

# COLLEGE of CHARLESTON

SCHOOL OF SCIENCES  
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## Geology Abstracts

31<sup>st</sup> Annual Poster Session Abstracts - April 18, 2019

### 1. A multi-basin sedimentary mercury analysis of the Miocene Monterey Formation

Clara L. Meier, Marisa D. Knight, Leanne G. Hancock, Richard J. Behl, Timothy W. Lyons, and Theodore R. Them II

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Mercury (Hg) contents have been used as a novel tool to track ancient volcanic activity. Hg emitted from volcanoes is thought to be directly preserved in the sedimentary environment and, therefore, the sedimentary record. Mercury is delivered to oceans by weathering, soil loss, and biomass burning, so these factors must be considered when determining the controls on Hg anomalies. Furthermore, Hg is a redox-sensitive element, and its accumulation can be controlled by local redox processes. It is therefore necessary to constrain the local redox conditions of the basin in which Hg records are generated to provide context during data interpretation. Here, we will assess the various controls on Hg contents from three basins from the eastern Pacific Ocean during the Miocene. The local redox history has already been constrained using multi-proxy approach. This provides an opportunity to test the Hg proxy across a transect of terrigenous input.

### 16. Comparison of Multispectral Imagery and Backscatter Classification for the Use of Nearshore Marine Habitat Mapping, Charleston, SC

Darina DeBenedictis<sup>1</sup> and Jennifer Kist<sup>2</sup>

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Benthic habitat mapping is developing as acoustic mapping technologies advance. Multibeam sonar data containing backscatter and multispectral backscatter were collected by the U.S. Army Corps of Engineers offshore from Charleston Harbor's main channel entrance. The site is a probable location for the implementation of a mitigation reef. Uncalibrated backscatter data collected at three different frequencies were combined as spectral bands into one mosaic. The backscatter values were analyzed, interpreting the highest dB values as the densest substrate, likely indicative of hard bottom. Detecting hard bottom is important in finding sites for habitats since marine invertebrates recruit more

successfully to denser material. Ground-truth verification would be necessary to know the reliability of these methods. In this particular dataset, both the backscatter and multispectral mosaics portray the same results, suggesting that there is no obvious benefit to using multispectral imagery in place of backscatter when searching for potential marine habitat sites.

## **21. Analysis of Deep Coral Mounds in Proximity to the Gulf Stream Axis on the Central Portion of Stetson Mesa**

Nicholas A. Burch and Dr. Leslie R. Sautter

Department of Geology and Environmental Geosciences, College of Charleston

The NOAA Office of Ocean Exploration and Research's (OER) Windows to the Deep 2018 expedition was conducted May-July on the Southeast U.S. Continental Margin aboard the NOAA Ship Okeanos Explorer exploration vessel. Scientists collected high-resolution video of the seafloor at dive sites along the Stetson Mesa on the western edge of the Blake Plateau for the purpose of locating deep sea coral and sponge habitats. The remotely operated vehicle Deep Discoverer dove multiple sites to explore benthic habitat areas predicted by the South Atlantic Fisheries Management Council. The area of this study is located beneath the Gulf Stream on the central portion of Stetson Mesa. Multibeam sonar data from NOAA OER cruises EX1403 and EX1805 were used to make bathymetric, backscatter intensity, and slope surfaces to calculate the average shoalest depth of coral mounds mapped, for comparison with other mounds in proximity from the Gulf Stream axis.

## **22. Geomorphology of Intraslope Terraces, Eastern Blake Plateau**

Dylan C. Coe and Dr. Leslie R. Sautter

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As part of the effort to better understand, manage, and protect deep sea coral and sponge habitats of the southeastern U.S. continental margin, NOAA Ocean Exploration and Research conducted the Windows to the Deep 2018 expedition from May through June, 2018. The expedition produced high definition video collected by the remotely operated vehicle, Deep Discoverer. Multibeam sonar data collected by the NOAA Ship Okeanos Explorer were used to generate high resolution bathymetry, slope, and backscatter intensity surfaces. The geomorphology of intraslope terraces along the continental margin's Blake Escarpment was examined to classify benthic habitats. ROV dive videos of the expedition's three intraslope terrace sites show that sponges and deep sea corals inhabit areas of high slope along hard rock substrate. These areas often display high backscatter intensity suggesting that future similar benthic habitats can be identified on intraslope terraces using backscatter intensity.

