

# YBRA UPLIFT



Issue 5 Spring, 1999



The new YBRA firepit: please see Page 2 for story

## PENN STATE FIELD COURSE UNDER NEW LEADERSHIP By Donald Fisher

The Geosciences Field Camp is offered as Geosc. 472, a 6 credit, 6 week course in the Rocky Mountains of Montana, Wyoming, Idaho, and Utah. At Penn State, field camp is usually taken after the junior year, a capstone course that integrates the disciplines covered in the core of our geosciences major. The intention is to study a diverse array of geologic problems after students have the necessary background to think analytically in the field. Under these circumstances, students can make first hand observations relevant to the internal processes and surface processes that shape the earth. The itinerary is built around some of the important tectonic and stratigraphic events in the history of North America that incorporate sedimentary, metamorphic, volcanic and intrusive rocks ranging in age from more than a billion years to thousands of years. Within this context, we focus on fundamental skills such as rock and mineral identification, geologic mapping, and cross section construction-- skills that are necessary for the characterization and interpretation of field data. Ultimately, we expect students to use the landscape and the surface geology to describe the three-dimensional geometry of geologic features and the spatial and temporal variations in geologic processes.

We continue to maintain bases of operation at the Yellowstone -Bighorn Research Association Camp, near Red Lodge, Montana (June) and the Alta Peruvian Lodge in Alta, Utah (July). At Red Lodge, students complete maps of glacial deposits and faulted and folded rocks, whereas the Alta area offers a more advanced excercise in structural mapping, with Sevier fold-and-thrust structures overprinted by Tertiary normal faults and intrusions. Students also map the Alta stock and associated contact metamorphic aureole. Both Red Lodge and Alta offer excellent facilities for lecturing, drafting maps, and writing reports.

Geosc. 472 is scheduled to start on June 3 with a cross-country drive to Utah for an excercise in sequence stratigraphy. In the interval between the Red Lodge and Alta base camps, we observe the hydrothermal activity associated with the Yellowstone hot spot and drive west along the Snake River Plain to Craters of the Moon National Park, where we examine (continued on page 2) (Penn State continued from page 1) the cinder cones and lava tubes associated with hot spot volcanism and Basin and Range extension. We then head north

#### From the President...

The past year saw significant progress for YBRA while at the same time some disappointments in the lack of such progress on several fronts.

First, the positives, which include:

- 1. Camp infrastructure remains strong, though continued work is required on all aspects, including the water filtration, water pipes, road maintenance and repair, fire safety measures, and kitchen equipment.
- 2. Camp utilization continued to be fairly good, with two Penn-YBRA Field courses; SIU and Penn State field courses; a Penn graduate course in Environmental Science; and a small Franklin and Marshall Alumni College.
- 3. Response to Work Week was fairly good, with a dozen adult participants and four kids ranging in age from 10 to 13.
- 4. Thanks to the efforts of Russ Dutcher, with construction by Matt Henke, we now have a cover over the reservoir.
- 5. We expect another full camp this year, with field course offerings as usual, a graduate program by Penn, and an Alumni College by Amherst, and possibly another "alumni-college style program" by Phil Robertson and me.

Some areas of disappointment included:

- 1. Lack of significant movement on replacing the bridge. Although we have been assured the bridge is still safe, we have nearly unanimous agreement that the bridge must be replaced soon. We are now looking at the Fall of 1999 as the most likely time for such construction.
- 2. Princeton's cancellation of their Alumni College for 1998: several internal factors at Princeton required them to cancel their original plans for a 1998 Alumni College. Through the urging of some Princeton faculty, the Alumni Office did provide YBRA with a donation toward some costs of such a cancellation to the organization. Princeton has committed to an Alumni College in 2000.
- 3. No progress on land swap for so-called "buffer zone". Although this idea was originally discussed with the new owners of the Sundance Estates and was met with positive response from nearly all parties concerned, the probability of such action has declined considerably. We will continue with these discussions if Council wishes and if there seems to be some possibility of mutually satisfactory outcomes.

