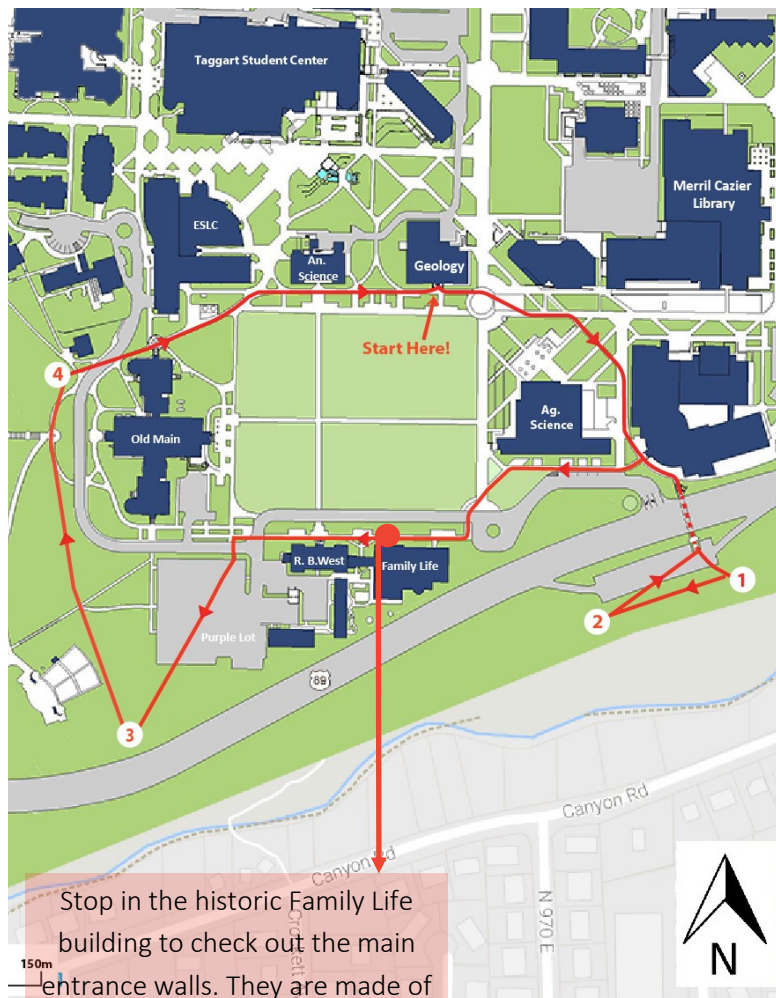


UtahStateUniversity™

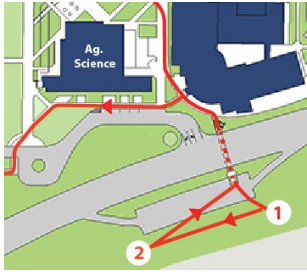
Geology

**Campus Field Trip  
on the  
Geology of Cache  
Valley**



Stop in the historic Family Life building to check out the main entrance walls. They are made of limestone and have fossil gastropods and bivalves in them!

## STOP 1



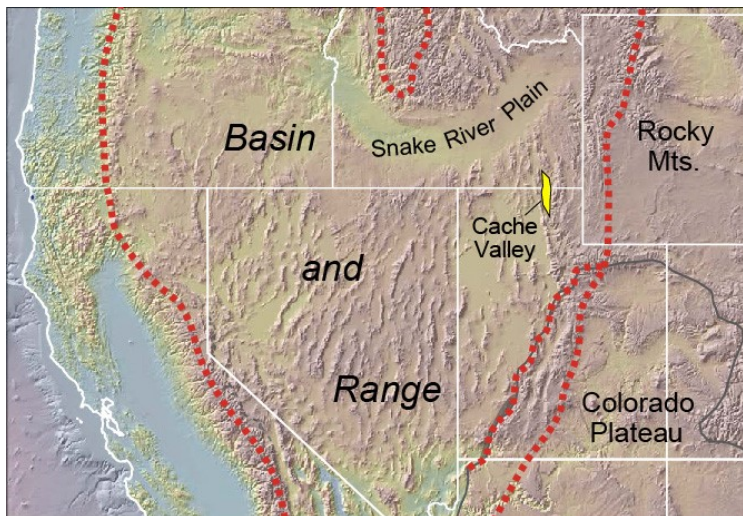
*underpass beneath Hwy 89  
to parking lot south of  
Huntsman School of Business*

### Bedrock:

The layered rocks of the Bear River Range, visible in the canyons from this vantage point, are Paleozoic sedimentary rocks deposited from 600 to 250 million years ago, depending upon which rocks and where you are in the overall range. They are largely carbonates – limestone and dolostone – with fossil corals, shelled creatures, trilobites, and other critters living in or near the shoreline of an ancient sea. This was the seacoast and beaches of our continent at that time!

