MANAGING A HYDROGEOLOGIC RESEARCH STATION AT WESTERN CAROLINA UNIVERSITY: AN UNDERGRADUATE PERSPECTIVE

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SOIL CORES OF FOUR ORGANIC-RICH WETLAND DEPOSITS FROM WESTERN NORTH CAROLINA PROVIDE A RECORD OF HOLOCENE ENVIRONMENTAL CHANGE FOR THE SOUTHERN APPALACHIANS

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FOLD-RELATED STRUCTURES: IMPLICATIONS FOR VARIABILITY IN GROUNDWATER STORAGE AND RECHARGE IN THE BLUE RIDGE, WESTERN NORTH CAROLINA

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EVIDENCE OF POOR EVOLUTION EDUCATION AMONG SOUTHERN UNIVERSITY STUDENTS

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_ABIOTIC DAMAGE ON GASTROPOD SHELLS AND IMPLICATIONS FOR PREDATION RESEARCH

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LATERAL VARIATION OF DRILLHOLE FREQUENCY WITHIN THE MIOCENE ST. MARY’S FORMATION, MARYLAND

MONTOYA, Leslie Marie, FORCINO, Frank L., and STAFFORD, Emily S., Geosciences and Natural Resources Department, Western Carolina University, 331 Stillwell Building, Cullowhee, NC 28723, lmmontoya1@catamount.wcu.edu

HYDROGEO MORPHIC INFLUENCES OF HYPORHEIC EXCHANGE IN A HEADWATER STREAM, CULLOWHEE, NC

STEPHENS, Chelsea¹, KEEVER, Michael¹, BECK, Hans¹, HUDSPETH, Reece¹, LORD, Mark¹, GANNON, J.P.¹, KINNER, David¹, and CAMPBELL, Ted², (1) Geosciences & Natural Resources, Western Carolina University, Cullowhee, NC 28723, colydeen1@catamount.wcu.edu, (2) Division of Water Quality, North Carolina Dept. of Environment and Natural Resources, Swannanoa, NC 28778
RUN OVER, RUN UP, AND RUN OUT: A STORM WAVE ORIGIN FOR FENESTRAL POROSITY IN LAST INTERGLACIAL EOLIANITES OF THE BAHAMAS

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WHAT'S PAST IS PROLOGUE: EVIDENCE OF CLIMATE INSTABILITY AND INTENSE STORMS DURING THE LAST INTERGLACIAL ON ELEUTHERA ISLAND, BAHAMAS

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HYDROGEOLOGIC TRAITS AND SETTING OF HEADWATERS STREAM BOUND BY ALLUVIAL AND COLLUVIAL DEPOSITS WITH A DISTRUBANCE HISTORY TYPICAL OF THE SOUTHERN APPLACAHIANS: A CASE STUDY

BARTL, Eric, MOUNTJOY, Bryant, HARTIGAN, Sean, GATLIN, Jesse, LORD, Mark, KINNER, David A., and GANNON, J.P., Geosciences and Natural Resources, Western Carolina University, Cullowhee, NC 28723, ewbartl1@catamount.wcu.edu

LONG TERM CARBON SEQUESTRATION RATES OF SOUTHERN APPALACHIAN WETLANDS

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COMPARING THE PUBLIC’S UNDERSTANDING OF EVOLUTION IN THE SOUTH TO THE REST OF THE UNITED STATES USING OPEN RESPONSE ITEMS

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FALLING BEHIND IN THE SOUTH: COMPARING EVOLUTION UNDERSTANDING OF THE SOUTHEAST TO THE REST OF THE USA

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MICROSTRUCTURAL EVIDENCE OF CYCLIC HYDRAULIC AND CATACLASTIC BRECCIATION IN A DILATIONAL FAULT ZONE, JERVOIS RANGE REGION, CENTRAL AUSTRALIA

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DETERMINING THE VULNERABILITY OF MARINE HABITATS AT CUMBERLAND ISLAND NATIONAL SEASHORE TO CLIMATE CHANGE STRESSORS

PEEK, Katie McDowell, STAFFORD, Emily S.1, COBURN, Andrew, YOUNG, Robert S.1, FOWLER, Alicia, and MCCREEDY, Cliff, (1) Program for the Study of Developed Shorelines, Western Carolina University, Cullowhee, NC 28723, emmastaf@gmail.com, (2) National Park Service, Washington, D.C., NC 20005
MANAGING A HYDROGEOLOGIC RESEARCH STATION AT WESTERN CAROLINA UNIVERSITY: AN UNDERGRADUATE PERSPECTIVE

MOUNTJOY, Bryant¹, CATO, Michael¹, PADGETT, Mark², FERRI, Kelly¹, FULLER, Joshua¹, LORD, Mark¹, KINNER, David A.¹, and WALSH, Danvey¹, (1) Geosciences & Natural Resources, Western Carolina University, Cullowhee, NC 28723, bdmountjoy1@catamount.wcu.edu, (2) Geological Sciences, University of Alabama, Tuscaloosa, AL 35487

The undergraduate management of a long-term hydrogeologic research station provides students with practical job experience, while still being able to deliver scientifically significant data. When undergraduates do engage in research, it tends to have a specific question in mind with a fixed time period (e.g. end of summer or semester). This presentation examines a different model of undergraduate research, where the role of ‘research fellows’ is to help sustain undergraduate research and long-term environmental monitoring.

