STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

APPLICATIONS OF GOODNIGHT MIDSTREAM PERMIAN, LLC FOR APPROVAL OF A SALTWATER DISPOSAL WELL, LEA COUNTY, NEW MEXICO.

CASE NO. 23614-23617

MOTION TO COMPEL PRODUCTION OF DOCUMENTS

Goodnight Midstream Permian, LLC ("Goodnight Midstream") respectfully files this motion to compel Empire New Mexico, LLC ("Empire") to produce all material documents, including electronic records, in its possession or control responsive to Request Nos. 1 through 7 under a Subpoena issued on September 22, 2023. In support of this motion Goodnight Midstream states:

INTRODUCTION

1. On September 22, 2023, the New Mexico Oil Conservation Division Director issued a Subpoena (the "Subpoena"), attached as **Exhibit A**, to Empire for the production of documents within 15 days of service.

2. While Goodnight Midstream seeks to compel production of responsive documents under all requests in the Subpoena, it is particularly interested in the information sought under Request Nos. 1, 6, and 7. Request No. 1 seeks documents reflecting the presence or absence of hydrocarbons in the San Andres aquifer—the formation Goodnight Midstream is targeting for its proposed injection and the formation Empire claims contains an economic residual oil zone. Request No. 6 requests documents and information reflecting potential communication between the proposed injection interval in the San Andres and the overlying Grayburg formation. *See*

Exhibit A. Request No. 7 asks for documents reflecting Empire's geologic pick for the top of the San Andres aquifer.

3. These requests go to the heart of the contested issues in these cases and Empire's objections to Goodnight Midstream's proposed injection. *See* Empire's Motion to Stay Issuance of Order, filed Aug. 25, 2023, in Case No. 22626.

4. As outlined below, Empire withheld responsive documents and information from its production to Goodnight Midstream on these key issues that Empire now relies on its testimony and exhibits. In some instances, Empire's witnesses either provide the data or attach documents that should have been produced. In other instances, Empire's witnesses simply state that certain information is "documented," "identified," or "confirmed," without providing the data or information to substantiate the claims. Attached as **Exhibit B** is a non-exhaustive breakdown of the information referenced, cited to, or relied on by Empire's experts that are responsive to the Subpoena and should have been produced.

5. Because Empire did not produce all documents and data it relies on to support its testimony and exhibits, it is not possible to confirm what adverse information or data it may have withheld from production. Empire is the operator of the EMSU. It controls the information relevant to this inquiry, which includes the entire history of the EMSU, but has refused to produce responsive documents and data—especially information adverse to their claims.[1] *See* Resp. to Subpoena in Case No. 22626, attached as **Exhibit C**.

[1] Empire has testified that it has historical EMSU documents and records in its possession and control. In his testimony on September 15, 2022, Empire's former Chief Operations Officer Eugene Sweeney stated that Empire has "physical files out at location" and "some files . . . [it received] electronically," from XTO, its predecessor-in-interest, in addition to any files Empire may have created itself. *See* Case No. 22626, Hrg. Tr. 225:12-19.

6. To give Goodnight Midstream a fair opportunity to evaluate Empire's claims and ensure a contested hearing results in a reasonable approximation of the objective truth, Empire must be compelled to produce all responsive documents—not just the documents and data that favor its position. Accordingly, an order to compel is necessary to preserve the integrity of the Division's adjudicatory proceedings and its statutory authority to require production of data and documents through its subpoena power. *See* § 70-2-8 NMSA ("No person shall be excused . . . from producing books, papers and records before the commission or the division, or from obedience to the subpoena[.]").

BACKGROUND

7. Goodnight Midstream served the Subpoena on Empire's counsel on September 22, 2023, making the deadline to produce responsive documents October 9, 2023. Goodnight Midstream granted Empire a one-week extension until October 16, 2023; however, Empire did not use the full extension. It served its response and documents on October 10, 2023.

Request Nos. 1 & 6

8. In its response, Empire raised broad objections to the requested discovery, asserting that Request Nos. 1 through 6 "seek[] information that is protected by the attorney-client privilege, the attorney work-product doctrine, and exemptions afforded consulting experts." *See* Empire Response to Goodnight Subpoena attached as **Exhibit D** (emphasis added). Empire stated that "Goodnight seeks information currently being formulated by Empire's expert witnesses and consultants in coordination with Empire's attorneys for the hearing of the instant cases." *Id.* (emphasis added).

9. Subject to its objections, Empire produced seven documents it claimed were responsive to Request Nos. 1 and 6. *See id.*[2] The responsive documents are identified in an Index of Produced Documents that Empire prepared and served with its production, attached as **Exhibit E**.

10. The only document prepared or created by Empire itself is document "1a" on the index, titled "Maps_EMSU Oil Bubble Map and MITs v. 2." *See id.* It calls out seven producing wells in the EMSU—the EMSU-200H, EMSU-214, EMSU-624, EMSU-294, EMSU-325, and the EMSU-319—and includes summary information on their production histories. None of these wells are completed in or produce from the San Andres aquifer. The information included in this document is not responsive to Request No. 1 or 6. In fact, Empire does not cite or reference these wells or any of the information included in this document anywhere in its exhibits or testimony.

11. Document "1b" addresses a residual oil zone development in Lithuania and has nothing to do with any of the information requested in the Subpoena. It is not responsive.

12. Document "1c" is an engineering paper addressing factors for evaluating potential residual oil zone developments based on a project in West Texas. It provides no direct information bearing on Request No. 1 or 6. It is not responsive.

13. Document "1d" is a presentation by Dr. Bob Trentham on evaluating residual oil zone developments within the Permian Basin, including in New Mexico. His slide presentation includes figures and information attributed to Steve Melzer and Robert Lindsay, who are both testifying experts for Empire in these cases. Two of the slides—out of 59—address the EMSU and include unsupported statements from Messrs. Melzer and Lindsay that there are oil shows in cores within the San Andres and that there is a residual oil zone within the upper portion of the San

[2] Empire's response states that it "submits the documents in the attached Index of Produced Documents" in response to Request Nos. 1 and 6. *See* Exhibit C.

Andres. *See* pages 23-24 of "1d) ROZ Long Term EOR in Permian Basin & Elsewhere," attached as **Exhibit F**. These slides and the information in them are not new, but the assertions are unsupported and contradicted by Goodnight Midstream's data. Goodnight Midstream therefore requested data and information that the slides in this presentation suggest exist and on which Messrs. Melzer and Lindsay rely. However, the underlying supporting information was not produced.

14. Document "1e" is a slide presentation by Mr. Melzer that explains what residual oil zones are and generally discusses where active ROZ developments are located in the Permian Basin but contains no specific information regarding the San Andres aquifer in the EMSU. It is not responsive to Request No. 1 or 6.

15. Document "1f" is a paper prepared by Mr. Melzer reviewing the histories of several residual oil zone developments in Texas. This paper is not responsive to Request No. 1 or 6.

16. Document "1g" is a presentation by Dr. Trentham that addresses two specific ROZ projects in Texas. It contains no specific information regarding the San Andres aquifer in the EMSU. It is not responsive to Request No. 1 or 6.

Request Nos. 2, 3, & 4

17. In response to Request Nos. 2, 3, and 4, which seek information regarding Empire's plans to evaluate the San Andres aquifer for potential hydrocarbon development and analyses on potential impacts from Goodnight Midstream's proposed injection, Empire offered the same blanket objections. *See* Exhibit C. But Empire also asserts that any "written plans" referred to by Empire's prior Chief Operations Officer in testimony "was contained in [his] testimony in OCD Case No. 22626." *See* Exhibit C. But that response is directly contrary to the testimony of Empire's former Chief Operations Officer, Eugene Sweeney, that Empire has a written plan and that "I'm

not sure that I would even want to share that and I – that I would have to." Case No. 22626, Hrg. Tr. 232:21-22. Rather than deny the existence of a written plan, Mr. Sweeney confirmed Empire had such a plan but asserted that he did not have to produce it. In light of Mr. Sweeney's testimony and for the reasons stated below, Empire should be compelled to produce its written plan in response to Request No. 4 and its analyses responsive to Request Nos. 2 and 3.

Request No. 7

18. As to Request No. 7, Empire produced two Division orders related to the EMSU. However, neither order is responsive to the request. Request No. 7 asks for documents and information reflecting Empire's geologic pick for the top of the San Andres formation within the EMSU. In response, Empire states that the "vertical limits of the Eunice Monument South Pool are defined in" the orders referenced. *See* Exhibit C. But the request does not ask for the vertical limits of the pool; it asks for documents reflecting Empire's geologic pick for the top of the San Andres. The orders are not responsive.

19. While contending the documents produced are responsive, none of the documents appear to be cited by Empire's witnesses in the testimony submitted on October 26, 2023. Instead, Empire's witnesses relied on information and data cited in their testimony and exhibits that were not produced to Goodnight Midstream that are plainly responsive, not protected by attorney-client privilege or work-product immunity, and do not fall under exemptions applicable to "consulting experts." As demonstrated below and in the attached summary in Exhibit B, Empire should be compelled to produce all documents, information, and communications responsive to Request Nos. 1-7.

ARGUMENT

20. "[S]ubject to" the Division's subpoena powers, the hearing examiner "shall afford full opportunity to the parties at an adjudicatory hearing . . . to present evidence and to cross examine witnesses." 19.15.4.17.A NMAC (emphasis added). The rules of evidence do not control but serve as guidance. *Id.*

21. Under 19.15.4.16.A NMAC, the Division has authority to issue subpoenas to produce "books, papers, records, other tangible things or electronic data in a proceeding" before the Division. *See also* § 70-2-8 NMSA.

22. The subpoena power is necessary to afford parties to an adjudicatory hearing a full opportunity to present evidence and cross examine witnesses. Accordingly, the Division's rules governing presentation of evidence at hearings is subject to the requirement for all parties to obey the production requirements of a subpoena. This requirement is of critical importance.

23. Rules governing discovery "are designed to enable parties to easily discover all of the relevant facts and therefore the discovery provisions should be given as liberal an interpretation as possible in order to effectuate this design." *Carter v. Burn Constr. Co.*, 1973-NMCA-156, ¶ 10, 508 P.2d 1324 (emphasis added). Accordingly, only limited exceptions apply to prevent production of relevant information. Here, Empire objected on three grounds, none of which shield discovery.

24. First, Empire objected that the "information" sought is protected by the attorney-client privilege. However, the privilege applies only "to protect communications—not facts." *State ex rel. State Highway Comm'n v. Steinkraus,* 1966-NMSC-134, ¶ 4, 417 P.2d 431. The attorney-client privilege does not preclude discovery of facts, data, and information sought in the Subpoena. The information should have been produced.

25. Second, Empire objected that the information sought is protected against disclosure under work-product immunity. That doctrine shields some information from disclosure, particularly the mental impressions, conclusions, opinions or legal theories of an attorney or party representative concerning a litigated matter. *See Santa Fe Pac. Gold Corp. v. United Nuclear Corp.*, 2007-NMCA-133, ¶ 38, 175 P.3d 309 ("The work-product rule is an immunity that protects documents and tangible things prepared in anticipation of litigation by or for a party or its representative, including materials prepared by the attorney's agents and consultants."). However, it does not prevent disclosure of the "substance of the facts and opinions" to which an expert will testify, which are subject to discovery through production requests. *See* Rule 1-026(B)(6) NMRA.

26. Empire has presented the testimony of seven different expert witnesses. The substance of the facts, information, and opinions of testifying experts are not protected against discovery through the Division's Subpoena. Rule 1-026(B)(6) NMRA. Under New Mexico law, "the conclusions of an expert are as much evidence as are his observations." *State ex rel. State Highway Comm'n v. Steinkraus*, 1966-NMSC-134, ¶ 4, 417 P.2d 431. Similarly, communications, information, data, and facts provided to testifying experts are discoverable and also should have been produced. *Santa Fe Pac. Gold Corp. v. United Nuclear Corp.*, 2007-NMCA-133, ¶ 55, 175 P.3d 309.

27. Third, Empire objected that the information sought is information that was "being formulated by Empire's expert witnesses and consultants in coordination with Empire's attorneys for the hearing of the instant cases." *See* Exhibit C (emphasis added). But the mere fact that an attorney may have been involved does not shield the opinions or the facts and information relied on by testifying experts from being produced in discovery. Rule 1-026(B)(6) NMRA; *Santa Fe Pac. Gold Corp.*, 2007-NMCA-133, ¶ 55.

28. Instead of producing the information relied on, cited by, or provided to its experts, Empire withheld that information from Goodnight Midstream only to rely on it in its testimony and exhibits presented to the Division. This has severely prejudiced Goodnight Midstream by preventing it from having a full opportunity to present evidence and cross-examine Empire's witnesses at hearing. It also substantially impairs the Division's ability to discern the truth and undermines the integrity of the Division's adjudicatory proceedings.

29. Empire should be required to produce all material responsive documents, including electronic records, or confirm in a sworn statement submitted to the Division that it has produced all such records or that the requested records do not exist.

CONCLUSION

For the foregoing reasons, Goodnight Midstream respectfully requests this Motion be granted.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that on October 30, 2023, I served a copy of the foregoing document to the following counsel of record via Electronic Mail to:

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Attorneys for Empire New Mexico, LLC

/s/ Adam G. Rankin
Adam G. Rankin

EXHIBIT A

STATE OF NEW MEXICO
DEPARTMENT OF ENERGY, MINERALS AND NATURAL RESOURCES
OIL CONSERVATION DIVISION

APPLICATIONS OF GOODNIGHT MIDSTREAM PERMIAN, LLC FOR APPROVAL OF A SALTWATER DISPOSAL WELL, LEA COUNTY, NEW MEXICO

CASE NOS. 23614-23617

SUBPOENA

To: Empire New Mexico, LLC
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YOU ARE HEREBY COMMANDED pursuant to NMSA 1978, §70-2-8 and Rule 19.15.4.16.A NMAC to produce the following documents at the offices of Holland & Hart LLC, 110 North Guadalupe, Santa Fe, New Mexico, 87501, within fifteen (15) days of service of this subpoena:

1. Documents, communications, correspondence, emails, data, analyses, reports, and summaries, including but not limited to internal and external correspondence, memoranda, and assessments, that address, reflect on, or concern the existence or non-existence of hydrocarbons in the San Andres formation within the Eunice Monument South Unit.

2. A copy of the analysis, including all drafts, identified in Paragraph 4 of Empire's Motion to Stay Issuance of Order, filed with the Division in Case Nos. 223614-23617.

3. Documents, communications, correspondence, emails, data, and summaries, including but not limited to internal and external correspondence and memoranda, that address, reflect on, or concern the analysis identified in Paragraph 4 of Empire's Motion to Stay Issuance of Order, filed with the Division in Case Nos. 223614-23617 on August 25th, 2023.

4. A copy of Empire's written plan, including all drafts, to evaluate the San Andres formation for production of hydrocarbons identified by Eugene Sweeney in Case No. 22626 at the hearing on September 15, 2023. *See* Tr. 238:18-22.

5. Documents, communications, correspondence, emails, data, and summaries, including but not limited to internal and external correspondence and memoranda, that address, reflect on, or concern Empire's plan to evaluate the San Andres formation for production of hydrocarbons identified by Eugene Sweeney in Case No. 22626 at the hearing on September 15, 2023. *See* Tr. 238:18-22.

6. Documents, communications, correspondence, emails, data, analyses, reports, and summaries, including but not limited to internal and external correspondence, memoranda, and assessments, that address, reflect on, or concern evidence that there is communication between the proposed injection intervals in Case Nos. 23614-23617 and the overlying Grayburg formation, including core analyses.

7. Documents, communications, correspondence, emails, reports, and summaries identifying Empire's geologic pick for the top of the San Andres formation within the Eunice Monument South Unit, including references to the measured depth and/or subsea depth for the top of the San Andres formation.

This subpoena is issued on application of Goodnight Midstream Permian, LLC through its attorney, Adam G. Rankin of Holland & Hart LLP.

Dated this 22nd day of September 2023.

NEW MEXICO OIL CONSERVATION DIVISION

BY: _____

Date: 9/22/2023

EXHIBIT B

BREAKDOWN OF RESPONSIVE INFORMATION AND DATA RELIED ON AND REFERENCED BY EMPIRE'S WITNESSES AND EXHIBITS THAT WERE RESPONSIVE BUT NOT PRODUCED

Request No. 1: Documents, communications, correspondence, emails, data, analyses, reports, and summaries, including but not limited to internal and external correspondence, memoranda, and assessments, that address, reflect on, or concern the existence or non-existence of hydrocarbons in the San Andres formation within the Eunice Monument South Unit.

Ex. B – Robert F. Lindsay Statement

- Mr. Lindsay's full reports and complete papers that are used, referenced, or relied on in his testimony and exhibits, including underlying data, logs, cores, and supporting information are responsive and but were never produced.

- Para. A.6 at page 236 of 369: Testimony states that the San Andres contains an ROZ.

    - Testimony states that there is data showing oil saturated porosity down section to depths of -719 feet subsea to potentially -750 subsea.

    - The underlying data supporting these statements is responsive but was never produced.

- Para. A.1 pages 246-248 of 369: R.R. Bell #4, EMSU-649 and EMSU-679:

    - Testimony references cores within the San Andres showing porosity and oil staining, a core analysis showing porosity and oil saturation, and data showing there is an oil-water contact in the San Andres ROZ at -719 subsea and potentially -750 subsea.

        - The information and data supporting these statements, including core analyses, relied on by Mr. Lindsay are responsive but were not produced.

        - Figures B16-B20 include geologic picks for the San Andres top that are responsive to Request No. 7 but were not produced.

- Pages 249 of 369: Core analysis for R.R. Bell #4

    - Testimony and Figures B20-B21 show oil saturation at depths that are alleged to be in the San Andres, but were not produced.

    - The core analysis for the R.R. Bell #4 is responsive and should have been produced but was withheld.

- All core reports and analyses below Empire's pick for the top of the San Andres are responsive and should be produced.

Ex. E – Galen Dillewyn

- Para. 2 at page 294 of 369: Previous NUTECH log analyses.
  - Testimony states that NUTECH previously prepared 8 calculated well logs for XTO as the previous operator of the field.
  - These calculated logs and any related information explaining the parameters used to conduct the petrophysical analysis are responsive and should have been produced but were not.

Ex. D – Nicholas Cestari

- Para. 9 at page 310 of 369 and Ex. F-3 at page 319 of 369: Interpreted well logs.
  - Testimony states that there are 9 legacy interpreted logs done by NUTECH and of those 7 covered some portion of the San Andres within the EMSU (4 logs were recently evaluated using 2005 vintage OH triple combo logs).
  - Apparently, at least 5 well log interpretations were done previously by NUTECH; These logs are responsive and should have been produced.
- Para. 11 at page 311 of 369 and F-4 at page 329 of 369: Mudlogs on EMSU-660
  - Testimony states that a mudlog that was run on EMSU-660 during drilling indicates the presence of hydrocarbons in the San Andres.
    - This mudlog is responsive and should have been produced along with all other mudlogs purporting to include Empire's geologic pick for the San Andres.
  - F-4 at page 329 of 369 – Exhibit states that "multiple mudlogs were run at the EMSU all showing indications of a Residual Oil Zone in the San Andres."
    - All mudlogs purported to be completed within the Empire's pick for the San Andres should have been produced in response to this request.
- Para. 12 at page 311of 369 and Ex. F-5 at page 330 of 369: Testimony and exhibit addresses a geochemical analysis of EMSU-679 showing a ratio of immobile to mobile oil.
  - The geochemical analysis and facts that support it are responsive and should have been produced along with any other similar analyses that show adverse results.

