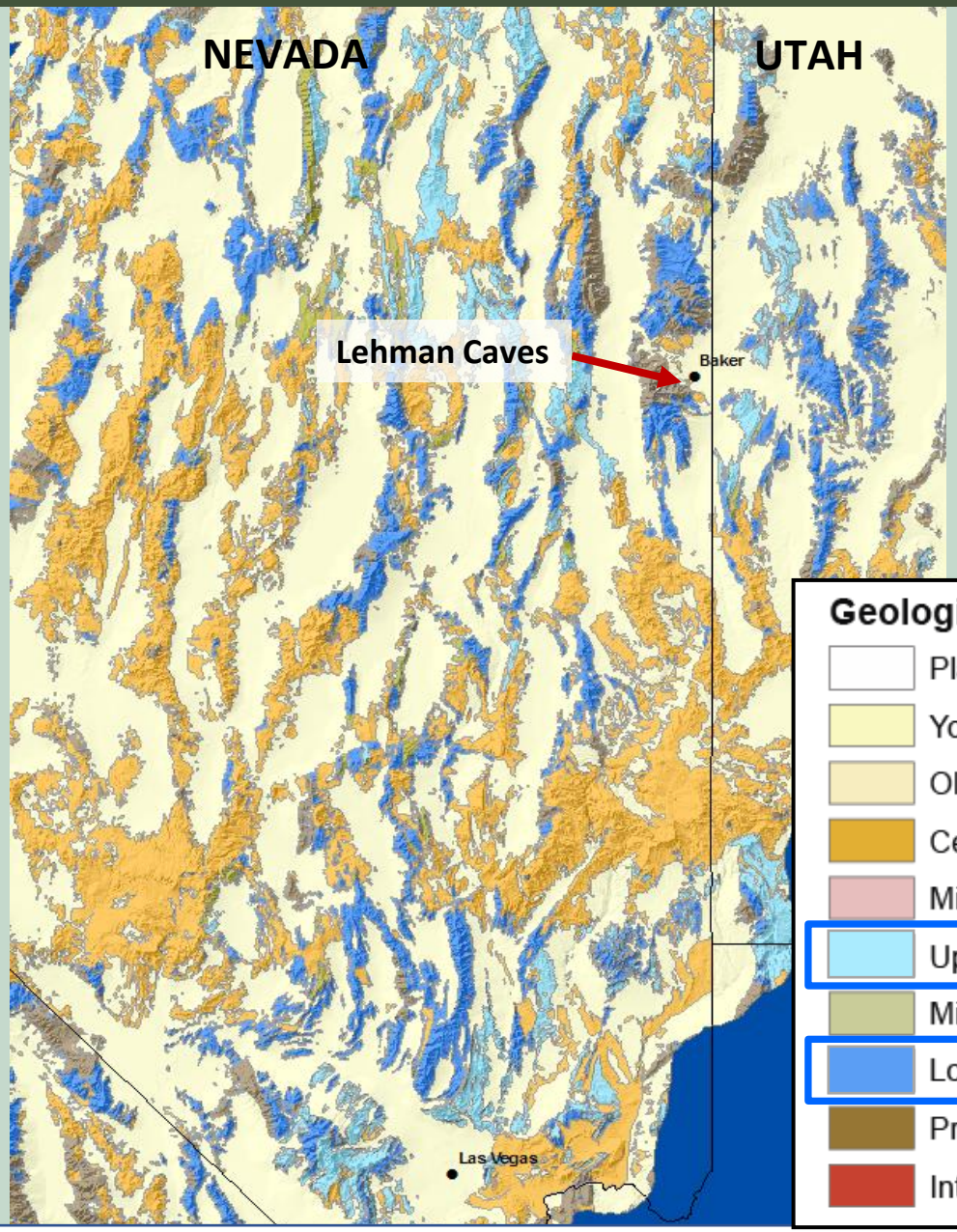
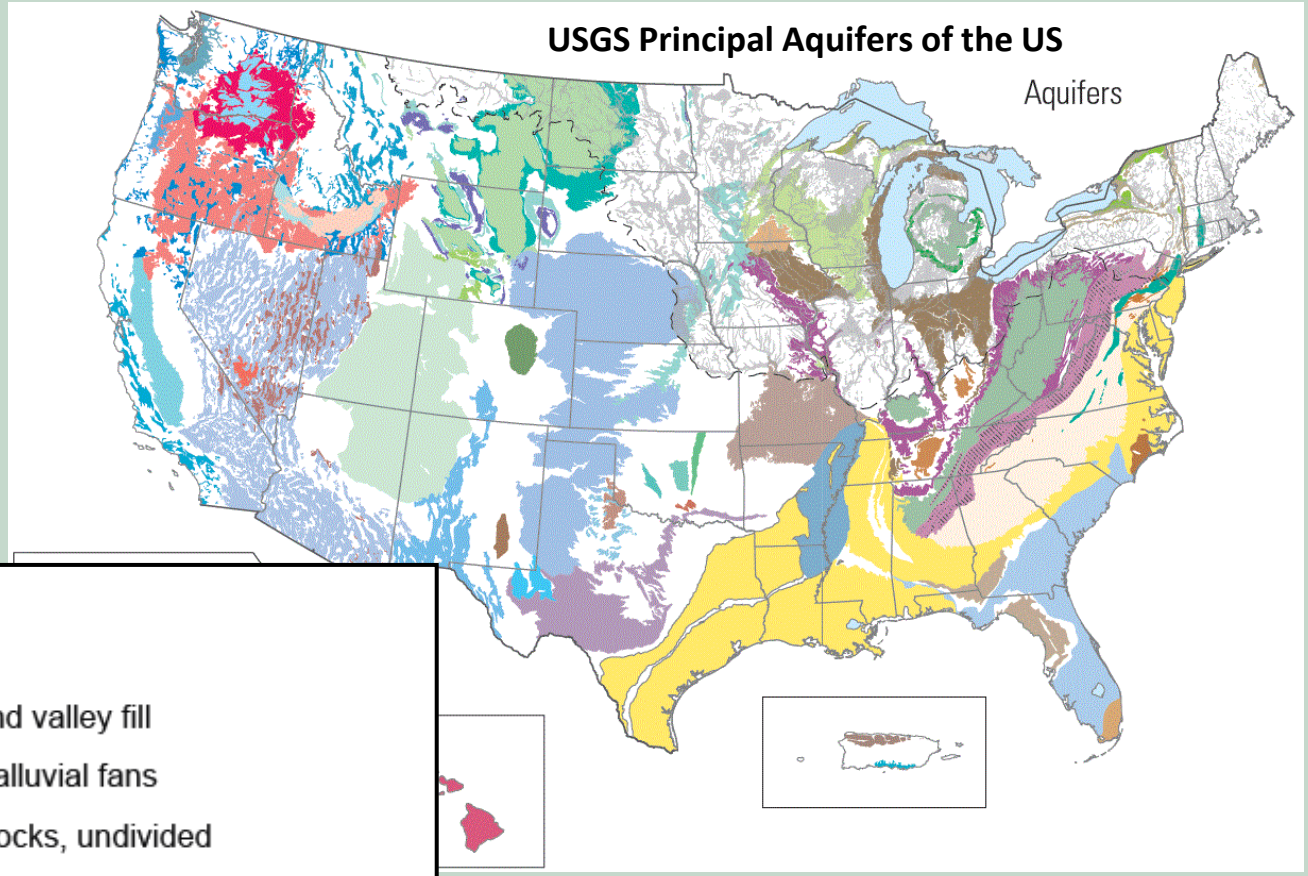
Sacramento Pass, Nevada

- Introduction 0900 PDT
- Stop 1 – Cueva de Villa Luz 0905 PDT
- Stop 2 – Frasassi Caves 0930 PDT
- Stop 3 – Carlsbad Cavern 0955 PDT
- Stop 4 – Lechuguilla Cave 1015 PDT
- **Stop 5 – Sacramento Pass 1035 PDT**
  Don Sweetkind, Doug Powell
- Break/Intermission 1055 PDT
- Stop 6 – Lehman Caves 1105 PDT
- Break/Intermission 1245 PDT
- Stop 7 – Burial Cave 1255 PDT
- Stop 8 – Crystal Ball Cave 1305 PDT
- Stop 9 - Pescio Cave 1315 PDT
- Stop 10 – Discovery Cave 1325 PDT
- Stop 11 – Old Mans Cave 1335 PDT
- Summary and questions 1345 PDT

