Sensitive Clay Landslides pre-conference field trip

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August 7th Sensitive Clay Landslides pre-conference field trip led by Greg Brooks and Heather Crow, Ontario Geological Survey.

This was a great way to see the Ottawa region and learn about the clay landslides that have caused fatalities there. Despite the sweltering heat, 17 people enjoyed a great excursion. Marine clay was deposited when the Champlain Sea used to be here. The clay deposit behaves like a house of cards velcroed together by salt molecules. Once the halide leaches away, the clay becomes less stable and prone to landslides.

The escarpment seen in the distance is called the Gatineau Hills.

We learned that many of the past landslides over a large region were found to co-date. This suggests that the same trigger caused them all to go simultaneously - likely a paleoearthquake.

The last stop on this excellent field trip was to see the site of a 2016 landslide, where trees, now leaning, had rafted on boats of sediment downslope. This landslide was not caused by an earthquake, but probably due to failure from the salt leaching.

Greg Brooks indicates a point of interest.

Heather Crow talks about Breckenridge borehole research -water content, density, grain size, bulk conductivity, natural gamma, M.S., mineralogy, and salinity over 70 meter depth.

A visit to the Lalonde Radiocarbon Lab and associated offices. Our guide stands on this amazing period table showing all the isotopes. The black isotopes are the stable ones.

We walked from the Lalonde Radiocarbon Lab along the canal to the Parliament building. Here, Joshua Kurek provides scale for Napoleon, or vice versa.

Recent Graduates

Michelle A. Chaput (2018) Environmental Change and Population History of North America from the Late Pleistocene to the Anthropocene. PhD thesis, Department of Geography, Environment and Geomatics, University of Ottawa. Advisor: Konrad Gajewski

Abstract: The assumption that prehistoric Native American land use practices had little impact on the North American landscape persists in the literature. However, recent research suggests the effects of prehistoric burning, deforestation, and agriculture may potentially have been greater than previously considered. To resolve this discrepancy, quantitative estimates of changes in human population size and forest structure and composition over the course of the Holocene are needed. This thesis addresses this need by providing radiocarbon-based paleodemographic reconstructions and pollen-inferred estimates of vegetation change, as well as analyses of associations between the two at both continental and regional scales, from the late Pleistocene to the Anthropocene.

One way to estimate paleodemographic change is to use the number of radiocarbon (^{14}C) dates from a given area to study patterns of human occupation through time. A review of the literature and compilation of existing databases relevant to this method showed there is now sufficient data to study the paleodemographic history of many regions around the world. An analysis of ^{14}C datasets from North America and Australia compared well with model-based reconstructions of past demographic growth, and provided higher frequency fluctuations in population densities that will be important for future research. Using a kernel density estimation approach, the first estimates of prehistoric population density for North America were obtained and synthesized into a series of continental-scale maps showing the distribution and frequency of ^{14}C dates in the Canadian Archaeological Radiocarbon Database (CARD). The maps illustrated the space-time evolution of population and migration patterns, which were corroborated by independent sources of evidence.

A methodology based on the statistical evaluation of cross-correlations between population and plant abundance was then developed to analyze the associations between these population estimates and plant communities derived from pollen databases. Periods of high spatial cross-correlation (positive and negative) between population and plant abundance were irregular and did not improve over time, suggesting that ancient human impacts are not discernable at a continental scale, either due to low populations or varying human land use practices.

To further examine the relationship between pollen data and human land use at a regional scale, estimates of plant density and landscape openness are needed. The REVEALS (Regional Estimates of VEgetation Abundance from Large Sites) model corrects for the non-linear relationship between pollen production and plant abundance and can therefore be used to map histories of land use and land cover change. The model was applied to pollen records from lake sediments in the deciduous forest of southeastern Quebec. A preliminary analysis comparing these results to population density revealed low population during times of high *Populus* abundance and high population following the appearance of the mixed temperate forest suggesting a discernable human-environment association at regional scales.

