Diagenesis of Sandstones Surrounding Gypsum Valley Salt Diapir, Paradox Basin, CO: An Example From the Jurassic Fluvial Salt Wash Member of the Morrison Formation*

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Search and Discovery Article #51602 (2019)**
Posted August 12, 2019

*Adapted from oral presentation given at 2019 AAPG Annual Convention and Exhibition, San Antonio, Texas, May 19-22, 2019
 DOI:10.1306/51602Bailey2019

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Abstract

Diagenesis in fluvial quartz sandstones of the Jurassic Salt Wash Member of the Morrison Formation varies both stratigraphically and spatially with proximity to Gypsum Valley Salt Diapir. It consists of amalgamated and isolated channel fill facies surrounded by poorly exposed floodplain mudstones. The exposed Gypsum Valley salt wall (GVSW) is 25 miles long and 2 to 3 miles wide and is flanked by strata Late Pennsylvanian to Cretaceous in age that dip away from the diapir and thicken into adjacent flanking minibasins. During deposition of Salt Wash the northern end of GVSW was no longer rising passively but was buried by Salt Wash that locally thickens into a syndepositional synclinal structure (Hat Basin). In contrast, Salt Wash outcrops on the southern end of GVSW are only preserved at margins where they show thinning and onlapping of upturned older units indicating continued passive rise of the southern end of the salt wall during Morrison deposition. Different depositional settings of the fluvial system with respect to the salt wall permit study of differences in diagenesis when the fluvial system directly overlies the salt, is proximal to, or distal from the diapir. Samples were collected from sandstones throughout the entire Salt Wash from exposures surrounding the diapir in locations directly overlying salt (Hat) and flanking salt in diapir proximal and distal locations. Samples were stained for calcite and feldspar and analyzed under a petrographic microscope. Abundance of different detrital grain types, cement types, porosity, and degree of compaction were compared for each of the 3 locations. Samples collected from over top of the diapir at the Hat decrease upward in degree of compaction and quartz overgrowth cements but increase in abundance of carbonate lithic grains and porosity that is (intergranular and secondary). Carbonate cements are common in the Salt Wash throughout Paradox Basin but are absent from the Hat section. Samples from proximal flanking sections also decrease upward in degree of compaction, but quartz overgrowth cements increase, and carbonate cements decrease upward. Distal sections have only rare carbonate lithic grains and little to no carbonate cement. Carbonate lithics are abundant throughout the sections, margins have high percentages of carbonate grains. Over the diapir the sandstones are highly affected by the brine halo and elevated isotherms. In contrast to many other studies the Salt Wash in Gypsum Valley illustrates potential for high quality reservoirs on flanks and crests of diapirs.

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OUTLINE

- Objectives
- Previous Studies in Gypsum Valley
- Background
- Stratigraphy
- Methods
  - Sample locations
- Results
  - What do the rocks look like?
  - Paragenesis
  - Distribution of cements
- Conclusions
- Acknowledgements & Questions