Eastern Great Basin carbonate-rock province

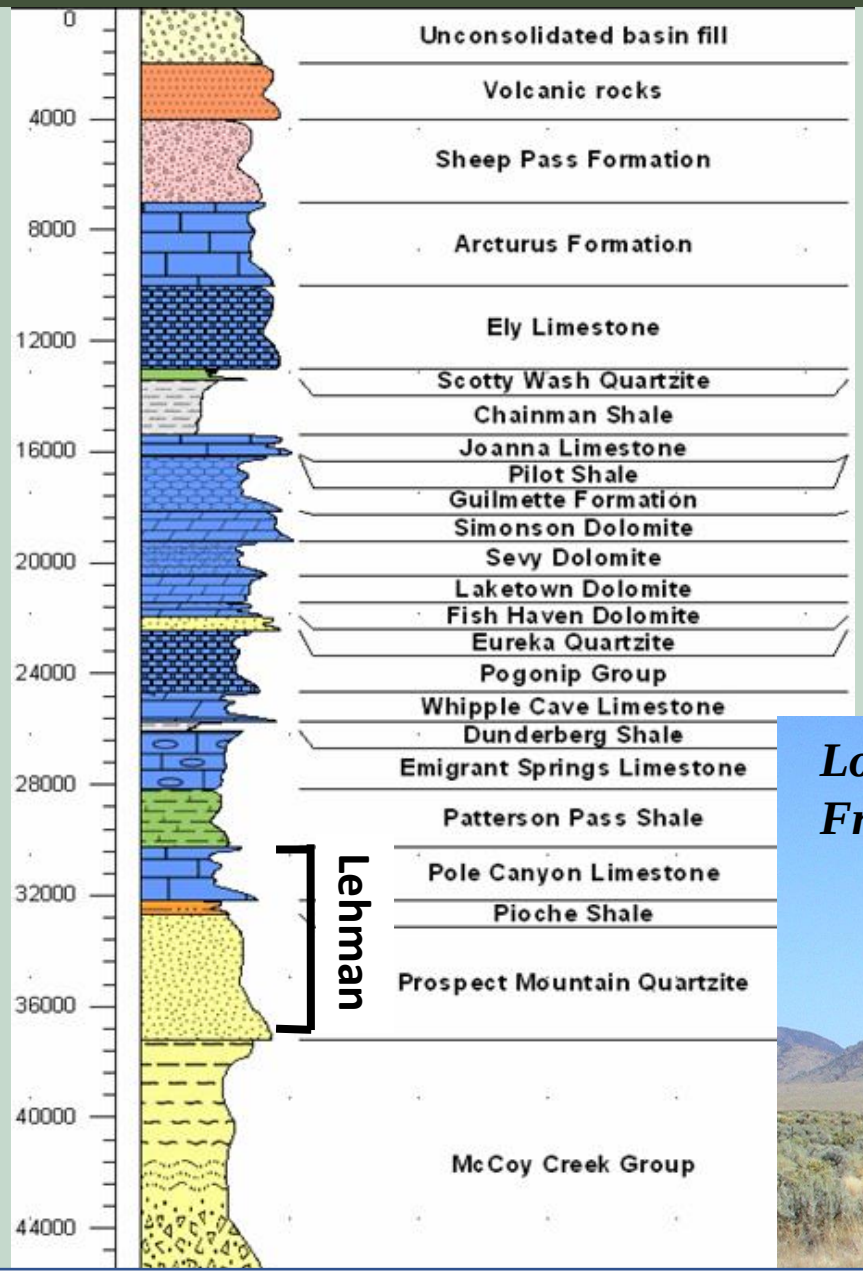




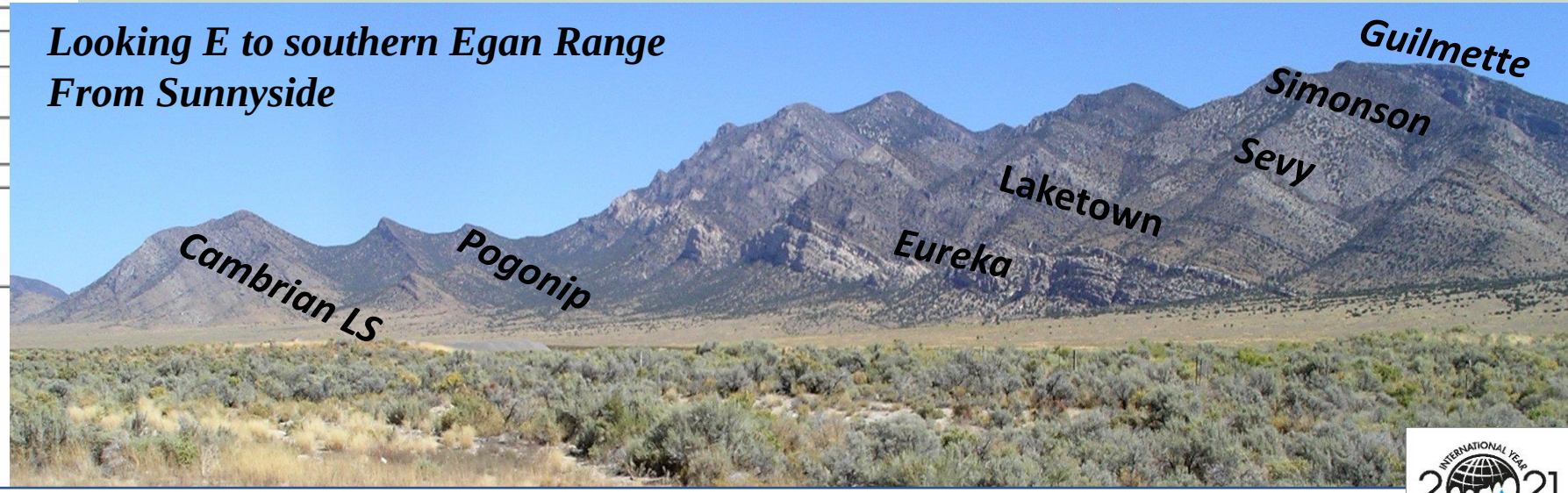
Geologic Unit

- Playa deposits
- Younger alluvium and valley fill
- Older alluvium and alluvial fans
- Cenozoic volcanic rocks, undivided
- Miocene sedimentary rocks
- Upper Paleozoic carbonate rocks
- Mississippian siliciclastic rocks
- Lower Paleozoic carbonate rocks
- Proterozoic and Lower Cambrian siliciclastic rocks
- Intrusive rocks, undivided

Eastern Great Basin carbonate-rock province



- In eastern Great Basin, Paleozoic carbonate rocks are many thousands of feet thick
- Lehman Caves area exposes the lowest Cambrian part of the carbonate-rock section



