[AV]Key Attributes of Canadian and U.S. Productive Shales: Scale and Variability

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Search and Discovery Article #110129 (2010)
Posted June 14, 2010

*Adapted from oral presentation at session, Genesis of Shale Gas--Physicochemical and Geochemical Constraints Affecting Methane Adsorption and Desorption, at AAPG Annual Convention, New Orleans, LA, April 11-14, 2010

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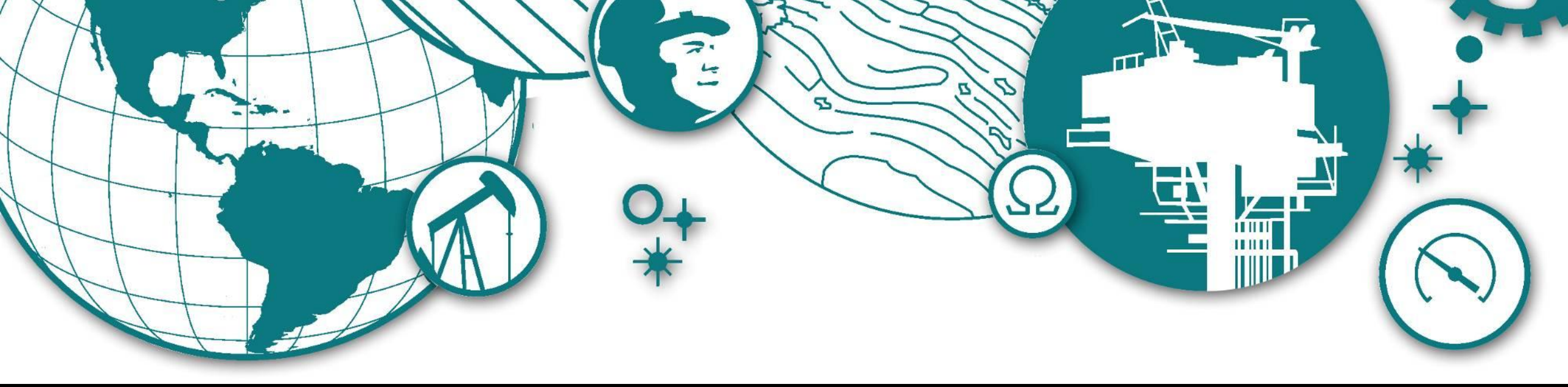
Abstract

Shale gas reservoirs have come of age. This class of reservoirs has changed the landscape of gas resources in North America. Gas shale geochemical, mineralogical and textural attributes within a shale-gas system approach is needed. These reservoirs are heavily engineered, and understanding scale and variability is needed for continuous production improvement.



Key Attributes of Canadian and U.S. Productive Shales: Scale and Variability

Basim Faraj and Meghan Brown
Talisman Energy Inc.

AAPG 2010 Annual Convention & Exhibition
New Orleans, April 11-14

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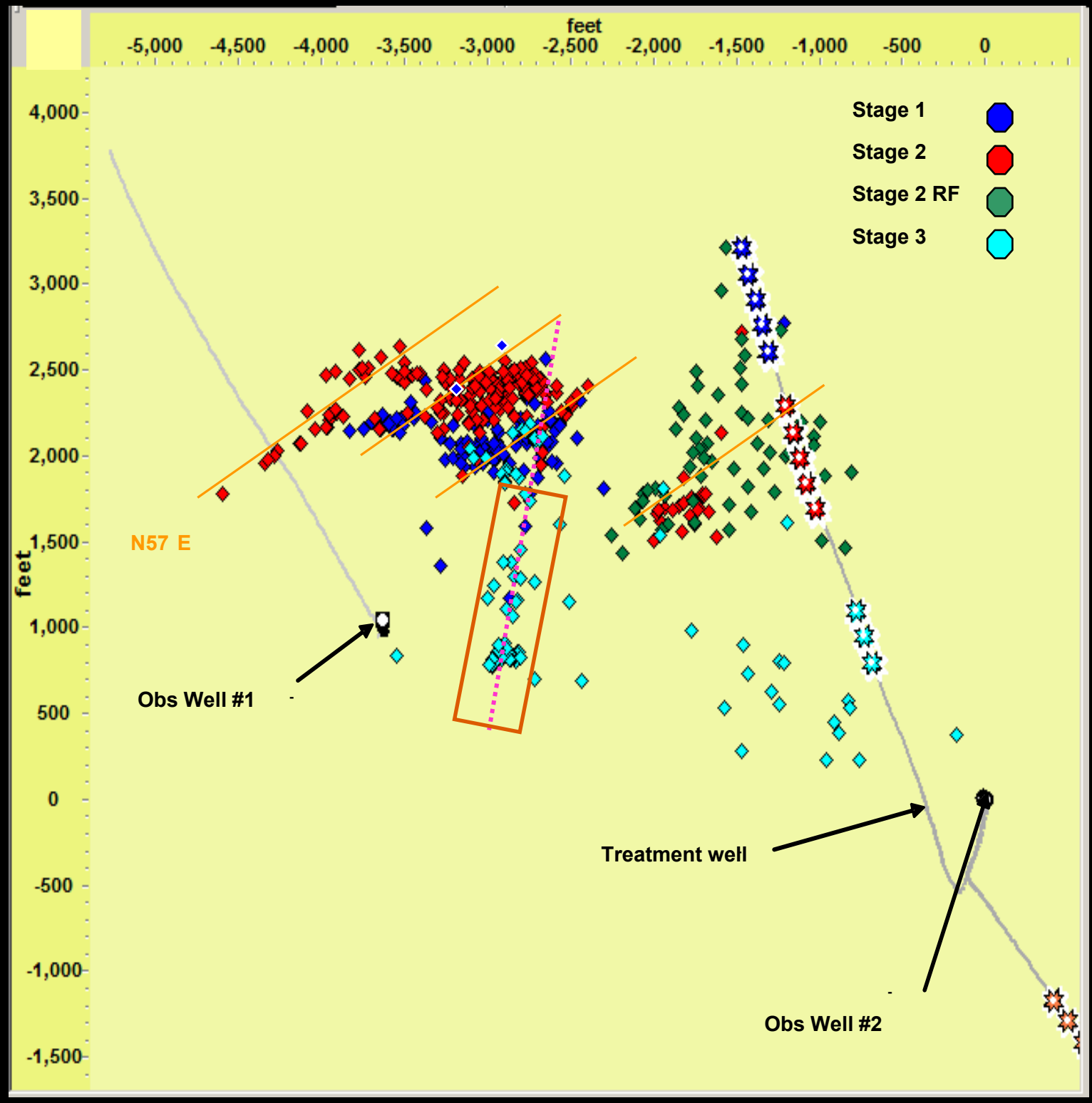
Preamble