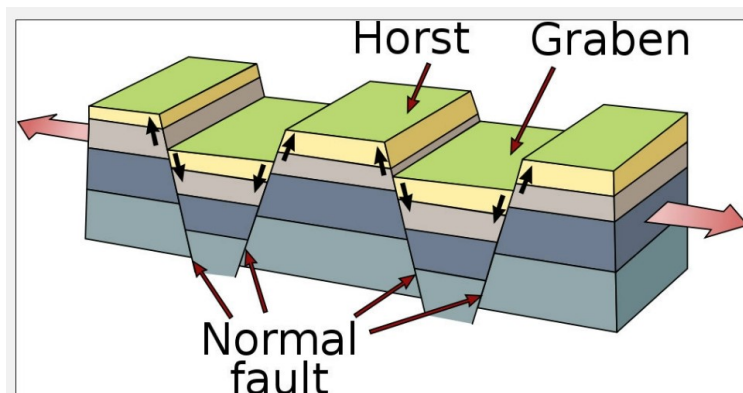
How have things changed from the Paleozoic time to the present here in Cache Valley?

### Basin and Range, East Cache Fault:



The Bear River Range is separated from the low-lying basin of Cache Valley by a linear fault, which runs along the base of the mountains, from north-to-south. This is the East Cache fault. The similar West Cache fault lies along the base of the Wellsville Mountains at the west side of the basin.

Cache Valley is at the east edge of the Basin and Range, and our faults create “horst and graben” terrain. Cache Valley continues to



drop relative to the bounding mountain ranges because of movement along these faults during earthquakes! The most notable historic earthquake in Cache Valley occurred in 1962 with an epicenter east of Richmond (13 miles north). It was a magnitude 5.9 earthquake that critically damaged many buildings in downtown Richmond. But the earthquake did not rupture Earth's surface.

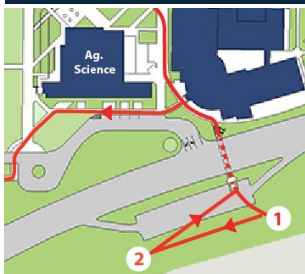


On the west side of the Wellsville Mountains is a segment of the famous Wasatch Fault Zone. This Brigham City segment is the most overdue for an earthquake of the segments of Wasatch Fault. Most of the active faults in our region have a recurrence interval of 1000-1500 years for large, surface-rupturing, and damaging earthquakes. These large earthquakes are the ones that build our landscape.

Considering scientists' estimates of the rates of movement along faults in northern Utah, the relief we see today, from mountain top to basin, would take 1 to 2 million years to form. In fact, our faults have been active longer than that, and material long eroded from the mountain tops are stored deep beneath our dropping valley floors.

Can you see the linear fault scarps or breaks that run along the base of the Bear River Range?

## STOP 2



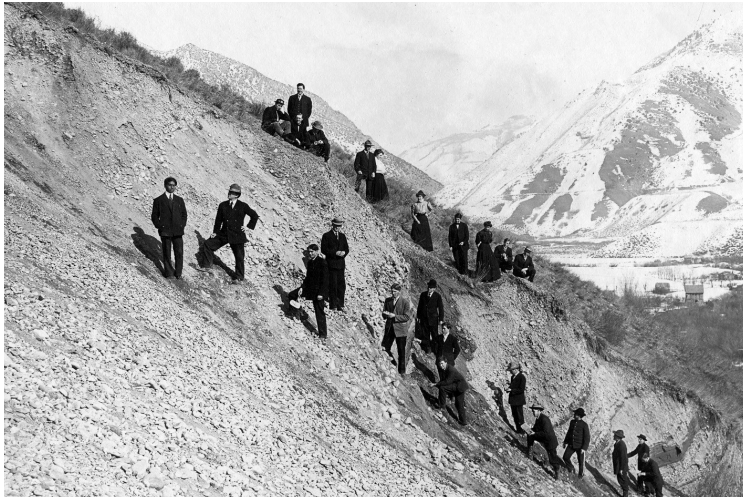
***west end of parking lot***

### Landslides:

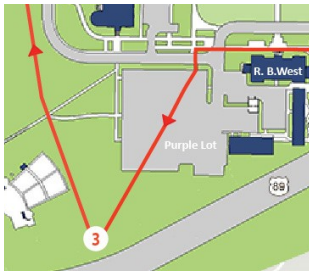
Look out over the Logan River as it enters the basin, through the "Island" neighborhood of Logan. The snaking hillslope below you that separates the bench of the University from the low floodplain of the Logan River is scalloped by landslide scars. Several landslides have occurred along this slope over historic time. Indeed, in 2009 three people tragically died from a landslide that initiated just west of this point and turned into a mudflow that entered the basement of a house.