## **23. Characterizing Geomorphologic Features of a Northwestern Portion of the Blake Plateau, Southeast U.S. Continental Margin**

Emanuel Byas and Dr. Leslie R. Sautter

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Multibeam bathymetric surveys were conducted on the southeast U.S. continental margin aboard the NOAA Ship Okeanos Explorer by the NOAA Office of Ocean Exploration and Research in May through July, 2018. One of the areas mapped lies 135 km southeast of Charleston, South Carolina, on the northwest portion of the Blake Plateau. The purpose of this study is to characterize and interpret various geomorphologic features within the study area by examining the bathymetry, slope, and aspect surfaces of features such as a distinct scour, a few scarps, as well as some areas with tilted strata. The scour, located to the north is likely an iceberg scour whose channel width increases as the iceberg progressed south. Scarps to the east of the study area appear as cliffs, and have a dramatic change in bathymetry. To the south, tilted strata sites were identified by comparing slope and aspect trends.

## **25. Comparison of Seabed Features Within the Richardson Ridge Complex, Blake Plateau**

Mikayla Drost and Leslie Sautter

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In May-July 2018, multibeam sonar data and HD video of the seafloor were collected on the Southeast U.S. continental margin's Blake Plateau eastern edge. The discovery of deep-sea coral habitat in this area and subsequent exploration of adjacent expanses of similar habitat have generated new ideas on the geomorphology of deep-sea coral habitat. The purpose of this study was to characterize the geomorphology of these coral mounds for comparison with the geomorphology of other seabed features in the Richardson Ridge Complex. Data collected revealed that there are weak to no correlations among slope, intensity, and the presence of corals in these deep-sea environments, therefore we cannot rely on the traditional markers of high slope and high intensity to indicate the presence of coral habitat. Instead, using bathymetric data to identify mound features and locate mound crests can effectively aid in finding coral habitat and live corals.

## **26. First record of the leatherback sea turtle (*Dermochelyidae*) from the Mio-Pliocene Purisima Formation of Northern California**

Bailey Fallon and Robert Boessenecker

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The leatherback sea turtle family *Dermochelyidae* has an extensive evolutionary history, though it is represented by only one living species today, *Dermochelys coriacea*. *Dermochelyid* fossils occur worldwide from late Cretaceous to Pliocene marine strata. Herein described is the first occurrence of a sea turtle from the earliest Pliocene Purisima Formation of Northern California, a single carapacial nonridge ossicle. The ossicle exhibits morphological, microstructural and geochronological characteristics that are comparable to the extinct genus *Psephophorus* and to the extant genus *Dermochelys*. Classification of the ossicle as cf. *Psephophorus* is based on examination of its thickness, internal structure, surface textures and age. This paper reports the third occurrence of leatherback sea turtle fossils from the western coast of the United States.

## **27. Classifying Coral Mound Geomorphology at Stetson Mesa off the Southeastern U.S. Continental Margin**

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NOAA's Office of Ocean Exploration and Research funded an exploratory bathymetric surveying expedition Windows to the Deep 2018: Exploration of the Southeast U.S. Continental Margin (EX1806) aboard NOAA Ship Okeanos Explorer. The study concentrates on Stetson Mesa's southern region located on Blake Plateau's western edge, approximately 184 km east of and parallel to Jacksonville, FL, lying directly beneath the Gulf Stream's main axis, where current velocity, water temperature, and nutrient abundance are high, creating a favorable environment for deep sea coral growth and mound development. Coral mound geomorphology was analyzed using multibeam sonar post processing software. Countless numbers of coral mounds observed were classified into three distinct morphological categories, Ridge Scarp Mounds, Connected Mounds, and Individual Mounds, based on their association with geological seafloor features, length, height (relief), and number of peaks. These results are significant for comparing benthic habitat throughout the Blake Plateau region.