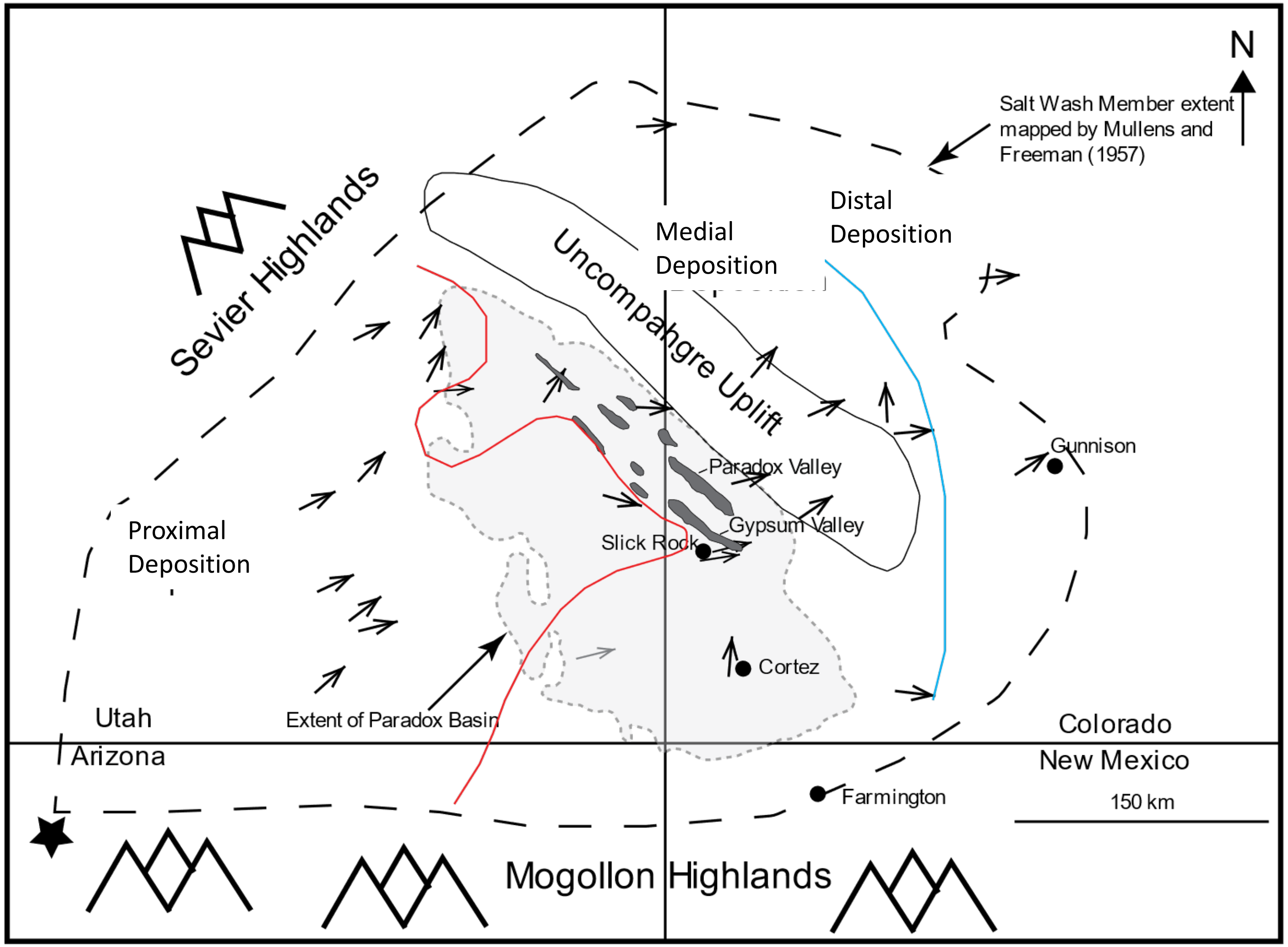
OBJECTIVES

- To identify diagenetic changes and document alteration patterns within the sandstones of the Salt Wash Member of the Morrison Formation on top of, on the margin, and distal from the Gypsum Valley Salt Diapir.
  - To better understand the potential of sandstones surrounding salt diapirs as reservoirs.

PREVIOUS STUDIES IN GYPSUM VALLEY

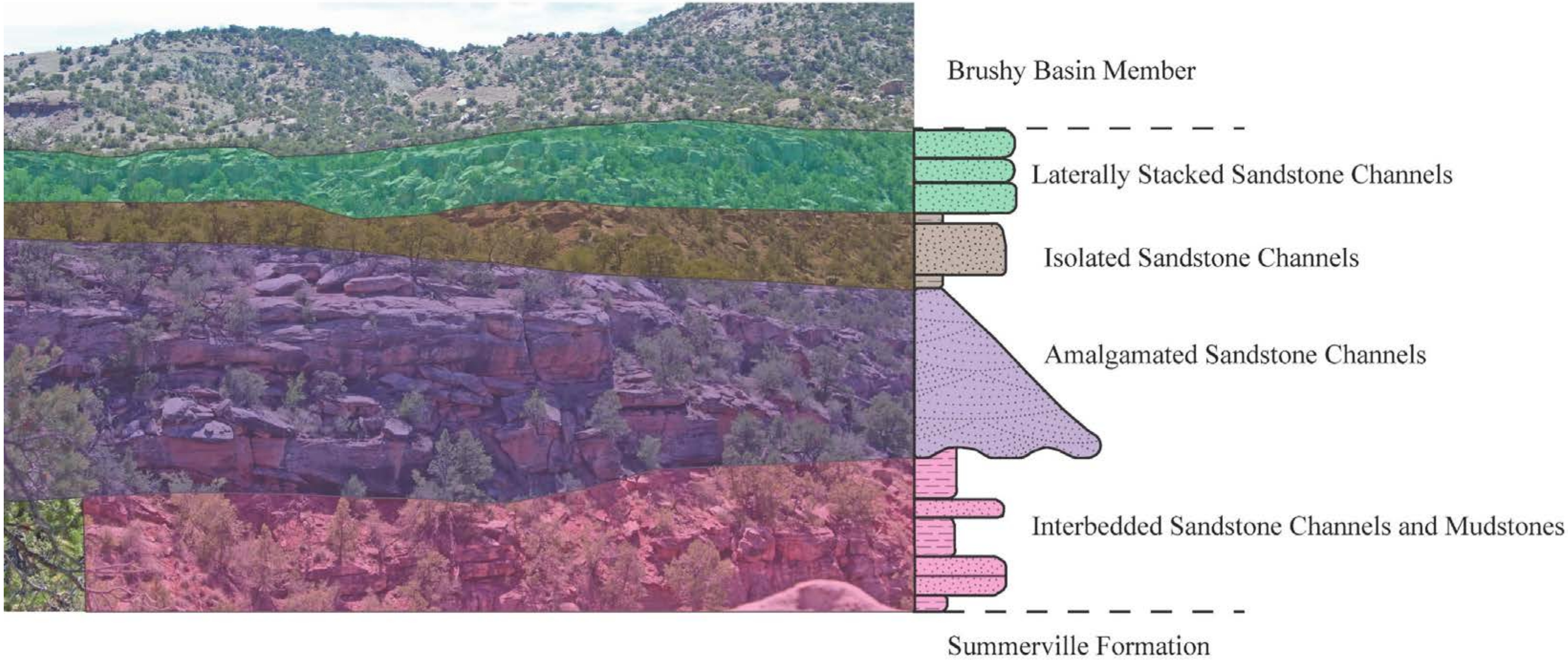
- Elizabeth A. Heness, 2016
  - Study focused on the Chinle Formation
    - Found both early and late stages of calcite and dolomite cementation
    - Found calcite and dolomite cements on diapir margin and a more mixed signature away from the salt diapir
- Ryan Ronson, 2017
  - Focused on the Carmel Entrada Formation
    - Found early and late stages of calcite cementation
    - Dolomite cementation was late stage
    - Porosity is relatively high in all samples but highest on diapir margin
    - Calcite cements on diapir margin and dolomite cements distal to diapir

