: Joseph I. Boyce, Eduard G. Reinhardt, and Richard M. Rothaus

Title: *Multi-proxy paleoenvironmental record of coastal uplift and abandonment (6th c. CE) of Lechaion's inner harbour, Corinth (Greece)*

Abstract: Lechaion, the western port of Ancient Corinth, was constructed in the 6-7th c. BCE and was abandoned sometime in the 6th c. CE. The decline in the harbour has been attributed variously to natural siltation of the inner basin, co-seismic uplift, subsidence of the coast and damage by tsunami impacts. A multi-proxy paleoenvironmental study was conducted on 7 cores collected from the inner harbour basin and entrance channel to determine changes in the coastal environments and timing of harbour abandonment. Elemental abundances were measured using high-resolution, micro-XRF core scanning and combined with sedimentologic, isotopic ($\delta^{18}\text{O}$, $\delta^{13}\text{C}$) and micropaleontologic analyses (foraminifera). The harbour basin lithostratigraphy consists of interbedded silt and pebbly sand containing abundant marine fauna and pottery fragments, overlain by laminated marl unit (> 1 m thick). A thin (5-10 cm) calcrete layer dividing the two units records the transition from a marine harbour basin to an evaporitic lagoonal environment. The transition is marked by a distinct shift in the abundance of terrigenous elements (Al, Si, K) and an upwards increase in Sr, Ca, Ca/Fe ratio and $\delta^{18}\text{O}$ values within the marl. Foraminiferal abundances indicate a eutrophic harbour environment, dominated by *Ammonia*, *Adelosina* and *Bolivinelina*, followed by a freshwater to brackish lagoon with low abundance of foraminifera and other marine fauna. Radiocarbon dates bracketing the calcrete layer date the transition to ca. 6th c. CE, consistent with archaeological data indicating a decline in use of the harbour. The calcrete layer basin-wide extent and sharp contact with underlying harbour deposits is interpreted as rapid basin restriction, resulting from tectonic uplift (> 1.1 m) of the harbour basin. The uplift event may have been linked to destructive earthquake events (551/552 and 524 CE) recorded for the Gulf of Corinth in the 6th c. CE.



Morgan Ritchie [Sts' ailes] – (Podium Presentation)

Co-Authors: Emma Lowther and Francesco Berna

Title: *Multi-scalar geoarchaeology study of Human Settlement of Riverine Islands and the formation of the Harrison-Chehalis Confluence, SW, British Columbia*

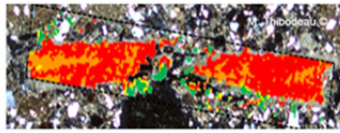
Abstract: This paper is a multi-scalar examination of the geoarchaeological context of the lower margin of a large alluvial fan at the Harrison-Chehalis confluence, in SW British Columbia, one of the most ecologically rich landscapes and productive salmon habitats in North America. The (trans) formation of this landform and riverine environment over the last few thousand years has been concurrent with increasing human settlement by the ancestors of the Sts' ailes people who significantly re-contoured their surroundings. To understand the long-term interactive human-environment relationships, this study focuses predominantly on small low-lying islands which are highly sensitive to environmental changes and flooding. The remains of human occupation on these islands present reliable chronological controls in reconstructing their intertwined natural and cultural histories, including reconstructing times and conditions that influenced island formation, habitation and inhabitability, and ultimately, abandonment. Our historical study of this important alluvial confluence, long-term human settlement, and climatically driven fluvial changes moves between macro and micro scales of analysis, drawing on LiDAR data, years of settlement survey and mapping, and soil micromorphology and micro-sedimentology. This research project builds on and contributes to a growing body of research focused on exploring long-term human-environment entanglements, sustainability, and resiliency.

