Hydrogeology of the San Agustin Plains

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New Mexico Bureau of Geology
New Mexico Tech
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AQUIFER MAPPING PROGRAM

New Mexico Tech
SCIENCE · ENGINEERING · RESEARCH · UNIVERSITY

New Mexico Bureau of Geology and Mineral Resources
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Earth Science for the 21st Century

Acknowledgments

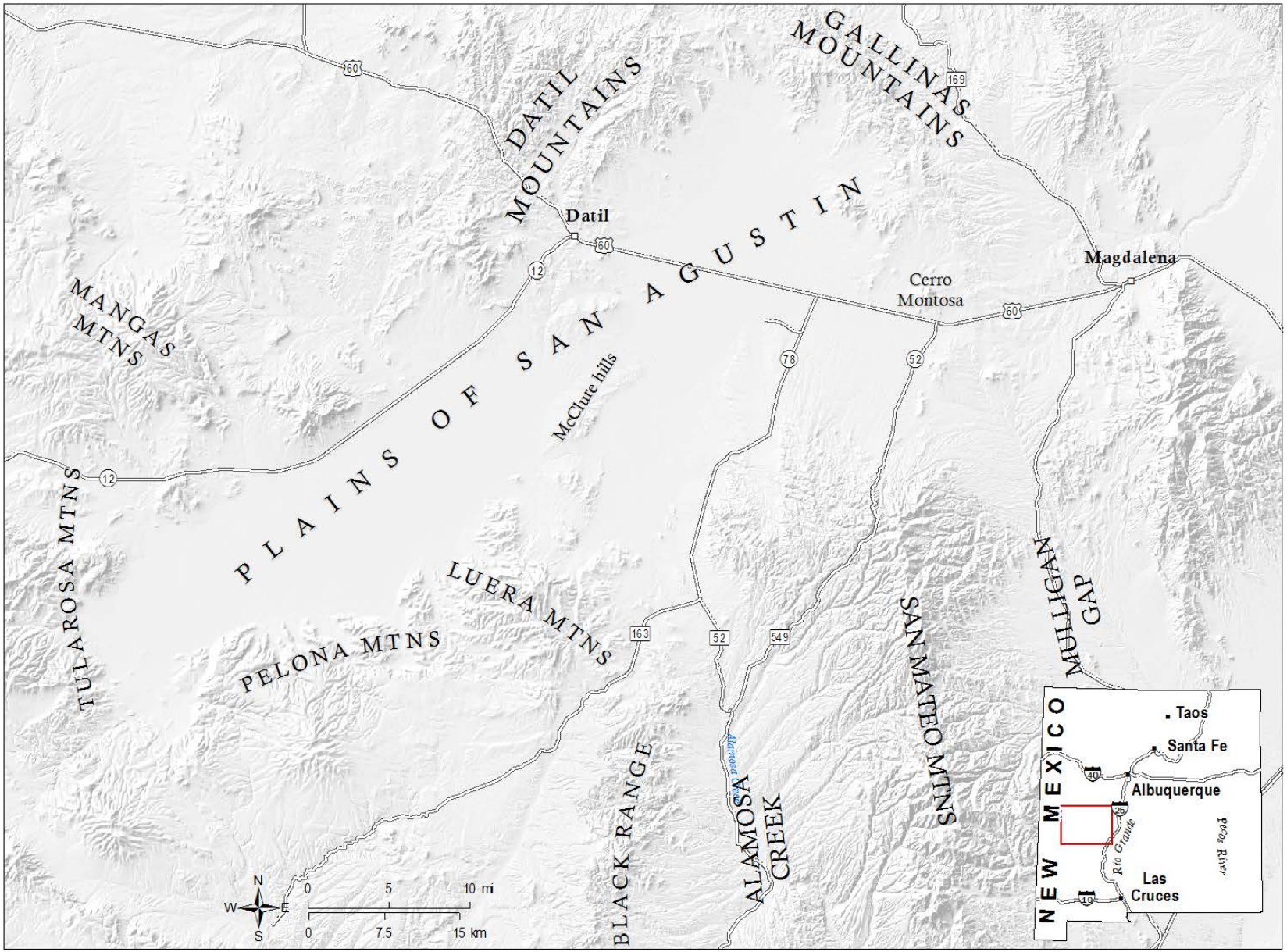
Community members of Datil and surrounding area, local land owners, VLA and Augustin Plains Ranch, LLC, for access to wells for measurements and sampling.

John Shomaker and Associates for access to well records and cuttings from pilot wells.

Talon Newton, Trevor Kludt, Brigitte Felix, Kitty Pokorny and Sara Chudnoff.

Majority of funding provided through the Aquifer Mapping Program under the New Mexico Bureau of Geology state legislative budget, and by the Hydrology Bureau (M. Johnson) of the NMOSE.

Study Area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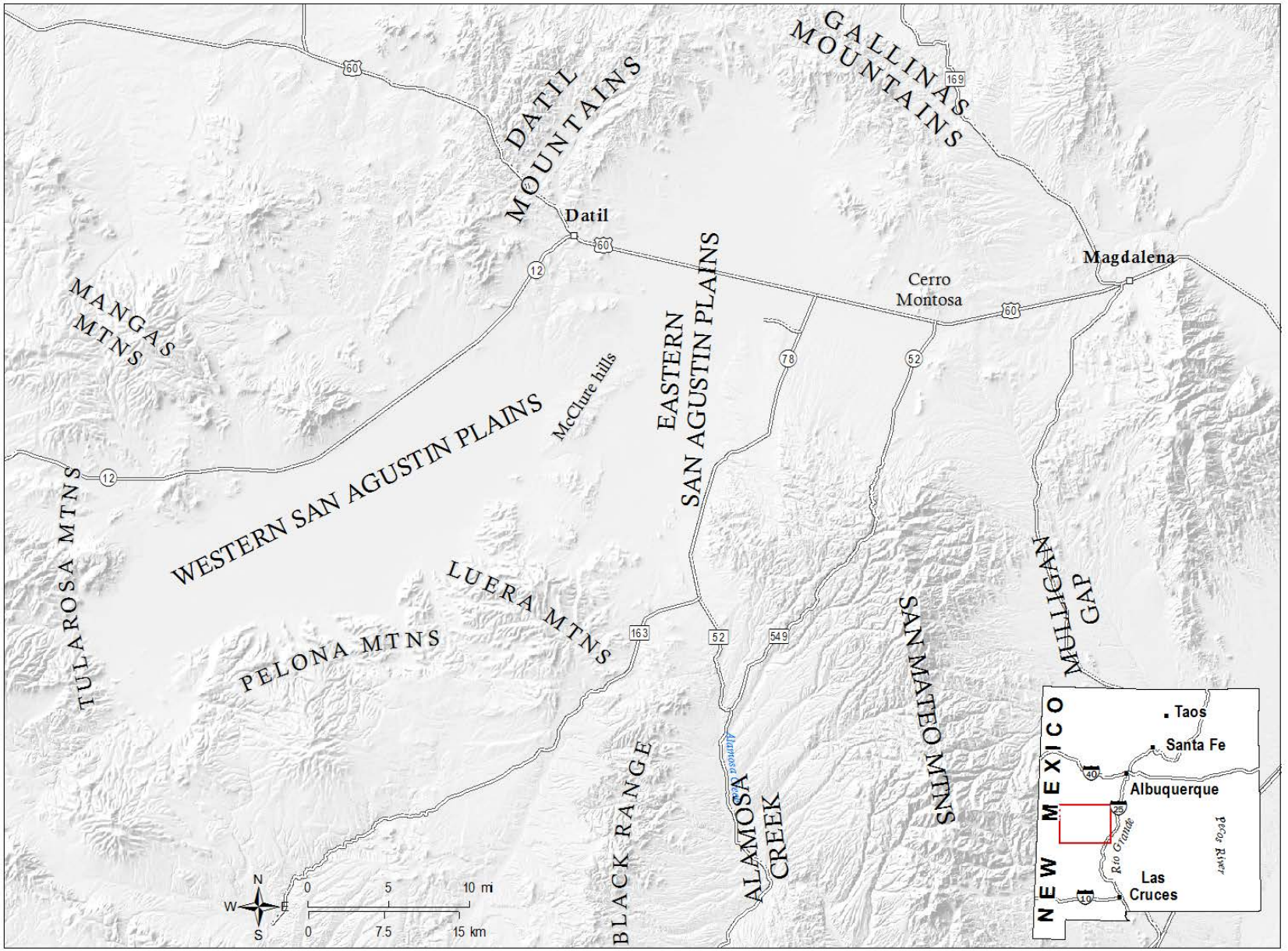
Study Area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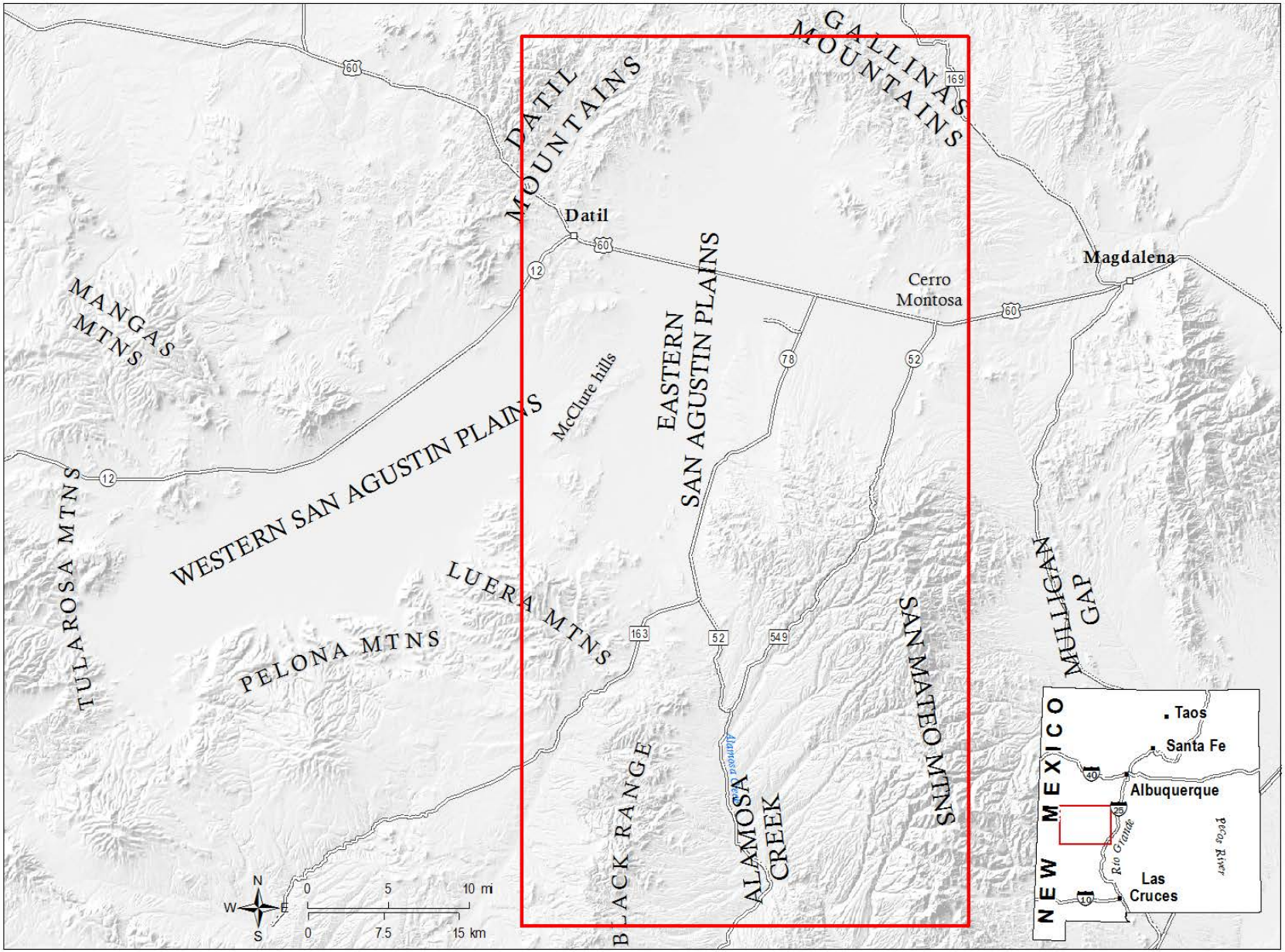
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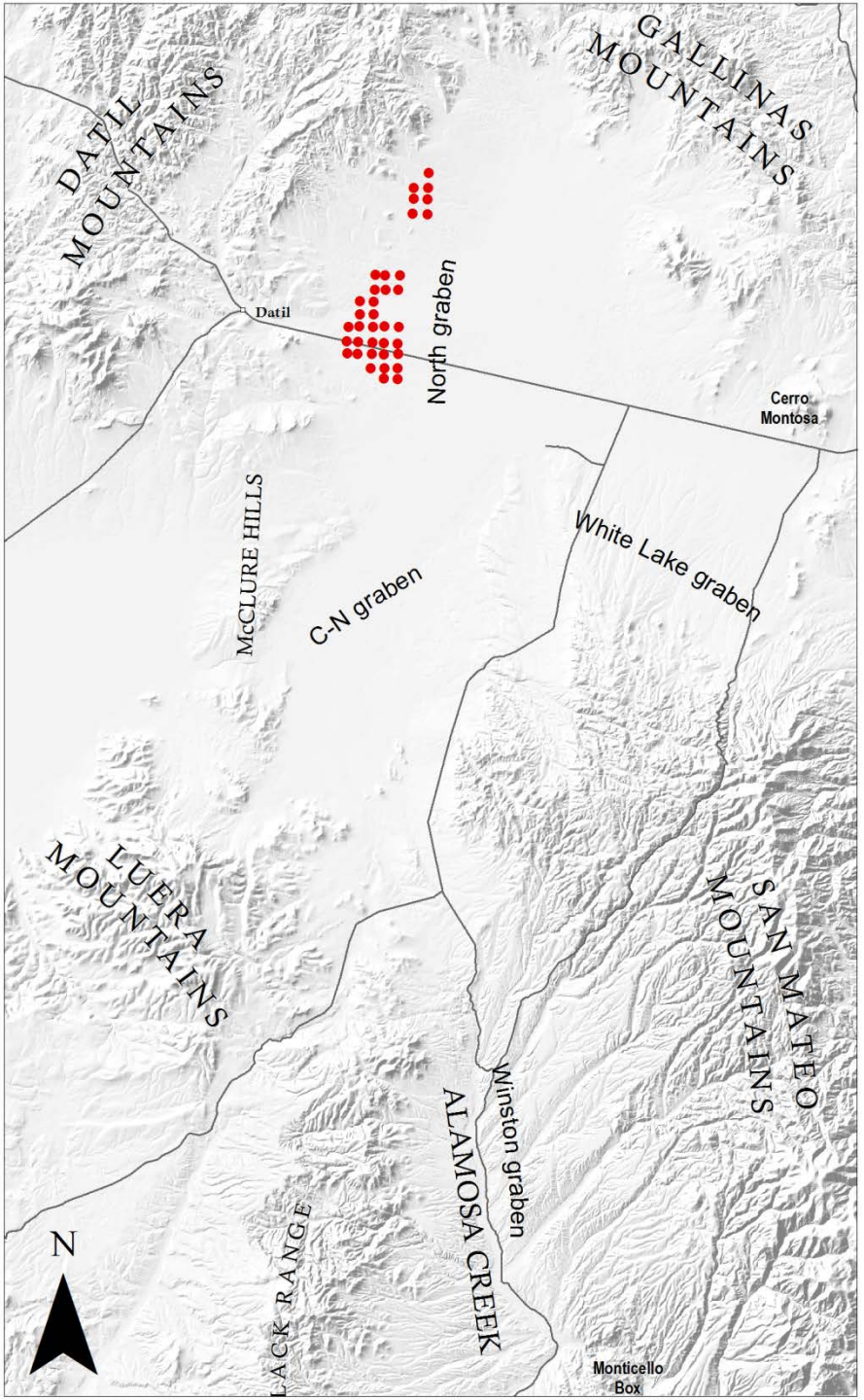
Societal Concerns

