Designing and Implementing Field Experiences through Distance Learning

Saturday Seminar
June 13, 2020

SIGkit: Software for Introductory Geophysics toolkit

Charly Bank, University of Toronto, Canada
Sarah Kruse, University of South Florida, Tampa, FL
(w/ input from Jackie Caplan-Auerbach, W Wash U, and Alain Plattner, U of AL and several undergraduate and graduate students)

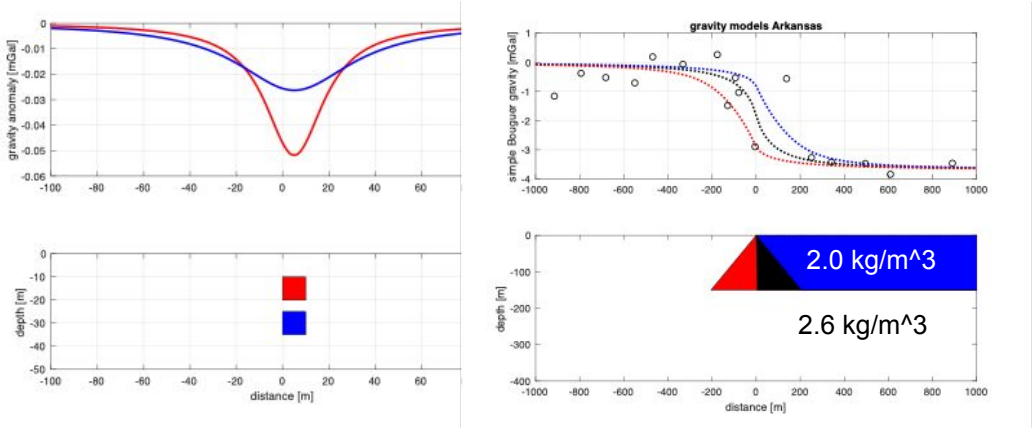
highlights:

- includes methods typically taught in field course and intro class:
  gravity, magnetics, resistivity, seismic, GPR, EM
- provides opportunity to experience how data may differ if input parameters are changed (forward modeling)
- can read and visualize field data (including that collected by students)
- allows students to compare data to synthetic models and make interpretations

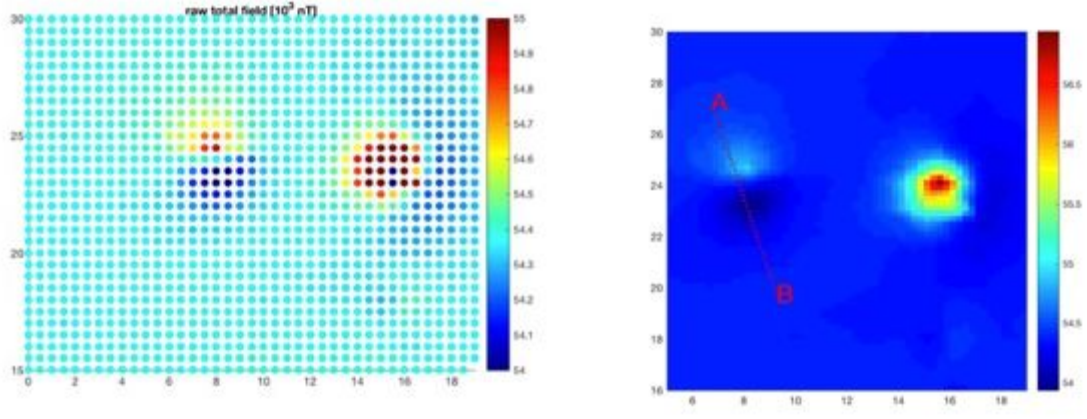
gravity and magnetics

- create models (non-uniqueness)
- show data
- grid data
- extract profile
- match data to a model

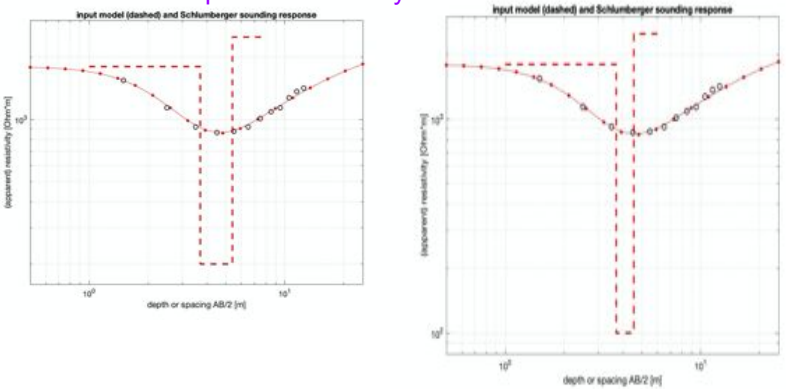
Upper Arkansas valley gravity dataset



Forensic testsite magnetic dataset



Deep River resistivity dataset



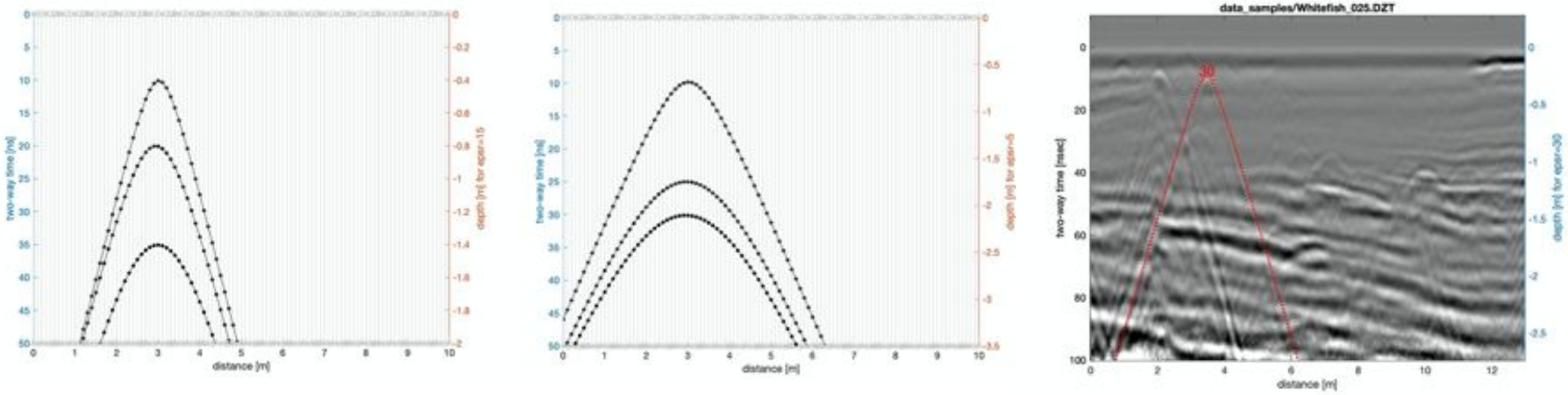
resistivity sounding

- equivalent layers
  (different teams will get different results)

ground-penetrating radar

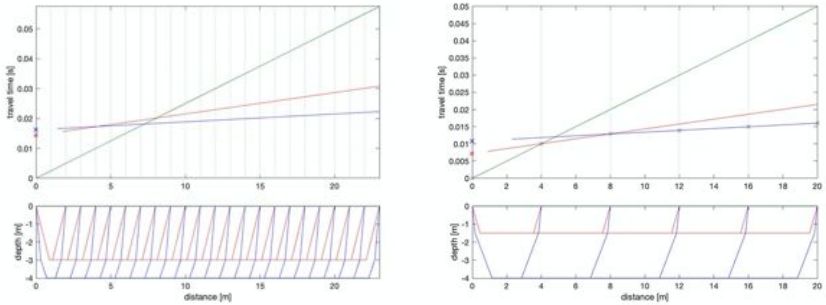
- how diffraction hyperbola change w/ depth and dielectric constant
- conversion of two-way time to depth

