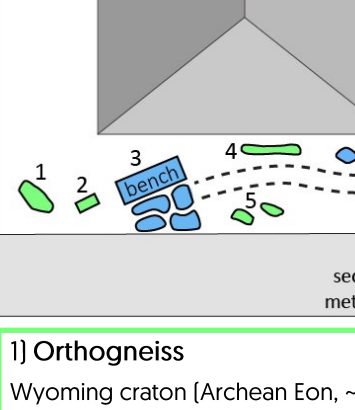
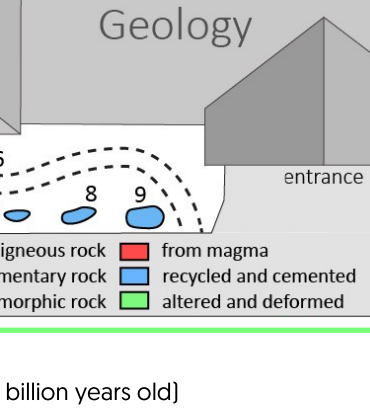


## GEO SCIENCES

### Centennial Rock Garden Tour



1918



2018

The Centennial Rock Garden is the result of group effort over the 2017-2018 academic year in celebration of the 100th anniversary of the construction of the Geology Building (originally the Plant Industry Building).

Large rock specimens ranging in age from 3 billion years to 2,500 years old are placed in chronological order from west to east. They were collected during the years on class field trips, research expeditions, and by serendipitous circumstances.



#### 1) Orthogneiss

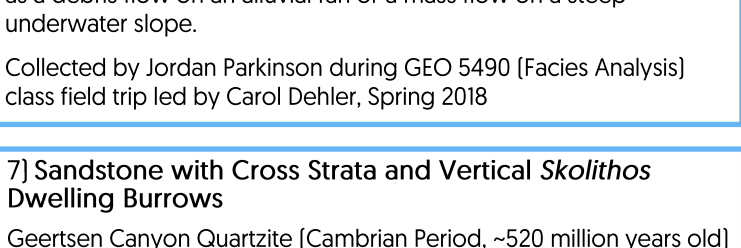
Wyoming craton (Archean Eon, ~3 billion years old)  
This rock has experienced multiple deformation events over continental accretion and mountain-building episodes, producing a tectonic fabric with isoclinal folds. Metamorphism has transformed what was originally an igneous rock into this really gneiss rock.

Bear Trap Canyon, southwestern MT  
Collected by GEO 5200 [Field Camp] class field trip led by Alexis Ault, Summer 2018.

#### 2) Banded Iron Formation

Golden Meadows Formation (Archean Eon, ~2.5 billion years old)  
This sample consists of alternating layers of metamorphosed dark gray or black magnetite (Fe<sub>3</sub>O<sub>4</sub>) and yellow or red chert (SiO<sub>2</sub>) layers. Band Iron Formation (BIF) was formed prior to the presence of an oxygen-rich atmosphere. BIF deposits are an important source of iron ore.

Atlantic City mining area near South Pass, WY  
Collected by L. C. Allen Jones [BS Geology 1989, MS Geology 1995]



AJ Jones (second from right) and 1988 Geology Field Camp class that collected the Banded Iron Formation sample.

#### 3) Bench showing ripple marks and climbing ripples on cut edge

Moenkopi Formation (Triassic Period, ~240 million years old)  
San Rafael Swell, UT

Collected by Josh Barna, Mike Ferraro, Kenny Kehoe, and Evan Millsap, Fall 2017. Bench crafted by Mike Ferraro.

#### 4) Fault Mylonite in Quartzite

Elba Quartzite (Proterozoic Eon, ~2.5-1.6 billion years old)  
The sample consists of metamorphosed, interbedded sandstone and micas (formerly clays). This popular decorative stone is known as "Oakley Stone."

Raft River Range, UT

#### 5) Gneiss/Migmatite

Farmington Canyon Complex (Paleoproterozoic Era, ~1.8 billion years old)  
These rocks were originally igneous or sedimentary rocks that were subsequently metamorphosed.