Irini Sifogeorgaki [Leiden University] – (Poster Presentation)

Co-Author: Gerrit Dusseldorp

Title: *Stratigraphic assessment of Umhlatuzana Rock Shelter, KwaZulu-Natal, South Africa*

Abstract: Umhlatuzana rock shelter is an important archaeological site for the study of the Middle and Later Stone Age in South Africa (~70,000 BP - 1,800 CE). The site was first excavated in 1985 by Jonathan Kaplan within a limited timeframe and was reported to have a complicated stratigraphy. One of the main problems in comprehending the formation processes of the site was the lack of clear stratigraphic boundaries in the Pleistocene deposits. In 2018, a high-resolution geoarchaeological study of the site was initiated. We re-excavated part of the site applying state-of-the-art methods and techniques designed to clarify the stratigraphy and the archaeological context. Our stratigraphic assessment of the site is based on a combination of field observations with geospatial, sedimentological, and geochemical analyses. Specifically, we have conducted grain-size, pH, and Loss-on-Ignition analyses. Within the Holocene part of the sequence pH and Loss-on-Ignition analysis confirms the presence of combustion features. Within the lower part of the sequence, our results suggest differential preservation across the sequence, explaining the absence of faunal remains and charcoal in several units. In addition, based on our analysis of piece-plotted finds, we suggest that the Pleistocene Later Stone Age occupations at the site may have been characterized by a low occupation intensity. Additional geoarchaeological work including micromorphological analysis is underway to address outstanding questions on the stratigraphic integrity of the site. With a clearer stratigraphic



understanding of the site, we plan to study the archaeological materials and assess whether the existing collections are representative.

Shari Maria Silverman [Washington State Parks and Recreation Commission] – (Podium)

Title: *Landform Study to Understand its Sites: West Beach Barrier Berm, Whidbey Island, Washington state, United States (Puget Sound)*

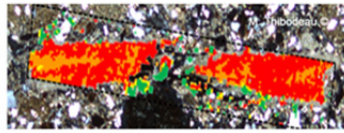
Abstract: West Beach, an area with sites about which much is unknown, is located on the northwest edge of Whidbey Island, Washington state, one of Puget Sound's San Juan Islands. Both the West Beach barrier berm and its sites exhibit unusual characteristics, so regular investigation strategies may miss site components. The West Beach barrier berm contains sites with roasting features dating approximately between 830 to 520 B.P. within its top meter. All the sites as yet found lie mostly within its interdune, although some shell midden appears in the eroding shoreline. Cobbles are strewn across the interdune surface, which stretches over much of the berm's four km length. Many of these cobbles have been transformed into tools or have become fire-modified. A 1950s archaeological survey and later investigations found clusters of fire-modified rock along the interdune surface. A camas oven was uncovered approximately at the halfway mark of the dune's length. In Puget Sound, study of archaeological sites and landforms together have correlated geomorphological changes with alterations in landscape use. Whidbey Island bears the scars of both glacial and tectonic geomorphology, including kettles, glacial striations, changing sea-level shorelines, faults, shingle beaches, and, of course, beach berms. Washington State Parks and Recreation Commission is currently developing strategies to assess archaeologically uninvestigated portions of West Beach within Deception Pass State Park's boundaries, which are along the northern third of the berm. West Beach's known sites (45IS90, 45IS91, 45IS107, and 45IS383), Whidbey Island's geomorphic features, Whidbey Island's and other southern Puget Sound beach berm archaeological sites and geomorphology will be compared to better assess West Beach.

Earl Stefanysen [Simon Fraser University] – (Poster Presentation)

Co-Author: Francesco Berna

Title: *Microstratigraphic protocol to assess the wildfire impact to buried archaeological sites*

Abstract: Here we report upon the impact of forest fires on archaeological sites and a novel method for analyzing and quantifying such effects. This involved describing the chemical and mineralogical changes that took place in soils and sediments at the site of a wildland fire. There are several indicator minerals that react predictably to high temperatures and which are part of the natural soil matrix. Our study examined the post-fire thermal impact upon these minerals in order to determine the heat diffusion below the surface. After considering sites from among the many fires that have erupted in southern British Columbia in the past year, a suitable location was found near the village of Logan Lake where a 165-hectare wildfire had burned in a forest of Ponderosa pine (*Pinus ponderosa*) and lodgepole pine (*Pinus contorta* var. *latifolia*) for three days before being brought under control. We began our field research after the incident had occurred and the fire had already been officially designated as "out" for more than a month. Intact soil samples were recovered from the site at locations within the perimeter of the burn, and



