



*Thirty-Seventh Annual*

# **GEOSCIENCE DAY**

**PROGRAM AND ABSTRACTS**

**INDIANA UNIVERSITY OF PENNSYLVANIA  
GEOSCIENCE DEPARTMENT**

**April 29, 2011  
Room 134 Weyandt Hall**

*Thirty-Seventh Annual*

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# GEOSCIENCE DAY SCHEDULE

9:00 am      **Opening Remarks - Dr. Steven A. Hovan**

## **Session I**

9:05 - 9:20      **Matthew R. Harding**

VEIN STRUCTURES AND FAULTS IN CORE  
SAMPLES FROM NANTROSEIZE EXPEDITION  
315, SITES C0001 AND C0002

9:20 – 9:35      **Anthony J. LeDonne**

FRACTURE ORIENTATIONS IN DEVONIAN  
MARCELLUS SHALE OUTCROPS IN THE  
VALLEY AND RIDGE PROVINCE ADJACENT  
TO THE ALLEGHENY FRONT

9:35 – 9:50      **Daniel M. Saftner**

EOLIAN DEPOSITION PATTERNS IN THE  
EASTERN EQUATORIAL PACIFIC OCEAN  
AND THE PALEO-CLIMATE OF THE LATE  
CENOZOIC

9:50 – 10:05      **Mark R. Smith**

PETROGRAPHIC CHARACTERIZATION OF  
DEFORMATION MECHANISMS AND  
KINEMATICS IN POST-CLEAVAGE FAULTS  
ACCOMMODATING DIFFERENTIAL UPLIFT  
OF THE HSUEHSHAN RANGE: TAIWAN

10:05 – 10:20      **Refreshment Break**

## **Session II**

10:20 –      **Guest Presentation**  
**Mr. Keith A. Rittle**  
**Trihydro Corporation**

AN OVERVIEW OF THE VAPOR  
INTRUSION PATHWAY AT  
ENVIRONMENTAL SITES

11:45      **No-Host Lunch at Pizza Hut**

5:00      **Geeoscience Banquet**  
**Rustic Lodge, Indiana, PA**

7:00      **Student Awards Presentation**

## VEIN STRUCTURES AND FAULTS IN CORE SAMPLES FROM NANTROSEIZE EXPEDITION 315, SITES C0001 AND C0002

HARDING, Matthew R.

Cores retrieved from Sites C001 and C0002 during Integrated Ocean Drilling Program (IODP) Expedition 315 offshore SW Japan provide an excellent opportunity to examine deformation processes occurring across the Nankai Trough. Historically, this region is well known for its great (magnitude >8) earthquakes. On-board core logging and analysis of X-ray computed tomography scans revealed numerous core-scale deformation structures. These structures include faults, vein structures, kind bands, deformation bands, brecciated horizons, shear zones and rare folds. Here we document the first order geometries and textural characteristics specifically of faults and vein structures. This is done principally through mm-scale microscope observation and petrographic analysis. At the hand-sample-scale the faults and vein structures are mm-scale thick structures that appear visually as darker anastomosing features against the lighter colored wallrock. In thin section these structures show some sign of grain orientations oblique to bedding. The faults and vein structures have diffuse tips and terminations, respectively. The faults typically occur as isolated structures whereas the vein structures typically occur in groups of three or four. At Site C0001 these structures occur in zones with abundant faults and shear zones as noted during on-board core logging, and mostly occur below an m-scale thick zone of breccia encountered at ~220 meters below the sea floor. A single sample from C0002 displays particularly well-preserved cross-cutting relations between several faults. Preliminary analyses suggest that that the steeper dipping (>60°) faults are older than the shallower dipping (~45°) faults. These findings are being examined in the context of fault kinematic data obtained from core observations during the expedition in hopes of shedding light on the sequence of faulting within the accretionary wedge. Understanding how these deformation structures might fit into the earthquake cycle remains an important question.

## FRACTURE ORIENTATIONS IN DEVONIAN MARCELLUS SHALE OUTCROPS IN THE VALLEY AND RIDGE PROVINCE ADJACENT TO THE ALLEGHENY FRONT

LEDONNE, Anthony J.

Three outcrops exposing Marcellus Shale along the westernmost margin of the Appalachian Fold and Thrust Belt along the Allegheny Mountain front are being investigated. Lithologic units bounding the Marcellus are identified where possible to determine the stratigraphic position of the outcrop. Fracture sets in these outcrops are measured and described. Here we present our initial results from one well-exposed outcrop. Our goal is to better understand the history of tectonic stresses the rocks have experienced and possibly predict fracture orientation and spacing of the Marcellus shale beneath the nearby portions of the Allegheny Plateau. Detailed transects of fracture measurements have been made at an outcrop in Tyrone, PA to document the relative age of different fracture sets. We identified three distinct fracture geometries, two of which are generally not mineralized and have a conjugate geometry, and one that is commonly filled with fibrous calcite. The conjugate fractures display intersection lineations approximately normal to bedding and we tentatively interpret these to have formed due to tectonic loading when bedding was nominally horizontal. The acute bisector of these fractures in a bedding-horizontal reference frame suggests shortening oriented toward 333°. These fractures display mutual cross cutting relations and clear conjugate geometries suggesting that they do not record two distinct episodes of jointing. The calcite-filled fractures are subvertical and were sampled for petrographic. These fractures may post-date the conjugate fractures however to date we have not found cross-cutting relations. Ongoing analyses are aimed at establishing a possible temporal relation between these fractures and a late-stage fault zone that cuts the outcrop. Overall our initial findings suggest that a subset of fractures in Valley and Ridge exposures of the Marcellus shale are useful for understanding the history of stresses experienced by the rock and predicting the orientation and spacing of fractures beneath the Allegheny Plateau.

