

Anza Borrego Geology Trip Spring 2012

Credits: 3.0

Special Topics Course **CRN:** 447

Prerequisite: a 100 level Geology course and a 200 level Geology course

Class meets: January 9-20, 2012 in the field, and MW, 8:00-8:50 am (intermittently throughout course) on campus

Instructor: Les Hasbargen

Office: 219 Science 1 Ph. 607-436-2741

Office hours: MWF, 11:00-11:50 am

Personal web site: <http://employees.oneonta.edu/hasbarle/index.html>

Textbooks

Required: *Rite in the Rain Geology Field Note Book*, ISBN 978-1-932149-35-7.

Required: Anza Borrego Geology Guide, with maps of the field trip stops, exercises, etc. You will need to print this document, preferably in color, before departing on the trip. It will be available on Angel, and on Les Hasbargen's personal web site.

Optional: *Paleontology and geology of the western Salton Trough detachment, Anza-Borrego Desert State Park, California*, Field Trip Guidebook and Volume for the 1995 San Diego Association of Geologists Field Trip to Anza-Borrego Desert State Park, Volume 1, edited by Paul Remeika and Anne Sturz, 1995.

Optional: *Geology of Anza-Borrego: Edge of Creation (California Desert Natural History Field Guides, No 1)*, by Paul Remeika, Sunbelt Publications, 1992, ISBN #9780932653178.

Optional: *Geology in the Field*, by Robert Compton ; John Wiley and Sons, 1985; ISBN: 0-471-82902-1.

Course Description

This field course examines the geology, surface processes, and geomorphology along a complex tectonic plate boundary in southern California. Students will decipher connections between modern depositional processes and environments and the sedimentary structures that are preserved in the rock record. Students will identify and characterize the various ways in which rocks deform. Students will develop geologic field mapping skills and gain experience in the construction of geologic maps and graphical representations of the geology in the area. A minimum of 9 students is needed for the trip to run. Costs should not exceed \$825 per student including air fare, food, lodging, transportation, and tuition. Students will stay in campgrounds. The field trip will take place over winter break, with additional classroom teaching during spring semester.

Course Justification

There is a persistent need for trained geoscientists with experience in geologic field investigation. This course will expose students in Geology, Earth Science, Environmental Science, and Water Resources programs to an active plate tectonic boundary in southern California, with most of the trip taking place in Mecca Hills Wilderness and Anza Borrego Desert State Park. These locales provide extraordinary learning opportunities for students,

exposing numerous faults and folds, a spectrum of rocks including clastic and chemical sedimentary rocks, intrusive igneous rocks and metamorphic rocks. The landscapes in the area exhibit premier examples of landscape processes and geomorphology, including uplifting mountains, huge landslides, dunes, playas, alluvial fans, and desert pavement.

The focus of Geol 394 is on applied field observation—students integrate much of what they have learned in prior coursework in a real world context. The nearly 100% exposure of rocks and structures in the area offers a view into Earth's processes and the geologic record of past environments. In addition, the close juxtaposition of eroding mountains, and modern depositional settings for clastic and chemical sediments permits field based projects which couple stratigraphy with processes in a very direct way. Field exercises will require students to identify rocks, characterize processes, and develop skills in collecting and analyzing spatial and geologic information. This course will be a profound learning experience.

The course will take place mostly on the field trip, which will run winter break in January 2012, and with lectures during the spring semester. After returning, students will select a field location for greater examination, and present their literary investigation of the area to the class. Students will be evaluated based on participation on the field trip, field notes, field maps, and post-trip presentation.

Specific course objectives. Students learn how to: relate sedimentary features and structures to depositional environments and surface processes; map rock units; identify and map faults and folds; and recognize relationships between tectonic activity and landscape form.

