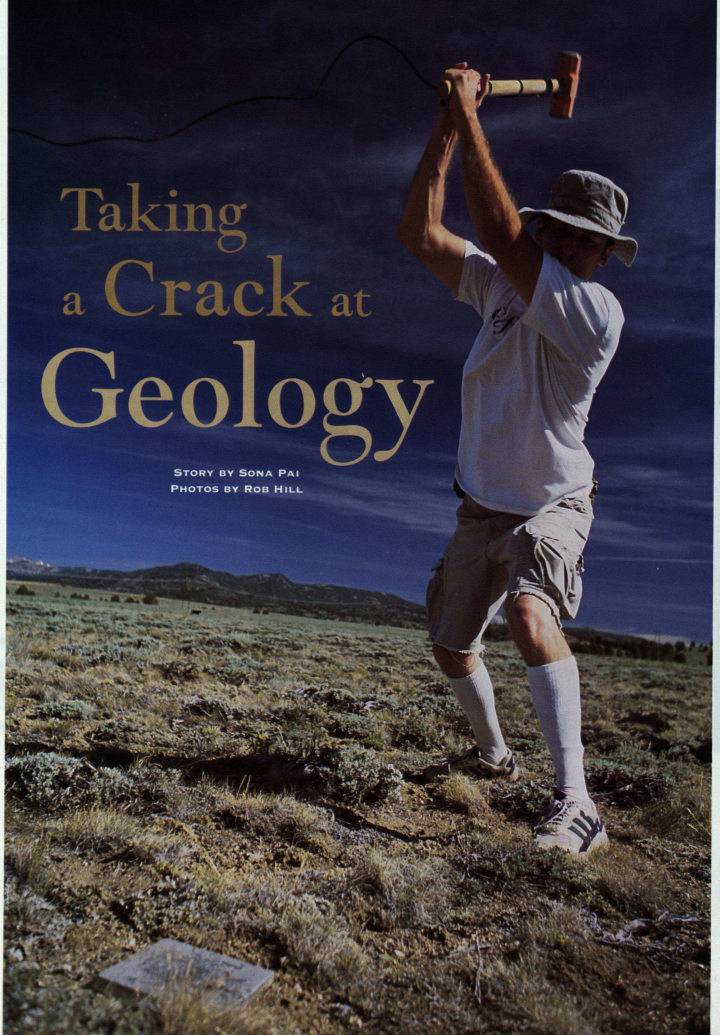

Taking a Crack at Geology

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GEOLOGY MAJORS CAP OFF THEIR COURSE WORK DURING A SIX-WEEK FIELD CAMP FULL OF MAPS, ROCKS, SUN AND TOUGH ASSIGNMENTS THAT DRAW ON ALL THEIR SKILLS.

In Sinks Canyon, on the northeastern flank of Wyoming's Wind River Mountains, the Popo Agie River disappears. Its waters tumble and crash, gushing over smooth chunks of rock before descending into a dark, limestone cavern known as "the Sinks." There, the current finds its way through gaps and fissures in the rocks, creeps through cracks and seeps through crevices deep in the earth until the wild, rushing river simply vanishes from sight.

About a quarter of a mile down canyon, and after a mysterious two hours underground, the river reappears in a pool called "the Rise," and it has changed. Here, the water returns to the light of day calm and green as malachite. It has increased in volume and taken on an esoteric gleam, the geological knowledge of two hours and a quarter-mile of earth that no one has ever seen.

Just before the Popo Agie (pronounced puh-POE-zha, like ambrosia) makes its subterranean descent, it meanders and gurgles around MU's Edward B. Branson Geology Field Laboratory, or Camp Branson, a cluster of red-roofed cabins about 10 miles from Lander, Wyo. Every summer, between 20 and 45 students from MU and around the country spend six weeks here and earn six credit hours, hiking, mapping, plotting, studying and learning to read the geology of Wyoming. Camp Branson's director, Bob Bauer, BS '71, MS '74, attended the camp as a student in 1970. He says the field camp experience is the first time many students fully comprehend the intricacies of their chosen career path.

