The Off-Campus Chronicle - Canyon Loop ’98
By Bruce Selleck (’71), Professor of Geology

We are off to the western US. For the last eight years, the Colgate Geology Off-Campus Field Program has included a four-week component in Colorado, Utah and Arizona. The first two weeks comprise the ‘Canyon Loop,’ which begins in the Front Range west of Denver, and ends at the North Rim of the Grand Canyon. The last two weeks of the western leg is centered near Silverton Colorado, where students map in the San Juan Mountains with Art Goldstein. Bruce Selleck leads the group through the Canyon Loop, and here chronicles the 1998 trek.

Monday, June 15:

After three weeks of eastern US geology in the Champlain Valley, Adirondacks and Mohawk Valley, in 1998’s cool rainy late spring, we all look forward to the change of scene ahead. Three vans loaded with cooking gear, tents and backpacks, 13 students, one professor and a teaching assistant head out from 118 Broad Street at 6:00 am. The green fields and forests of the Chenango Valley will seem much more inviting after the dry, rocky vistas of the Colorado Plateau, but now it is just ground to be covered on what is a very long drive. We spent last evening covering the ground rules for the trip - regular changes of drivers, ‘shotgun’ passenger awake at all times, plenty of coffee, and sleep for those not in the front seats. Every one of this year’s group is a Colgate-approved van driver, which distributes the driving burden.

Onto the New York Thruway at Canastota, we head west to Buffalo, and cross the border into Pennsylvania by 11:00 am. Every year we seem to pass through a strong frontal thunderstorm system, and this year it is waiting for us in eastern Ohio. We encounter heavy rains through Indiana and Illinois, and through the St. Louis area. No great problem, but wonderful to leave behind. Interstate 70 takes us into the late evening through Missouri, and then into Kansas in the early morning.

Tuesday, June 16:

Russell, Kansas, birthplace of Bob Dole, is our first morning pit stop. The sun breaks behind us to the east, lighting the high clouds with tints of coral and red-orange. We see stripper wells near Hays, working Cretaceous Dakota Sandstone beneath the Pierre Shale. The cornfields of Illinois and Missouri have given way to expanses of winter wheat, and the drier landscape signals our rise onto the High Plains. From hereabouts ‘til Denver, we rise every so slightly with each mile that passes. Near Hays, we see outcrops of Late Cretaceous Niobrara Chalk, a deposit formed from tiny marine shells which settled to the bottom of the vast interior seaway which stretched from the present Gulf of Mexico to the Arctic Ocean. The Niobara, which is similar in age and composition to the Chalks of the White Cliffs of Dover, marks the highest sea level attained in the last 250 million years. During the Cretaceous, large areas of the ocean basins were made up of active spreading ridges, and the water of the oceans was displaced onto the continents. Further west in Kansas, we encounter the late Tertiary gravel and sand of the High Plains aquifer begins near Hays, Kansas. These sediments are an important source of groundwater for irrigation in western Kansas, and in other High Plains states.

We cross the Kansas-Colorado border and stop for breakfast at yet another Burger King. Heading on west, the sky brightens and we know we are fully on the High Plains. A brief stop in Limon for postcards and souvenirs, and we head through Denver with the Front Range and Pike’s Peak in full view. Up the Front Range on I70, we see the classic stratigraphy in which we will begin our mapping project tomorrow. Passing by the Buffalo Bill Memorial, we arrive at Chief Hosa Campground - home for the next three days. This year’s group made the 1700 mile trip in 32 total hours - a new record with no speeding tickets After tents are set up and vans unpacked, a few head off for lunch and shopping. A few games of half-court basketball get us accustomed to the altitude. Dinner at six, then an early and well-deserved sleep.
Wednesday, June 17:

We awake to light rain showers and a cold north wind. After breakfast we head back east on I70 and stop for a quick look at the Proterozoic basement rocks of the Idaho Springs Formation, which hold up the higher topography of the Front Range. Then, at Red Rocks we begin our 2-day mapping project. The relatively simple stratigraphy, consisting of Fountain Formation overlying basement, Lyons, Lykins, Ralston Creek, Morrison, Dakota, Benton/Pierre, Fox Hills and Laramie Formations are well-exposed from Red Rocks Park to the east crossing Dinosaur Ridge. We cross paths with a field trip led by John Curchin, a Colgate geology graduate in the class of 1979. We also meet up with Phil Whitney, a geologist at the New York State Survey, who is vacationing in the area. Our mapping traverse crosses the entire sequence, ending with the Rooney Road exposures of the Fox Hills and Laramie. Spectacular dinosaur tracks in the Dakota, and dinosaur bone fossils in the Morrison Formation punctuate the sequence.

The weather improves through the day, with sunny, but breezy weather as we return to Chief Hosa to work on maps and cross-sections prior to dinner. Tory Milazzo (CU 2000) and a friend stop by at dinnertime. They had been to ski at Loveland Pass that day, and encountered snow showers. In Thursday’s Denver Post, Tory and friend are featured in a front page photo as they climb the slopes at Loveland Pass. Following dinner, we take a trip into Golden for a visit to a local establishment. A few games of pool are played, and we watch Dave Sunderlin make his attempt at 100 hot wings.

Thursday, June 18:

A cool, cloudy early morning gives way to bright, warm, sunny, but breezy weather. We head back to the map area, and make a traverse from the Proterozoic rocks to the I70 roadcut There we inspect the contact between the Late Jurassic Morrison Formation and the overlying Early Cretaceous Dakota Formation, and note that this contact represents the beginning of the the deepening of the western interior seaway. The maximum flooding, related to both global sea level rise in the early Cretaceous and foreland basin development due to the early stages of Laramide compressional tectonics to the west.

We then head south to map exposures in the area of Morrison Village. We finish off the field day by visiting the Turkey Creek exposures of the Dakota Formation, where a petroleum seep at the surface illustrates the movement of crude oil from more deeply-buried Benton and Pierre Shales that have been overthrust by the Dakota along segments of the Golden Thrust system. The late afternoon back at camp allows time to complete final copies of the map and cross-section.
During the dinner hour we are joined by Roger Wiggin, John Curchin and Joel Schneyer, all Colgate geology graduates from the late 1970’s who live in the Denver area. Roger is in the petroleum industry, John teaches in a local community college, and Joel is in the banking/precious metals business. Students have an opportunity to talk about career paths and options that are available with a geology degree. We end the evening with a trip to the Morrison Inn for nachos and more conversation.

Friday, June 19:
Up at 6:30 to bright sunny skies, we break camp and head west on I70. We detour off I70 onto US 6 at Loveland Pass and climb to 11,900 feet at the Continental Divide. After a brisk hike up, a bit of sliding in the snowfields and mandatory group pictures, we descend to Dillon, Colorado and Arapahoe Basin Ski Area. We pass through a bit of Mesozoic stratigraphy in a Laramide fault at Dillon, then back into Proterozoic basement of the Park Range. We encounter the Pennsylvanian Maroon Formation at Vail, and then the marine rocks of the Permian Minturn Formation, which marks the flooding of the Eagle Basin of the Ancestral Rockies. Mesozoic rocks appear soon after, but then we descend through the section to see Cambrian sandstone overlying Proterozoic Rocks at Glenwood Springs.