Sample 1: Collected by GEO 4700 [Geologic Field Methods] class field trip led by Susanne U. Janecke, Fall 2017.  
Sample 2: Collected by GEO 3500 [Minerals and Rocks] class field trip led by Katie Potter, Spring 2017

#### 6) Sedimentary Breccia/Conglomerate

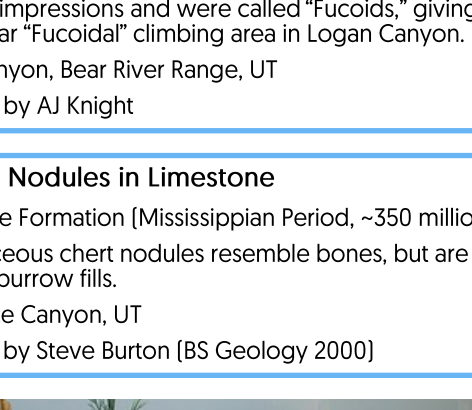
Jesse Ewing Canyon Formation, Uinta Mountain Group (Tonian Period, Neoproterozoic Era, ~765 million years old)  
This breccia/conglomerate is indicative of a high-energy event such as a debris flow on an alluvial fan or a mass flow on a steep underwater slope.

Collected by Jordan Parkinson during GEO 5490 [Facies Analysis] class field trip led by Carol Dehler, Spring 2018

#### 7) Sandstone with Cross Strata and Vertical Skolithos Dwelling Burrows

Geertsen Canyon Quartzite (Cambrian Period, ~520 million years old)  
These burrows are indicators of shallow-water, near shore conditions. The cross strata can indicate current directions.

Bear River Range, UT



Skolithos are made by worms and/or arthropods in coastal settings.

#### 8) Sandstone Showing Paired Diplocraterion Burrows

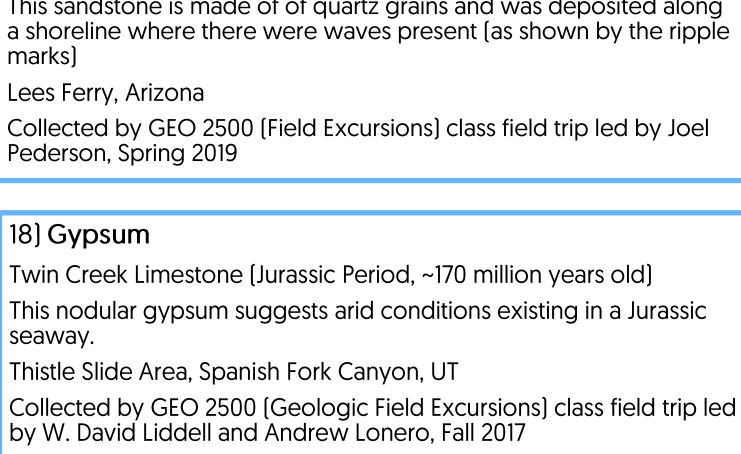
Geertsen Canyon Quartzite (Cambrian Period, ~520 million years old)  
These burrows were inhabited by a filter-feeding worm-like organism. The "U"-shaped burrows helped to set up water flow through the burrow.

Cataract Canyon, Wellsville Mountains, UT  
Collected by Mark Szorik on GEO 3550 [Sedimentation and Stratigraphy] class field trip led by W. David Liddell, Fall 2009

#### 9) Sandstone with Vertical Skolithos Dwelling Burrows

Geertsen Canyon Quartzite (Cambrian Period, ~520 million years old)  
These burrows are indicators of shallow-water, near shore conditions.

Bear River Range, UT



#### 10) Rhythmically-Bedded White Marble and Gray Argillite

Cambrian Marjum Formation (~507 million years old)  
Limestone and shale that was metamorphosed by the Jurassic (~170 million years) Notch Peak Intrusion.

Marjum Pass, House Range, UT  
Collected by GEO 6350 [Paleoecology] class field trip led by W. David Liddell, Spring 2018

#### 11) Flat Pebble Conglomerate

Limestone Formation (Cambrian Period, ~507 million years old)  
Limestone with intraclasts; these rip-up clasts are an indicator of ancient storm activity.