Overall, the results of thesis support the growing body of literature that suggests prehistoric Native Americans impacted their environments and that these impacts can be detected and quantified by integrating archaeological and paleoecological information. However, the timing, location, and intensity of human land use has changed in both space and time, suggesting regional- to local-scale analyses of human-environment interactions are most appropriate for continental North America. The methodology presented here can be used to study additional North American regions for the purpose of developing a continental history of human-environment interaction.

View the thesis

The thesis is available in the University of Ottawa's digital repository at the following address: https://ruor.uottawa.ca/handle/10393/38082

What's next?

Michelle is continuing her research at the Laboratory for Paleoclimatology and Climatology at the University of Ottawa while working as an Education Programs Coordinator with the Royal Canadian Geographical Society.

Karen Neil (2018) Ecosystem Responses to Holocene Climate Variability through the Analysis of High-Resolution Lake Sediment Cores from Southwestern Québec, Canada. PhD thesis, Department of Geography, Environment and Geomatics, University of Ottawa. Advisor: Konrad Gajewski

Abstract: Lake biotic responses to natural climate variability, fire disturbances, and human impacts over the Holocene were studied at two proximate sites in southwestern Québec. Sediments from Lac Noir and Lac Brûlé had annually deposited laminations (varves), enabling for the precise dating of continuous time-series and high-resolution analysis of subfossil diatom assemblages. The Lac Noir (45° 46'31"N, 75°8'23"W, 176 m a.s.l.) record spanned ~11000 years of the Holocene. Stratigraphic changes in diatom assemblages of the lake could be divided into early, mid-, and late periods, broadly paralleling Milankovitch-scale climate intervals and vegetation changes inferred from regional palynological records. The early Holocene (11.1-8.0 ka) climate was cooler and dry, vegetation in the region was comprised of *Picea*-dominated woodlands, and the lake diatom flora included primarily benthic taxa. Warming in the mid-Holocene (8.0-3.6 ka) allowed for stabilization of soils and forests in the catchment, stronger thermal stratification in the lake, and resultant increases in oligo-mesotrophic diatom taxa such as *Discostella stelligera*. During the late Holocene (3.6 ka to present), an increase in the abundance of deciduous trees (e.g., *Betula* and *Alnus*) in response to cooling led to nutrient-enrichment and higher overall lake productivity. The record from Lac Brûlé (45°43'09"N, 75°26'32"W, 270 m a.s.l.) encompassed the last ~1200 years of the late Holocene. Generalized additive models (GAM) revealed a tight coupling between diatoms and catchment-mediated processes (e.g., vegetation and disturbances), which were closely aligned with climate variations. During the Medieval Warm Period (800-1300 CE), pollen-based inferences of warmer summer temperatures were associated with high abundances of *Cyclotella bodanica* var. *intermedia* and *Cyclotella rossii*; this signalled oligotrophic lake conditions and prolonged thermal stratification. The onset of the Little Ice Age (1450-1850 CE) marked a cooling in the region, and a decline in *Tabellaria flocculosa* str. IIIp indicated increased nutrient loading from the catchment area.

Research Project Reports

Multi-agency study: US Atlantic margin Quaternary stratigraphy

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In 2015 the Bureau of Ocean Energy Management (BOEM), in collaboration with numerous state and federal agencies and academic personnel, initiated the Atlantic Sand Assessment Project (ASAP) to evaluate offshore sand resources. This effort has been motivated by post-Hurricane Sandy demands for coastal restoration and protection. For the mid- and southeastern Atlantic studies, geophysical surveys, vibracore (maximum length 20') and bottom grab sampling have been completed from New Jersey to Georgia.

A map legend listing all the states involved in the Atlantic Sand Assessment Project. https://www.boem.gov/Atlantic-Sand-Assessment-Project/

Review of prior studies, where relevant, is on-going. Fifty cores from Georgia to Cape Lookout (North Carolina), taken in 2015, and over 60 cores from northeastern North Carolina to central New Jersey, taken in 2015, 2016, and 2017, are currently under study. Archive core-halves are housed at Lamont-Doherty Geological Observatory, Palisades, New York.