Student Learning Outcomes for the Geology Major addressed by this course:

- Students will demonstrate their ability to describe and identify geologic materials. (GEOL-SLO #1)
- Students will demonstrate their understanding of how rocks, sediments, and soils form. (GEOL-SLO #2)
- Students will demonstrate comprehension of the role of deep time in Earth history. (GEOL-SLO #3)
- Students will demonstrate understanding of processes that occur on and within the Earth and interactions among Earth's systems. (GEOL-SLO #5)
- Students will demonstrate their ability to collect and analyze geologic information in field and laboratory settings. (GEOL-SLO #6)
- Students will demonstrate their ability to apply scientific reasoning and technology to solve geologic problems. (GEOL-SLO #8)
- Students will demonstrate their ability to work collaboratively to solve geologic problems (GEOL-SLO #9)
- Students will utilize scientific methods to design and execute research projects that include collection, analysis and interpretation of data. (GEOL-SLO #10)
- Students will demonstrate their ability to communicate scientific and technical information effectively through appropriate oral, visual and written presentation. (GEOL-SLO #11)

Student Learning Outcomes for the Earth Science Major addressed by this course:

- Students will demonstrate understanding of the governing concepts related to all components of the Earth system (meteorology, geology, oceanography, astronomy) and the relationships that link them. (ES-SLO #1)
- Students will demonstrate understanding of the structure of Earth's interior and the processes that operate within and on the Earth's surface, including a working knowledge of plate tectonics and natural hazards. (ES-SLO #4)
- Students will demonstrate their ability to describe and identify geologic materials and interpret the processes by which these materials form. (ES-SLO #5)
- Students will utilize scientific methods to design and execute research projects or solve problems that include collection, analysis and interpretation of data. (ES-SLO #7)
- Students will demonstrate their ability to communicate scientific and technical information effectively through appropriate oral, visual and written presentation. (ES-SLO #8)

Grades

Students will be evaluated based on **participation (5%)** on the field trip, **field notes (50%)** and **maps (30%)**, and a post-trip **presentation (15%)**.

Participation (5%) on the field trip, which includes asking questions in the field, assisting with tent set-up and tear down, doing dishes at the camp, helping with food preparation, cleaning up the camping area, and assisting with packing up camping gear.

Field notes (50%). These must include a record for each stop, including date, time, location (UTM GPS location), verbal descriptions, sketches, and comments on key themes at the stop.

Geologic maps (30%). Students will create geologic maps for the reconnaissance exercises at select sites including Painted Canyon and Split Mountain. Each map must have a descriptive title, author, date, and lithologic legend. The finished map (the desk copy) should have lithologic contacts, folds, faults, and rock orientation symbols. Lithologic units must be color-coded in the map and on the legend (desk copy only). Students are encouraged to transfer their map data to a GIS format, but paper maps with legible writing and hand-drawn features will not receive less credit.

Post trip presentation (15%). Students will choose a topic on the trip to investigate further in the scientific literature, and present their findings to the group. The presentation must be in the form of a slide show; must have a title, author, and date; must provide new information about the site not contained in this guide book or the textbook, and should give a more detailed picture of what is known about the topic or site.

Rubric for Field Notes (50% of course grade)

Each stop must have the following elements (listed in the criteria) recorded in the field notes.

Weight (%)	Quality Points Awarded	Criteria
10	0-4	Date, time, location (GPS coordinates)
20	0-4	Purpose and Description of stop
40	0-4	Detailed notes of observations

30	0-4	Sketches
Quality Points: 4 = Excellent; 3 = Good; 2 = Fair; 1 = Poor (but passing); 0 = No credit		
Grade assignment: A: 100-87.5%, B: 87.5-62.5%, C: 62.5-37.5%, D: 37.5-25%, E: < 25%		

Rubric for Geologic Maps (30% of course grade)

Field and finished (office) copies of your geologic maps. Each office copy map will be evaluated based on the criteria below.

