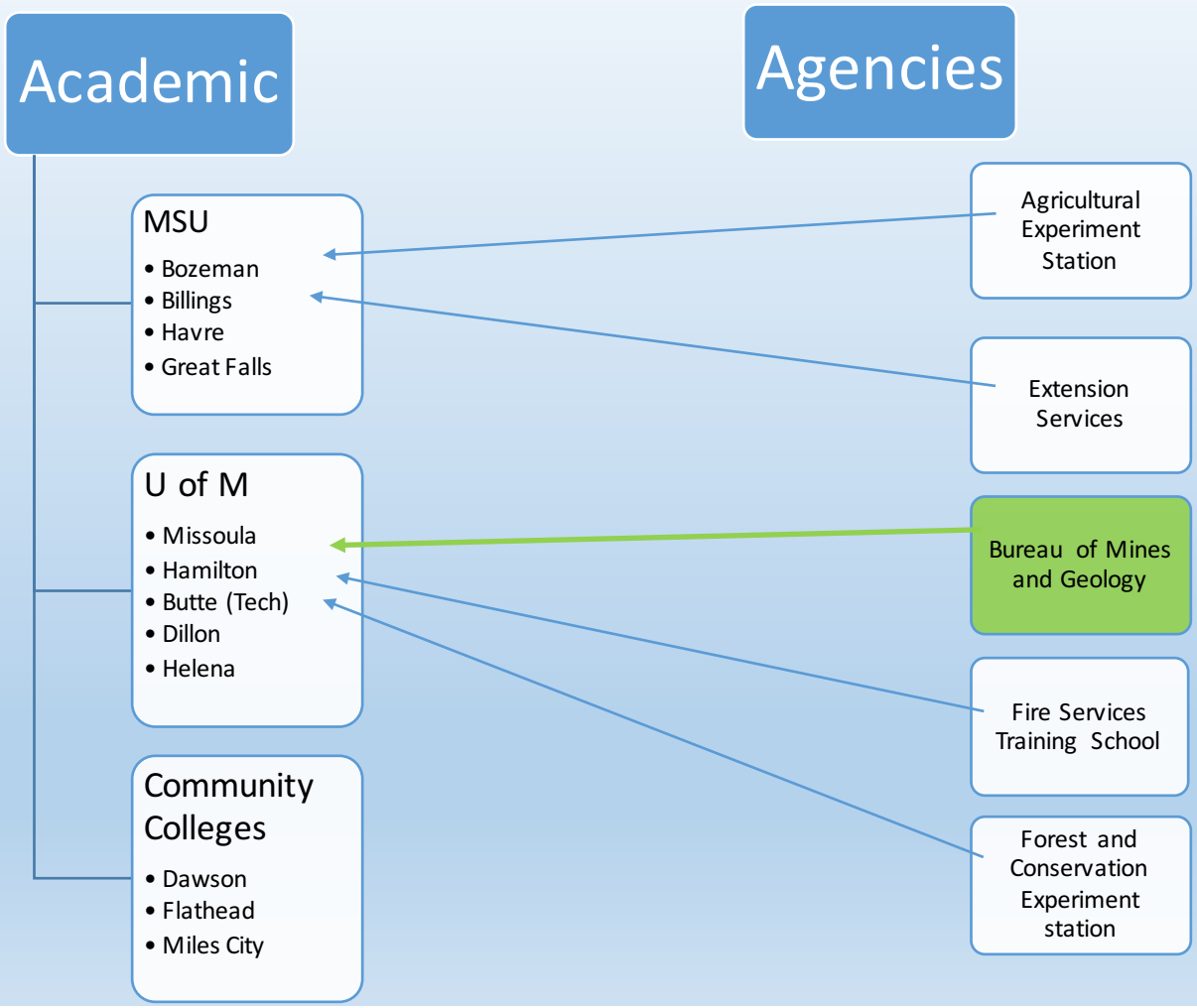
3-Dimensional Geologic Model of the Flathead River Valley at Kalispell Montana

April 6, 2016
Kalispell Montana

James Rose

Answering complex, locally identified hydrologic questions across Montana

Montana University System



http://www.mbmg.mtech.edu/datacenter/datacenter.asp

The Flathead Valley, Deep Aquifer Project
Ground Water Investigations Program – MBMG

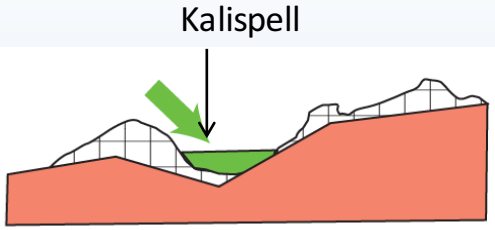
Research Questions --- Why was this project selected?

- **Confining Unit-** Does the confining unit separate the Deep Aquifer from surface water?
- **Water storage capacity-** Does increased development of the Deep Aquifer by new wells negatively impact aquifer water levels or water quality?
- **Is Deep Aquifer Connected to Flathead Lake-** Does the Deep Aquifer discharge to Flathead Lake?
- **Provide scientific information to assist with local planning**

How do we form these rows of mountains and deep valleys?

Mountain building forces occurred west to east.

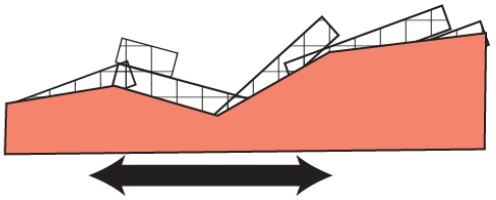
setting



YOUNGEST - Present Day

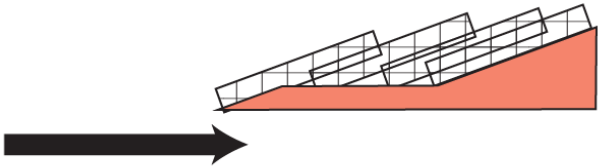
Valley Fill:
3 Quaternary Stream
2 Quaternary Glacial
1 Tertiary Stream

Erosion and Deposition



Valley Formation:
Relaxation

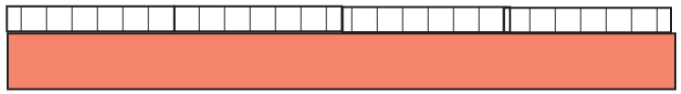
Extensional Relaxation
and Down Dropping