Ex. G – William West

- Page 335 of 369: Testimony and exhibit include an internal XTO well file document for the EMSU-660 alleging to show San Andres production.
    - This document and the entire internal well file for the EMSU-660 is responsive and should have been produced—along with any other internal well files that purport to show completions and production history within Empire's geologic pick for the San Andres aquifer.
- Page 337 of 369: Testimony states that the following facts have been documented:
    - Testimony states that there is an increase in sulfur content of EMSU produced water showing that there is communication between the Grayburg and San Andres formations through fractures.
        - All data and information regarding sulfur content of EMSU produced water over time is responsive and should be produced but was not.
    - Data shows a pressure drop in the San Andres interval which occurred before water supply well production commenced from the San Andres for waterflood operations.
        - All data and information regarding downhole pressure measurements associated with wells purported to be completed within Empire's geologic pick for the San Andres aquifer are responsive and should be produced.

Request No. 6: Documents, communications, correspondence, emails, data, analyses, reports, and summaries, including but not limited to internal and external correspondence, memoranda, and assessments, that address, reflect on, or concern evidence that there is communication between the proposed injection intervals in Case Nos. 23614-23617 and the overlying Grayburg formation, including core analyses.

Ex. B – Robert F. Lindsay Statement

- Para. B.7 page 240 of 369: Testimony references an EMSU-679 fracture study.
    - The complete fracture study was responsive and should have been produced.
- Para. B.7 page 240 of 369: Testimony references water chemistry studies that verify plumes of water were sourced from underlying San Andres aquifer.
    - The complete water chemistry studies are responsive and should have been produced.

- Para. B.8 page 240 of 369: Testimony references "additional work" that was done confirming that there are three types of water within the EMSU.
    - The data and information reflecting this "additional work" is responsive and should have been produced.
- Para. C.3 page 253 of 369: Testimony references that "it has been documented that San Andres… water enriched in sulfate, is in communication with Grayburg reservoir strata through fractures in the crest of the structure[,]" allowing San Andres water to communicate, and that these plumes have been identified through water chemistry.
    - The underlying reports, data, analyses, and documents supporting these statements are responsive and should have been produced.

Ex. D – Nicholas Cestari

- Para. 14 page 312 of 369 and Ex. F6 at page 331 of 369: Testimony references "extensive work done both in outcrop and in core that shows the presence of dissolution features and fractures near the top San Andres."
    - The reports, data, analyses, and documents supporting these statements are responsive and should have been produced.

Ex. G – William West

- Para. A.6 page 337 of 369; Exs. G-3 page 351 of 369 & G-4 page 352 of 369:
    - Testimony and exhibits address an open-hole Repeat Formation Test that was taken on April 8, 1986, in EMSU-211 prior to the start of injection showing depths for pressure measurements that supports Empire's position.
        - *See also* Para. B22 page 340 of 369.
    - The reports, data, analyses regarding this Repeat Formation Test in EMSU-211 and any other wells are responsive and should have been produced.
- Para. A.8 page 337 of 369; Ex. G-5 page 353 of 369; Testimony states that differences in water production before water flood commences is an indication of communication between the Grayburg and San Andres, which is confirmed by the sulfur content of produced water increasing in the San Andres.
    - Empire's water chemistry and production data (gas, oil, water production) for the wells referenced in this testimony and exhibit are responsive and should have been produced.

- Para. A.10 page 337 of 369; Ex. G-7 Chevron's 1996 NACE Paper number 181, titled "Utilization of Geological Mapping Techniques to Track Scaling Tendencies in the EMSU Waterflood."
    - Testimony states that Chevron concludes San Andres water is finding its way into the wellbores and resulted in barium sulfate scale, barite, and deposition problems before injection of San Andres water into the Grayburg during waterflood.
        - This paper and related communications or analyses are responsive and should have been produced.
- Para. D.27 page 341 of 369: Testimony states that Empire has previously identified communication between the Graybrug and San Andres intervals.
    - Empire's analysis and facts and data supporting this conclusion are responsive and should have been produced.
- Para. F.30 page 342 of 369 – Testimony addresses a report showing some wells are experiencing high water production while surrounding wells are not and that Empire conducted an analysis concluding that "this phenomena is due to communication with the San Andres."
    - Empire's analysis and facts and data supporting this conclusion are responsive and should have been produced.

Request No. 7: Documents, communications, correspondence, emails, reports, and summaries identifying Empire's geologic pick for the top of the San Andres formation within the Eunice Monument South Unit, including references to the measured depth and/or subsea depth for the top of the San Andres formation.

Ex. G – William West

- Para. A.6 page 337 of 369; Exs. G-3 & G-4: Testimony and exhibits identify Empire's pick for the top of San Andres at 3975 feet measured depth in the EMSU-211 well and this depth equates to -399 subsea.
    - Empire's geologic picks for the top of the San Andres are responsive and should have been produced. Empire's exhibits and testimony include numerous references to different San Andres tops, e.g., Exhibits B16, B18, D3, D4, E2, F1-F4, F6, G4, G5. Any communications, documents, reports, analysis, identifying Empire's geologic pick for the top the San Andres should be produced.

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EXHIBIT C

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

APPLICATION OF GOODNIGHT MIDSTREAM PERMIAN, LLC FOR APPROVAL OF A SALTWATER DISPOSAL WELL, LEA COUNTY, NEW MEXICO **Case No. 22626**

RESPONSE TO SUBPOENA

Empire New Mexico, LLC, by and through their counsel of record, hereby responds to the Subpoena as amended by the Order issued by the Division on July 26, 2022 as follows:

1. The Subpoena requests:

   All (1)documents, (2)communications, (3)correspondence, (4)emails, (5)data, (5)analyses, (5)reports, and (5)summaries, including but not limited to internal and external correspondence, memoranda, and assessments, that address, reflect on, or concern the existence or non-existence of hydrocarbons in the San Andres formation within the Eunice Monument South Unit.

2. Response as to the enumerated requests:

   1) Documents: there are no documents specific to the area of review.
   2) Communications: there are no documents specific to the area of review other than communications contained in the pleadings in this case or communications which are protected by the attorney client privilege.
   3) Correspondence: there are no documents specific to the area of review other than correspondence contained in the pleadings in this case or communications which are protected by the attorney client privilege.
   4) Emails: there are no documents specific to the area of review other than emails contained in the pleadings in this case or emails which are protected by the attorney client privilege.
   5) Data, Analyses, Reports: see data attached hereto:

a. Goodnight SWD San Andres- Eunice Monument South Unit 200H-Well Card Detail;
b. Proximity map of Goodnight SWD San Andres- Eunice Monument South Unit 200H-Well;
c. Goodnight SWD Application_EP Exhibit;
d. EMSU 200H Slide;
e. Empire Petroleum Corporation Announces Final Closing of the Operated New Mexico;
f. 2010GTWI_ROZ_Scienct to Exploitation (1) Chevron Presentation;
g. Residual_Oil_Zones_Mother_Natures_Water;
h. Significant San Andres play emerging amid ROZ fairways.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the forgoing was served to counsel of record by electronic mail this 24th day of August, 2022, as follows:

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Adam G. Rankin	agrankin@hollandhart.com
Julia Broggi	jbroggi@hollandhart.com

/s/ Ernest L. Padilla
Ernest L. Padilla

EXHIBIT D

STATE OF NEW MEXICO
DEPARTMENT OF ENERGY, MINERALS AND NATURAL RESOURCES
OIL CONSERVATION DIVISION

APPLICATIONS OF GOODNIGHT MIDSTREAM PERMIAN, LLC FOR APPROVAL OF A SALTWATER DISPOSAL WELL, LEA COUNTY, NEW MEXICO

CASE NOS. 23614-23617

RESPONSE TO GOODNIGHT SUBPOENA

For its response to the Goodnight Midstream Permian LLC subpoena to Empire New Mexico LLC (Empire) states:

1. Documents, communications, correspondence, emails, data, analyses, reports, and summaries, including but not limited to internal and external correspondence, memoranda, and assessments, that address, reflect on, or concern the existence or non-existence of hydrocarbons in the San Andres formation within the Eunice Monument South Unit.

RESPONSE:

Empire objects to this request because it seeks information that is protected by the attorney-client privilege, the attorney work-product doctrine, and exemptions afforded consulting experts. Goodnight seeks information currently being formulated by Empire's expert witnesses and consultants in coordination with Empire's attorneys for the hearing of the instant cases. Subject to that objection, in addition to the documents submitted by Eugene Sweeney in his testimony in Case 22626, Empire submits the documents in the attached Index of Produced Documents.

2. A copy of the analysis, including all drafts, identified in Paragraph 4 of Empire's Motion to Stay Issuance of Order, filed with the Division in Case Nos. 23614-23617.

RESPONSE:

Empire did not file a Motion to Stay Issuance of Order in Case Nos. 23614-23617. Empire did file such a Motion in Case No. 22626. To the extent that Goodnight seeks information regarding the Motion to Stay Issuance of Order filed by Empire in Case No. 22626, Empire objects to this request because it seeks information that is protected by the attorney-client privilege, the attorney work-product doctrine, and exemptions afforded consulting experts. Goodnight seeks information currently being formulated by Empire's expert witnesses and consultants in coordination with Empire's attorneys for the hearing of the instant cases.

Subject to that objection, Empire states that any intended plan or analysis that may have been formulated by Empire was contained in Eugene Sweeney's testimony in OCD Case 22626.

3. Documents, communications, correspondence, emails, data, and summaries, including but not limited to internal and external correspondence and memoranda, that address, reflect on, or concern the analysis identified in Paragraph 4 of Empire's Motion to Stay Issuance of Order, filed with the Division in Case Nos. 23614-23617 on August 25th, 2023.

RESPONSE:

Empire objects to this request because it seeks information that is protected by the attorney-client privilege, the attorney work-product doctrine, and exemptions afforded consulting experts. Goodnight seeks information currently being formulated by Empire's expert witnesses and consultants in coordination with Empire's attorneys for the hearing of the instant cases. Subject to that objection, please see response to Request No. 2.

4. A copy of Empire's written plan, including all drafts, to evaluate the San Andres formation for production of hydrocarbons identified by Eugene Sweeney in Case No. 22626 at the hearing on September 15, 2023. See Tr. 238:18-22.

RESPONSE:

See Responses to Requests Nos. 2 and 3.

5. Documents, communications, correspondence, emails, data, and summaries, including but not limited to internal and external correspondence and memoranda, that address, reflect on, or concern Empire's plan to evaluate the San Andres formation for production of hydrocarbons identified by Eugene Sweeney in Case No. 22626 at the hearing on September 15, 2023. See Tr. 238:18-22.

RESPONSE:

See responses to Request Nos. 2, 3, and 4.

6. Documents, communications, correspondence, emails, data, analyses, reports, and summaries, including but not limited to internal and external correspondence, memoranda, and assessments, that address, reflect on, or concern evidence that there is communication between the proposed injection intervals in Case Nos. 23614-23617 and the overlying Grayburg formation, including core analyses.

RESPONSE:

Empire objects to this request because it seeks information that is protected by the attorney-client privilege, the attorney work-product doctrine, and exemptions afforded consulting experts. Goodnight seeks information currently being formulated by Empire's expert witnesses and consultants in coordination with Empire's attorneys for the hearing of the instant cases. Subject to that objection, in addition to the documents submitted by Eugene Sweeney in his testimony in Case 22626, Empire submits the documents in the attached Index of Produced Documents.

7. Documents, communications, correspondence, emails, reports, and summaries identifying Empire's geologic pick for the top of the San Andres formation within the Eunice Monument South Unit, including references to the measured depth and/or subsea depth for the top of the San Andres formation.

RESPONSE:

See response to Request No. 6. The vertical limits of the Eunice Monument South Pool are defined in Oil Conservation Division Orders Nos. R-7767 and R-7767-A.

Respectfully submitted by:

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EXHIBIT E

INDEX OF PRODUCED DOCUMENTS
Goodnight Midstream Permian, LLC
Subpoena Responses from
Empire New Mexico, LLC
OCD Case Nos. 23614-23617

Response to Request Number 1

1a) Maps_EMSU Oil Bubble Map and MITs v. 2.;
1b) Exploiting the ROZ in Lithuania;
1c) ROZ determination for EOR in Means Field;
1d) ROZ Long Term EOR in Permian Basin & Elsewhere;
1e) ROZ testimony 2023;
1f) Stranded oil in the ROZ – Melzer2006;
1g) Two geological case histories of ROZ Permian Basin;

Response to Request Number 6 and 7

OCD Orders R-7767 and R-7767-A.

EXHIBIT F

"Residual Oil Zones: The Long Term Future of Enhanced Oil Recovery in the Permian Basin and Elsewhere".

5th Annual EORI CO2 Workshop, Casper Wyoming

Dr. Bob Trentham, University of Texas of the Permian Basin.

The 100 Billion Barrel Question

- For decades, when asked, geologists would say there were +/-100 BB OOIP in the Permian Basin and that we have produced roughly ~1/3 of that total.
- 75 MYA the answer to that question may have been 300 BB OOIP.
- Today, with our new understanding of the potential extent of, and oil saturation within, Residual Oil Zones (ROZ's) the answer lies somewhere between those numbers.
- How did we get here from there?
- Through Mother Nature's Waterflood.

Size of the Prize

Advanced Resources International, Inc.

56 fields in five major Permian Basin oil plays that have potential for significant TZ/ROZ resources were identified by Advanced Resources Intl.

TZ/ROZ OOIP in these 56 fields is estimated to be 30.7 Billion Barrels.

Field/Unit	MPZ OOIP (BB)	TZ/ROZ OOIP (BB)	No. of Fields	No. of MPZ Fields with CO2-EOR Projects	No. of Fields with TZ/ROZ CO_2-EOR Projects
1. Northern Shelf Permian Basin (San Andres)	13.0	13.2	13	5	1
2. North Central Basin Platform (San Andres/Grayburg)	2.9	2.6	6	2	1
3. South Central Basin Platform (San Andres/Grayburg)	9.9	7.9	16	5	0
4. Horseshoe Atoll (Canyon)	5.4	2.9	10	4	2
5. East New Mexico (San Andres)	2.3	4.1	11	2	0
Total	**33.5**	**30.7**	**56**	**18**	**4**

Koperna, et, al., 2006

Advanced Resources International, Inc.

Technically Recoverable Resources from the MPZ and ROZ

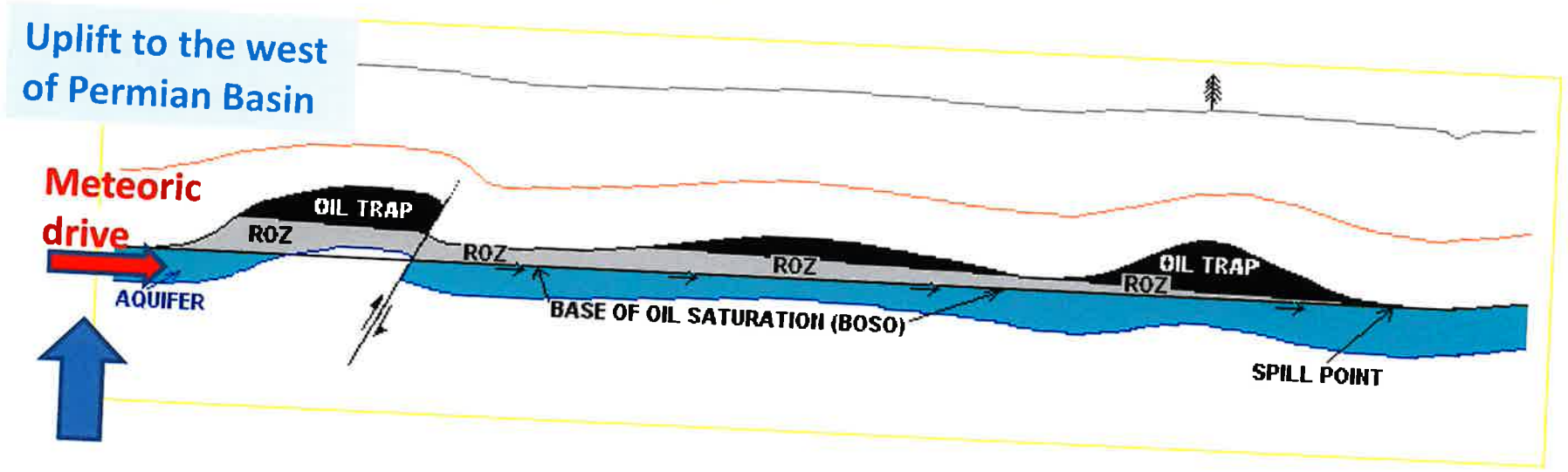
Based on reservoir modeling of applying CO_2-EOR to the TZ/ROZ resources, ARI estimates that there are 11.9 Billion BO is technically recoverable from the 30.7 Billion BO of TZ/ROZ oil in-place in these five Permian Basin oil plays.

Field/Unit	Total CO_2-EOR (BB)	MPZ CO_2-EOR (BB)	TZ/ROZ CO_2-EOR (BB)
1. Northern Shelf Permian Basin (San Andres)	8.3	2.8	5.5
2. North Central Basin Platform (San Andres/Grayburg)	1.5	0.6	0.9
3. South Central Basin Platform (San Andres/Grayburg)	4.6	1.7	2.9
4. Horseshoe Atoll (Canyon)	2.7	1.4	1.3
5. East New Mexico (San Andres)	1.7	0.4	1.3
Total	18.8	6.9	11.9

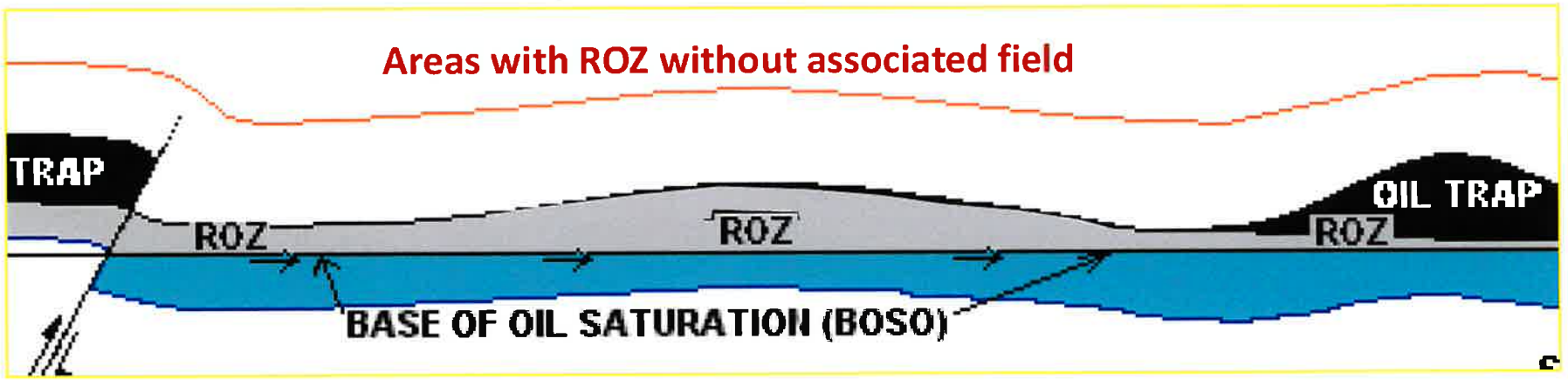
Koperna, et, al., 2006

Mother Nature's Waterflood

Changes in Hydrodynamic Conditions, Sweep of the lower part of the Oil Column, and Development of a Residual Oil Zone.