Although the primary focus of the project is the assessment of offshore sand resources, ancillary products will include detailed sedimentologic and stratigraphic analysis of the cores, heavy mineral and geochemical analyses, detrital zircon dating, geochronology based on radiocarbon and aminostratigraphy, and, in some cases, molluscan or foraminiferal assemblage analysis. Currently available data identify regions of thin-to-absent Holocene sediment (overlying Pleistocene or even pre-Quaternary units in some cases) on the shelf, other regions of thick (~ 3 m) Holocene units, and still other regions where several Quaternary units are identified and can be related to at least two Pleistocene glacial-interglacial cycles. Workshops for core sampling and data review have occurred at the South Carolina and Delaware Geological Surveys, and presentation of results will occur at the 2019 Geological Society of America Southeastern Section in Charleston, South Carolina.

More information about the BOEM ASAP project can be found at the links below:

https://www.boem.gov/Atlantic-Sand-Assessment-Project/

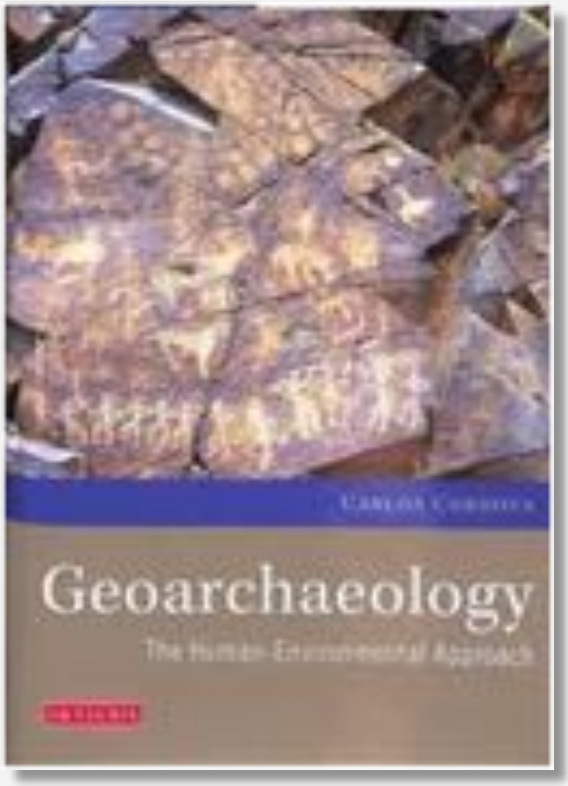
https://www.boem.gov/MMP-Federal-State-and-Other-Stakeholder-Partners/

https://www.boem.gov/Building-a-National-Offshore-Sand-Inventory/

Recent Publications

Geoarchaeology: The Human-Environmental Approach

by Carlos Cordova



Cordova, C. (2018) Geoarchaeology: The Human-Environmental Approach. I.B.Tauris & Co. Ltd., 336 p. ISBN: 9781788313018

For more details go to:

https://ibtauris.com/books/humanities/archaeology/geoarchaeology%20the%20human%20environment%20approach

Synopsis

Geoarchaeology is traditionally concerned with reconstructing the environmental aspects of past societies using the methods of the earth sciences. Once a purely technical subject, the field has been steadily enriched by scholars from a diversity of **disciplines** and by the introduction of the human-environmental approach pioneered by Karl Butzer in the late 1970s. Yet much has happened since that time, particularly as the importance of global perspectives on environmental change has emerged.

Geoarchaeology: The Human Envrionmental Approach provides a fully up-to-date account of geoarchaeology that reflects the important changes that have occurred in the past four decades. Its innovative features include accounts of: the development of the human-ecological approach and the impact of technology on this approach; the diversity of disciplines and their contribution to archaeological questions; the frontiers of archaeology in the deep past, particularly the Anthropocene; the geoarchaeology of the contemporary past; the emerging field of ethno-geoarchaeology; and the role of geoarchaeology in global environmental crises and climate change.

The book is unique in featuring a review of the methodological and epistemological aspects of geoarchaeology. The result is a work of outstanding scholarship that will be essential reading for environmental historians, archaeologists, geographers, environmental scientists, and anthropologists.