With this brief summary, we hope you keep YBRA in mind with your participation, both financially and physically. Please respond positively to the opportunities YBRA provides, including Work Week 1999 (See article elsewhere in this paper.) Our annual Open House is planned for Sunday, August 8.

Mary Kauffman YBRA President **WORK WEEK IV:** Approximately a dozen adults and four children (ages 10-13) spent many hours cleaning out brush around buildings, repairing and replacing wooden shelves, coating the outside of several cabins, caning another porch chair, and painting the exterior of both study halls.

WORK WEEK V: Work Week 1999 (Tuesday, August 3 through Monday August 9). Much work needs to be done around camp - repairing leaky roofs, squirrel-proofing several more cabins, clearing brush from buildings, putting preservatives on exterior walls, repairing and replacing broken deck boards, among other chores. At least one family of four has already signed up - Marcie Machenberg Ryan F&M,'79, whose husband is a skilled carpenter and cabinet builder (wow, can we use them?!) Of course, we can use any and all volunteers, skilled or not!

Please contact Marv Kauffman if you can help this year.

#### 1999 Y.B.R.A. Summer Activities

Penn-Y.B.R.A. Field Course:

Session I: Dinner June 7 - July 12 Session II: Dinner July 12 - August 16 The Pennsylvania State University Field School: Dinner June 10 - June 24

- Southern Illinois University at Carbondale Summer Field Course: Dinner June 26 - August 2
- University of Pennsylvania Graduate Course: July 2 - July 17
- Work Week V: August 3 August 9
- Annual Open House: Sunday, August 8
- "Beartooth Experience at Red Lodge, Montana, a study of Geology and Ecology in Montana's Beartooth

along a valley that marks the hanging wall of a regional listric normal fault that forms the western boundary of the Lost River Range. This active fault is characteristic of Tertiary basin and range extension and was the site of a magnitude 7.0 earthquake in 1983 (the Borah Peak Earthquake). The Borah Peak area provides a nice example of how individual seismic events relate to the more protracted history associated with the landscape and regional subsurface structure.

A transect across the footwall of the Lost River fault gives us a complete section of the Paleozoic stratigraphy, with the Cambrian-Ordovician quartzites and sand-shale sequences, the major carbonate bank environments of the Devonian and Mississippian, the intervening Lower Mississippian influx of distal turbidites from the Antler Orogeny to the west, and the carbonate-cemented aeolian-derived sand and carbonates of the Pennsylvanian. These strata are spectacularly exposed within regional Sevier-age fault-related folds that are not dissected by Tertiary normal faults. A four-day mapping excercise is completed to the west of this area, where Sevier thrust faults are intricately related with conglomerate units.

The Field Camp Director is Donald Fisher (B.A., F. and M., 1983; Ph. D., Brown University, 1988). He has been teaching at Penn State for ten years and has taught Physical Geology, Structural Geology, Geodynamics, Field Methods, and Geology for Engineers. His research interests are in Structural Geology and Tectonics and he has ongoing studies in Costa Rica, Taiwan, Spain, and Alaska. He currently serves as an Associate Editor of the Journal of Structural Geology and the Journal of the Geological Society of China. He is a fellow of the Geological Society of America and a member of the American Geophysical Union. He is also a current member of the National Science Foundation Tectonics panel. Other faculty who also contribute to the teaching of the field course include Professor Rudy Slingerland, Professor David Eggler, and Professor Duff Gold.

#### Old Friends Build a New Fire Pit

By Kevin "Doc" Hoover

The origin of the fire pit at camp may be lost from memory, and it has likely had many previous incarnations, but it has certainly been a social highlight of the YBRA experience for generations. Students and faculty have enjoyed countless nights out on the Point, singing songs, watching stars and thunderstorms, and dodging the shifting smoke. However, by 1997 it was apparent that improvements were needed in fire safety and the visual appearance of the existing pit. Trees and grass were encroaching within spark range, and over time the "pit" had become a mound of ashes completely exposed to the wind. Near the closing of camp that summer, Marv Kauffman, Phil Robertson, and I made the commitment to change by slicing up the rotted, knotty logs that were serving as "seats" and marking out a new, more open location on the Point. To meet Forest Service safety recommendations, we still needed to install a lined, belowground pit and a reliable source of water. Not having a shovel handy at the time, we decided to leave this to the next year's students.