Weight (%)	Quality Points Awarded	Criteria
5	0-4	Lithologic contacts
5	0-4	Faults
40	0-4	Rock Orientation symbols, correctly plotted
15	0-4	Legend: Color-coded for lithologic units; all geologic symbols need a symbol (fault, strike-dip, contact, etc)
30	0-4	Verbal description of lithologic units in legend
5	0-4	Title, author, date, references for data sources, north arrow, scale
Quality Points: 4 = Excellent; 3 = Good; 2 = Fair; 1 = Poor (but passing); 0 = No credit		
Grade assignment: A: 100-87.5%, B: 87.5-62.5%, C: 62.5-37.5%, D: 37.5-25%, E: < 25%		

Rubric for Student Presentations (15% of course grade)

You will present a topic to the class based on a literature search and your field observations of some topic on the field trip. The presentation should be 10-15 minutes long. The presentation will be evaluated based on the *criteria* below.

Weight (%)	Quality Points Awarded	Criteria
10	0-4	Title, author, date
25	0-4	Introduction: Provides the setting for the topic
25	0-4	Discovery of information from a literature review
25	0-4	Description of information from field observations
15	0-4	Discussion of what you would like to explore further if you went back...
Quality Points: 4 = Excellent; 3 = Good; 2 = Fair; 1 = Poor (but passing); 0 = No credit		
Grade assignment: A: 100-87.5%, B: 87.5-62.5%, C: 62.5-37.5%, D: 37.5-25%, E: < 25%		

The rubric score will be re-scaled to the University curve, and final grade assignments will be guided by the standard University curve given below.

Percent	Grade	Percent	Grade	Percent	Grade	Percent	Grade
93-100	A	87-89.9	B+	77-79.9	C+	67-69.9	D+
90-92.9	A-	83-86.9	B	73-76.9	C	63-66.9	D
< 60	F	80-82.9	B-	70-72.9	C-	60-62.9	D-

Tentative Schedule for Field Trip

Date	Day	Weekday	Activity
1/9/2012	Day 1	Monday	Fly to Ontario/Whitewater Canyon
1/9/2012	Day 1	Monday	Desert Hot Springs
1/10/2012	Day 2	Tuesday	Palm Springs Tram
1/10/2012	Day 2	Tuesday	1000 Palms Canyon/Coachella Valley Preserve
1/10/2012	Day 2	Tuesday	Mecca Beach/Salton Sea State Recreation Area
1/11/2012	Day 3	Wednes.	Box Canyon
1/11/2012	Day 3	Wednes.	Mecca Beach Paleoshorelines
1/12/2012	Day 4	Thursday	Painted Canyon
1/13/2012	Day 5	Friday	Painted Canyon; Ladder Canyon
1/14/2012	Day 6	Saturday	Imperial Dunes (Glamis, CA)
1/14/2012	Day 6	Saturday	Mud Volcanoes (Nyland, CA)
1/14/2012	Day 6	Saturday	Obsidian Buttes (Westmoreland, CA)
1/14/2012	Day 6	Saturday	Fossil Canyon
1/14/2012	Day 6	Saturday	Agua Caliente Hot Springs Campground
1/15/2012	Day 7	Sunday	Arroyo Tapiado
1/15/2012	Day 7	Sunday	Canyon Sin Nombre
1/16/2012	Day 8	Monday	Torrey Pines
1/17/2012	Day 9	Tuesday	Anza-Borrego Visitor Center
1/17/2012	Day 9	Tuesday	Split Mountain
1/18/2012	Day 10	Wednes.	Lute Fault Scarp/Fonts Point/Borrego Badlands or
1/18/2012	Day 10	Wednes.	Tule Wash/Pumpkin Patch/Shell Reef
1/19/2012	Day 11	Thursday	Wonderstone/Fish traps/Landslide/Travertine
1/20/2012	Day 12	Friday	Pines to Palms/ Fly to Albany

Class Schedule (this schedule is subject to change as needed).