Our lunch stop near Rifle, Colorado gives us a view of the Late Cretaceous and Early Tertiary strata to the north, including the white cliffs of the Eocene Green River Group. Following the Colorado toward Grand Junction, we pass Late Cretaceous coal-bearing strata of the Mesa Verde Group, and descend into Mancos Shale outcrops at the base of the Book Cliffs. At Grand Junction we climb into Colorado National Monument, where we see the Triassic Chinle Formation resting directly on the Proterozoic basement of the Uncompahgre Uplift. Back on I70, we continue west into Utah, crossing through the broad outcrop belt of Mancos Shale. At Cisco, Utah (a true garden spot) we leave I70 to take Utah Route 128 down the ‘Little Grand Canyon’ of the Colorado. We make a photo stop near Castle Valley, where the snow-capped peaks of the LaSal Mountains form a backdrop to the array of erosional buttes and mesas developed in the Moenkopi, Chinle and Wingate Formations. We pass through the East Portal into Moab Valley, and find our campground - Slickrock. It is hot, clear and dry, and welcome. Swim, light dinner, a trip into town, and we are ready for bed.
Colorado National Monument - looking northwest toward the Colorado River Valley and Grand Junction/Fruita area.

LaSal Mountains as seen from the "Little Grand Canyon", with Castle Valley in the distant mid-ground.
Saturday, June 20:

A bright clear morning greets us, along with crowing roosters and squabbling birds at Slickrock Campground. We head out to Canyonlands, stopping to view the stratigraphy near Canyonlands entrance. The Moab fault brings down the Morrison-Dakota sequence against the Triassic Moenkopi and Chinle. We then drive out to Island in the Sky to view the confluence of the Green and Colorado Rivers, and discuss the large-scale geologic setting and plate tectonic history of the western US. Following Canyonlands, we drive to Deadhorse Point to view the Colorado River and the spectacular incised meanders, and get a fine overview of the evaporation ponds at Potash. Brine extraction from the Hermosa evaporites is a major source of sylvite for fertilizer.

We have lunch at the entrance to Arches, and then begin our mapping project on the Moab Fault. To the west, the Chinle-Wingate scarp forms the boundary of the Moab Valley. The fault brings down the Entrada against the older Permian Culter Group adjacent to the highway. We return to camp for dinner and relaxation, and the cooler temperatures. A few members of the group venture into Moab Village for a movie and other entertainments.
Sunday, June 21:
A light shower overnight does little to cool down the morning sun. We head out early to continue our mapping along the Moab Fault. We encounter a group from University of West Virginia, who are also on field camp in the Moab area. Their professor, Ron Harris, was a TA with Bruce in Alaska in the early 1980’s. After covering the area south of the Arches entrance, and mapping in the two faults, which comprise the Moab Fault system, we have lunch at Arches entrance and head into the park area. We discuss the origin of the Moab Valley and fault system. The faulting is in response to the dissolution of Hermosa Group evaporites in the subsurface. The evaporites - gypsum and halite - have flowed upward into the core of the Spanish Valley anticline, a broad north-northwest trending upfold that defines the Moab Valley. As the salts encountered the fresh waters of the Colorado River Valley aquifer, the soluble salts dissolved away, resulting in volume loss at depth. The overlying sandstones and shales have slid downward along the Moab and other faults along the flanks of the valley.

Visiting North and South Windows, we then head out to Delicate Arch. In the hot of the afternoon, part of the group takes the hike up to the arch (Newhall, Sunderlin, Johnson, Bosek, Carnahan, Shaw, Flynn, Selleck) while the remainder view the arch from below.

Back at Slickrock Campground, we enjoy the pool and hot tubs in the late afternoon sun. After dinner, we plan tomorrow’s activities on our day off.

Monday, June 22:
The morning of our day off is another bright and clear start. A group heads off to hike in the LaSal Mountains (Brackett, Carahan, Flynn, Selleck). Another three (Newhall, Bosek, Tindall) take a morning raft ride on the Colorado. The rest (Faubert, Shaw, Close, Sunderland, Grassl, Johnson, Steinglas) rent kayaks for a trip down the Colorado. We collect back at Slickrock for rest, and escape from the sun, and head into the town of Moab for dinner ‘out’. 
Tuesday, June 23:

We arise at 5:30 am for an early departure for Bryce Canyon. After packing, we drive north to I70, and then west through Green River (where John Wesley Powell began his trip down the Green and Colorado Rivers in 1876), and west to the flank of the San Rafael Swell. Heading south, we stop in Hanksville at the "Hole in the Wall" store, and then continue on to Capitol Reef National Monument, where we stop for lunch.