- **Shales are not homogeneous and should not be treated as such**

- **There is no such thing as “cookie cutter” drilling and completion**

- **We always need to learn from well to well and area to area, changing our methods according to what the rocks are telling us**

Woodford Shale-Interaction with Geology



SPE 110029

Mayerhofer, 2010

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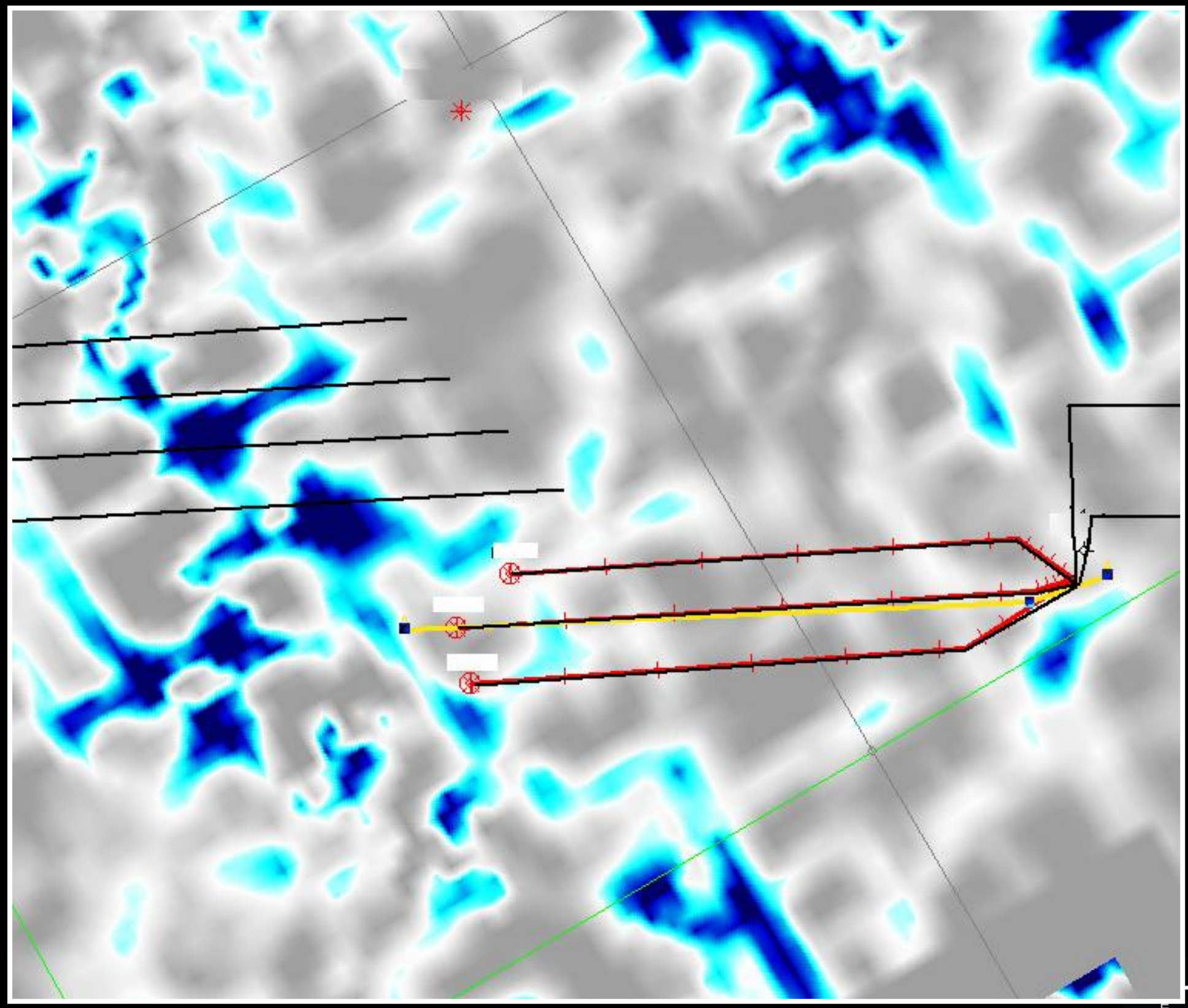
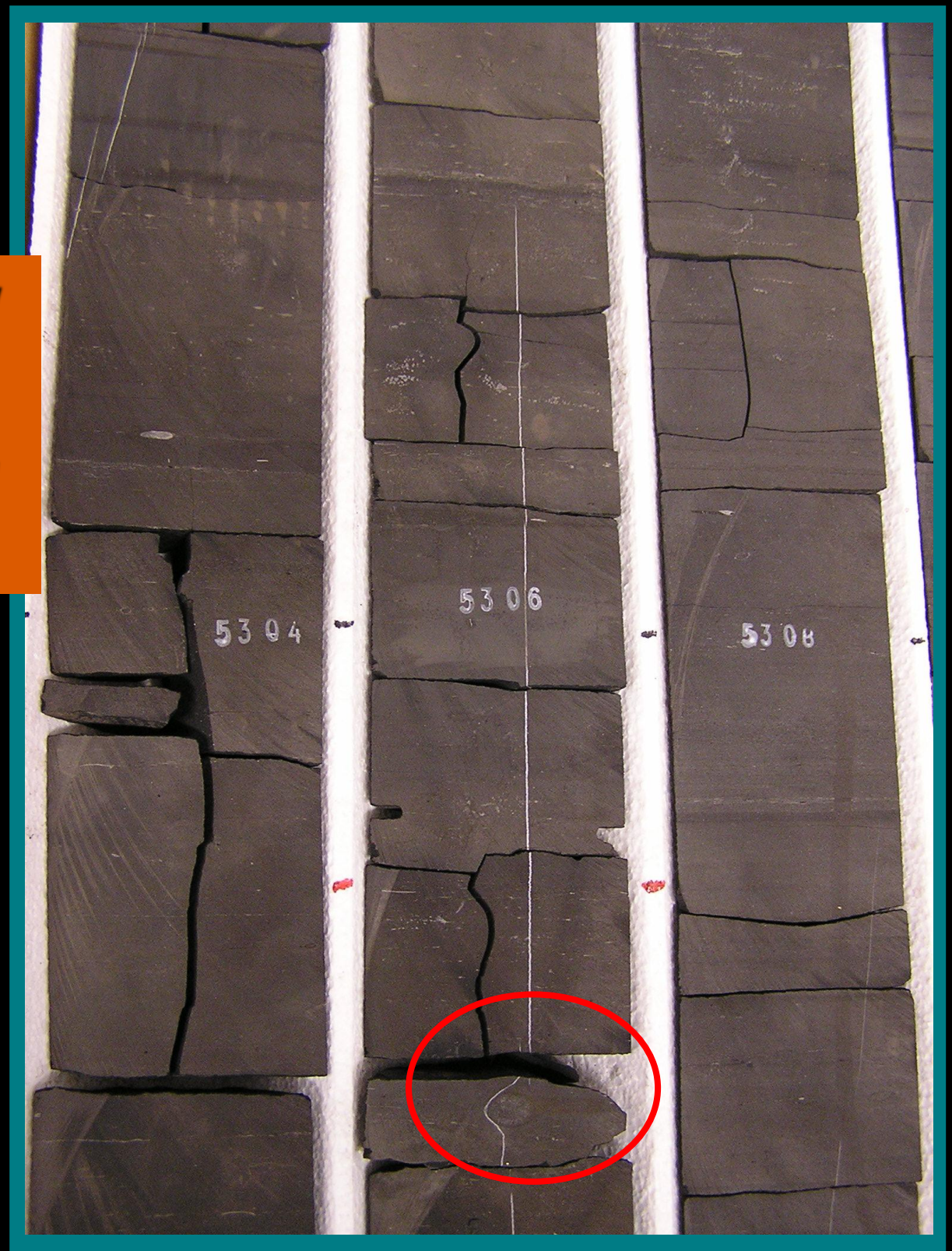
Taking 3-D Seismic to a New Level: Maximum Curvature Analysis