Dynamic System



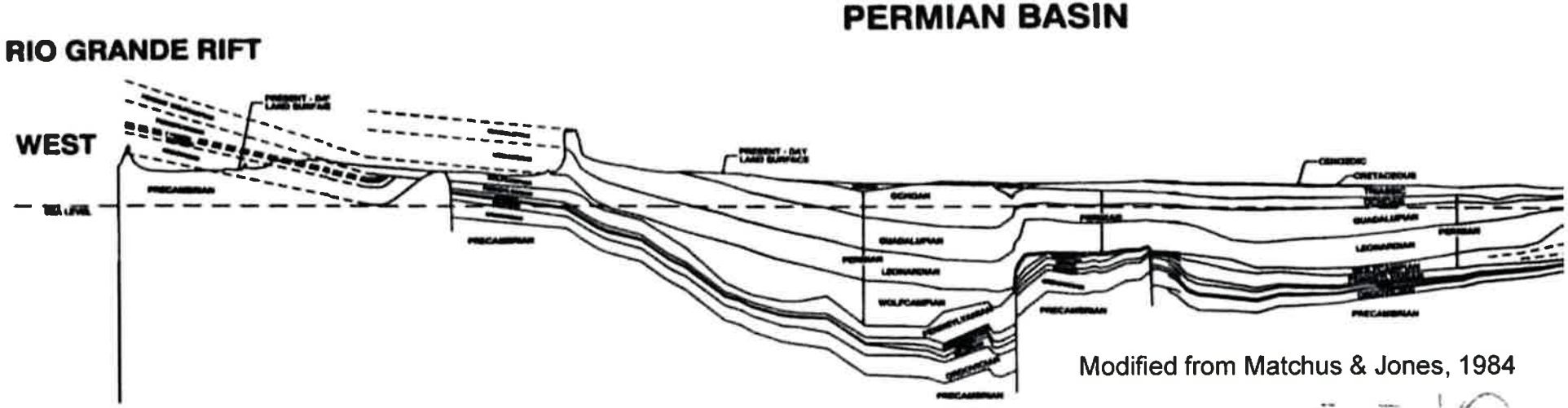
Timing of Post Permian Tectonic Overprint and Meteoric Flushing

Quat	Pliocene - Pleistocene - Holocene	-5 Ma to Present	Base level downcutting of ancestral Pecos River. At ~600 Ka Capitan Aquifer hydrologically connects with Pecos River at Carlsbad. Possible draining of lower Carlsbad and Lechuguilla Caverns.
Cenozoic	Late Miocene	-12 to -5 Ma	H2S ascends into Guadalupe Mtns from basin. Sulfuric acid caves develop from Se to NE, enlarge and cut across older thermal caves.
	Early Miocene	-25 to -12 Ma	Rio Grande Uplift accelerating. Maximum uplift of Guadalupe Mtns block begins (~20Ma). Delaware Basin geothermal gradient reaches 40-50°C/km. "Second" maturation and migration of hydrocarbons. H2S produced where hydrocarbons react with evaporites. Thermal caves developing. Dewatering Calcite spar fills basin and range fault zones.
	Oligocene	-40 to -25 Ma	Trans-Pecos Magmatic Province: Tertiary intrusives and extrusives to SW, dikes in Delaware Basin.. Transition from volcanic to Basin and Range in Delaware Basin Delaware Basin tilts eastward and heats up. "Second" maturation and migration of hydrocarbons. H2S produced where hydrocarbons react with Castile anhydrite. Begin Rio Grande Uplift in late Oligocene.
	Paleocene	-65 to -58 Ma	Laramide uplift continues into Early Tertiary. Older caves get enlarged and connected.
Meso	Cretaceous-Gulfian	-95 to -65 Ma	Late Cretaceous Laramide Orogeny begins. Guadalupe and Apache Mtns. Lifted 1000's of feet above sea level.
Paleo	Guadalupian	-255 to -251 Ma	Seven Rives Yates and Tansill Backreef, Capitan Reef, Delaware Mountain Group Deposition. Early dolomitization in Apache and Glass Mountains.

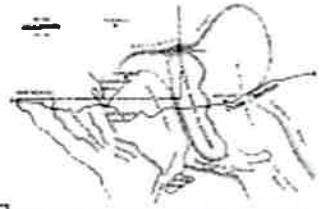
The top of the San Andres was uplifted over 7000' by the tectonism. A gradient of ~80' mile exists today between the Guadalupe Mountains (+6000') and the Central Basin Platform (-1000').

Modified from Hill, 1996

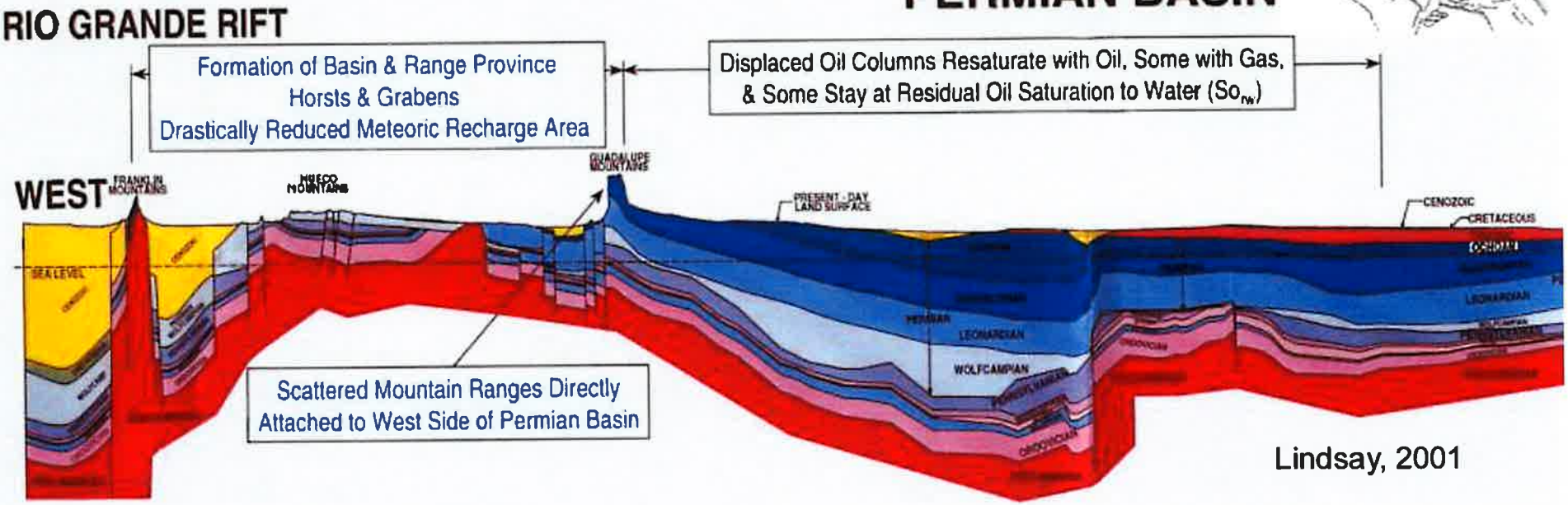
Bob Lindsay, correlated outcrops to Guadalupian fields, identifying the flushing pathway of "Mother Nature's Waterflood" and framed it's history.



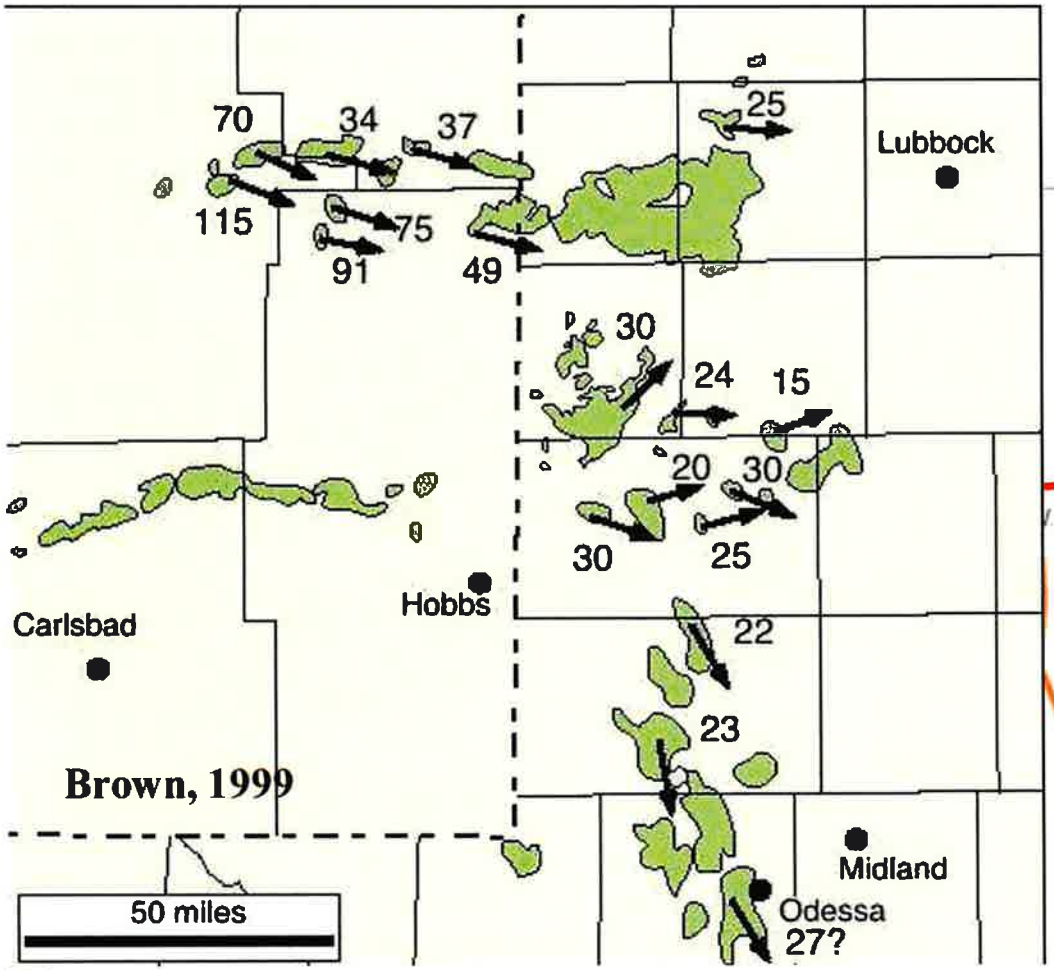
Modified from Matchus & Jones, 1984

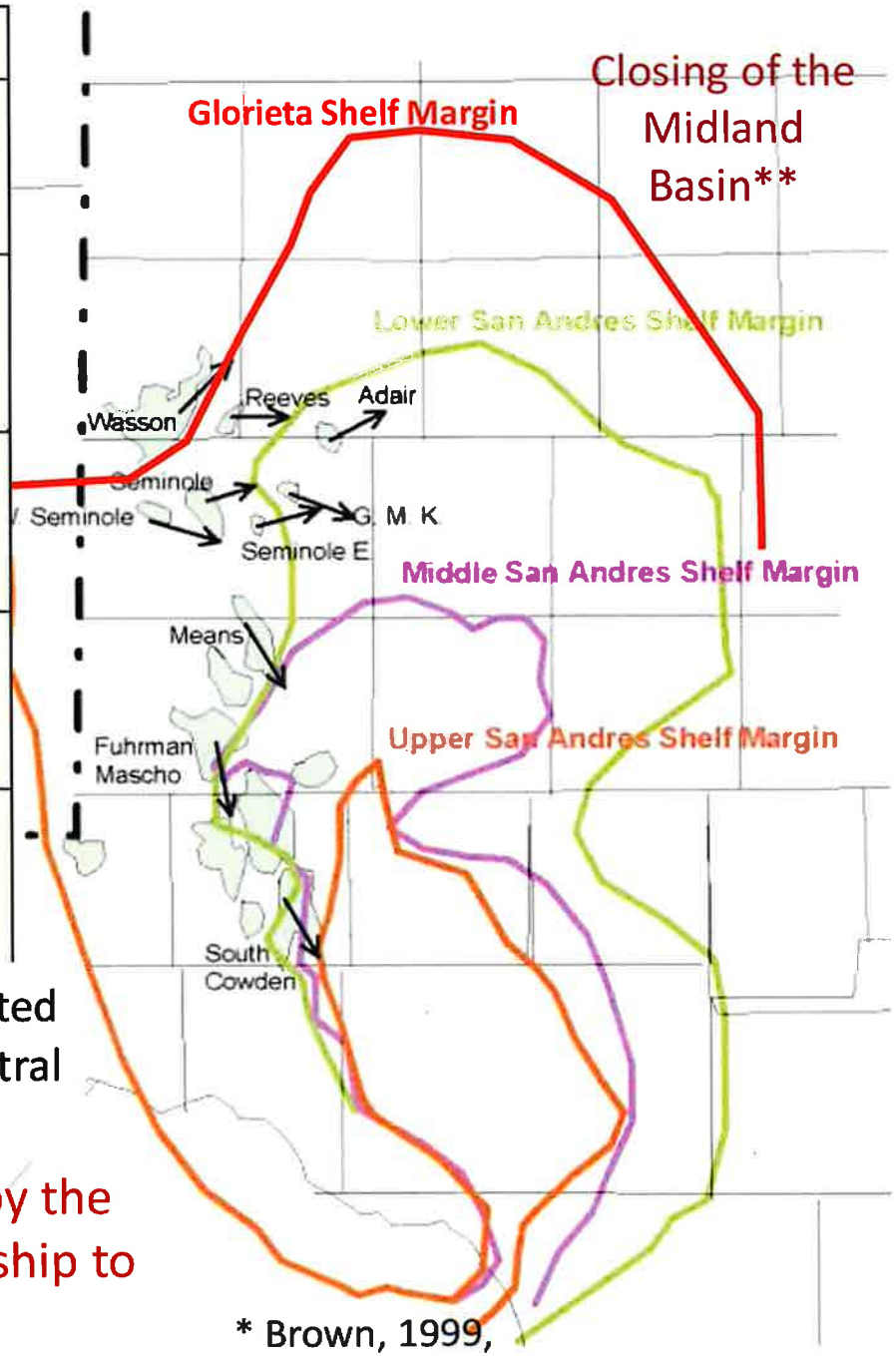


Phase III Slow Extension, Pliocene - Recent
Phase II Rapid Extension, Middle - Late Miocene



Lindsay, 2001



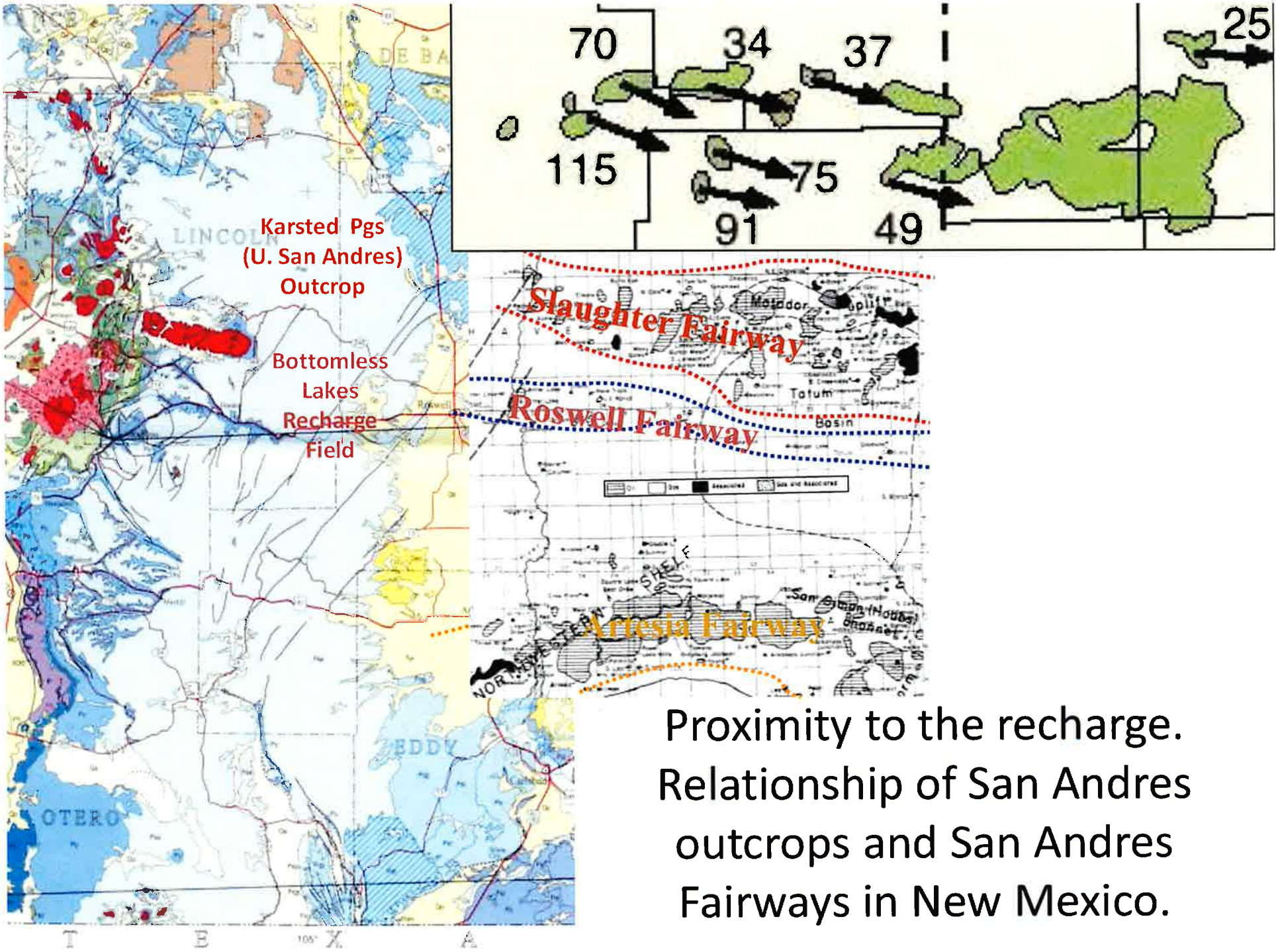


Alton Brown documented the distribution of Tilted Oil-Water Contacts in the Northern Shelf and Central Basin Platform Areas of the Permian Basin*

The direction of OWC tilt may be influenced by the age of the producing interval and it's relationship to the shelf margin.

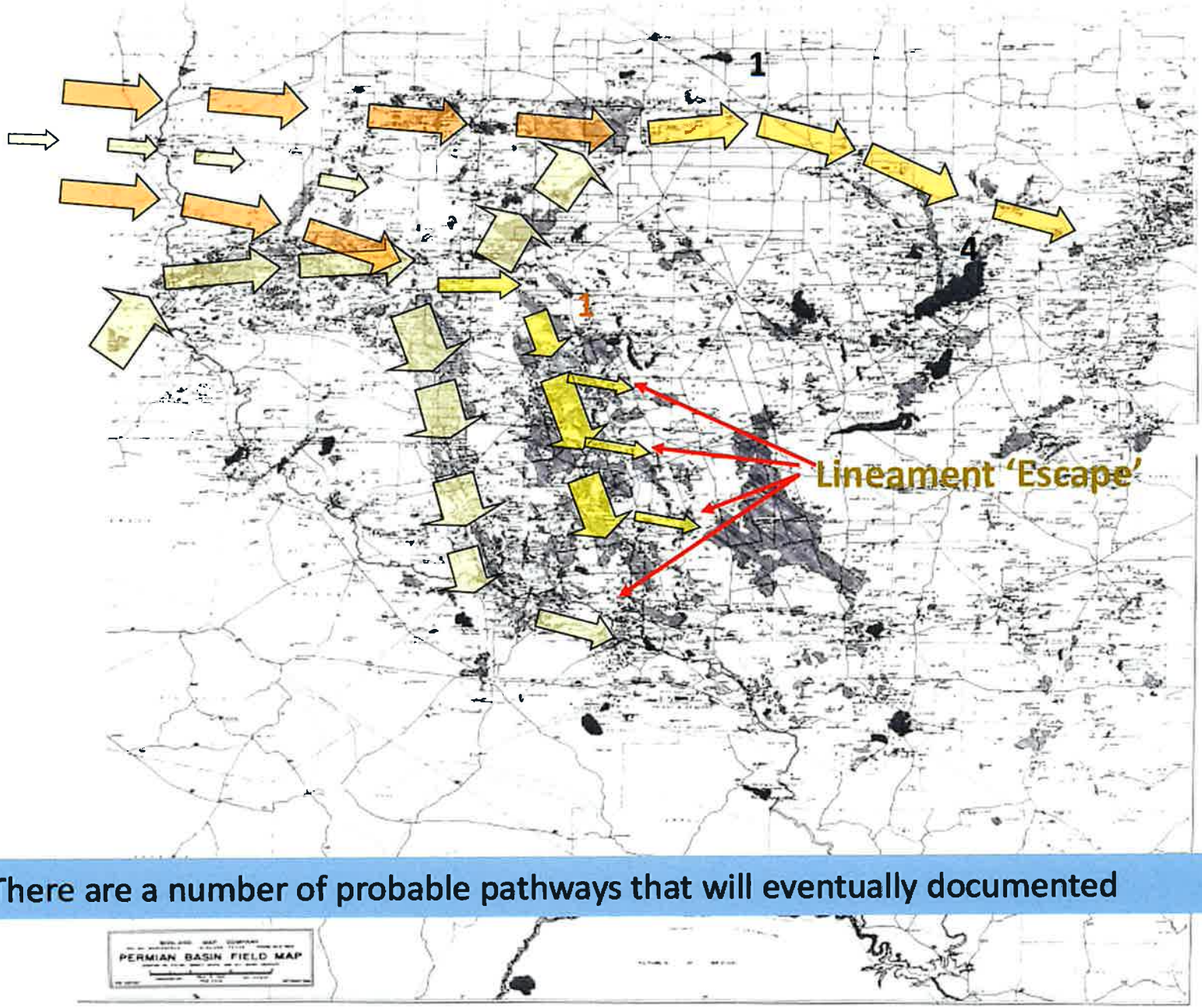
Melzer COnsulting

* Brown, 1999,
** Ward et al, 1986



Proximity to the recharge. Relationship of San Andres outcrops and San Andres Fairways in New Mexico.

