

# KECK GEOLOGY CONSORTIUM

## PROCEEDINGS OF THE TWENTY-FOURTH ANNUAL KECK RESEARCH SYMPOSIUM IN GEOLOGY

April 2011  
Union College, Schenectady, NY

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**2010-2011 PROJECTS**

**FORMATION OF BASEMENT-INVOLVED FORELAND ARCHES: INTEGRATED STRUCTURAL AND SEISMOLOGICAL RESEARCH IN THE BIGHORN MOUNTAINS, WYOMING**

Faculty: *CHRISTINE SIDDOWNAY*, *MEGAN ANDERSON*, Colorado College, *ERIC ERSLEV*, University of Wyoming

Students: *MOLLY CHAMBERLIN*, Texas A&M University, *ELIZABETH DALLEY*, Oberlin College, *JOHN SPENCE HORNBUCKLE III*, Washington and Lee University, *BRYAN MCATEE*, Lafayette College, *DAVID OAKLEY*, Williams College, *DREW C. THAYER*, Colorado College, *CHAD TREXLER*, Whitman College, *TRIANA N. UFRET*, University of Puerto Rico, *BRENNAN YOUNG*, Utah State University.

**EXPLORING THE PROTEROZOIC BIG SKY OROGENY IN SOUTHWEST MONTANA**

Faculty: *TEKLA A. HARMS*, *JOHN T. CHENEY*, Amherst College, *JOHN BRADY*, Smith College

Students: *JESSE DAVENPORT*, College of Wooster, *KRISTINA DOYLE*, Amherst College, *B. PARKER HAYNES*, University of North Carolina - Chapel Hill, *DANIELLE LERNER*, Mount Holyoke College, *CALEB O. LUCY*, Williams College, *ALIANORA WALKER*, Smith College.

**INTERDISCIPLINARY STUDIES IN THE CRITICAL ZONE, BOULDER CREEK CATCHMENT, FRONT RANGE, COLORADO**

Faculty: *DAVID P. DETHIER*, Williams College, *WILL OUIMET*, University of Connecticut

Students: *ERIN CAMP*, Amherst College, *EVAN N. DETHIER*, Williams College, *HAYLEY CORSON-RIKERT*, Wesleyan University, *KEITH M. KANTACK*, Williams College, *ELLEN M. MALEY*, Smith College, *JAMES A. MCCARTHY*, Williams College, *COREY SHIRCLIFF*, Beloit College, *KATHLEEN WARRELL*, Georgia Tech University, *CIANNA E. WYSHNYSZKY*, Amherst College.

**SEDIMENT DYNAMICS & ENVIRONMENTS IN THE LOWER CONNECTICUT RIVER**

Faculty: *SUZANNE O'CONNELL*, Wesleyan University

Students: *LYNN M. GEIGER*, Wellesley College, *KARA JACOBACCI*, University of Massachusetts (Amherst), *GABRIEL ROMERO*, Pomona College.

**GEOMORPHIC AND PALEOENVIRONMENTAL CHANGE IN GLACIER NATIONAL PARK, MONTANA, U.S.A.**

Faculty: *KELLY MACGREGOR*, Macalester College, *CATHERINE RIIHIMAKI*, Drew University, *AMY MYRBO*, LacCore Lab, University of Minnesota, *KRISTINA BRADY*, LacCore Lab, University of Minnesota

Students: *HANNAH BOURNE*, Wesleyan University, *JONATHAN GRIFFITH*, Union College, *JACQUELINE KUTVIRT*, Macalester College, *EMMA LOCATELLI*, Macalester College, *SARAH MATTESON*, Bryn Mawr College, *PERRY ODDO*, Franklin and Marshall College, *CLARK BRUNSON SIMCOE*, Washington and Lee University.

**GEOLOGIC, GEOMORPHIC, AND ENVIRONMENTAL CHANGE AT THE NORTHERN TERMINATION OF THE LAKE HÖVSGÖL RIFT, MONGOLIA**

Faculty: *KARL W. WEGMANN*, North Carolina State University, *TSALMAN AMGAA*, Mongolian University of Science and Technology, *KURT L. FRANKEL*, Georgia Institute of Technology, *ANDREW P. deWET*, Franklin & Marshall College, *AMGALAN BAYASAGALN*, Mongolian University of Science and Technology.