## **29. The Utilization of Global Bathymetric Data to Characterize Large-Scale Bedforms in Atlantic Submarine Basins**

Hayley C. Drennon<sup>1</sup>, Dr. Vicki L. Ferrini<sup>2</sup> and Dr. Leslie R. Sautter<sup>2</sup>

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Knowledge of deep sea bedform morphology and stability can be used to understand current flow and circulation patterns. Large-scale bedforms were observed in the Labrador, Atlantic, and Argentine Basins. The observed bedforms have average heights ranging from 120m to 40m, with wavelengths as great as 10km. A unified understanding of the classification, formation, and migration of these bedforms does not exist at this time. This study explores the morphology of deep-water bedforms to better understand mechanisms of their formation. GeoMapApp was utilized to generate cross-sectional profiles of wave geometry and orientation to infer bottom current direction. Symmetry and peakedness were calculated and compared to extant circulation models to determine the regional current. The Argentine Basin was observed to have opposing currents, The Atlantic Basin was found to have bidirectional currents with linear wavelengths up to 8.5km, while in the Labrador Basin 1.91km wavelengths with consistent heights and symmetry were detected.

## **31. Geomorphic Analysis of Richardson Scarp on the Southeast U.S. Continental Margin**

Katie Kehler and Dr. Leslie R. Sautter

Department of Geology and Environmental Studies, College of Charleston

In summer of 2018, the NOAA Office of Ocean Exploration and Research explored the Southeast U.S. Continental Margin as a part of the Windows to the Deep 2018 expedition. The NOAA Ship Okeanos Explorer was used to obtain multibeam sonar data along with high definition video collected using the

remotely operated vehicle (ROV) Deep Discoverer. The purpose of this study is to characterize the geomorphology of an extensive feature, Richardson Scarp, that lies approximately 240 km off the coast of Charleston, South Carolina, where water depths range from 800 to 1050 m. The scarp has an average vertical relief of 100 m and trends northeast-southwest for over 24 km. Deep sea corals were discovered at the edge of the scarp during expedition ROV dives. Bathymetric surfaces as well as slope, aspect and backscatter intensity are used to analyze the geomorphology of the scarp to possibly predict additional deep coral habitat.

### **36. Bathymetric Processing and ROV Live-Stream Integration for Public Outreach**

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In May-June of 2018, the NOAA Ship Okeanos Explorer conducted the Windows to the Deep 2018: Exploration of the Southeast U.S. Continental Margin project. The Benthic Acoustic Mapping & Survey (BEAMS) Program's visualization lab at the College of Charleston was utilized to integrate acquired bathymetry and telepresence technologies of the Okeanos, and to engage local students, faculty, residents, and visitors to the Charleston area in deep-sea exploration. Telepresence technology allowed over 200 guests to experience live exploration of our oceans, and watch as scientists around the world collaborated using online chat rooms to identify the geologic features and biological communities broadcasted from the sea floor. We educated these visitors through the experience of mapping acquisitions, dive preparations, and real time exploration, while emphasizing the importance of understanding habitats of the deep sea, and the role of our ocean moving into the age of the blue economy.

### **38. Geomorphologic Characterization of the Richardson Hills Region of the Blake Plateau, Southeast U.S. Continental Margin**

Jason Mueller and Dr. Leslie R. Sautter  
Department of Geology and Environmental Geosciences, College of Charleston

During May and July of 2018, the NOAA Office of Ocean Exploration and Research conducted the Windows to the Deep 2018 expedition on the Southeastern United States Continental Margin, on board the NOAA Ship Okeanos Explorer. The expedition's goal was to explore and gather information of seafloor characteristics and identify potential deep-sea coral and sponge habitats. Multibeam sonar data collected during NOAA OER cruise EX1805 were used to produce bathymetric, backscatter intensity and slope surfaces of the seafloor. The purpose of this study is to characterize the geomorphology of a northern section of the Blake Plateau referred to as the Richardson Hills Region, located approximately 250 km east of Hilton Head Island, South Carolina. The study area consists of flat lying strata, scattered potential deep sea coral mounds, and prominent areas of small, shallow basins with steep scarps.