Mountain Building:
Compression

Mountain Building
by Compressional
Forces

Basement Rocks:
Belt Supergroup

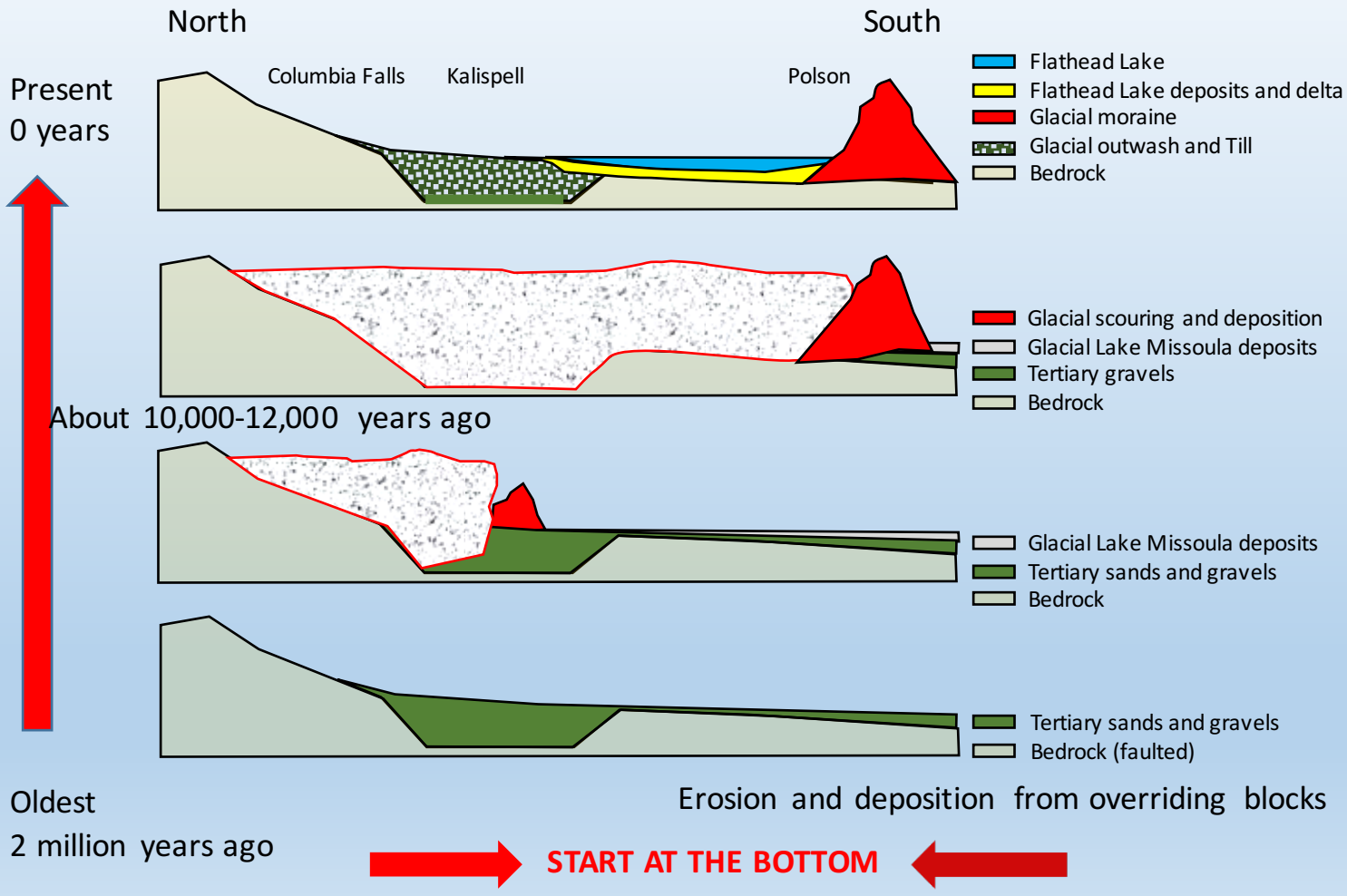


Sedimentary Packages
Overlying Basement Rocks

OLDEST - 1 Billion Years Ago

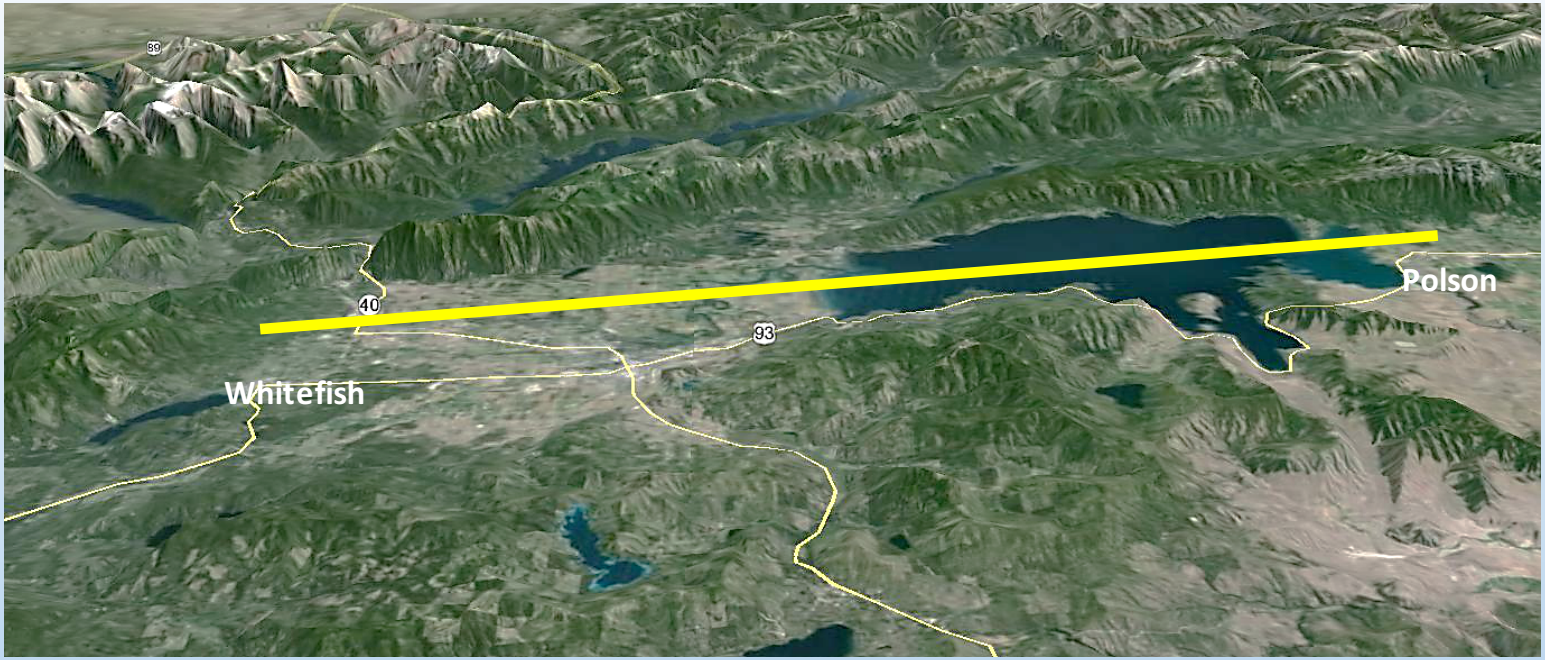
START HERE, AT THE BOTTOM

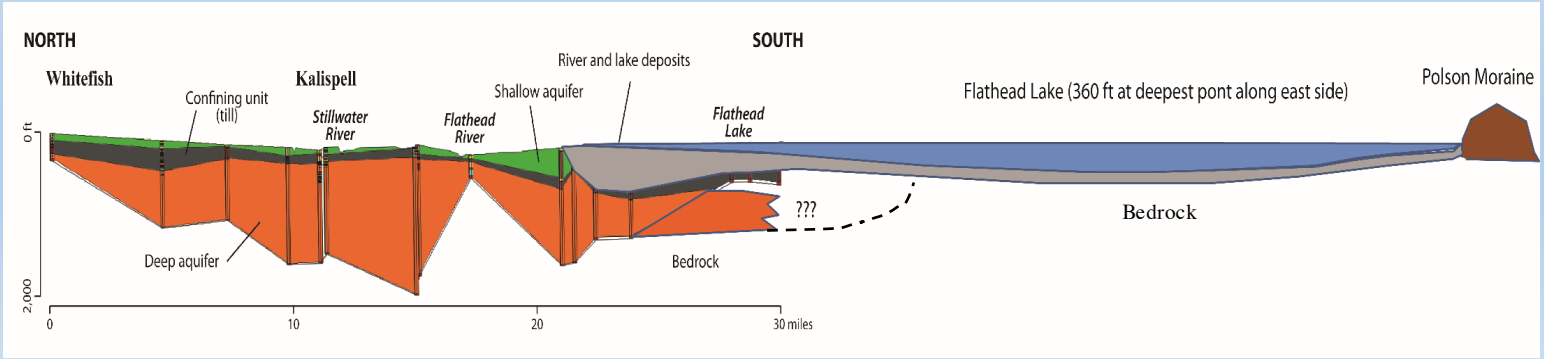
A possible geomorphological history of the Flathead Valley glaciation.