Our route takes us over Boulder Mountain, where we stop to view the Henry Mountains, and the Escalante-Grand Staircase National Monument, and talk a bit about public lands policy in the western US. We drive over the "Beastmaster" highway, and stop to inspect the fine exposures of Navajo Sandstone. Soon we are at Ruby's Inn, and make arrangements for our afternoon horseback trek to the canyon rim, and get free tickets for the rodeo. After dinner, a few of us head into the Sunset overlook in the park, while the rest head to the rodeo.

Wednesday, June 24:

We arise at Ruby's Inn, and head out to the canyon for our morning hike on the trails on the east rim. We see the Eocene Claron Formation, a series of shallow lake deposits with abundant volcanic ash beds. The azure blue Utah sky provides a wonderfully contrasting backdrop for the coral, pink and orange hues of the Claron Formation cliffs and spires.

After lunch at the Bryce Canyon Lodge General Store, we depart for Zion National Park. Heading west to the Siever River Valley, we drive south on Utah 89. The Siever River flows north, following the older drainage system toward the Siever Desert in the eastern Basin and Range Province. The Siever drainage area is being progressively reduced by headward erosion of the Virgin River drainage, which carries water south to the Colorado. We pass through the drainage divide, and then head west into the Zion Park area. The entrance road takes us by steep winding cliffs of Navajo Sandstone, which display the exquisite aeolian crossbedding for which the Zion area is so well-known. Into the winding entrance road tunnel, we exit into Springdale and arrive at our campground. It is hot and dusty, but the winding rapids of the Virgin River provide welcome respite.

Following dinner, a few of the group head out to the Narrows area along the Virgin River in Zion Canyon. The rest catch up on mapping projects and work from the last week.
Thursday, June 25:

It is still relatively cool at 6:30 am as we get ready for our hikes in Zion Canyon. We stop at the Grotto Parking area and hike up to Hidden Canyon, which is a slot cut into the Navajo along a fracture in the rock. We inspect, close-up, the aeolian dune crossbedding, and speculate about conditions in the canyon during summer downpours and spring snowmelt. The canyon also nicely illustrates the strong control exerted by fractures on the erosional patterns in the area. We hike along a set of closely-spaced joints which form planes of weakness in the otherwise resistant Navajo Sandstone.

After our descent from Hidden Canyon, we head back to the Grotto picnic area for lunch. Then a group (Newhall, Bosek, Tindall) drives up for a hike in the Narrows. The rest take the Angel’s Landing trail and climb the stirring heights for a great view of the Zion Canyon. The last quarter mile is challenging, but we are at the top in one hour and ten minutes. We are all back at camp by 3:00, and a few take dips in the Virgin River. Following dinner, we are treated to cookies by a family gathering at the campsite next door. Sleep comes easily and early.

Cathy Bosek admires the Navajo Sandstone from the Zion Tunnel Overlook.
Friday, June 26:

Yet another cloudless sky greets us as we arise at 6:30 for breakfast and packing. Exiting the Zion tunnel, we stop for a quick hike to view the canyon yet again, then continue on through Mt. Carmel Junction, and south toward the Arizona border. We buy food for the next couple of days in Kanab, then on to a brief stop for an overview of the Grand Staircase. From our vantage point on the lower reaches of the Kaibab Plateau, we see the distant Pink Cliffs (Paleocene-Eocene Claron Formation), Gray Cliffs (Cretaceous Tropic Shale and Mesaverde Formation), White Cliffs (Jurassic Navajo Formation), Vermillion Cliffs (Triassic Kayenta Formation), and Chocolate Cliffs (Triassic Moenkopi Formation). As we stand on the Permian Kaibab Formation, the entire Mesozoic sequence of the western interior is set out before us.