### **39. The One That Got Away: A Mysterious Species of Fossil Stem-Swordfish from the Oligocene of South Carolina**

William McCuen, Aika Ishimori, and Robert W. Boessenecker  
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A partial billfish rostrum fossil from the Chandler Bridge Formation (Early Chattian, Oligocene) Wallace Ackerman Site, Summerville, South Carolina, U.S.A., is described and identified as *Xiphiorhynchus* sp. cf. *aegyptiacus*. The Chandler Bridge Formation is a sequence of marine clays and assorted siliciclastics likely deposited in a coastal environment. The new specimen is compared with species of *Xiphiorhynchus*, especially *Xiphiorhynchus aegyptiacus* (from the Birket Qarun Formation, early upper Eocene) as well as a *Xiphiorhynchus* indet. (ChM PV8137, also from the Chandler Bridge Formation). Examining the angle of taper, depth to width ratio of the cross section, and other morphological features, we established that the new specimen has a marked similarity to these two; we conclude that it and ChM PV8137 likely either represent either a relict population of the late Eocene *X. aegyptiacus* or a closely related, as-yet unnamed species endemic to South Carolina.

#### **44. Deep Sea Coral Mound Geomorphology & Orientation on Stetson Mesa, Blake Plateau**

Samuel Croft and Dr. Leslie R. Sautter  
Department of Geology and Environmental Geosciences, College of Charleston

NOAA Ocean Exploration and Research (OER) collected multibeam sonar data on the Southeast U.S. Continental Margin in May 2014. The NOAA Ship *Okeanos Explorer* obtained bathymetric data 160 km east of Georgia's southeast coast in 600 to 900 m of water, along the western edge of the Blake Plateau, in an area directly beneath the main axis of the Gulf Stream. The purpose of this study is to characterize the geomorphology of recently discovered deep coral mounds with respect to their shape, slope, and backscatter intensity, for comparison with the geomorphology of other seabed features in the region. Mound shape was characterized specifically for the top 10 m of vertical relief including orientation, length vs. width measurements. Information gathered will be supplemented with ROV dives from the NOAA OER Windows to the Deep 2018 Expedition. This study relates mound shape and orientation to mound proximity within the Gulf Stream.

#### **57. Earthquake and Groundwater Interactions Using Water Level and Seismic Data**

Paige Freeman and Timothy Callahan  
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Oklahoma has been injecting their wastewater deep into the ground and low magnitude earthquakes have been occurring. Groundwater levels also seem to change during or after an earthquake, such as seen in Alaska and California. Water level data from wells were used to obtain information about changes in the water table that may correlate to seismic activity, and injection site location and seismic data were used to study cases from Oklahoma. A correlation between well injection sites and earthquakes over a 3.0 magnitude were determined using the data provided. There was also a correlation between dramatic water table changes and earthquakes. The results show how groundwater and earthquakes can influence each other and that people should plan accordingly when it comes to their water resources and the potential of earthquake hazards.

## **58. Landsat-5 mapping of environmental change-over-time in North Charleston, South Carolina**

Nicole Moor<sup>1</sup> , Kiah Krus<sup>1</sup> , Grant Thompson Jr.<sup>2</sup> , Taylor Cronin<sup>2</sup> , and Dr. John Chadwick<sup>1</sup>

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Within the last few decades, development in the South Carolina Lowcountry has accelerated, resulting in a measurable loss of natural vegetation. In this study, satellite-based multispectral remote sensing (visible and near-infrared) data were used to map land-cover with change over time in a broad area of North Charleston. The data were collected from 10 Landsat-5 images of the area from 1984 to 1998. ENVI 5.5 and the minimum distance classification algorithm were used to conduct a supervised classification of the images into six broad categories of natural and man-made land cover based on their spectral reflectance. Change in the proportion of land-cover types was monitored over time, revealing a loss in natural vegetation. Classification fidelity was verified by field work and recording geo-coordinate data using handheld GPS devices. The results show a decline in natural vegetation types, and one implication is the risk of flooding in inhabited areas increases.

## **60. Monitoring Natural Vegetation in Charleston, SC in the 21st Century Using Landsat Data**

Noah Katz<sup>1</sup>, Anna Liu<sup>1</sup>, Michael Schwartz<sup>1</sup>, Caroline Vill<sup>2</sup>, and Dr. John Chadwick<sup>1</sup>

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The population in Charleston, South Carolina has risen from 310,964 people in 2000 to 401,438 people in 2017. The growing population has led to a significant loss of natural vegetation. The goal of this study was to map land cover types in Charleston throughout the 21st century with remote sensing to determine the effect that population growth has had on the proportion of natural vegetation. Ten multispectral images (from 2002-2018) collected by Landsat 5 and 8 were used, with moderate spatial resolution (30 m). Landsat's orbital repeat cycle of 16 days is beneficial for monitoring urban growth and land cover types. The images were processed in ENVI software, and the percent change in area of six land cover types over time was calculated using minimum distance supervised classification. The percent of natural vegetation in Charleston decreased over time with the increasing population.