The Geoscience and Natural Resources Department at Western Carolina University developed the Western Carolina Hydrological Research Station (WCHRS; wchrs.wcu.edu) in partnership with NC DENR. Since, NSF support has created sustained support for undergraduate research at the station, including equipment and research fellows. The station includes over 50 groundwater wells, 9 soil moisture sites, 6 stream gages, a lysimeter, and 3 rain gauges. The research objectives the WCHRS focus on groundwater and surface water interaction and the hydrologic impact of historic land usage.

The NSF grant objective of the research is to better understand the benefits associated with undergraduate research, not only through in-class projects, but also for research fellows who operate the station on a longer-term basis. Since the research station was developed in 2010, around 15 undergraduates have been trained as research fellows. These research fellows have taken responsibility for the day-to-day functions of the station, participating in data analysis, and improving the research station through their own initiative and creativity. Benefits experienced among current and past research fellows range from learning how to be a leader to obtaining a greater knowledge of field techniques and equipment. Dozens of research projects have been conducted by students using the station, many of which have been presented at GSA conferences. Undergraduate research fellows have largely been responsible for the continued expansion of the station. In the future, the WCHRS plans to continue to be operated by undergraduate students, offering its benefits to students in class, research fellows outside of class, and contributing relevant research to the scientific community.

Session No. 39--Booth# 51
T5. Undergraduate Research II (Posters)
Friday, 20 March 2015: 1:00 PM-5:00 PM
Chattanoogan Hotel & Conference Center Ballroom
Geological Society of America Abstracts with Programs. Vol. 47, No. 2, p.0
SOIL CORES OF FOUR ORGANIC-RICH WETLAND DEPOSITS FROM WESTERN NORTH CAROLINA PROVIDE A RECORD OF HOLOCENE ENVIRONMENTAL CHANGE FOR THE SOUTHERN APPALACHIANS

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There is currently considerable debate as to the presence and magnitude of Holocene climate events, such as the hypsithermal, in the southeastern U.S. due to a lack of suitable sites that preserve a record of environmental change. Four previously unstudied southern Appalachian wetlands have been located in western North Carolina that contain thick organic deposits that potentially provide a record of changing Holocene environmental conditions. Two of the sites were cored and radiocarbon dated and show deposition that spans the entire Holocene (Speedwell site) or the middle to late Holocene (Alarka site). A separate site (Sam Knob) has been cored and contains >150 cm of organic-rich sediments. The fourth site, near Mills River, has been probed and preliminary investigation of this deposit suggests that it contains > 200 cm of organic-rich sediments. Bulk density, carbon, nitrogen, and carbon isotope measurements have been completed for the Speedwell, Alarka, and Sam Knob cores. These data provide a record of changing environmental conditions in the region through the Holocene. Analysis at the Mills River site is ongoing. The trends seen in both the Alarka and Speedwell cores indicate a climate response in the southern Appalachians concurrent with the mid-Holocene hypsithermal event recorded elsewhere in North America. The Sam Knob and Mills River sites will contribute additional data to the growing western North Carolina paleoenvironmental record once analysis is complete.

Session No. 11--Booth# 39

T9. Wetlands in the Southeast: Hydrology, Soils, and Environmental Change (Posters)
Thursday, 19 March 2015: 8:00 AM-12:00 PM
Chattanoogan Hotel & Conference Center Ballroom
Geological Society of America Abstracts with Programs. Vol. 47, No. 2, p.0
FOLD-RELATED STRUCTURES: IMPLICATIONS FOR VARIABILITY IN GROUNDWATER STORAGE AND RECHARGE IN THE BLUE RIDGE, WESTERN NORTH CAROLINA

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Groundwater resource availability is difficult to assess in fractured crystalline bedrock. Km-scale structures should be an indicator of the variation in fracture network orientation and intensity. Case studies of these relationships therefore improve the ability to predict heterogeneity in permeability and groundwater storage.

The ~6 km² Panthertown valley is part of the Appalachian Blue Ridge thrust complex in SW North Carolina. Neoproterozoic and Ordovician bedrock is comprised of granodioritic and micaceous gneiss. Penetrative foliation defined by aligned lithologic contacts and grain shapes was deformed by late Paleozoic contraction into a km-scale, gently NE-plunging, steeply SE-inclined, antiform outlined by a 10 m-scale micaceous layer. The fold core is granodioritic gneiss, in which both the deepest weathering and highest relief occur.

