

# ARCHEAN ROCKS OF THE TOBACCO ROOT MTNS, MONTANA

## WORKSHOP

### FACULTY

John Brady, Smith College  
Robert Burger, Smith College  
Jack Cheney, Amherst College  
Tekla Harms, Amherst College

### STUDENTS

Reyna Abeyta, The Colorado College  
Daniel Blednick, Amherst College  
Sarah Carmichael, Smith College  
Jessica Frisch, Amherst College  
Caroline Harris, Pomona College  
Christine Hatch, Amherst College  
Brian Monteleone, College of Wooster  
Carlos Picornell, University of New Orleans  
Kurt Steffen, Carleton College

# Archean rocks of the Tobacco Root Mtns, Montana - Workshop

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## INTRODUCTION

Archean rocks exposed in the SW Tobacco Root Mountains consist primarily of three distinct lithologic assemblages - the Spuhler Peak Metamorphic Suite (SPMS), the Indian Creek Metamorphic Suite (ICMS), and the Pony-Middle Mountain Metamorphic Suite (PMMMS). All three of these Archean assemblages presently occur as suites of gneisses and schists that have been subjected to polyphase deformation and contain a complex metamorphic history. The latter two suites are cut by a volumetrically minor but geologically important swarm of metamorphosed mafic dikes (MMD's). The objectives of the ongoing Keck research project in the Tobacco Root Mountains are: to characterize the metamorphic and deformation events that have reworked these Archean suites; to see through that metamorphism to determine the original tectonic setting in which these lithologic assemblages accumulated and the original nature of their mutual contacts; and to describe the process by which the suites became juxtaposed. We believe that this work will add substantively to the field of early continental evolution.

On January 16, 17 and 18, 1998, participants in the 1997-98 Tobacco Root Mountains Keck Project gathered at Amherst College for a collaborative workshop. The timing of the workshop was designed to fall midway through the course of students' individual analyses and independent projects. All of the student projects are, to some degree, interdependent and rely on the results of the other studies, and the overarching goals of the team project require collaboration and combination of all results. The workshop provided an opportunity for students and faculty alike to share results to date, to obtain additional data, to be instructed on critical analytical techniques, and to gain time on Amherst's electron beam instrumentation.

## WORKSHOP ACTIVITIES:

The workshop opened on the evening of Friday, January 16 with a round-robin slide show and the premier of the video: "Tobacco Roots - The Movie".

The scientific work of the meeting started Saturday morning, January 17. Bob Burger and John Brady, project faculty, reviewed the present state of knowledge for the geology of the Tobacco Root Mountains, drawing both from published previous work by academic and USGS geologists, and from the body of data and interpretations produced by the two preceding Keck projects in the mountain range. This culminated in the construction and debate of a provisional 1.5 Ga-long time line for genesis, metamorphism, deformation and juxtaposition of the main Archean rock suites of the study area. The workshop then turned its focus to the accomplishments of the nine 1997-98 student researchers. Each gave both an informal poster display (all students had a 2.5 x 5' area to post preliminary stereonet, photomicrographs, geochemical analyses, maps, AFM diagrams, etc) and a 15 minute oral presentation. The workshop format allowed ample time for discussion following each talk, and everyone used this to compare and contrast results, methods, and difficulties or problems. The day culminated with a lecture ("The Evolution of the Deep Crust: Interaction of mantle, magma, metamorphism and deformation, East Athabasca Mylonite Triangle, Saskatchewan") by our guest speaker, Dr. Mike Williams of the University of Massachusetts. This was an opportunity for all to think in terms of general principles regarding processes at work in continental crust at mid to lower-crustal depths, which can be drawn from the geology of regions like the Tobacco Roots study area and the Canadian shield.

On Sunday, January 18, the workshop was designed as a series of working sessions - tailored to the types of projects students are undertaking, and addressing the necessary analytical techniques and their underlying principles. The working sessions focused on: geothermobarometry from electron beam compositional data of coexisting mineral phases, lattice preferred orientation analysis with the U-stage for quartz and calcite, and major and trace element geochemical analyses and the interpretation of discriminant diagrams.

Using the workshop as a springboard, we were also able to bring two of the student participants in the Tobacco Root Mountains project to Amherst college for a longer period - one for the week preceding the workshop and one for the week following the workshop - to complete the electron beam analysis portion of their studies on Amherst's SEM. We all gratefully acknowledge the generous guidance Jack Cheney gave to this effort.

**WORKSHOP PROGRAM:**

**FRIDAY, JANUARY 16:**

6:30 - 7:30 pm Informal Pizza dinner  
7:30 - 10:00 pm Round robin slide and photograph show, and Tobacco Roots video premier

**SATURDAY, JANUARY 17:**

8:00 - 9:00 am Breakfast - Valentine Dining Commons  
9:00 - 9:30 am Research result poster set up  
9:30 - 10:30 am Overview and review of Tobacco Root geology and project objectives  
Bob Burger and John Brady  
10:30 - 10:45 am Break  
10:45 - 12:00 am Research progress reports  
Christine Hatch  
Brian Monteleone  
Kurt Steffen  
12:00 - 1:00 pm Lunch - Room 212, Pratt Geology Building  
1:00 - 4:00 pm Research progress reports, cont'd  
Jess Frisch  
Reyna Abeyta  
Caroline Harris  
(break)  
Sarah Carmichael  
Carlos Picornell  
Dan Blednick  
4:00 - 5:00 pm Guest speaker Dr. Mike Williams, University of Massachusetts: "The Evolution of the  
Deep Crust: Interaction of mantle, magma, metamorphism and deformation,  
East Athabasca Mylonite Triangle, Saskatchewan"  
5:00 - 6:00 pm Posters and Discussion  
6:00 pm Dinner at Season's Restaurant  
after dinner Amherst College Women's Ice Hockey vs. Trinity

**SUNDAY, JANUARY 18:**

7:30 - 9:00 am Breakfast Lord Jeff and Lord Jeff Inn Check out  
9:00 - 11:30 am Thematic group work sessions on data analysis  
Petrology Group - SEM Analysis (SEM lab)  
Structure Group - Petrofabrics (Room 124)  
GeoChem Group - IgPet Analyses (Computer lab)  
(10:00 - 10:15 am Coffee break)  
11:30 - 12:30 pm Lunch - Room 212, Pratt Geology Building  
12:30 - 1:30 pm Final comments, review of objectives, data sharing. Keck symposium  
planning.  
1:30 pm Van to Bradley International Airport for late afternoon departures

**WORKSHOP FOR THE VIRGINIA KECK PROJECT:  
CENOZOIC LANDSCAPE EVOLUTION IN THE SOUTHERN  
SHENANDOAH VALLEY, VIRGINIA**

**FACULTY**

David Harbor, Washington and Lee University  
Tom Gardner, Trinity University  
Dorothy Merritts, Franklin and Marshall College

**STUDENTS**

Martha Carlson, Carleton College  
Benson Chow, Mississippi State University  
Bala Dodoye-Alali, Whitman College  
Dylan Easthouse, Whitman College  
Carrie Elliott, Carleton College  
Peter Erickson, Carleton College  
Dennis Linney, Elizabeth City State University  
Justin Ries, Franklin and Marshall College  
Dan Rittenhouse, College of Wooster

**PARTICIPATING SCIENTISTS**

Cullen Sherwood, James Madison University  
Scott Eaton, University of Virginia  
Bruce Panuska, Mississippi State University