Date	Week in sem.	Day	Location	Activity
Jan 12-20	Pre-Spring	M→F	Anza Borrego, California	Field Trip
Jan-23	Week 1	M	Class does not meet	
Jan-30	Week 2	M	Field notes DUE!	
Feb-6	Week 3	M	Create digital data sets	

Feb-13	Week 4	M	Plot digital geologic data	
Feb-20	Week 5	M	Plot digital geologic data	
Feb-27	Week 6	M	Choose research topics	
Mar-5	Week 7	M	Literature searches	
Mar-12	Week 8	M	Work on maps	
Mar-19	Week 9	M	Class does not meet	Spring Break!
Mar-26	Week 10	M	Work on maps	
Apr-2	Week 11	M	Work on maps	
Apr-9	Week 12	M	Work on presentations	Maps DUE!!
Apr-16	Week 13	M	Student presentations	
Apr-23	Week 14	M	Student presentations	
Apr-30	Week 15	M	Student presentations	
May 7	Week 16	M	Student presentations	
May 14	Week 17	M	Finals	

Spring 2012 Calendar

January 22-24	Sunday-Tuesday	New student arrival & orientation
January 25	Wednesday	Classes begin
March 16	Friday	College closes after last class
March 26	Monday	Classes resume
May 9	Wednesday	Study Day
May 10-16	Thursday-Wednesday	Finals

Emergency Evacuation/Shelter-in-Place Procedures In the event of an emergency evacuation (i.e. fire or other emergency), classes meeting in Science I are directed to reassemble at Chase Gymnasium so that all persons can be accounted for. Complete details of the College's emergency evacuation, shelter-in-place, and other emergency procedures can be found at <http://www.oneonta.edu/security> .

Course Guidelines and Expectations for Students

The following list provides a baseline of what is expected from students in this course (quoted section from the list of *Student Responsibilities* approved by SUNY Oneonta).

“In class responsibilities

Students will:

- Attend all classes and arrive punctually.

- If unavoidably late for a class, enter quietly and unobtrusively, and behave in other required ways to minimize distraction.
- Remain alert and attentive during lectures, discussions, and other class/lab activities.
- Avoid unnecessary conversation during lectures, discussions, and other class/lab activities.
- Contribute to class experiences by asking relevant questions, offering relevant examples or views, adequately answering questions posed by others, engaging in critical and independent thought, and challenging both the instructor and the curriculum materials assigned for the course.
- Demonstrate courtesy and respect in dealing with instructors and classmates.
- Recognize and seek to understand diverse points-of-view.”

In the field responsibilities*Students will:*

- Assemble all materials they need to conduct field investigations and bring these items with them (this list will be supplied at the start of the semester)
- Participate in group camping activities, such as setting up and taking down tents, preparing food and cleaning up after meals
- Be respectful of fellow students on the trip and of other campers in the campground
- Maintain quiet time from 10 pm to 6 am in the campground (or according to the local campground guidelines)
-

ADA (Americans With Disabilities Act) Statement

All individuals who are diagnosed with a disability are protected under the Americans with Disabilities Act, and Section 504 of the Rehabilitation Act of 1973. As such, you may be entitled to certain accommodations within this class. If you are diagnosed with a disability, please make an appointment to meet with Student Disability Services (SDS), 209 Alumni Hall, ext. 2137. All students with the necessary supporting documentation will be provided appropriate accommodations as determined by the SDS Office. It is your responsibility to contact SDS and provide the teacher with your accommodation plan before a test.

Check list of Useful Items (Think Christmas Wish List!)