Whitefish Falls GPR dataset



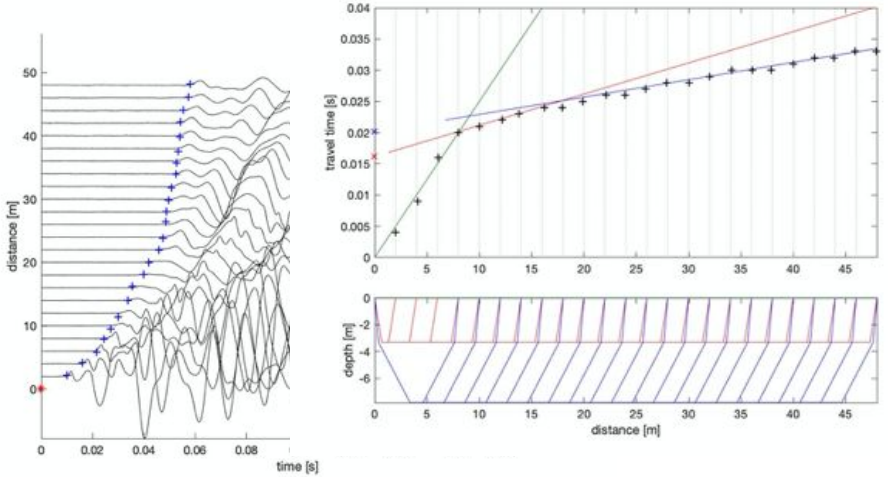
refraction seismic

- limit of this method (eg, hidden layers, or bad geophone spacing)
- selecting geophone spacing for a survey
  (from expected subsurface structure)



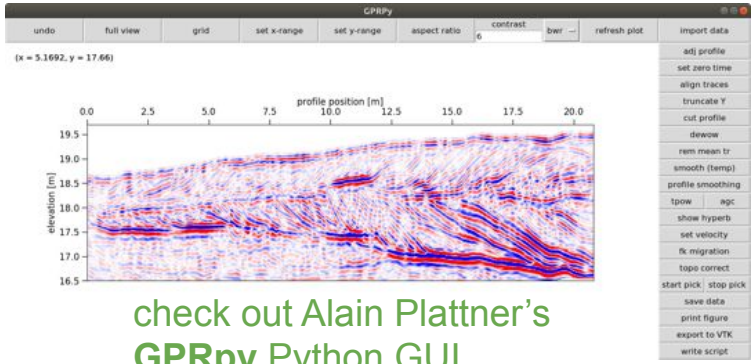
- picking first arrivals
  and finding a matching model

Bestwood seismic refraction dataset



SIGkit

- includes modeling software + datasets + activity sheets (posted on SERC) and solutions (by request)
- requires a MATLAB installation (or access to MATLAB online) but we are considering Python (Jupyter notebooks?)
- does not replicate commercial software,
  but shows initial processing steps suitable for field instruction and basic undergraduate research
- is not a "black box", not overwhelming, students can include their own data
- may be used for a virtual geophysics field camp (including discussion about survey setup) and/or to introduce the methods and simple processing in a geophysics course
- addresses several of the field experiences learning outcomes



check out Alain Plattner's **GPRpy** Python GUI

Karst Hydrogeology: A virtual field introduction using Google Earth and GIS

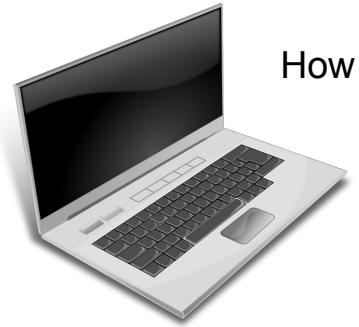
Rachel Bosch
University of Cincinnati

Who

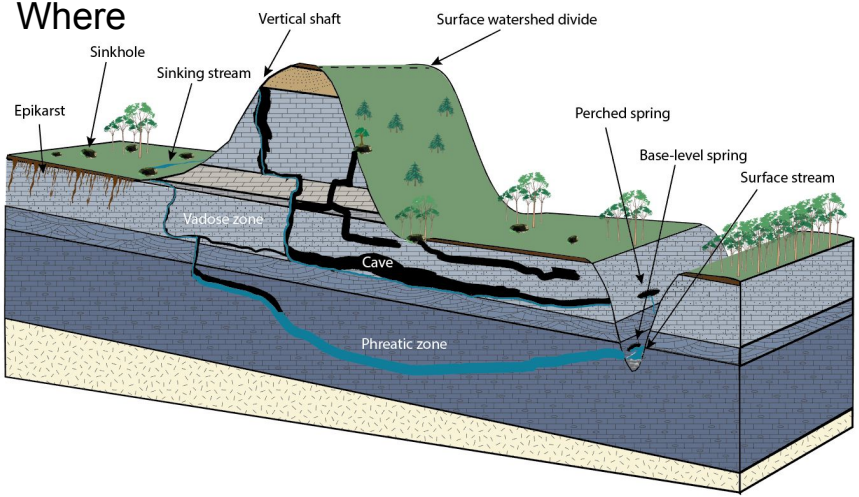
What

When

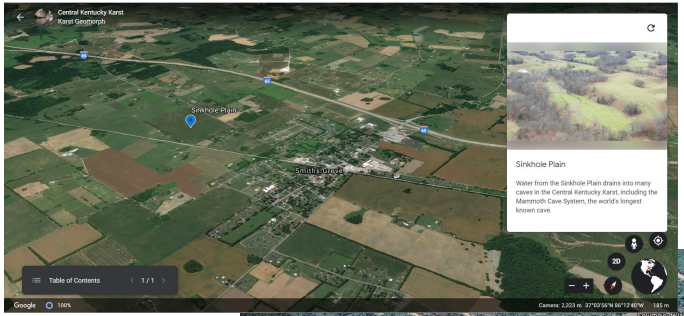
How

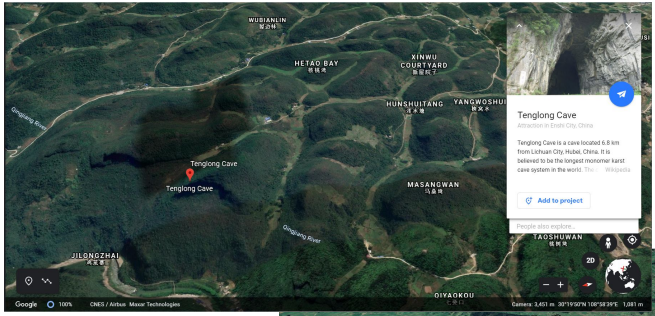


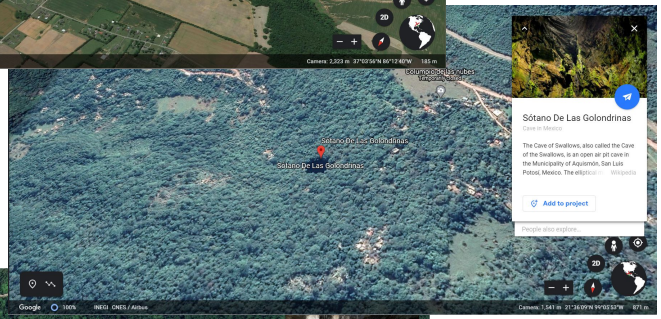
Where

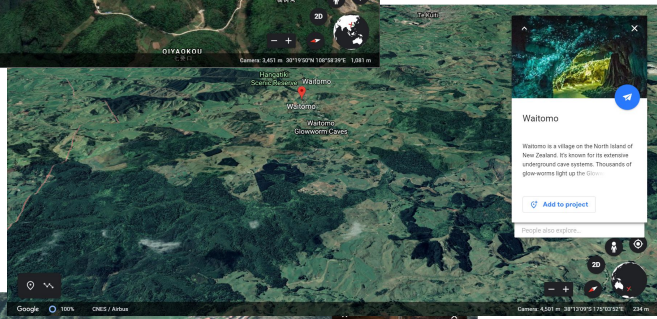


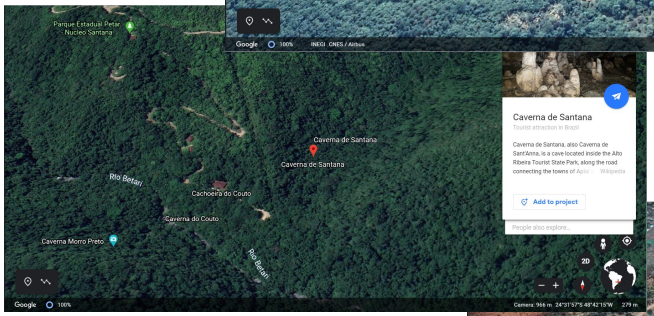
Why

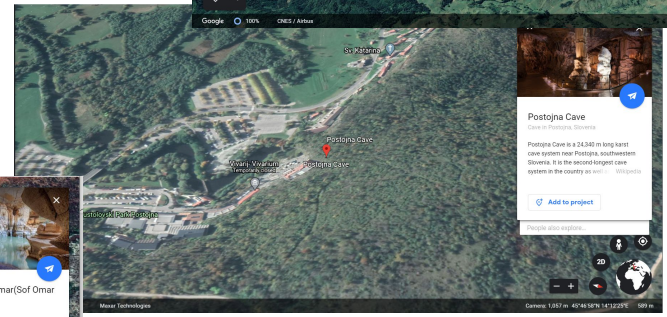

Central Kentucky Karst
Karst Geomorph
Sinkhole Plain
Sinkhole Plain
Water from the Sinkhole Plain drains into many caves in the Central Kentucky Karst, including the Mammoth Cave System, the world's longest known cave.
Table of Contents
1 / 1
Google
100%
2D