## **73. The Contrasting use of Fractured Rock Aquifers in California and Pennsylvania: A Multifaceted Analysis**

Ben Norvell

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Fractured rock aquifers are groundwater reservoirs in which groundwater is stored and transported through cracks, joints, or voids in the rock. In the past, fractured rock aquifers have been of little interest due to their unreliable well yields and rates of flow. Due to developments in drilling technology and increased demand for groundwater around the world, fractured rock aquifers are becoming increasingly significant. Analyzing the use of fractured rock aquifers could offer greater insight into an area of

hydrogeology in which our current knowledge is somewhat limited. Pennsylvania is an example of a state that is dependent on fractured rocks for its groundwater. California, however, is not. The goal of this study was to compare and contrast the use of fractured rock aquifers in California and Pennsylvania, and reach a conclusion as to why each states' dependence on fractured rock aquifers is so different, despite sharing many geological/geographical similarities. To do this, factors such as economic demands and population distribution were examined. The results of the study indicate that the states' underlying geology is the primary cause of their reliance (or lack thereof) on fractured rocks for groundwater.

#### **79. Chemical incompatibility with tire material of a common digestion reagent in microplastic analysis**

Gracie Eldridge and Dr. Barbara Beckingham

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Extensive usage of tires leads to material shedding onto roadway surfaces, which can lead to dispersal in the environment. Ongoing studies are finding that tire particles are likely a dominant type of microplastic emitted into Charleston Harbor. This material also is known to carry contaminants, such as heavy metals and polycyclic aromatic hydrocarbons. It is important to develop methodologies for monitoring these environmental particles. Hydrogen peroxide digestion is a recommended method for isolating microplastics from environmental matrices. Digestion trials were performed with crumb rubber at 1%, 10%, and 30% H<sub>2</sub>O<sub>2</sub>(aq) at varying temperatures, and weight, particle number and area were metrics used to track compatibility of the method. Microscopy images were analyzed using ImageJ. Results suggest that this standard methodology is not ideal for crumb rubber because of potential deterioration of particles. Ongoing work will test the method in presence of organic matter and evaluate alternative methods for environmental monitoring.

#### **100. Incorporation of New Data to Refine the Tectonic History of the Gulf of Mexico, 230 Ma - 180 Ma**

Hannah Hartley<sup>1</sup>, Dr. Erin K. Beutel<sup>1</sup>, Dr. Irina Filina<sup>2</sup>, and Mei Liu<sup>3</sup>

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When Pangea assembled ~330 million years ago, several small tectonic plates, including the Yucatan and Florida, were accreted to the margin of North America. Though the broad tectonic history of the area is well understood, details such as the exact placement and movement of these small blocks remain unresolved. We incorporated new data from potential fields, seaward dipping reflectors, pre-salt stratigraphy, extension estimates, and rift basin orientation to build our own model that reconstructs the movement of the Yucatan plate. With this model, we determined the position of the Yucatan and Florida blocks at 180 Ma, 200 Ma, and 230 Ma. We found that the blocks underwent a significant change in deformational style at ~200 Ma, reflecting a change in stress and plate motion associated with the Central Atlantic Magmatic Province and the opening of the Atlantic Ocean.

#### **104. Exploration and Analysis in Active Filtration of Water in Stormwater Retention Ponds**



Hailey Connell, Shannon Ware, Addie Miller, Alex Hoppersberger, Dana Pelkey, and Dr. Vijay Vulava  
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South Carolina is currently undergoing rapid urbanization, leading to both increased flooding potential and watershed pollution. Stormwater retention ponds (SWPs) are a management practice built to alleviate flooding hazards. However, SWPs are not well regulated and often become highly contaminated with harmful nutrients and trace metals through runoff from the surrounding area. The College of Charleston's Geochemistry course has designed and engineered laboratory scale filtration devices that utilize hemp fibers and activated charcoal to remove these contaminants. The experiment was conducted using samples from a SWP in Park West, Mount Pleasant, and compared levels of targeted contaminants before and after filtration. The results are consistent with the need for specialized filtration equipment that can be successful in removing contaminants. This project will fuel future College of Charleston research in different methods of remediation and the effects that a lack of SWP regulation creates in South Carolina.