Rimrock Energy, LLC

Barnett Shale Core



Fractured (Brittle) Shale Gas Play

TOC ~4%
%Ro ~1.3

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1 cm

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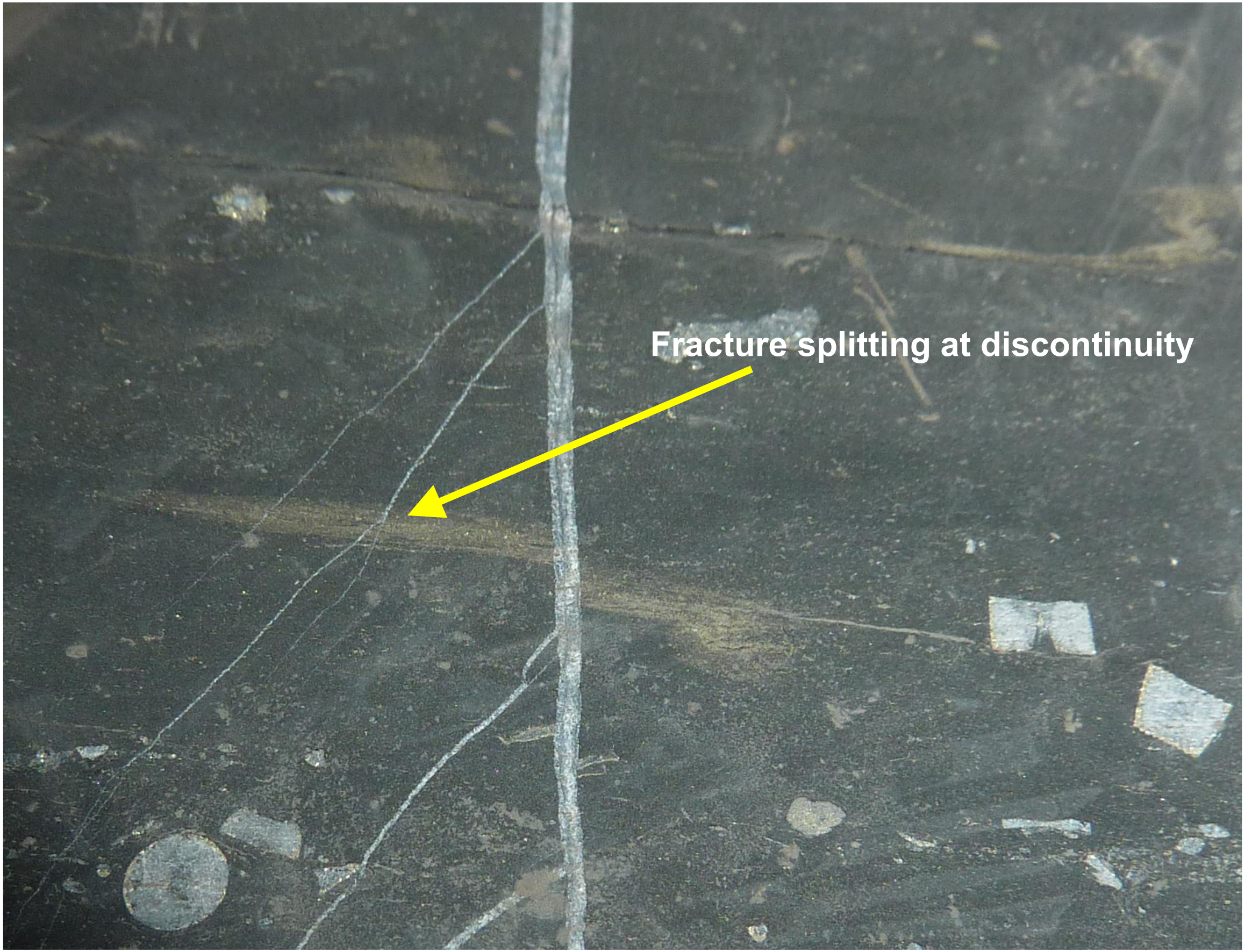
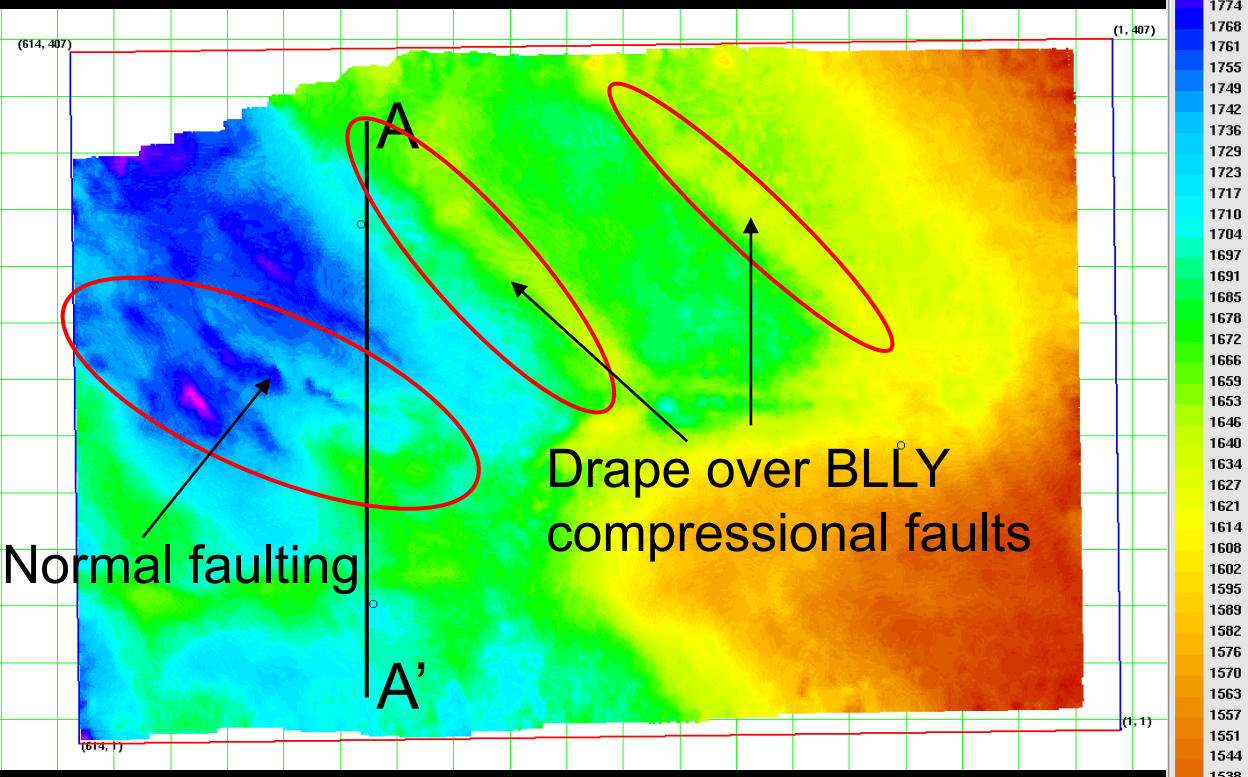