Camp Branson near Lander, Wyo.

"By the time they get here, students have spent most of their time studying geology in the classroom in two and three dimensions, but there's only so much you can learn from charts and photographs. This is where they learn to see the fourth dimension, the effect of time. This is where things really begin to click."

Camp Branson was established in 1911, and it is the oldest continuously running geology field camp in the country. It has long been the site of a capstone course for MU geology students, the cli-

Darren Bielejeski, left, pounds a steel block as part of a seismology exercise during MU's six-week Edward B. Branson Geology Field Laboratory near Lander, Wyo. Camp Branson, the longest continuously running geology field camp in the country, attracts students from many universities. It's the site of the capstone course for MU geology majors.

During a mapping exercise, geology students spend the day hiking over varied terrain in search of rock outcrops, such as this one at right. Students plot the location and type of each rock outcrop on a map. This map helps them understand the geological processes that shaped the area.

Instructor Dallas Rhodes leads students in a hydrogeology project in Red Canyon, about 20 miles from Camp Branson. Before students begin an exercise on a nearby stream, Rhodes tells them that the first step in any project is to assess the surrounding terrain.

max of the bachelor of science program in which all accumulated skills and knowledge are put to use. Most geology programs across the country require some kind of field course, but MU is one of a handful of schools that maintains an actual camp, complete with lodging and dining facilities. MU's camp is unique because, as Tom Freeman, professor emeritus of geology and former camp instructor, says, "Everything's taken care of, so geology is all they have to think about." The experience is intense, the academic component rigorous, and the dry surroundings, wind-worn, sunbaked and short on shade, can be unforgiving.

"It's like the old military experience," Freeman says. "You hate it when you're in it, but once you come out of it, you'll think it's the best thing you've ever done."

Last summer, as in the summers before it, students from Missouri and beyond plunged, like the Popo Agie, deep into the geological history of Wyoming at Camp Branson. They learned the tools and tricks of the trade, trekked all over the arid Wyoming landscape and made solid, lasting friendships. Also, as in the summers before, last year's students groaned about the long hours in the field and the challenging exams. They scraped bare legs on stiff sprigs of sage and tiptoed away from their fair share of rattlesnakes. They cooled burnt skin and aching muscles in the chilly Popo Agie River. They discovered that, as Herman Ponder, AB '55, PhD '59, a student at Camp Branson in 1951, remembers, "Those rocks just weren't as clear cut as they seemed in the textbooks."

Fifty years after Ponder's experience, Darren Bielejeski, a senior at MU, feels the same frustration and laments, "They're just rocks. They'll never love you back."

On a hot, bone-dry Wyoming day in July, Dallas Rhodes, BS '69, stands at the base of Red Canyon, a spectacular site about 20 miles as the crow flies from Camp Branson. He shields his eyes from the unfiltered afternoon sun as he addresses a group of students. Rhodes, along with instructors Jim Luepke, BS '97, MS '99, and Don Siegel, leads a hydrogeology project, which mimics the kind of work environmental geologists do. "OK, first things first. You've got to get your mind around the setting. You've got to know what is going on around you and understand the processes at work," Rhodes says.

During the early part of the Paleozoic

Era, roughly 500 million years ago, a vast and shallow sea covered the western United States, a sea whose waters swelled and receded over what was then a relatively flat landscape. The sea swept up eroded bits of distant mountains, rock and earth from places north and east, and left them like gifts all over the land we now call Wyoming.

In the ages to follow, the earth would rise here, in crusty layers, bursting and wrinkling, cracking like the top of a soufflé. Mountain ranges would emerge and then erode. Land would fold and fault. During the Pleistocene Age, glaciers of icy debris moved out of the mountains, depositing their cargo of still more rock and earth in the adjacent basins of Wyoming, where they would melt while in motion, flow without moving forward. From the south and southwest, winds would whip volcanic ash over the land, where it would settle and add to the already complex story of Wyoming geology. It is a tale shaped and sculpted by mysterious twists in plot — an expansive, rolling narrative laid bare under the Western sun, challenging geologists to comprehend it.