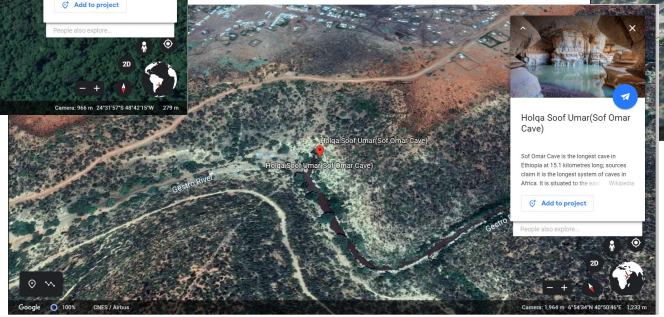

WUBIANLIN
HETAO BAY
XINWU COURTYARD
HUNSHUITANG
YANGWOSHU
Tenglong Cave
Tenglong Cave
MASANGWAN
JILONGZHAI
YAOSHUWAN
OIYAOKOU
Tenglong Cave
Attraction in Enshi City, China
Tenglong Cave is a cave located 6.8 km from Lichuan City, Hubei, China. It is believed to be the longest monomer karst cave system in the world.
Add to project
People also explore
Google
100%
CNES / Airbus Maxar Technologies
2D

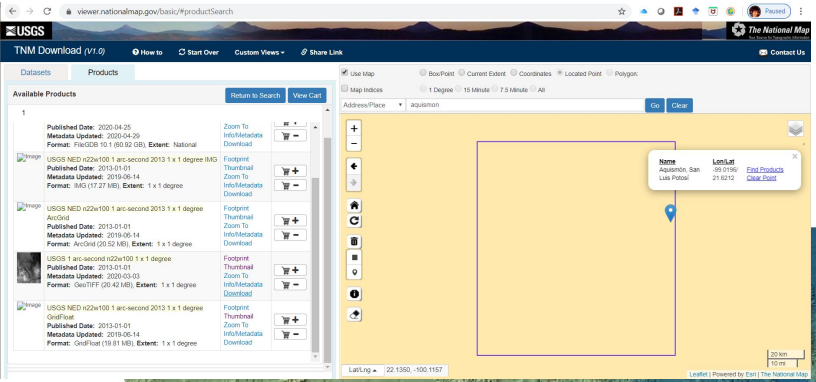

Sótano De Las Golondrinas
Sótano De Las Golondrinas
Sótano De Las Golondrinas
Cave in Mexico
The Cave of Swallows, also called the Cave of the Swallows, is an open air pit cave in the Municipality of Aquismón, San Luis Potosí, Mexico.
Add to project
People also explore
Google
100%
INEGI CNES / Airbus
2D

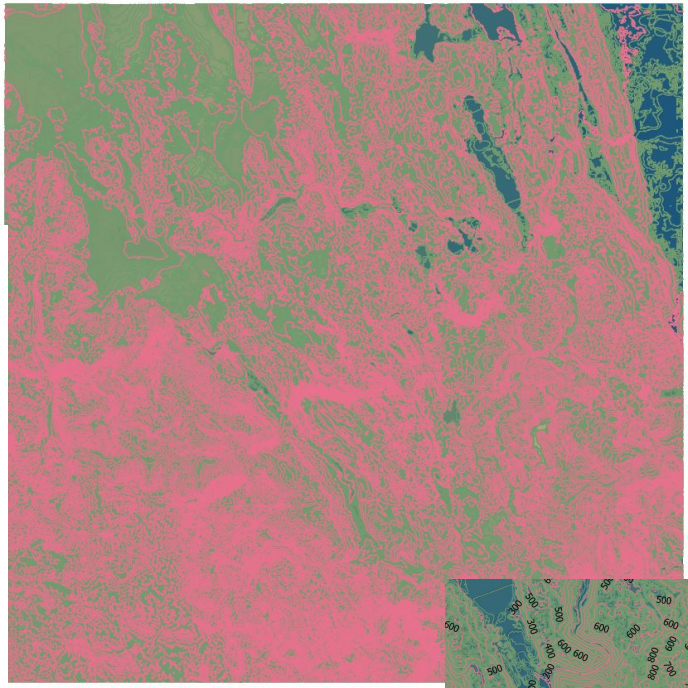

Hangatiki Scenic Reserve
Waitomo
Waitomo
Waitomo Glowworm Caves
Waitomo
Waitomo is a village on the North Island of New Zealand. It's known for its extensive underground cave systems. Thousands of glow-worms light up the
Add to project
People also explore
Google
100%
CNES / Airbus
2D

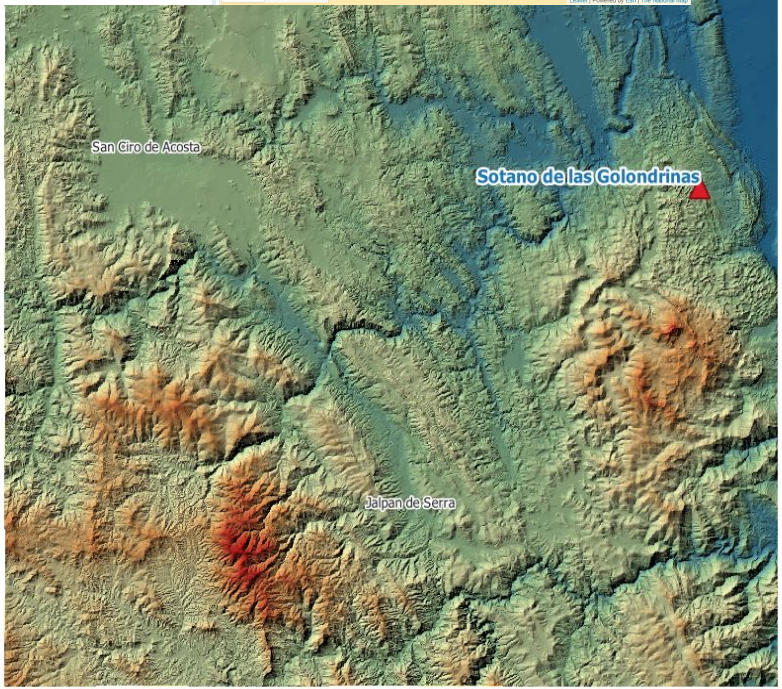

Parque Estadual Pedra do Núcleo Santana
Caverna de Santana
Caverna de Santana
Caverna de Santana
Tourist attraction in Brazil
Caverna de Santana, also Caverna de Sant'Anna, is a cave located inside the Alto Ribeira Tourist State Park, along the road connecting the towns of
Add to project
People also explore
Rio Betari
Cachoeira do Couto
Caverna do Couto
Caverna Morro Preto
Rio Ribeira
Google
100%
2D

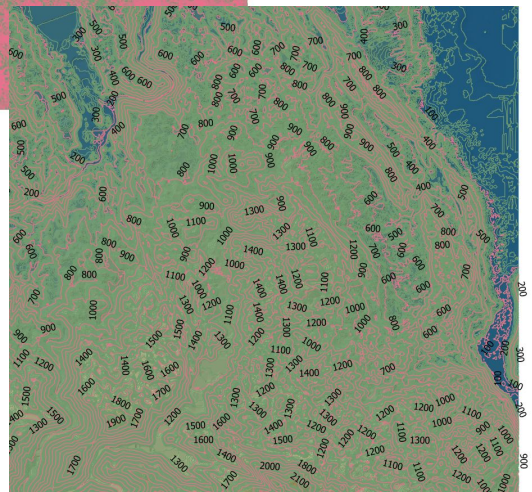

Postojna Cave
Postojna Cave
Postojna Cave
Cave in Postojna, Slovenia
Postojna Cave is a 24,340 m long karst cave system near Postojna, southwestern Slovenia. It is the second-longest cave system in the country as well
Add to project
People also explore
Maxar Technologies
2D