Fracture splitting at discontinuity

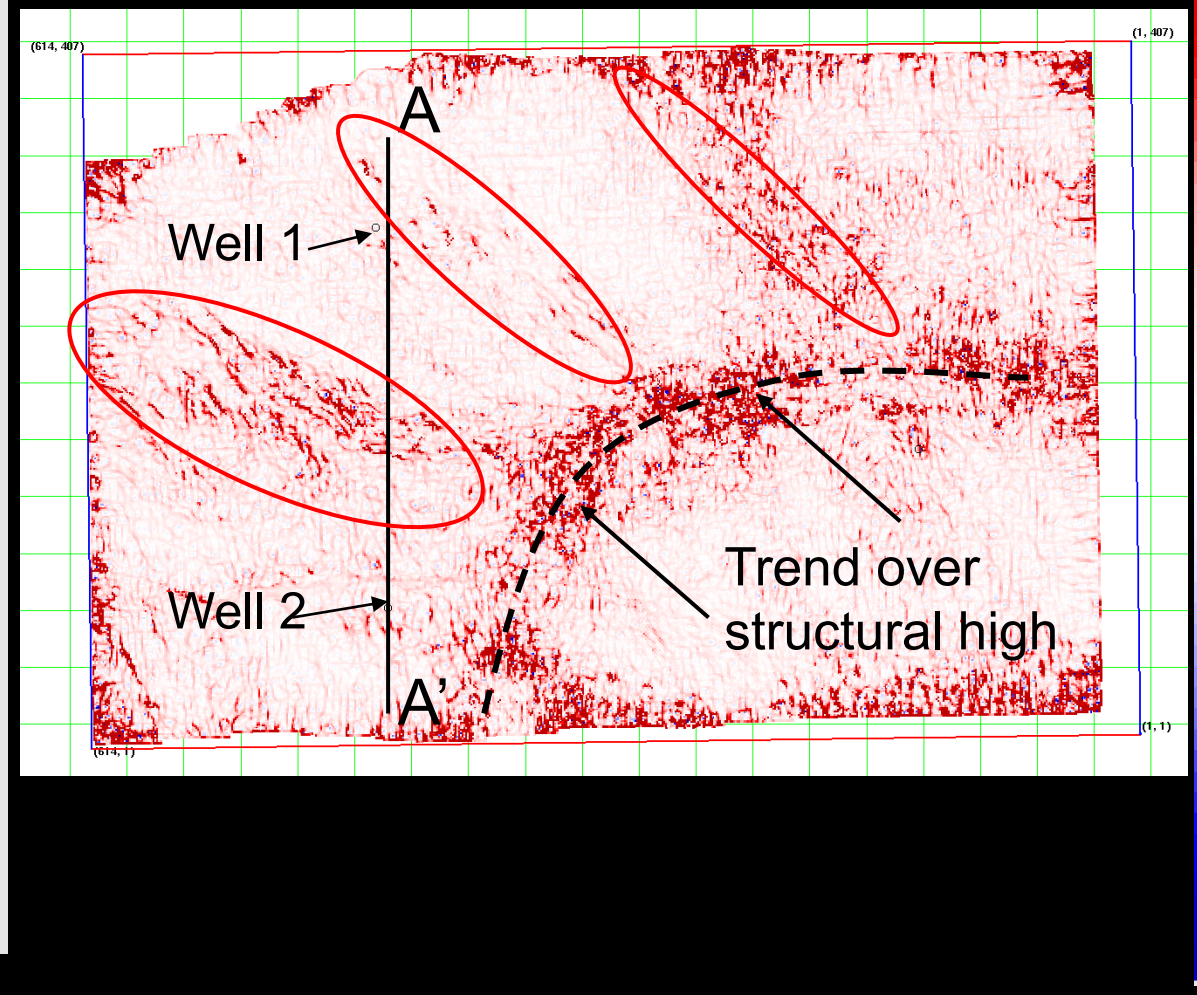
Seismic Area A

Curvature analysis at Reservoir Level

•Reservoir subsea structure (m)



•Maximum Curvature at reservoir level



- Curvature analysis (a fracture detection method) highlighting known faults and structural features
- May indicate high level of natural fracturing in these areas

(Seismic courtesy of CGGVeritas)