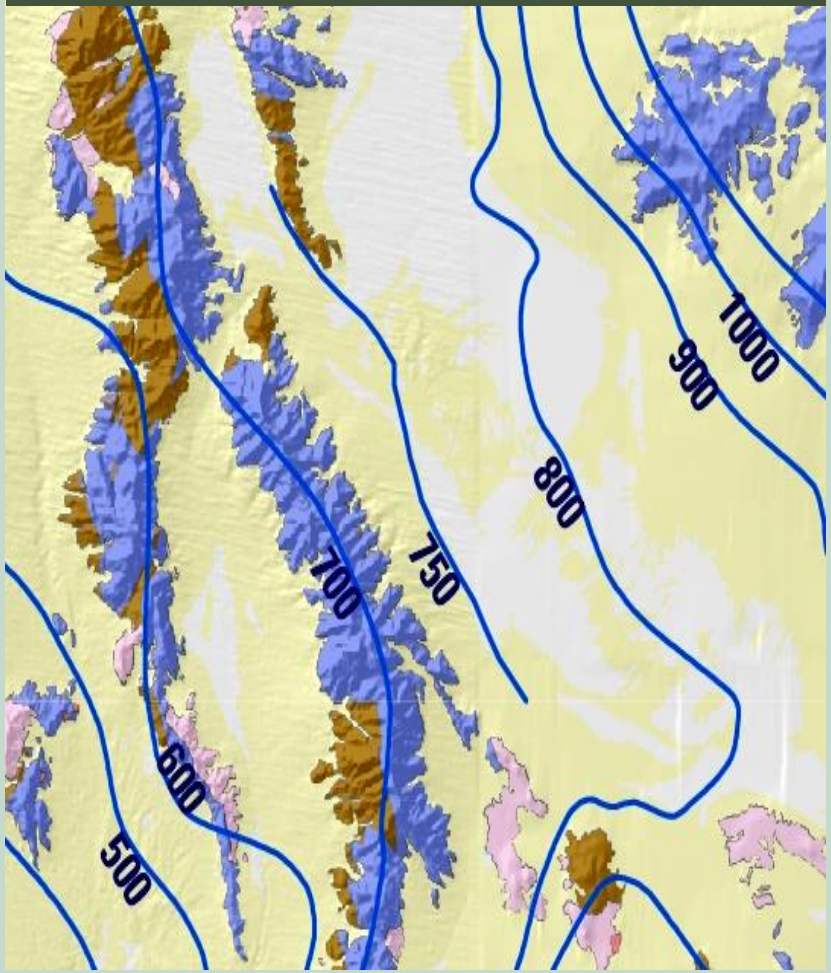
“Many of the desert springs in southern Nevada derive their flow from distant recharge areas rather than from nearby rainfall.”

W.C. Mendenhall (1909) Some desert watering places in southeastern California and southwestern Nevada U.S. Geological Survey Water-Supply Paper 224

Hot Creek, White River Valley

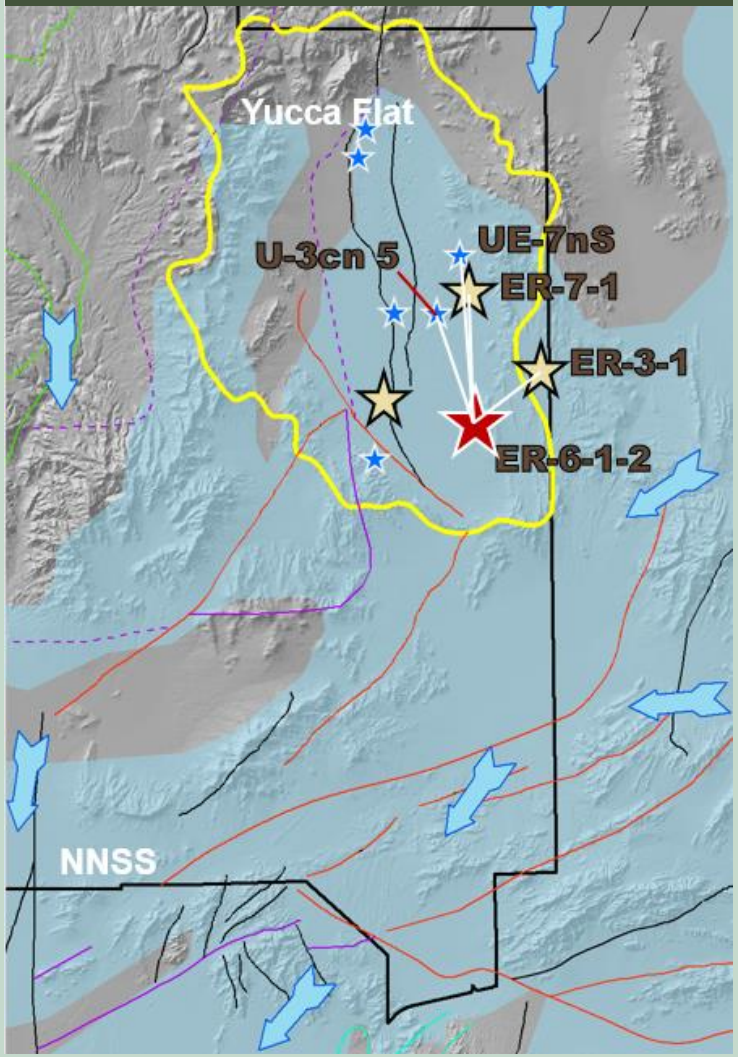
Evidence for permeability in Paleozoic carbonate-rock aquifers

Potentiometric surface



Harrill, 1965, Ground-water storage depletion in Pahrump Valley, Nevada-California, 1962-75 U.S. Geological Survey Water-Supply Paper 2279

Pump tests



Contouring of regional potentiometric surface

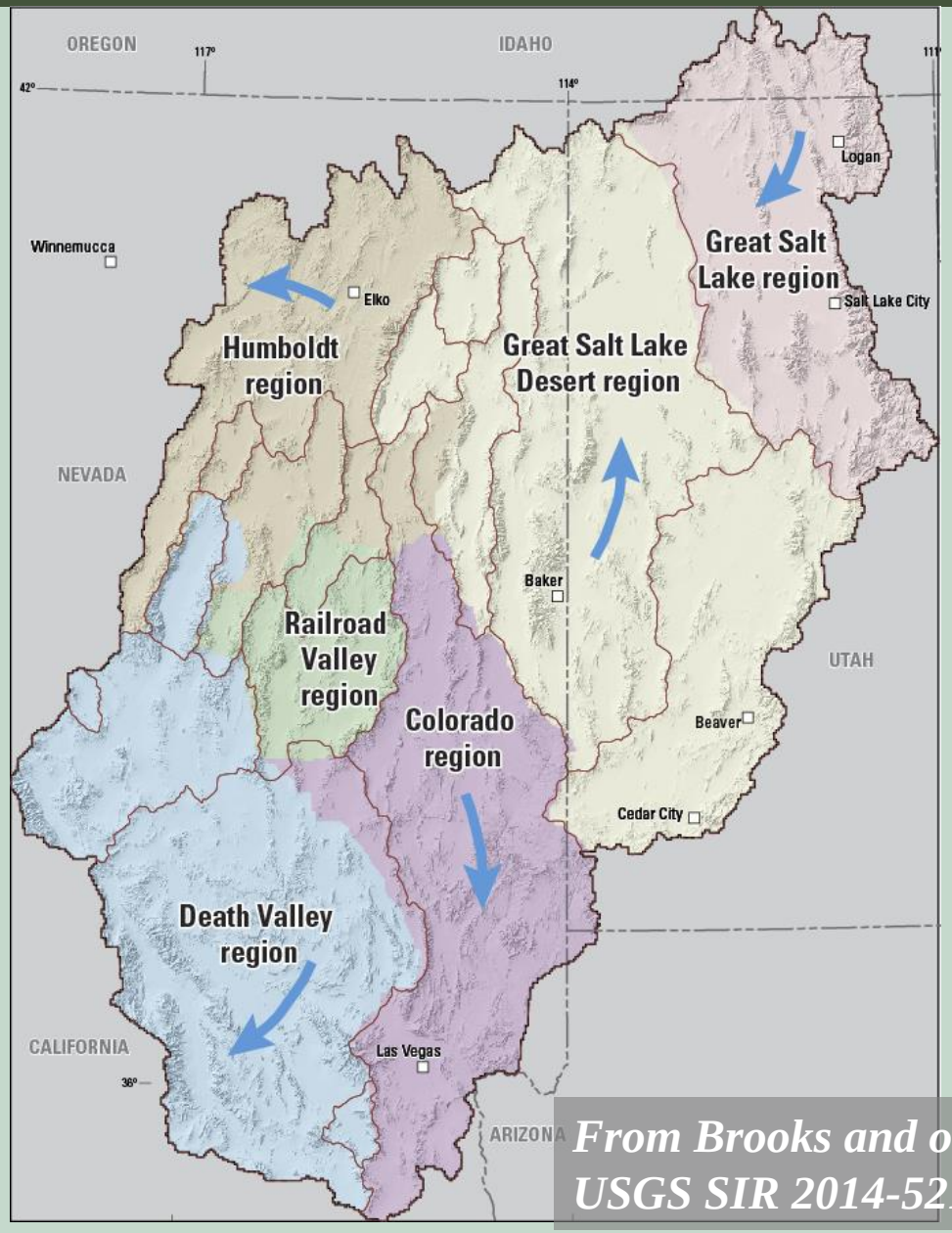
Evidence from springs

- **Elevated temperature**
- **Large volume, constant flow**
- **Chemistry**
- **Isotopes**