Through the winter, a number of PSU alumni from Duff Gold's 1997 retirement reunion in Utah expressed interest in a gathering at the YBRA. Building a new fire pit sounded like a good excuse, so it was decided that we would have our own "work weekend" in June of 1998 while the PSU student group was in camp. Additionally, the PSU alumni Internet group was able to raise over \$1,200 towards the construction, the lion's share coming from Duff himself. Since he has been such an enthusiastic participant at the evening fires for so many years, despite never having learned the words to "American Pie," we christened our project the "Duff Gold Memorial Fire Pit."

Scheduling conflicts hampered many hopeful participants, but seven PSU alumni, family, and friends made it to camp on Friday, June 19<sup>th</sup>, with Duff and myself already on hand with the students. Our first move was to draft the Penn-YBRA students to dig the pit itself, a feat that they accomplished with amazing speed, as they had the next day off and very much wanted a fire that night. They also trucked up a load of gravel from the camp quarry and rolled the old stones over to form the liner for the new pit, including a french drain to keep it dry. With help from the alumni, I cobbled together the first experimental log bench, and claimed the middle seat for the remainder of the night. It was a new experience to be seated out there without being impaled on knots or sitting on the ground.

On Saturday, while the PSU students were at Elk Basin and the Penn-YBRA students asleep, we set out to complete the ring of log benches and install a water line to the pit. The benches whet smoothly, but neglect on my part to tighten a hose clamp caused the water line to pop during dinner, draining the camp water lines and giving me several days of fits trying to get everything bled and restarted. Dinner also brought back Duff, with the PSU vans loaded to the springs with Elk Basin rocks bound for more pit lining. Evening started with heavy rain, but that failed to dampen our spirits or our fire on the official inaugural burn. This night, both student groups joined us for a long evening of song, and introduction to the remarkable guitar skills of new PSU field camp instructor Don Fisher. That rainy night demonstrated that bare earth simply would not do around the pit, despite now having seats. So, the PSU students finally got their workout, hauling more truckloads of gravel up and spreading an attractive, fire retardant perimeter of bleached Bighorn dolostone. They also helped us demolish the unsightly mound of the old pit and scatter its The recalcitrant water line was repaired as well, ending the long tradition of lugging full Indian tanks to the Point for every fire. All these improvements, though, have still not conquered the problem of the "faceseeking" smoke, only made it more comfortable for a crowd to slowly gyrate around the circle as the Point winds shift. I suppose some adversity must be left for the ambiance.

I would like to thank everyone who contributed time, effort, or in any other fashion to this project. It has been greatly appreciated by the students, and until the fire danger rose too high in late July, I understand that the new fire pit saw use nearly every night. I for one can sleep better knowing that a ready water source is there to drown an evening fire or for other emergencies. Later groups have continued to contribute to the upkeep of the pit, with more loads of gravel and additions to the circle rocks. (Duff is campaigning to make that a collection of sorts, so bring an interesting specimen when you visit and add it to the pile. No coal, please!) We still have funds remaining for more projects of this nature,

#### BEARTOOTH MOUNTAIN STRUCTURE-A BRIEF EXAMINATION

Douglas M. Clark, geologist

As many geo-scientists know, geologic structure along the Beartooth Mountain front and adjacent Big Horn Basin in south-central Montana and northwestern Wyoming has been the subject of considerable depbate for many years. In order to test seismic evidence of anticlinal structures below the Beartooth Thrust, the AMOCO Beartooth Number 1 and 1A Sidetrack, and Phillips Petroleum Co. Ruby "A: Federal Number 1-9 and Sidetrack were drilled in the northwest corner and the east side of the Beartooth Mountains, respectively. Public records of the Montana Board of Oil and Gas in Billings, Montana served as the primary source for well data.