"You can't just look at a creek and think, 'There's a creek.' You have to think about what a creek really is, what it does and what that means to your project," Rhodes says.

The students look up and around at the surrounding terrain. They see the stream, quietly winding through Red Canyon; the single cloud shadow that drapes across the canyon walls like a blanket; the walls themselves, stacked escarpments of reddish-cinnamon sandstone, siltstone, silty shale and limestone layered like lasagna and tilted toward the sky. When a burst of wind blasts through the canyon, grasshoppers swarm from sagebrush hideouts, and everyone is dusted with a fine layer of the land.

After taking note of their environs, the students begin gathering information for the project, a mock consulting exercise, in which they must determine if water from a nearby stream is leaking into the groundwater supply, or vice versa. They spend the next few hours collecting data at two workstations.

At one station, they test the stream water. Each group carries a blue tarp, a container for wastewater and a chemistry set in a blue case, like a tackle box. They spread the tarp on the ground and get to work. One person, ankle-deep in the sludgy "organics" at the bottom of the stream, takes physical measurements and collects a water sample; two people conduct chemical titrations with the sample; and someone else records the data. They communicate in shouts and questions that revolve around the matter at hand:

"Which test turns the water pink?"

"We're not doing that one yet. Are you checking water hardness?"

"Why do I always get stuck testing water hardness?"

Instructor Don Siegel, top, helps students collect groundwater from a well. Siegel brought a pump to draw the water out, but it was broken. Instead, he dropped plastic tubing down the well and sucked the water up. Bottom photo, from left, Melissa Dowling, Kate Berti and Melissa Owen conduct chemical tests on stream water during a hydrogeology exercise.

"One-eighty-eight for alkalinity. Is someone writing this stuff down?"

At the second station, a direct-push coring machine, the use of which was donated by the company Geoprobe, rams a steel rod deep into the ground and emerges with a 4-foot column of earth. Once the Geoprobe machine extracts the soil sample, Luepke and Rhodes insert a cylindrical screen and a PVC pipe in the hole, creating a small monitoring well for groundwater analysis. Students examine the soil in the tube by noting its color and moisture, looking for gravel and bits of roots, rolling it around in their hands and smelling it. Then, they use the well to access the groundwater.

"Come on everyone, let's get to work," says Siegel, a hydrogeology professor from Syracuse University, clapping his hands at signs of fading concentration. "We're not just going through the motions here. We're here to do science."

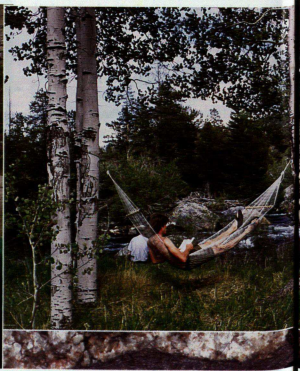
Students snap back to attention as they watch Siegel drop a length of plastic tubing into one of the monitoring wells. He kneels on the ground and says, "I brought a pump, but it's broken, so I'll just have to use my lungs instead. You always have to be prepared for equipment malfunction." Then, he draws the water out of the ground as though he were slurping up a thick milkshake. The students cheer and then scramble to collect and test the murky brown water in the same manner they worked on the stream sample.

Hydrogeology is new for most of the students here, but because they've spent all week working on smaller projects leading up to this one, they complete this exercise with the confident nonchalance of experience. They conduct each on-site chemistry analysis as if it were as routine as tying a shoe. They discuss things like dissolved oxygen levels and azimuths as though they were engaging in mere chitchat, the way people might talk about the weather.