Pump tests

Pumping at ER-6-1-2 at NNSS
Large, immediate, and widespread response
Responses noted miles away within hours of pumping
Two-feet of drawdown measured 8 miles away

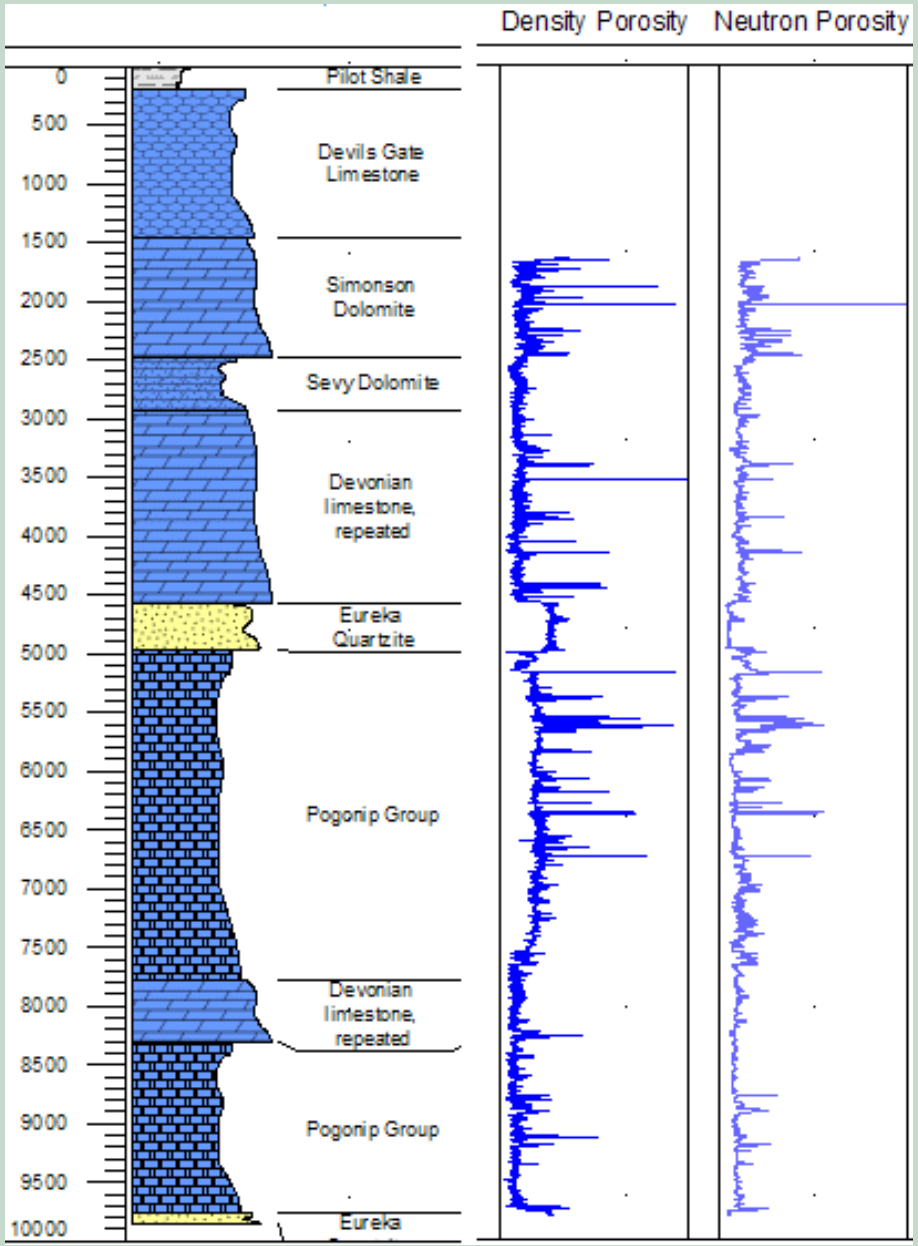
Regional flow systems in Paleozoic carbonate-rock aquifers



From Brooks and others 2014
USGS SIR 2014-5213

- Carbonate-rock province supports deep, regional flow
- Integrates recharge from numerous ranges and basins
- Broad regions of subsurface flow that connect recharge and discharge areas
- Variable degree of connection between regions

Type of permeability in Paleozoic carbonate-rock aquifers

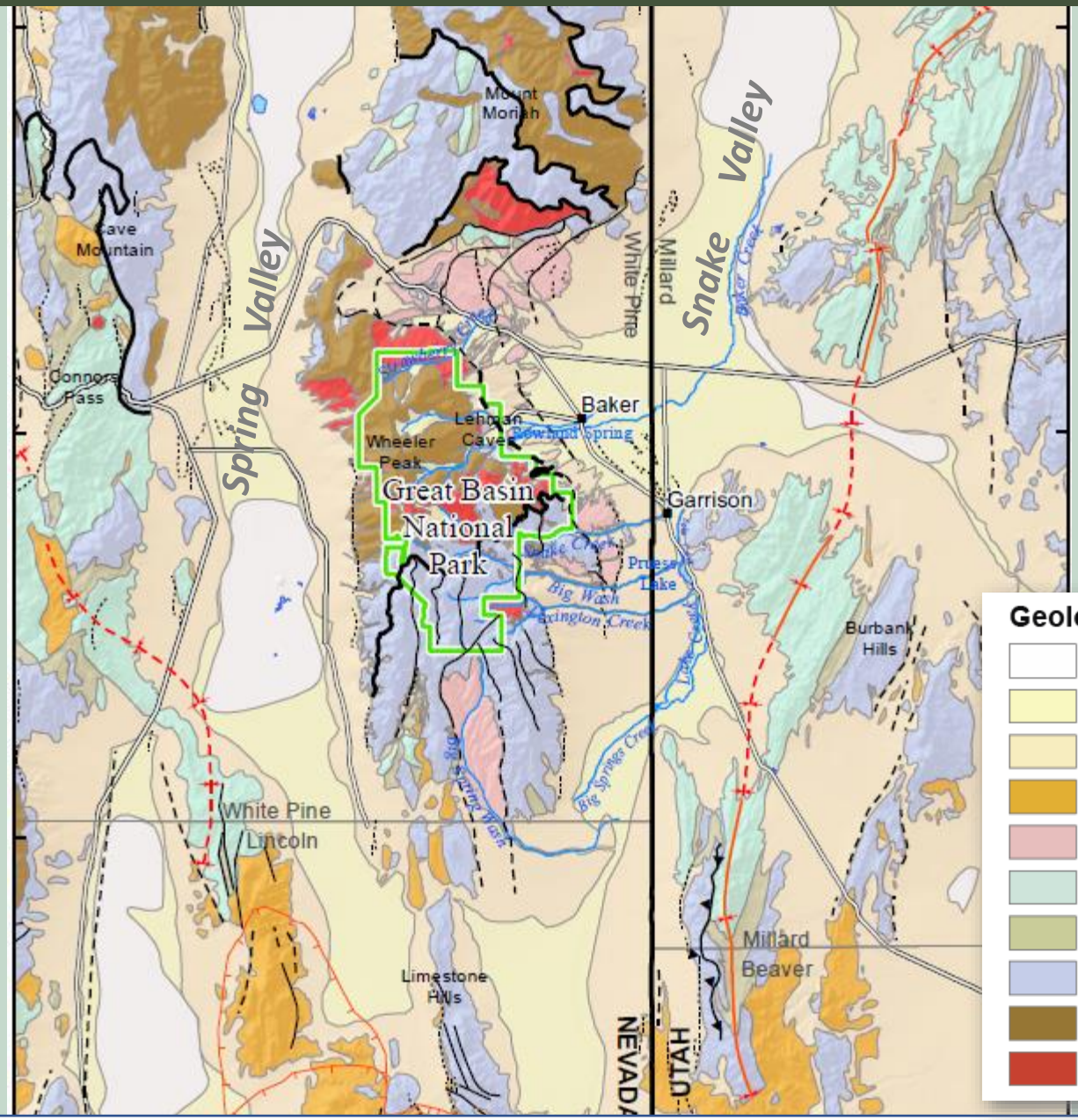


Fracture permeability

Solution-enhanced fault openings

- ***Low matrix porosity***
- ***Fracture-related permeability***
- ***Multiple fractured formations***
- ***Not much karst!***