BACKGROUND



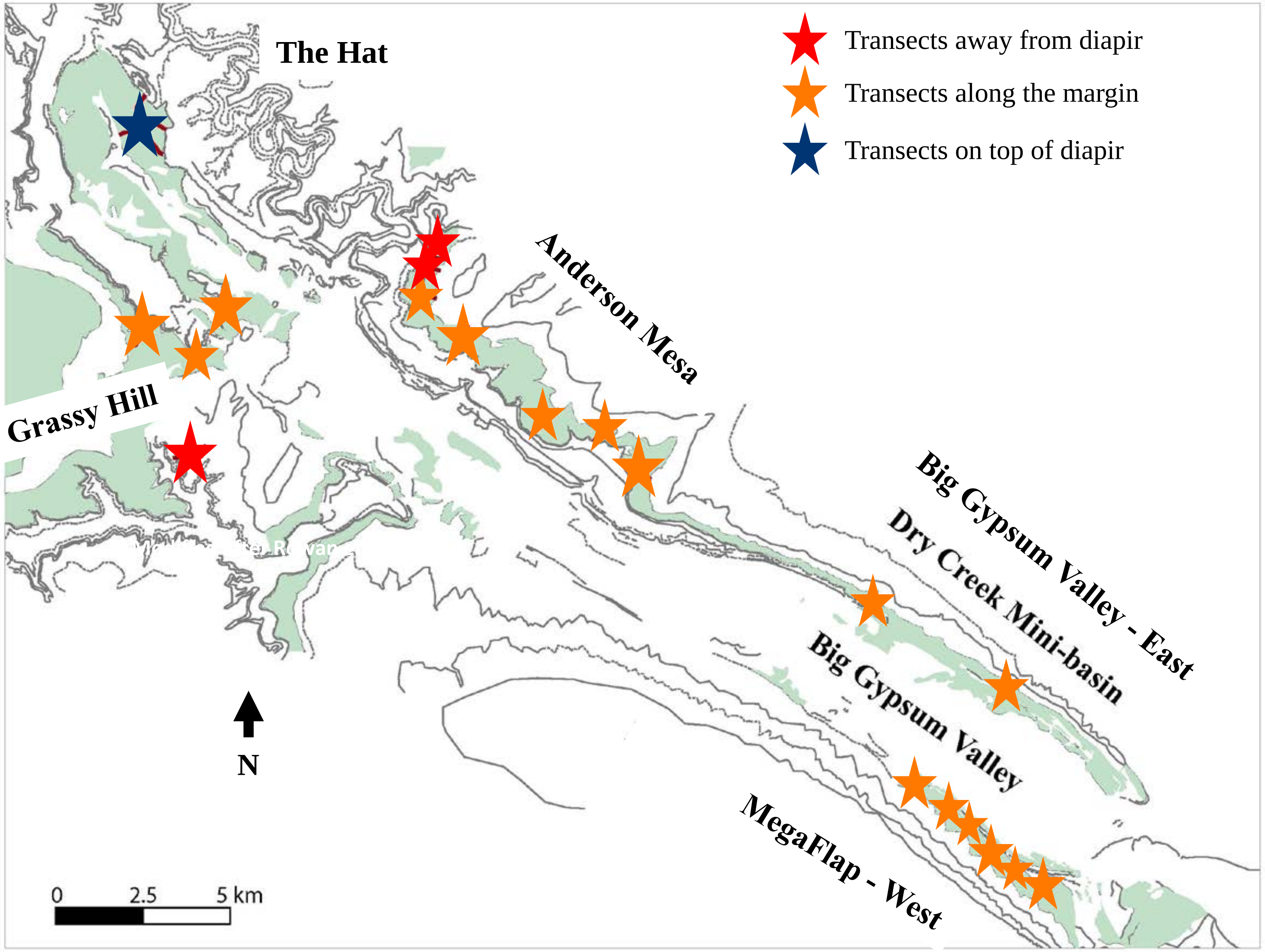
- Proximal
  - Laterally stacked amalgamated channels
  - Coarse-grained sand
  - Pockets of floodplain muds
  - 100-70% sand
- Medial
  - Channel packages separated by distinct packages of floodplain muds
  - 70-40% sand
- Distal
  - Dominantly floodplain muds
  - Channel belts absent
  - Ribbon channels
  - Less than 40% sand