Holqa Soof Umar(Sof Omar Cave)
Holqa Soof Umar(Sof Omar Cave)
Holqa Soof Umar(Sof Omar Cave)
Sof Omar Cave is the longest cave in Ethiopia at 15.1 kilometres long; sources claim it is the longest system of caves in Africa. It is situated to the east
Add to project
People also explore
Google
100%
CNES / Airbus
2D


viewer.nationalmap.gov/basic/#productSearch
USGS
The National Map
TNM Download (V1.0)
How to
Start Over
Custom Views
Share Link
Contact Us
Datasets
Products
Available Products
Return to Search
View Cart
Use Map
Box/Point
Current Extent
Coordinates
Located Point
Polygon
Map Indices
1 Degree
15 Minute
7.5 Minute
All
Address/Place
aquismon
Go
Clear
Name
Lon/Lat
Aquismón, San Luis Potosí
-99.0156 21.6212
Find Products
Clear Point
Lat/Lng
22.1350, -100.1157
Leaflet | Powered by Esri | The National Map




Ciudad Valles
San Ciro de Acosta
Sotano de las Golondrinas
Jalpan de Serra

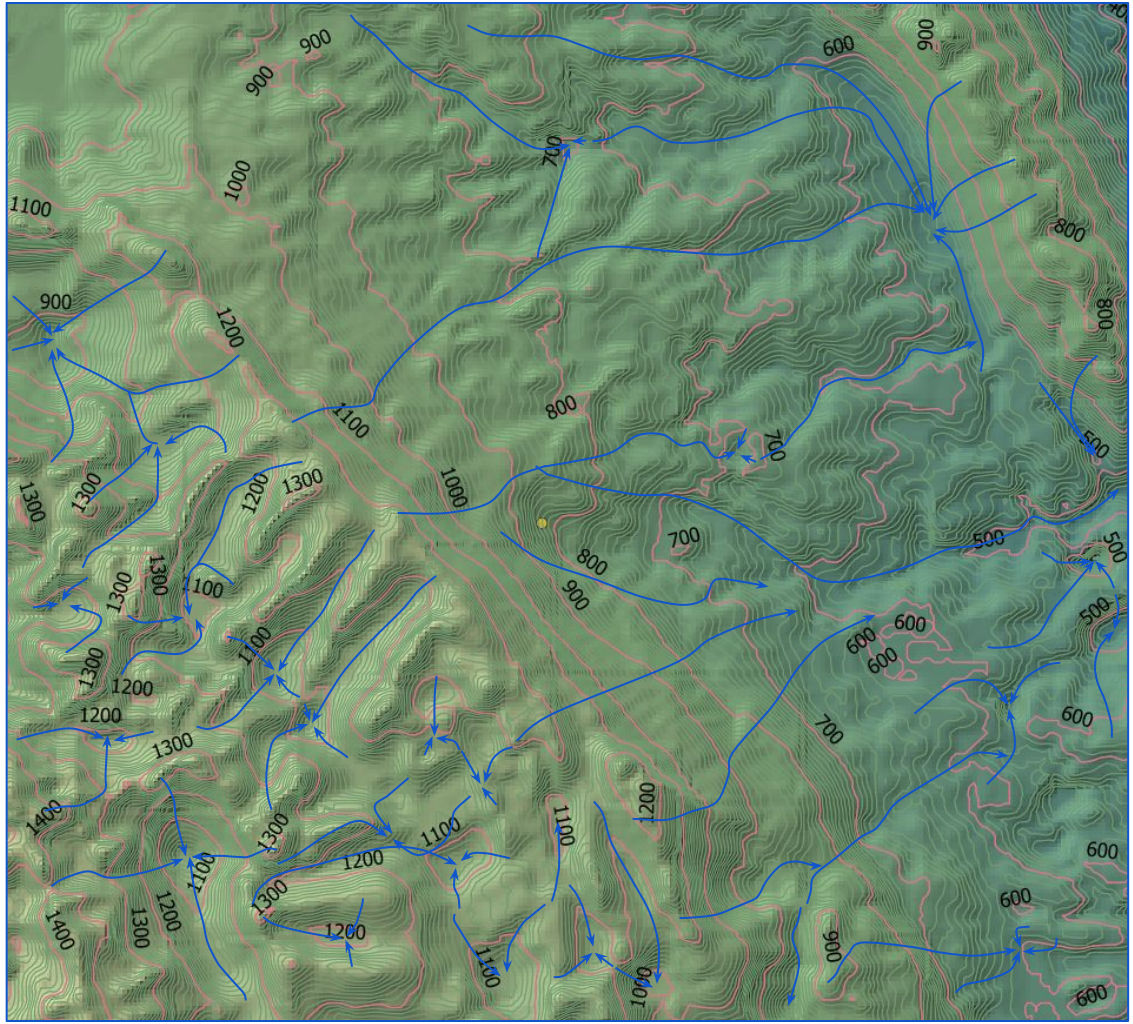


Water flow near Aquismón, San Luis Potosí, Mexico

- Rule of V's
- Karst is complex!

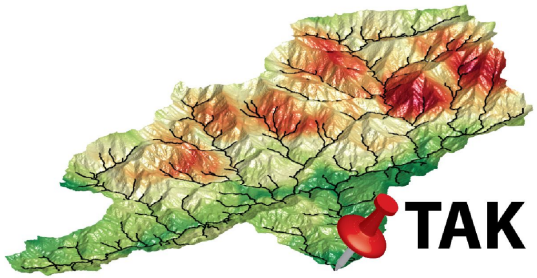
Sharing science

- Group presentation
- Individual written report



Karst Hydrogeology and Geomorphology: A virtual field experience using Google Earth, GIS, and TAK

Rachel Bosch
University of Cincinnati



TAK for TopoToolbox

Session Controls

Reset Defaults | Clear Loaded Data | Save Full State | Save Parameter State | Load Saved State

Output Files Name Prefix: Golondrinas

Idle

Select Output Directory: D:\NAGT\Karst\Golondrinas

Mat2Arc

Select MAT File | Raster Output Type: ascii | Run Mat2Arc

Data Input | Stream Selection and Projection | Ksn & Chi Maps | Select and Extract Basins | Summarize Basins | Junctions and Erosion | Swaths

MakeStreams

Load DEM File

Threshold Area: 1e+06

Minimum Flat Area: 1e+08

Resample Cell Size: 0 | Resample

No Data Expression:

Load Precipitation Grid | Load Runoff Ratio Grid

Run MakeStreams

RemoveFlats

Load DEM File

Strength: 1 2 3 4

Run RemoveFlats

ConditionDEM

Load MAT File

Conditioning Method: mincost

Run ConditionDEM

FindThreshold

Load MAT File

Threshold Method: average of selected streams

Pick Method: slope-area

Number of Streams: 5

Reference Concavity: 0.5

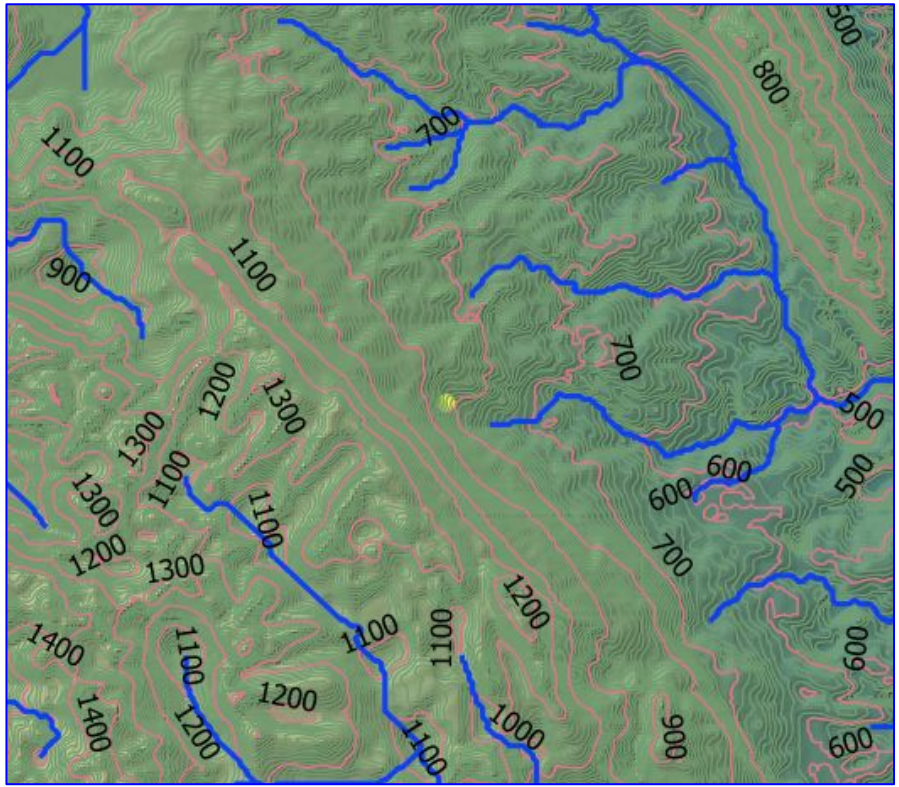
Maximum Threshold Area: 0

Remake Stream Network

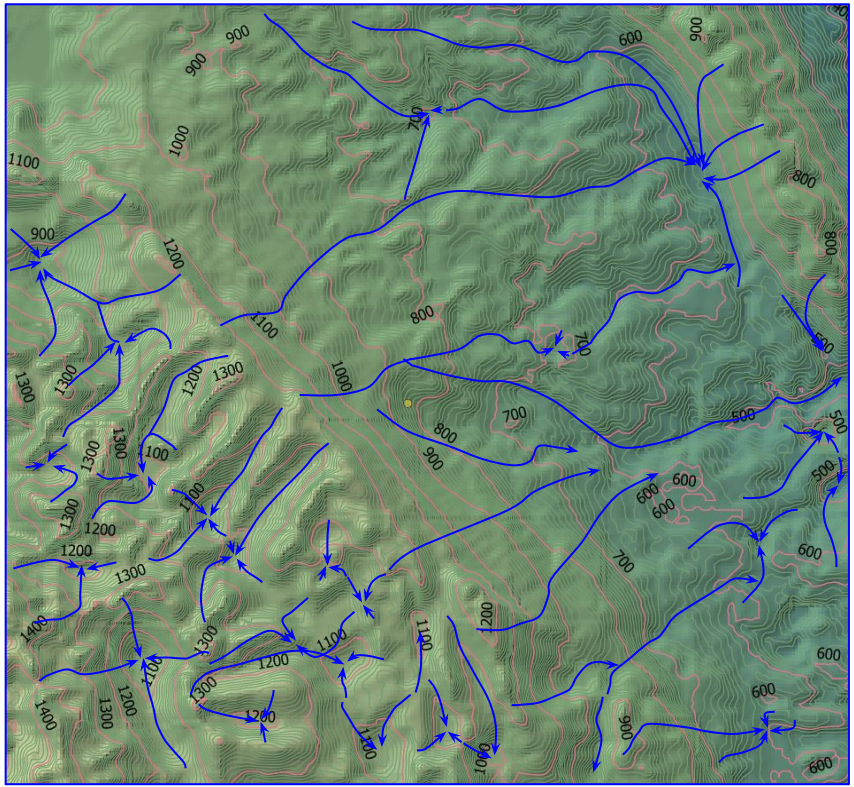
Run FindThreshold

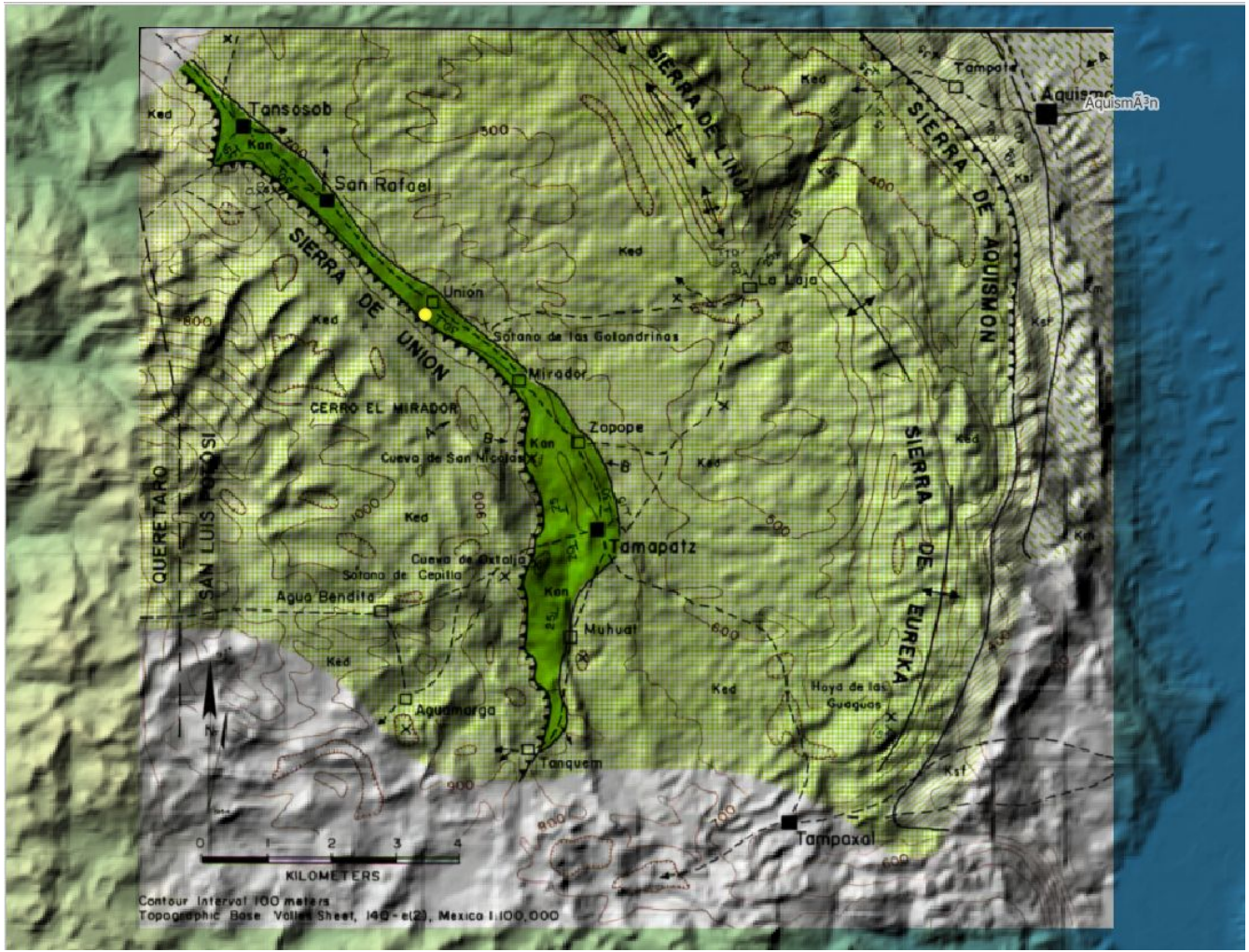
Water flow near Aquismón, San Luis Potosí, Mexico

Using TAK



Using Rule of v's

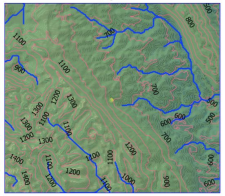


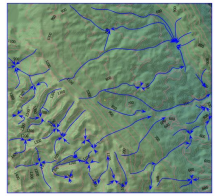


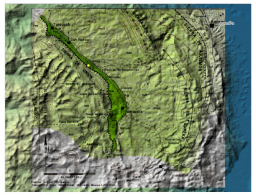
Geology near Aquismón, San Luis Potosí, Mexico

- Raines, Terry. "Sótano de las Golondrinas." *Association for Mexican Cave Studies Bulletin* 2 (1968): 20pp.
- Screenshot, georeferenced in QGIS

- Data analysis
  - Compare two stream networks
  - Integrate geology, topography, and hydrology to construct a geologic/geomorphic history
- Hypothesis formulation
  - Speculative parts of hx
  - Environmental or natural-disaster hazards
- Experimental design
  - Data collection
  - Field, laboratory, or numerical techniques
- Sharing science
  - Group presentation
  - Individual written