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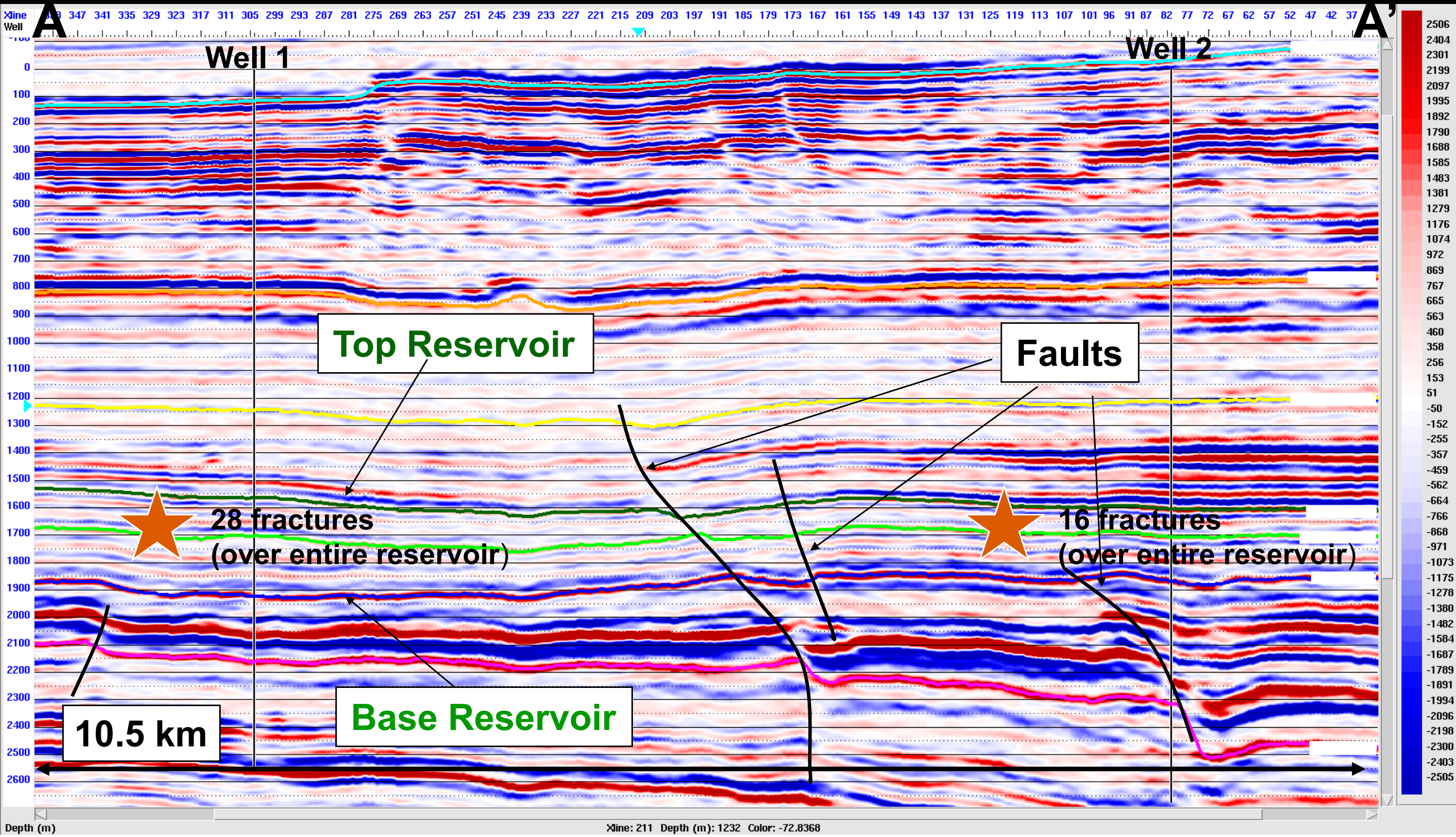
Seismic Area A

Depth converted section (2x vertical exaggeration)



Presence of fault systems in area A is likely to provide increased levels of natural fractures

(Seismic courtesy of CGGVeritas)