For the third time since 2007, Augustin Plains Ranch, LLC, has submitted permit application with NMOSE to

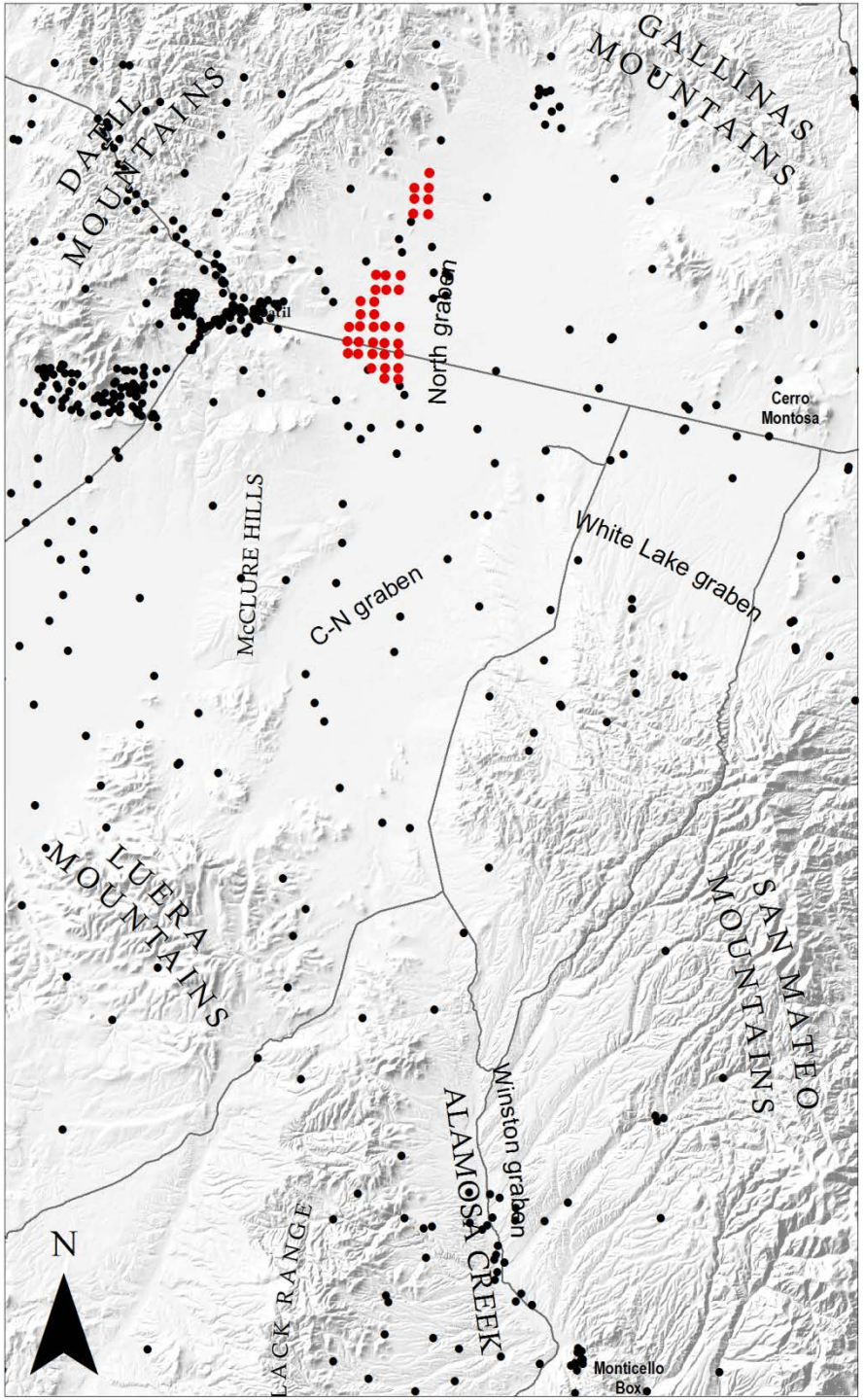
- Remove 500,000 acre-feet of groundwater over ten years (50 kaf/year for 10 years)
- Pipe water from near Datil, NM to Rio Rancho with multiple spurs.
- Enough head to power in-pipe hydroelectric plant.

Latest permit application states company has spent over $3M to try to get permits for project.



Societal Concerns

All permitted drilled wells from NMOSE



Societal Concerns

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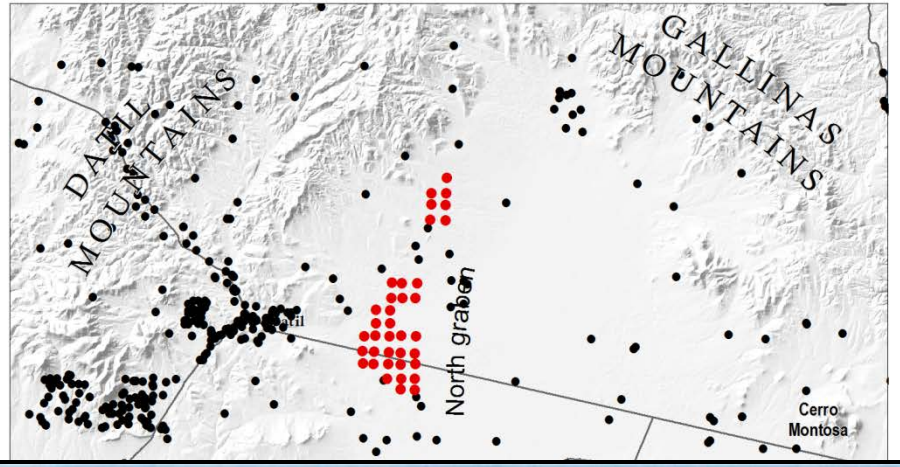
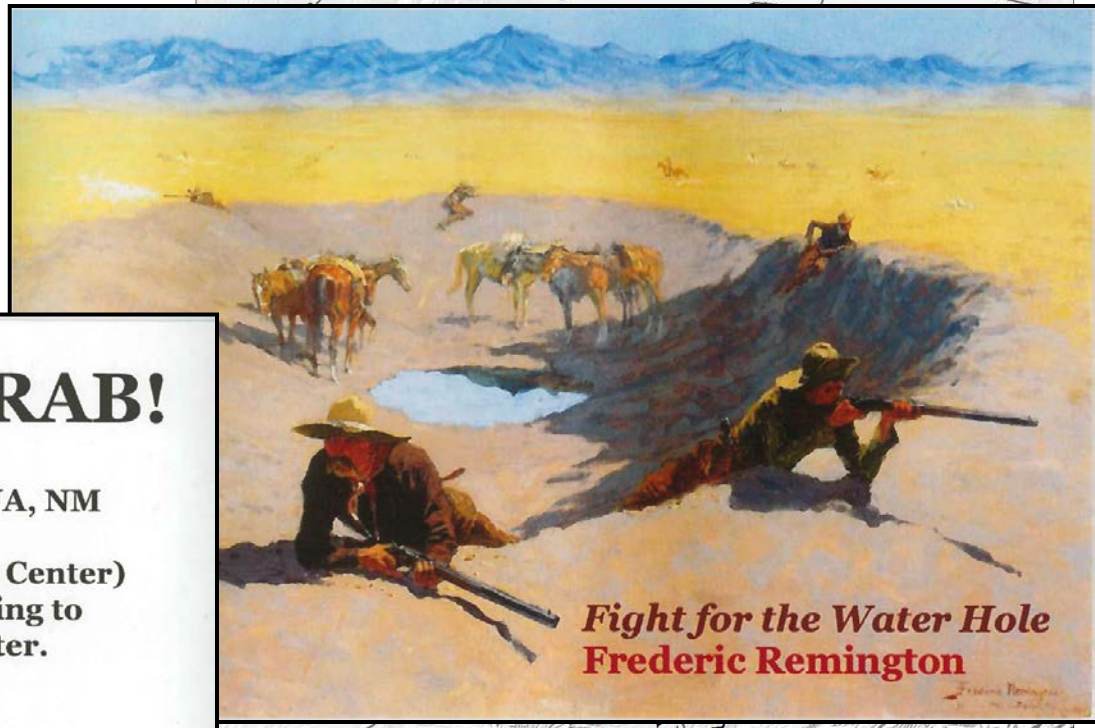
Local community members have been extremely vocal against the proposed water transfer.



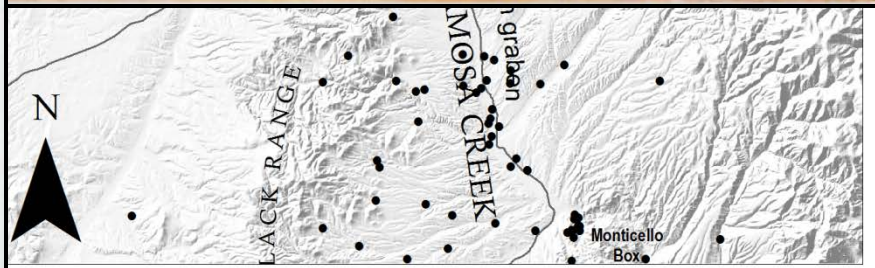


STOP THE WATER GRAB!

Saturday, May 13
THE GOLDEN SPUR SALOON - MAGDALENA, NM
A Benefit Party & Dance for the
Legal Defense Team (NM Environmental Law Center)
fighting the foreign-owned corporation trying to steal the San Augustin Plains aquifer water.

Music starts at 6:30 with "Tuesdays at 2" (light country and bluegrass) till 8:30.
The Ely James Band from Las Cruces plays at 9!
Snacks by The Magdalena Cafe
Please come and show your support - help keep the scum out of New Mexico's water!
Admission $10

ALL PROCEEDS will be delivered directly to the New Mexico Environmental Law Center.
(Bring your checkbook!)



Conclusions

- Groundwater **moves west** from eastern San Agustin (SA) Plains to the western San Agustin Plains, and then out **into the Gila River Basin**.
- Eastern SA Plains show little connection with Mulligan Gap (near Magdalena) to the east or Alamosa Creek to the south—**SA Plains groundwater is not flowing into the Rio Grande basin**.
- In the eastern SA Plains, the North graben (where proposed well field is located) **may be hydrologically separate** from C-N and White Lake grabens.
- Groundwater in Eastern SA Plains is old (latest Ice Age), but has some recharge slowly coming in from surrounding mountains in ephemeral washes and volcanic mountain aquifers.
- Data used to generate storage estimates, aquifer properties, subsurface geology are sparse, making it **difficult to accurately assess** impact of the proposed project.

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Study Area: Physiography and Climate

- In valley, 8” to 13” of precip., ~60% as rainfall.
- Basin elevations: 6800 ft amsl to 7000 ft amsl (lowest in SW).

- About 15” precip in uplands, still mostly as rainfall.
- Most mountain peaks between 8500 ft amsl and a little over 10,000 ft amsl.

Basin is made of fan-delta-lake complexes, underlain by 2k ft of volcanics and volcaniclastics. Mountains made of the volcanics and volcaniclastics.