Animate to reveal next image

Here we are, but how did we get here?





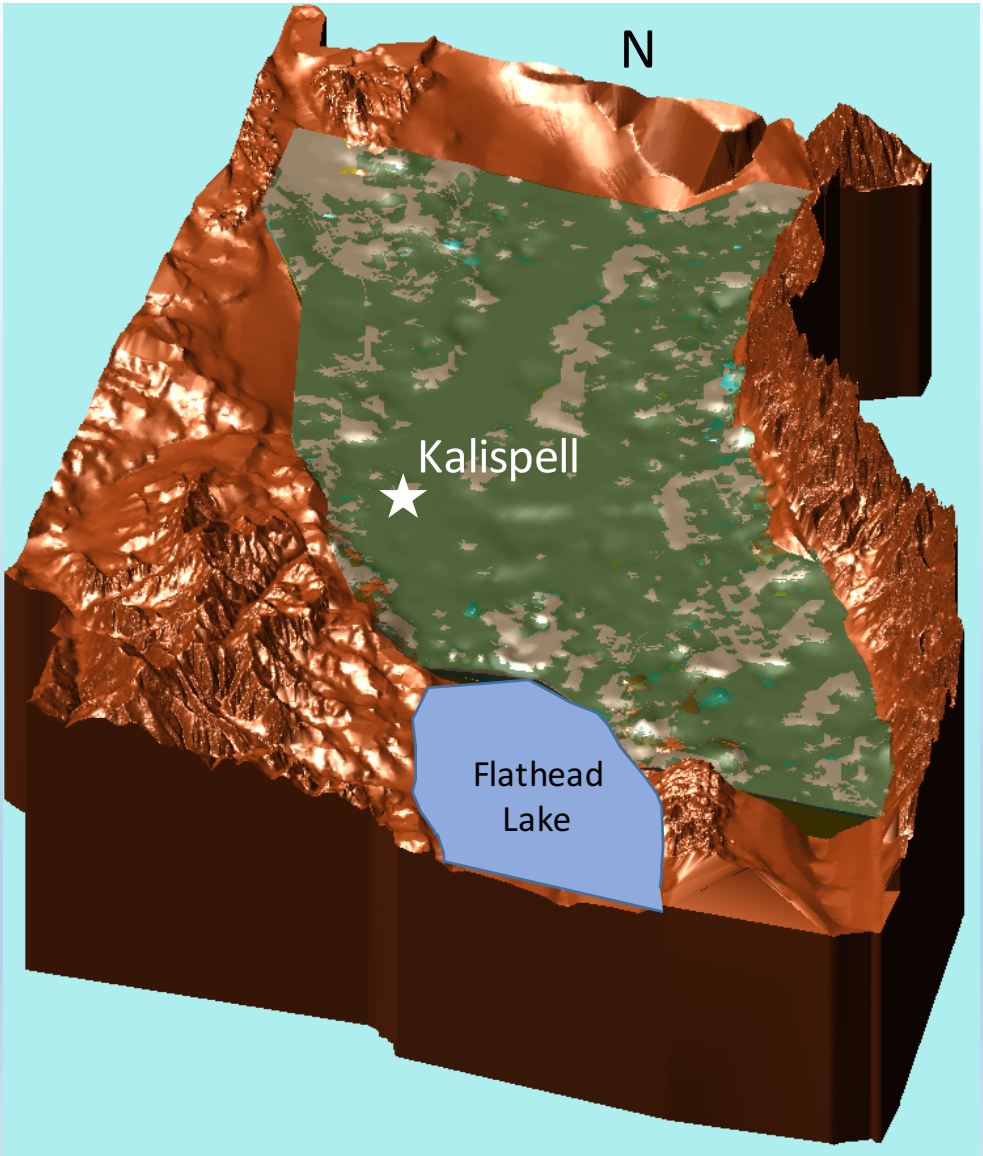
Geologic Section

Thickness of unit	Hydrogeologic Unit	Age	Material Description
0-200’	**Shallow sand and gravel**	Holocene-present	sand and gravel with silt and clay
<50’-400’	**Confining Unit**	Pleistocene - Holocene	Silt and silty-clay lacustrine sediments and till (gravel embedded in clay)
0’-100’	**Upper Deep Aquifer**	Quaternary	coarse sand and gravel with abundant silt or clay
	Deep Aquifer	Quaternary	Clean coarse sands and gravels with occasional silty or clay-rich intervals
	Tertiary Sediments	Tertiary	semi-consolidated sands and gravels and conglomerate
	Belt bedrock	Pre-Cambrian	argillite,quartzite, siltite, mudstone, marble, dolomite