Geologic setting of Great Basin National Park



- Snake Range a regional-scale anticline, flanked by two synclines
- Thick section of marine carbonates and black shales in Snake Valley
- Northern part of the Park: siliciclastic rocks, intrusive rocks, surface drainage
- Southern part of Park: faulted carbonate rocks, lack of surface drainage

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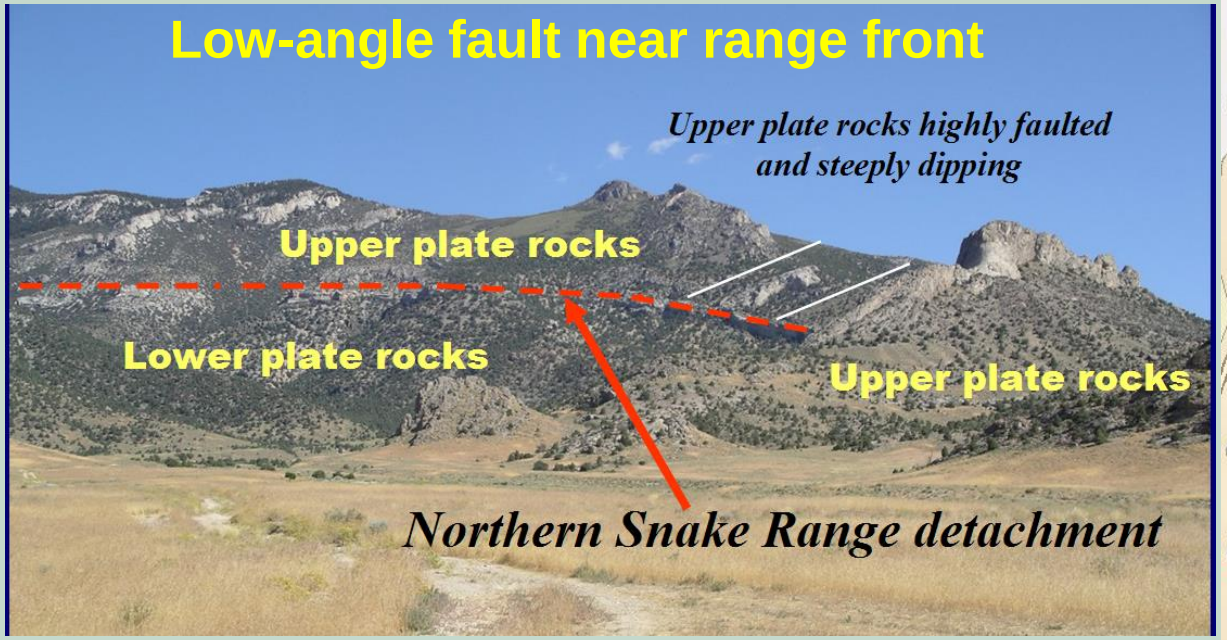
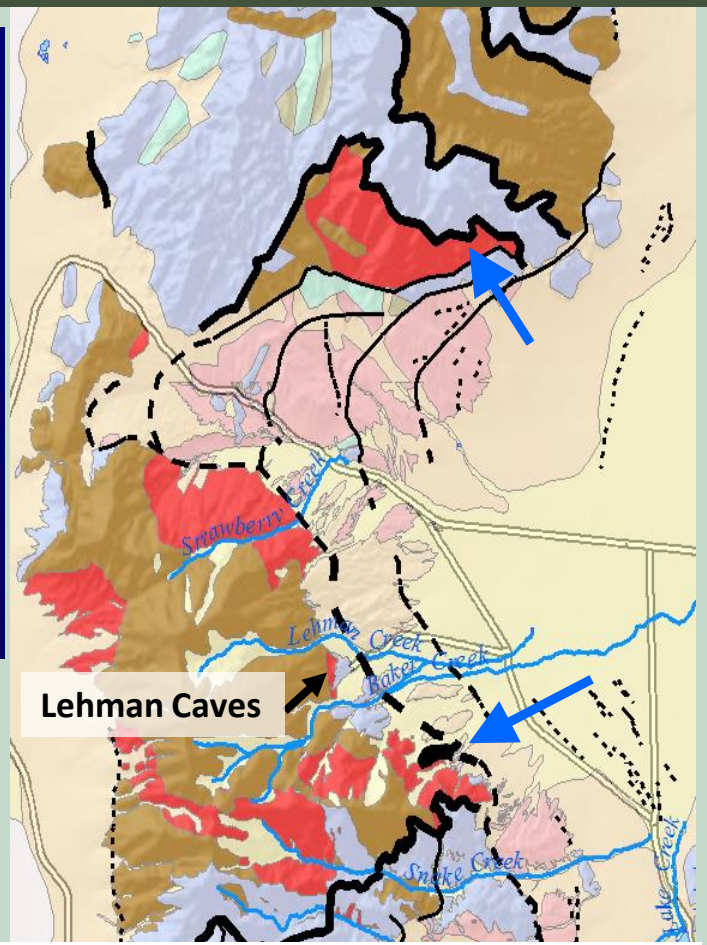
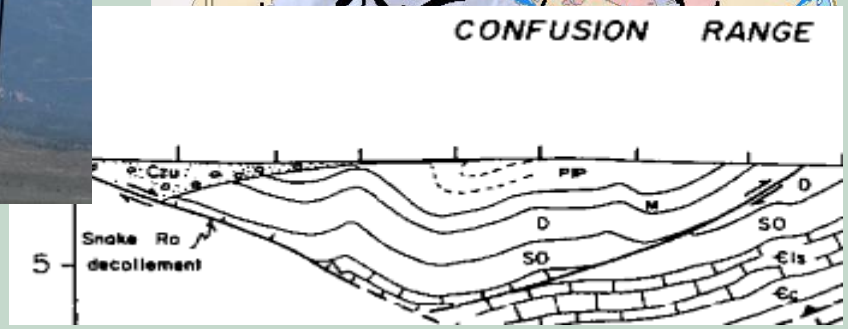
Faulting and uplift of the Snake Range