STRATIGRAPHY

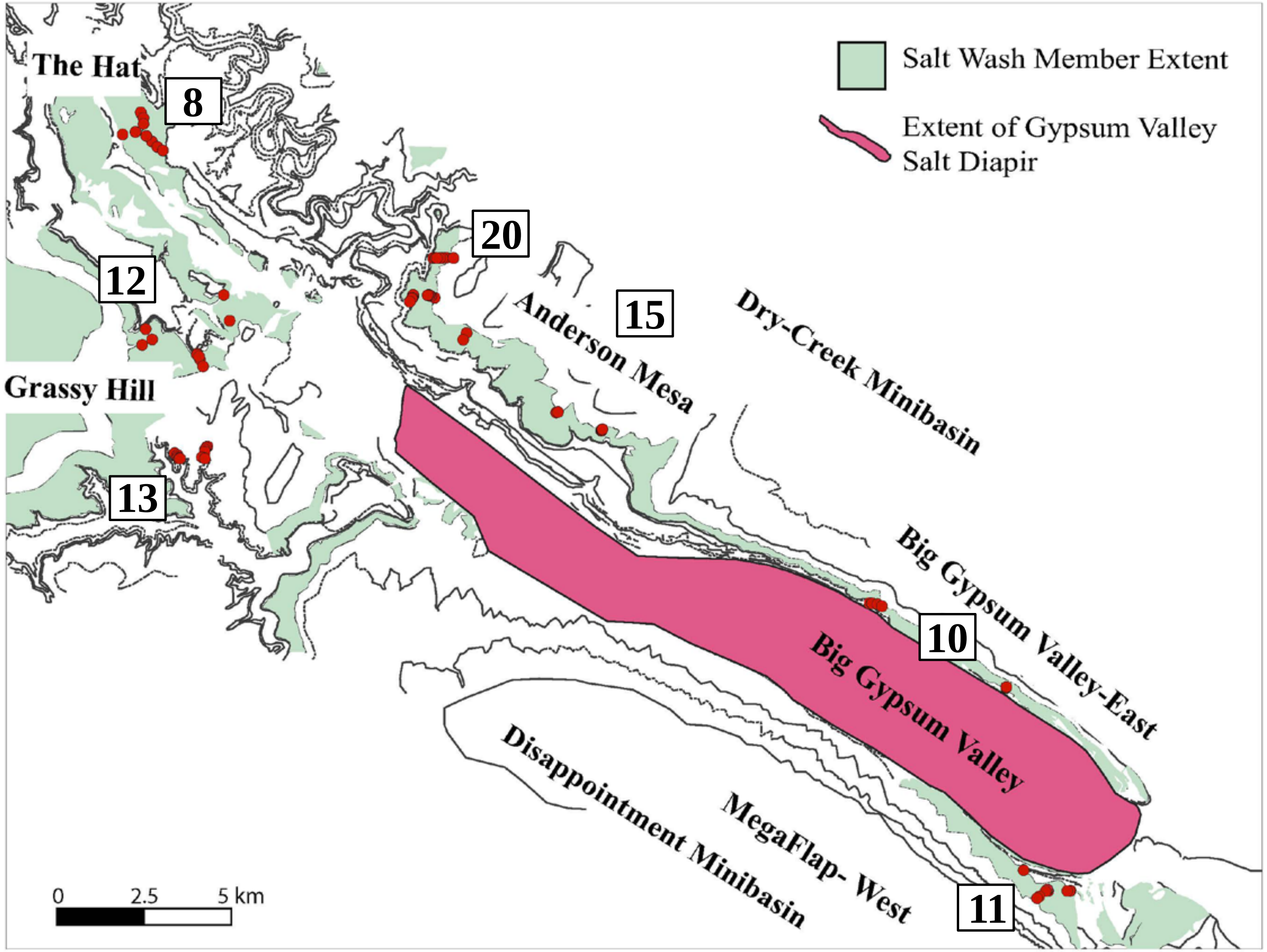


METHODS

- Field Methods
  - Samples collected along **24** stratigraphic sections on top of, along the margins, and away from the diapir
- Petrographic Analysis
  - Samples stained for calcite, ferroan calcite, ferroan dolomite, and feldspar
  - Blue epoxy for porosity
  - Point count analysis- 300 pts/slide
    - Diagenetic cement types identified
    - Changes in Porosity
  - Paragenetic history interpreted for each group of samples