New field work results suggest the valley’s geomorphology is the result of fold-related structures within the granodioritic gneiss, which also controlled exfoliation development during exhumation. The valley’s axis is parallel to, but just NW of, the mapped fold axis. Axial planar foliation occurs in schistose outcrops at the fold closure, but foliation does not occur along the fold axis in the granodiorite. Mineral abundances, grain size, and foliation intensity elsewhere in the granodiorite gneiss core are consistent, suggesting contraction during folding removed the pre-existing foliation. Between the walls and valley axis, NW-SE trending secondary drainages create km-long lineaments perpendicular to the fold axis. Steep, NE-SW-facing and NW-SE-facing, exfoliation slopes underlain by granodiorite form both the main and secondary valley walls. The secondary drainages are consistent with a cross-fold joint set with ~0.5 km-scale spacing. The deepest weathering developed along the fold axis where cross-joints occur and pre-existing gneissic foliation has been removed. If the relative resistance to weathering corresponds to fracture intensity and therefore permeability, this case study suggests that fracture affects on recharge and flow rates can vary greatly at the <0.5 km scales, but that this heterogeneity can be modeled using constraints from km-scale geologic mapping.
EVIDENCE OF POOR EVOLUTION EDUCATION AMONG SOUTHERN UNIVERSITY STUDENTS

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There is a plethora of research on the acceptance of the theory of evolution in the US. There has been less research on the understanding of evolution. In order to improve education of evolution in the US, educators and researchers must better constrain current gaps in and misconceptions of the public’s understanding of evolution. States in the southeastern (SE) US are of particular interest because they have higher rates of conservatism, which correlates with lower evolution acceptance. In addition, SE states historically have had more lax evolution education standards. Here, to gauge the current state of evolution understanding in the south, we compare the evolution understanding of university non-science majors in the south to the general public from the rest of the US.

Using Amazon Mechanical Turk (MTurk), a survey of six valid multiple choice evolution understanding items was administered to 305 participants, 63 from SE states and 242 from non-SE states. We used Turk because the results are fast and more diverse than a random sampling of the general public. In addition, the six questions also were asked to 157 students attending a medium-sized public liberal arts university in western North Carolina. We also asked participants to provide demographics and to complete a religiosity scale.

The MTurk population from non-SE states scored significantly higher (3.6 out of 6) than then the college students (2.7; p < 0.001). Thus, the general public from the non-SE has a better understanding of evolution than those enrolled in a university in the south. MTurk participants from SE states also had a significantly higher score (3.1) than the southern university students (p = 0.04). This finding is troubling in that a population of university students in the south, who mostly attended high school in the SE, has a poorer understanding of evolution than the southern general public. This difference was likely influenced by the higher religiosity of the university students compared to those on MTurk. Gender, ethnicity, and income had no effect on score for any population. These results suggest that students from the south attending college have not had sufficient biological education.

Session No. 27
T12. Teaching Evolution in the Southeast I
Friday, 20 March 2015: 8:00 AM-12:00 PM
Chattanoogan Hotel & Conference Center Amphitheater
Geological Society of America Abstracts with Programs. Vol. 47, No. 2, p.0
**ABIOTIC DAMAGE ON GASTROPOD SHELLS AND IMPLICATIONS FOR PREDATION RESEARCH**

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One impediment to studying crushing predation on gastropod shells in the fossil record is the possibility that predatory damage (particularly damage to the outer apertural lip due to shell peeling) may be confused with abiotic (post mortem) damage. Predatory damage occurs when a predator breaks the shell to access the edible tissue. Peeling the shell from the aperture is a characteristic strategy of crustaceans. Abiotic damage occurs when the shell comes in contact with hard particles (sediment) in moving water. Few studies have characterized abiotic damage to gastropod shells to assess the plausibility that such damage could be mistakenly ascribed to predation.

To examine abiotic damage, we placed empty gastropod shells in a rock tumbler with two different grain sizes of sediment to simulate the conditions of relatively high-energy environments, such as a fast-moving stream or the surf zone of a beach. Five to six clean, empty shells of five gastropod taxa each were placed in a rock tumbler with sediment and water. This protocol was repeated for two grain sizes: finer-grained (1 – 3 mm) and coarser-grained (3 – 5 mm). The shells were checked periodically during the tumbling period, then removed after ten days and examined for damage incurred during tumbling.

Despite morphological differences among the five taxa, the damage was generally consistent. The most common type of damage, observed among all taxa, was abrasion to the shell surface. In the smaller-grain trial, shell condition ranged from undamaged to minor holes due to abrasion. One cerithiid shell lost the apertural lip, likely as a result of a widening abrasion hole. The larger-grain trial resulted in considerably more damage. All taxa had holes worn into the body whorl and many also had significant damage to the spire. Most ornament was completely abraded. Apertural lip damage, as a result of growing abrasion holes, was observed among three taxa. Although apertural damage did occur in a few specimens, the damage is unlikely to be confused with predatory fragmentation. The abraded margins of the damaged aperture, along with other signs of extensive abrasion, indicate abiotic origins. However, further experiments are needed, approximating a wider range of environmental conditions, to rule out the possibility that abiotic forces can cause predation-like damage.