Major Geologic Units

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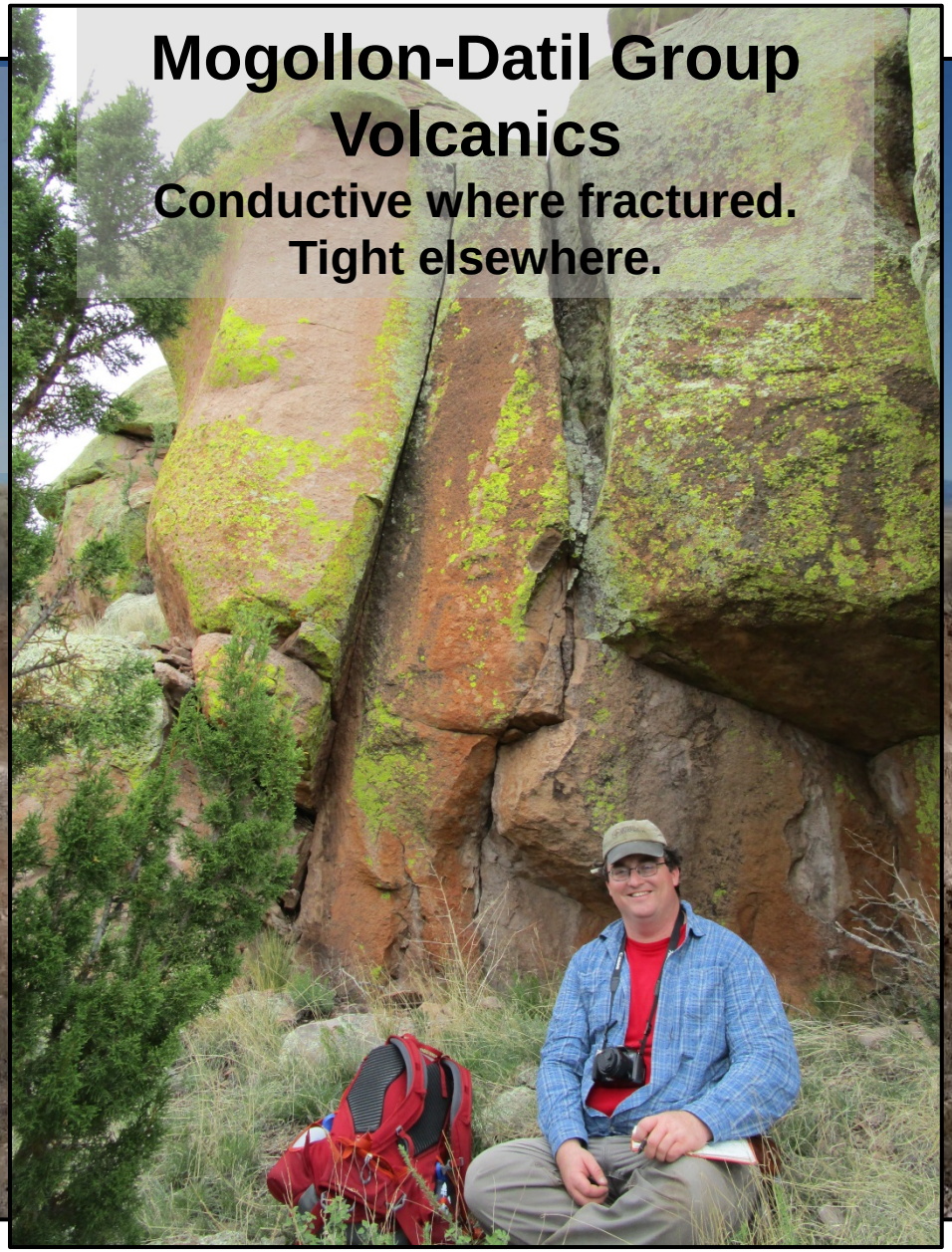
Basin-fill and alluvium

Conductive where not clay-rich (away from playas and in paleochannels)



Mogollon-Datil Group Volcanics

Conductive where fractured. Tight elsewhere.

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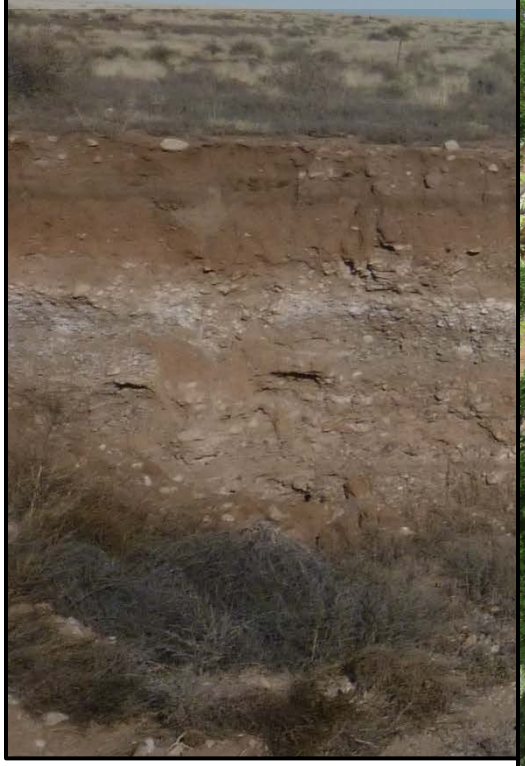

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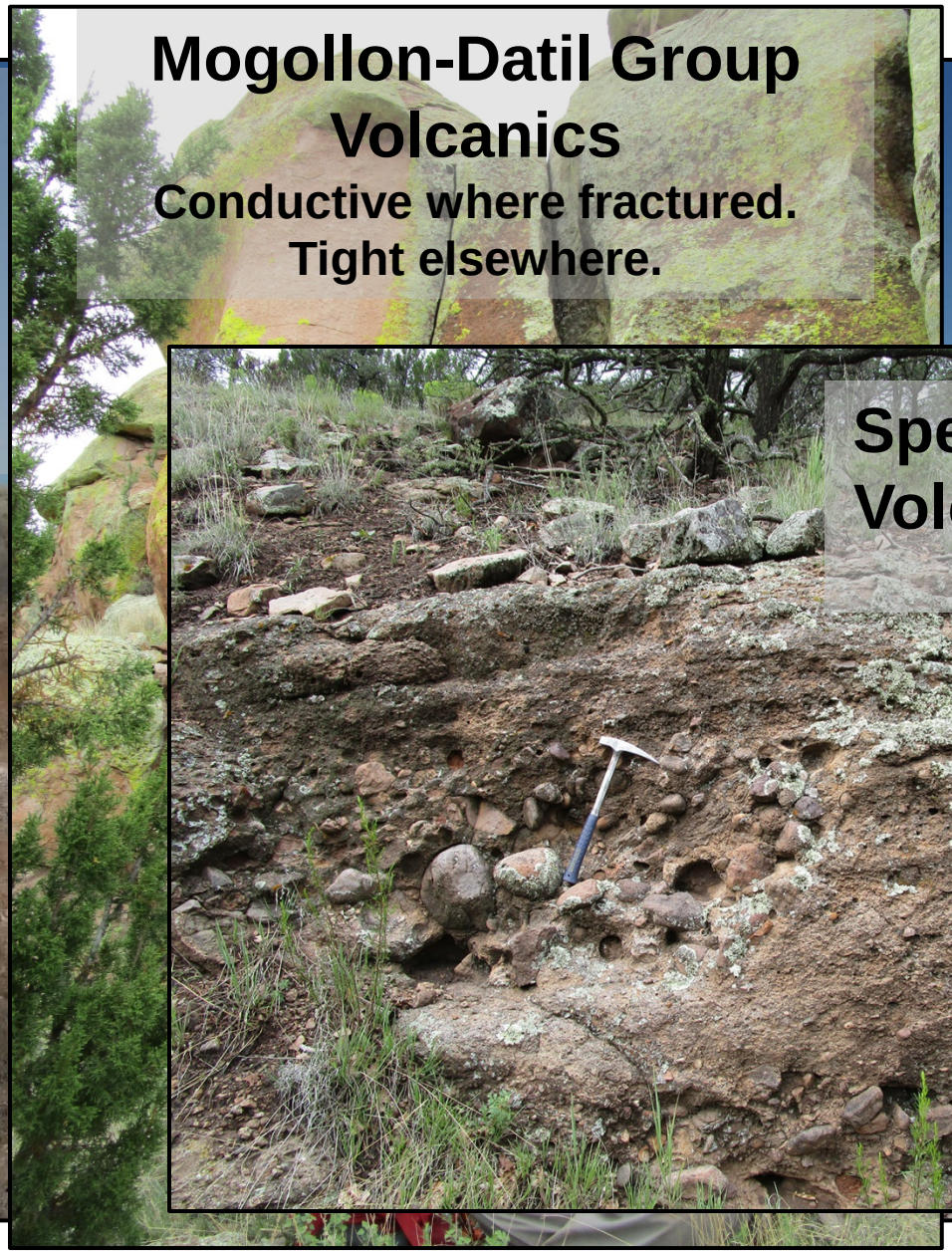
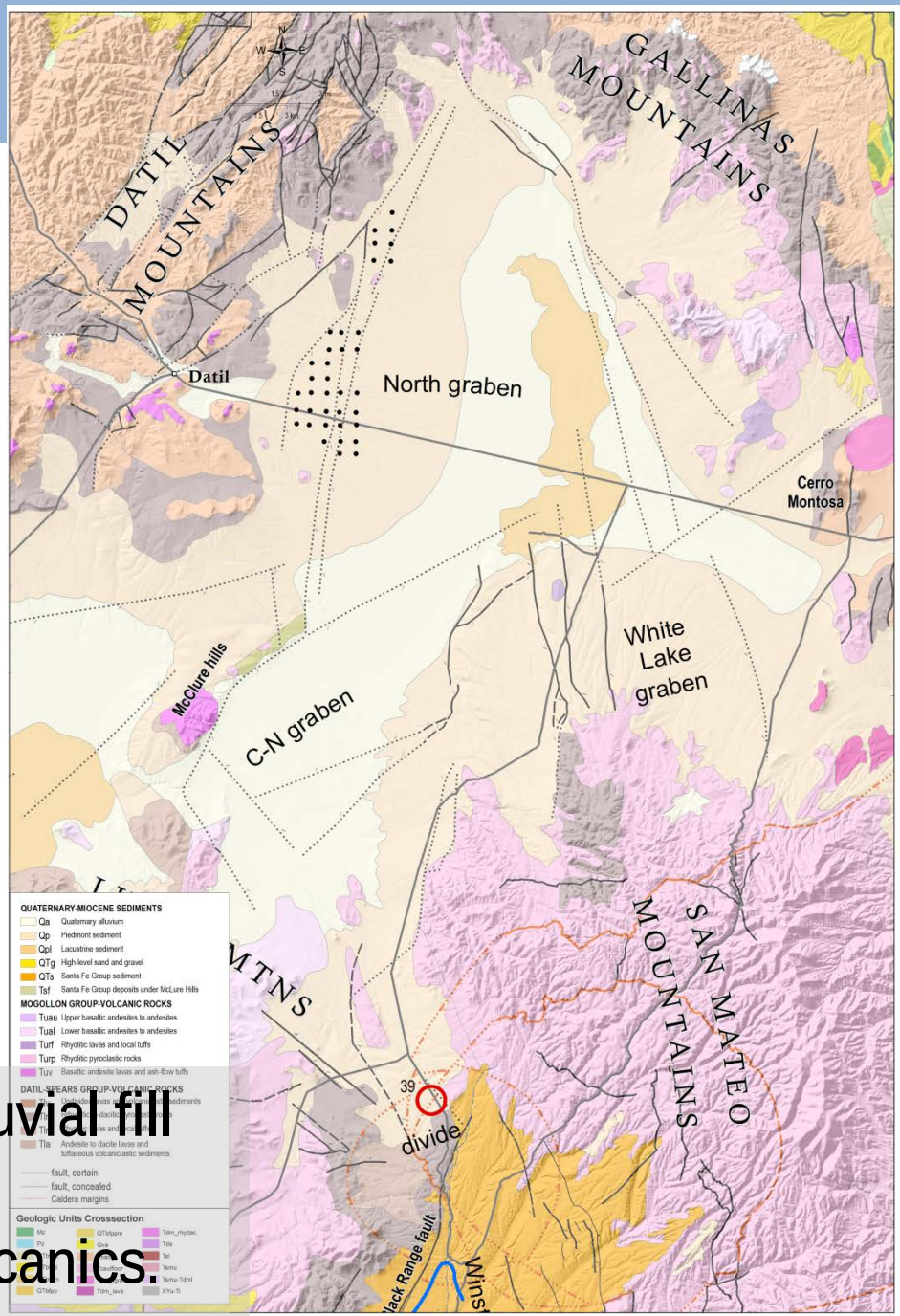


Spears Group Volcaniclastic

Tight

Geologic Boundaries

- Fault-bounded grabens and half-grabens.
  - Eruptions 34-28 Ma.
  - Key calderas shown by red lines
  - Down-dropping related to Basin-and-Range extension.
- Western SA Plains filled by lake until ~8 ka, then slowly drained.
- Eastern SA Plains likely dry after 9 ka. Only C-N graben has playa deposits.