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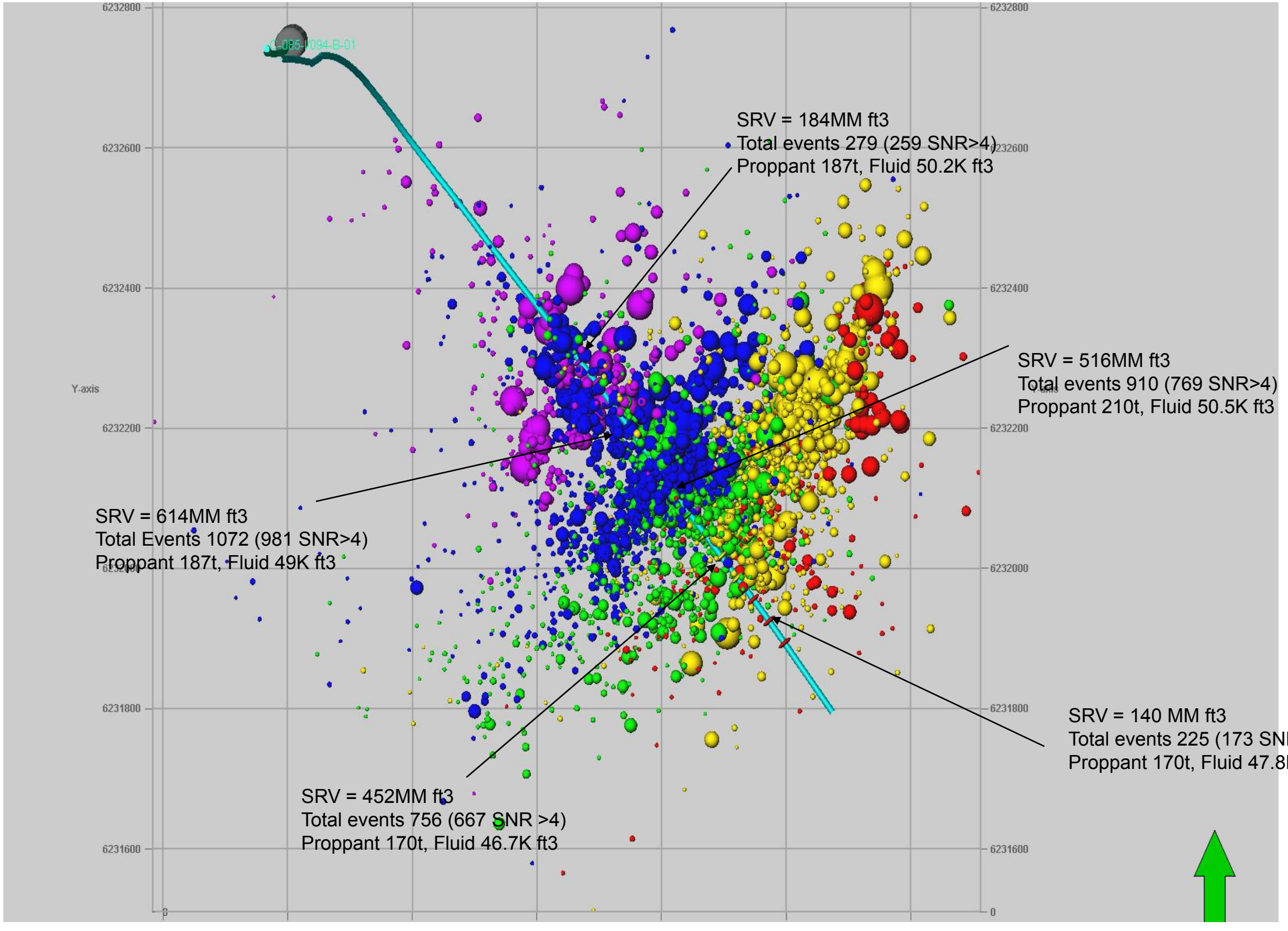
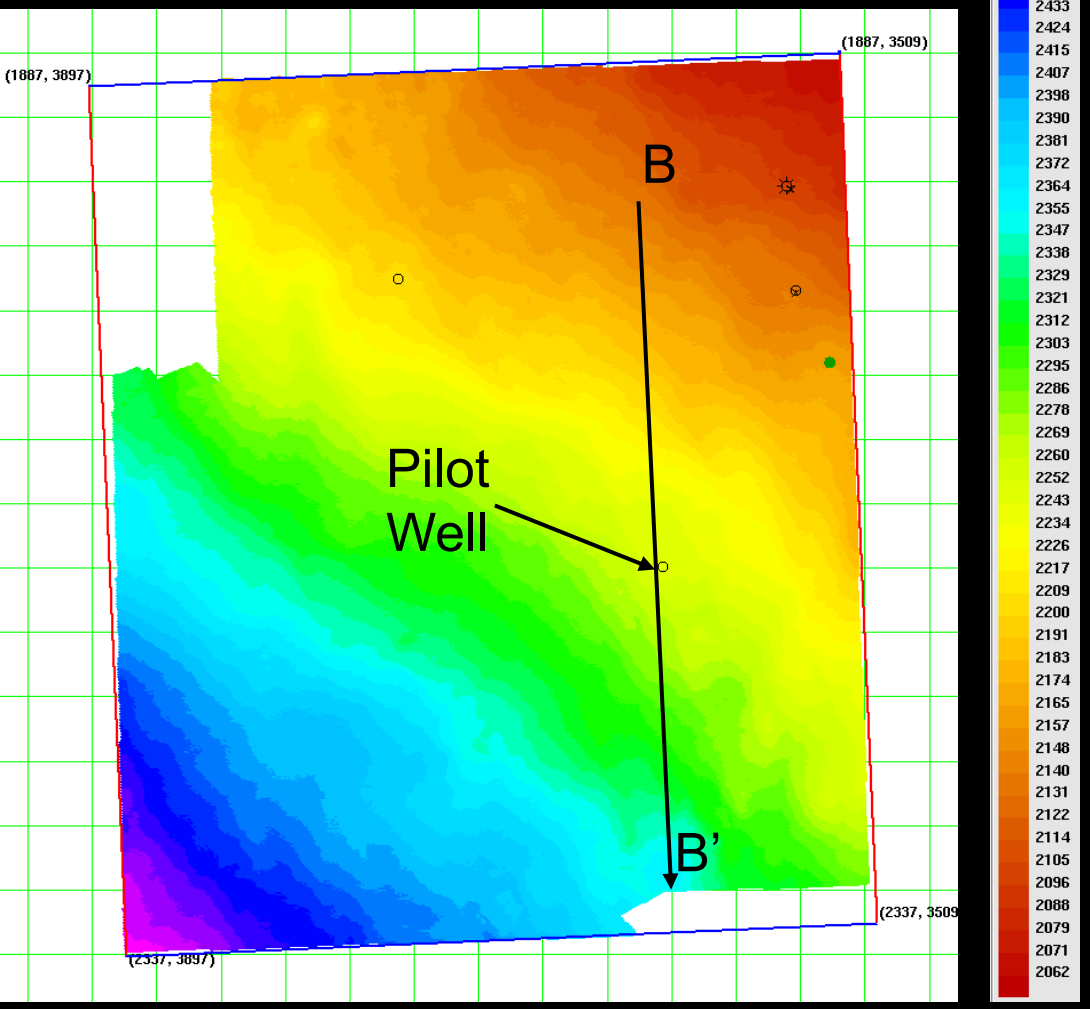
Microseismic of well in Area A (SRVs calculated with SNR>4)