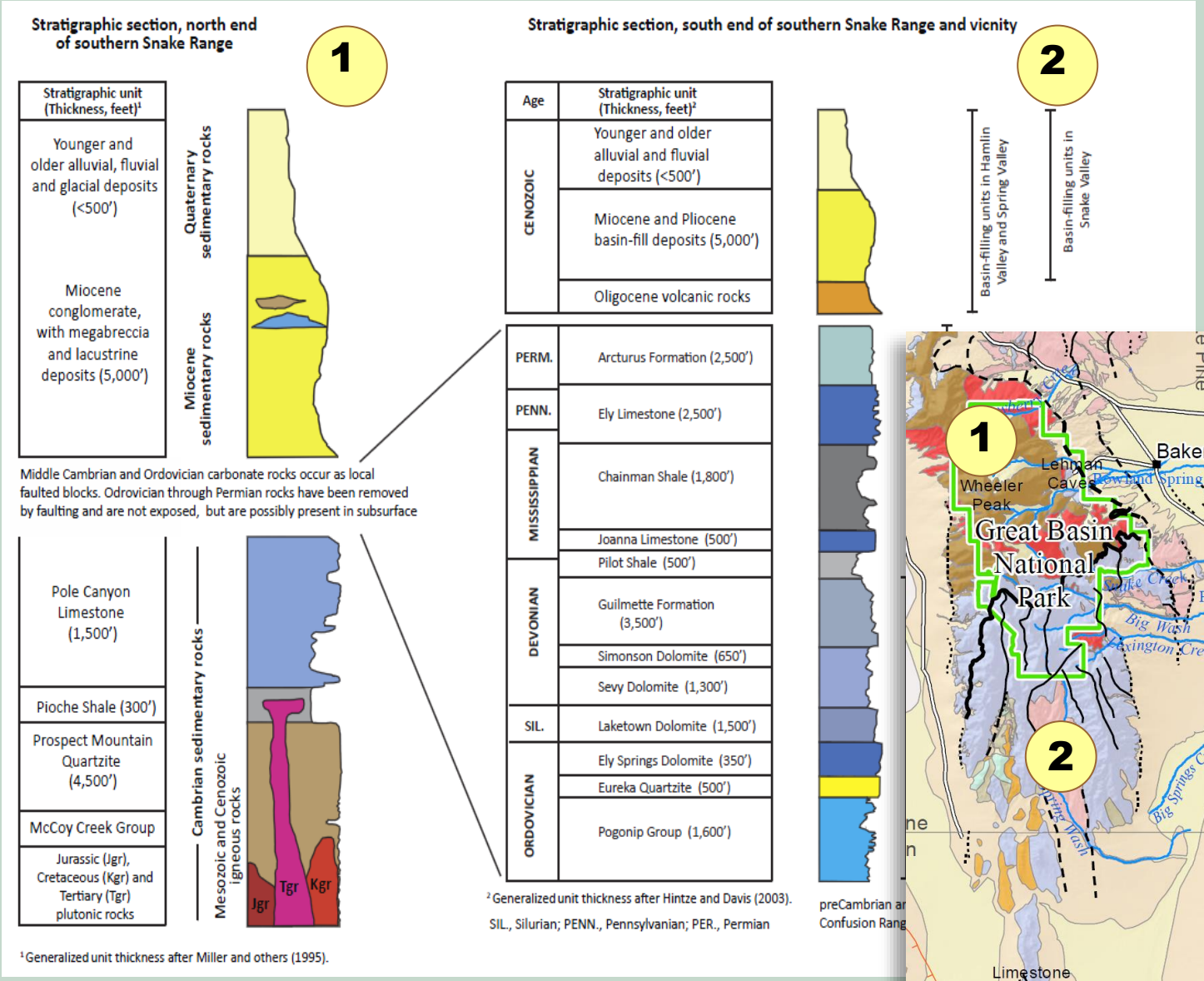


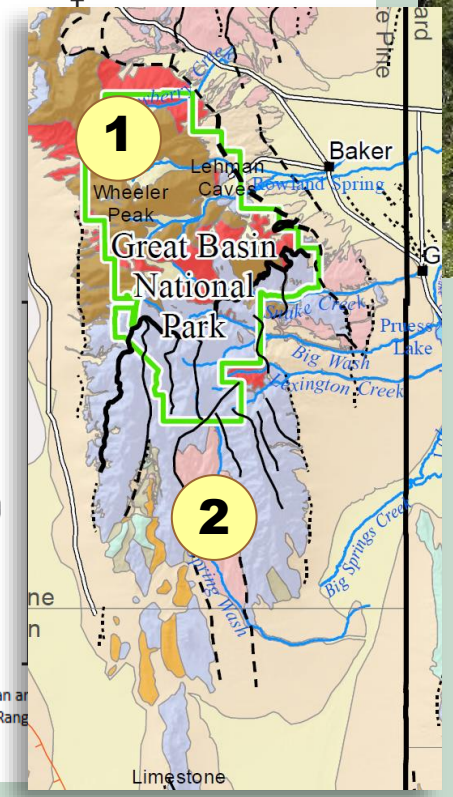


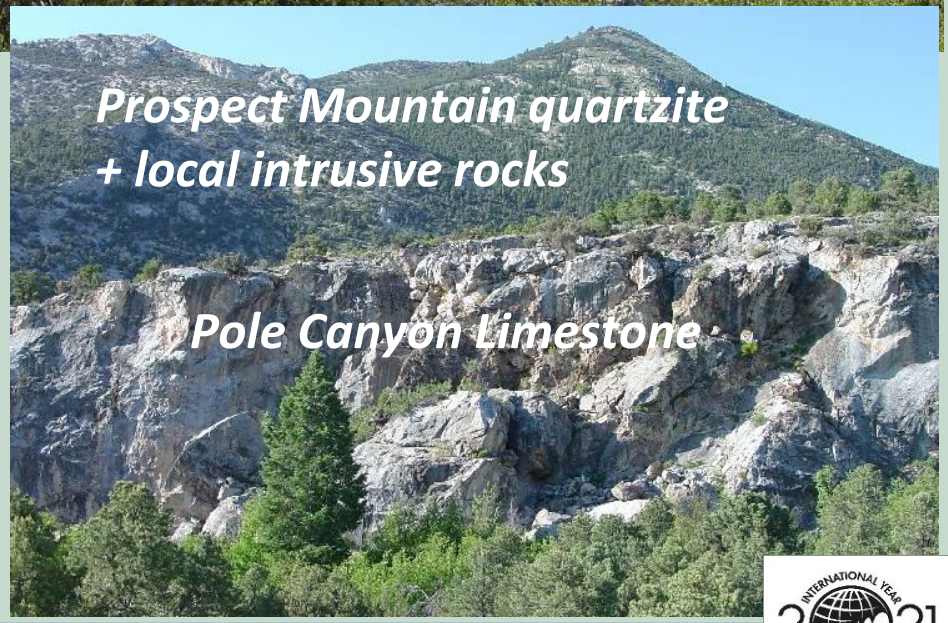


- Low-angle and high-angle faults near range front
- Youngest intrusions are 36 Ma Young Canyon pluton, 28.5 Ma aplite
- Faulting causes considerable Miocene uplift of range block
- Footwall, lower-plate rocks (including Pole Canyon Limestone) are foliated and metamorphosed

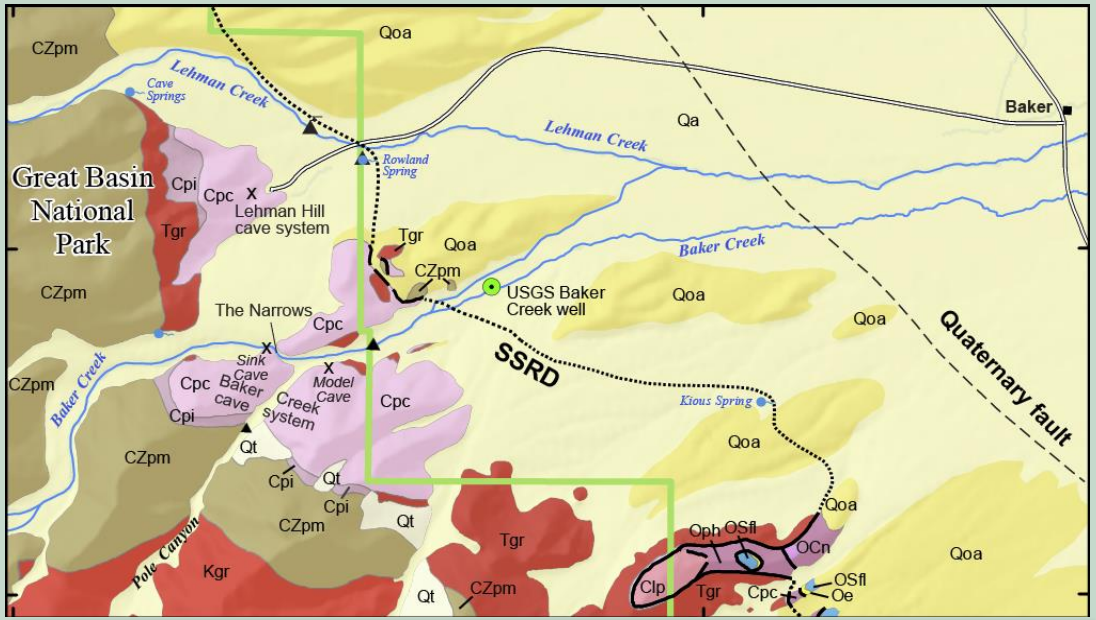
Geologic setting of Great Basin National Park