Students: *BRIANA BERKOWITZ*, Beloit College, *DAENA CHARLES*, Union College, *MELLISSA CROSS*, Colgate University, *JOHN MICHAELS*, North Carolina State University, *ERDENE BAYAR TSAGAANNARAN*, Mongolian University of Science and Technology, *BATTOGTOH DAMDINSUREN*, Mongolian University of Science and Technology, *DANIEL ROTHBERG*, Colorado College, *ESUGEI GANBOLD*, *ARANZAL ERDENE*, Mongolian University of Science and Technology, *AFSHAN SHAIKH*, Georgia Institute of Technology, *KRISTIN TADDEI*, Franklin and Marshall College, *GABRIELLE VANCE*, Whitman College, *ANDREW ZUZA*, Cornell University.

**LATE PLEISTOCENE EDIFICE FAILURE AND SECTOR COLLAPSE OF VOLCÁN BARÚ, PANAMA**

Faculty: *THOMAS GARDNER*, Trinity University, *KRISTIN MORELL*, Penn State University

Students: *SHANNON BRADY*, Union College. *LOGAN SCHUMACHER*, Pomona College, *HANNAH ZELLNER*, Trinity University.

**KECK SIERRA: MAGMA-WALLROCK INTERACTIONS IN THE SEQUOIA REGION**

Faculty: *JADE STAR LACKEY*, Pomona College, *STACIL LOEWY*, California State University-Bakersfield

Students: *MARY BADAME*, Oberlin College, *MEGAN D'ERRICO*, Trinity University, *STANLEY HENSLEY*, California State University, Bakersfield, *JULIA HOLLAND*, Trinity University, *JESSLYN STARNES*, Denison University, *JULIANNE M. WALLAN*, Colgate University.

**EOCENE TECTONIC EVOLUTION OF THE TETONS-ABSAROKA RANGES, WYOMING**

Faculty: *JOHN CRADDOCK*, Macalester College, *DAVE MALONE*, Illinois State University

Students: *JESSE GEARY*, Macalester College, *KATHERINE KRAVITZ*, Smith College, *RAY MCGAUGHEY*, Carleton College.

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**Keck Geology Consortium: Projects 2010-2011  
Short Contributions— Teton Range, Wyoming**

**EOCENE TECTONIC EVOLUTION OF THE TETON RANGE, WYOMING**

JOHN CRADDOCK, Macalester College, DAVE MALONE, Illinois State University

**FAULT-GENERATED CARBONATE INTRUSIONS FOUND AT WHITE MOUNTAIN,  
HEART MOUNTAIN DETACHMENT, WYOMING**

JESSE GEARY, Macalester College

Research Advisor: John P. Craddock

**INSIGHTS INTO THE ORIGIN OF THE SOUTH FORK DETACHMENT, WYOMING,  
USING CALCITE STRAIN ANALYSIS**

KATHERINE KRAVITZ, Smith College

Research Advisor: Robert Burger

**U-PB DETRITAL ZIRCON PEAK, WYOMING MOUNTAIN**

RAY MCGAUGHEY, Carleton College

Research Advisor: Cameron Davidson

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# EOCENE TECTONIC EVOLUTION OF THE TETON RANGE, WYOMING

JOHN CRADDOCK, Macalester College

## PROJECT SUMMARY

Our initial goal was to work primarily near the Teton Range, sampling Eocene quartzite conglomerates (Pinyon, Harebell, Pass Peak) and two footwall folds in Paleozoic sediments overthrust by Archean gneisses in the high, western Tetons. Sadly, deep snowpack made the folding projects inaccessible but we were able to include the Hominy Peak Eocene section in our project and were able to include these results in our regional evaluation of Eocene volcanism and sedimentation, relative to the Heart Mountain detachment. To adapt to the lack of Teton access, we moved east to the Heart Mountain detachment area, and discovered that the detachment microbreccia was injected 120 meters into the hanging wall carbonates, and that these “injectites” are common in and around White Mountain. In conjunction with a group of 5 from Illinois State University (1 faculty, 4 students), we spent time mapping the chaotic and poorly understood Eocene South Fork detachment exposed over 400 Km<sup>2</sup> southeast of Cody, WY which led to a study of calcite twinning strains in upper plate Jurassic Sundance (Twin Creek) limestones.