**Session No. 29**

**Paleontology**

Friday, 20 March 2015: 1:00 PM-5:00 PM
Chattanoogan Hotel & Conference Center Walker
Geological Society of America *Abstracts with Programs*. Vol. 47, No. 2, p.0
Predation in the fossil record is an important indicator of the state of an ecosystem. Drill holes found in fossilized gastropod shells are evidence of successful predation. Although drill hole frequency (DHF) is often used to quantify predation through time, few have examined how variation in DHF though space may affect the perception of predation through time. Here, we examine how predation varies within one temporally-equivalent stratigraphic bed in order to determine if it would be sufficient to collect samples from one spot or if multiple lateral samples are required.

Six laterally-equivalent samples were collected from the Miocene St. Mary’s Formation of Maryland. Fossils were collected at 0, 1.7, 1.85, 2.1, and 2.25 km from the southwest most assessable point of the formation to examine if DHF varies between these samples. The fossils were cleaned, sorted by genus, and counted. We specifically targeted *Ilyanassa* because it was present in all of the samples taken, abundant, and easy to count. *Ilyanassa* was sorted into drilled, undrilled, and unusable fossils, and the DHF was calculated. We compared the DHF of each of the five samples to one another using two-proportion z-tests. Finally, we qualitatively compared gastropod richness and total gastropod abundance to DHF.

The two northern-most samples had DHFs of 0.25 and 0.265, and the two directly to the south had DHF of 0.34 and 0.365. These two pairs of samples were only 400 m away from each other and varied significantly in DHF (p < 0.001). These results suggest that when collecting samples for studying DHF through time, taking samples from too narrow a lateral distance could give inaccurate results. That two samples can vary significantly in DHF while only being 400 m apart implies that there may be considerable differences in predation and prey availability throughout the area. There was a negative relationship between gastropod richness and DHF as well as abundance and DHF; richness and abundance decreased and then increased from the south to the north. This may mean that predators had more prey options and therefore could be pickier about what organisms they preyed upon. When studying predation through time, researchers should collect several lateral samples from each stratigraphic bed to ensure variation in DHF does not unnecessarily distort the results of the study.
HYDROGEOMORPHIC INFLUENCES OF HYPORHEIC EXCHANGE IN A HEADWATER STREAM, CULLOWHEE, NC

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Headwater streams make up the majority of the stream length in the U.S. and are a significant control on downstream water quality and biodiversity, especially so in the mountainous Southern Appalachians. The zone of interchange between surface and groundwater, the hyporheic zone, likewise exerts a strong control on stream health. The purpose of this study was to evaluate hydrogeomorphic controls that influence the hyporheic zone in headwater streams. The study area, the Gribble Gap catchment, is part of the Western Carolina Hydrologic Research Station (wchrs.wcu.edu); it has an area of 0.62 km\(^2\) in a setting typical of the region.

To determine hydrogeomorphic controls in Gribble Gap, 11 stream-valley sections were characterized for numerous traits: side-slope angles; canopy; side-slope and riparian soils; stream bank height, bed material, shape, and width; and basic stream water chemistry (pH, temperature, conductivity). Analysis of these data showed differences in geomorphic setting and stream chemistry, which we interpreted to reflect differences in the hyporheic zone. Four representative sites were selected for detailed analysis of setting and water chemistry; 4-6 stream-bed and riparian groundwater wells were installed per site. Of the additional parameters evaluated, the stable isotope ratios, \(\delta^{18}O\) and \(\delta D\) (n=49) were most informative.

The absolute difference between stream water and groundwater for both \(\delta^{18}O\) and \(\delta D\) values was used as an indicator of mixing. Similar values of \(\delta^{18}O\) and \(\delta D\) were interpreted to be well mixed and part of the hyporheic zone. From this, the extent of mixing was analyzed against the geomorphic traits. Of the traits evaluated, slope angle has a considerable effect \((r^2 = 0.5 – 0.7)\) on the extent of mixing. Low slope angles correlate with a zone of well mixed stream water and groundwater, whereas poorly mixed waters were at stream sides adjacent to steep slopes. In many places, stream channel banks adjacent to low slopes are undercut with evidence of pipe flow, and are composed of porous gravels. The low slope angles coupled with porous channel banks promote active mixing of waters, thus a larger hyporheic zone. The results found here could be tested in other places and see if it extends to biotically important parameters.
RUN OVER, RUN UP, AND RUN OUT: A STORM WAVE ORIGIN FOR FENESTRAL POROSITY IN LAST INTERGLACIAL EOLIANITES OF THE BAHAMAS

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Fenestral pores form in the swash zone of beaches worldwide, as waves wash over dry sand, trapping air bubbles in the underlying sediment. In the carbonate environments of the Bahamas, where cementation rates are accelerated, beach fenestrae (keystone vugs) are readily preserved and lithified. Though most commonly associated with beach facies, fenestral porosity has been observed in last interglacial (MIS 5e) eolian deposits on islands throughout the Bahamas, in some cases up to 43 meters above sea-level.