control-group samples were also gathered from locations outside the perimeter. These were processed into petrographic thin-section slides and analyzed for soil micromorphology and infrared microspectroscopy (mFTIR). A quantitative representation was produced which accounted for the effects of wildfire thermal impact on the samples. The results were considered especially pertinent for our research as there was a documented archaeological site located less than 300 meters from the fire perimeter which shared the same geological and pedological characteristics as the sampling site. Our findings show that affected humus layers and upper layers of sediments can reveal the temperatures that were reached during a period of intense thermal exposure at the surface, as was determined by analysis using mFTIR. These findings were produced from a wildfire incident that occurred several weeks after the combustion of forest fuels had taken place. Thus, a new protocol has been devised which could find application into post-burn investigations into the effects of thermal stress on the soils and sediments, features and artifacts of archaeological sites.

Meghan Thibodeau [Simon Fraser University] – (Poster Presentation)

Co-Authors: Francesco Berna

Title: *Wood ash in the Oldowan layers of Wonderwerk cave, South Africa*

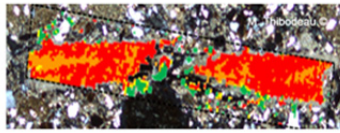
Abstract: Evidence of in situ fire associated with Acheulean stone tools at Wonderwerk cave include burnt bone, potlided chert fragments, burnt clay minerals and putative ashed plant materials. Ashed vegetation material, also known as “wood ash”, is recognized as microscopic calcified plant tissues and/or clacite rhombus-like crystals (i.e., calcium oxalate pseudomorphs). This type of calcification occurs at temperatures above 500°C with the formation of pyrogenic calcite from the carbonation of CaOH or CaO intermediate phases. Calcification of plant tissues occurs also at ambient temperature due to calcite precipitating from the soil solution and adhering to or replacing plant fibres. It has been demonstrated that Fourier transform Infrared spectroscopy (FTIR) and microspectroscopy (mFTIR) can reliably distinguish pyrogenic calcite from other type of geogenic calcites. We thus devised a mFTIR analytical protocol to discriminate pyrogenic, pedogenic and geogenic calcite in order to unequivocally determine if calcified plant materials are the results of high or ambient temperature processes. Our mFTIR protocol suggests that in the Acheulean context of Wonderwerk cave there is an even larger than expected presence of ashed plant material, suggesting that some of these may be the remains of small hearths fuelled with grasses or twigs.

Joanna Walker [University of Cambridge] – (Podium Presentation)

Co-Authors: Cameron A. Petrie, Julie A. Durcan, Hector Orengo, and Charly A.I. French

Title: *Buried Indus Landscapes: Using Geoarchaeology to assess Human-Environment Interactions in northwest India*

Abstract: One of the main theories postulated for decline of the Indus Civilisation is that unpredictable monsoon rainfall and water availability as a result of the 4.2 ka event influenced the decline of large urban centres. However, very little work has been done to investigate the relationship between Indus era sites and the landscapes in which they existed, with water sources

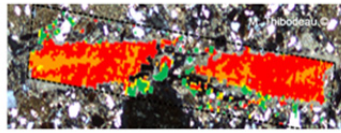


often left unidentified outside of major channels. Recent high-resolution GIS analysis of the Indo-Gangetic Plain has shown a considerably larger network of meandering channels in this region than previously imagined. However, these river channels have rarely been ground-truthed, and often insufficient geological and sedimentological data exists for claims of river losses impact on urban decline to be assessed. Here, results are presented from a substantial coring survey undertaken around the Indus Civilisation settlement of Lohari Ragho, located in the hinterland of Rakhigarhi in northwest India. The high-density of cores analysed by this study allowed for an unprecedented comprehensive palaeo-environmental reconstruction of the proximal area around Indus Civilisation sites to be made. Sedimentological analysis showed a far more hydrologically complex land setting than present, with a river channel remotely sensed by Orengo and Petrie (2017) confirmed, alongside a raft of other palimpsest hydrological features. A series of landsystems maps showing the development of the landscape through the Late Pleistocene and Holocene were developed using the results of sedimentological and geomorphological analyses. Indus resilience to this changing environment and water availability, and ways in which humans have continued to modify of the landscape in this region shall be discussed.