#### **106. Development of Methods to Study Ingestion of Microplastics by Fishes in Charleston Harbor**

Brianna Ingram<sup>1</sup>, Brittney Parker<sup>2</sup>, Barbara Beckingham<sup>3</sup>, and Gorka Sancho<sup>1</sup>

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Pollution of our oceans with plastics made by humans has become a world-wide problem, and is expected to increase exponentially in the future. Microplastics are one of the most common marine debris, and are less than 5 mm in length. Types of microplastics include fibers, fragments, and beads. Because of their small size, many marine organisms ingest microplastics, accidentally or purposely, since they can be confused with edible particles. Methods were developed in order to successfully characterize microplastic ingestion by six species of fish resident to the Charleston Harbor. Fishes, like those in this study, can be used to estimate the incorporation of microplastics into the estuarine food web. Future results will establish which fish species have the highest incidence of microplastic pollution ingestion in Charleston Harbor, providing valuable information on the corresponding ecotype.

#### **120. Determining Accuracy of Field Water Quality Tests For Citizen Science Use**

Watson, S., Beckingham, B., Vulava, V. and Mullaugh, K.

Department of Geology and Environmental Geosciences

Citizen science may enable public engagement with stormwater issues, including water quality of ponds in their communities, but management based on citizen science requires data accuracy. This study assessed the reliability of simple water quality test kits using known concentrations of nitrate (NO<sub>3</sub>-N) for on-site water quality monitoring of stormwater ponds. A laboratory exercise for an undergraduate Analytical Chemistry course was created where students ran calibration curves using Hach DR900 Colorimeter and either Vernier SpectroVis Plus or Oceans Optics USB-650 Red Tide Spectrophotometer

with nitrate standards and evaluated an unknown sample (7.8 ppm) using pre-programmed and calculated calibrations. Accuracy of results improved when a calculated calibration curve was applied, with 31% of results within 10% of the known value, 62% within 15%, and 75% within 20%. Accuracy of field-collected stormwater pond samples by Hach colorimeter was also compared to ion chromatography which validated their in-field accuracy for well-trained citizen scientists.

#### **122. Green lakes from space: monitoring stormwater ponds in coastal SC by remote sensing**

Burke, J., Beckingham, B., and Ali, K.A.

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In coastal South Carolina, wet detention ponds are the go-to best management practice to mitigate flooding concerns associated with increased development. Due to the nature of stormwater these systems have a tendency to be sinks for pollutants. That said, there is concern that these ponds act as gateways for the transport of contaminants from developed landscapes to receiving estuarine waters. The objective of this research is to understand whether water quality parameters in stormwater ponds can be adequately monitored using optical remote sensing through both satellite and near ground instrumentation. Optical measures may include color, clarity, and visual appearance—these signatures may be relatable to priority water quality measures, specifically chlorophyll-a (CHL-a). Initial results show trend between CHL-a and spectral ratios; however, atmospheric and benthic sediment interferences are significant.

#### **123. Volumetric Calculation of The Pacific Mantle 0-30 Ma**

Wm. Aidyn Trubey and Dr. Erin Beutel

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Since about 30 mya, the subducted plates and cratons that surround the mantle beneath the Pacific Basin have been converging. Below this mantle is the olivine transition zone which resides near 440km depth. As this basin is getting smaller, does the mantle have a place to go? To assess whether the mantle in question is completely closed-in by these parameters, the volume generated by slab-rollback was compared to that which was output by the Mid-Ocean Ridge (MOR). The results show a 106 -108 difference between outputs and inputs. This suggests the amount of mantle removed by the MOR is significantly higher than that which is displaced by subducting slabs between 100-400 km depth. The difference in input and output indicates there is a distinct lack of accountability for mantle input at this scale and time frame and that there may be other inputs which need to be considered.