To explain the presence of fenestrae in the MIS 5e eolianites, numerous formation mechanisms have been proposed; from tsunamis and bank margin slumps, to torrential rainstorms. However, detailed descriptions of ten MIS 5e eolianite outcrops on the islands of Eleuthera, San Salvador, and Providenciales, demonstrate rather conclusively that these fenestrae formed as intense storm waves ran over, ran up, and ran out on coastal dunes.

There are several lines of evidence that support a storm wave origin for the eolian fenestrae of MIS 5e. Eleuthera, San Salvador, and Providenciales are all situated on the Atlantic margin of the Bahamas Bank, where they are exposed to the full impact of tropical storms. Furthermore, at each locality fenestrae-rich beds occur in separate horizons, signifying repeated inundation by multiple events. Finally, with increasing elevation and distance from shore, the character of fenestral bedding changes, as does the abundance and geometry of individual fenestral pores.

During the last interglacial, lowland dunes in the Bahamas were repeatedly run over by storm waves and reworked into storm-beach ridges with abundant tabular, fenestrae beds, and only minor remnants of eolian cross-beds and root structures. At moderate elevations and further inland, wave run up formed discrete packages of fenestral beds within the dunes, often associated with scour and rip-ups. Within the highest and most distal dune ridges, storm waves ran out, leaving thin, discontinuous, fenestral beds in the seaward-dipping backsets. With the current warming trend and acceleration of sea-level rise, the frequency and intensity of tropical storms is expected to increase. Thus, the powerful superstorms of the last interglacial may serve as a solemn harbinger of things to come.
WHAT’S PAST IS PROLOGUE: EVIDENCE OF CLIMATE INSTABILITY AND INTENSE STORMS DURING THE LAST INTERGLACIAL ON ELEUTHERA ISLAND, BAHAMAS

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In order to understand the potential of sea-level rise during the current interglacial, it is critical to examine the climatic shifts of the last interglacial (MIS 5e). The Bahamas are dominated by carbonate sediments which, due to rapid cementation, often preserve sedimentary structures that reveal conditions at the time of deposition. Eleuthera is located on the Atlantic margin of the Bahamian platform near the boundary of the Westerlies and Trade wind belts where depositional environments are particularly sensitive to wind variability and the influence of tropical storms.

Prior studies on Eleuthera have shown sea-level fluctuated rapidly and storms intensified toward the end of the last interglacial. By examining sedimentary structures such as cross-bed geometry, rhizomorphs, fenestrae (keystone vugs), and grain composition, along with stratigraphic relationships within several additional exposures on Eleuthera, the sea-level and climate history of the last interglacial can be better resolved.

Detailed descriptions from a previously undescribed MIS 5e eolianite exposure in the town of Tarpum Bay indicate that dune deposition occurred rapidly with limited lateral migration. This is evidenced by well-preserved backset and topset bedding coupled with trees buried in upright position and a relative lack of rhizomorphs. Furthermore, abundant fenestral beds occur within the dune at multiple horizons, often with scour and rip-ups, signifying an increase in storm wave activity.

Additional evidence of storm intensification and a destabilized climate has been observed at eight other localities on Eleuthera. Overall, MIS 5e eolian bedding has the same signature of rapid deposition at each location. At low elevations, coastal dunes were reworked by high energy waves, forming storm beach ridges rich in fenestrae, while at high elevations, fenestral beds are present in eolianites, in some cases up to 43 meters above sea-level. Along the Atlantic sea cliffs, large boulders were broken off and emplaced on top of MIS 5e eolianites. Collectively, these storm deposits on Eleuthera indicate a rapid destabilization of climate at the end of the last interglacial. Thus when it comes to the current interglacial, what’s past may be prologue.

Session No. 28--Booth# 25

T5. Undergraduate Research I (Posters)
Friday, 20 March 2015: 8:00 AM-12:00 PM
Chattanoogan Hotel & Conference Center Ballroom
Geological Society of America Abstracts with Programs. Vol. 47, No. 2, p.0
HYDROGEOLOGIC TRAITS AND SETTING OF HEADWATERS STREAM BOUND BY ALLUVIAL AND COLLUVIAL DEPOSITS WITH A DISTURBANCE HISTORY TYPICAL OF THE SOUTHERN APPLACACHIANS: A CASE STUDY

BARTL, Eric, MOUNTJOY, Bryant, HARTIGAN, Sean, GATLIN, Jesse, LORD, Mark, KINNER, David A., and GANNON, J.P., Geosciences and Natural Resources, Western Carolina University, Cullowhee, NC 28723, ewbartl1@catamount.wcu.edu

Downstream water quality has been shown to be influenced by small but numerous headwater streams, which are largely unregulated. Long Branch (4.4 km² area) is bound by alluvial and colluvial deposits in a setting typical of the Southern Appalachians. The site is part of the Western Carolina Hydrologic Research Station (WCHRS; wchrs.wcu.edu). The purpose of this study is to determine the primary controls on groundwater traits, groundwater and stream water interaction, and impacts of land use on hydrology of the Long Branch site.