●Northeast Corner of the Beartooth Mountains: The Beartooth foreland thrust structure on the northeast corner of the Beartooth Mountain block was directionally drilled twice, from the same location, by AMOCO Production. The surface location (SWSE Sec 19 T8S R20E) is approximately 4.9 miles (7.9km) southwest of Red Lodge, Montana. The first borehole, AMOCO Beartooth Number 1, was drilled in the fall of 1987 and winter of 1988 to a total measured depth of 13,968 feet and a total vertical depth of 13,7777 (4,199 m). The second borehole, AMOCO Beartooth Number 1A Sidetrack, drilled in the fall of 1988 and winter of 1989, terminated at a total measured depth of 15,413' (4,228 m) with a final borehole inclination of 48.6 degrees to the southwest.

This northeast corner structure was described by this author in 1995 as a large sub-horizontal, recumbent, synclinal fold with the overturned upper limb cut diagonally by the Beartooth Thrust or Thrust Zone, dipping approximately 19 degrees.

•Northeast Corner-Thrust Zone: In the final 70-80' (20-25 m) of Precambrian crystalline rock, a thrust fault zone was encountered and is interpretated as the Beartooth Thrust Thrust Zone. It is of interest to note that this thrust fualt zone is partially within the Precambrian section and the dip is approximately 19 degrees. This dipmeter dip angle on the Beartooth Thrust seems to valadate the foreland structural theory of decreasing dip angles in the Precambrian crystalline basement-at this location near the vertical depth of 8,232' (2,509 m).

After drilling out of the Precambrian, both boreholes initially encountered the overturned Paleozoic Ordovician Bighorn formation. Upon drilling through these rocks in the footwall, borehole records indicate a complex thrust and shear fault zone. The majority of faults within this complex fault zone in the overturned upper limb of this large fold seem to follow formational contacts between the more competent rock units of the Paleozoic and Mesozoic section. However, a small number of faults within incompetent units of the Mesozic section have been interpreted to account for variable formation thicknesses. Drilling records through this complex fault zone indicate thickened, thinned oir repeated rock units, as well as an estimated 2,000' (610 m) of Paleozoic and Mesozoic section missing or faulted and sheared out.

- •Northeast Corner-Vertical and Horizonal Offset: One of the most often asked questions concerns the vertical and horizonatal offset at the northeast corner of the Beartooth block? Although the Precambrian crystalline basement was not encountered in the footwall by either borehole, it is possible to calculate a very rough estimate of vertical separation and lateral overlap of the Precambrian. Assuming an average thickness of lower Paleozic rocks not drilled, and measuring vertically from the projected top of the Precambrian footwall surface to the projected top of the hanging wall Precambrian-Paleozoic contact, the vertical separation is approximately 4 miles (6.4 km). Measuring horizonatally from the inferred surface exposure of the Beartooth Thrust and also, assuming a consistent thrust fault dip of 19 degrees at depth, the Precambrian hanging wall lateral overlap is approximately 2.7 miles (4.3 km).
- ●The East Side of the Beartooth Mountains: in the summer of 1990 and 1991 Phillips Petroleum Company drilled two directional boreholes to the west-northwest into the eastern Beartooth Mountain foreland structure from the same surface location near Ruby Creek (NW4 NW4 Sec 15 T9S R20E), Carbon County MT designated the Ruby "A" Federal Number 1-9.

The first borehole was drilled to a total depth of 11,749' (3,584 m). There are no electrical log data in this first borehole from 9,100' (2,774 m) to total depth due to poor hole conditions. Mud log records indicate the base of the Precambrian crystaline hanging wall at a measured depth of approximately 2,100' (640 m). Mud logs also indicate an overturned Mesozoic section (Jurassic Gypsum Springs to Cretaceous Fuson) from a measured depth of 9450' (2.880 m) to total depth.