Matthea Wiebe [Simon Fraser University] – (Podium Presentation)

Title: *Experimental strike-a-light fire-starting and its use as a starting point for identification of pyrogenic microdebitage in the archaeological record*

Abstract: The use of fire by hominins represents several significant technological advancements in our species' prehistory. It is widely agreed that the adoption of fire into the lives of hominins may have influenced cognition, subsistence patterns, and even survival. However, a distinction must be made between the use of fire and the ability to create fire at will. This distinction is important since access to fire when it was not freely available on the landscape may have made the difference between survival and extinction in a cooling climate. Developing an understanding of how fire-starting techniques exist and preserve in the archaeological record is therefore of key importance to pursuing hypotheses of fire-starting abilities as survival mechanisms. Fire-starting techniques known from ethnographic sources fall into the two categories of wood based and mineral based activities. Work in the paleolithic has centered on mineral based techniques due to their more reliable preservation potential. The presented research follows this convention but focusses on the microscopic debitage of striking iron disulphide nodules against hard substances such as flint, a technique known as strike-a-light in the English literature. While previous experimental work has been done to identify strike-a-light specific use-wear on macroscopic artefacts, microscopic debitage associated with the activity is currently understudied. My research is focused on the question of whether this microdebitage can be found in the paleolithic archaeological record. Experimental production of microdebitage and Scanning Electron Microscope (SEM) analysis was undertaken in order to provide fundamental descriptions of the materials of concern and to test methods for future research into microdebitage. Preliminary findings suggest a consistent range of morphotypes and size produced by strike-a-light spark making, as well as a high potential for the preservation of iron disulphide crystal shapes observable in SEM.



Lucy Wilson [University of New Brunswick, Saint John] – (Poster Presentation)

Title: *Geochemical Characterisation of Flint from the Vaucluse, Southern France*

Abstract: In geoarchaeology, the geochemical characterisation of flint aimed at identifying the sources of flint used for artifacts starts by comparing flint samples from sources identified within the region of a site, looking for consistent compositional differences. This is well known to be complicated by the fact that flint is both highly uniform in composition (if it is not almost entirely silica, it is not flint), and highly variable in its trace element content: the small percentage of the rock that is not silica generally stems from the presence of impurities, and the abundance and compositions of these can vary not only from source to source, but also within sources and within nodules. Our goal must be to see past these non-meaningful variations in order to tease out any variations which are significant. In this presentation I work through a geochemical analysis of 95 flint samples from the Vaucluse department of southern France, demonstrating a method of accounting for standard types of variations (what do we get if there is clay in the rock?, what if there is a bit of limestone?) in order to eliminate them and see whether any meaningful differences between flint samples from different sources remain.

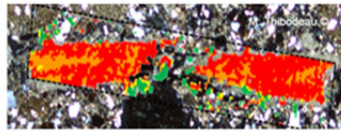
Michael C. Wilson [Douglas College] – (Podium Presentation)

Title: *Late Pleistocene to Early Holocene Trends in Landscape Stability: Geoarchaeological Findings from British Columbia and Alberta, Western Canada*

Abstract: Western Canadian geoarchaeological studies suggest early Holocene swings from landscape instability to stability (represented by a prominent, widespread paleosol predating Mazama tephra), then renewed instability, with erosion/deflation, lag deposits, aeolian sand and silt deposits, and alluvial cutting and filling. The paleosol, dated between >9000 and 8000 rcybp in southern Alberta, appears correlative with the “Altithermal soil” of the northern U.S. plains and indicates increased effective vegetative cover. A key question is whether the preceding and following episodes of instability were similar in character. Regionally, the direct variable was effectiveness of vegetative cover, in turn reflecting trends in precipitation, insolation, airmass dynamics, etc.; therefore equifinality is a concern. Early postglacial, paraglacial landscape “relaxation” is strongly expressed in mountainous areas, associated with thawing and downslope movement of unstable, glacially emplaced debris, and the resulting alluvial and aeolian sediment pulses can locally obscure other elements of the regional signal. In south-central British Columbia, sites near Pritchard (EdQx-45 and EeQw-102), east of Kamloops (Terra Archaeology), displayed deeply stratified pre-Mazama archaeological sequences extending back over 9000 rcybp, in deposits at the toes of debris-flow fans along the South Thompson River valley. Paraglacial debris-flow activity was likely under way by 11,000 rcybp but tapered before site occupation; slopewash deposition was overtaken by loess between ~9500 and 8000 rcybp, after which fan sands and gravels began again to increase. Sudden, renewed debris-flow activity near the time of the Mazama tephra fall suggests upslope forest fires analogous to recent wildfire events. Aeolian deposition during fan inactivity precluded development of a single thick soil though weak pre-Mazama incipient paleosols are present. Investigations at sites EdPI-10 (Metke Site) and EdPI-76, on the Highwood River west of High River, Alberta (Lifeways of Canada), revealed unstratified aeolian silts from just before the time of Mazama tephra to after ~5000 rcybp, in the floor of a late-Glacial meltwater channel upon which the Highwood was