THEORIZED (U. PERMIAN) HYDRODYNAMIC FAIRWAYS



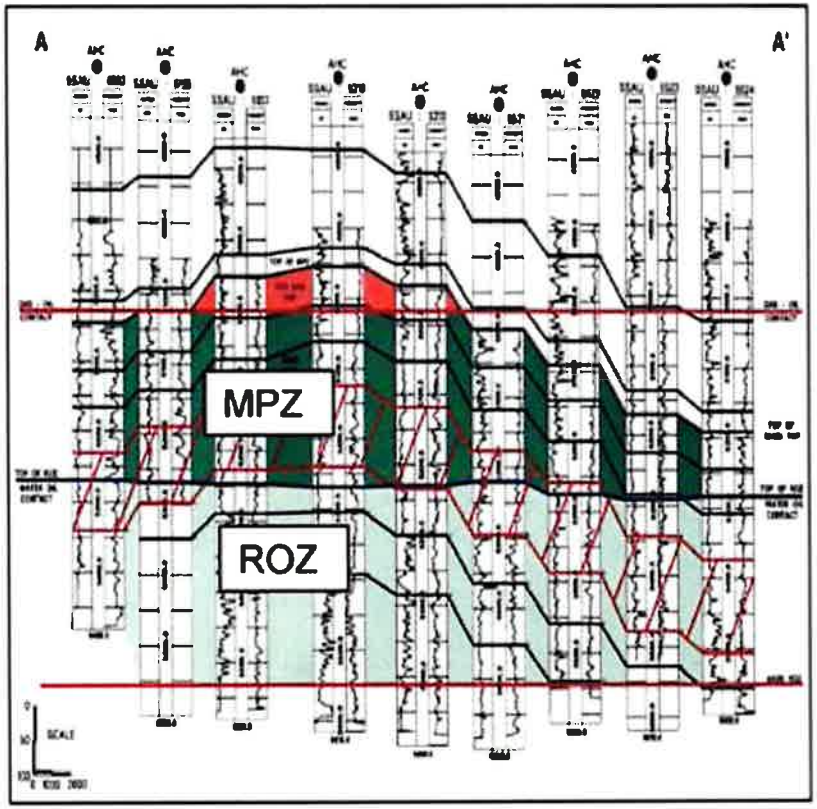
There are a number of probable pathways that will eventually documented

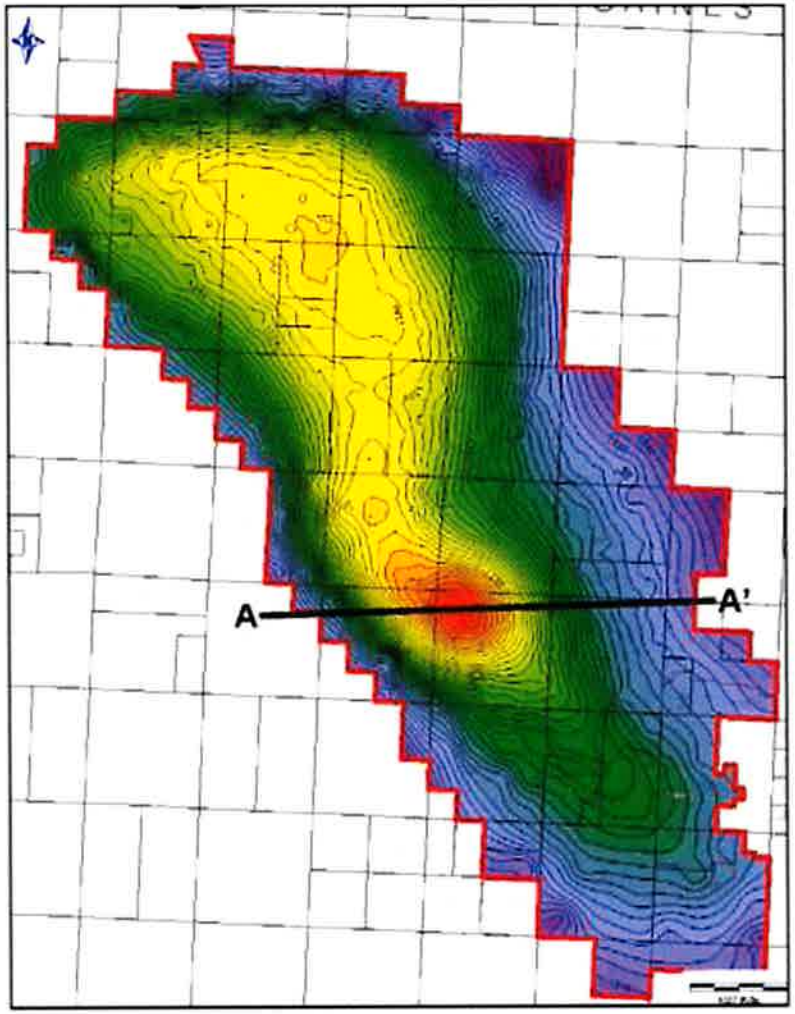
The Gold Standard

Seminole San Andres Unit

SSAU Structure Map & Cross Section

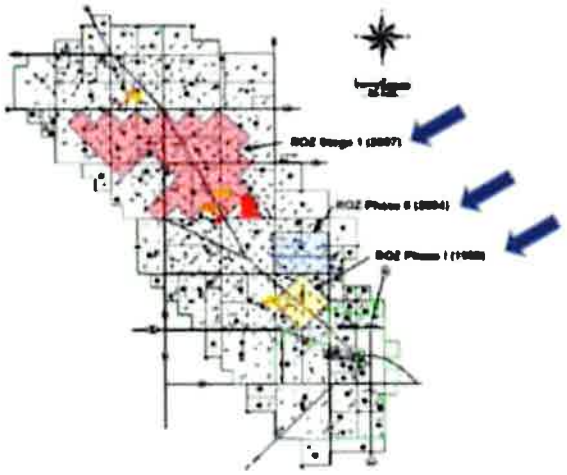
	Net Thickness	Average Permeability	Initial Oil Saturation
Main Pay Zone (MPZ):	126'	9 md	84%
Residual Oil Zone (ROZ):	213'	12 md	32%



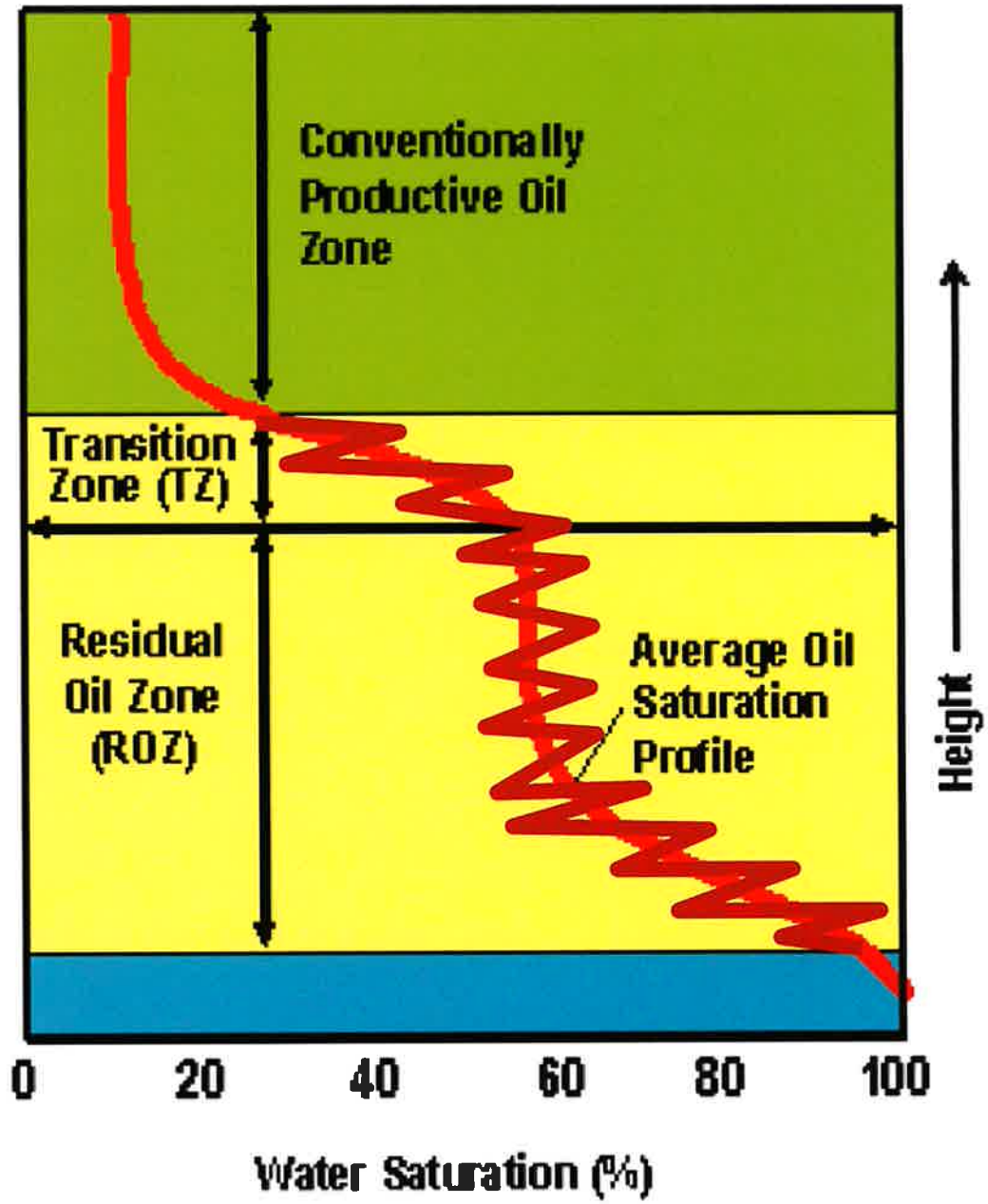


HESS

Reservoir Description	Limestone and dolomite deposited in a shallow carbonate ramp environment
Fluid Type	Saturated black oil
Drive Mechanism	Gas in solution and gas cap during primary. External energy from water and CO2 injection during secondary and tertiary recovery.
Develop. History	1936 Discovery 1936 First Production 1969 Unitized/Waterflood 1983 MPZ CO2 Flood Begins 1996 ROZ Phase 1 Pilot 2004 ROZ Phase 2 Pilot 2007 ROZ Stage 1
Cumulative Production	878 MMBO, 40 MMBOE NGL, 702 BCF HC Gas
Current Rate	19.6 MBOPD, 209 MMCFD CO2+HC 25,500 MBOEPD (Oil+NGL+Gas)



Seminole Water Saturation Profile.



Anecdotal Evidence

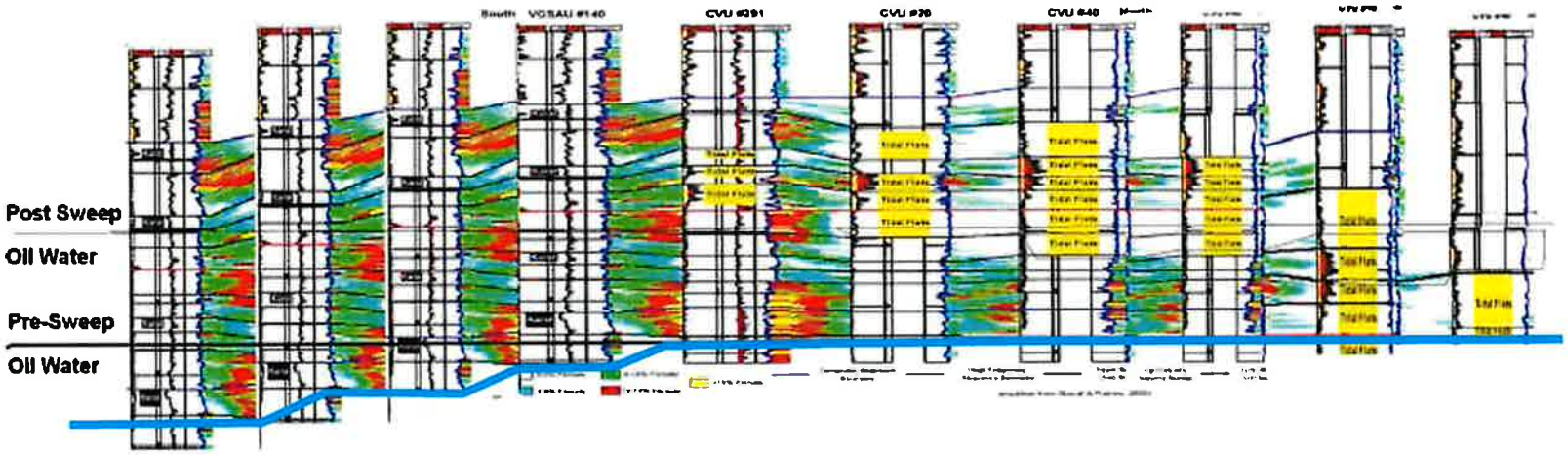
- Info from a growing number of exploration wells documents what can be interpreted as ROZ's where the tests were unsuccessful as there was no associated primary production. Data from a number of explorationists and review and reinterpretation of research articles on Permian Basin fields, suggest a set of common ROZ characteristics:
  - Sample shows of oil and/or gas throughout the ROZ interval,
  - Sulfur water or salty sulfur produced on DST's or attempted production tests, not salt water,
  - Cores with 20-40% oil saturation,
  - Log calculations that suggest producible hydrocarbons,
  - IP's similar to mature waterflood.

  - Evaporites may be dissolved or altered in the lower part of the main pay.
  - The presence of sulfur crystals associated with gypsum/anhydrite/calcite in the ROZ,
  - Solution enhanced fractures in lower portion of the ROZ
  - Enhanced porosity and permeability in the ROZ relative to in the main pay zone as the result of meteoric dissolution of sulfates.
  - Pervasive "late" dolomitization indicating meteoric sweep.
  - "Tight" high So intervals near the BOSO transition.
  - Sequence stratigraphic boundaries to top and bottom of ROZ.
  - Possible oil and water chemistry differences between main pay and ROZ.

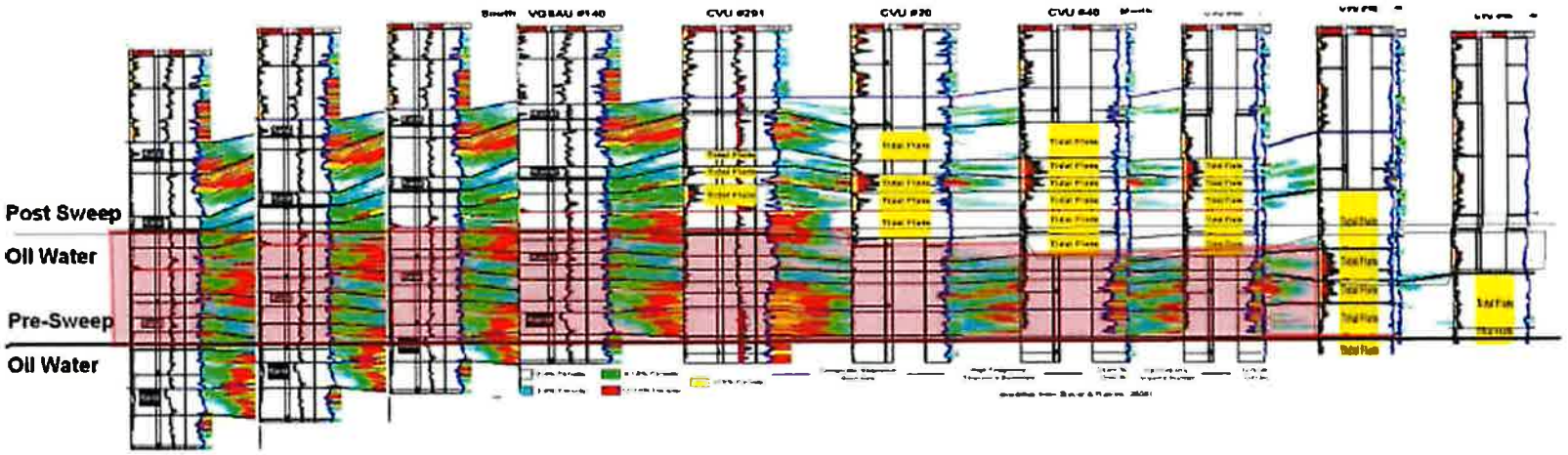
The new Residual Oil Zone Paradigms

- Large intervals and areas have been swept by the tectonically driven "Mother Natures Waterflood" which occurred post basin subsidence and oil emplacement.
- Thick intervals within the ROZ's intervals have the same saturation characteristics as mature waterfloods (30-40% Sorw).
- Tests of ROZ's produce high percentage of water on DST's or completions, but not a "deal killer".
- ROZ's often are interpreted/calculated as producible in Exploration Wells, and Primary and Secondary Production Environments:
  - Good Odor, Cut, Fluorescence, and Gas in samples
  - 20 -40 % oil saturations in core
  - Calculate as oil productive on logs
- The "faux-productive" appearance of ROZ's with significant thicknesses (50 to 300') of CO2 EOR producible hydrocarbons and 20-50% So exist beneath both producing fields (Brown Fields) and in areas where there is no, or a minimum, producible oil column (Green Fields).

Pre Laramide
Original Oil Water contact at base of present ROZ



Post Basin and Range - Flow units, deeper in the reservoir and with higher permeability are swept

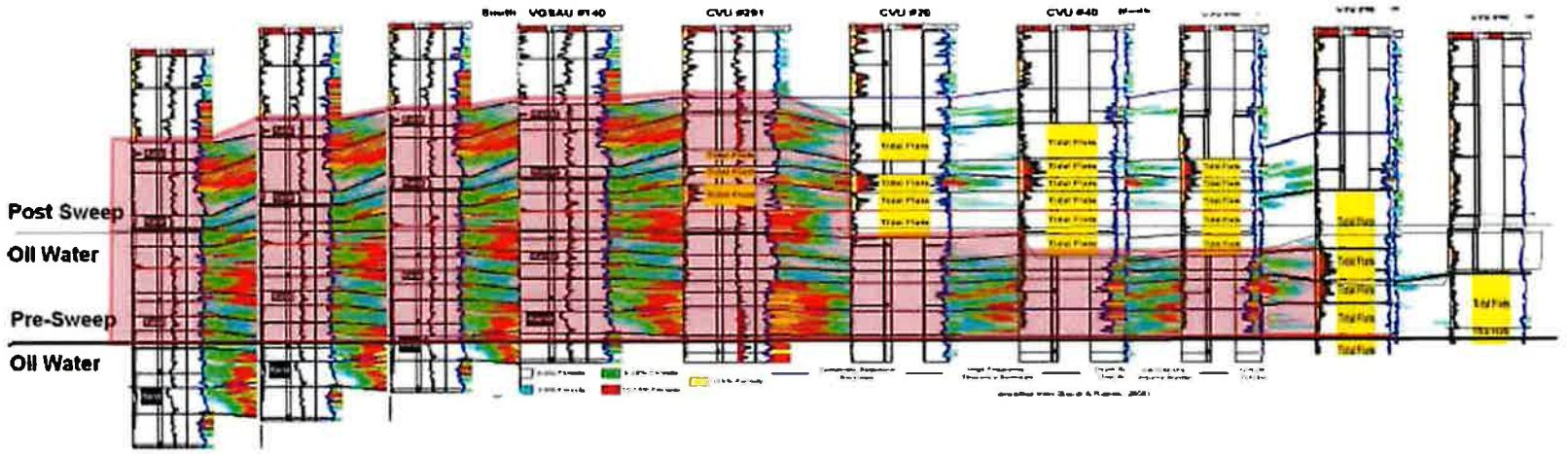


Field Wide - Tidal Flat/Sabkha provide updip permeability trap.