- _____ Hat—preferably wide brim to shade the ears/neck
- _____ Sunglasses
- _____ Hiking shoes
- _____ Sunscreen
- _____ Warm jacket
- _____ Gloves
- _____ Rain jacket
- _____ Undergarments
- _____ Long johns
- _____ Long-sleeved and short-sleeved shirt
- _____ Several pair of socks
- _____ A pair of long pants and shorts
- _____ Toiletries (check with airlines for permissible container sizes)
- _____ Towel
- _____ Flipflops or shower sandals
- _____ Sleeping bag (to 25°F) and small pillow
- _____ Sleeping mattress
- _____ Flashlight/headlamp
- _____ Eating utensils (fork, spoon, knife, plate/bowl, cup)
- _____ Water bottle (just make sure it's plane transport friendly; or buy water bottles in CA)
- _____ Camera (optional, but really helpful!)
- _____ Field book (with water resistant paper, such as Rite in the Rain)
- _____ *Compass with azimuth and inclinometer
- _____ Hand lens (see Geo-Tools for geology hardware: <http://www.geo-tools.com/index.htm>)
- _____ *Rock hammer (protective eye wear/goggles are a good idea)
- _____ Calculator
- _____ Whistle (in case you get lost)
- _____ Clipboard and/or map case (you can make your own with a clear plastic cover)
- _____ Pencils (mechanical pencils, or wood pencils with sharpener)
- _____ Pens and Permanent Marker
- _____ Protractor/6" ruler
- _____ *GPS unit
- _____ Charger for cell phone/electronic devices
- _____ Medium size duffel bag for clothes, sleeping bag, mattress, and personal items (choose a size within airline guidelines)
- _____ Day pack for lunch/snack items, pockets for water bottles, room for rain jacket, misc. tools
- _____ *Hard hat for caving

* Indicates item can be checked out from Earth Sciences Dept

Waiver for Use of Photographs

Please initial the statements below and sign and date this form at the bottom, if you agree to the terms.

_____ I understand that photographs will be taken of me during the course of this class field trip (Geol 394, Anza Borrego Geology Trip, Spring 2012).

_____ I grant permission to Earth Sciences Department and SUNY Oneonta for the photographs to be used for educational and promotional purposes.

Name (Please Print)

Signature

Date

Key Themes

Tectonics

Opening of Gulf of California
Initiation of Colorado River sedimentation in Salton Trough
Basin segmentation
Origin of strike slip boundary
San Andreas fault
San Jacinto fault
Elsinore fault
Transtension
Transpression
Pull-apart basins
Strike slip faults
Thrust faults
Normal faults
Restraining bends
Releasing bends

Geomorphology

Mountains
Lakes
Streams
Arroyos
Washes
Slot canyons
Alluvial fans
Dissected fans
Drainage divides
Divide migration
Perched basins
Shorelines
Travertine
Hot springs
Springs
Oases
Deltas
Scarps (erosional and fault)
Sag ponds
Beheaded streams

Shutter ridges
Offset streams
Playas
Pavement
Ventifacts
Wind gaps
Dunes
Stream evolution
Badlands
Pseudokarst
Spheroidal weathering
Concretions
Landslides
Debris flows
Potrero

Intrusive rocks

Granite
Granodiorite
Pegmatite dikes
Mafic dikes
Felsite dikes
Restite
Xenoliths
Tonalite
Hydrothermal alteration

Sedimentary rocks and environments

Sed structures
Sedimentary Basins from Miocene to Pleistocene
Marine
Lacustrine
Deltaic
Fluvial
Fanglomerate
Evaporite
Transgressive sequence
Regressive sequence
Walther's law

Fossils: marine and terrestrial; vertebrates, invertebrates, plants

Extrusive rocks

Lava flows
Tuffs
Domes (obsidian buttes)

Metamorphic rocks

Gneiss
Schist
Marble
Quartzite
Hornfels

Minerals

Orthoclase
Plagioclase
Quartz
Biotite
Chlorite
Muscovite
Magnetite
Tourmaline
Hornblende
Pyroxene
Olivine
Pyrite
Gypsum
Anhydrite
Calcite
Halite
Kaolinite
Illite

Cultural

Mines
Artifacts (morteros, geoglyphs, petroglyphs, fish traps)
Trails and roads

Environmental

Salton Sea
 Energy resources
 (geothermal, wind,
 solar)
 Water usage
 Climatic changes
 Microclimates
 Diurnal air movement
 Environmental lapse
 rate
 Sky islands
 Rain shadows

Mapping Places

Painted Canyon
 Box Canyon
 Split Mountain
 Borrego Badlands
 North Fork Arroyo Salado
 (the mighty mess)