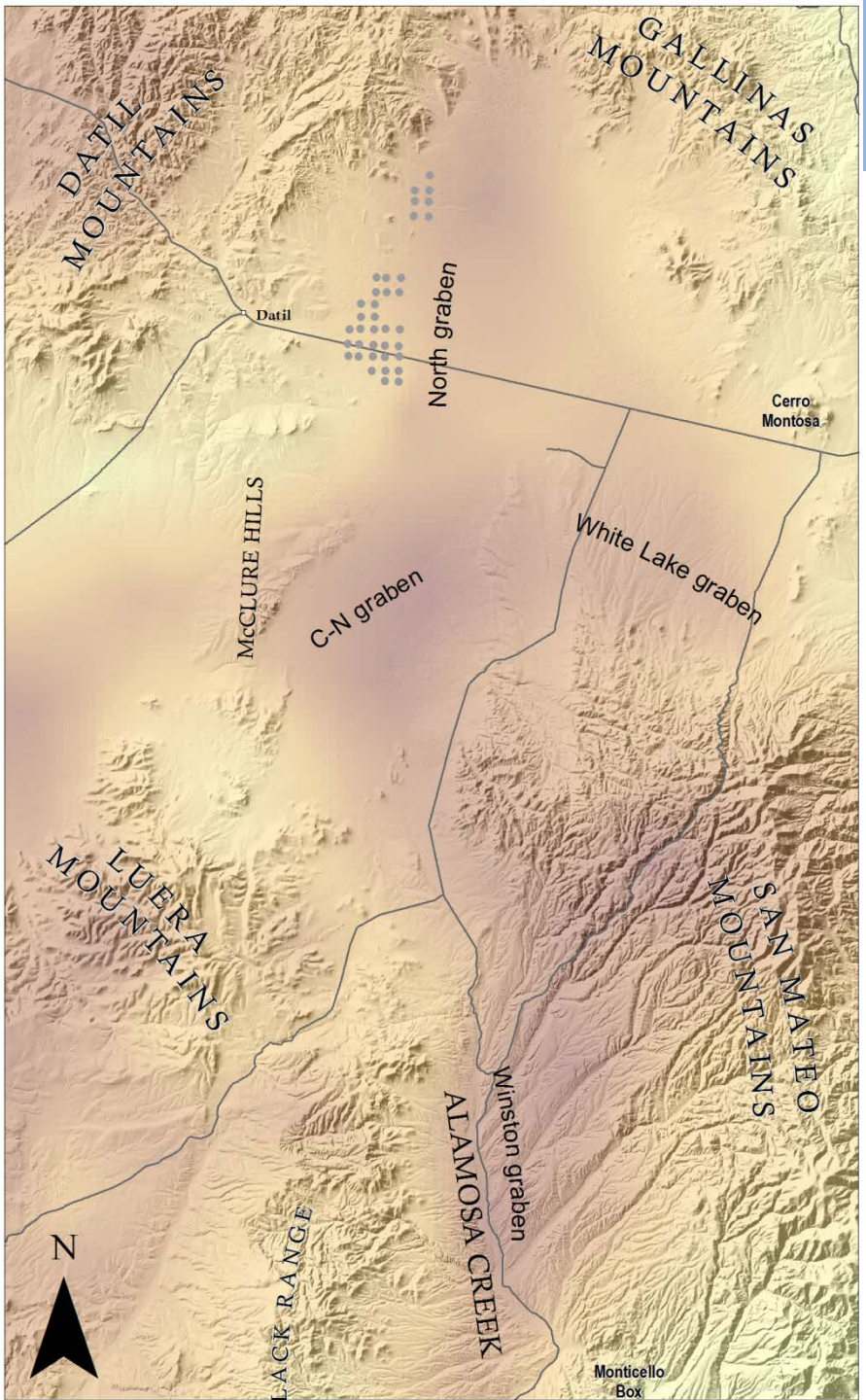


Yellowish = Pleistocene to modern alluvial fill
Pinkish-purples = Mogollon Group
Browns = Spears Group and older volcanics.

Geologic Boundaries

Dark colors = basins
Light colors = highs

- **Eastern SA Plains has three grabens:**
  - **North graben**
  - **C-N graben**
  - **White Lake graben**
- **Eastern and western SA Plains separated by horst, but there is a thin alluvial valley cut and connection in volcanics.**



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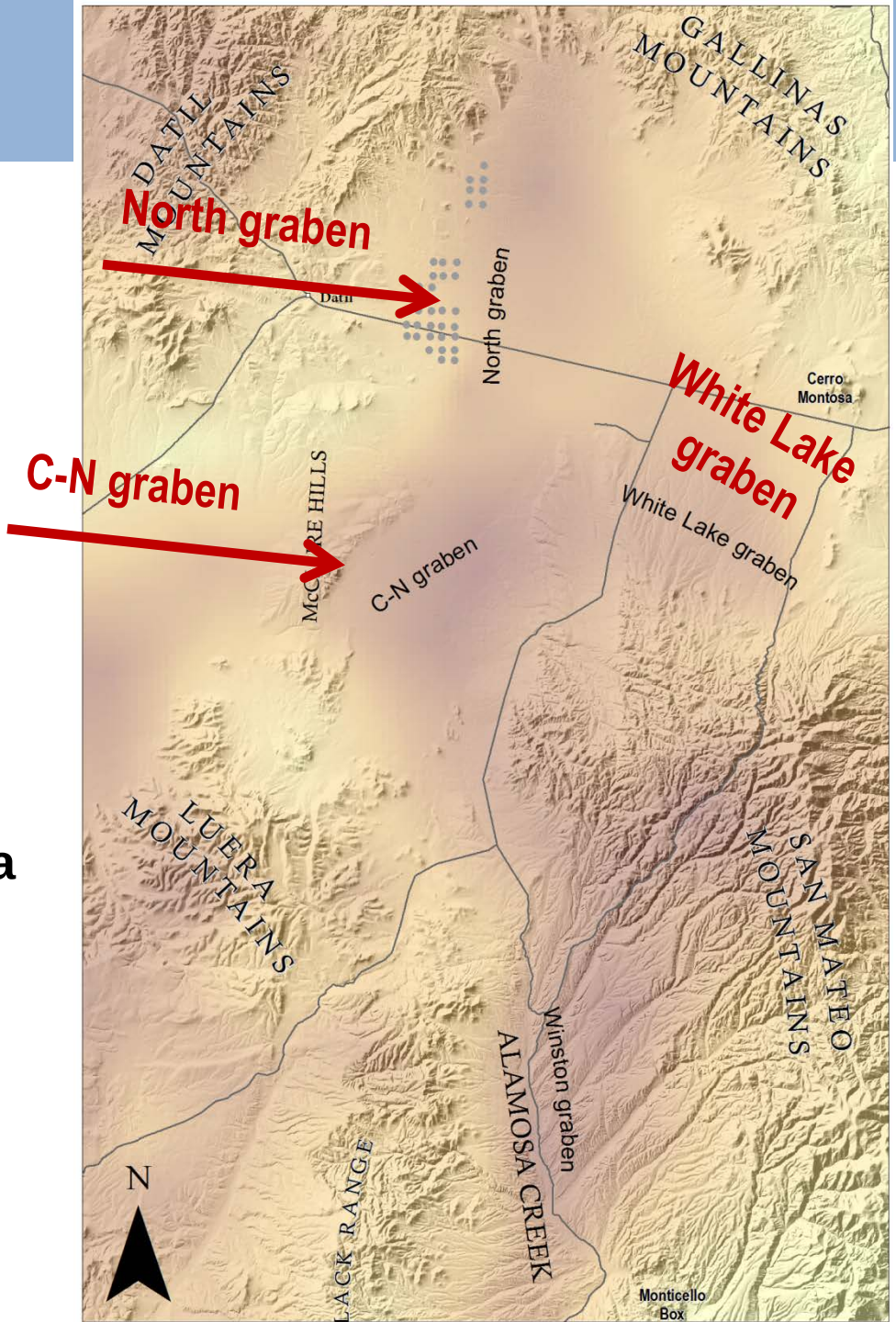

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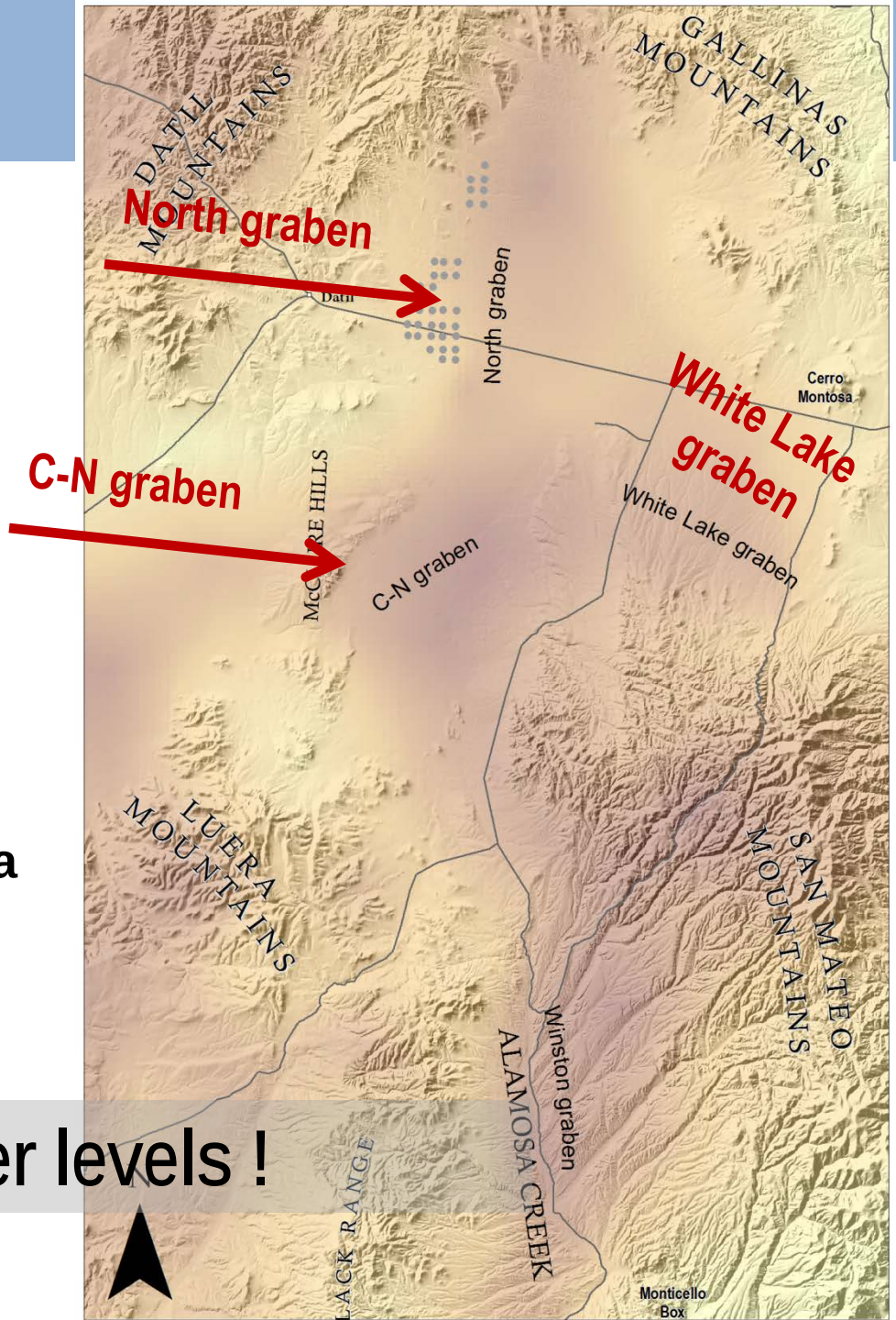


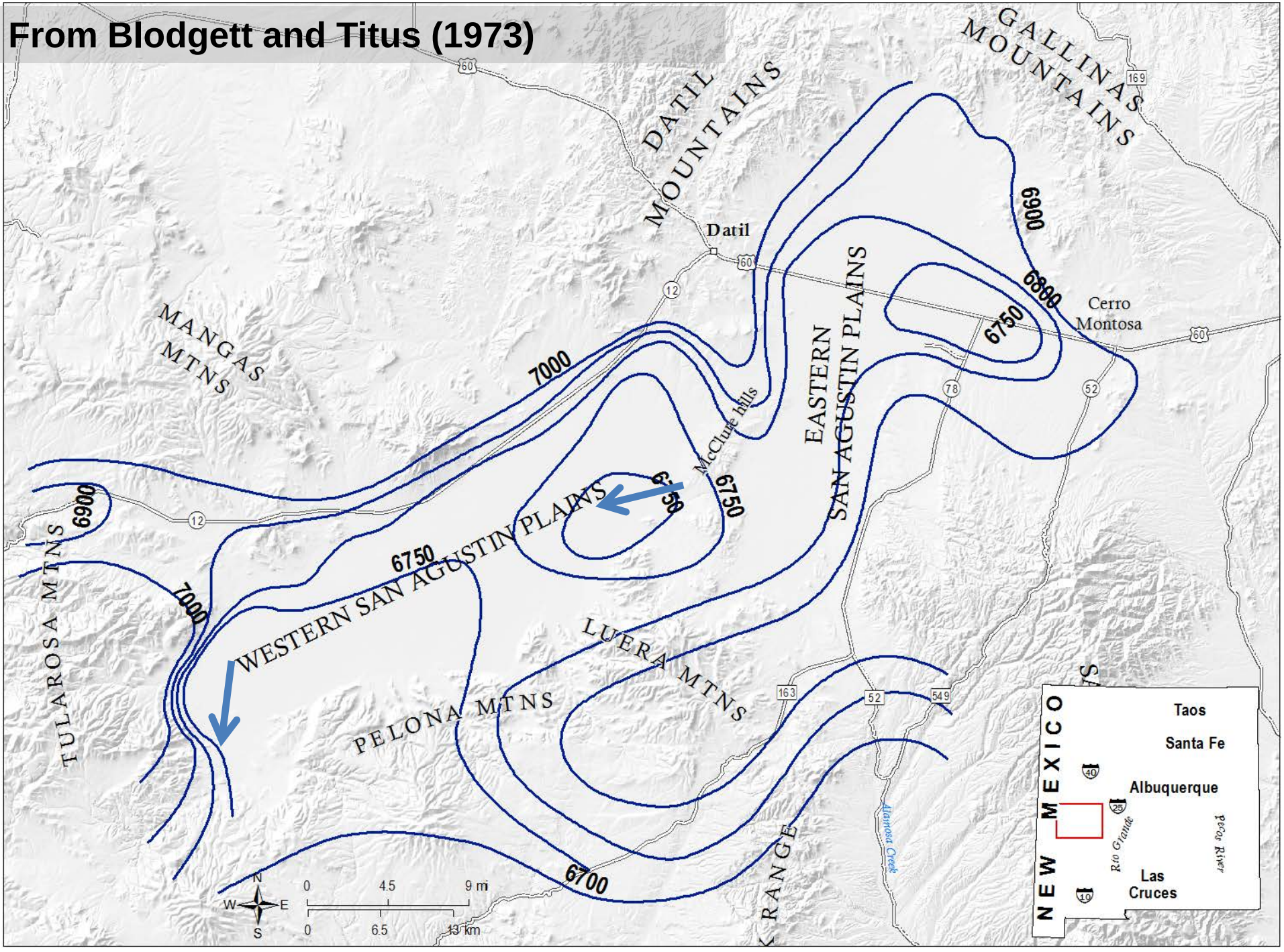
Onto groundwater levels !