MP - Flow units within Main Pay unaffected by Meteoric derived sweep.

ROZ - Updip shallow subtidal and intertidal will produce low volumes/ low water cut
Downdip higher energy shelf produces "Mature Waterflood" oil cuts and volumes

Post Basin and Range
Most higher permeability Flow Units are Swept



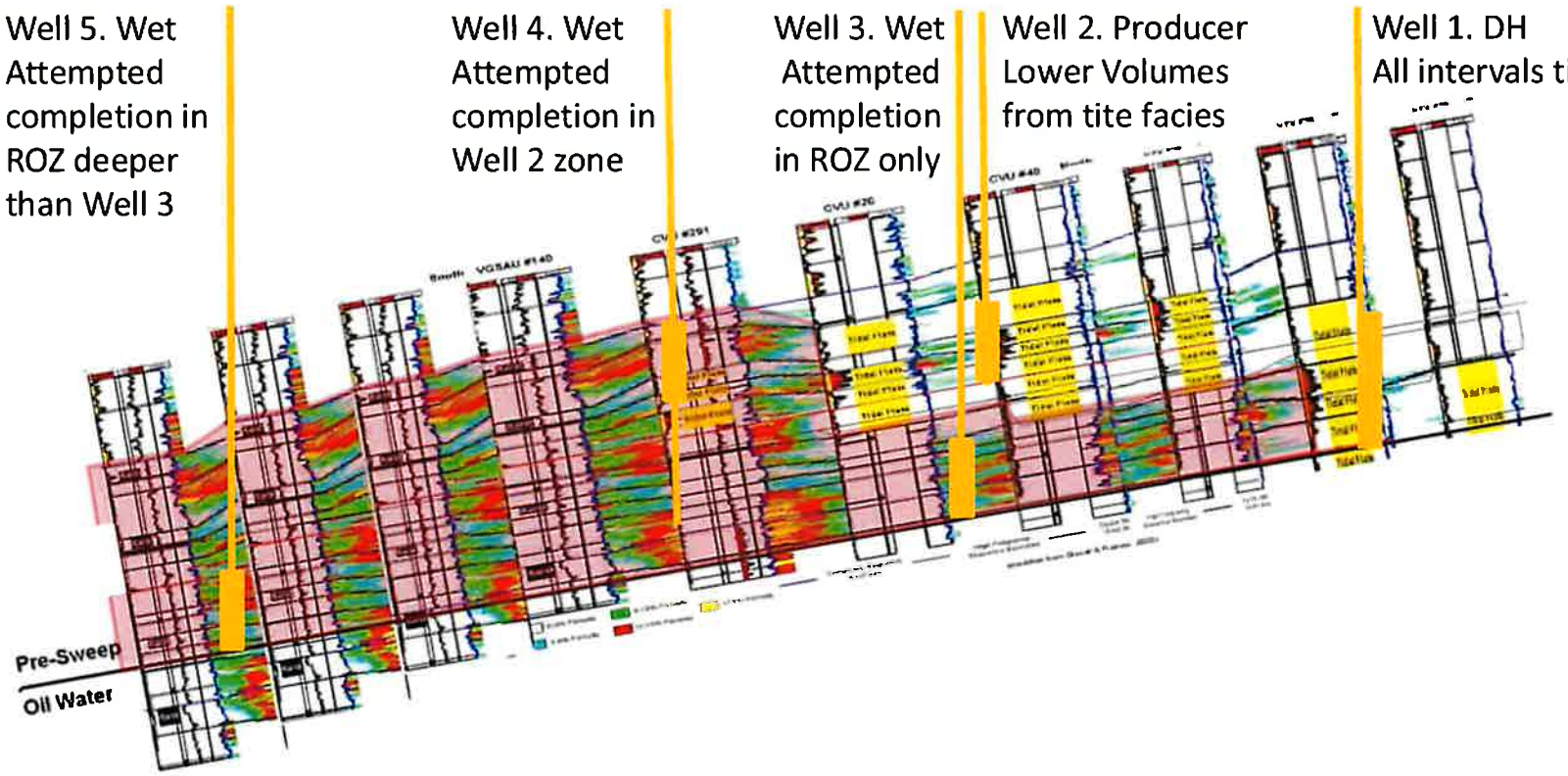
Field Wide - Tidal Flat/Sabkha provide updip permeability trap.

Main Pay- Either thin producing interval or no associated producing interval

ROZ - Updip shallow subtidal and intertidal will produce low volumes/ low water cut

Downdip higher energy shelf with "Mature Waterflood" oil cuts & large volumes

Post Basin and Range
Updip shallow subtidal and Intertidal are productive, downdip swept with mature waterflood IP's



Wells drilled in different portions of the interval will have different recoveries.

W. A. Estes "Holt" Field (actually Glorieta)

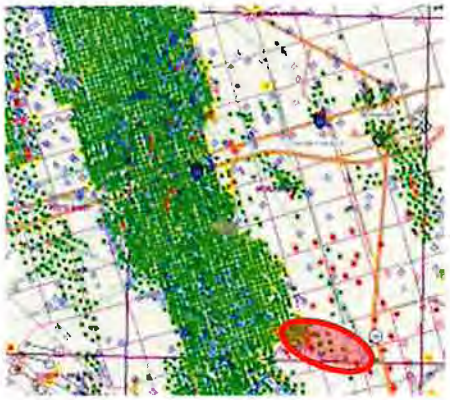
Discovered in 1991, produced over 1MMBO from a small closure with "tight" tidal flat and shallow subtidal carbonates.

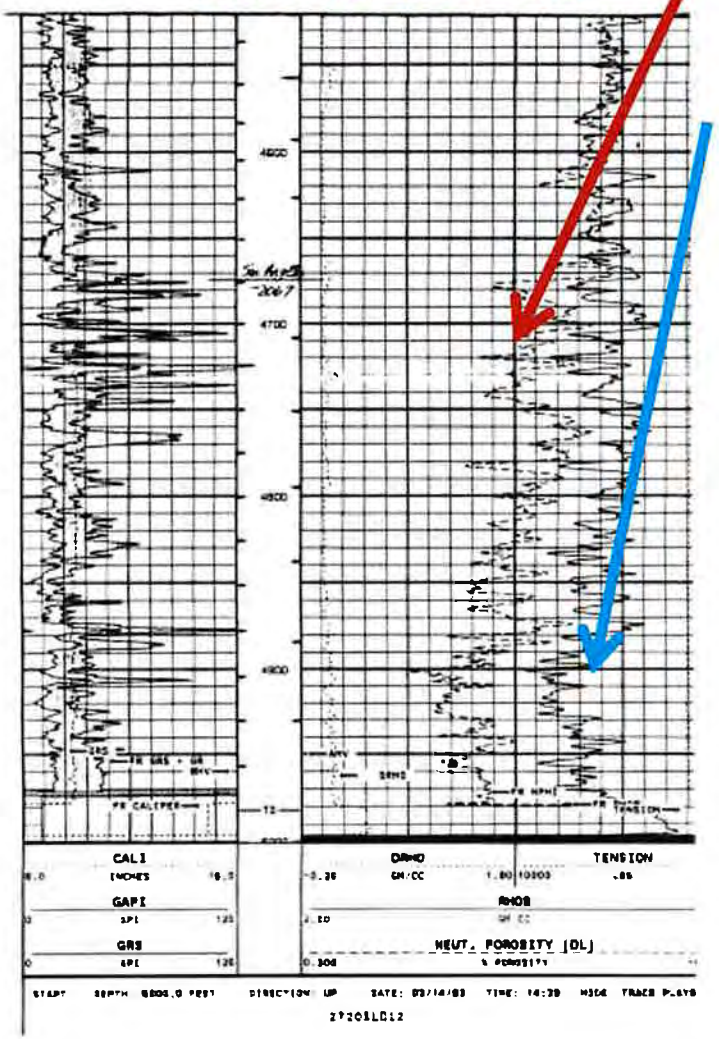
Why did it take so long to discover it?

It's a cap for a thick porous dolomite considered to be the "pay" in the area. The interval had shows & calculated as productive, DST's a skim of oil and lots of sulfur water, tested a few times and left alone.

What is going on? It's postulated that the lower, porous portion was swept and only the tight, up-dip facies were left with >70% S_o.

Thick, porous ROZ with CO2 potential?

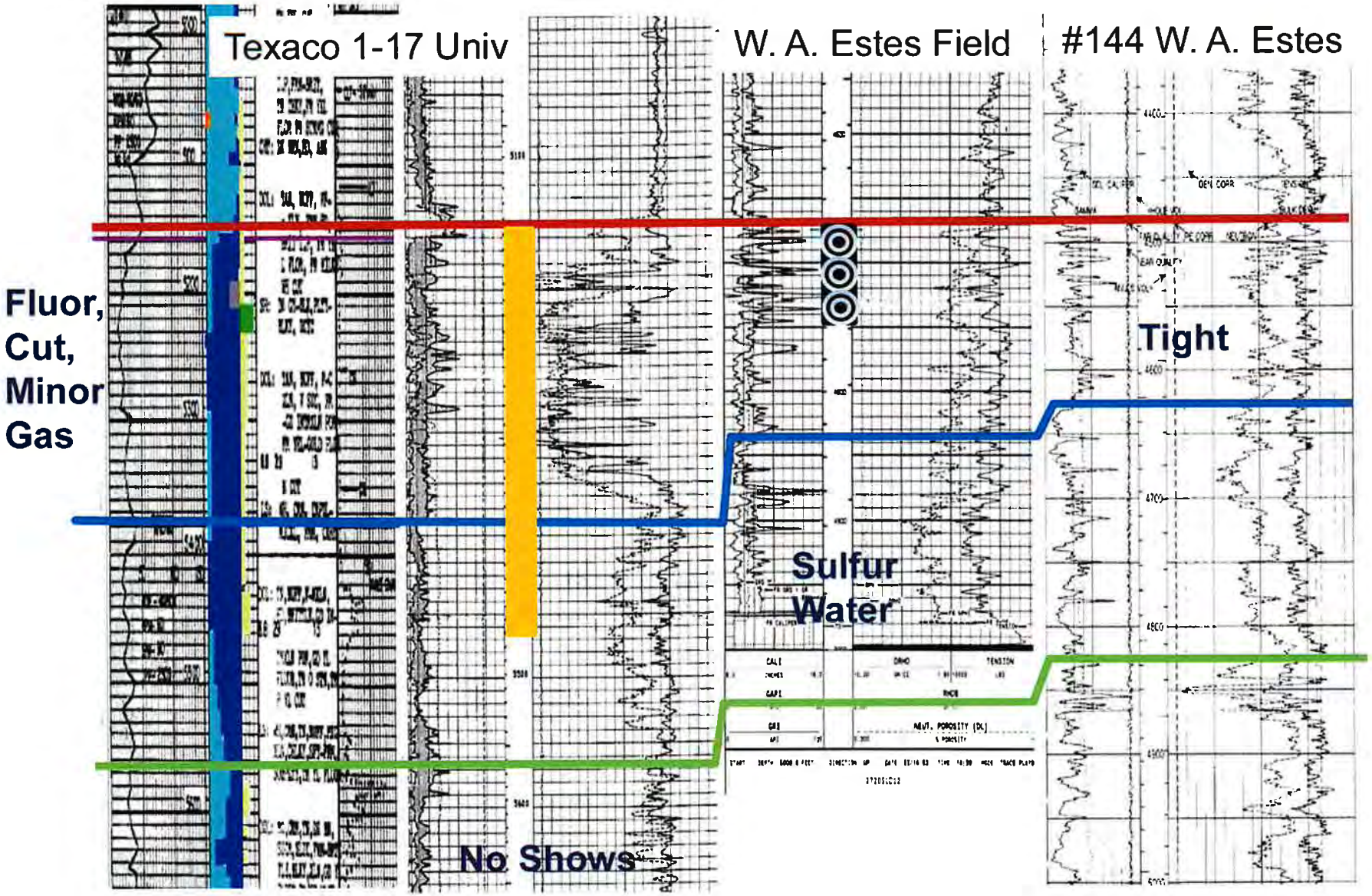


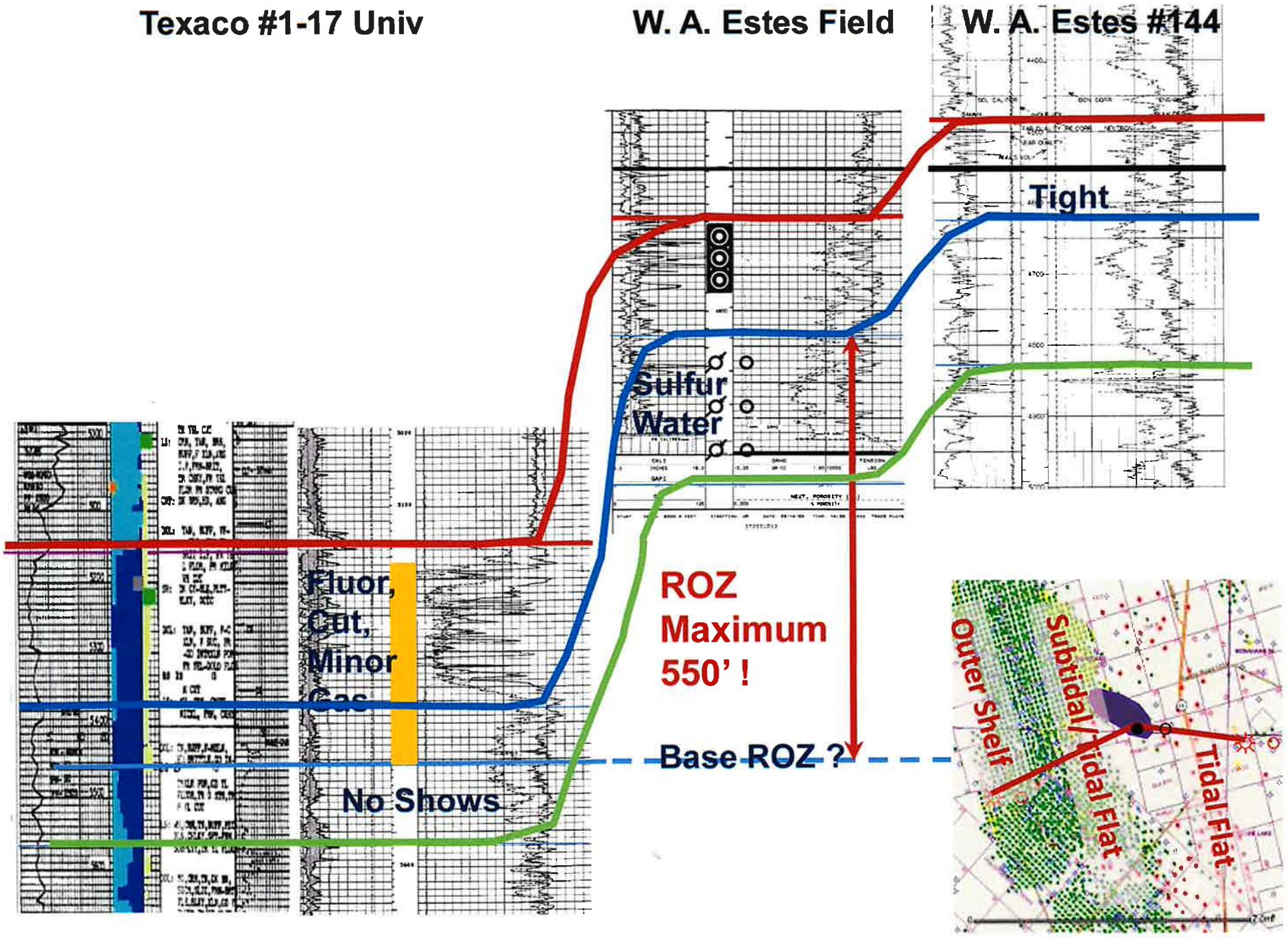


The pay is the upper Glorieta/San Angelo. The more porous lower section calculates as productive on logs and is oil stained BUT 100% sulfur water productive.