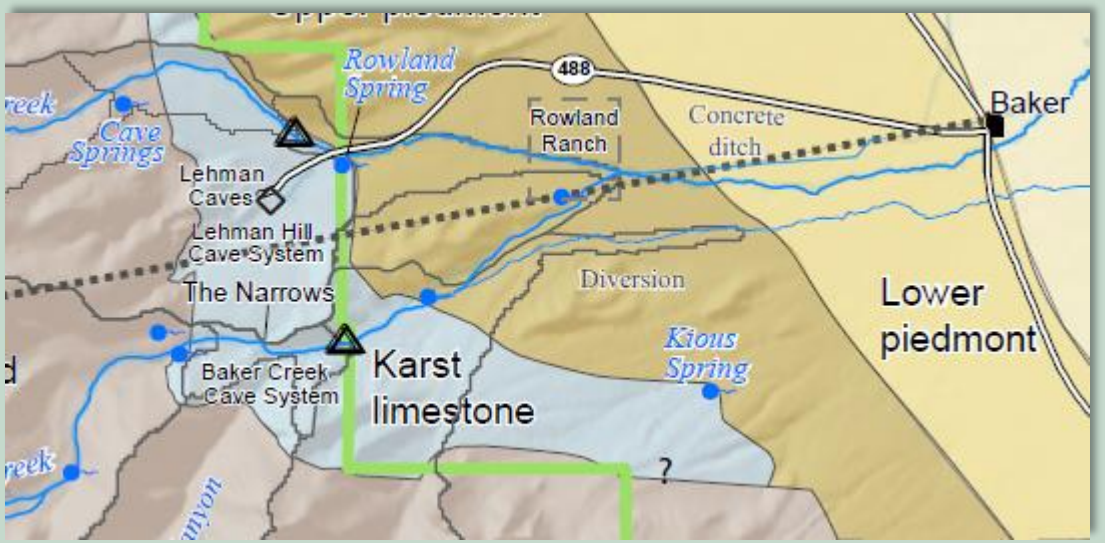


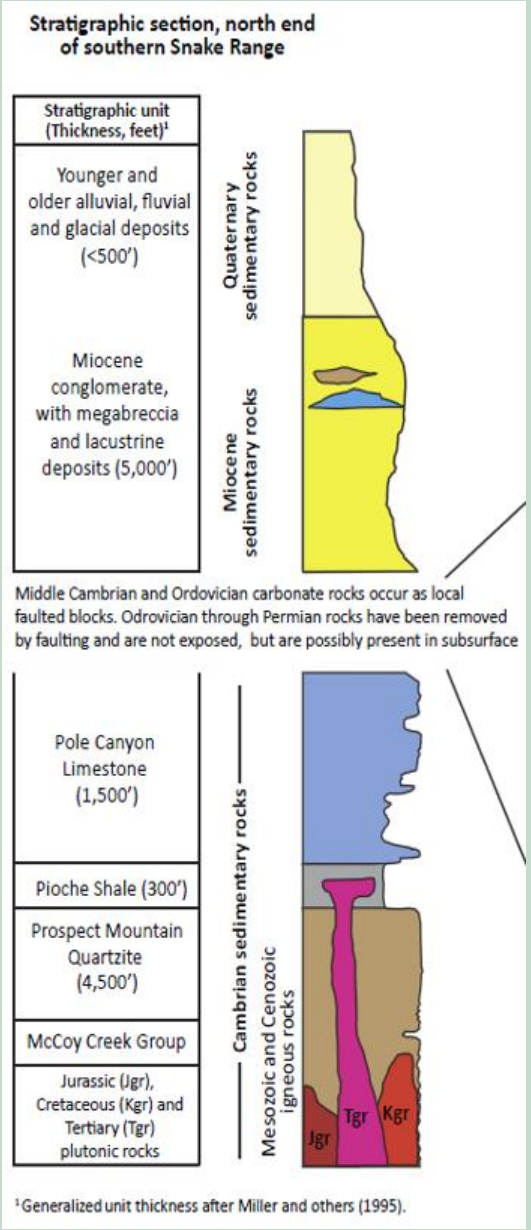




Geologic setting of Lehman Caves

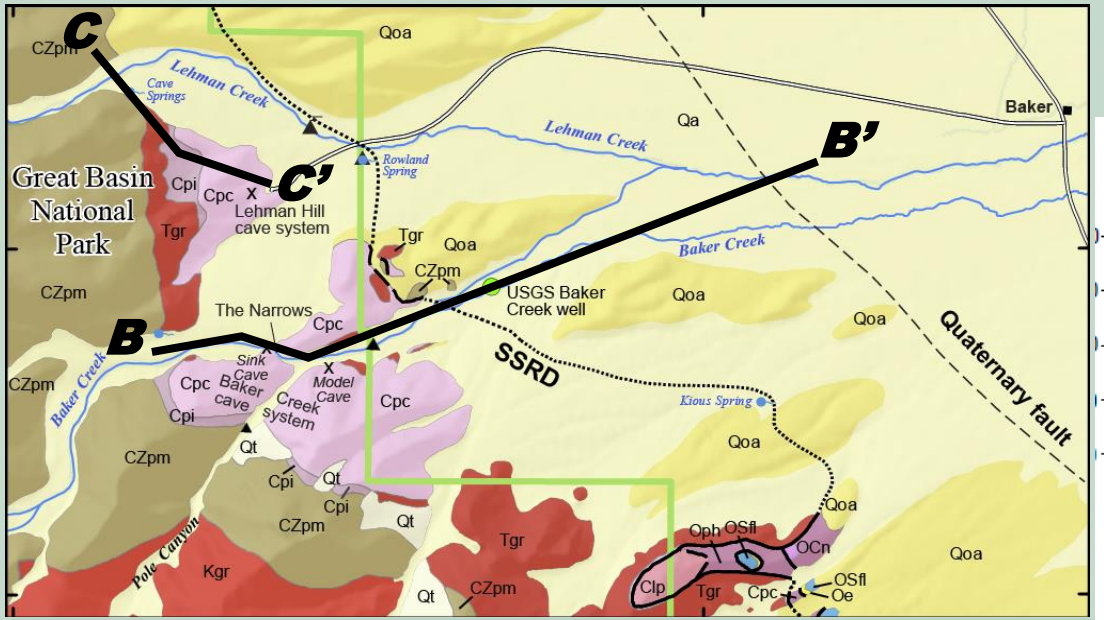


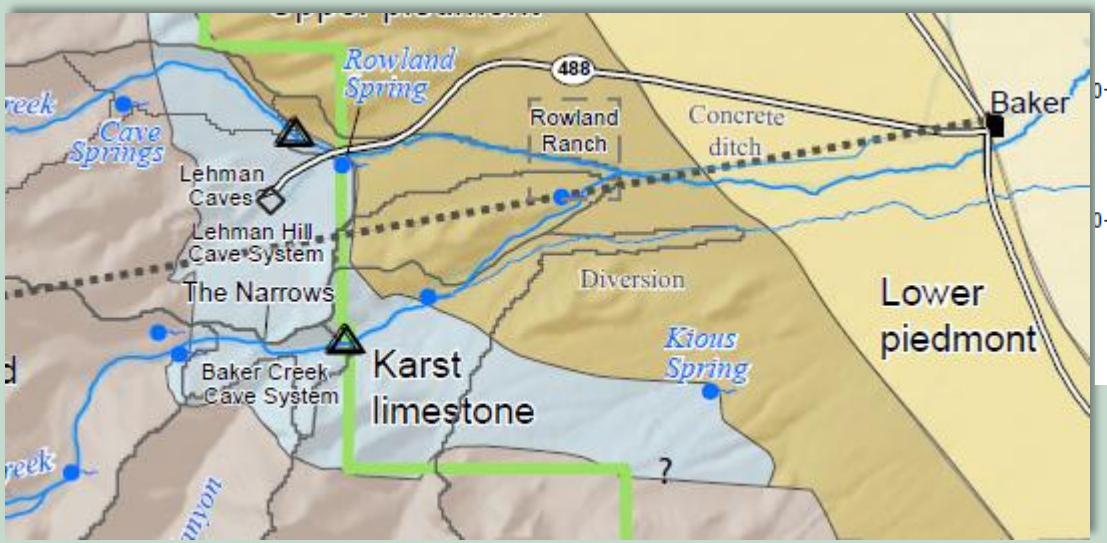


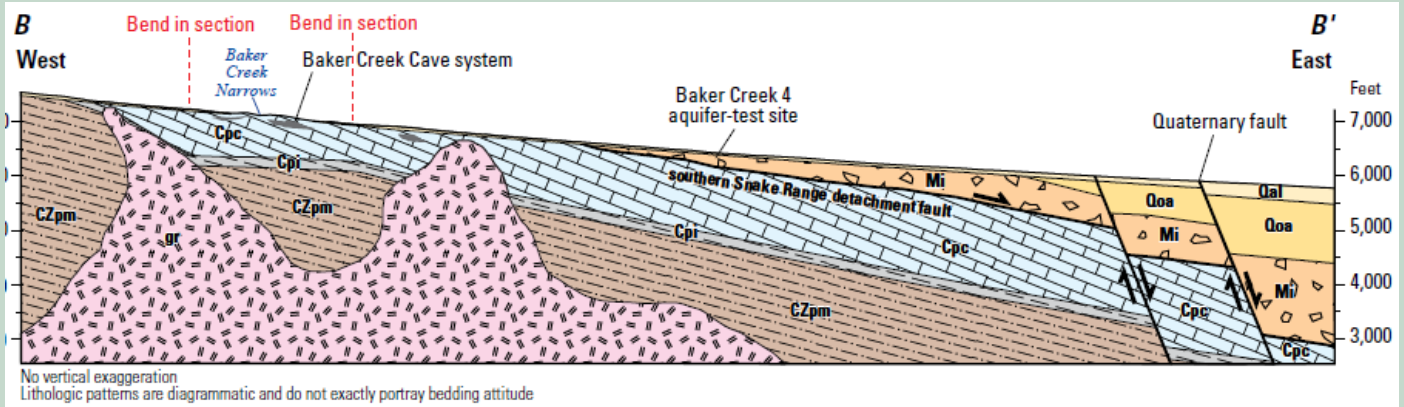


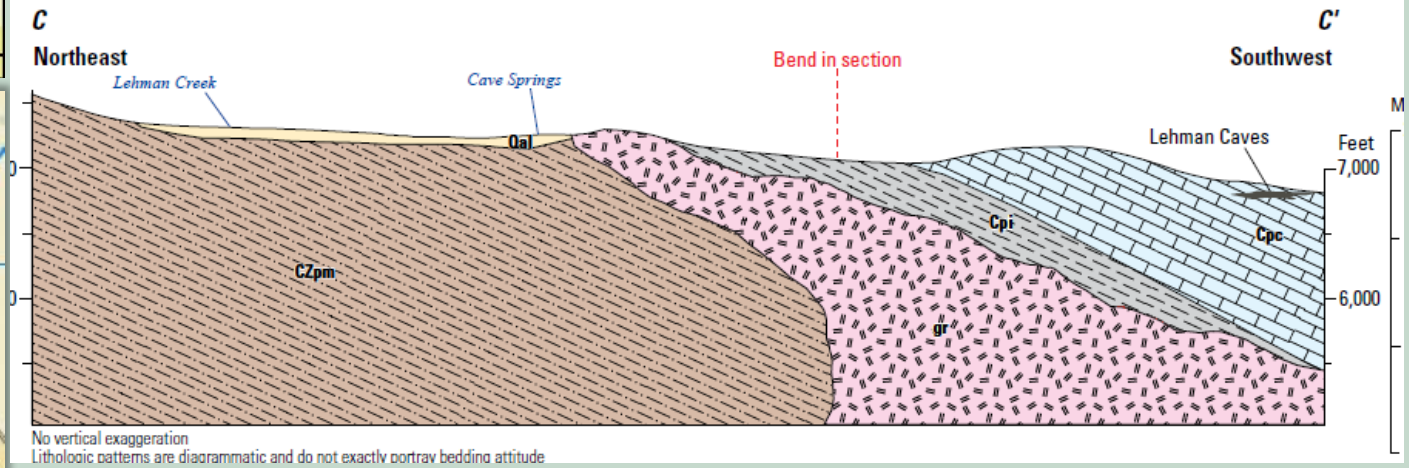
- **Extensive cave development in Pole Canyon Limestone**
- **Subsurface extent of limestone is limited**

Geologic setting of Lehman Caves