The concave scar right below where you stand is the headscarp of a landslide that failed in 2005. Landslide scars like this provide

exposures that have long given geologists a glimpse into what underlies campus, including famous pioneering geologist, G.K. Gilbert, featured at the next stop.



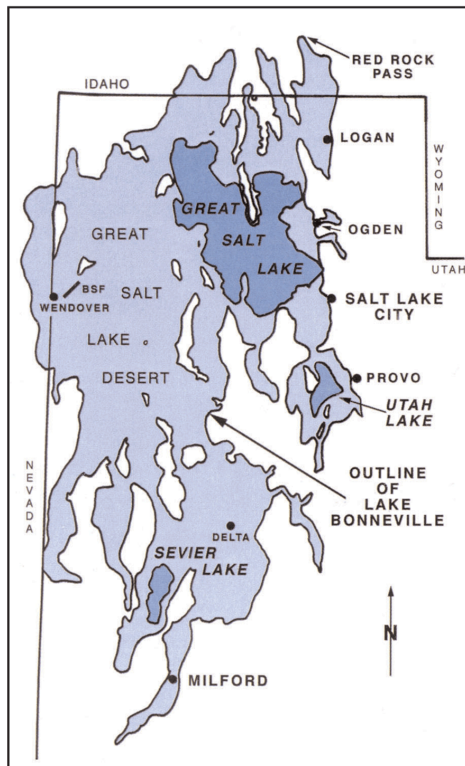
### STOP 3



*south of Old Main, above old amphitheater*

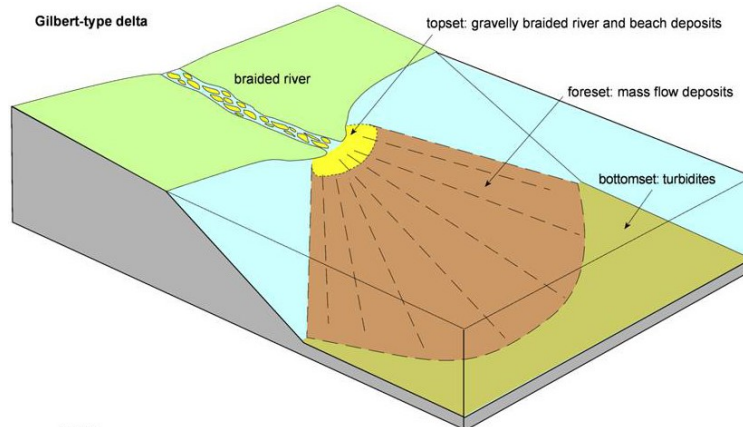
#### Campus Is on a Delta, Formed in Ancient Lake Bonneville:

The flat bench USU is built upon is the top of a delta--with a claim to geologic fame! G.K. Gilbert, a founding father of geology and one of the first employees of the U.S. Geological Survey, was here conducting research in the early 1880s. He discovered the evidence for ancient Lake Bonneville, which he correctly interpreted as an ice-age predecessor to modern Great Salt Lake that was up to 1,000 feet deep and filled the Great Basin across northern Utah and then some. The drawing of "The Ancient Deltas of the Logan River, As Seen From the Temple" (centerfold, under main map) which was under construction at the time is a classic of scientific illustration.



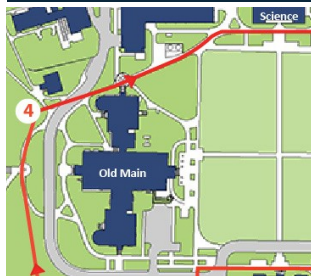
What is a delta? A delta is a landform built of sediment deposited by a river where it meets a body of standing water. In this case, the Logan River met ancient Lake Bonneville, and with its sediment

load, constructed the benches of Logan from 25,000 to 15,000 years ago. The bench the University is built upon marks the “Provo” shoreline, which is prominent across the valleys of northern Utah. In fact, all the major universities in northern Utah are built upon the Provo shoreline. Can you see the matching Provo bench across the valley to the south?



Exposures from landslides like the one viewed from stop 2, along the slope from the Logan Temple east to campus, provided some of the key evidence for this ancient lake and delta. G.K. Gilbert utilized the distinctive sediments exposed to show that the bench is the top of a delta, and that Old Main Hill, sloping west into town, represents a delta foreset extending below the shoreline of the ancient lake. In fact, coarse-grained deltas like at this type-locality at USU, are called “Gilbert deltas” by geologists around the world!