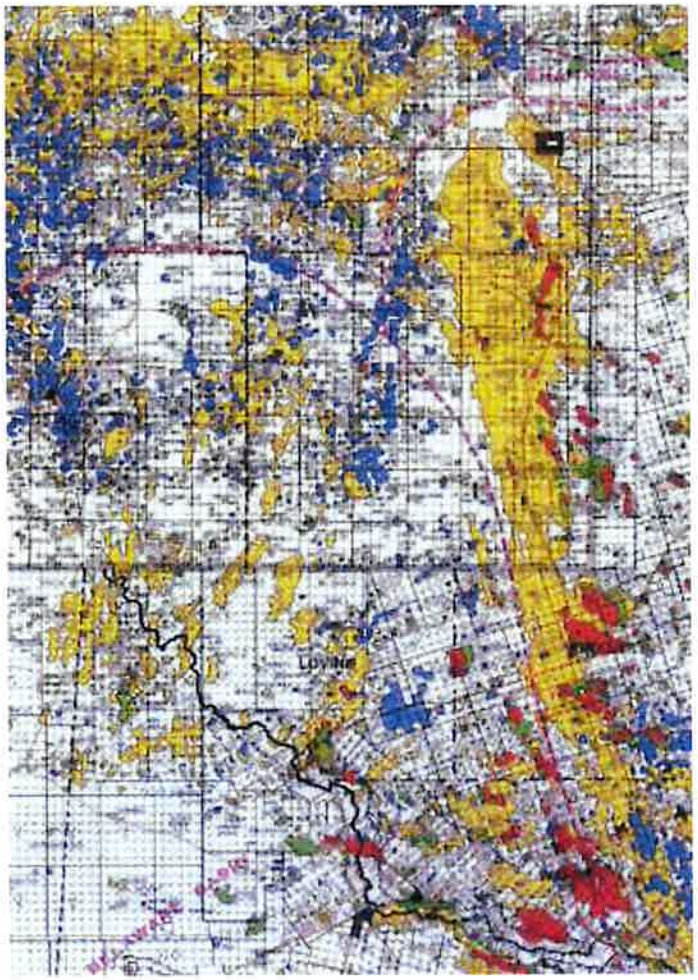
Outer Shelf to Tidal Flat

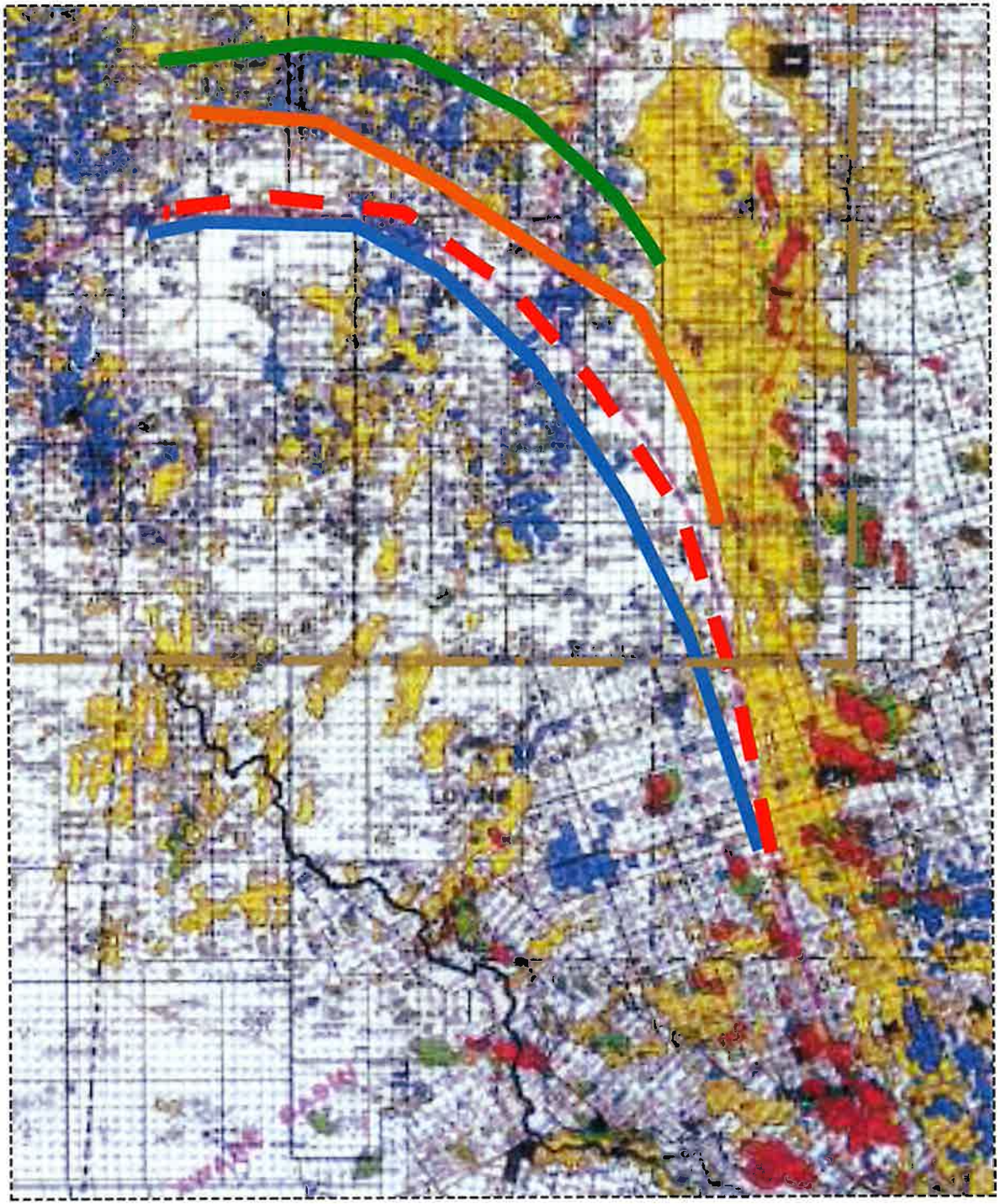
The updip section thinned by pre San Andres tilt and Erosion





What is the impact of the prograding Capitan Reef ?





Eunice Monument/South Monument

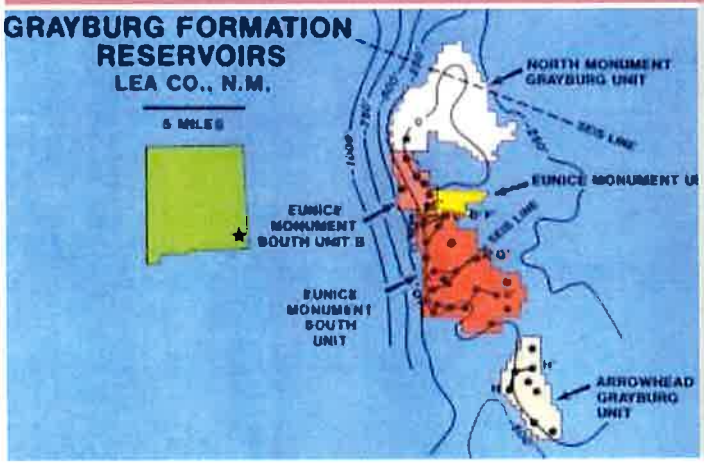
- Grayburg productive with NaCl rich connate water
- San Andres mostly wet with sulfate rich connate water
- Two different sources for the connate waters
- Thickness of San Andres swept reservoir?
- **Eunice Monument South Unit** Productive from the Grayburg with minor production from the underlying San Andres Formation–
- Discovery Oil/Water contact -350'
- Unitization Oil/Water contact -540'
- Deepest Grayburg Oil in core -664'
- Deepest San Andres Oil in core -719'
- >300' thick SADR w/oil saturation below O/W in Eunice Monument

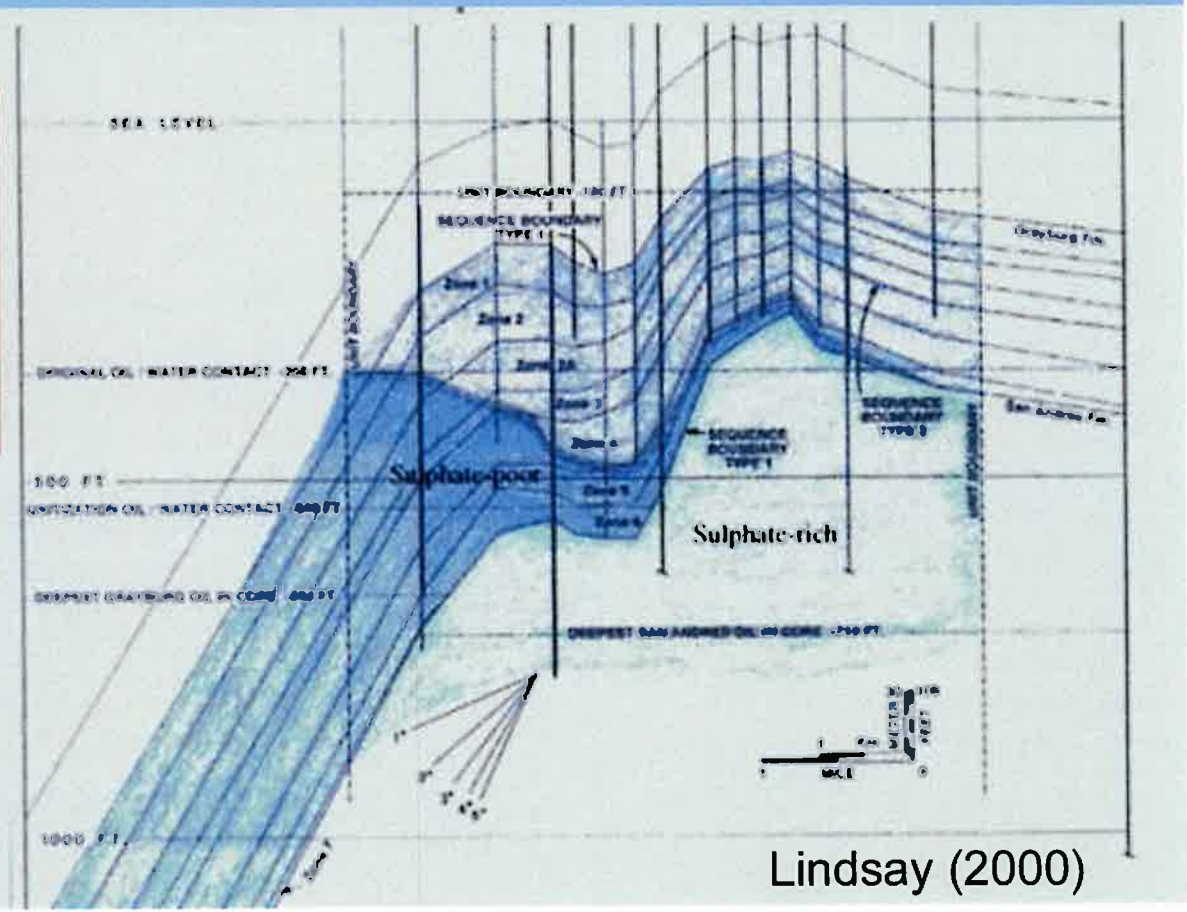
Melzer Consulting

North Monument Grayburg, Eunice Monument, Eunice Monument South "B", Eunice Monument South, and Arrowhead Grayburg Unit .

- area combined total of 57 square miles.
- Lindsay suggests the sulfate poor edge water is recharged from the Guadalupe Mountains thru the Goat Seep Reef. The Sulfate-rich bottom water drive in the San Andres is recharged from the Sacramento Mountain thru the evaporite rich San Andres. **Eunice Monument South Unit.** The edge water was pulled into the oil leg since production was established in 1929 (from Lindsey, Chevron in-house pubs).
- Structural closures formed by re-activation of existing deep seated faults which folded and fractured the Permian. The structural event increased closure on the reservoir and trapped a larger oil column.

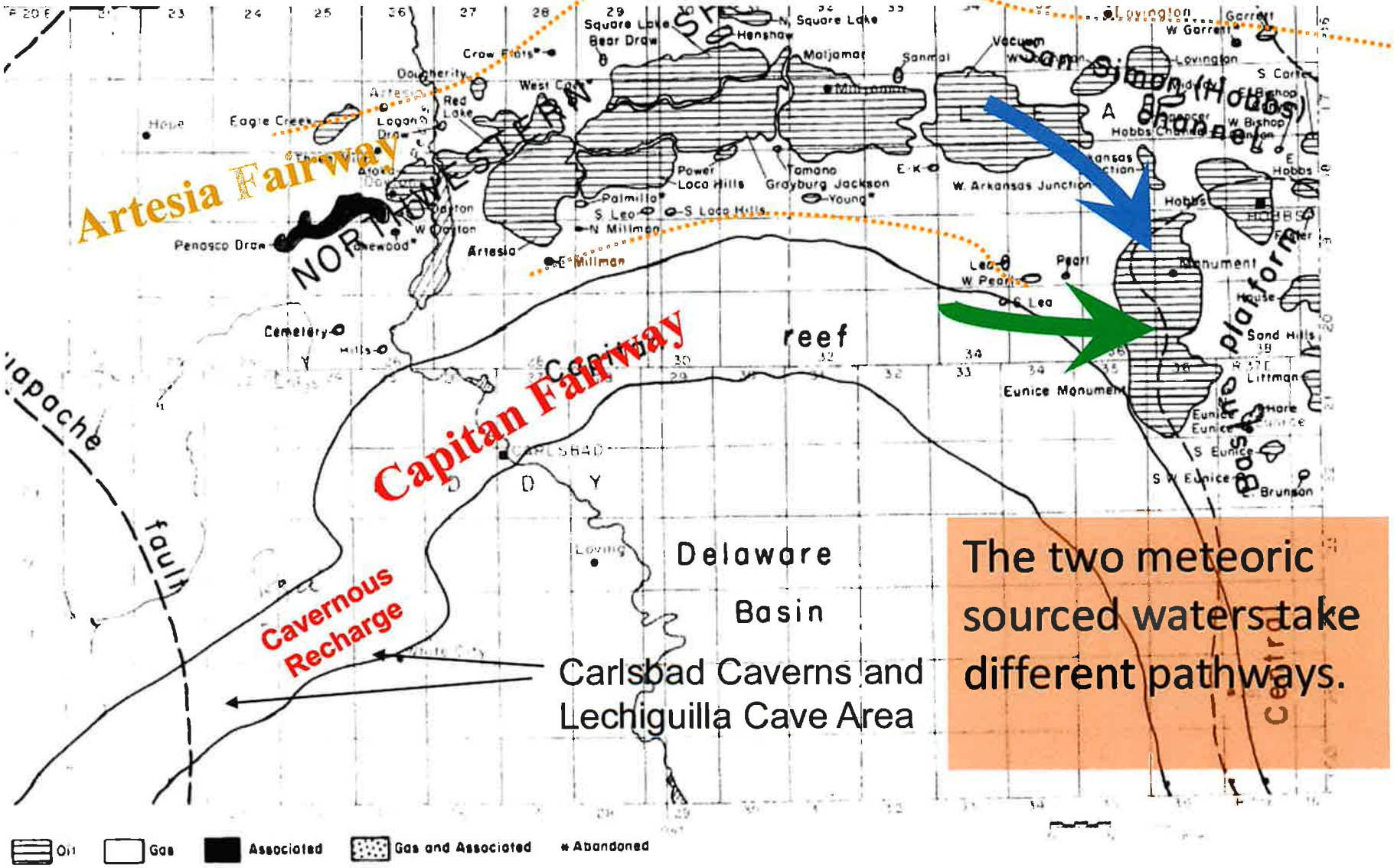
- Eunice Monument
- -150 G/O, -400' O/W (150' below top SADR).
- Na 2000ppm, Cl 2950ppm, TDS 7800PPM (similar to Capitan Reef in Winkler Co.)





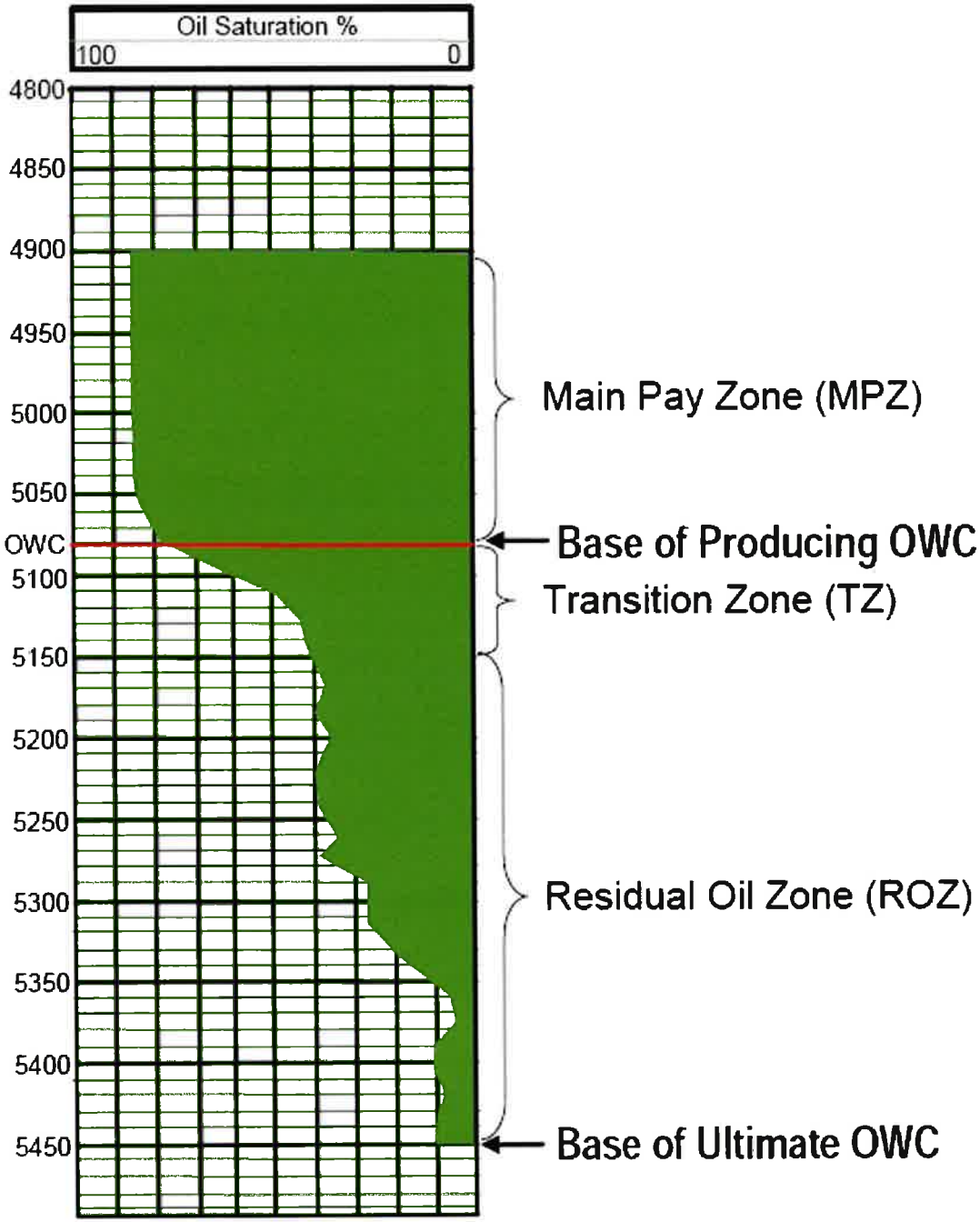
Lindsay (2000)

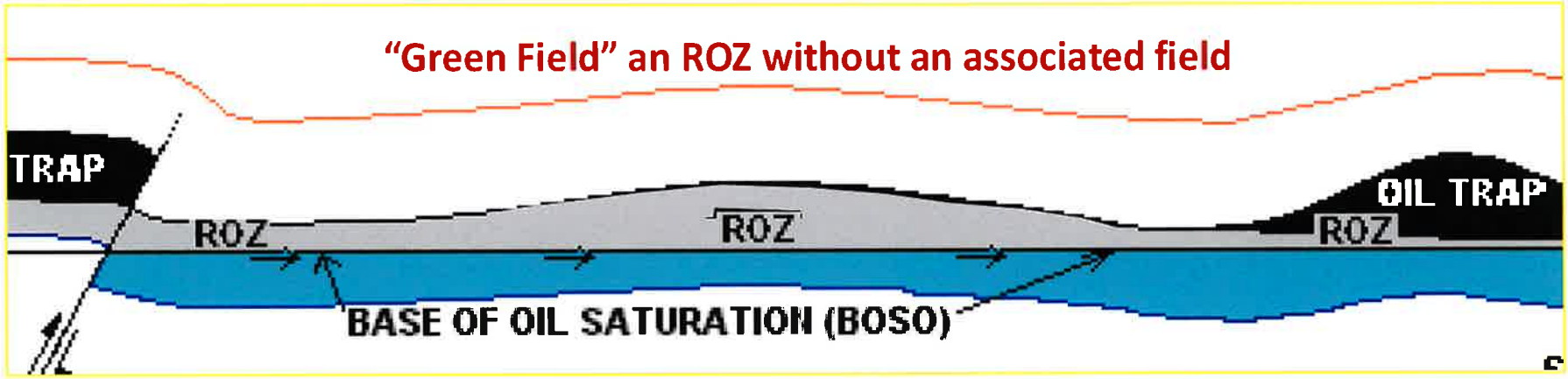
SE NM Grayburg & Upper San Andres Dolomitization Trend



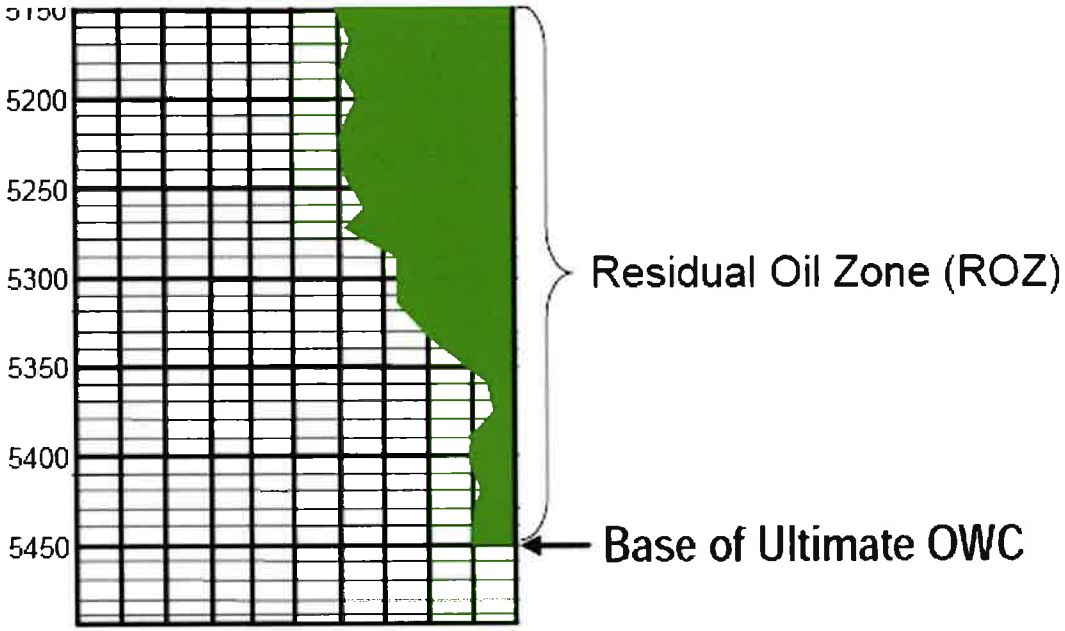
Ref: Future Petroleum Provinces in New Mexico – Discovering New Reserves, Philip R. Grant, Jr. and Roy W. Foster, NM Bur of Mining & Mineral Resources, 1989

What happens when the entire oil column is swept by Mother Nature?