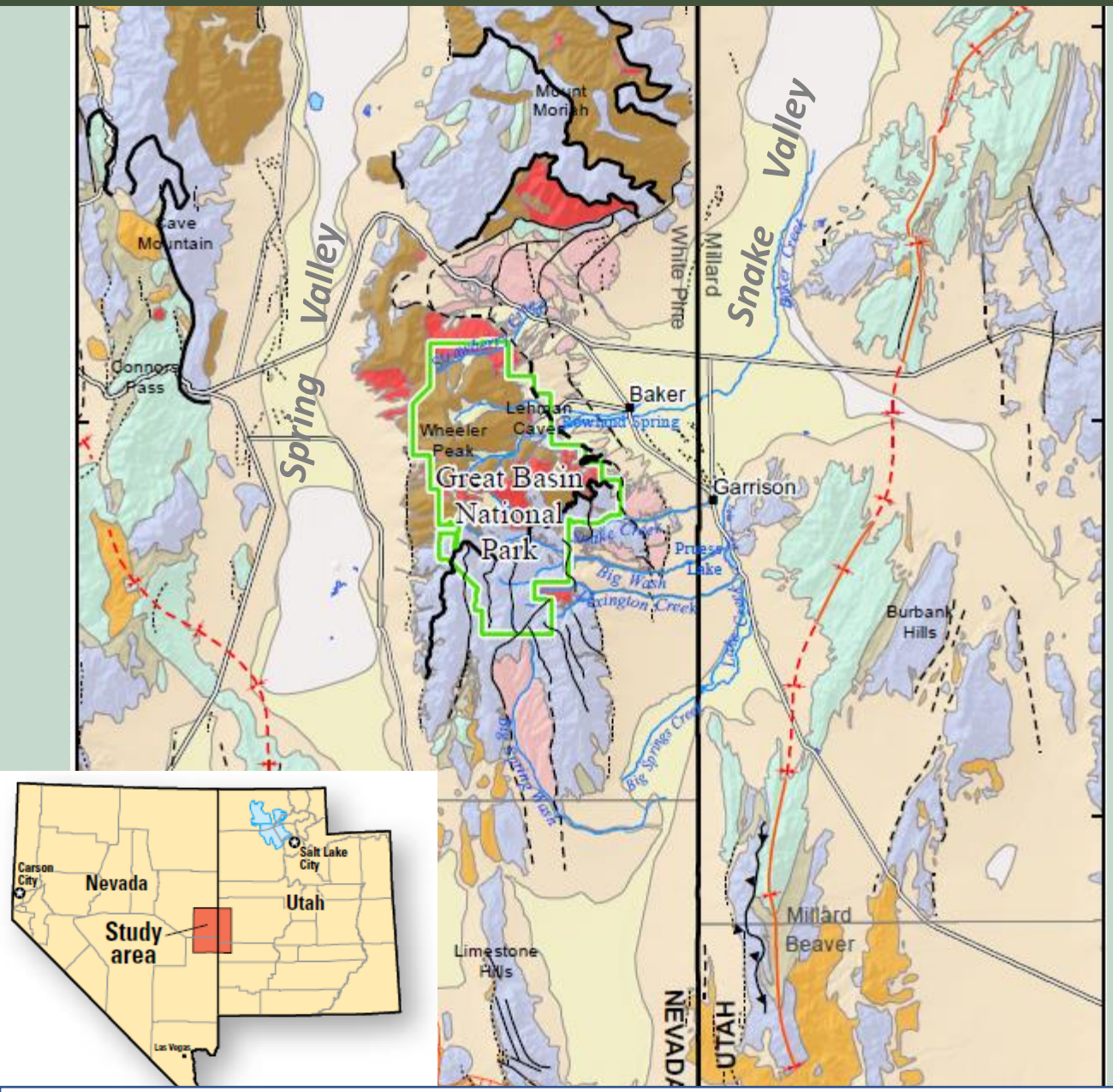








Hydrogeologic questions



- Deep subsurface extent of carbonate rocks and cavernous porosity to east of Lehman Caves
- Connection between Pole Canyon Limestone and either basin-fill or deep carbonate aquifers in Snake Valley
- Precise uplift and thermal history of the southern Snake Range since Miocene time
- Paleohydrology of Snake Valley during and after extension, uplift, and Miocene intrusions

On to the cave tour!