Sinks Area, Logan Canyon, Bear River Range, UT  
Collected by Mike Ferraro on GEO 3550 [Sedimentation and Stratigraphy] class field trip led by W. David Liddell, Fall 2016

#### 12) Burrows in Limestone

Bloomington Formation (Cambrian Period, ~507 million years old)  
Sinks Area, Logan Canyon, Bear River Range, UT

Collected by W. David Liddell, Fall 2017

#### 13) Trace Fossils in Sandstone

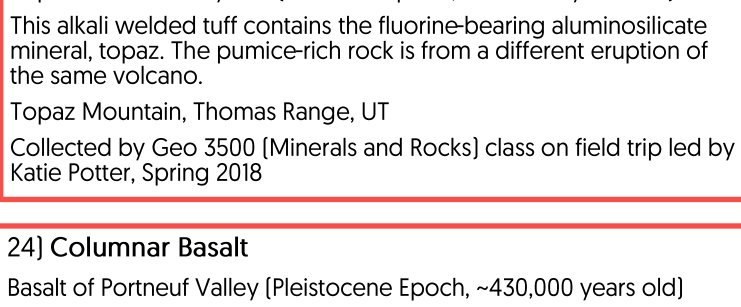
Swan Peak Quartzite (Ordovician Period, ~465 million years old)  
Fine-grained sandstone with abundant feeding trace fossils on lower surface. At one time these were erroneously thought to be seaweed impressions and were called "Fucoids," giving the name to the popular "Fucoidal" climbing area in Logan Canyon.

Green Canyon, Bear River Range, UT  
Collected by AJ Knight

#### 14) Chert Nodules in Limestone

Lodgepole Formation (Mississippian Period, ~350 million years old)  
These siliceous chert nodules resemble bones, but are actually replaced burrow fills.

Providence Canyon, UT  
Collected by Steve Burton [BS Geology 2000]



A view of Paleozoic sea life like that fossilized in the Great Blue Fm.

#### 15) Fossil Brachiopods and Bryozoans

Great Blue Formation (Mississippian Period, ~325 million years old)  
Dry Lake roadcut on Hwy 89-91, Cache County, UT

Collected by Mike Ferraro, Winter 2018

#### 16) Rhythmic Bedding in Limestone

Kaibab Limestone (Permian Period, ~270 million years old)  
Limestone showing high frequency cyclicity, perhaps indicating ancient storm activity.

San Rafael Swell, Spotted Wolf rest area, I-70 west of Green River, UT  
Collected by Mike Strange on GEO 2500 [Geologic Field Excursions] class field trip led by W. David Liddell, Spring 2013

#### 17) Mature Sandstone with Ripple Marks

Lower Triassic Moenkopi Formation (~245 million years old)  
This sandstone is made of of quartz grains and was deposited along a shoreline where there were waves present (as shown by the ripple marks)

Lees Ferry, Arizona  
Collected by GEO 2500 [Field Excursions] class field trip led by Joel Pederson, Spring 2019

#### 18) Gypsum

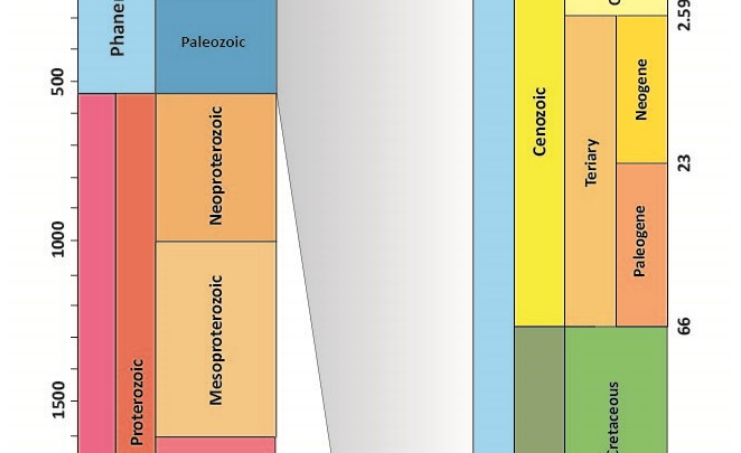
Twin Creek Limestone (Jurassic Period, ~170 million years old)  
This nodular gypsum suggests arid conditions existing in a Jurassic seaway.