Summary of Previous Hydrology Work

Blodgett and Titus (1973, NMBG OFR 79)

- Water quality good (low TDS).
- Very low, linear gradient.
- Basin drains into Gila basin through volcanic aquifer between Tularosa Mts. and Pelona Mountains.

From Blodgett and Titus (1973)



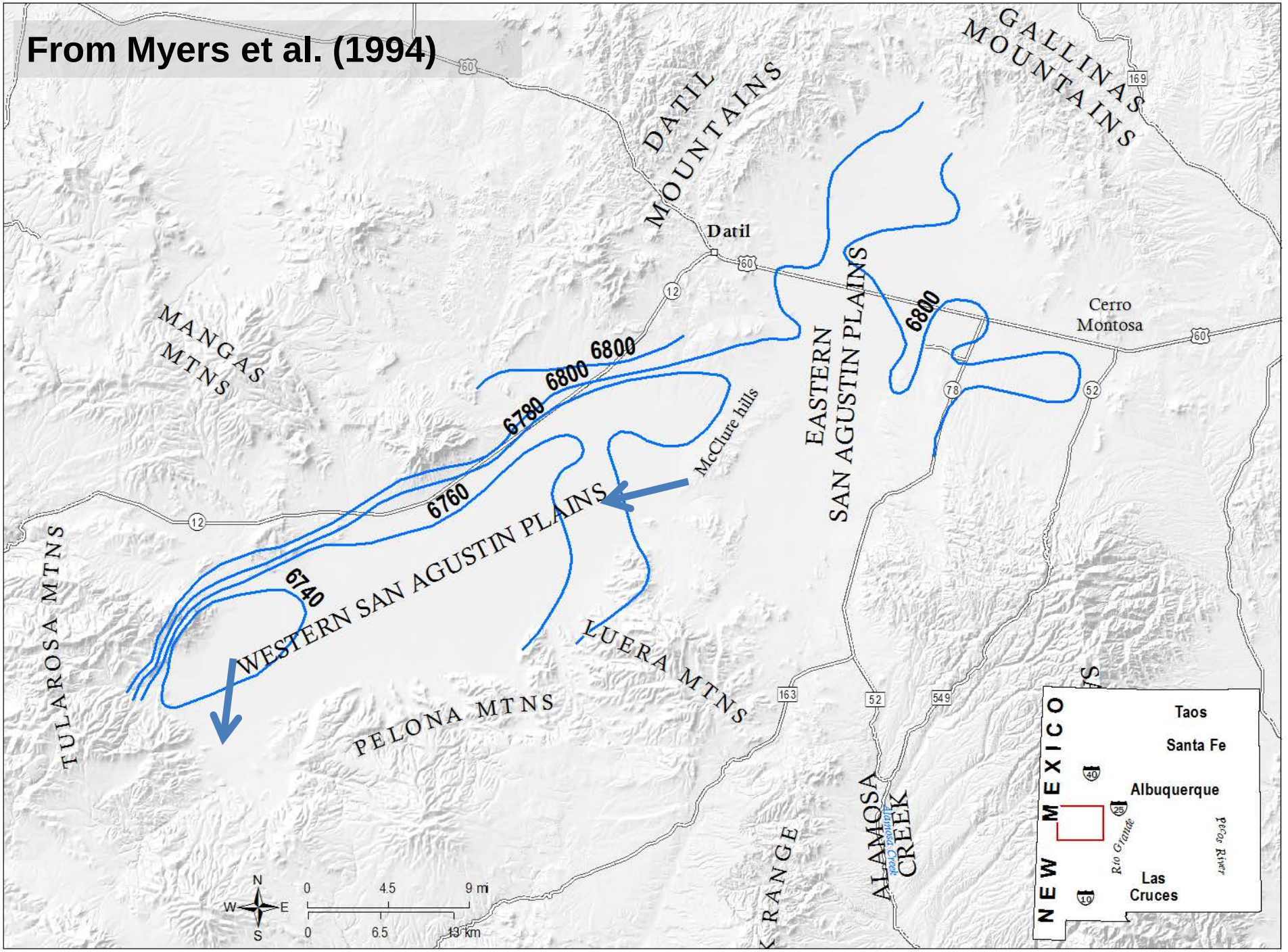
Summary of Previous Work

Myers et al. (1994, USGS OFR)

- **Water quality good in eastern SA Plains**, possible brackish water in western SA Plains ~1000 ft below ground surface.
- **Very low, linear gradient.** Showed essentially no-flow in North graben.
- **Basin drains into Gila basin** through volcanics between Tularosa Mts. and Pelona Mts.
- Volcanic aquifers and basin fill aquifers connected, but difficult to assess how well or where because of lack of data.
- Used resistivity to estimate basin-fill thickness and depth-to-brackish-water. Latter challenging because of variable clay content in sediments.
- Used 5 pump tests and resistivity data to estimate basin-fill water storage. States:

"Lack of sufficient aquifer-test data and well-logs makes accurate estimation of water in storage difficult."

- Storage **not corrected for compaction.** Estimated 34 Maf in eastern SAP and 19 Maf in western SAP, for 53 Maf total storage.


From Myers et al. (1994)
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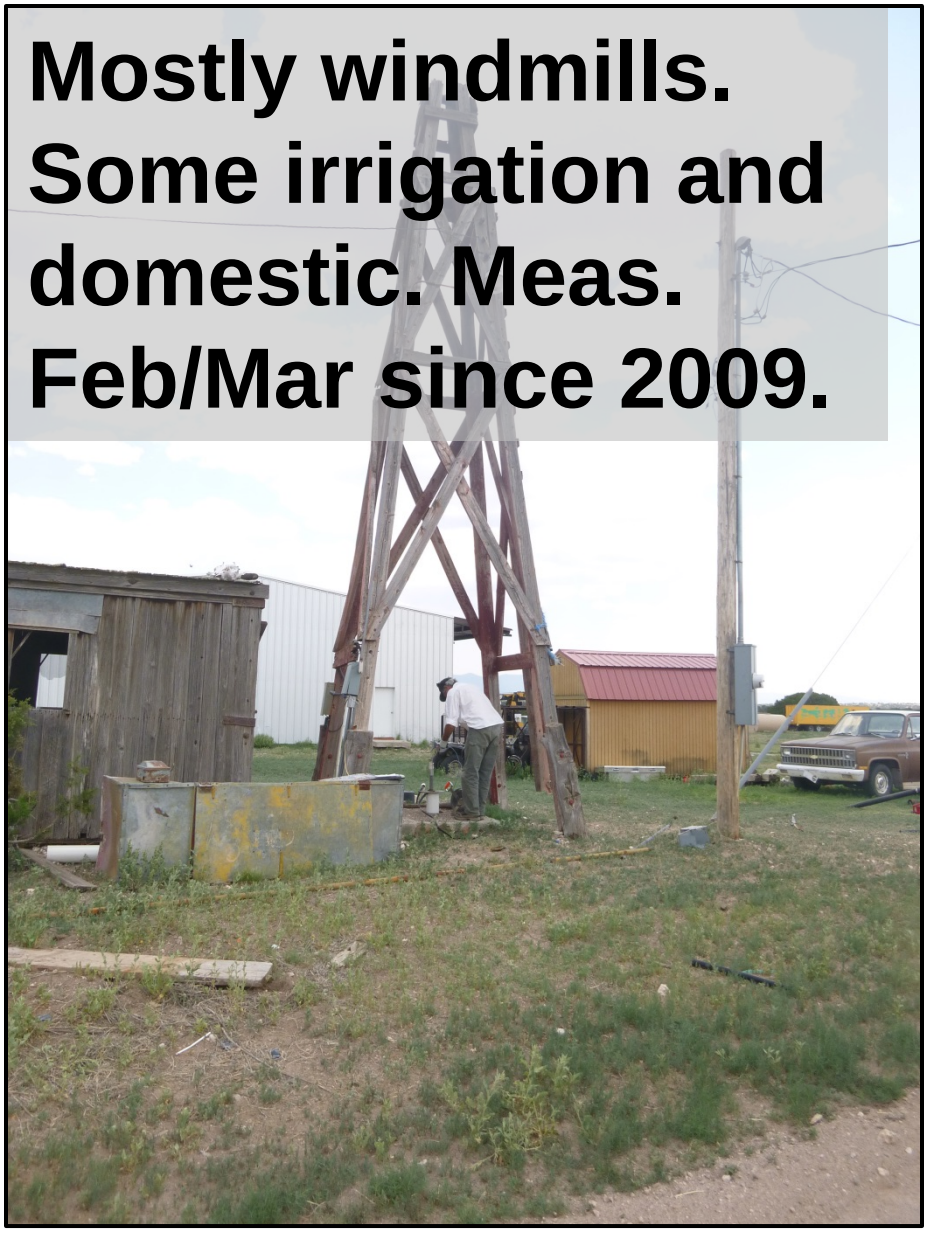
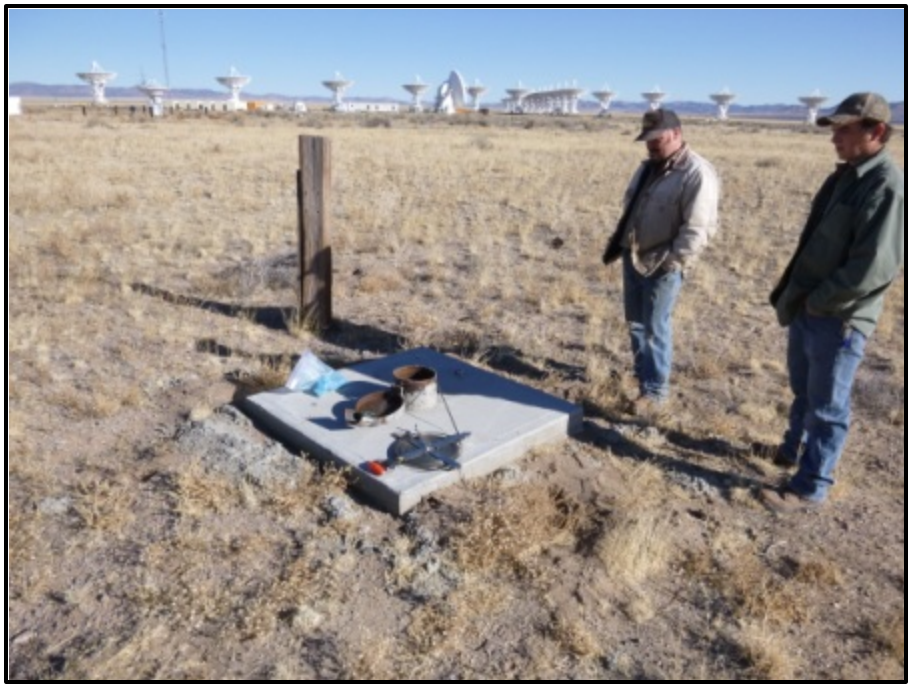
Water Elevations Methods

Mostly windmills. Some irrigation and domestic. Meas. Feb/Mar since 2009.