**Potential Hiking stops
 (fun!)**

Calcite Mine
 Arroyo Tapiado
 Fossil Canyon
 Earthquake valley

Ladder Canyon
 Coyote Canyon
 Lute fault scarp
 Marcus' place, SAF
 Whitewater
 1000 Palms
 Palm Springs Tramway
 Toro Peak
 Pines to Palms Highway
 Anza Borrego Museum
 La Brea Tar Pits
 Torrey Pines State Beach
 Lake Elsinore sag pond
 Moreno Valley migmatite

Info on Anza-Borrego Desert: Places to visit

Vallecito Stage Station , Earthquake valley

Aqua Caliente County Park , hot springs, camping

Imperial Sand Dunes

Mud Caves 22 known caves and 9 slot canyons,

http://www.hiddensandiego.com/wiki/index.php?title=Preview_Arroyo_Tapiado

Canyon Sin Nombre**Carrizo Badlands Overlook**

Tamarisk Grove is a tree-shaded campground with restrooms and hot showers

Blair Valley is hidden coves near the rocky margins of the valley. Hikers enjoy walks to the **Marshal South Home site (also called Yaquitepec)**, the **Morteros** and the **Pictographs**. Along the southern Emigrant Trail and the Butterfield Overland Stageline Route lies Box Canyon, a narrow defile still scarred by the early wagon roads.

Visitor Center - The Anza-Borrego Desert State Park Visitor's Center is an excellent place to begin your park visit. Maps, books, brochures, exhibits on the desert environment and a superb slide program will give you a general overview of the park and the many points of interest within the park boundaries. The Visitor's Center is located 1.7 miles west of Borrego Springs on Palm Canyon Drive. The Center is open daily 9 AM to 5 PM October through May and Saturdays, Sundays and holidays 9 AM to 5 PM June through September.

Borrego Palm Canyon is located one mile from the Visitors Center. It is the location of the Palm Canyon Campground and the trailhead for an easy three-mile round-trip nature trail that leads to a grove of native California Fan Palms. A free self-guided trail brochure is available to introduce visitors to the canyon and palm grove.

Coyote Canyon is famous for its year-round stream and lush plant life. The canyon is used by hikers, horseback riders and those with sturdy four-wheel-[drive vehicles](#). The roads are

rough, but the hiking and riding trails are good. The historic trail of explorer Juan Bautista de Anza passes through Coyote Canyon.

[Journey Through Coyote Canyon - Wildlife Viewing Area](#)

Carrizo Gorge Railroad - Follows the old railway route between Campo to El Centro and Imperial Valley. [Read about it here.](#)

Ocotillo Flat and Lower Willows

The attractions of [Lower Willows](#) are the fresh waters of Coyote Creek running through it and the color, density and variety of the surrounding vegetation.

[Ocotillo Flat](#) starts at Coyote Creek and stretches across soft sandy soil to the naked hills and canyons to the east and north. It is bird country, reptile country, and cactus country with wildflowers in season. It includes one of the most impressive stands of ocotillo anywhere

Truckhaven Rocks are orange-colored sandstone slabs that are tilted at a 45 degree angle. They are a favorite spot for desert photographers and can be reached by a 1.5 mile roundtrip walk through a wash. The Truckhaven Rocks can be seen from S-22. Trailhead starts at mile 35.5 on the S-22.

[Article - Riding your ATV's over Pegleg's Gold/Ocotillo Wells.](#)

[Video - Riding your ATVs over Pegleg's Gold/Ocotillo Wells?](#)

[Article - Was Pegleg's Gold Found?](#)

[Article - Gold Fever In The Desert.](#)

[Article - The Man Who Found Pegleg's Gold.](#)

[Pegleg Smith Liars' Contest](#)

[17 Palms, 5 Palms and Una Palm are Palm Oases](#) located near the Arroyo Salado Primitive Campground off of S-22. There are many palm oases located within the Park boundaries. These areas are well-known watering holes for the regional [wildlife](#) of the Borrego Badlands. The palms at the Oases are often green and brilliant compared to the stark and barren desert that surrounds them. Click here to read more about these oases and directions on how to get to them.