Logistically, we spent 3+ weeks in the field, starting and ending at Macalester College. We also spent a week at Macalester preparing thin section tabs (Kravitz, Geary), and separating zircons and other heavy minerals from Eocene quartzite conglomerates. We were in Tucson, AZ Nov. 7-13 using the LA-ICPMS in George Gehrel’s lab U-Pb dating both igneous and detrital zircons (~110 continuous hours).

### Heart Mountain detachment “injectites” (Jesse Geary)

Faults of all types have a linear relationship between fault offset and the thickness of generated fault gouge (Scholz, 1989). Faults that generate a frictional melt force that melt into the adjacent country rock a dis-

tance equal to the fault zone melt thickness. The discovery of 120 m high carbonate breccia “injectites” at White Mountain is anomalous to all reported fault-fluid breccia (pseudotachylite) relationships. Heart Mountain detachment upper plate blocks moved ten’s of kilometers and the resultant fault gouge is grossly under-represented. On the other hand, the fault gouge, while not a carbonate melt, behaved as a fluid and would be expected to have been injected 3 meters. The injectites are only found in the hanging wall, and up to 120 meters in height. Geary mapped and sampled the injectite relations at White Mountain, and documented their common origin chemically (XRF) and petrographically (microscope, SEM-WDS).

### Absaroka Volcanism at Hominy Peak, West Tetons (Ray McGaughey)

The now-buried Sunlight volcano is thought to be responsible for the Eocene chaos of the Heart Mountain detachment, including the 6000 ft. of andesitic flows in the upper section erupted between 50-45 Ma. Love et al. (1978) also mapped a volcanoclastic section on the west side of the Teton Range, ~110 Km west of the Sunlight volcano. The west-dipping section at Hominy Peak contains a basal ash, volcanic conglomerates, quartzite conglomerates, and a variety of Paleozoic limestone blocks as clasts. Radiometric ages on the basal ash indicate the section is 50 Ma and younger, and the zircon cores have interesting Archean and Proterozoic cores. Histograms of the upper detrital units constrain a maximum depositional age (~50 Ma), and have a wide spectrum of zircon ages including Archean and Proterozoic populations.

### Calcite Twinning Strains, S. Fork Detachment (Katherine Kravitz)

In addition to the Sunlight volcano ejecta being found on the west side of the Teton Range (~50 km), and the eruption initiating the chaos of the Heart Mountain detachment, the allochthonous sediments exposed in

the S. Fork of the Shoshoni river valley is even more exotic. The South Fork detachment (SFD) is exposed over ~400 km<sup>2</sup> in a valley eroded through all the Sunlight (Absaroka) volcanics that has a relief of 6000 feet. The SFD rocks include allochthonous sediments of Jurassic-Cretaceous age that are in fault contact with the underlying Eocene Willwood Fm. The kinematics of this fault contact change along strike. The hanging wall sediments are folded (SW-NE trends, shallow plunges), and in places, are overturned nappes. Kravitz helped remap parts of the SFD, and collected oriented samples of the Jurassic Sundance Fm. (biosparite limestone). Upper plate Sundance samples record a layer-parallel shortening strain, in many orientations, and footwall samples record a predominantly bedding-normal shortening strain. The SFD rocks underly the basal Sunlight eruption rocks, the so-called “debris flow avalanche” that was contemporaneous with the Heart Mountain detachment. As the SFD motion was pre-HMD, was this rootless allochthon a contemporaneous landslide block, or is it part of the older Sevier-Laramide tectonism??

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