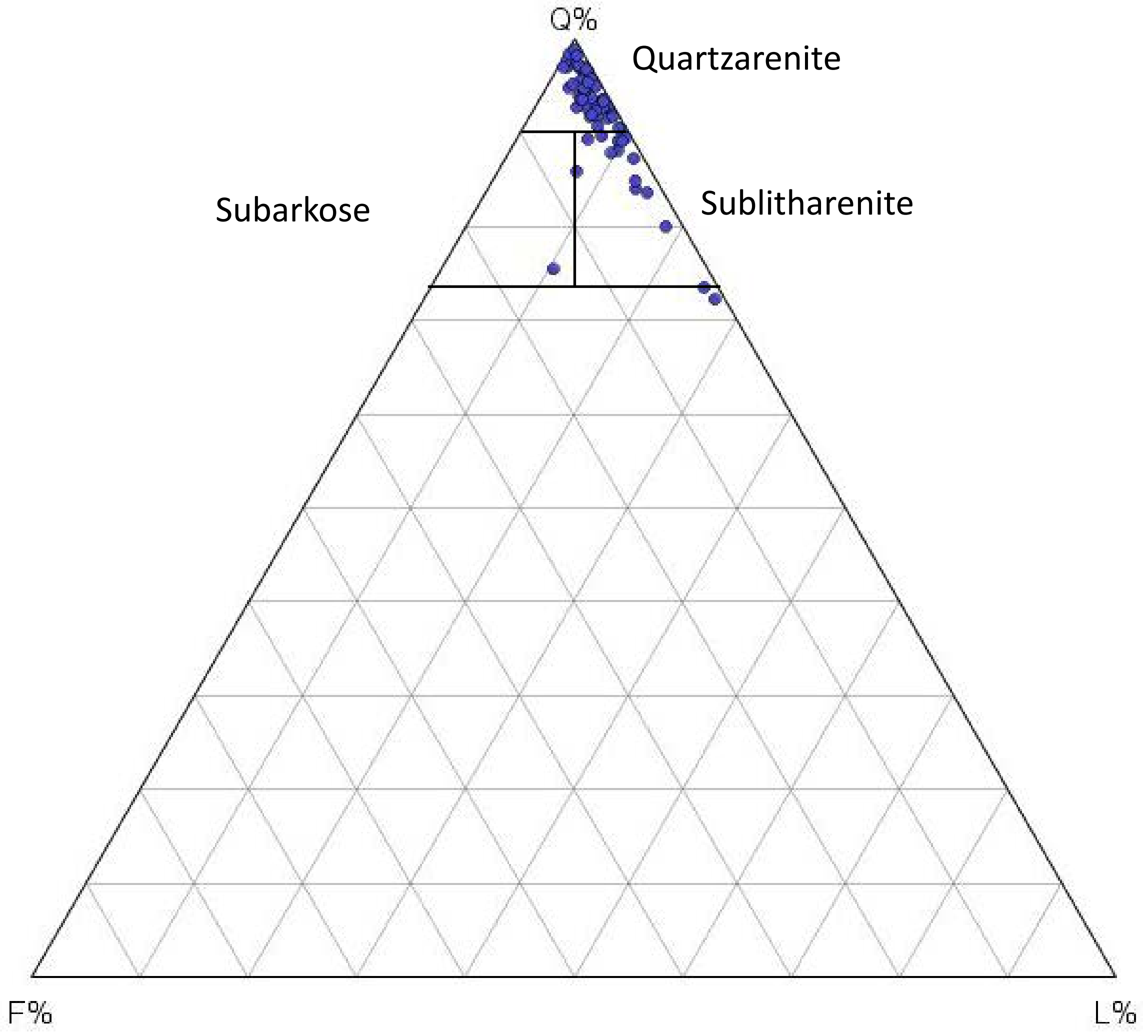


SAMPLE LOCATIONS



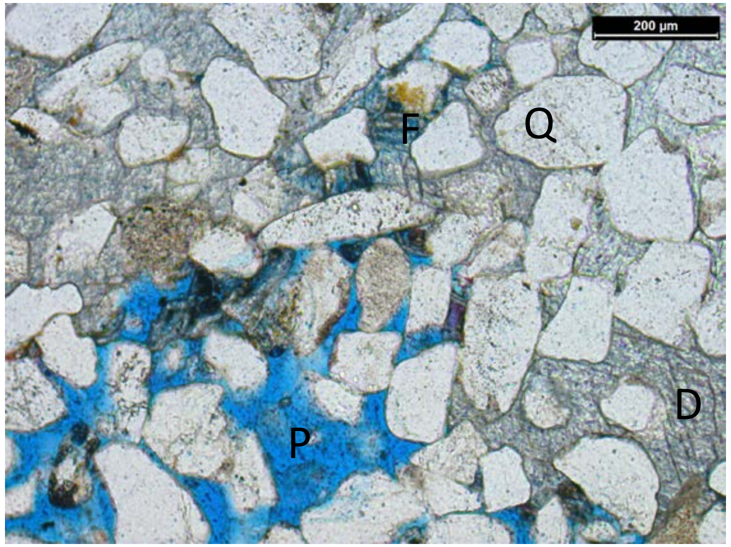
WHAT DO THE ROCKS LOOK LIKE?