**8th Developing International
Geoarchaeology Conference**

Simon Fraser University, Canada
June 17th - 21st, 2019



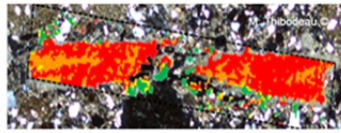
superposed. This indicates an unstable surface with reduced vegetative cover, consistent with Hypsithermal warming/drying, peaking about the time of the Mazama tephra fall. In this light the reason for any interval of landscape stability must be sought. Two early Holocene Northern Hemisphere cooling events were associated with meltwater outbursts into the Atlantic and Arctic Oceans during late Laurentide Ice Sheet retreat. One may be marked by sediment isotopic ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) trends at Pritchard, but the onset of the “quiet” period with reduced fan alluvial/colluvial activity appears to precede it; the same appears true for the onset of pre-Mazama paleosol development in Alberta. The Alberta paleosol and the time of fan inactivity in BC do appear themselves to correspond. Yet it is not possible to reject a model of the “Hypsithermal [or Altithermal] soil” as time-transgressive, marking northward migration of a time of balance between early postglacial pioneer landscape instability and instability from Hypsithermal warming/drying. Aeolian deposition in both areas depended upon sediment supply; and in both areas there were unstable, eroding glaciolacustrine deposits nearby. Local conditions may have overwhelmed any regional signal. Aeolian deposition in western Canada may therefore be more a heritage of the complex transition from glacial-to-nonglacial landscapes than a paleoclimatic signature. Continued study of sites such as these will contribute to explanatory models, relevant also in understanding the consequences of modern climatic changes.