Among other skills, students at Camp Branson learn to identify minerals and rock formations, create geological maps from their own field observations and use the Brunton compass, aka the Swiss Army knife of geology. They must then use the information gathered in the field to decipher the geological history of Wyoming and make inferences about the geological processes that formed and continue to alter the landscape.

"Yeah, this is about as clear as mud," Bielejeski says during an exercise in the South Pass area, a little more than an hour's drive from camp. He kneels next to a rock outcrop, Brunton compass in one hand, notebook in the other. He holds his book up and tries to visualize the bedrock he's supposed to measure, which forms in layers like the pages of a book. "This stuff actually made sense in the lecture," he says, laughing.

Lectures in the evenings or the mornings before most projects explain the science behind the exercises and prepare students for what they're about to encounter. Students work in groups of three or four on most projects, each of



The Popo Agie River, right, meanders around Camp Branson, and students can hear the crash of its rushing water from their cabins. Just beyond the camp, the Popo Agie descends into a dark limestone cavern and then, after a quarter of a mile, it mysteriously emerges in a calm, green pool.

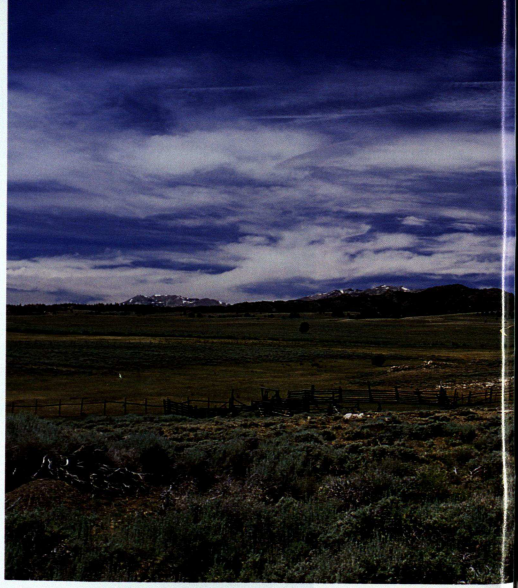
Bottom left, full days of rock hunting can make for hefty appetites. On July 4, students line up for a holiday barbecue dinner before heading off to see a local fireworks show in nearby Lander, Wyo.

Bottom right, students spend their free time hiking, swimming in the chilly Popo Agie River, tossing horseshoes, or just relaxing and enjoying the scenic surroundings.

which emphasizes collaboration and cooperation. Projects are short, usually lasting one to three days, so that a range of geology topics can be covered in the six weeks. Bauer recruits faculty members from MU and other universities, and instructors are cycled in for a week or two at a time to lead projects that fall within their particular expertise.

"We try to expose the students to as many different geological settings, techniques and concepts as possible while they're here," Bauer says. "When they leave, they are well-prepared to handle most geology field experiences."

Students record all of their data in small, orange hardcover field notebooks, which they are never without. The field notebooks are as much a part of the field geologist's gear as the magnifying hand lenses hanging from necks, the Brunton compasses tucked away in brown leather pouches, and the rock hammers and canteens that swing from belts and backpacks as the students hike. Norm Grannemann, BS '74, MA '76, attended the camp in 1974 and still has his field notebook from the experience that, he says, "made me sure I had made the right career decision." Kim Keel, BS '01, uses her field notebook to press and preserve Wyoming wildflowers — pink bitterroot blossoms and flaming red Indian paintbrush, white columbine and wild blue flax, delicate reminders of her time among sagebrush and sky.



Bob Bauer, associate professor of geology and Camp Branson's director, helps a team of students during a particularly complex exercise. For this final assignment, students spend days trekking all over a little more than one square mile of land in search of sparse, telltale rock outcrops. They plot this data to create a geological map of the area.