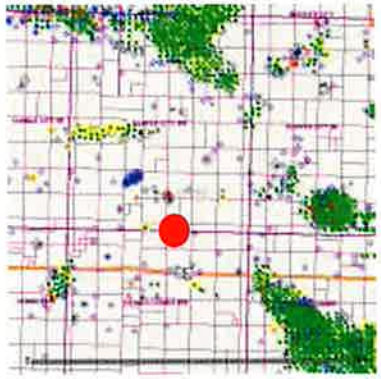


Your left with a tertiary recovery target.



Gaines, Future Targets or goat pasture?

- A Clearfork test, the **IP #1 Campbell Heirs "158"** pipe on "WET" San Andres test just south of Seminole.
- All wireline logs, drill time, gas curves and sample shows said "slam dunk" oil production. Atlas log analyst said it should be a producer.
- 100% water test with barely a sniff of live oil. ROZ?
- **Anschutz #1 Patrick Keating** "447", drilled for San Andres west of Seminole, had good shows but made only water for a few months before P & A (3600 BW, 3 BO). Water analyses show progressive drop in TDS over the two months of production.



- The 2 CORED intervals, from 5464 – 5602, had oil saturations ranging from 15 to 35%, 3 - 12% porosity, & 50-100% fluorescence.
- These are what we term "GREENFIELDS"
- TZ/ROZ's are "BROWNFIELDS".

ROZ Regional Context

- Establish regional flow paths through and between reservoirs along the "reservoir trend".
- Modeling to establish inflow and outflow pathways.
- Determine timing of oil emplacement(s) relative to potential regional sweep events.
- Develop a regional understanding and time line for the relationships among major post depositional/oil emplacement tectonic events and the meteoric associated flushing that create the ROZ's.
- Understand the impact of tectonic events on the fluid/rock properties along the reservoir trend.
- Characterize the difference and similarities between "classic" reservoir and Residual Oil Zone (ROZ) Reservoir.

"Early" Reservoir Parameters

Main Pay

- >80% So
- Salt Water – higher TDS
- Will respond to Waterflood
- CO2 EOR Potential
- Dolomite Reservoir
- Infill potential
- More Karst
- No Sulfur in cuttings and core
- Lower Porosity and Permeability
- Mixed wet
- No Greenfield Potential
- Oil Gravity
- Man made flowpaths /fractures

Residual Oil Zone

- 20 to 40% So
- Sulfur Water – lower TDS
- NO waterflood potential
- CO2 EOR Potential
- Dolomite Reservoir
- Deepening potential
- Less Karst
- Sulfur in cuttings and core
- Higher Porosity and Permeability
- Wettability issues
- Greenfield Potential
- Oil Gravity
- "Virgin" Reservoir Conditions

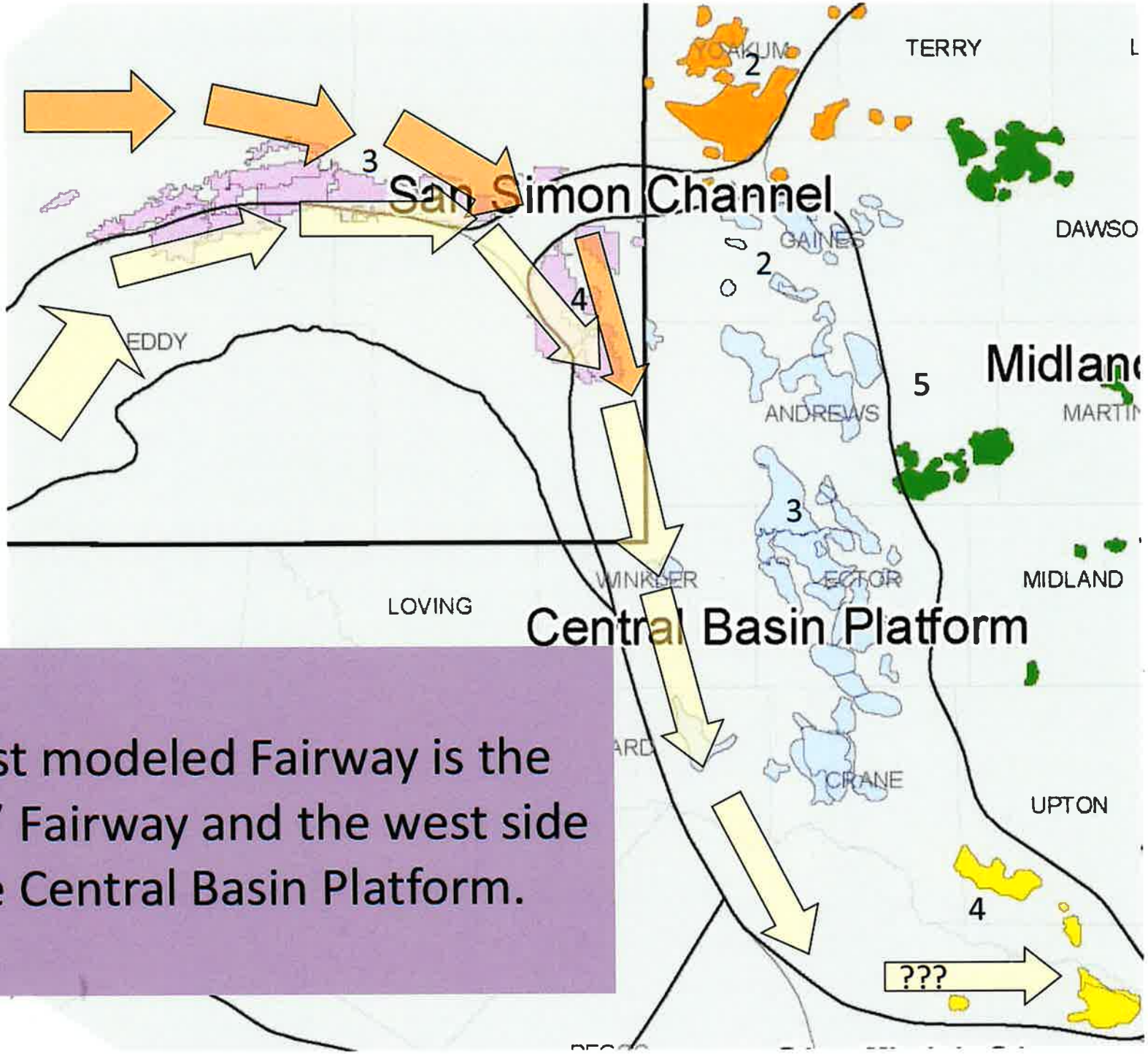
"Late" Reservoir Parameters

Waterflooded Main Pay

- 20 to 40% So
- Salt Water – ???? TDS
- No remaining Waterflood Potential
- CO2 EOR Potential
- Well known reservoir parameters
- Enhanced high perm streaks
- Mixed wetability
- Man made flowpaths /fractures

Residual Oil Zone

- 20 to 40% So
- Sulfur Water – lower TDS
- NO waterflood potential
- CO2 EOR Potential
- Estimated reservoir parameters
- Potentially more homogeneous
- Wettability questions
- Untouched



The first modeled Fairway is the "Artesia" Fairway and the west side of the Central Basin Platform.

Some other questions to consider:

- The total thickness of the San Andres at major producing field ranges from 650-750' [Yates and Goldsmith] to 1400 to 1600' [Seminole to Vacuum], yet,
  - The ratio of ROZ to main pay thickness in many of those large field may remain close to 1:1.
  - In other fields the thickness of the ROZ can equal or exceed the thickness of the main pay AND the ROZ elsewhere, and
  - Where there is no main pay, "Greenfields", the ROZ can be 50 – 300' thick or more. WHY?
- Why is there no major San Andres, Grayburg or Clearfork production south of the Texas/New Mexico border on the west side of the Central Basin Platform?
- How many pore volumes of water passed through the ROZR during Mother Nature's Waterflood (MNW)?
- How does that relate to the volumes of water that passed through our Main Pays during modern Waterfloods.
- Consider the time frame in which these two "sweeps" occur, would you expect to see the same results?
- Significant ROZ's appear to be present in the Leonard (Glorieta and upper and lower Clearfork) which are below the San Andres (Guadalupian) path across the San Simon channel.

Camels passing through the eye of a needle

- Dolomitizing pathways.
- Basin dewatering is often invoked for late dolomitization of reservoirs
- How many pore volumes can you pass through a reservoir when the updip traps are sabkha's?
- What is the pathway down dip to up dip then parallel to the margin?

Working backward from what we see. Characteristics of the ROZ vs. the Main Pay.

- Sulfur crystals associated with anhydrite and calcite in vuggy porosity at the Base of ROZR.
- Patchy high oil saturation above/at/below the Base of Saturation of Oil (BOSO) in low permeability intervals.
- Late stage solution enhanced fractures
- Solid Hydrocarbon Residue
- Oil Chemistry differences
- Oil Gravity differences
- Transition from limestone below the ROZ reservoir, to dolomite within the ROZ reservoir.
- Relationship of Limestone to dolomite transition to Sequence Stratigraphic Boundaries
- Enhanced Porosity due to the limestone-to-dolomite conversion
- Enhanced Porosity due to the dissolution of evaporites
- Enhanced Permeability due to limestone to dolomite conversion and secondary dolomitization
- Changes in wettability
- Vertical ROZ salinity variations
- Lateral/Trend salinity variations
- Chloride to sulfate water transition
- Bow Shaped, Pervasively Dolomitized Intervals (PDI)
- Relationship between ROZ and MP thickness.
- 90 degree turn for fluids
- Relationship of MP/ROZ/100% water transitions to Sequence Stratigraphic boundaries.

RESIDUAL OIL ZONE HISTORICAL FRAMEWORK
THE EVOLUTION OF ROZ PROGRESS TO TODAY

- Private Characterization Studies, ROZ Pilot and Field Demos (and now… Full Scale) Projects
- Reframing the ROZ Origins
  - Permian Basin Observations,
  - Chipping Away at Some Myths (e.g., Transition Zones, Weathered Oil, etc.)
- Defining the Areal Distributions and The Properties

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THE RESEARCH FRAMEWORK: *ROZ HISTORY / INITIATIVES*

1) EARLY PRIVATE TZ/ROZ* INVESTIGATIONS
   - Private Industry Research
   - UTPB, Melzer Consulting, and ARI Syntheses
2) 2006 DOE REPORT AND SUBSEQUENT SPE PAPERS
3) RPSEA** ROZ ORIGINS AND HYROLOGICAL MODELING
4) DOE: ROZ & MPZ CO_2 FLOODING OIL RESPONSE
5) REGIONAL ROZ ORIGINS AND DISTRIBUTIONS

* Transition Zone/Residual Oil Zone **Research Partnership to Secure Energy for America

INITIATIVE 1)
THE EARLY WORK (TZ/ROZ)

- Hess' Seminole Field 'Thinking'
- Shell's Wasson Field Approach
- TZ Sweet Spot Pilot at Denver Unit, Wasson Field
- Hess' Phase I and Phase II Pilots at Seminole
- Chevron's Vacuum Field Investigations

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INITIATIVE 2
GOING PUBLIC

The CO2 Flooding Conference in Midland and It's Role

References

- Stranded Oil in the Residual Zone, U.S. Department of Energy Report, February 2006.
- "The Origin and Resource Potential of Residual Oil Zones," SPE paper 102964, L.S Melzer., G.J. Koperna and V.A. Kuuskraa, presented at the SPE Annual Technical Conference and Exhibition, San Antonio, Tx Sept 24-27, 2006.
- "Recovery of Oil Resources from the Residual and Transitional Oil Zones of the Permian Basin", SPE 102972, w/ G.J. Koperna and V.A. Kuuskraa presented at the SPE Annual Technical Conference and Exhibition, San Antonio, TX, Sept 24-27, 2006.

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INITIATIVE 3

THE RPSEA PROJECT (all about the Science)

- Building a ROZ Team
- ROZ Symposium
- Defining and Gathering the Anecdotal Evidence of ROZ Presence
- Assimilating Hydrodynamic Fairway Data (Fluid, Rock Property Data)
- Developing Some Related Hypotheses
  - Pervasive (Laterally) Dolomitized Intervals
  - Oil Wetting

Chevron

LEGADO resources

THE GOLDSMITH FIELD STUDY - (INITIATIVE 4)

The DOE/NETL Project (Almost All about Oil Response…'the Engineering')

LEGADO resources

- Selecting a Field Partner (Legado Resources)
- 'Perfect' Timing (Jump Start on Field Work)
- Six Cored Wells
- Opportunity for Modeling Permutations
- Venues for Vetting ROZ Response/Commerciality
- Opening the Door for Larger Scale Implementation
  - Industry Acknowledgment/Acceptance

Advanced Resources International, Inc.

APTA

INITIATIVE 5

RPSEA II

- Permian Basin-Wide ROZ Distributions
- Relationships
  - Sorw = F (water salinity)
  - Lineament Exit Pathways
  - Other?
- Extrapolations to Other Basins
  - Bighorn
  - Southern Williston

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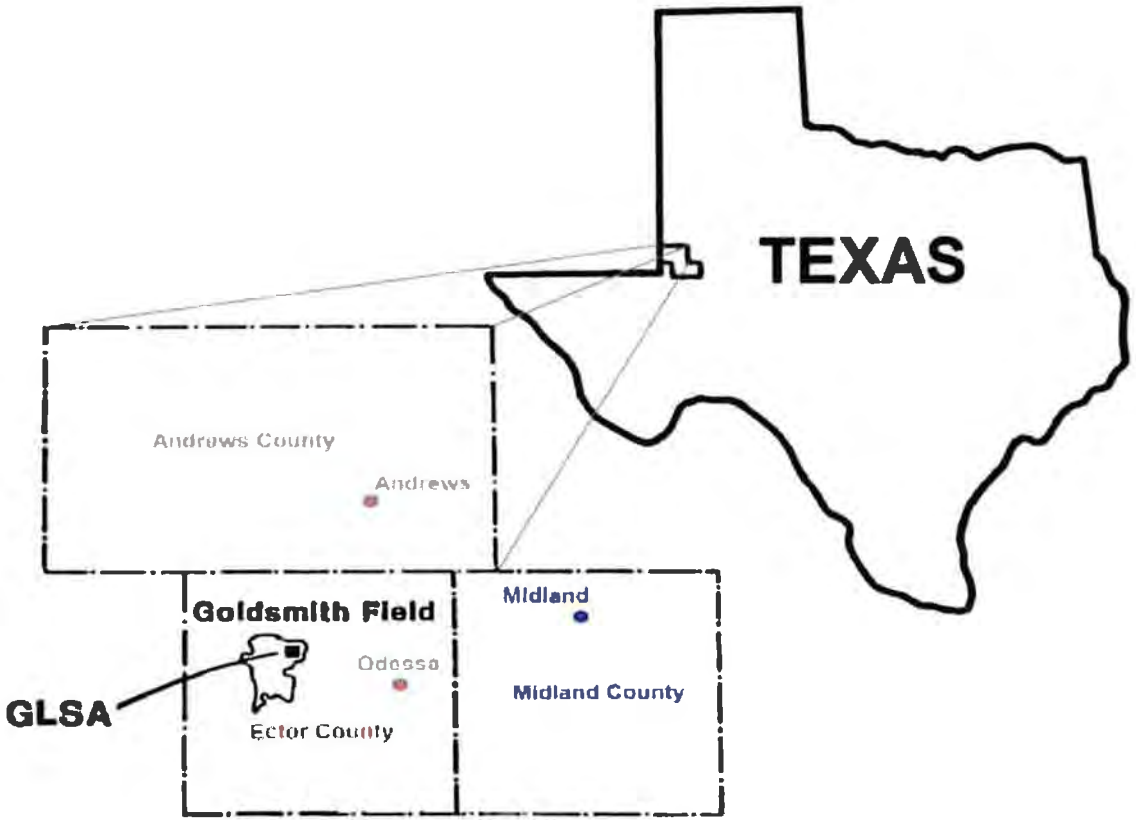
DOE ROZ Project Description/Plans

"Next Generation" CO2 EOR Technologies To Optimize The Residual Oil Zone CO2 Flood At The Goldsmith Landreth San Andres (GLSAU) Unit, Ector County, Texas



Project Overview

- **The Project:** Characterizing and Defining the Response of the GLSAU San Andres Formation to CO2 in both the Main Pay Zone and the Residual Oil Zone
- **Project Goals:** Develop a Case History of ROZ Response to CO2 which will Allow Demonstration and Comparison of the Commerciality of CO2 EOR in both the MPZ and ROZ
- **Project Scope:** Perform a Detailed Characterization of the MPZ & ROZ Reservoirs; Illustrate, Individually and Collectively, the Response of MPZ & ROZ to CO2 EOR; Model Response; Examine Next-Generation Diagnostics and Sweep Improvement Methods