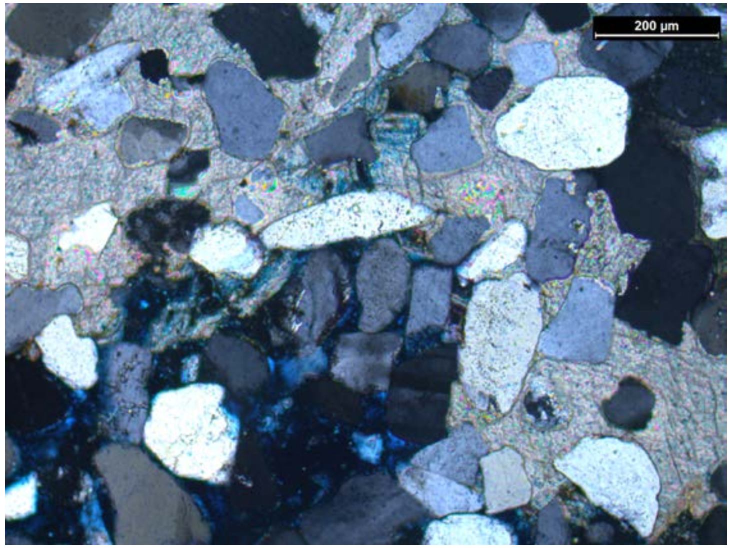
- Samples are dominantly quartzarenite.
  - 85-97% quartz
  - Medium sized grains
  - Well to moderately sorted
  - Low-high compaction



PARAGENESIS

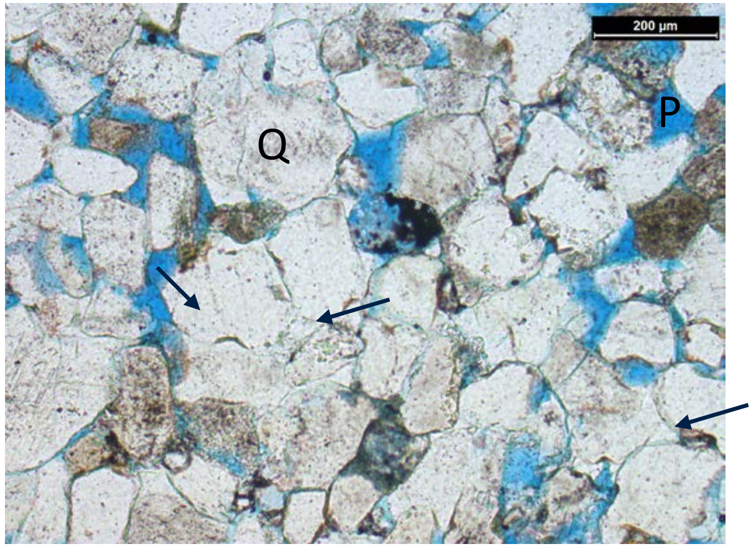
1. Early Ferroan Dolomite Cements

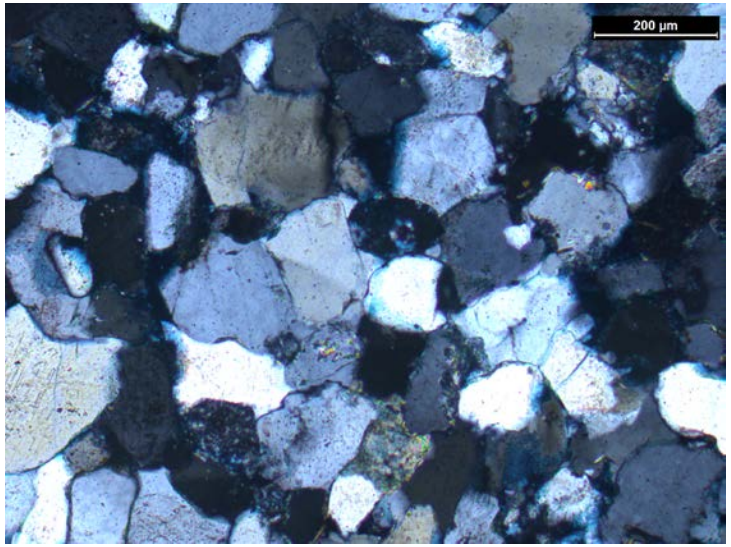




PARAGENESIS

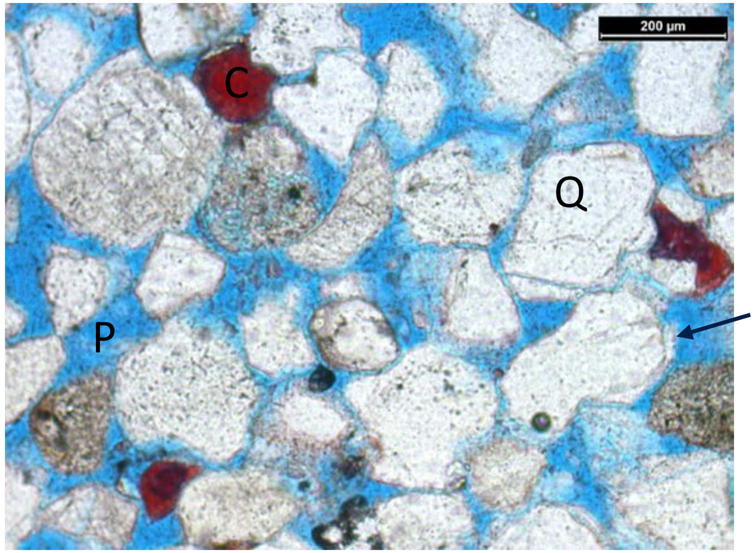
1. Early Ferroan Dolomite Cements
2. Quartz Overgrowths
3. Compaction