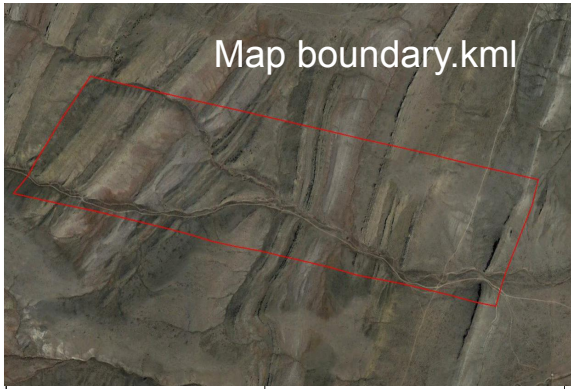


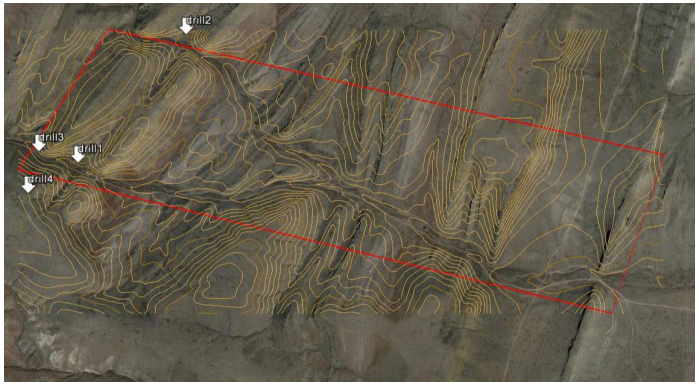


FRYING PAN GULCH, MT MODULE - BASIC LEVEL)

- Designed as something students might actually do at a real job these days – collect all available background info, do as much virtual mapping as possible, make calculations and quantitative assessments, write a full report on findings.
- In addition, have them discuss about the uncertainties in their contact locations, dips, unit thicknesses, etc.
- Intro-level (warm-up) project designed to get familiar with the geological history of the region, digital tools, and establish a “camp” routine.
- CSUF students used Google Earth Pro, Adobe Illustrator, Strat Desktop (by Allmendinger), and field notebooks.

WHAT IS PROVIDED TO STUDENTS?





5m contour lines (from mark Helper) and drill data to a particular contact on the W-limb of the anticline

Kklc - Basal sandstone and mudstone: Upper part recessive, mostly reddish and greenish mudstone; lower part is ridge-forming, coarse- to medium-grained, cross-bedded to massive, brown to yellowish gray, chert-rich lithic sandstone with local lenses of chert-rich conglomerate and limestone pebble conglomerate; interbedded with reddish and greenish mudstone.

Morrison Formation

Jm - Pale green, olive green, red, and gray variegated mudstone, shale, and siltstone with thin, interbedded yellowish brown to grayish orange, very fine-grained sandstone, siltstone, and gray limestone. **Poorly exposed.**

Dinwoody Formation

Interbedded shale, limestone, and calcareous sandstone characterized by platy, thinly laminated beds that weather a distinctive pale to light grayish brown.

Trdu - Upper part has massive calcareous, rippled sandstone beds as much as 1 m (3 ft) thick with shaley interbeds and massive, gray, pinkish gray weathering, limestone as much as 1 m (3 ft) thick. Phosphatic pelecypod Lingula and fish bone fossils are locally abundant.

Trdl - Lower part is predominantly olive drab, chippy-weathering, hard fissile shale with interbedded dark brown weathering, silty limestone beds 10 cm (4 in) or thinner. Thickness about 200 m (650 ft). **Moderately cliff-forming.**

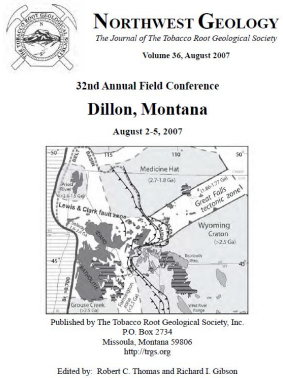
Phosphoria formation

Pp - dark gray to black, carbonaceous and phosphatic mudstone with scarce phosphate beds, grayish and gray brown cherty quartz sandstone, cherty or sandy dolomite, fine-grained dolomitic sandstone, and yellowish tan sandy siltstone with subordinate beds of vitreous quartz sandstone. **Cliff forming.**

Unit descriptions from Geol. Map of Twin Adams Mt. Quadrangle

outcrops

overview



Reference reading materials

WHAT DID THE STUDENTS TURN-IN IN ADDITION TO THEIR REPORT?

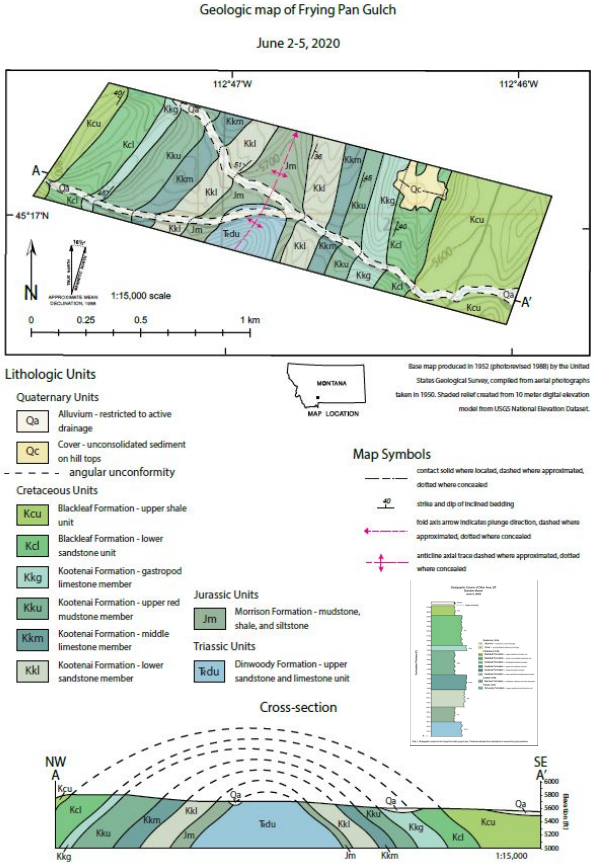
GE_map.kml

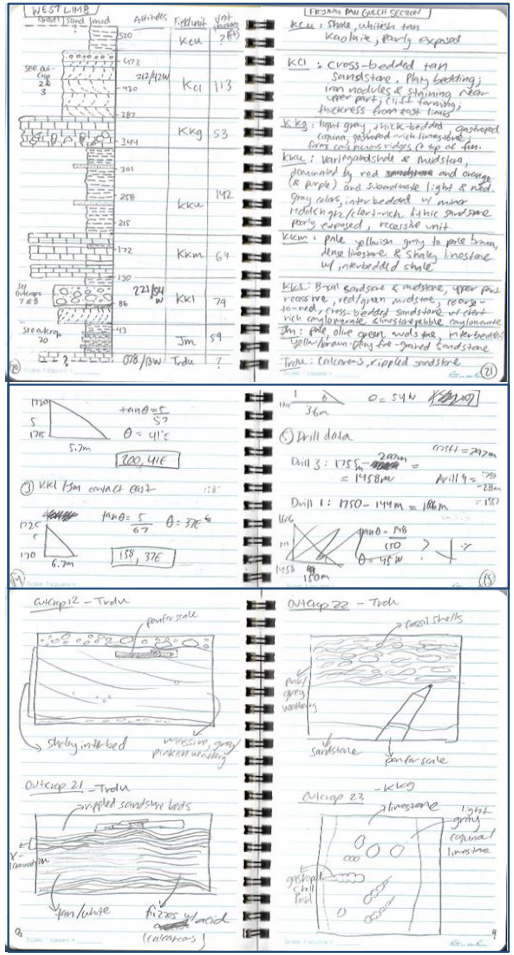
Jurassic

- The Ellis Group- Sawtooth, Rierdon, Swift
  - Dominated by the tectonism and therefore localized deposition into the Belt Island
  - The south to north encroachment of the Jurassic sea caused south to north truncations
  - Deposition is localized and thin in the Dillon area
- The Morrison Formation (Jm)
  - Uplift in western North America changed the setting from marginal marine to continental
    - Mudflats and fluvial plains with intermittent fluvial channels
  - Tectonically quiet environment allows for greater deposition

Outcrop photo 11; Adam Woods, CSUF

Group presentations





WHAT DID IT TAKE?

VERY HANDS ON.