Site infrastructure includes 17 shallow groundwater wells, a stream staff gage, and a rain gage. Data collected includes ground penetrating radar (GPR) cross-sections, soil and sediment hydraulic conductivity, stream water-stream bed temperature surveys, stream discharges, temperature and level logger data, soil-sediment descriptions, and vegetative traits from remote sensing imagery.

The south side of Long Branch is incised into the distal end of a fan underlain by a mix of sediments typical of southern Appalachian debris flow dominated fans. The upper 1.5 m of sediments range from clay loam to loamy gravels. GPR surveys show a persistent cobble-rich layer at depths ranging from 0.5 to 1.5 m. Measured hydraulic conductivity values range from $10^{-3}$ to $10^{-6}$ cm s$^{-1}$. Fine-grained sediments near the fan surface support a shallow water table (<20 cm) with a patchy wetland and gleyed soils even though the Long Branch is incised about 1 m deep. Temperature surveys of the stream water and stream bed (~15 cm depth) show zones of high groundwater flux into the stream bed/banks along the study reach, with more influence from the fan side, which has cooler groundwater, than the side with a small floodplain at the base of the opposing valley slope.

Remote sensing imagery shows human disturbance of the riparian vegetation has decreased greenness, which is reflected by less diurnal variation in water table levels. Recent construction, a large building in a cut-fill site (~4 ha), changed the slope hydrology contributing to Long Branch by disrupting shallow groundwater flow paths and increasing storm runoff. The knowledge from this study and the future work provides a strong basis for estimating the hydrologic traits of similar settings and can help provide an improved basis for planning and management decisions.

Session No. 11--Booth# 46

T9. Wetlands in the Southeast: Hydrology, Soils, and Environmental Change (Posters)
Thursday, 19 March 2015: 8:00 AM-12:00 PM
Chattanoogan Hotel & Conference Center Ballroom
Geological Society of America Abstracts with Programs. Vol. 47, No. 2, p.0

Southeastern Section - 64th Annual Meeting (19–20 March 2015)

Paper No. 26-6
Presentation Time: 9:40 AM
Wetland organic deposits represent a significant global carbon sink. Wetlands are rare in the Southern Appalachians and there have been very few studies that have directly measured their carbon storage potential. Thus, their contribution as a carbon sink is largely unknown. Long term carbon sequestration rates were determined for three wetland deposits in western North Carolina that have been accumulating organic matter for over 500 years. These three sites were cored and radiocarbon dated and their soils were measured for bulk density and carbon content. Soil carbon accumulation rates vary through time for each wetland, but average soil carbon accumulation rates for each site are within an order of magnitude and vary from a low of $1.0 \times 10^{-3}$ g C cm$^{-2}$ yr$^{-1}$ for the Alarka wetland, to $1.4 \times 10^{-3}$ g C cm$^{-2}$ yr$^{-1}$ for the Panthertown wetland, and to a high of $4.1 \times 10^{-3}$ g C cm$^{-2}$ yr$^{-1}$ for the Pink Beds wetland. Variability in soil carbon accumulation rates through time and between sites will be discussed in terms of differences in site characteristics (e.g. vegetation patterns, hydrology), local climate and environmental change (derived from other analyses completed at the sites), and will be related to variations in sedimentation rate, soil bulk density, and carbon content between and within sites. The long term carbon sequestration rates of Southern Appalachian wetlands will be compared to other ecosystem types and also to carbon sequestration rates of wetlands from other regions.

Session No. 26
T9. Wetlands in the Southeast: Hydrology, Soils, and Environmental Change
Friday, 20 March 2015: 8:00 AM-10:00 AM
Chattanoogan Hotel & Conference Center Kelley
Geological Society of America Abstracts with Programs. Vol. 47, No. 2, p.0
COMPARING THE PUBLIC’S UNDERSTANDING OF EVOLUTION IN THE SOUTH TO THE REST OF THE UNITED STATES USING OPEN RESPONSE ITEMS