[Article about Arroyo Salado, Truckhaven Trail and the Palm Oases.](#)

Pumpkin Patch his unique landscape is the result of wind and water continuously eroding the surface soil and revealing globular sandstone concretions that look much like pumpkins in size and shape. Such concretions are believed to be formed by the natural cementing of sand particles to a small object such as a piece of shell, a grain of sand or even an insect.

[Information and photos of the Pumpkin Patch](#)

Font's Point offers a commanding view of the Borrego Valley and **Borrego Badlands**. This prominent viewpoint is reached by a sandy four-mile primitive road, which more often than not is soft and rutted. Four-wheel-drive vehicles are required to reach the view point. Check the road conditions board at the Visitor's Center prior to attempting to visit Font's

Point. If you can get to Font's Point the view is well worth the effort. It is one of the most breathtaking viewpoints in the southwest desert regions.

[Video - Font's Point - Borrego Badlands](#)

Ocotillo Wells OHV Area includes over 80,000 acres of magnificent desert area open for off-road exploration and recreation. The area includes campgrounds, miles of ATV trails and tracks. Self-guided vehicle tours are available. Check the nearest bulletin board, or visit the Ranger Station to find out about current activities.

[Information and maps of the Ocotillo Wells OHV area.](#)

[Video about Ocotillo Wells](#)

[Video about riding your ATVs over Pegleg's Gold?](#)

Split Mountain, Fish Creek Wash and Elephant Trees Trail

The narrow divide between the Fish Creek Mountains and the Vallecito Mountains is called Split Mountain. Split Mountain is a geological wonder, formed by numerous earthquakes and floods revealing layers of geological and paleontologic history within its walls. You can often drive a passenger [car](#) to its entrance for the view from inside a mountain. A walk or drive through the Split will open new worlds for the visitor and the terms "geology," "faults" and "erosion" will take on new meanings.

Take Split Mountain Rd. where it intersects from Ocotillo Wells (Hwy 78) heading South. You will continue South on Split Mountain Rd. for approximately 8 miles where you will turn right (West) on Fish Creek Wash towards the Fish Creek Primitive Campgrounds. Fish Creek Wash will take you through Split Mountain.

The Elephant Tree Trail – Only one living Elephant Tree remains, but this hike through a rocky wash is still a delight. This easy walk covers 1.5 miles and takes about one hour. The Elephant Tree Trail turn off is on Split Mountain Rd. approximately 5.9 miles from Ocotillo Wells and Hwy 78.

[Article about Elephant Tree Trail](#)

Fish Creek Wash will take you to the **Fish Creek Primitive Campground** and on through Split Mountain. The wash is a [jeep trail](#) that you can walk, bike or drive through in a 4WD vehicle. Fish Creek Wash points of interest include: Anticline, Wind Caves, Elephant Knees, Loop Wash, Sandstone Canyon and Olla Wash.

[Hike - Fish Creek Walk -](#)

[4WD - Fish Creek Jeep Trail](#)

[Article about Fossils From Split Mountain, Fish Creek and Surrounding Area](#)

Split Mountain Wind Caves - The sandstone caves and arches are created from erosion caused by wind. You can explore the caves by hiking approximately 1 mile from the Wind Cave Trailhead (2 miles round trip). Trail head is located in Fish Creek Wash just past Split Mountain.

Mud Hills Wash and Elephant Knees - One of the most spectacular sights in the Split Mountain area is a formation known as [Elephant](#) Knees. It's a mudhill ridge with thick fluted ridges that look like the knees of elephants.

From the road, you look up at it and view it from a distance. You can also walk Mudhill Wash, to the east of Elephant Knees, to get a closer view. The flat top of Elephant Knees is a layer of marine sediments. You can look at it, but you mustn't climb on it. [Click here](#) to read more about Elephant Knees.

[Elephant Knees Information and Location Hike - Mud Hills Wash/Elephant Knees](#)