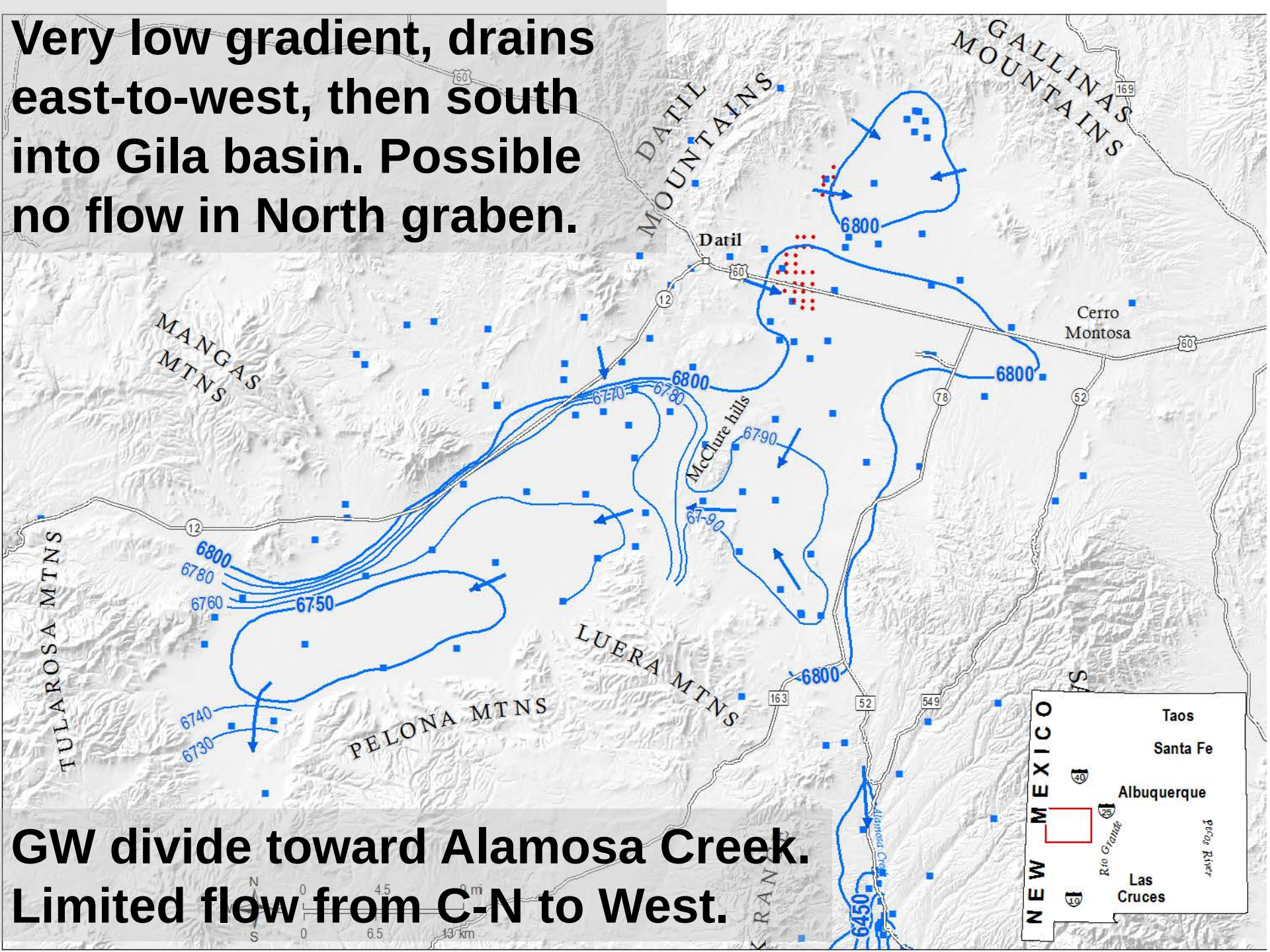




Water Elevations Methods

Mostly windmills. Some irrigation and domestic wells. Feb/Mar since 2009.

Measurements taken with steel tape. Repeated until w/in 0.02 ft (static water levels)


Very low gradient, drains east-to-west, then south into Gila basin. Possible no flow in North graben.
GW divide toward Alamosa Creek. Limited flow from C-N to West.
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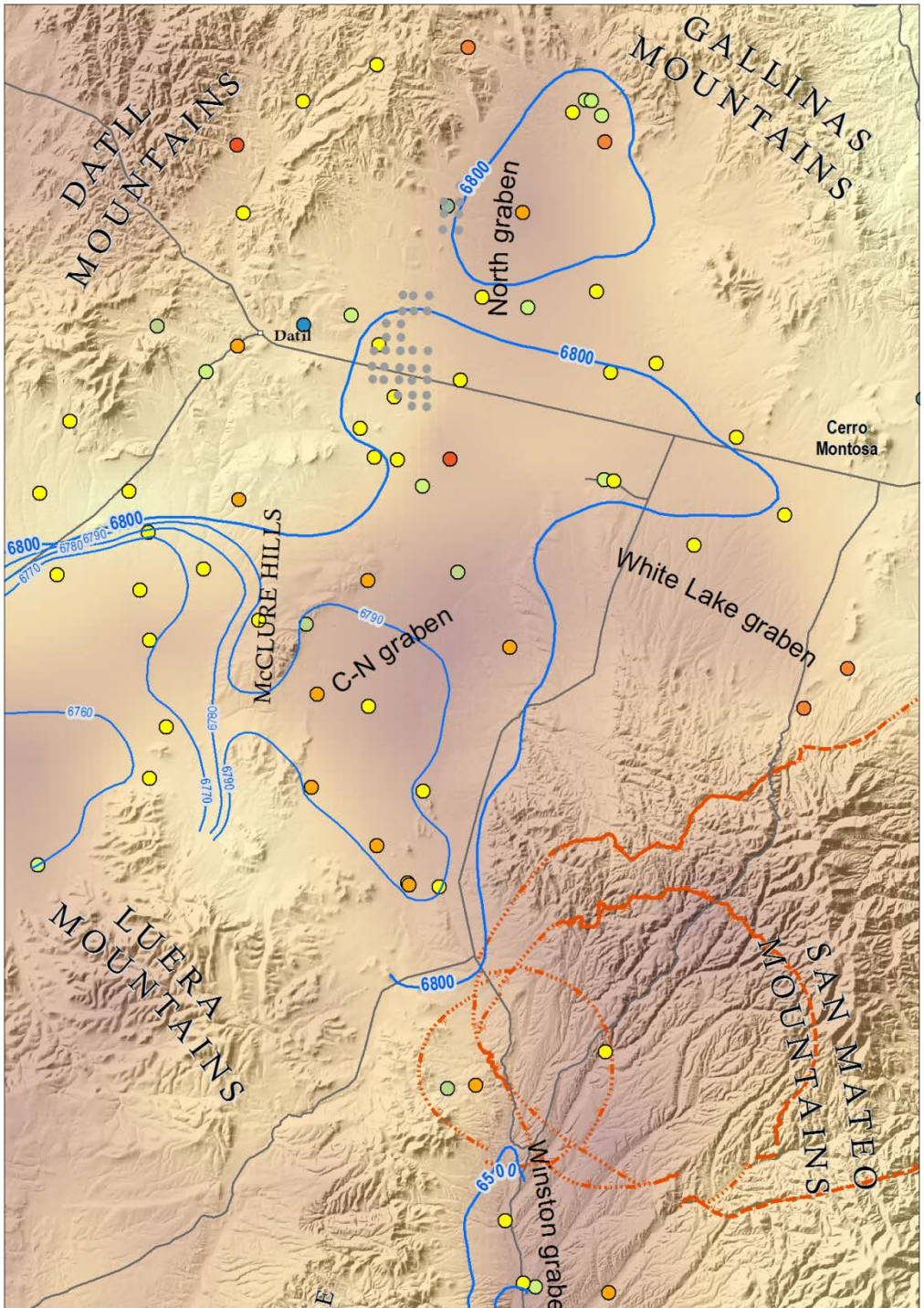
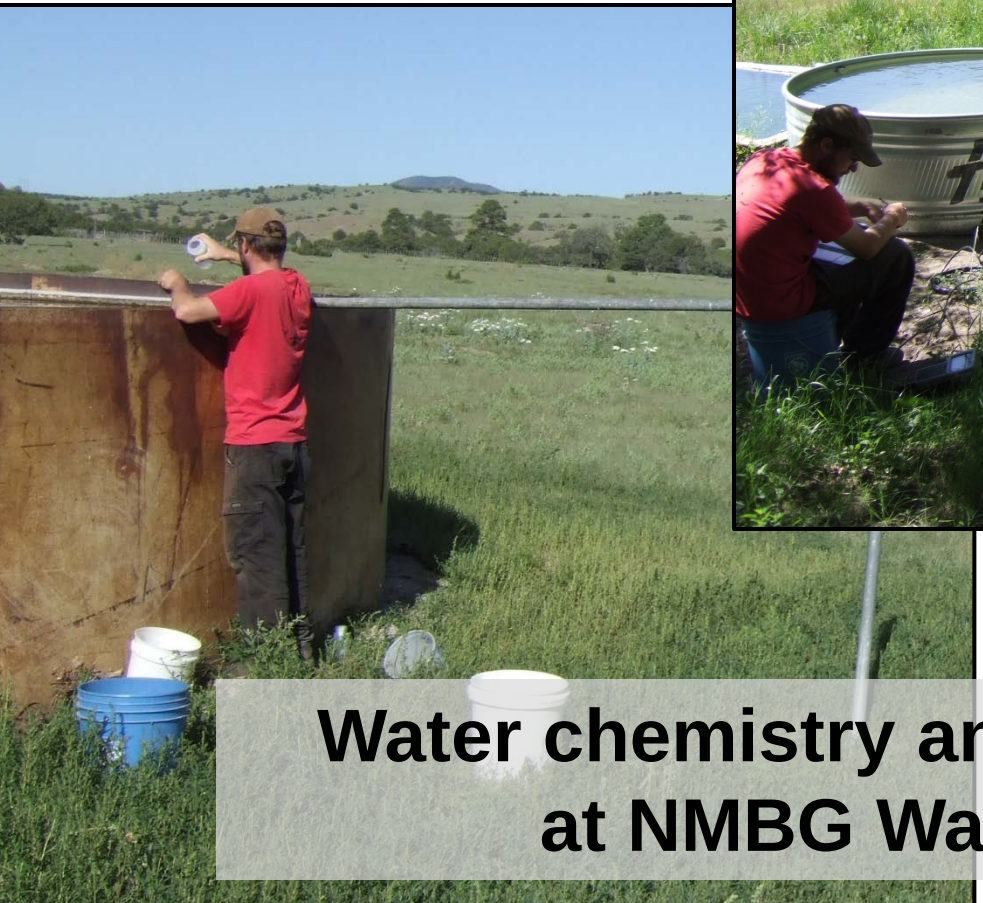
Water Elevations

- **Depth-to-water range in eastern SA Plains are between 150 and 300 ft bgs.**
- **Changes mostly along edge of basin.**
- **Groundwater divide between SA Plains and Alamosa Creek.**
- **North graben appears isolated, possible shallow cone of depression.**
- **Limited flow from C-N into west SA Plains.**
- **Recharge does occur along the flank, but slowly.**
- **Flow from North graben limited by bedrock highs.**



Water Chemistry Sampling Methods

Field sampling after field parameters stabilize. Standardized bottles, rinsing, etc.



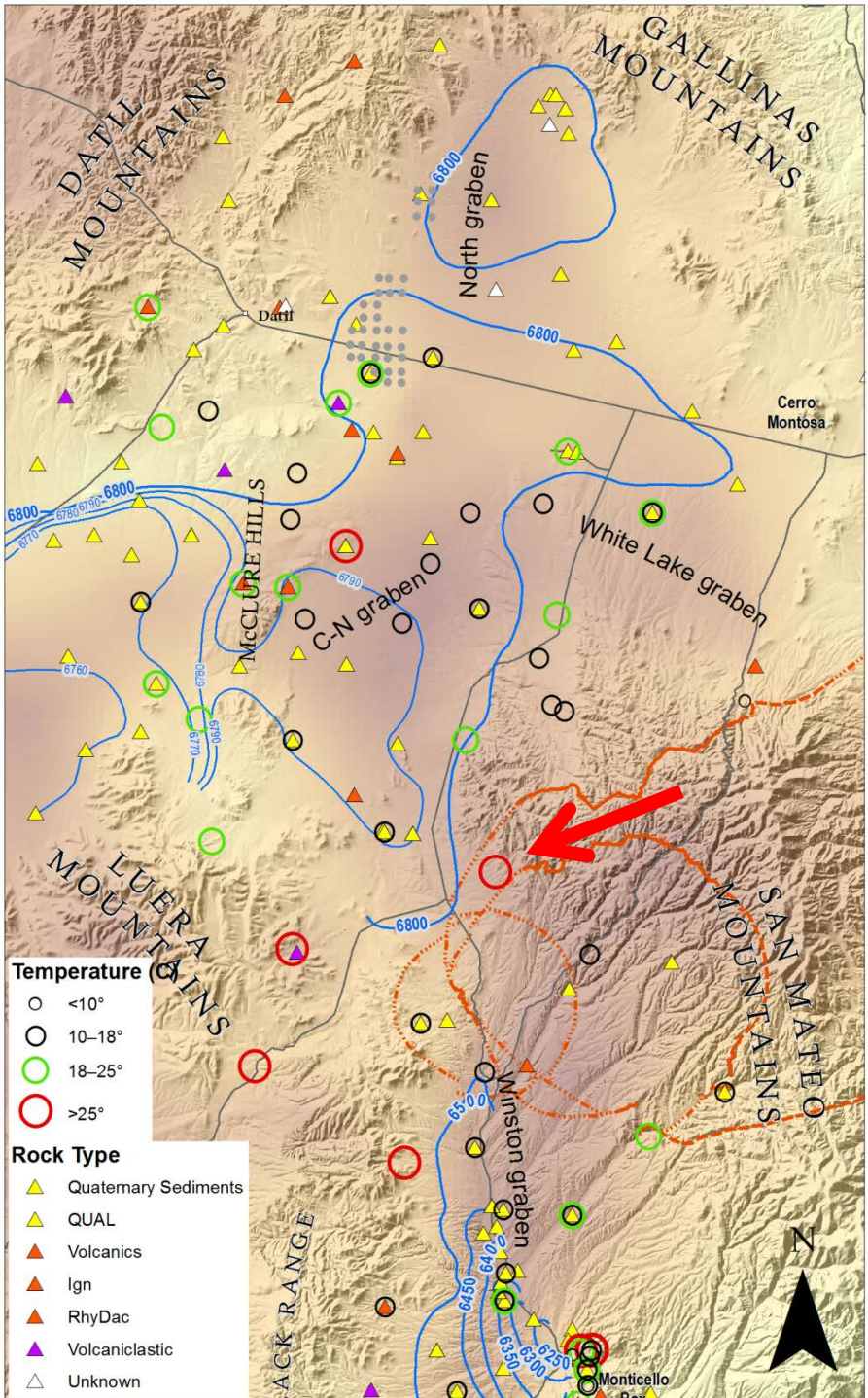
Water chemistry and isotopic analyses done at NMBG Water Chemistry Laboratory.