Thistle Slide Area, Spanish Fork Canyon, UT  
Collected by GEO 2500 [Geologic Field Excursions] class field trip led by W. David Liddell and Andrew Lonero, Fall 2017

#### 19) Concretion

Mancos Shale (Cretaceous Period, ~100 million years old)  
These structures "grew" in place in the deep water Mancos Shale, which was part of the Western Interior Seaway in Cretaceous time. One specimen is a septarian nodule that shows fractures that occurred during growth. These fractures are now filled with crystals.

San Rafael Swell, east of Castle Dale, UT  
Collected by GEO 2500 [Geologic Field Excursions] class field trip led by W. David Liddell and Andrew Lonero, Fall 2017

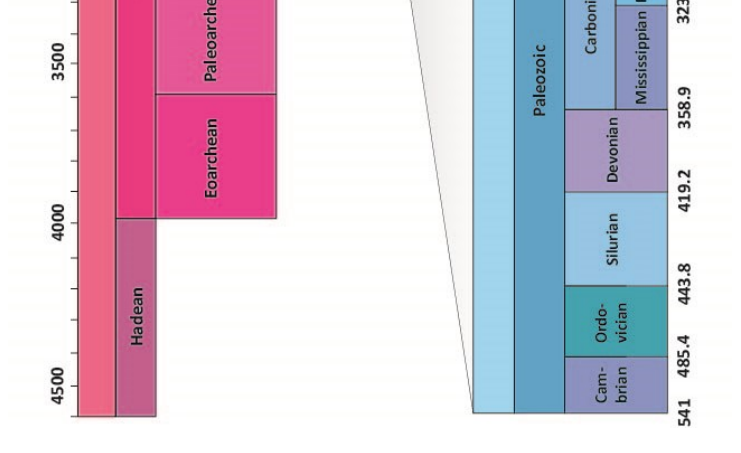


Geology 2500 class collecting Mancos Concretion in the San Rafael Swell.

#### 20) Copper Ore With Azurite and Malachite

The Boulder Batholith is the protolith for the mineralization which occurred ~64 million years ago.

Continental Mine, Butte, MT  
Collected by Susanne U. Janecke and Jim McCalpin



Bingham Canyon Mine (aka Kennecott Copper Mine), outside of Salt Lake City, UT

#### 21) Wasatch Formation Oncolite

[composed of spherical algal stromatolites]  
Early Eocene Epoch (~55 million years old)

These oncolites formed in the shallow waters of lakes, but also near the uplifted Sevier thrust belt, which shed the coarser sediment that dominates most of the Wasatch Formation.  
Collected on Temple Peak by Justin Collette, Spring 2019

#### 22) Vitrophyre [Volcanic Glass]

[Miocene Epoch, ~16 - 8 million years old)  
This black, glassy material has the same composition as rhyolite. This black portion of a tuff cooled rapidly and did not have a chance to crystallize, remaining in a glassy state. The more slowly-cooled parts of tuffs are typically brown to red.

Near Schipper Campground, Rock Creek, ID  
Collected by GEO 4500 [Igneous and Metamorphic Petrology] class field trip led by John W Shervais, Fall 2017

#### 23) Flow-Banded Tuff & Pumice-Rich Tuff

Topaz Mountain Rhyolite (Miocene Epoch, ~6 million years old)  
This alkali welded tuff contains the fluorine-bearing aluminosilicate mineral, topaz. The pumice-rich rock is from a different eruption of the same volcano.

Topaz Mountain, Thomas Range, UT  
Collected by Geo 3500 [Minerals and Rocks] class on field trip led by Katie Potter, Spring 2018

#### 24) Columnar Basalt

Basalt of Portneuf Valley (Pleistocene Epoch, ~430,000 years old)  
This sample exhibits columnar jointing due to cooling of a lava flow.

McCammon, ID  
Collected by USU Geology Club members Josh Barna, Mike Ferraro, Kenny Kehoe, Evan Millsap, and Mike Turley, Fall 2017



Mike Turley, Evan Millsap, Mike Ferraro, and Josh Barna (left to right) collecting columnar basalt samples near Pocatello, ID.