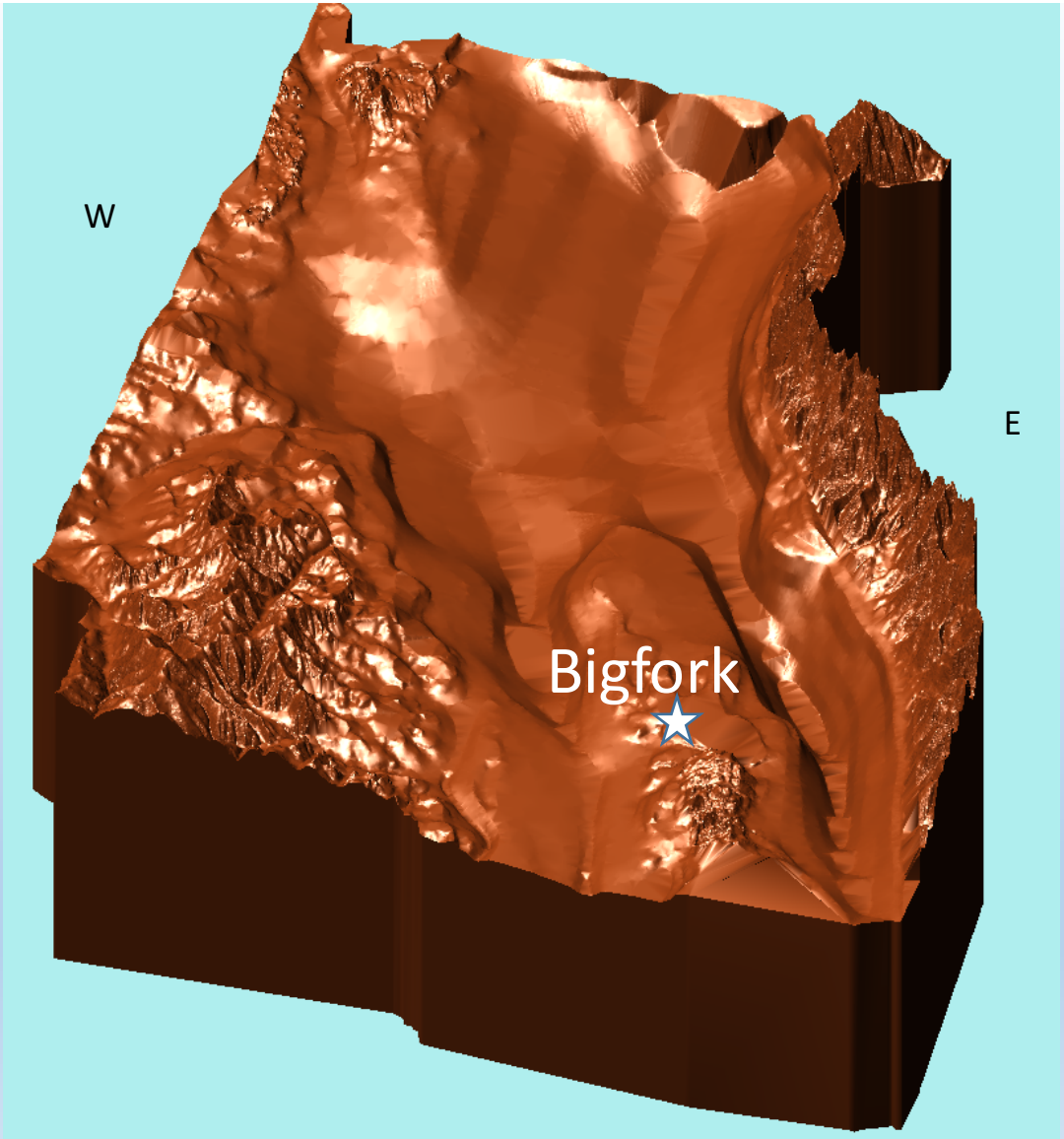
Wells data


Deep Sand and Gravel Aquifer

3-Dimensional computer generated Geologic Model

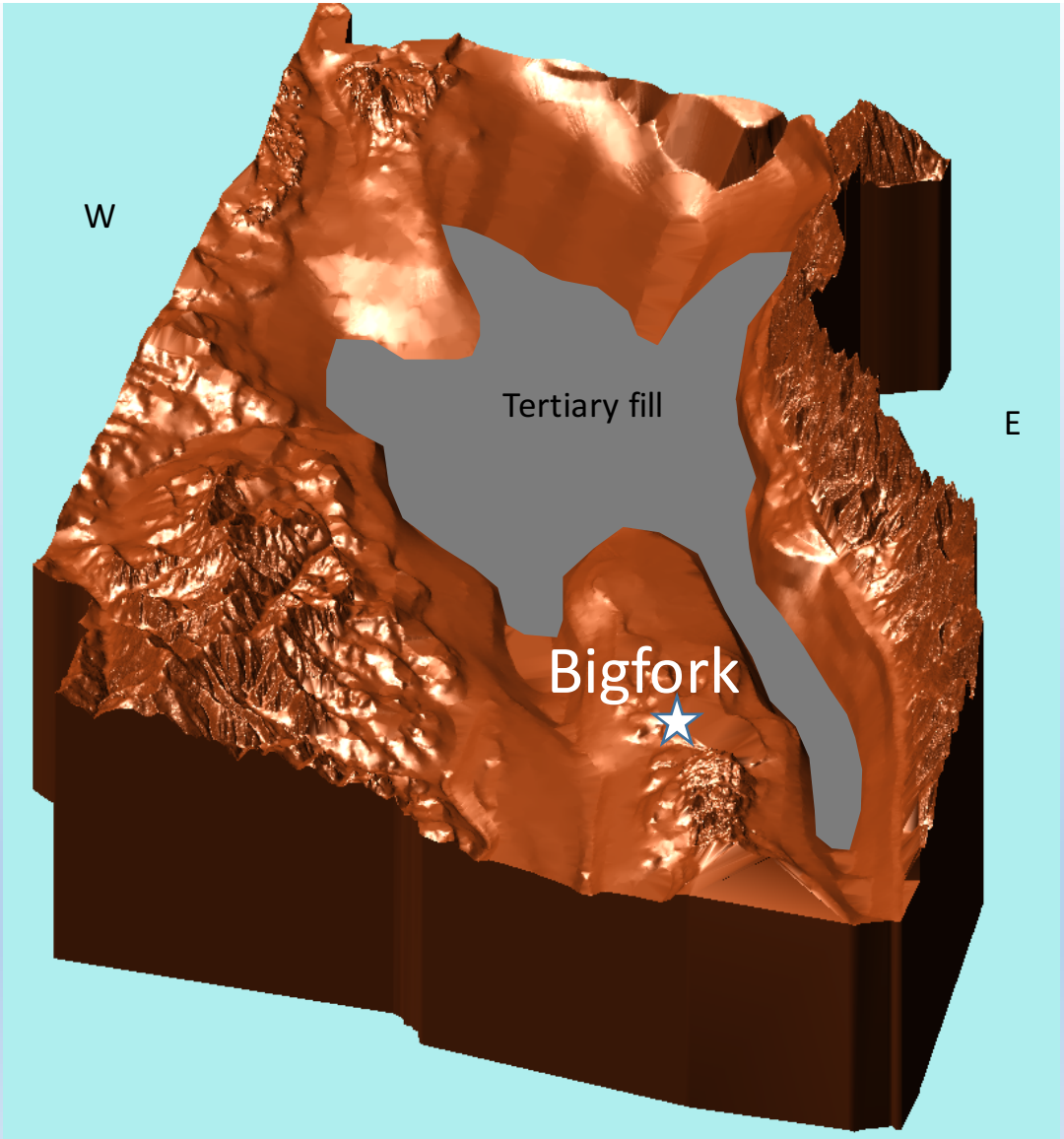


Consolidate existing information

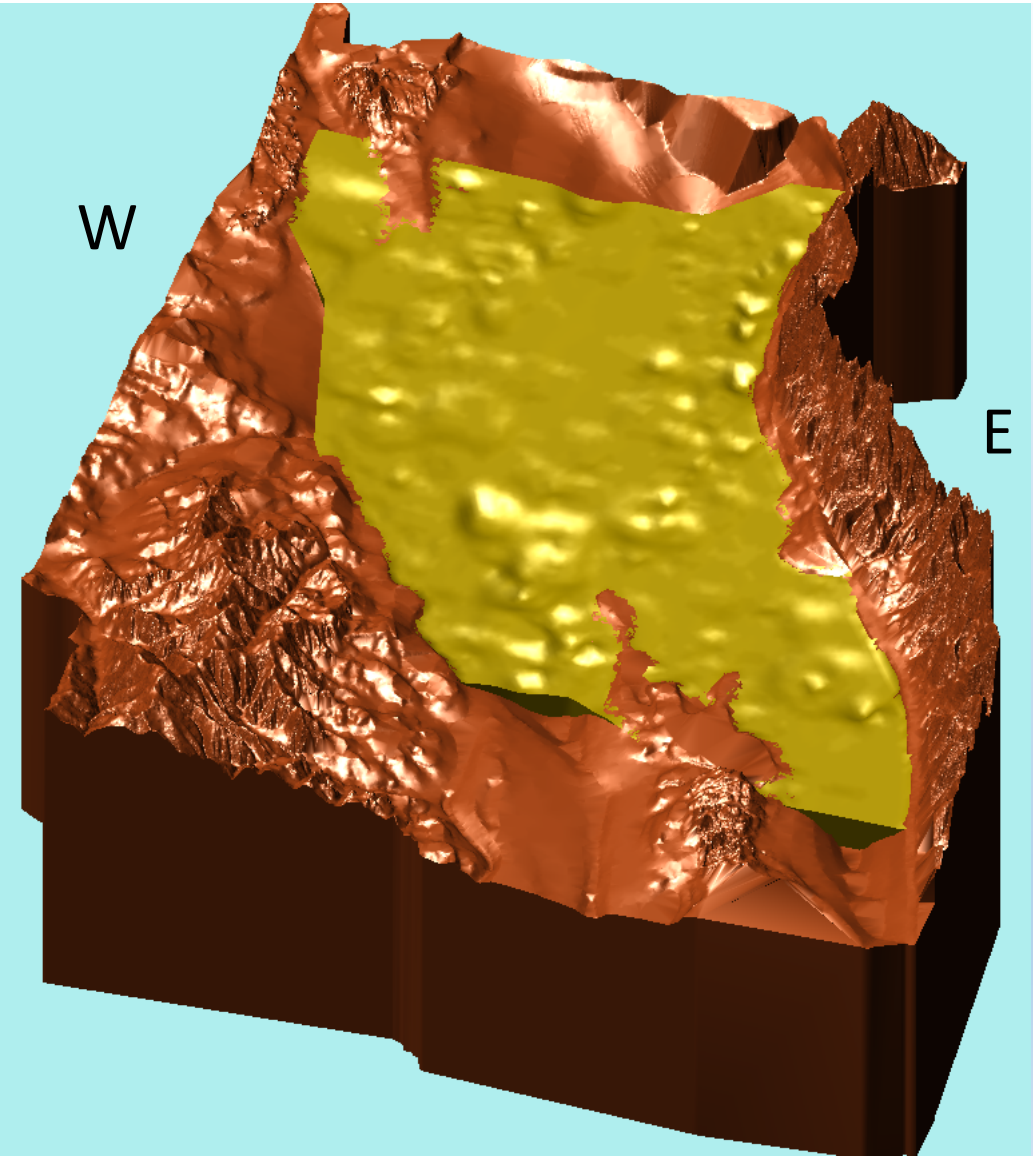


Bedrock surface troughs

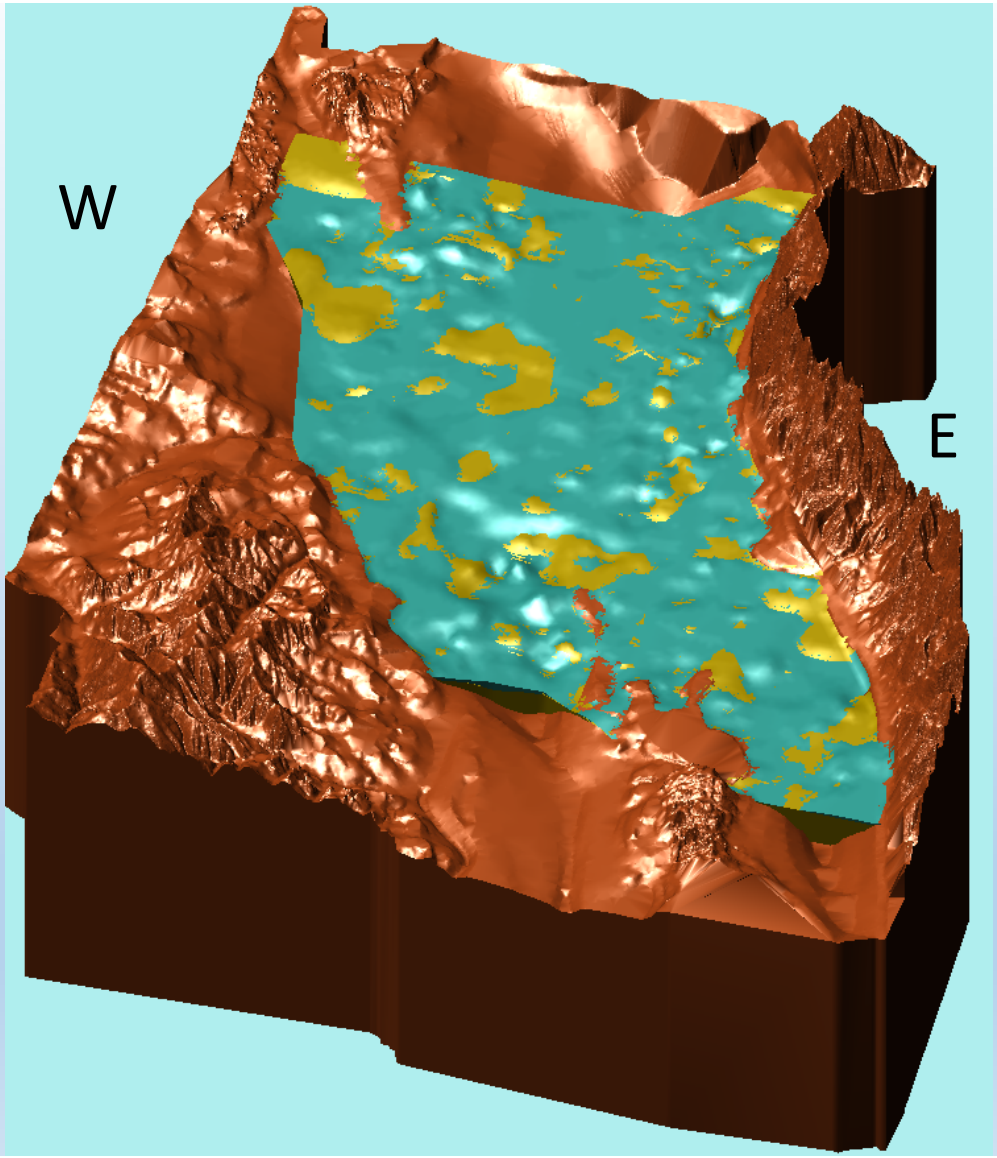
ridge



Estimated Tertiary sediment fill