Water Chemistry (Take-Homes)

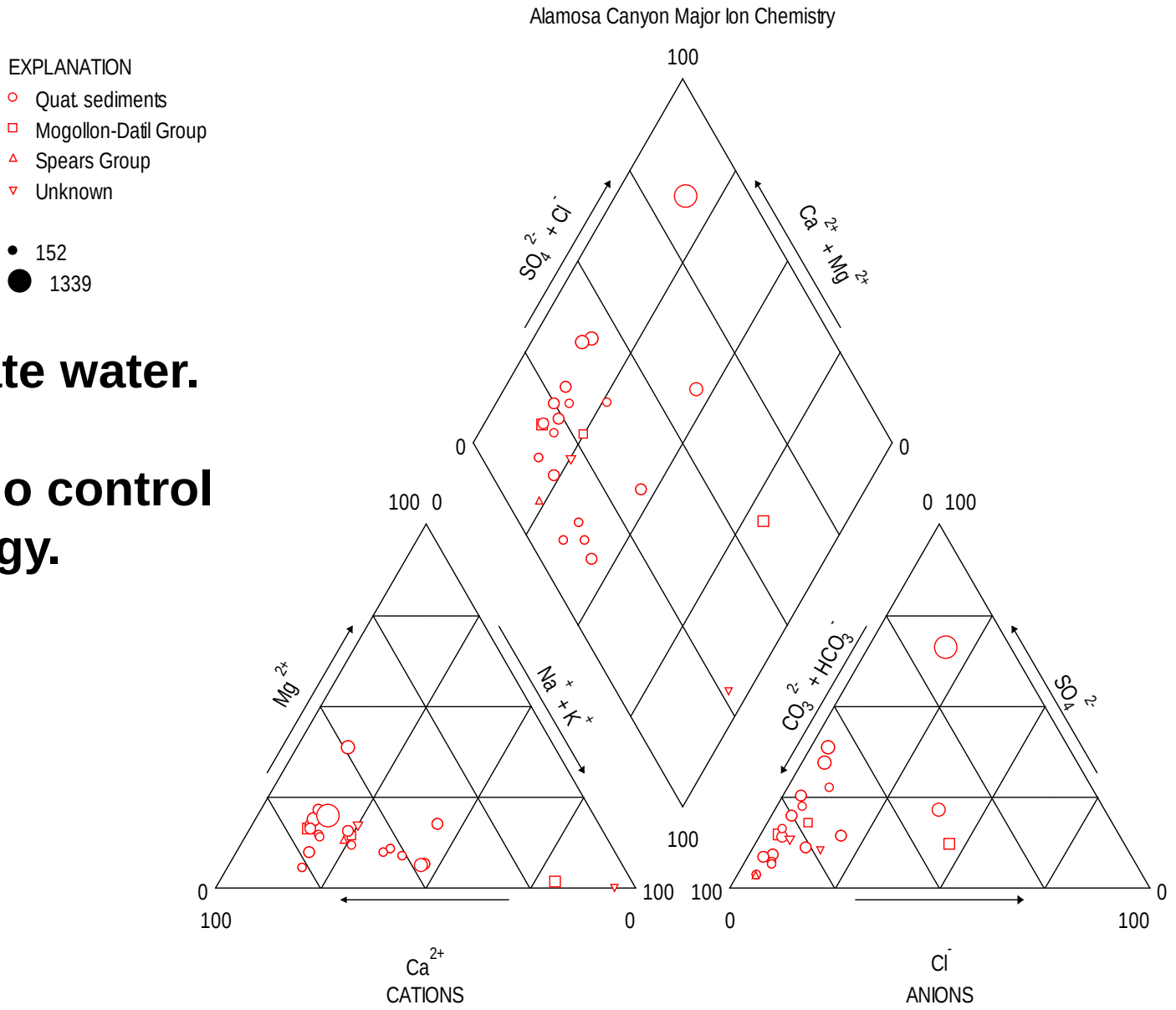
- **SA Plains separate (and older) than Alamosa Creek.**
- **Basin-fill aquifer and volcanic aquifer are connected, but limited by volcanic unit thickness and by isolation from tight volcaniclastics.**

Temp. and Rock Type

- **High temperature around faults and basin-margins.**
- **No strong relationship in SA Plains between rock-type and temperature.**
- **Most wells in basin have 10°C-18°C water temperatures.**
- **Warmest well is >35°C (arrow), on groundwater divide and among multiple caldera margins.**

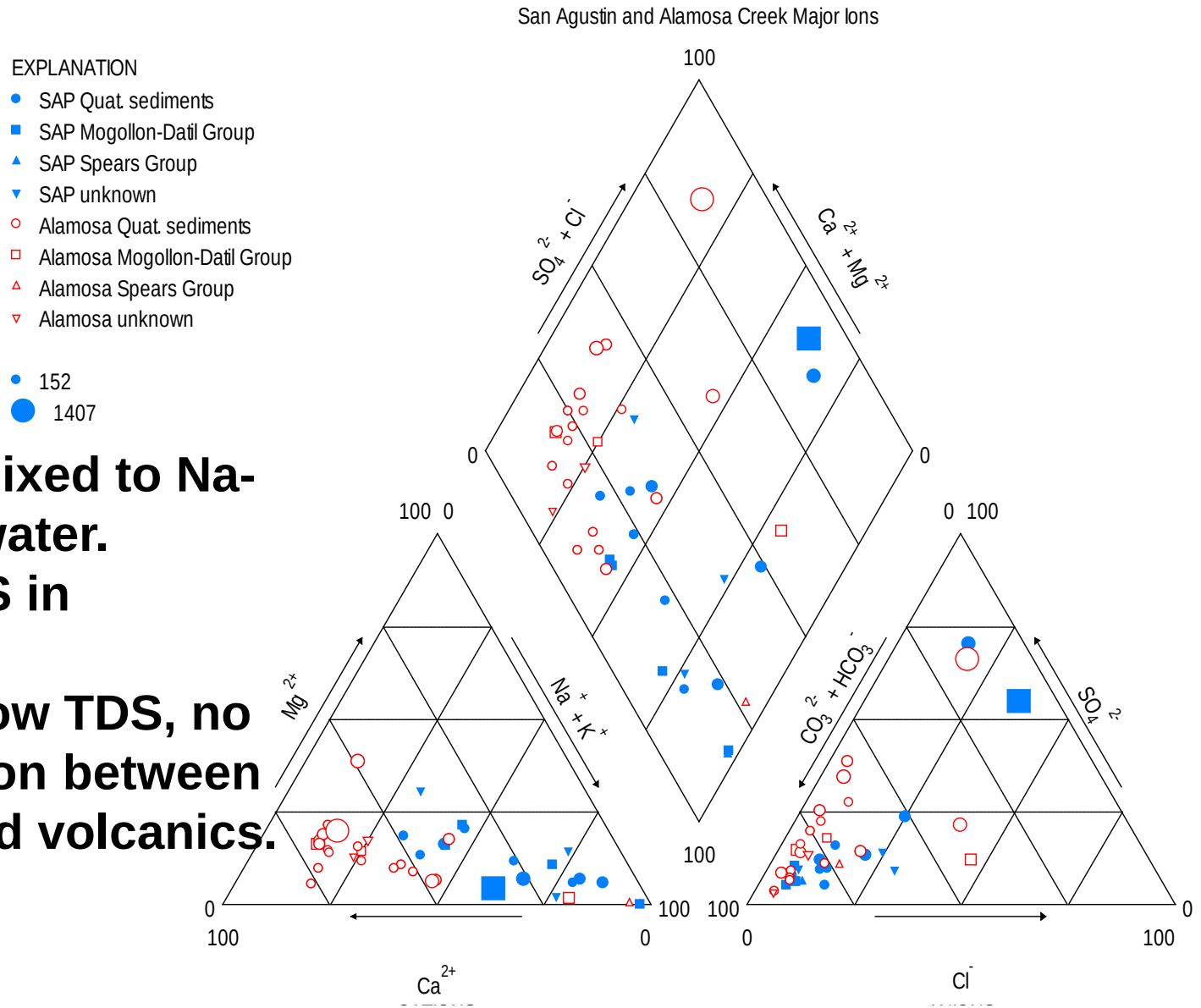


Water Chemistry: Piper Diagrams



- **Ca-Carbonate water.**
- **Low TDS.**
- **Limited to no control from lithology.**

Water Chemistry: Piper Diagrams



- **SA Plains mixed to Na-carbonate water.**
- **Highest TDS in volcanics.**
- **Generally, low TDS, no differentiation between basin-fill and volcanics.**

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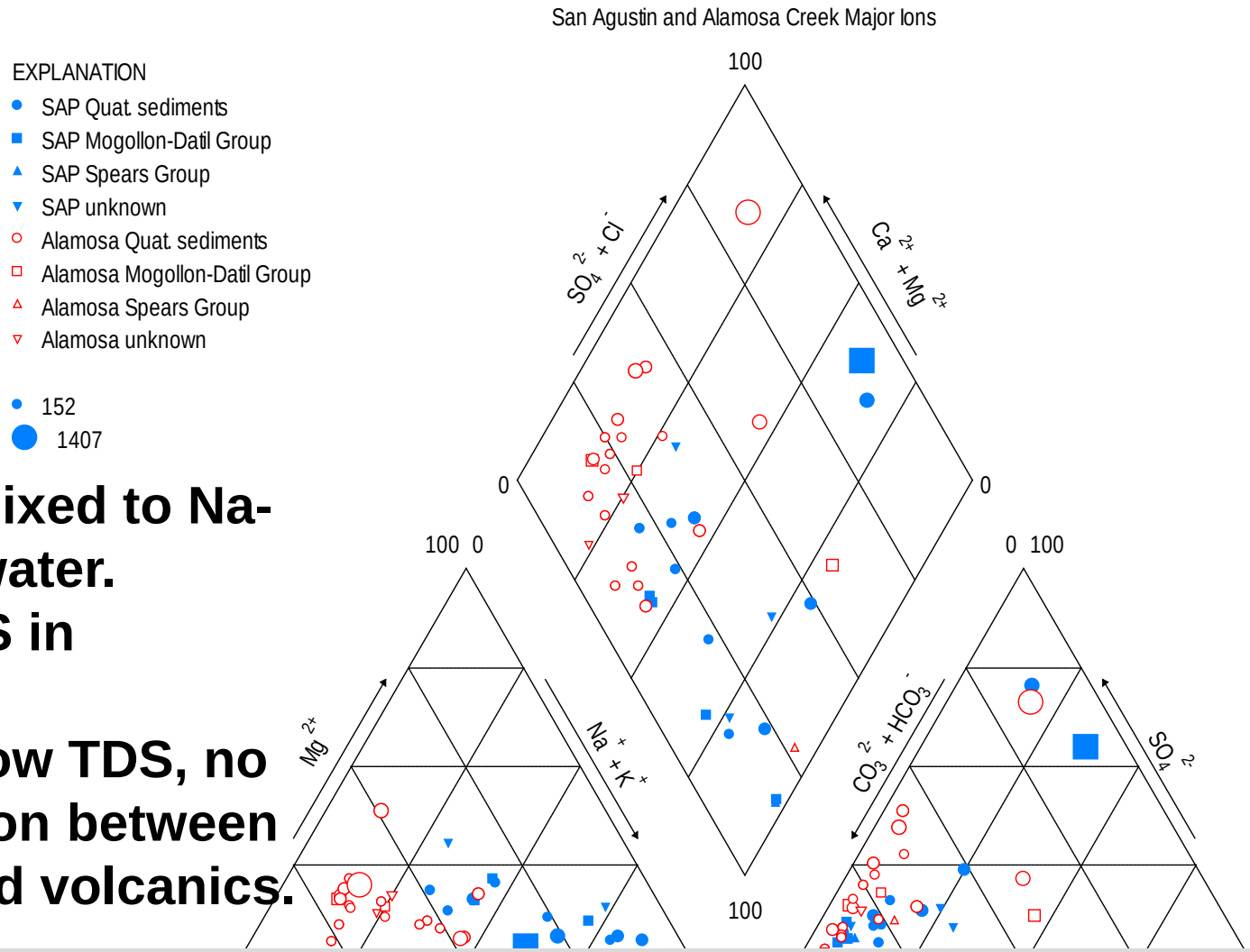

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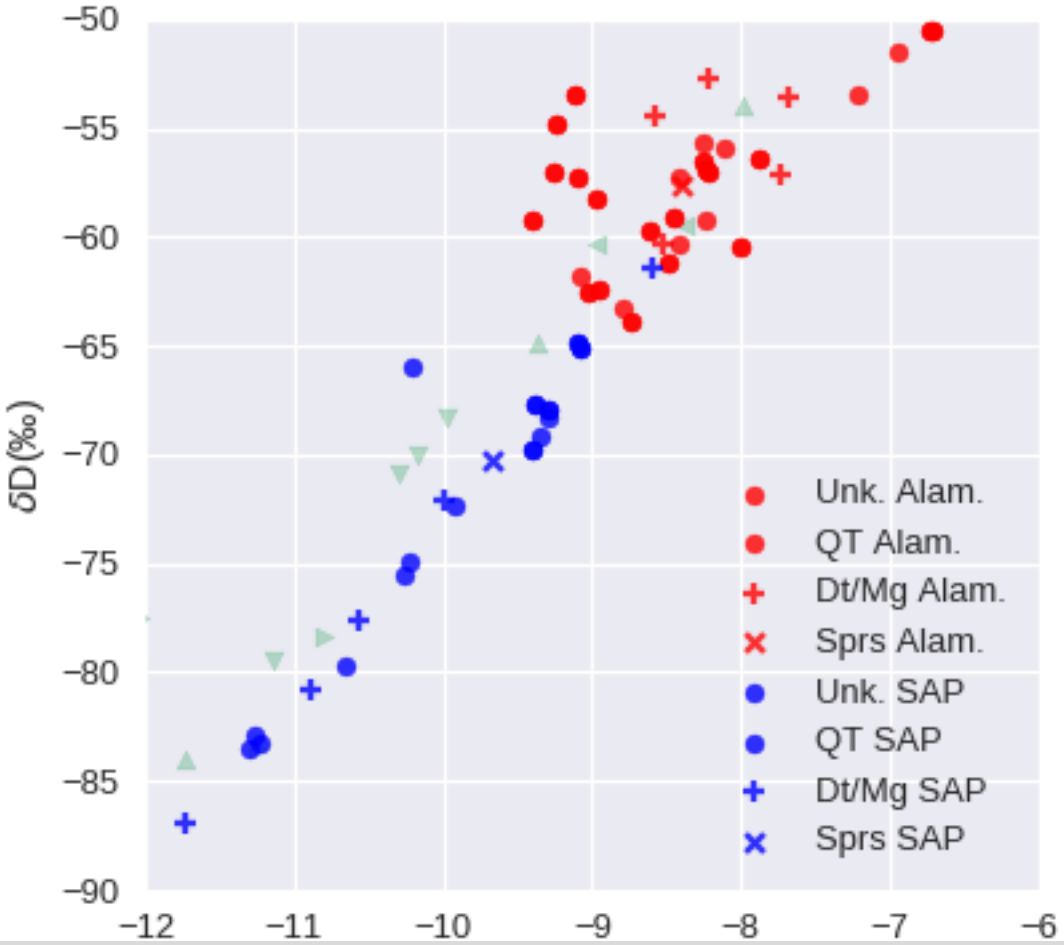
Alamosa Creek and SA Plains are chemically distinct.