#### 25) Tufa Mound

Lake Bonneville Deposits (Pleistocene Epoch, ~14,000 years old)  
Tufa is typically a spring deposit; this was deposited on a spit in Lake Bonneville at 4,630' (1,403m) elevation.

Newton, UT  
Collected by Robert Q. Oaks, Jr.

#### 26) Basalt Flow Lobe

Near Craters of the Moon National Monument, ID  
Collected by GEO 4500 [Igneous and Metamorphic Petrology] class field trip led by John W. Shervais, Fall 2017



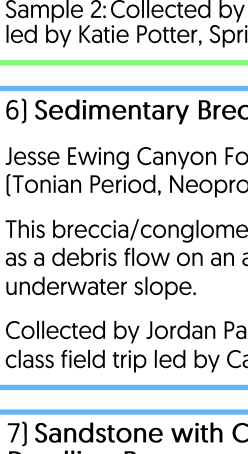
Basaltic Lava cooling into rock.

#### 27) Obsidian

Holocene (~2,500 years old)  
This obsidian has been found at many archeological sites in southern California.

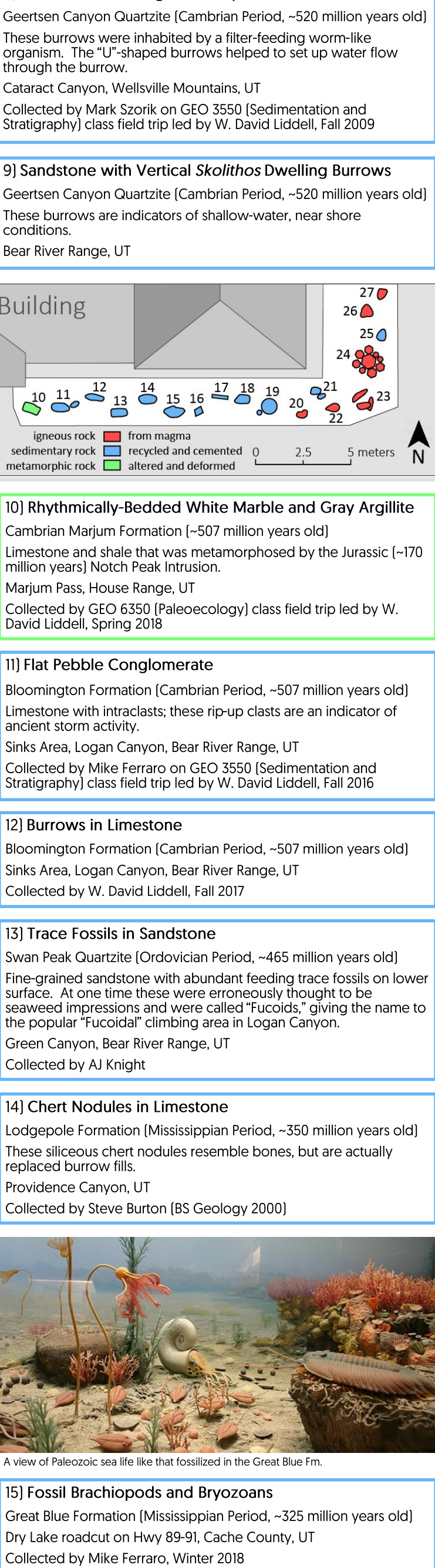
Obsidian Butte, along southeast shore of the Salton Sea, CA  
Collected by Evan Millsap on a GEO 5610 [Tectonics] class field trip led by Susanne U. Janecke, Spring 2018

Evan Millsap (1997 - 2019)  
Evan was a top student who received a Bachelor's degree from our department in 2018. He was working on a PhD in paleontology in Alaska when he tragically died in a rock-climbing accident. Evan enthusiastically helped collect several of the rocks in this garden. The sharp, heavy obsidian at the end of the garden was obtained solely through Evan's persistence. We remember Evan's bright and indomitable spirit.



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### Geologic Time Scale



### COLLEGE of SCIENCE