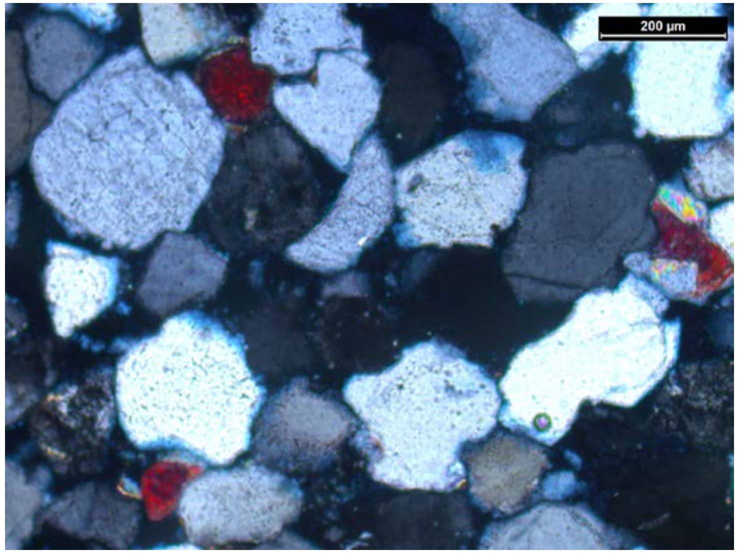




PARAGENESIS

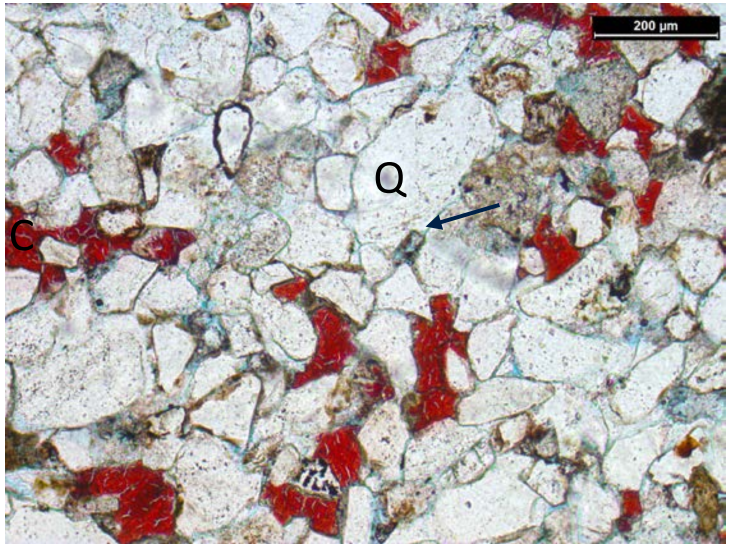
1. Early Ferroan Dolomite Cements
2. Quartz Overgrowths
3. Compaction
4. Dissolution of grains forming secondary porosity and enlarged pores.