Stable Isotopes

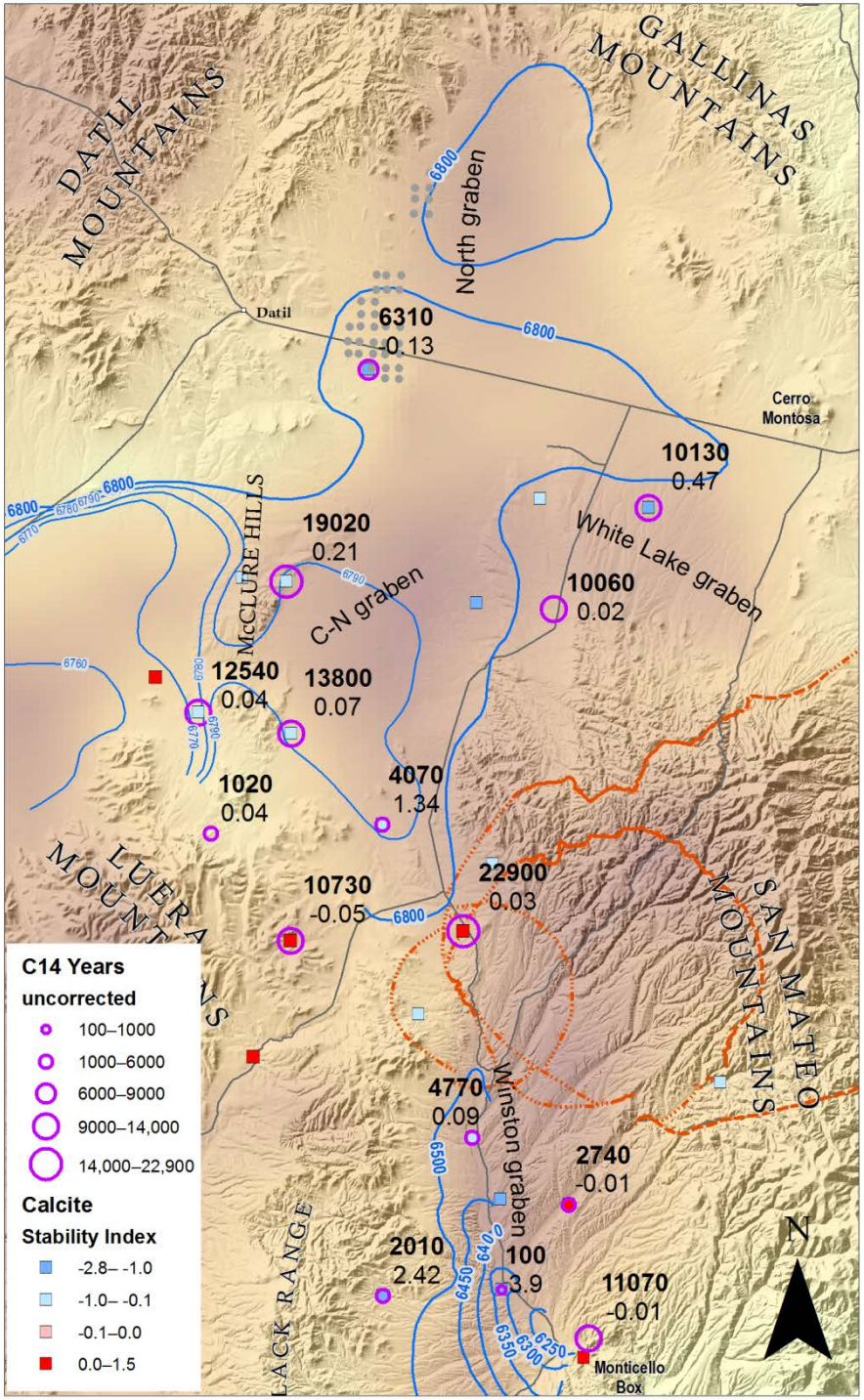
- **SA Plains values are lighter than and separate from Alamosa Creek.**
- **No rock-type differentiation.**



Alamosa Creek and SA Plains are isotopically distinct.

Groundwater Ages

- **Groundwater ages in center of eastern SA Plains about 10 kyr.**
- **Tritium present and C14 young in most Alamosa Creek wells.**
- **SA Plains temperature-affected well has 19 kyr C14.**
- **Well in caldera margings has oldest age (23 kyr C14)**
- **Most wells with ages are undersaturated with respect to calcite—more reliable.**
- **Paths of recharge are clear in ages, consistent with groundwater elevations.**



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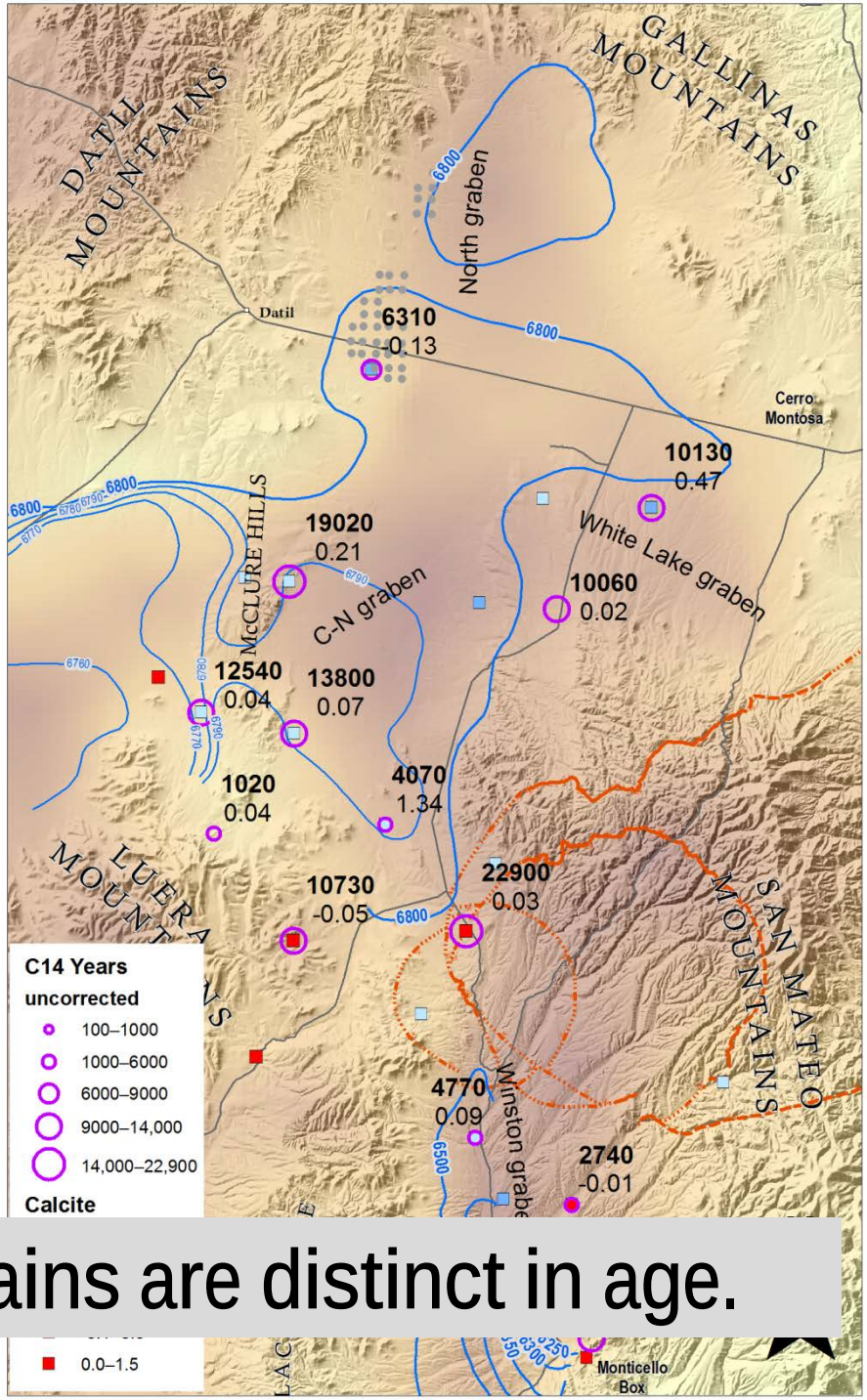

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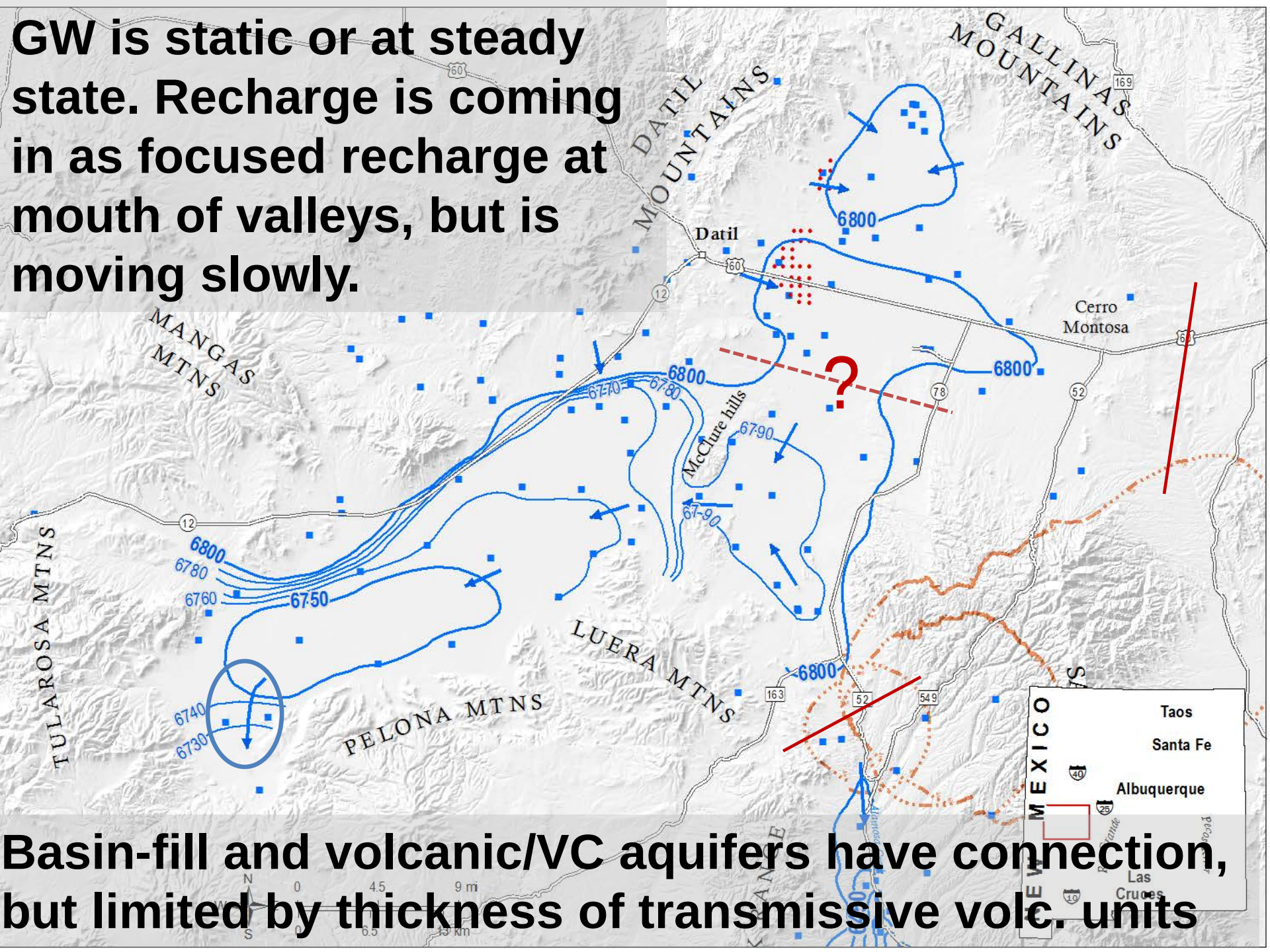
GW is static or at steady state. Recharge is coming in as focused recharge at mouth of valleys, but is moving slowly.
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Basin-fill and volcanic/VC aquifers have connection, but limited by thickness of transmissive volc. units

Conclusions

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