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THE PROJECT TASKS

I. PROJECT MANAGEMENT & PLANNING

II. IDENTIFY, MAP AND CHARACTERIZE THE GLSAU)

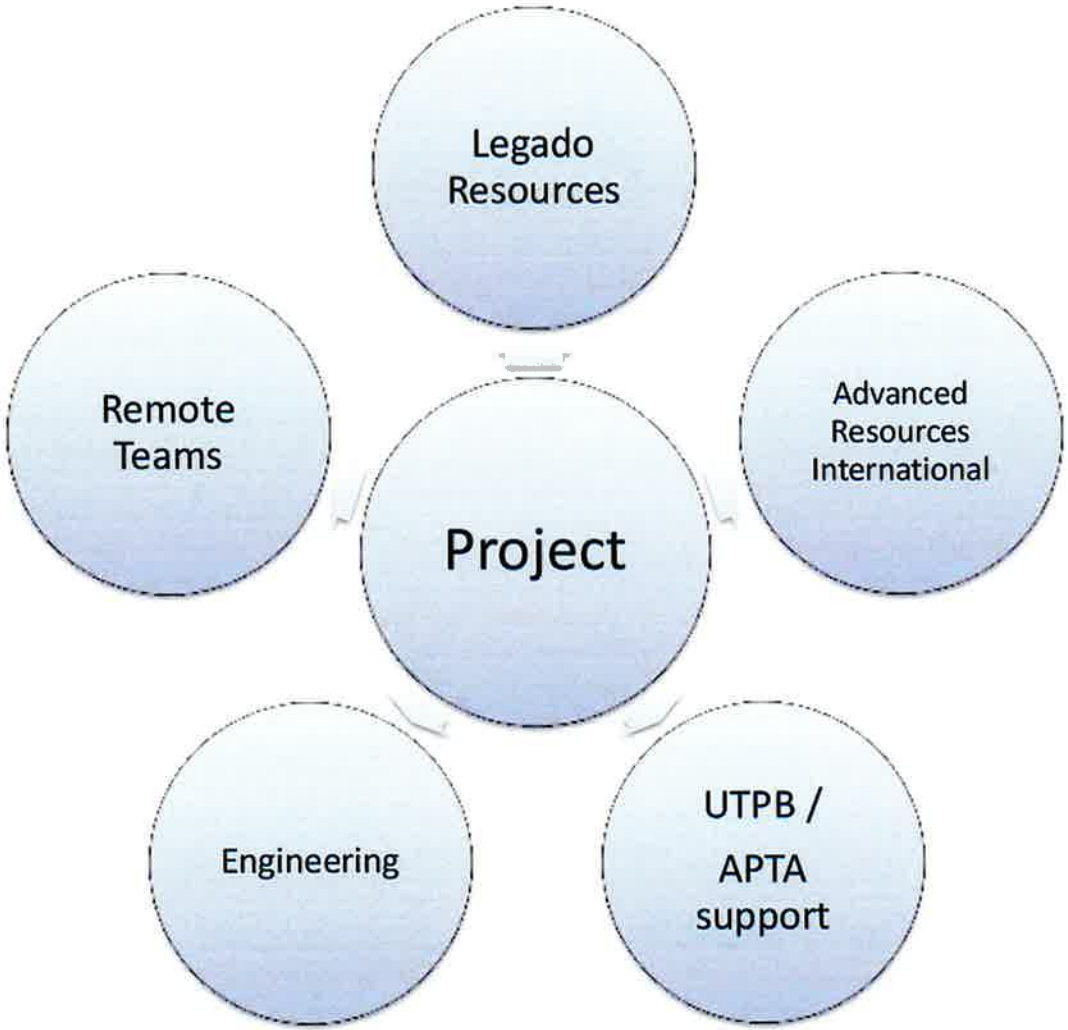
III. RESERVOIR SIMULATION

IV. NEXT GENERATION FEEDBACK AND CONTROL TECHNOLOGY TO OPTIMIZE THE CO2 FLOOD

V. CONDUCT DETAILED ANALYSIS OF THE ROZ AND MPZ CO2 EOR PROJECTS AT THE GLSA UNIT, ECTOR COUNTY, TX

VI. TECHNOLOGY TRANSFER

Task 1: Project Management and Planning



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Task 2: Identify, Map and Characterize a Major Permian Basin ROZ Field Area (GLSAU)

- Assemble Data on the Outline, Geologic Setting and Reservoir Properties of the ROZ
- Conduct Laboratory Work to More Accurately Establish the Level and Distribution of the Residual Oil in the ROZ and Compare to the Flushed Zone in the Waterflooded Area
- Integrate the Data and laboratory Work to Develop a Geologic Model for the ROZ

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Task 3: Undertake Reservoir Simulation to Assist with CO2 Flood Design – Track Project Performance

- Conduct Reservoir Modeling of the CO2 Flood Using a Full-Scale, compositional Simulator (GEM)
- Examine the Performance of the CO2 Flood Under Alternative Designs
- Establish Alternative Designs for the CO2 Flood

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Task 4: Apply Next Generation Feedback and Control Technology to Optimize the CO2 Flood

- Evaluate Alternative Techniques for Obtaining Real Time Feedback Data on Flood Performance

- Implement New Diagnostic/Feedback Data and Control System

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Task 5: Conduct Detailed Analysis of the ROZ CO2 EOR Pilot at the GLSA Unit, Ector Co, TX

- Document the Implementation of the ROZ CO2 EOR Pilot
- Gather All Flood Diagnostics Feedback Data on Performance
- Conduct Detailed Performance Analysis
- Use Diagnostics Data to Manage and Optimize a Dedicated CO2 ROZ Flood
- Use Diagnostic Data to Manage and Optimize a Commingled MPZ and ROZ Flood

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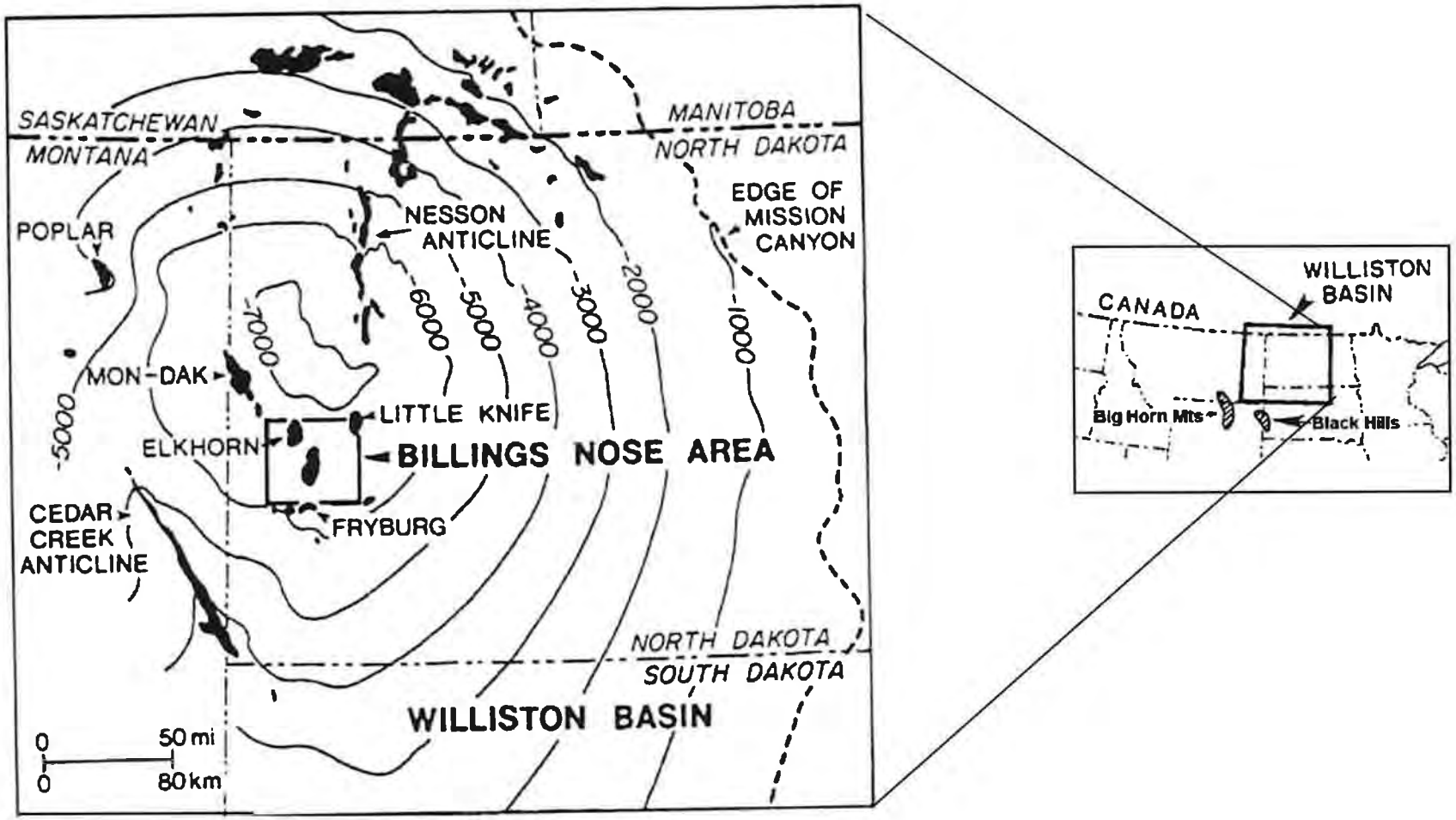
Task 6: Conduct Technology Transfer of Findings and Document These in a Draft and Final Report

- Conduct Engineering and Geologic Presentations at Local, State and National Workshops and Conferences*
- Prepare Final Report

How does this apply to Wyoming?

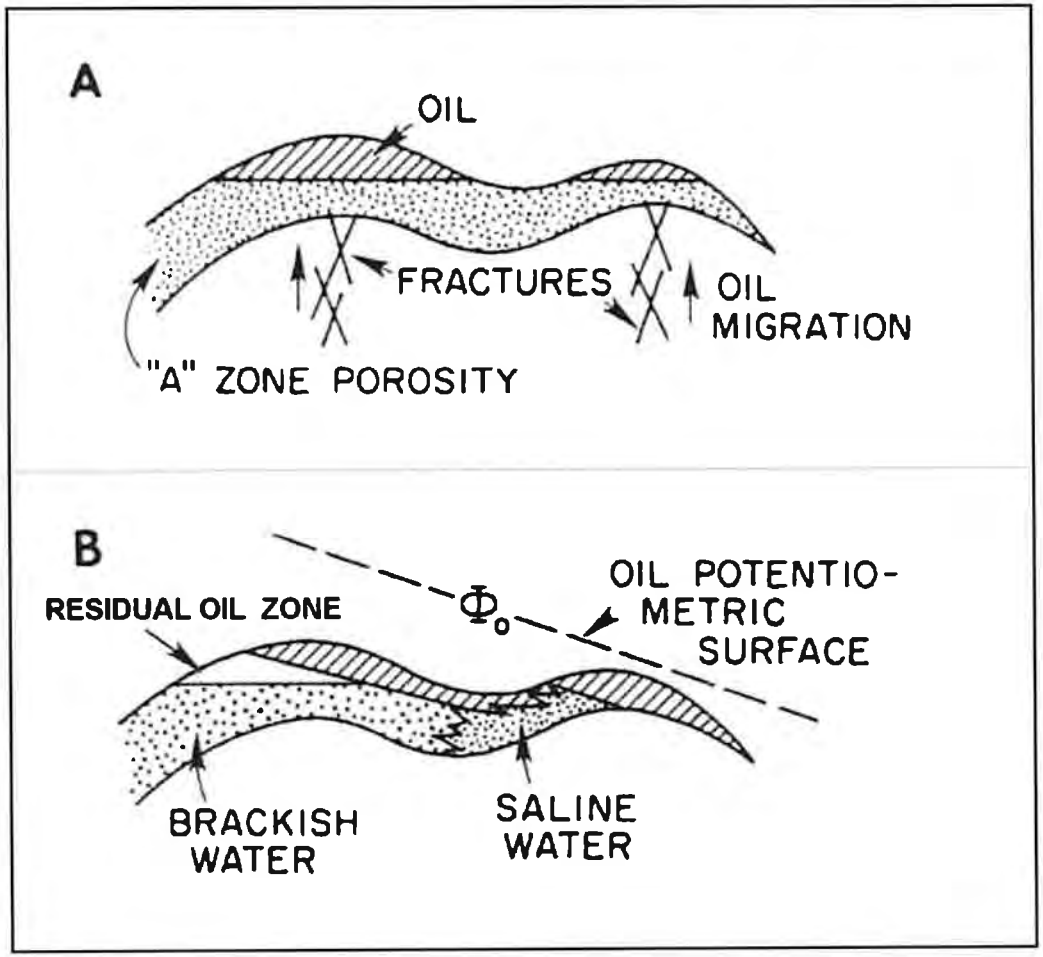
- CO2 has been increasingly important in EOR in Wyoming.
- With the continued development of a pipeline network, additional sources of Anthropogenic CO2 are being rapidly developed.
- Evidence suggests that long term, ROZ's are going to be a source of new EOR projects.
- Anthropogenic CO2 will be required for these ROZ projects.

Regional Structure of the Mission Canyon Fm. and Location of Important Oil Fields and Greater Billings Nose Study Area, Williston Basin *



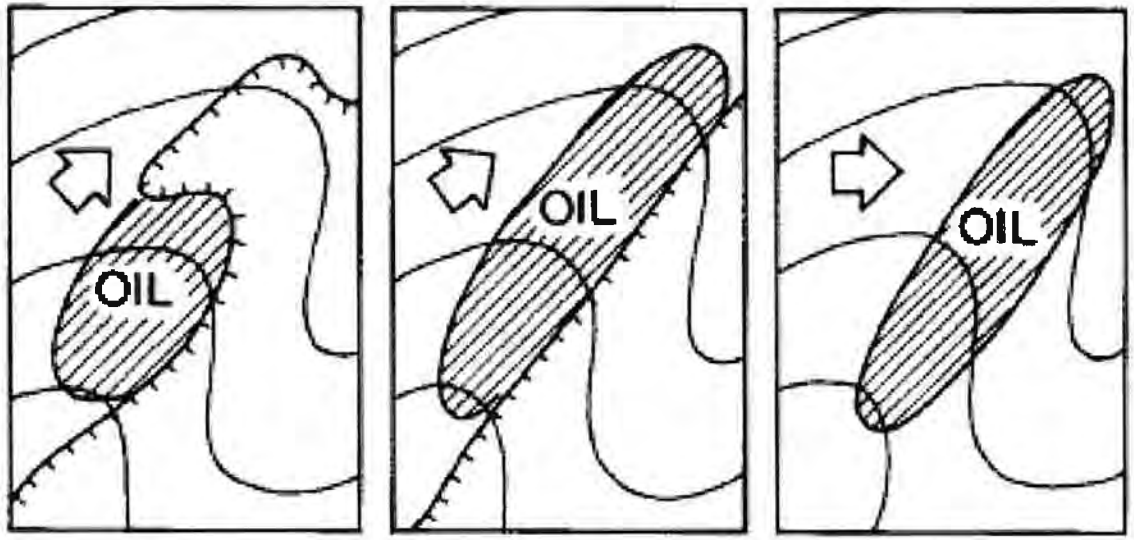
* Adapted from) Berg, R.R., DeMis, W.D., Mitsdarffer, A.R. (1994),

Early work suggesting the presence of ROZ's was seen in the sequence Of Oil Migration and Accumulation in the Billing Nose Fields, Williston Basin *



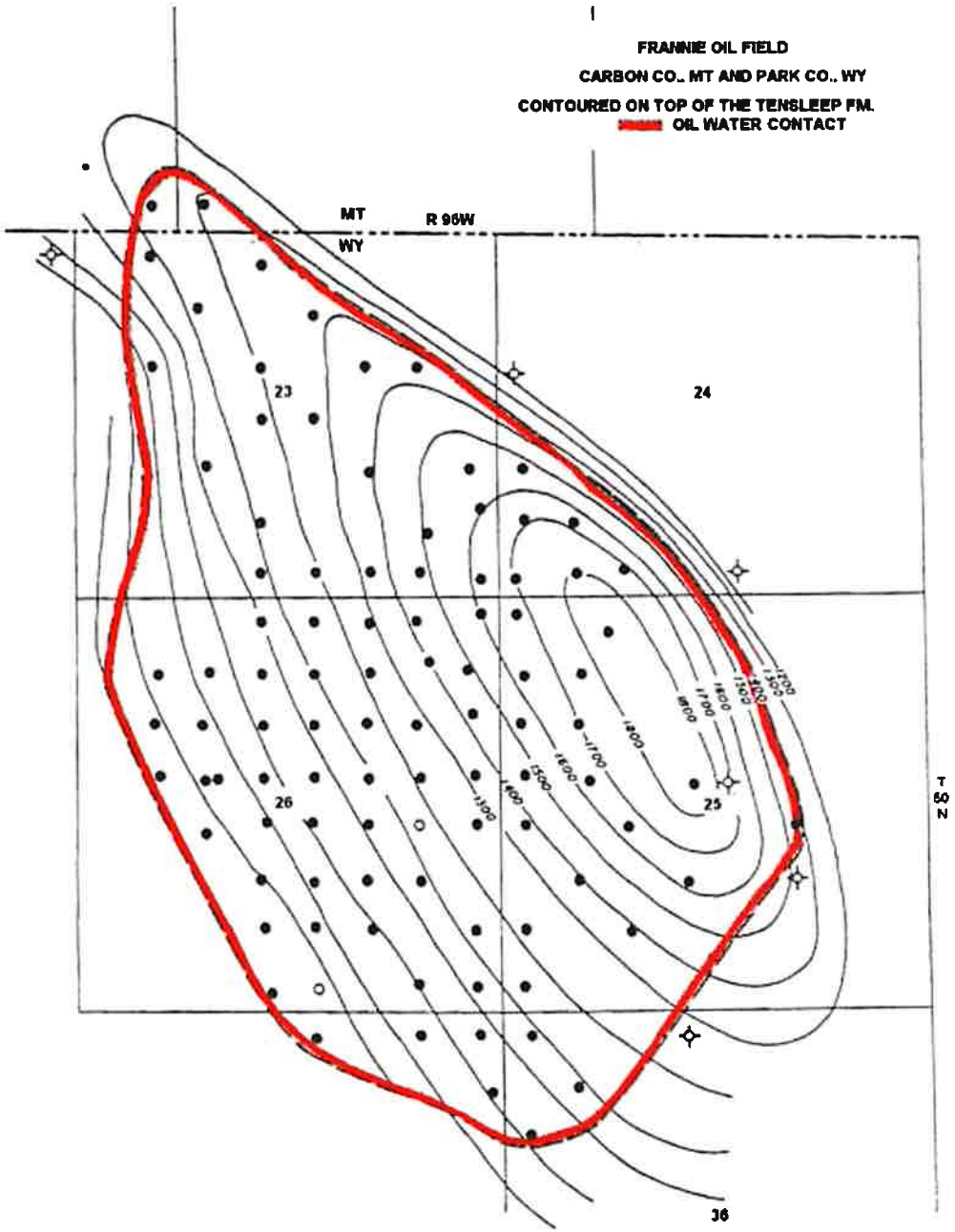
* Adapted from) Berg, R.R., DeMis, W.D., Mitsdarffer, A.R. (1994),

Examples of Hydrodynamic Traps seen in the Williston Basin



POROSITY PINCHOUT
STRUCTURAL FORM LINES
OIL ACCUMULATION
HYDRODYNAMIC FLOW DIRECTION

* Adapted from) Berg, R.R., DeMis, W.D., Mitsdarffer, A.R. (1994),



Frannie Oil Field, Big Horn Basin Illustrating the SW OWC Tilt of ~600 ft/mi

Adapted from Hubbert, M.K. (1953)

Anthropogenic CO_2 in Wyoming and points north

- The largest single source of anthropogenic CO2 used for EOR is the capture of 230 MMcfd (4+ MMmt/yr) of CO2 from the gas processing plant at La Barge in western Wyoming.
- This is followed by the "poster child" for integrating large-scale CO2-EOR with CCS - - the capture of 150 MMcfd
- (~3MMmt/yr) of CO2 from the Northern Great Plains Gasification plant in Beulah, North Dakota and its transport, via a 200 mile cross-border CO2 pipeline, to the two EOR projects at the Weyburn oil field in Saskatchewan, Canada.
- Other sources will be coming to a neighborhood new you in the future.

Rockies New Anthropogenic CO2 Sources

Location	MMcfd	Million mt/yr	Comments
Natural Gas Treating Plants			
1. Exxon La Barge, SW Wyoming	230	4.1	Plant Expansion
2. COP Lost Cabin, Central Wyoming	50	1.0	Under contract
3. Riley Ridge, SW Wyoming			Under Discussion
Subtotal	150	2.9	
Proposed Coal to Gas/Liquids Plants			
1. KRW/Medicine Bow, SE Wyoming	150	2.9	DOE Loan Guarantee
2. Refined Energy, SE Idaho	80-175	2.3	Diesel/Fertilizer
3. Gas Tech, NE Wyoming	115	2.2	UCG
4. Many Stars, C. Montana	250	4.8	Start in 2012
5. South Heart, SW N. Dakota	100	1.9	Coal to H2
Subtotal	595-690	14.1	
Total	745-840	17.0	

From Kuuskraa (2010)

Special Thanks to:

RPSEA
Steve Melzer
Arcadis - David Vance, Steve Tischer
Phil Eager, Edith Stanton, Saswati Chakraborty
Chevron & Legado our industry partners
George Koperna, Advanced Resources International
All those who have battled with ROZ's in the past.

Summary

- We've only just begun.
- ROZ's are real and a major tertiary recovery target for today and long into the future.
- Modeling using regional scale groundwater modeling package is underway.
- Documentation of areas/fields with potential is underway.
- Phase 2 – testing models in the field has begun.
- A number of presentations have been/or will be made and can be found on our RPSEA supported website: **Residualoilzones.com**.