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The interplay between religious beliefs and evolution acceptance is well documented. However, Americans’ understanding of the theory of evolution is still difficult to ascertain. In order to improve evolution education, educators and researchers must do a better job of mitigating the educational obstacles that have contributed to current gaps and misconceptions in the public’s understanding of evolution. States in the southeast (SE) US are of particular interest because they tend to have a higher level of conservatism, which correlates with lower evolution acceptance. In addition, SE states historically have had less rigorous evolution education standards. In this study, we compared evolution understanding in the SE to non-SE states. In addition, we searched for relationships between evolution understanding and religiosity. This study utilized one trait gain and one trait loss question from the Bishop & Anderson Open Response Instrument (ORI). The responses were graded using the published coding rubric. The survey was administered using Amazon Mechanical Turk (MTurk) to 298 participants, 70 from the SE and 228 from non-SE states. MTurk is an online survey tool; the demographics of participants are slightly more diverse than an average sample of Internet users and significantly more diverse than typical American college samples. Overall scores were low (21% SE, 22% non-SE). There was no difference in scores between the SE and non-SE states (p = 0.40). There was a difference in a complementary study when using a multiple-choice instrument. The differences found using the multiple-choice items may be due to the ability of participants to guess or spot vocabulary, whereas the free response test looks for more nuanced knowledge. The trait gain score (24%) was significantly different than the trait loss score (18%, p <0.001). Participants with only a high school education scored lower, which may relate to how evolution is being taught at the high school level. Religiosity was a predictor of non-SE scores but not scores in the SE states ($r^2 = 0.02$, p = 0.02). Regardless of location, there are still many strides to be made in teaching evolution. The low overall scores across the entire country indicate there is a need to overhaul evolution curriculum, not just in the SE but in the entire US.

Session No. 27
T12. Teaching Evolution in the Southeast I
Friday, 20 March 2015: 8:00 AM-12:00 PM
Chattanoogan Hotel & Conference Center Amphitheater
Geological Society of America Abstracts with Programs. Vol. 47, No. 2, p.0
FALLING BEHIND IN THE SOUTH: COMPARING EVOLUTION UNDERSTANDING OF THE SOUTHEAST TO THE REST OF THE USA

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In order to improve education of the theory of evolution in the US, educators and researchers must better constrain current gaps in and misconceptions of the public’s understanding of evolution. However, there have only been a few studies assessing the US public’s understanding of evolution. States in the southeastern (SE) US are of particular interest because they have higher rates of conservatism, which correlates with lower evolution acceptance. In addition, SE states historically have had more lax evolution education standards. Here, I compare evolution understanding between SE US states with the rest of the US.

Using Amazon Mechanical Turk (MTurk), a survey of eight multiple choice evolution understanding items was administered to 305 participants, 63 from SE states and 242 from non-SE states. MTurk is an online survey tool wherein registered MTurk workers complete tasks for pay. The demographics of MTurk participants are slightly more diverse than an average sample of Internet users and significantly more diverse than typical American college samples.

A factor analysis resulted in six of the eight items being valid within one construct (factor loadings ≥ 0.27). Participants from non-SE states answered a significantly greater number of items correctly than participants from SE states (3.5 vs. 3.0; p = 0.01), with no differential item functioning (DIF). In addition, a greater proportion of non-SE participants answered each of the six individual items correctly. The item resulting in the most drastic difference between the two groups was, “Which of the following processes is the primary mechanism responsible for the evolution of the many varieties of domestic dog alive today?” The correct response was “Artificial selection” with a primary distractor of “Natural selection”. Fifty percent of participants in the non-SE states answered this item correctly, but only 33% in SE states answered correctly. Based on linear regression models, religiosity and level of education had small effects on the difference in scores between the two populations. No effects were found due to gender, ethnicity, income, or age. These data suggest that improving the US public’s understanding of evolution goes beyond overcoming socioeconomic backgrounds, and may lie in improving the education in certain portions of the US.

Session No. 27

T12. Teaching Evolution in the Southeast I
Friday, 20 March 2015: 8:00 AM-12:00 PM
Chattanoogan Hotel & Conference Center Amphitheater
Geological Society of America Abstracts with Programs. Vol. 47, No. 2, p.0
DETERMINING THE VULNERABILITY OF MARINE HABITATS AT CUMBERLAND ISLAND NATIONAL SEASHORE TO CLIMATE CHANGE STRESSORS

PEEK, Katie McDowell¹, STAFFORD, Emily S.¹, COBURN, Andrew¹, YOUNG, Robert S.¹, FOWLER, Alicia¹, and MCCREEDY, Cliff², (1) Program for the Study of Developed Shorelines, Western Carolina University, Cullowhee, NC 28723, emmastaf@gmail.com, (2) National Park Service, Washington, D.C., NC 20005

Climate change, the varied effects of increasing global temperature and atmospheric carbon, is already affecting coasts and is anticipated to worsen in the coming century. Sea-level rise (SLR) and changes in ocean chemistry make coastal regions among the most threatened habitats. The National Park Service (NPS), managing almost 12,000 km of shoreline, has an urgent need to characterize and predict the effects of climate change for mitigation and management purposes. The goal of this project is to develop a methodology framework for assessing the vulnerability of marine habitats within NPS, beginning with a pilot project at Cumberland Island National Seashore (CUIS). This framework employs a vulnerability assessment (VA) approach in which vulnerability is the sum of exposure (the magnitude of the stressor), sensitivity (how strongly a system is affected by the stressor), and adaptive capacity (the potential to adjust in response to the stressor).