THE BERTHA AND LOUIS WEINSTEIN RESEARCH FUND



**8th Developing International
Geoarchaeology Conference**

Simon Fraser University, Canada
June 17th - 21st, 2019

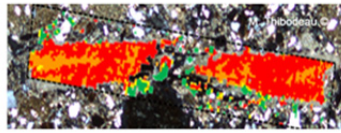


AUTHOR, CO-AUTHOR, ATTENDEE, (Institution) and email address

Aviad AGAM	(Tel-Aviv University)	aviadkra@post.tau.ac.il
Rosa M. ALBERT	(ICREA)	rosamaria.albert@icrea.cat
Hassan AHMADI KARVIG	(University of Tehran)	ahmadihassan.k@gmail.com
Aleš BAJER	(Mendel University in Brno)	bajer@mendelu.cz
Ramiro BARBERENA	(Universidad Nacional de Cuyo, Mendoza)	ramidus28@gmail.com
Ran BARKAI	(Tel-Aviv University)	barkaran@post.tau.ac.il
Robert BEARDSELL	(Salt Spring Island)	rjbeardsell@mac.com
Lauren BELL	(Vancouver)	ltmbell.ifol@gmail.com
Francesco BERNA	(Simon Fraser University)	fberna@sfu.ca
Emma BETZ	(University of Oxford)	emma.j.betz@gmail.com
Éric BÖEDA	(Université Paris Ouest)	eric.boeda@u-paris10.fr
Joseph I. BOYCE	(McMaster University)	boycej@mcmaster.ca
Lee BRAY	(University of Brighton)	lbray@dartmoor.gov.uk
Constance L. BROWNE	(University of New Brunswick, Saint John)	cbrowne@unb.ca
Lorenz BRUECHERT	(Haldimand/Norfolk Archaeological Regional Project)	hnarproject@gmail.com
Aubrey CANNON	(McMaster University)	cannona@mcmaster.ca
Christopher CAREY	(University of Brighton)	C.J.Carey@brighton.ac.uk
Valentina CARUSO	(Università degli Studi di Milano)	caruso.valentina@libero.it
Veerle CNUUDE	(Ghent University)	Veerle.Cnudde@UGent.be
Philippe CROMBÉ	(Ghent University)	Philippe.Crombe@UGent.be
Tim DE KOCK	(Ghent University)	Tim.DeKock@UGent.be
Julie A. DURCAN	(University of Oxford)	julie.durcan@ouce.ox.ac.uk
Gerrit DUSSELDORP	(Leiden University)	g.l.dusseldorp@arch.leidenuniv.nl
Alysha EDWARDS	(University of Northern British Columbia)	aedwards@unbc.ca
María V. FERNÁNDEZ	(Universidad Nacional de Río Negro)	fernandezvicky5@gmail.com
Géraldine FIERS	(Ghent University)	Geraldine.Fiers@UGent.be
Shelby FITCH	(University of Nevada, Las Vegas)	shelby.fitch@unlv.edu
Beatrice FLETCHER	(McMaster University)	fletchba@mcmaster.ca
Charly FRENCH	(University of Cambridge)	caif2@cam.ac.uk
Kasia GDANIEC	(University of Cambridge)	
Krista GILLILAND	(Western Heritage)	kgilliland@westernheritage.ca
Michael D. GLASCOCK	(University of Missouri Research Reactor)	GlascockM@missouri.edu
Avi GOPHER	(Tel-Aviv University)	agopher@post.tau.ac.il
Magnus M. HAALAND	(University of Bergen)	magnus.haaland@uib.no

**8th Developing International
Geoarchaeology Conference**

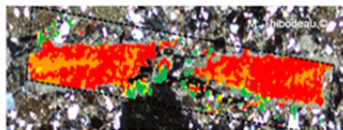
Simon Fraser University, Canada
June 17th - 21st, 2019



Susan HEINRICH	(Max Planck Institute for Evolutionary Anthropology)	
Éva HALBRUCKER	(Ghent University)	eva.halbrucker@ugent.be
Marsha HANSON	(British Columbia)	marsharhanson@gmail.com
Gelvam HARTMANN	(Universidade de Campinas)	gelvam@ige.unicamp.br
Ailidh HATHWAY	(Simon Fraser University)	ailidh_hathway@sfu.ca
Hannah HERRICK	(Simon Fraser University)	hherrick@sfu.ca
Jayde HIRNIAK	(Arizona State University)	jaydehirniak@gmail.com
Shauna HUCULAK	(City of Vancouver)	shauna.huculak@vancouver.ca
Kim HUNNISETT	(University of Brighton)	
Racheal JOHNSEN	(University of Nevada, Las Vegas)	racheal.johnsen@unlv.edu
Alison JOLLEY	(University of British Columbia)	ajolley@eoas.ubc.ca
Candice KOPOWITZ	(Simon Fraser University)	ckoopowi@sfu.ca
Andrew LATIMER	(Simon Fraser University)	alatimer@sfu.ca
Bertrand LIGOUIS	(University of Tübingen)	bertrand.ligouis@uni-tuebingen.de
Lenka LISÁ	(Czech Academy of Sciences)	lisa@gli.cas.cz
Peter LOCHER	(Simon Fraser University)	plocher@sfu.ca
Emma LOWTHER	(Simon Fraser University)	elowther@sfu.ca
Richard MACPHAIL	(University College London)	r.macphail@ucl.ac.uk
Brandi Lee MACDONALD	(University of Missouri Research Reactor)	macdonaldb@missouri.edu
Nicoletta MARINONI	(Università degli Studi di Milano)	nicoletta.marinoni@unimi.it
Teresa MATHESON	(Simon Fraser University)	tam5@sfu.ca
Matthew MCCARTY	(University of British Columbia)	matthew.mccarty@ubc.ca
Peter MEARS	(University of New Brunswick, Saint John)	pmears@unb.ca
Susan MENTZER	(University of Tübingen)	susan.mentzer@ifu.uni-tuebingen.de
Christopher E. MILLER	(University of Tübingen)	christopher.miller@uni-tuebingen.de
George NICHOLAS	(Simon Fraser University)	nicholas@sfu.ca
Hector ORENCO	(Catalan Institute of Classical Archaeology)	
Cameron A. PETRIE	(University of Cambridge)	cap59@cam.ac.uk
Matt PLOTNIKOFF	(Simon Fraser University)	mattp@sfu.ca
Cornel POP	(Max Planck Institute for Evolutionary Anthropology)	cornel_pop@eva.mpg.de
Emily PURCELL	(Simon Fraser University)	emclornp@sfu.ca
Farid RAHEMTULLA	(University of Northern British Columbia)	farid@unbc.ca
Rudy REIMER/YUMKS	(Simon Fraser University)	rudyr@sfu.ca
Eduard REINHARDT	(McMaster University)	ereinhar@mcmaster.ca
Minghua REN	(University of Nevada, Las Vegas)	minghua.ren@unlv.edu
Virginie RENSON	(University of Missouri)	rensonv@missouri.edu