WHEN THE FIRST GROUP OF campers arrived in 1911, the Branson Field Laboratory was just a patch of land leased from the USDA Forest Service. Students and faculty hiked the 10 miles up to the camp from Lander and carried their books, beds and cooking supplies on their backs. Today, the camp is located in the same spot, but camp life is decidedly more comfortable. Students drive their own vehicles or ride in University vans right up to the camp entrance. They eat, sleep and study in furnished cabins named after rock formations in Wyoming, such as Sundance, the reading room; Tensleep, the women's dormitory, equipped with its own bathroom facilities; Chugwater, the laundry hut; and Yellowstone, the men's restroom.

At 6:30 every morning, bleary-eyed students head to the dining hall, where they fill up on eggs, bacon, sausage, pancakes and oatmeal. For lunch, it's sack lunches of sandwiches, carrot sticks and fruit. In the evening, everyone lines up, scrubbed and starved, for generously portioned meat-and-potatoes feasts prepared by a husband-and-wife cooking team from nearby Riverton. Sometimes, they retire to the lab or the reading room afterward to prepare reports, study for exams and munch on care-package snacks from home. Often, they'll head down to the Lander Bar for late-night refreshments and live music. Bar patrons welcome them, sometimes by name, and ask about the day spent in the field or the last exam. "How're the rocks treatin' ya this week?" a bartender might say as he slides a cardboard coaster in front of a thirsty geology student. By the end of the six weeks, T-shirts, sweatshirts and ball caps emblazoned with the Lander Bar logo abound at Camp Branson.

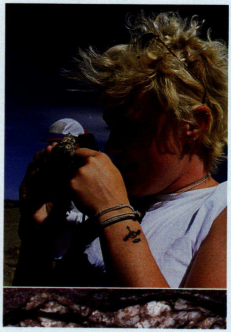
In the final week of camp, the students are tired, weighed down by the accumulated fatigue of the five preceding weeks.

The geology jokes that once had them in stitches — about finding anticlinal folds in their pancakes or listing the unlimited uses of the Brunton compass (cook an entire meal with it, fight a mountain lion, etc.) — have lost their charm. Students trudge where they once trekked and sigh, deflating like balloons, when they hear about the final project, a mapping exercise over a little more than one square mile of varied terrain.

Still, despite weary bodies and minds, they get the job done. They hike through galaxies of sagebrush and around constellations of cow piles in search of three types of rock: Miner's Delight, a dark-gray metamorphic rock with shiny gold flecks of biotite; South Pass granite, a milky-white granite; and Louis Lake batholith, a greenish-gray granitic rock. They use natural landmarks — a stream, the Wind River Mountains in the distance — as well as the squiggly contours on topographic maps and the delicate shade variations on aerial photographs to determine the location of each rock outcrop, which they then plot on a map. Later, when the plotting and mapping are done, they'll use the information to determine how and why the area formed the way it did.

The field camp curriculum is designed to make each project more challenging than the last. This final mapping project seems tedious to the students at first, like something they've done before, but it soon becomes clear that it is actually their most complicated assignment. "What do you think?" becomes the catchphrase of the day, often to be met with the reply, "I don't know, what do you think?" Student teams survey vast stretches of land with hands shielding faces from the sun and eyes squinted in concentration. Before they find even one rock outcrop, the teams must tromp through yards and yards of brush with no trail. They release the sweet, sharp scent of crushed sage with every step, but by this time they're so accustomed to it, they can't smell it anymore. This exercise requires the most of their patience as well as their cooperative and inferential skills. Making sense of the map that results will be like visualizing a jigsaw puzzle with most of the pieces missing.

But they know they can do it. They can do it, because after almost six weeks in Wyoming and six hard-earned credits, they have changed. Like the Popo Agie River, they have *been* changed. When they arrived, they were strangers, energetic and clean. They were eager and gushing with enthusiasm. They were students. Now, as they are about to emerge, they are friends, exhausted and coated in the dust of a common experience. They are wiser and confident in their abilities. They have become, at the end of it all, geologists. ❋



Kate Berti examines a rock through her hand lens, one of the field geologist's tools.