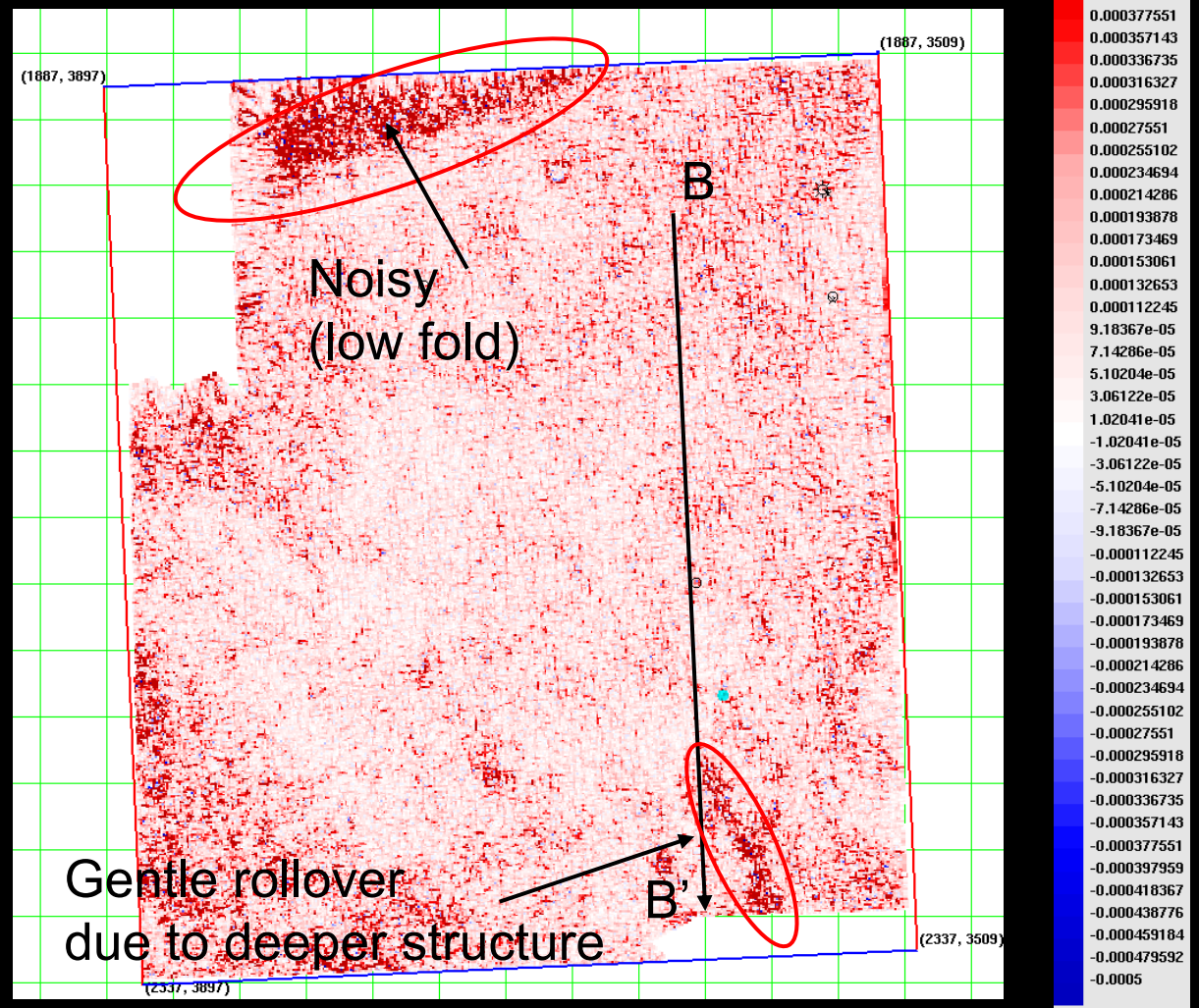


Seismic Area B

- Reservoir subsea structure (m)



- Maximum Curvature at reservoir level



Curvature analysis shows little distinguishing features in this structurally quiet area

(Seismic courtesy of Divestco)

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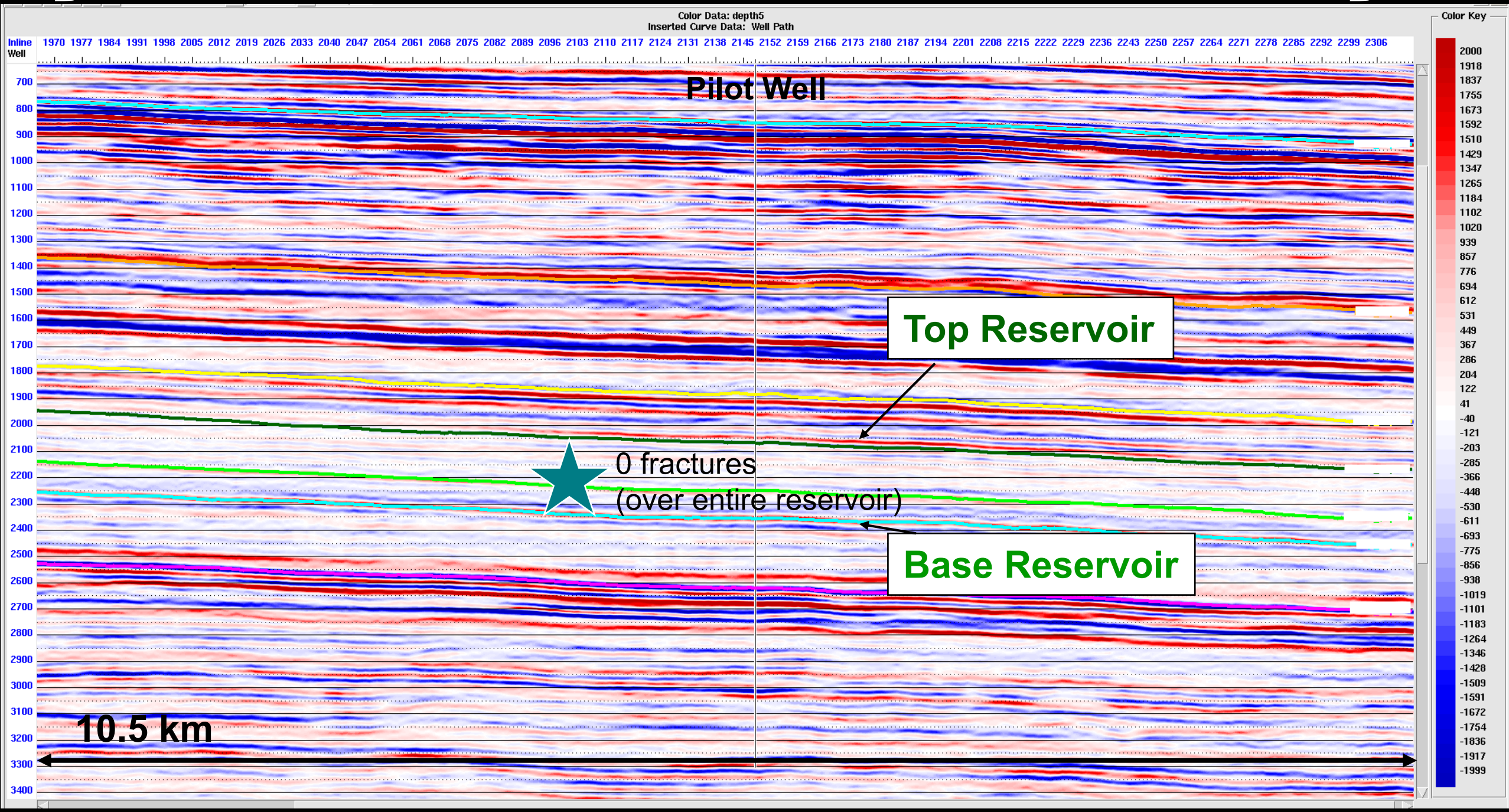
Seismic Area B

Depth converted section (2x vertical exaggeration)

B

B’



Seismic over area B shows relatively little structural features or faults at the reservoir

(Seismic courtesy of Divestco)