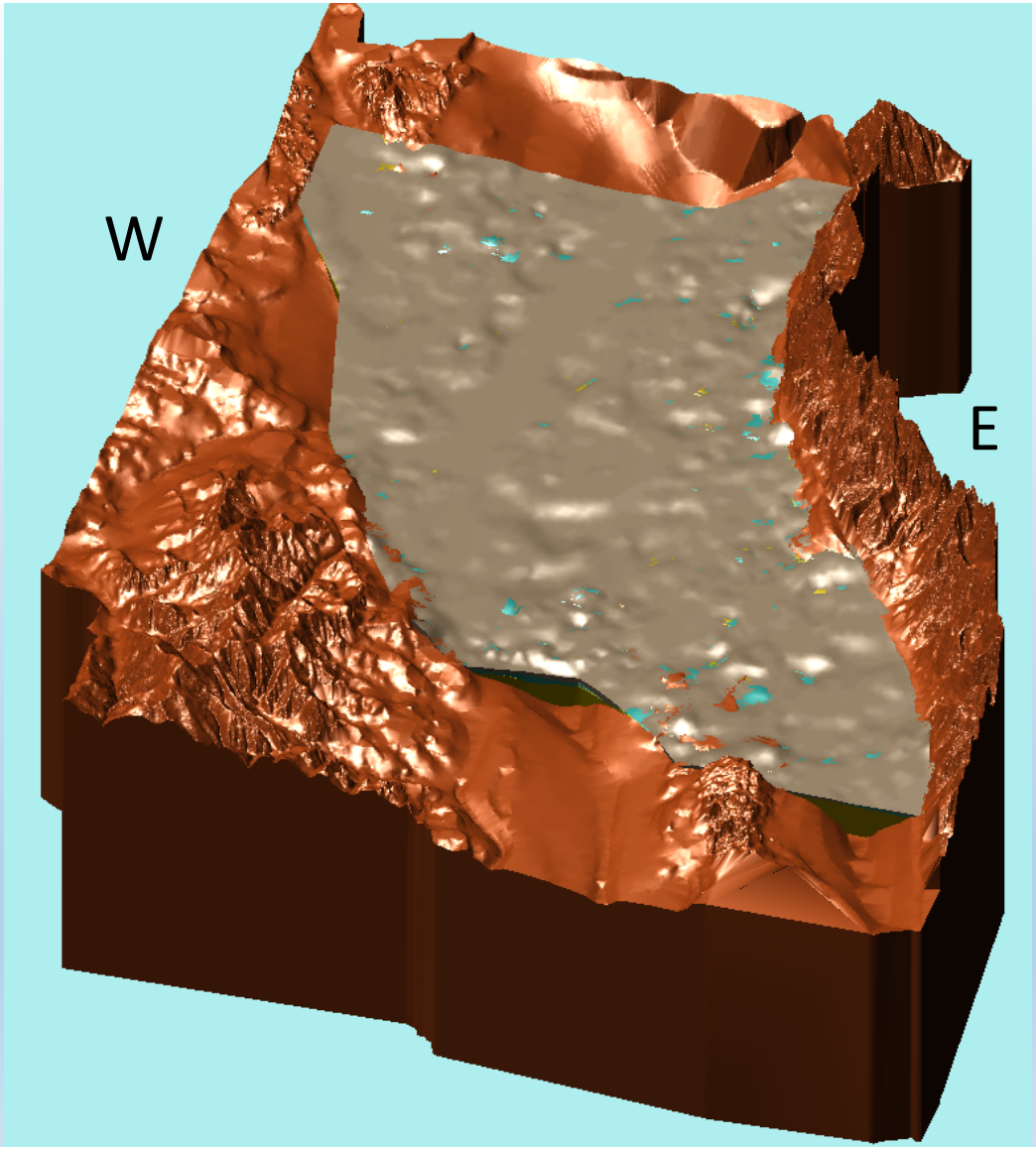


Deep sand and gravel aquifer



Top of Upper Deep Aquifer

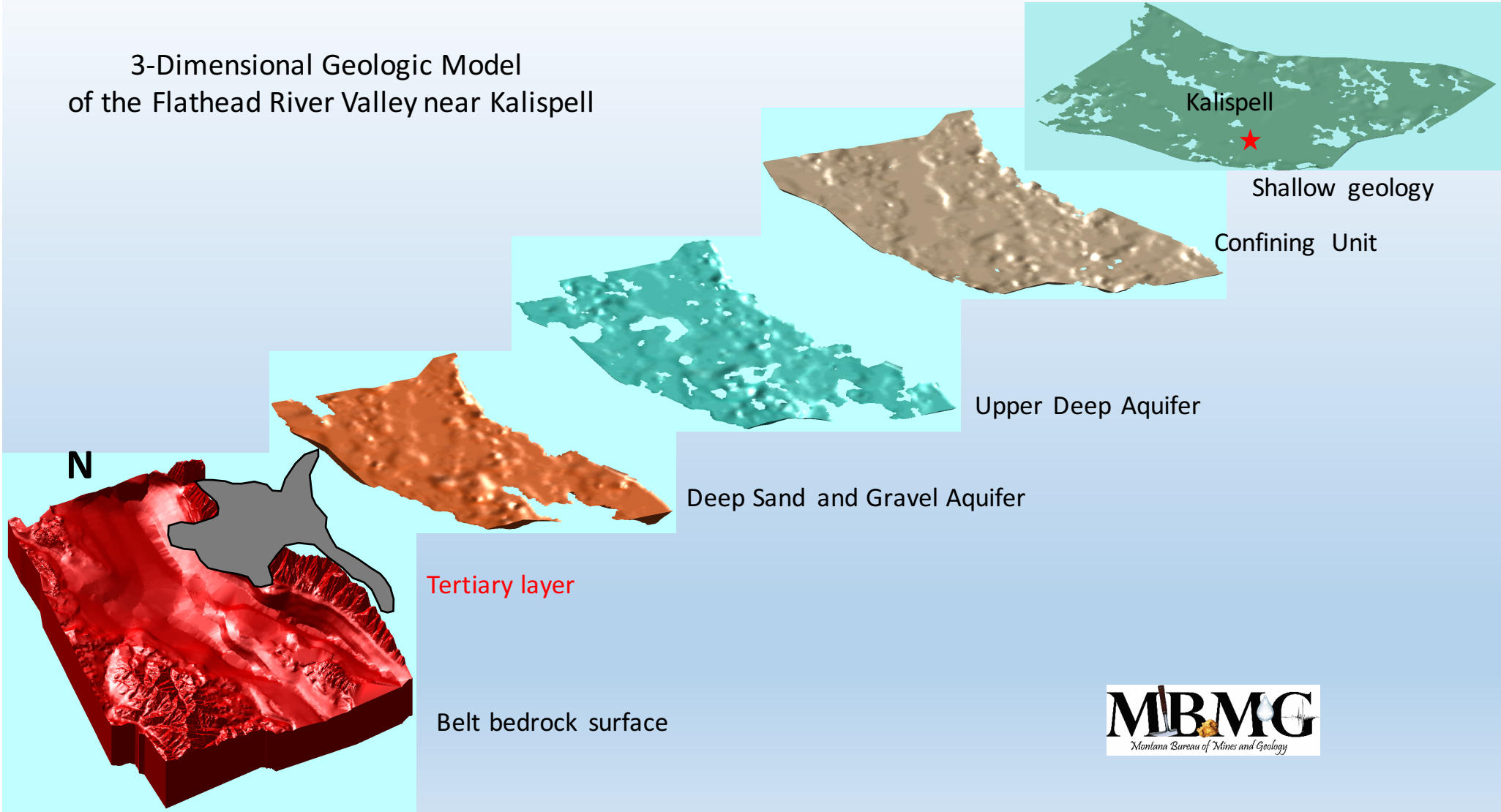
Very silty sand and gravel



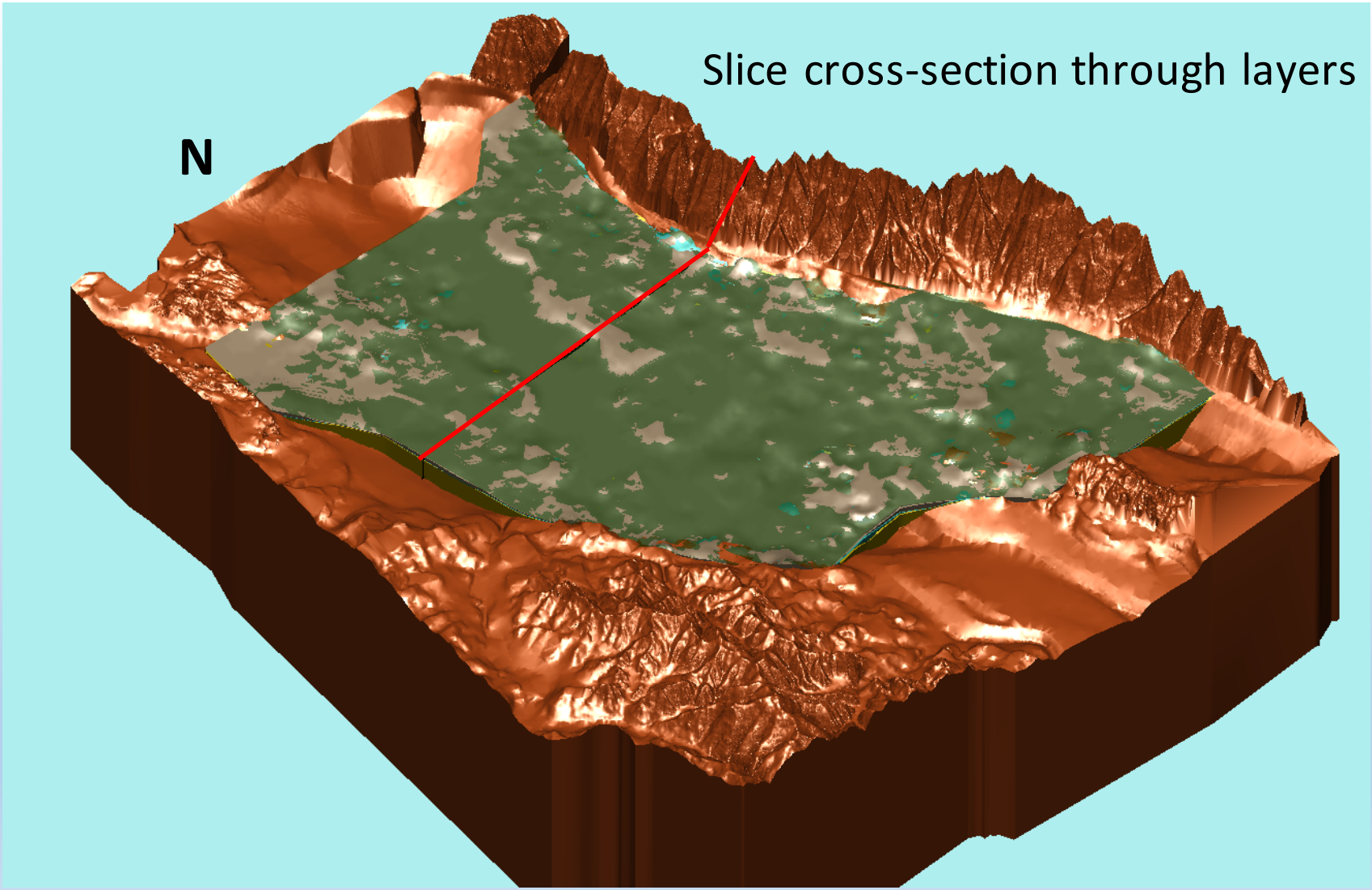
Confining Unit

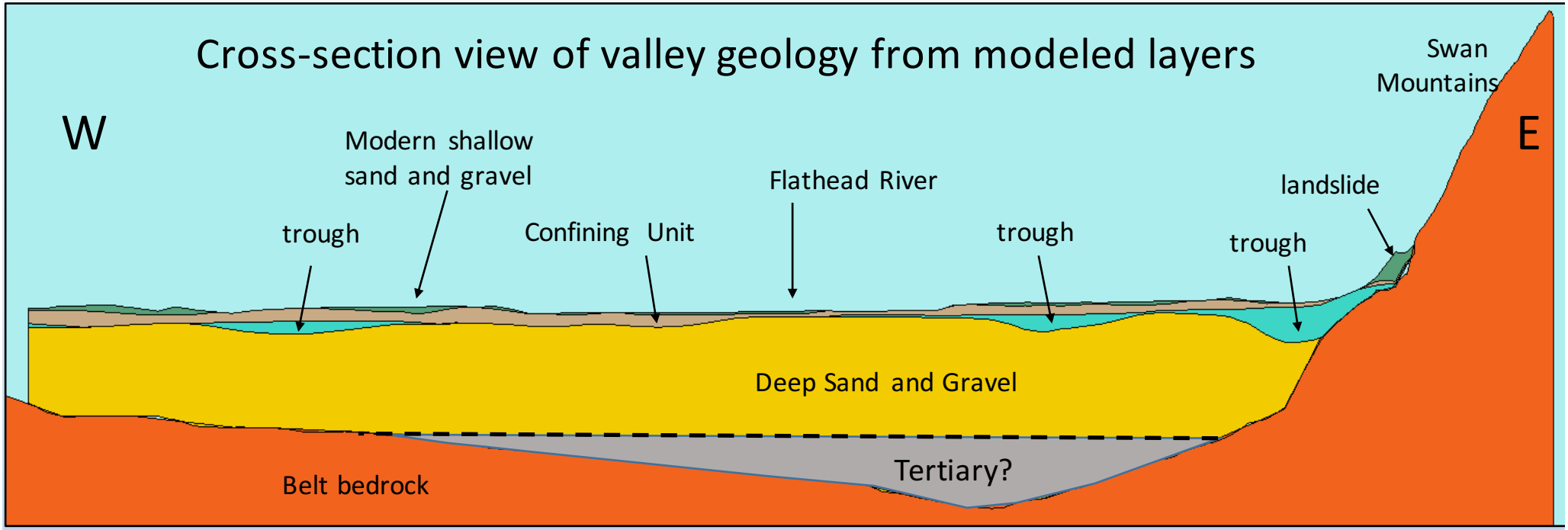
Silt-clay

3-Dimensional Geologic Model of the Flathead River Valley near Kalispell