8th Developing International Geoarchaeology Conference

Simon Fraser University, Canada
June 17th - 21st, 2019



Michael <i>RICHARDS</i>	(Simon Fraser University)	michael_richards@sfu.ca
Nicholas L. RIDDICK	(McMaster University)	Riddick.nicholas@gmail.com
Morgan RITCHIE	(Sts'ailes)	patrickmorganritchie@gmail.com
Rob <i>RONDEAU</i>	(Simon Fraser University)	rob_rondeau@sfu.ca
Richard M. ROTH AUS	(Central Michigan University)	rothlr@cmich.edu
Agustina A. RUGHINI	(Universidad de Buenos Aires)	agustinarughini@gmail.com
Danielle <i>SAMETZ</i>	(University New Brunswick - Saint John)	sametzd@hotmail.com
Irini SIFOGEORGAKI	(Leiden University)	irini.sifogeo@gmail.com
Shari Maria SILVERMAN	(Washington State Parks and Recreation Commission)	shari.silverman@parks.wa.gov
Eugene SMITH	(University of Nevada, Las Vegas)	gene.smith@unlv.edu
Mareike STAHL SCHMIDT	(Max Planck Institute for Evolutionary Anthropology)	mareike_stahlschmidt@eva.mpg.de
Earl STEFANYSHEN	(Simon Fraser University)	estefany@sfu.ca
Megan THIBODEAU	(Simon Fraser University)	megthibodeau@gmail.com
Michael TOFFOLO	(Université Bordeaux-Montaigne)	michael.toffolo@u-bordeaux-montaigne.fr
Ole Fredrik UNHAMMER	(University of Bergen)	Ole.Unhammer@uib.no
Elizabeth <i>VELLIKY</i>	(University of Western Australia)	elizabeth.velliky@research.uwa.edu.au
Ximena S. VILLAGRAN	(Universidade de São Paulo)	villagran@usp.br
Brent <i>WARD</i>	(Simon Fraser University)	bcward@sfu.ca
Joanna WALKER	(University of Cambridge)	jr95@cam.ac.uk
Matthea WIEBE	(Simon Fraser University)	mattheaw@sfu.ca
Lucy WILSON	(University of New Brunswick, Saint John)	lwilson@unbsj.ca
Michael C. WILSON	(Douglas College)	WilsonM@emeriti.douglascollege.ca
Barbara <i>WINTER</i>	(Simon Fraser University)	bwinter@sfu.ca
Sarah <i>WOYKEN</i>	(Simon Fraser University)	sarah_woyken@sfu.ca
Robin WOYWITKA	(Alberta Culture and Tourism)	robin.woywitka@gov.ab.ca

THE BERTHA AND LOUIS WEINSTEIN RESEARCH FUND



Archaeometry Laboratory at MURR