The second borehole deviated from the first borehole at a vertical depth of 4,651' and terminated at a total measured depth of 8,200'. Composite log and dipmeter data in this second borehole indicate a Mesozoic and Paleozic section (Jurassic Morrison through Mississippian Madison) from a measured depth of 5,019' to total depth. Dipmeter records also indicate the dip range on these units as 45 to 83 degrees to the west-northwest (overturned).

Foreland structural interpretation at this location is more speculative due to the limited extent of drilling data on the Phillips Ruby "A" Federal Number 1-9. This subsurrface foreland structure can probably be described as a horizontal to sub-horizontal, recumbent, synclinal fold with the upper limb cut by a large thrust fault or thrust faults that dip 35-45 degrees, steepening with possible splay near the surface.

• East Side-Thrust Zone: as hypothesized in earlier works by many other authors of eastern Beartoot Mountain structure, the dip of the Main Beartooth Thrust is steeper at this location than at

#### Significant YBRA People

#### Officers:

President: Marvin Kauffman, Red Lodge MT Vice President: Ed Beutner, F&M Past President: R. R. Dutcher, SIUC Secretary: Dale Springer, Bloomsburg U Treasurer: Betsy Campen Billings, MT

**Councilors:** 

Rich Yuretich, U Mass

Bob Giegengack, U Penn Kevin "Doc" Hoover, Story, WY Don Wise, F&M Duff Gold, Penn State Kirk Johnson, Denver Museum Nat History Linda Dutcher, Carbondale, IL Joe Nadeau, Rider U Virginia Sisson, Rice U James "Bud" Alcock, Penn State-Ogontz Peter Crowley, Amherst College Peter Muller, SUNY-Oneonta

**Special Councilors** 

Bill Bonini, Princeton John Utgaard, SIUC

Gerry Brophy, Amherst College

Accountant and member:

Denny McGinnis, PO Box 20598, Billings, MT 59106 Newsletter:

Newsietter:

Linda Dutcher

PO Box 128 Carbondale, IL 62903-0128 dutchrus@saluki-mail.siu.edu

Betsy Campen

3130 Reimers Park Drive Billings, MT 59102 ebcampen@wtp.net

**East Side-vertical and horizontal offset:** a rough estimate of vertical and horizontal offset, using the same qualifications relative to the Phillips-Ruby Creek location, are approximately 1 mile of vertical separation, and approximately 8.5 miles (1.35 km) of lateral overlap.

The AMOCO and Phillips wells did not discover any anticlines under the Beartooth Thrust, but they added some very useful data to the considerable wealth of information. And-there are still some Beartooth structural mysteries left for debate.

The author wishes to thank Linda Dutcher and Betsy Campen for the invitation to submit this brief examination of Beartooth Mountain structure to the

#### **New Members**

The YBRA would like to welcome the following new members:

Don Browne of UCLA, Los Angeles, CA

Mike Vice, Red Lodge, MT Nancy Immel, Red Lodge, MT Tom Oelesby, Cody, WY Mari Vice, University of Wisconsin, Plattevill, WI



#### FROM THE ARCHIVES:

By Linda Dutcher

It was late January. The Carbon County News first recorded the event on or around January 27, 1939:

### OVER 200 GO TO PRINCETON CAMP FOR WINTER SPORTS

Approximately 200 persons were at Princeton Camp Sunday for skiing and enjoyment of the excellent weather for winter sports. The day was warm, and enough snow fell during the preceding days to make skiing as enjoyable as it will be during the season. Merchants and businessmen in Red Lodge who donated prizes for the races to be given by the Red Lodge HIGHroad Ski club were: Palace Barber Shop, Richardson's Barber shop, and Keller and Reed's Barber shop, a free haircut each; Safeway, one dozen eggs; Sawyers, fifty cents in merchandise; Natali's Store, ash tray; Bloom & Co., knit tie; Pepsi Cola Bottling Works, one case Pepsi Cola; Gebo Grocery, two cans peaches.

\* Exactly how this arrangement came to be is unknown, but two letters written by Roy Wadsworth to W. Taylor Thom in November and December of 1938 indicate that Wadsworth was heavily involved.