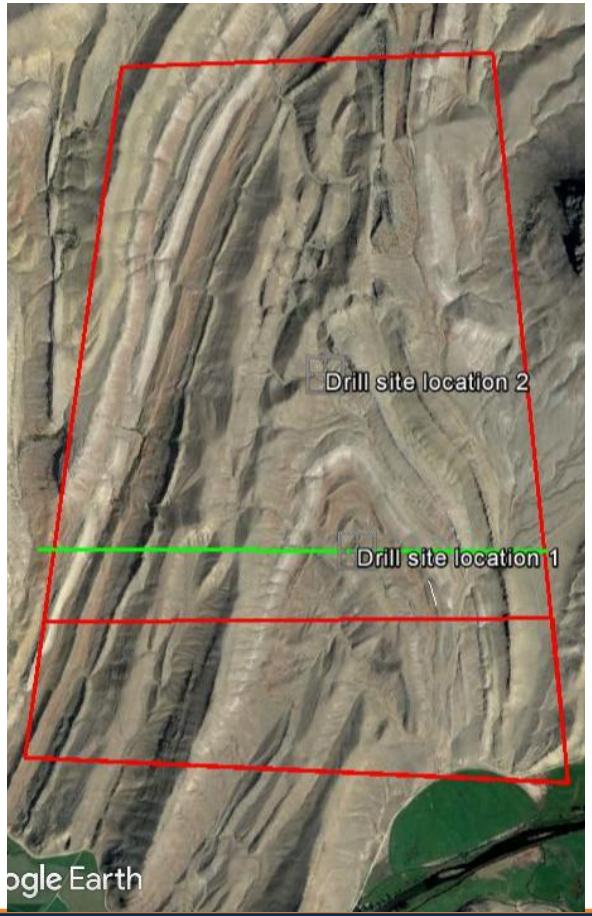
- Meet every morning (9 am) and afternoon (6 pm).
- Day 1:
  - GE introduction. Draw any lithological boundaries including Q contacts.
  - Introduction to Adobe Illustrator (This portion included a separate exercise on drawing a geological cross-section of the Twin Adams Mountain Quadrangle using only Adobe Illustrator).
- Day 2:
  - Small and large group discussions on where to draw formation/member contacts using the photos and stratigraphic unit descriptions. Required sketch drawing entries into their notebooks.
- Day 3:
  - Determine strike/dips using 3-point problem techniques on their contacts and the drill data given to them.Draw cross-section, determine unit thicknesses.
- Day 4:
  - Construct a stratigraphic column using Strat Desktop.
- Day 5:
  - Group presentations on the Regional Geological Setting
- Day 6: Turn in reports

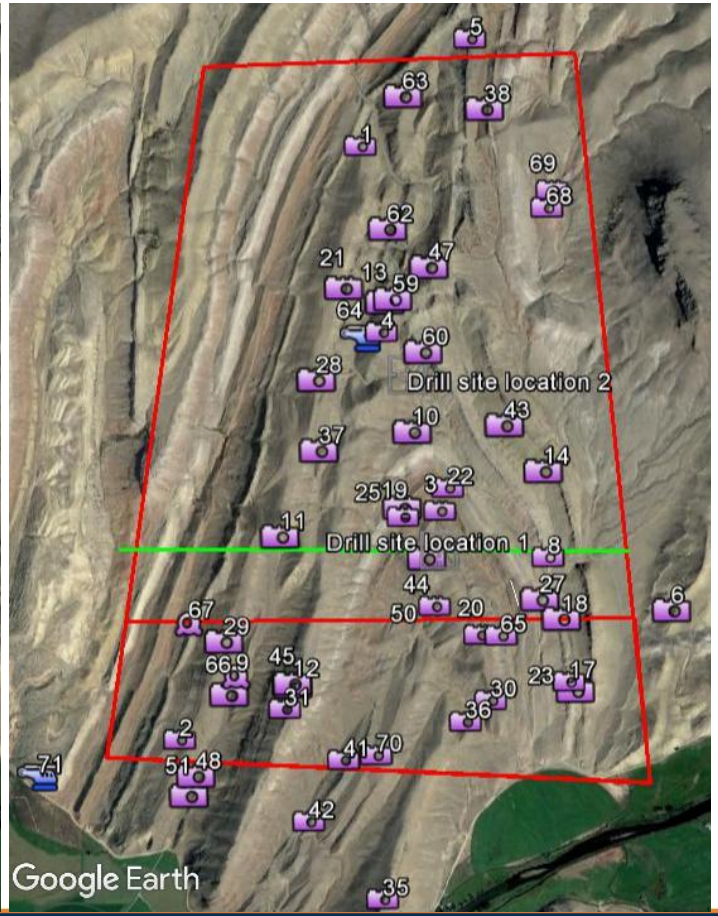
BLOCK, MT MODULE - INTERMEDIATE - ADVANCED LEVEL

- Designed as a follow up exercise to the Frying Pan Gulch module, but can probably be done on its own if it is tweaked a little.
- Expectations at the beginning of the module are:
  - comfortable with using Google Earth
  - competent users of Adobe Illustrator
  - Familiarity with the regional geological setting
  - Familiar with the units
  - Familiar with 3-point problems
  - Familiar with Strat Desktop

- While they need to produce a geological map and a geological cross section for the area, they are also given a specific problem of determining the depths to a particular contact at two different drill sites in the field area.

WHAT IS PROVIDED TO STUDENTS?





Map boundary, drill site locations, cross-section location, photos, same stratigraphic unit descriptions, 5m contour lines, and 31 strike/dip data from the Sandy Hallow Anticline (no locations or unit affiliations)

Stratigraphic Unit Descriptions from a nearby area with similar lithologies expected at the field site

Colorado Formation (90 m)
Kcu – shale. Whitish tan – kaolinite. Poorly exposed.

Kcl – Cross-bedded tan sandstone. Platy bedding; iron nodules and staining near its upper part. Cliff-forming

Kootenai Formation (300 m)
Kkg - Gastropod limestone member: Light gray, thick-bedded, gastropod coquina or gastropod-rich limestone that may also contain charophytes and ostrocodes. Forms conspicuous ridges at the top of the formation.

Kkuc - Red mudstone member: Variegated shale and mudstone, dominated by red, orange, and purple, and subordinate light and medium gray colors, interbedded with minor reddish quartz- and chert-rich lithic sandstone. Poorly exposed, recessive unit.

Kkl - Fine-grained limestone member: Pale yellowish gray to pale brown, dense limestone and shaley limestone with interbedded shale.

Kklc - Basal sandstone and mudstone: Upper part recessive, mostly reddish and greenish mudstone; lower part is ridge-forming, coarse- to medium-grained, cross-bedded to massive, brown to yellowish gray, chert-rich lithic sandstone with local lenses of chert-rich conglomerate and limestone pebble conglomerate; interbedded with reddish and greenish mudstone.

Morrison Formation
Jm - Pale green, olive green, red, and gray variegated mudstone, shale, and siltstone with thin, interbedded yellowish brown to grayish orange, very fine-grained sandstone, siltstone, and gray limestone. **Poorly exposed.**

Dinwoody Formation
Interbedded shale, limestone, and calcareous sandstone characterized by platy, thinly laminated beds that weather a distinctive pale to light grayish brown.