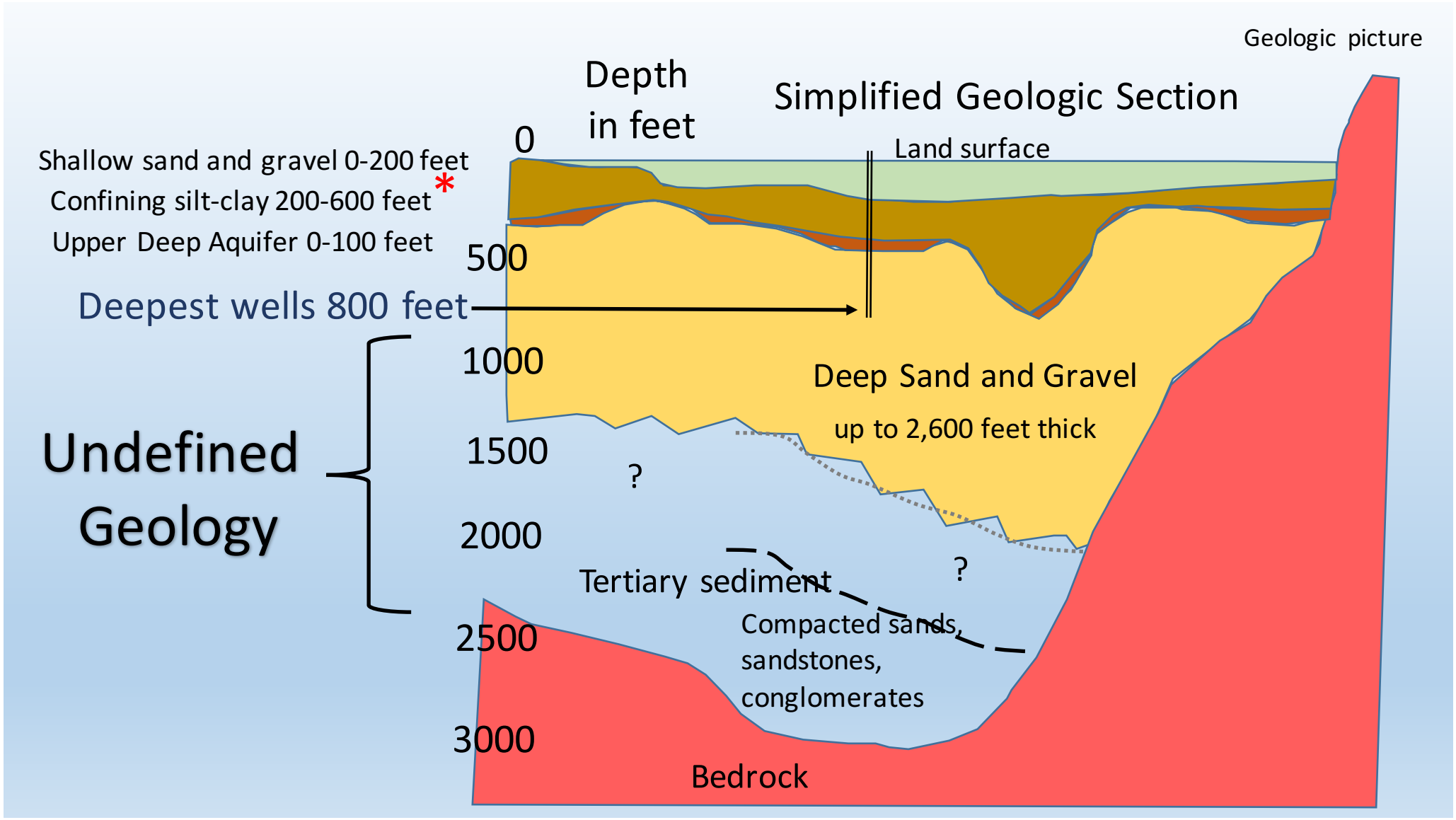


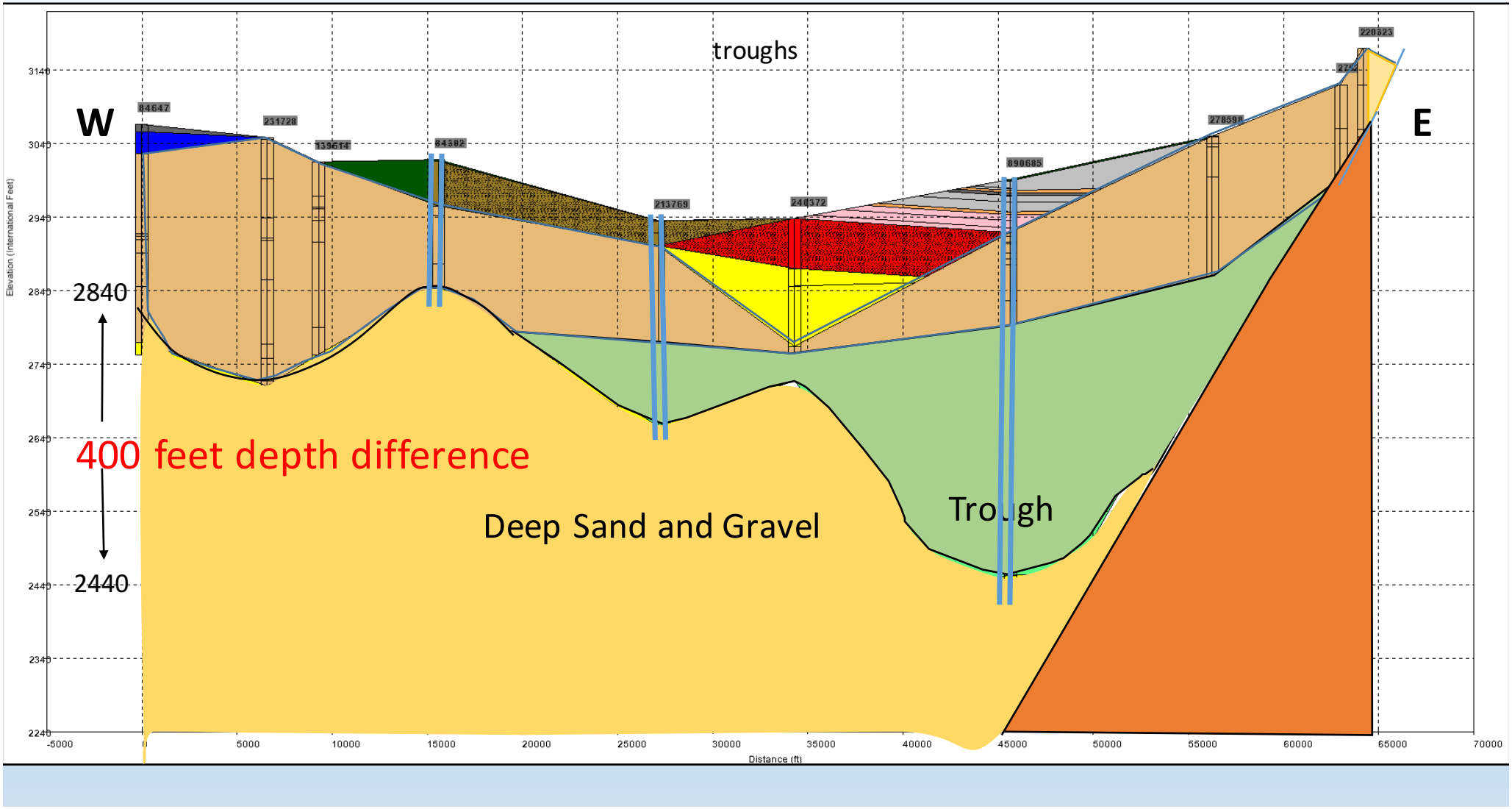
MBMG
Montana Bureau of Mines and Geology


Slice cross-section through layers
N



Vertical elevation 4x exaggeration


Geologic picture
Simplified Geologic Section
Depth in feet
0
Land surface
Shallow sand and gravel 0-200 feet
Confining silt-clay 200-600 feet *
Upper Deep Aquifer 0-100 feet
500
Deepest wells 800 feet
1000
Deep Sand and Gravel
up to 2,600 feet thick
Undefined Geology
1500
?
2000
?
Tertiary sediment
Compacted sands, sandstones, conglomerates
2500
3000
Bedrock


troughs
W
E
2840
2440
400 feet depth difference
Deep Sand and Gravel
Trough
Elevation (International Feet)
Distance (ft)

That's nice, but what did we learn

- **Plunging bedrock** Bigfork
- **Shallow bedrock** east of Kalispell
- **Trough channels** into the Deep Aquifer
- **Deep Aquifer surface**
- **Upper Deep Aquifer**
- **Confining Unit** thickness
- A 3-D Geologic model for **groundwater modeling**, **well siting** and **planning**, **Subsurface geology studies**
- Geologic volumes
- A view of subsurface geology