Dear Dr. Thom,

Last Sunday there was a large crowd up by camp skiing. I was there all day. I hear there was a piece in the Red Lodge paper say that the Lodge at camp was open but that is not so. I showed Mr. and Mrs. William McKay and six of their friends through the lodge. The McKay[s] were part of the skiing party, one of the party was the scout master of the Billing[s] Boy Scouts who asked about renting the Lodge for a winter camping trip. I gave him your address and am enclosing a letter I got from him since. I can make 10 or 12 dollars a day at camp as long as skiing is good by opening the gate and let them use the road to haul the people back up the hill in a truck. The N.P.R.R. is going to run ski trains on Saturday and Sunday. Billings and Red Lodge has gone crazy about winter sports. There is about 10 inches of snow at camp. Nothing has been bothered there this year so far. If you think it will be all right to make this extra money I will do so and send it to Ed or you. It would help to pay the watchman. We can't stop them from going on Mr. Clark['s] ground but if they come by the ranch the watchman can go up and be there and watch everything.

(signed: Sincerely yours, Roy; and dated November 27, 1938)

Dear Dr. Thom,

We would like to see you but it won't be necessary for you to come out and help me rent to the ski club. I was in Billing[s] a few days ago and while there I checked up on Mr. \_\_\_\_ and find he is not a very responsible person. When I talked to him up here he said it would not be necessary for me to be around. The reason was they were going to handle liquor. A saloon man in Billing[s] was to be in with him. I told him before that you would not allow liquor up there in the summer and I would not allow it in the winter. I would like to make the place make some winter money. But I don't think I would care to deal with Mr. \_\_\_\_. I have not seen him since I got your letter. The Red Lodge Ski club has come up there the last three Sundays and will be up three more during the holiday. I think I will make between 80 and 85 dollars this month. I can either deposit the money here and send Ed the receipts or send him the money and he can place it where he wants to. All I want is my wages and will be glad to be able to turn some money back to the Association. I am also making a ice skating rink at the ranch so will have a little coming in from that to help pay out. About the water at camp, we could not turn the water on for anything; the line is not deep enough and there the pipes would freeze in under the kitchen. The club has been hauling water from the creek. I hope you have a Merry Xmas and a Happy New Year.

(signed: Sincerely yours, Roy, and dated December 21, 1938)

Wadsworth and Thom apparently never discussed the matter again in any of their long-standing and frequent correspondance. \* Reprinted by permission of Carbon County News from January 27, 1999.

The benches when smoothly, but neglect on my part to tighten a hose clamp caused the water line to pop during dinner, draining the camp water lines and giving me several days of fits trying to get everything bled and restarted. Dinner also brought back Duff, with the PSU vans loaded to the springs with Elk Basin rocks bound for more pit lining. Evening started with heavy rain, but that failed to dampen our spirits or our fire on the official inaugural burn. This night, both student groups joined us for a long evening of song, and introduction to the remarkable guitar skills of new PSU field camp instructor Don Fisher. (He actually learned the chords to "Alice's Restaurant" on the drive out, all 45 minutes, so I could finally do that one without a tape!)

That rainy night demonstrated that bare earth simply would not do around the pit, despite now having seats. So, the PSU students finally got their workout, hauling more truckloads of gravel up and spreading an attractive, fire retardant perimeter of bleached Bighorn dolostone. They also helped us demolish the unsightly mound of the old pit and scatter its ashes. The recalcitrant water line was repaired as well, ending the long tradition of lugging full Indian tanks to the Point for every fire. All these improvements, though, have still not conquered the problem of the "face-seeking" smoke, only made it more comfortable for a crowd to slowly gyrate around the circle as the Point winds shift. I suppose some adversity must be left for the ambiance.

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Suggestions or interest in future gatherings can be sent to Kevin Hoover, PO Box 451, Story, WY, 82842 (doc@wave.sheridan.wy.us).

YBRA UPLIFT.

#### Work Week 1998

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Work Week 1999 (Tuesday, August 3 through Monday August 9)

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