## **EOLIAN DEPOSITION PATTERNS IN THE EASTERN EQUATORIAL PACIFIC OCEAN AND THE PALEO-CLIMATE OF THE LATE CENOZOIC**

SAFTNER, Daniel M.

Dust records from deep sea sediments help us understand ancient wind patterns during important climate transitions throughout the Cenozoic. We have isolated and analyzed the eolian fraction of bulk sediments recovered during Integrated Ocean Drilling Program (IODP) Expedition 320/321 in the eastern equatorial Pacific Ocean (EEP). Temporal and spatial patterns of grain size were examined to reveal changes in atmospheric circulation over the past 20 Ma. During the late Miocene to early Pliocene, the Earth's climate transitioned from a single-pole style glaciation (only Antarctica) to bi-polar glacial conditions (both Antarctica and glacial cycles in the Northern Hemisphere). The dust records transported by the ancient Southeast Trade Winds have been used to identify their intensity in relation to the paleo-locations of the intertropical convergence zone (ITCZ). The ITCZ is where the Trade Winds meet and is characterized by a reduction in the size of eolian dust. Past studies suggest a more northerly latitudinal position of the ITCZ during the middle to late Miocene, and a southerly shift as the Northern Trade Winds grew increasingly when northern hemisphere ice ages began in the late Cenozoic (Hovan, 1995). In our study, we have expanded the temporal resolution of these earlier studies to enable a better comparison between climate proxies such as past changes in wind intensity, global ice volume, equatorial upwelling, and biological productivity.

## **PETROGRAPHIC CHARACTERIZATION OF DEFORMATION MECHANISMS AND KINEMATICS IN POST-CLEAVAGE FAULTS ACCOMMODATING DIFFERENTIAL UPLIFT OF THE HSUEHSHAN**

**RANGE: TAIWAN**

SMITH, Mark R.

Much remains unknown about how continental margin architecture, built from a prior tectonic rifting event, can affect past and ongoing collisional orogenesis. West-central Taiwan can help us to understand the fundamentals of this problem because it is thought to be the site of a relic passive margin fracture zone that is controlling the contemporary uplift patterns of the Hsuehshan Range. We focus on microstructures within an oriented sample to identify the primary deformation mechanisms and kinematics. We found an abundance of clasts showing cataclasis while observing the deformation at grain scale. We found that our observations of the asymmetric microstructures are also consistent with the kinematics of the system observed in the field.

The focal point of our study is a single fault within a suite of recently recognized northwest-striking faults cutting Pliocene-Miocene sandstone sequences just southwest of the Hsuehshan Range. The sampled fault material consists of fault rock and cohesive fault rock taken from a meter-scale thick fault zone east of the Anmashan Anticline near Kukuan Taiwan. Thin sections were made normal to the fault plane and both parallel and perpendicular to the slip direction.

The bulk of the faults are north-northeast dipping oblique thrust faults and strain inversions suggests the maximum shortening direction to be southwest and northeast. These post-cleavage faults are north-northwest trending nearly normal to a northeast trending regional magnetic high that is believed to mark the edge of full-thickness continental crust northwest of the high. This offset nearly conforms with the topographic break that separates the higher Hsuehshan Range to the northeast from the lowlands of the Puli Basin to the southwest. We infer it to be the northeast facing margin of what appears to be a promontory in the lower plate pointing to the east. This promontory of continental crust in the footwall is now acting as a deformation guide as the trench-fill sediments making up the orogen move northwest in response to collision with the Luzon arc.

## **AN OVERVIEW OF THE VAPOR INTRUSION PATHWAY AT ENVIRONMENTAL SITES**

RITTLE, Keith A.

Vapor Intrusion (VI) is a rapidly evolving field in terms of assessment and mitigation, and can be highly controversial and sensitive when contaminant plumes extend under residential communities. VI evaluation in residential areas overlying a known contaminant plume typically begin with the installation of nested vapor wells to assess the pathway of volatile constituents from the source at depth to the shallow subsurface.

If a potential pathway of exposure to residents overlying a plume is indicated, samples may then be collected from beneath home foundations and/or from indoor air, and sample results are compared to risk-based standards. If exposure to contaminants above risk-based levels is indicated, the installation of mitigation measures is then undertaken. The impact of localized, alternate sources of petroleum hydrocarbons from shallow releases are rarely defined yet have the potential to significantly affect the VI pathway, primarily by depleting oxygen as it diffuses through the vadose zone. A review of typical VI investigation, interpretation and response protocols will be presented, followed by a case study summarizing the investigation of the effects of alternate contaminant sources on the VI pathway beneath a community situated near a former industrial site.