## STOP 4



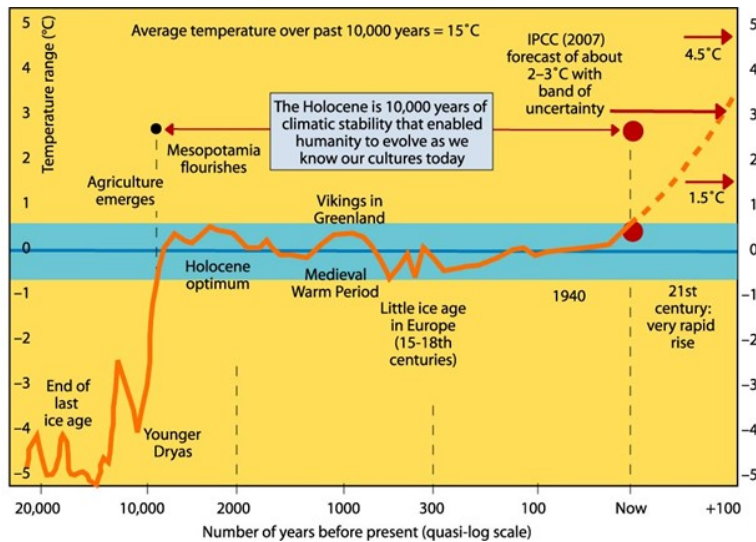
***top of Old Main Hill off the  
NW corner of Old Main***

### Glacial Features:

From this vantage point atop the Old Main Hill delta foreset, looking west across town, one can see the Wellsville Mountains at the other side of Cache Valley. Imagine waves are breaking along the shoreline at your feet, and as you look out across the choppy waters of ice-cold Lake Bonneville, you see alpine glaciers filling the valleys between the peaks of the Wellsvilles. The distinctive scoop-shaped upper valleys are called cirques by geologists and the highest peak of Wellsville Cone is a modest glacial horn, combined with the subtly U-shaped upper valleys, provide evidence of glacial erosion and climate changes during the recurring ice ages of Earth’s recent Pleistocene Epoch.

Researchers studying fossil plants from the last ice age have determined that average annual temperatures here in northern Utah were over 5° Celsius (41° Fahrenheit) colder than in the present day! This provides a greater context about climate changes. Scientists have shown that the glacial-interglacial changes of the Pleistocene have been triggered by oscillations in Earth’s tilt and orbit around the sun, as amplified by feedbacks involving greenhouse gasses. Over the past 11,000 years since the last ice age, human civilization has arisen during the relatively steady

climate of the Holocene Epoch. The global warming that scientists have documented over the past 150 years has occurred extremely rapidly relative to Earth's prior climate changes, and it has the distinctive signature of being driven by increasing greenhouse gases from human activities. Computer models indicate that, as our planet continues to warm over the coming centuries, we will match again the amazing amount of warming experienced at the end of the Pleistocene, when local glaciers melted and Lake Bonneville dried up.



In addition to alpine glaciers and dramatic climate changes, the shores of Lake Bonneville were visited by distinctive ice-age megafauna, such as giant sloths, mastodons and mammoths, saber-tooth cats, dire wolves, and perhaps even Pleistocene camels. Mammoth tusks have been found in the gravel pits of Cache Valley, which are excavated into the delta and shoreline sediments of Lake Bonneville.



### **Image Sources**

- Stop 1: Image 1- Basin and Range, [https://www.researchgate.net/publication/310778998\\_Spatiotemporal\\_evolution\\_of\\_fault\\_slip\\_rates\\_in\\_deforming\\_continents\\_The\\_case\\_of\\_the\\_Great\\_Basin\\_region\\_northern\\_Basin\\_and\\_Range\\_province/figures?lo=1](https://www.researchgate.net/publication/310778998_Spatiotemporal_evolution_of_fault_slip_rates_in_deforming_continents_The_case_of_the_Great_Basin_region_northern_Basin_and_Range_province/figures?lo=1)
- Image 2- Horst and Graben,  
[http://usacartrip.com/xenusa\\_board/1761308](http://usacartrip.com/xenusa_board/1761308)
- Image 3- Richmond, UT, 1962, USU Geology Department archive
- Stop 2: Image 1- USU field trip to landslide, about 1909,  
USU Geology Department archive
- Stop 3: Image 1- Map of the extinct Lake Bonneville,  
<https://geology.utah.gov/popular/general-geology/great-salt-lake/>
- Image 2- Gilbert-type delta, *Sedimentology & Stratigraphy*,  
by Gary Nichols, 2009, Wiley, ISBN 9781405193795
- Stop 4: Image 1- Timeline for average temperature,  
Spratt, D. and Sutton, P., 2009, *Climate Code Red*:  
Scribe Publications, Ltd., 320 p., ISBN 13:9781921372209