Four climate-change-related stressors were analyzed: SLR, temperature change, salinity change, and ocean acidification (OA). Within CUIS, the marine habitats of interest include subtidal and intertidal environments such as beach, salt marsh, shellfish beds, and tidal creeks. For each habitat-stressor combination, the exposure, sensitivity, and adaptive capacity were rated on a qualitative scale of low-medium-high.

Preliminary results show the most vulnerable marine habitat at CUIS to be high-fringing salt marsh (HFSM), a narrow and sporadic zone between the expansive low salt marsh and the uplands. Topography, environmental conditions, cultural resources, and the encroaching low salt marsh make the HFSM sensitive to SLR and salinity, as well as reduce its potential to adapt (i.e., migrate inland). The changes in salinity and sea level would likely reduce the overall suitability for the growth of HFSM species (i.e., Juncus roemerianus) as well as increase competition, particularly with the ubiquitous low marsh species Spartina alterniflora. Preliminary field analysis at the site shows S. alterniflora growing sporadically in the HFSM at many locations within CUIS. Of the four stressors, SLR is of the greatest concern, given the immediacy of the threat and its high potential to disrupt sensitive habitats.
Microstructural Evidence of Cyclic Hydraulic and Cataclastic Brecciation in a Dilational Fault Zone, Jervois Range Region, Central Australia

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Hydraulic and cataclastic (fault) brecciation are important processes influencing fault zone strength and mineralization. However, outcrop and microstructural studies of single-event breccia zones have yet to establish microstructural criteria distinguishing between these two brecciation processes, which is important in assessing whether both occurred to form one breccia zone.

The Jervois Range region of central Australia has experienced Proterozoic mineralization involving hydrothermal remobilization, making it an ideal area to study the structural setting of brecciation and possibly associated mineralization. NW-SE striking fault breccia zones originated during Neoproterozoic intracontinental basin formation and currently dextrally offset Paleozoic basin strata. Slickenlines plunge gently NW and SE. Oblique quartz dikes adjacent to, and truncating against, the breccia zones with tension gash geometry indicate dextral shear. The fault zones contain hematite-quartz breccia, with no clasts of host rocks observed. The breccia zones are characterized by fine-grained, purple-red (hematite rich) domains, cm- to dm-scale clasts, and cm-scale discontinuous quartz veins. Locally, across gradients perpendicular to the zone boundaries, the percentage of fine-grained material increases as the average clast size decreases.

Representative breccia samples have been used to catalog microstructures indicative of cataclasis or hydraulic brecciation and cross-cutting relationships between them. Microstructural relationships within the clasts include (1) white quartz matrix containing clasts of fine-grained hematite-rich domains and (2) fine-grained hematite-rich matrix containing white quartz clasts. The hematite-rich domains are overall finer grained and contain smaller quartz clasts, a texture similar to fault zone gouge. Discontinuous veins observed in the field are dilational antitaxial quartz veins. These microstructures are tentatively interpreted to represent (1) hydraulic brecciation, (2) cataclastic brecciation, and (3) static crystallization in veins. Since clasts include each of these relationships, at cm- and m-scale, this in addition to field relationships are all interpreted to represent cycles of both brecciation processes in a dilational shear zone.

Session No. 28--Booth# 39

T5. Undergraduate Research I (Posters)
Friday, 20 March 2015: 8:00 AM-12:00 PM
Chattanoogan Hotel & Conference Center Ballroom
Geological Society of America Abstracts with Programs. Vol. 47, No. 2, p.0
MOUNTJOY, Bryant
CATO, Michael
PADGETT, Mark
FERRI, Kelly
FULLER, Joshua
LORD, Mark
KINNER, David A.
WALSH, Danvey
CORCORAN, Kyle
DUNLAP, Chris
TANNER, Benjamin R.
WILLIAMS, Garic R.
WATERS-TORMEY, Cheryl
KINNER, David
DOUGLAS, Morgan L.
FORCINO, Frank L.
STAFFORD, Emily S.
FORCINO, Frank L.
MONTOYA, Leslie Marie
FORCINO, Frank L.
STAFFORD, Emily S.
STEPHENS, Chelsea
KEEVER, Michael
BECK, Hans
HUDSPETH, Reece
LORD, Mark
GANNON, J.P.
KINNER, David
CAMPBELL, Ted
TORMEY, Blair R.
DONOVAN, Bailey G.
DONOVAN, Bailey G.
BARTL, Eric
MOUNTJOY, Bryant
HARTIGAN, Sean
GATLIN, Jesse
LORD, Mark
KINNER, David A.
GANNON, J.P.
TANNER, Benjamin R.
SALTER, Rachel L.
FORCINO, Frank L.
FORCINO, Frank L.
FOWLER, Alicia
PEEK, Katie McDowell
STAFFORD, Emily S.
COBURN, Andrew
YOUNG, Robert
FOWLER, Alicia
MCCREEDY, Cliff