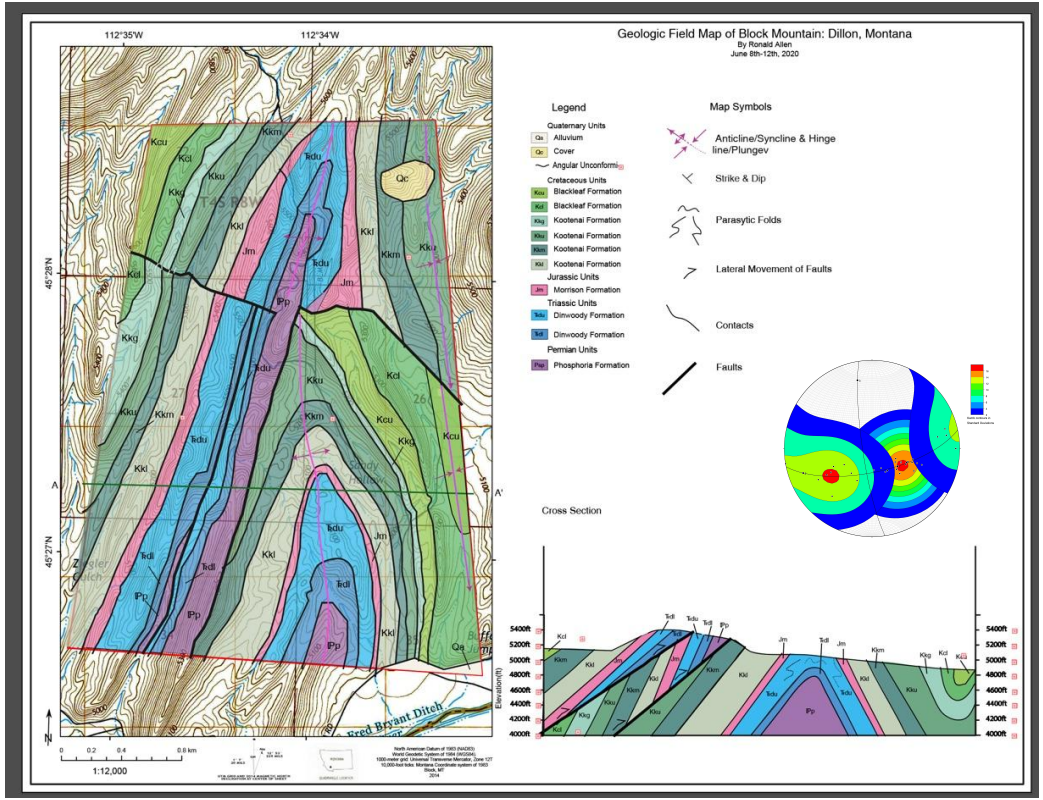
Trdu - Upper part has massive calcareous, rippled sandstone beds as much as 1 m (3 ft) thick with shaley interbeds and massive, gray, pinkish gray weathering, limestone as much as 1 m (3 ft) thick. Phosphatic pelecypod Lingula and fish bone fossils are locally abundant.

Trdl - Lower part is predominantly olive drab, chippy-weathering, hard fissile shale with interbedded dark brown weathering, silty limestone beds 10 cm (4 in) or thinner. Thickness about 200 m (650 ft). **Moderately cliff-forming.**

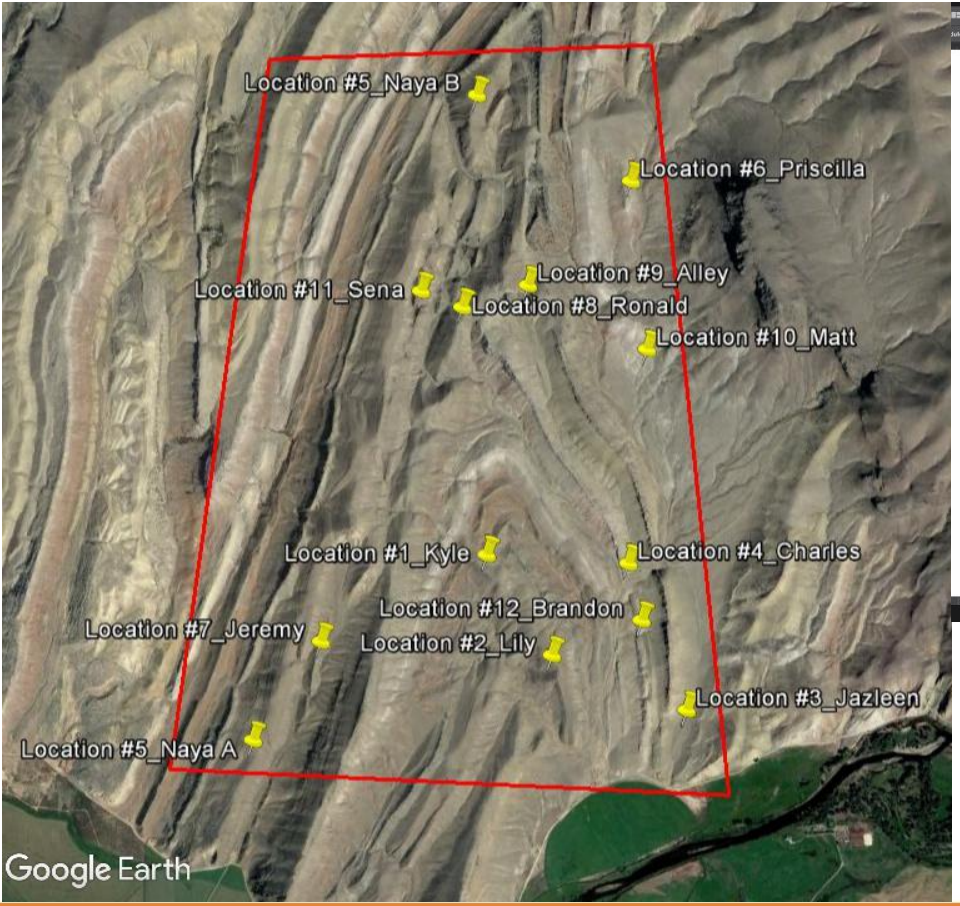
Phosphoria formation
Pp - dark gray to black, carbonaceous and phosphatic mudstone with scarce phosphate beds, grayish and gray brown cherty quartz sandstone, cherty or sandy dolomite, fine-grained dolomitic sandstone, and yellowish tan sandy siltstone with subordinate beds of vitreous quartz sandstone. **Cliff forming.**

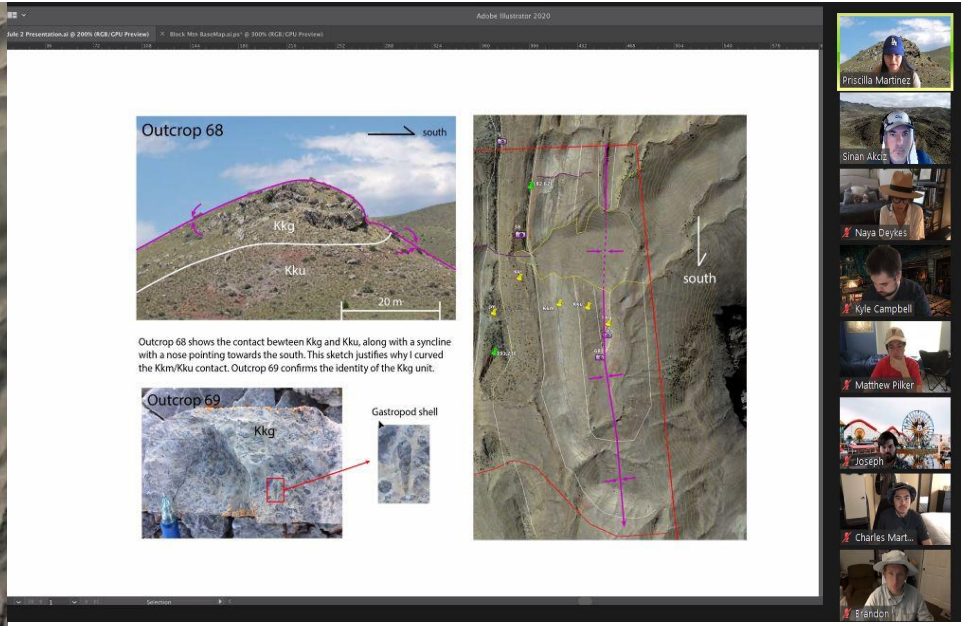
WHAT WILL THE STUDENTS TURN-IN AT THE END OF THE WEEK?

- Geological Map
- Geological cross-section
- Updated Stratigraphic column
- Stereographic analysis of the provided strike/dip data
- (OPTIONAL) Stereographic analysis of their own Strike/dip data
- Report
  - Many sections similar to Frying Pan Gulch report
  - Chance to improve their writing based on the comments they received.
  - Updated stratigraphic unit descriptions
  - Much expanded structural observations section
  - And geological history of the mapping area.



STUDENT RUN VIRTUAL FIELD TRIP!





WHAT DID IT TAKE?

VERY HANDS OFF.

- Meet every morning. Talk about plan for the day.
- Meet every afternoon to reflect on the day's accomplishments and frustrations.
- The southern portion of the map area had to be finished in Google Earth on day 1. Afternoon discussions gave an opportunity for everyone to decide where they want to have their contacts. A review session on how to recognize the thrust faults were discussed.
- No set due dates/times except for the final report which will include everything they have done on this project (geologic map, cross-section, modified stratigraphic column, stereonet analysis, strike/dip data they calculated, outcrop/overview photo sketches, alternative interpretations to their contacts and cross-section, summary page to the CEO of the company who really wants to know the depth to the Phosphoria formation contact.
- Scheduled a stereonet analysis software tutorial.
- Other discussions, tutorials were optional though everyone attended.