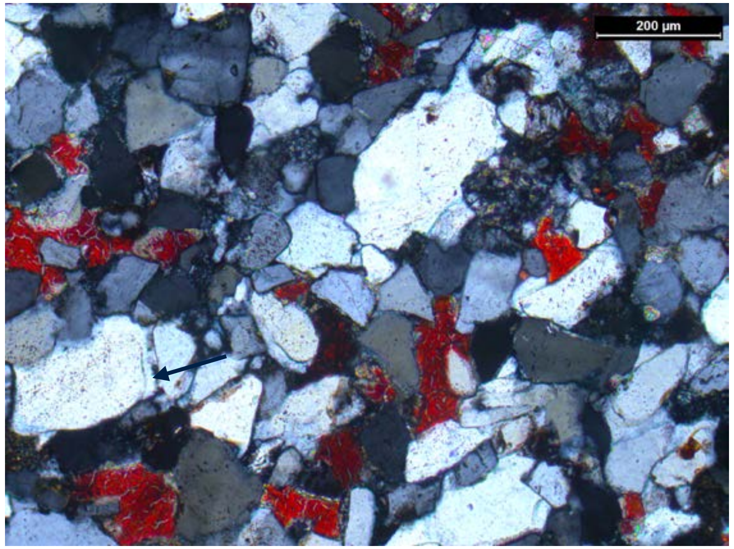




PARAGENESIS

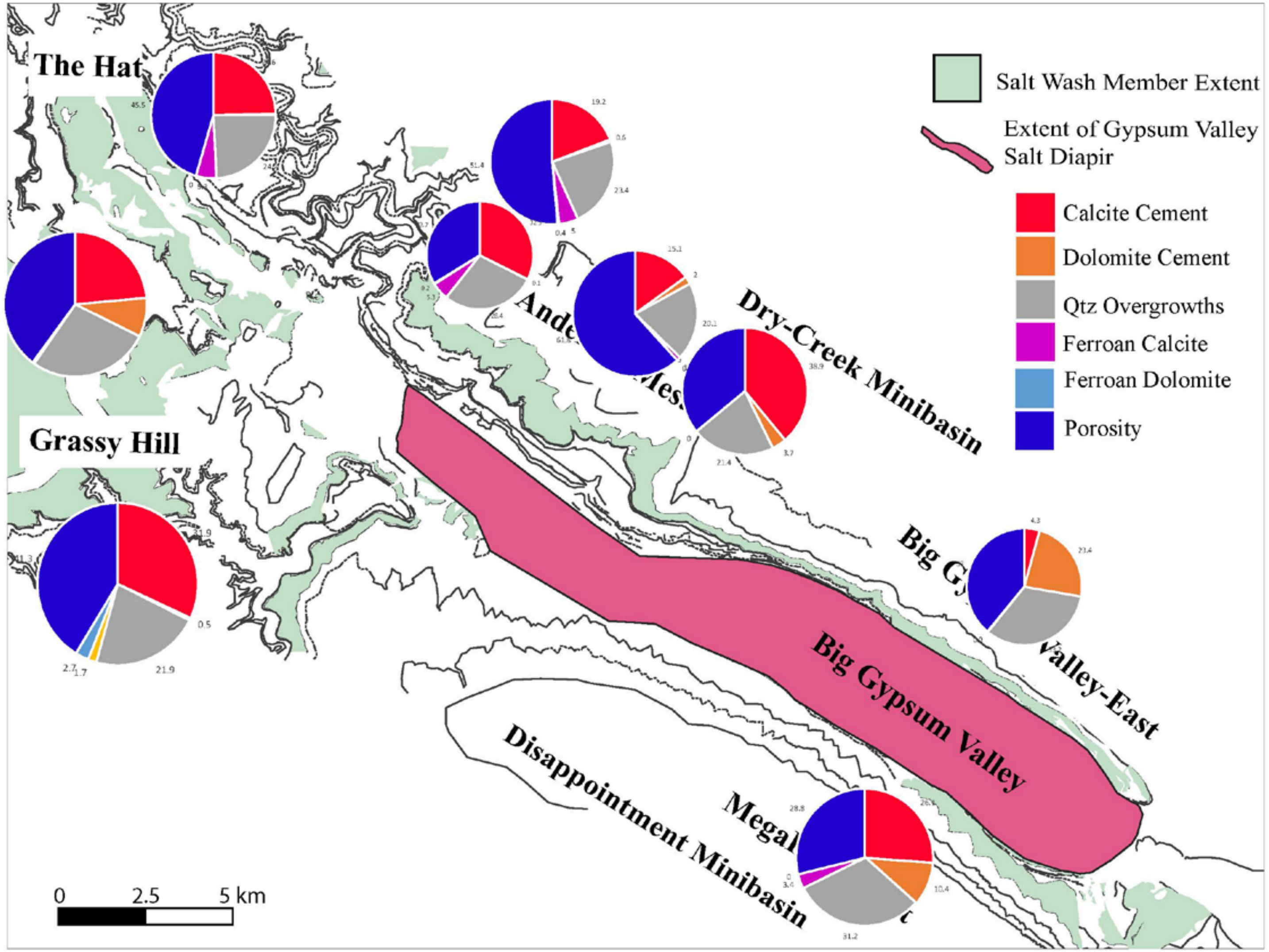
1. Early Ferroan Dolomite Cements
2. Quartz Overgrowths
3. Compaction
4. Dissolution of grains forming secondary porosity and enlarged pores.
5. Precipitation of calcite that fills secondary pores and fills grains.





DISTRIBUTION OF CEMENTS AND POROSITY

- Little Gypsum Valley
  - Porosity: 34-62%
  - Calcite cements: 19-39%
  - Quartz Overgrowths: 20-40%
  - Low amounts of dolomite cements
- Big Gypsum Valley
  - Porosity: 28-39%
  - Calcite cements: 5-26%
  - Quartz Overgrowths: 33%
  - Dolomite cements: 10-23%



CONCLUSIONS

- Described a paragenetic sequence for the Salt Wash Member of the Morrison Formation throughout Gypsum Valley
  - Identified early ferroan dolomite cements, quartz overgrowths, and late calcite cements.
  - Porosity is high in all samples.
- Samples in Little Gypsum Valley are similar in percentages of cements and porosity
- Ferroan dolomite cements in Big Gypsum Valley
  - Structures that go to the deep part of the basin.
  - Little Gypsum Valley has thick older units underlying the Salt Wash Member.

ACKNOWLEDGEMENTS

- Geological Society of America Research Grant
- ExxonMobil Research Grant
- AAPG Southwest Section Research Scholarship
- SIPES Foundation Earth Science Scholarship
- West Texas Geological Society Scholarship
- ExxonMobil Tech Scholarship

- **Salt Sediment Interaction Research Consortium**

ExxonMobil, BHP, Total, ConocoPhillips, Hess, Repsol, bp, Chevron, PGS, Kosmos Energy

- **Field Assistants**
  - Nathan Beck
  - Samantha Ramirez
  - Elizabeth Heness
  - Itza Fong
  - Keith Barnes
  - Raphael Delfin

QUESTIONS???