![The inner canyon from Cape Royal.](image)

Continuing on, we stop at Jacob’s Lake for gas, then drive south on the North Rim access road. Arriving at the North Rim Campground, we set up tents and then head out to Cape Royal for an overview of the Grand Canyon. Proterozoic Vishnu Schist is overlain by late Proterozoic Grand Canyon Series. The ‘Great Unconformity’ separates the Grand Canyon Series from the Cambrian Tapeats Sandstone (just like the Potsdam Sandstone we saw in the Champlain Valley. Overlying Bright Angel Shale, Mauve Formation and Redwall Limestone are easily identifiable, followed by the Supai Group, with prominent red Hermit Shale. The Coconino Sandstone, Toroweap Formation and Kaibab Limestone form the rest of this classic sequence. We discuss the late Cenozoic uplift history of this part of the Colorado Plateau, and the downcutting of the canyon, which is well-demarcated by numerous dated lava flows. The distant San Francisco Mountains near Flagstaff are still snow-capped.

We drive to Point Imperial to view a similar stratigraphic sequence, but there, looking northeast, we can see the distant Vermillion Cliffs (where California condors were released into the wild in hopes of establishing a breeding population) and the Marble Plateau and Marble Canyon. The Kaibab Monocline and Kaibab Fault are visible from this view, and we can identify the offset within the canyon, which brings Grand Canyon Series strata up against Redwall Limestone.

Back at camp, we have dinner, and are treated to a fine sunset and the sliver of moon over the canyon to the west of the campsite. Most work on completing earlier projects, and we prepare for our early hike down the Kaibab Trail.
Saturday, June 27:

Another cloudless sky awaits us at 5:30 am. After a quick breakfast, we drive to the Kaibab Trailhead, and begin our descent into the Grand Canyon. The hike is dry and dusty, and the mules have left us plenty of odiferous markings. A few of the group decide to stop at the halfway point, but the rest continue for the nine mile, 3400 feet vertical hike. We stop for a bite to eat at Roaring Springs, rest a bit, then begin the ascent back through the stratigraphy. The water faucet at the Hermit Shale is a welcome respite, and prepares us for the final "Coconino Switchback Torture". All are back at the trailhead by 12:30, and we head back to camp for an afternoon of relaxation and finishing of projects.

In the late afternoon we depart to the Grand Canyon Lodge for dinner. The Geology Alumni Discretionary Fund foots most of the bill (thank you generous alums!!), and we watch the sun set over the canyon from this splendid place. The later evening is an opportunity for socializing and completion of projects.

Sunday, June 28:

We are up at 5:00 (actually 6:00 Colorado time) and pack camp. Today’s drive takes us to the north to Jacob's Lake, then west toward the Marble Canyon of the Colorado. We pass by the Vermilion Cliffs, cross the river, and head south along the Navajo Cliffs within the Navajo Indian Territory. Turning east, we stop for lunch in Kayenta (the world’s best Burger King), and turn north through Monument Valley. We stop for the requisite "Forest Gump" photos, and continue into Utah. We head east again into Colorado near the Four Corners area. Shiprock is clearly visible to the south, and Tertiary Intrusive rocks of Ute Mountain come into view. We turn east again in Cortez, Colorado, and pass by the northern edge of Black Mesa, where Cretaceous coal is mined in the Mesa Verde Group. Mesa Verde Cliffs rise to the south, but time does not permit a visit to this classic Native American site. Continuing east, we stop in Durango, and meet up with Art Goldstein, who leads the next section at Molas Pass. Bruce says his goodbyes., and the rest head up the "Million Dollar Highway" to begin the mapping project in the San Juan Mountains. The Canyon Loop is over.