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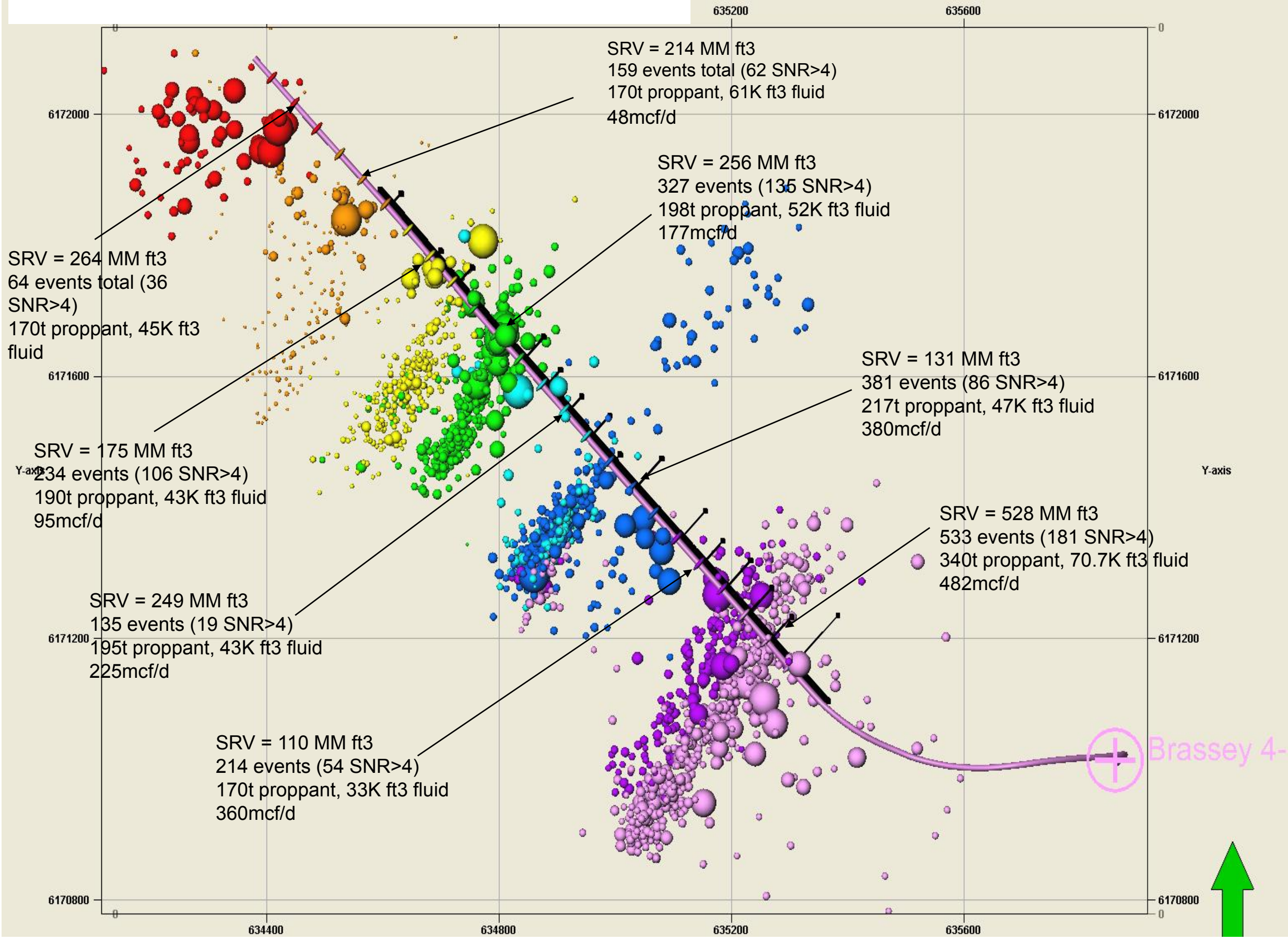
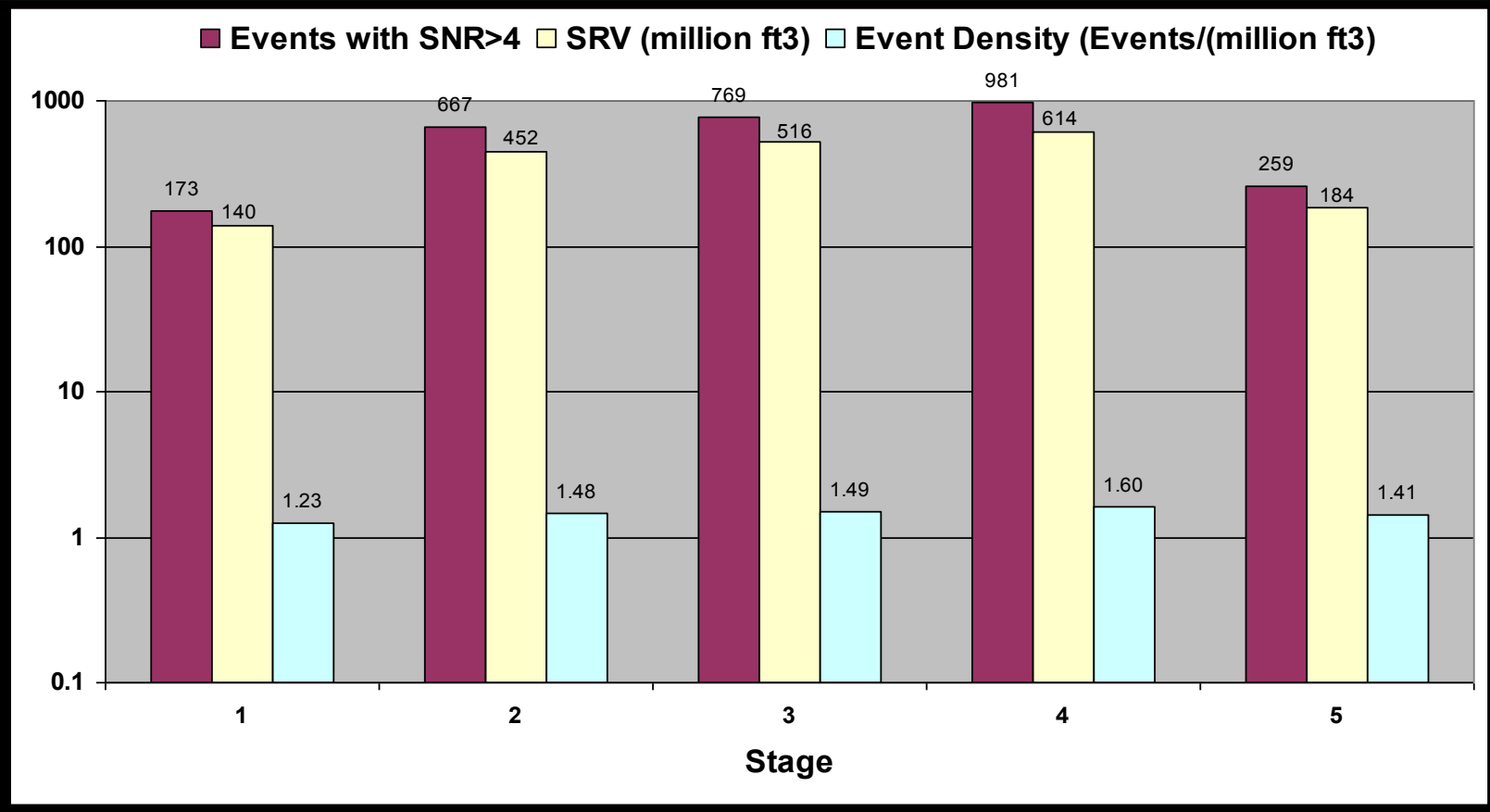
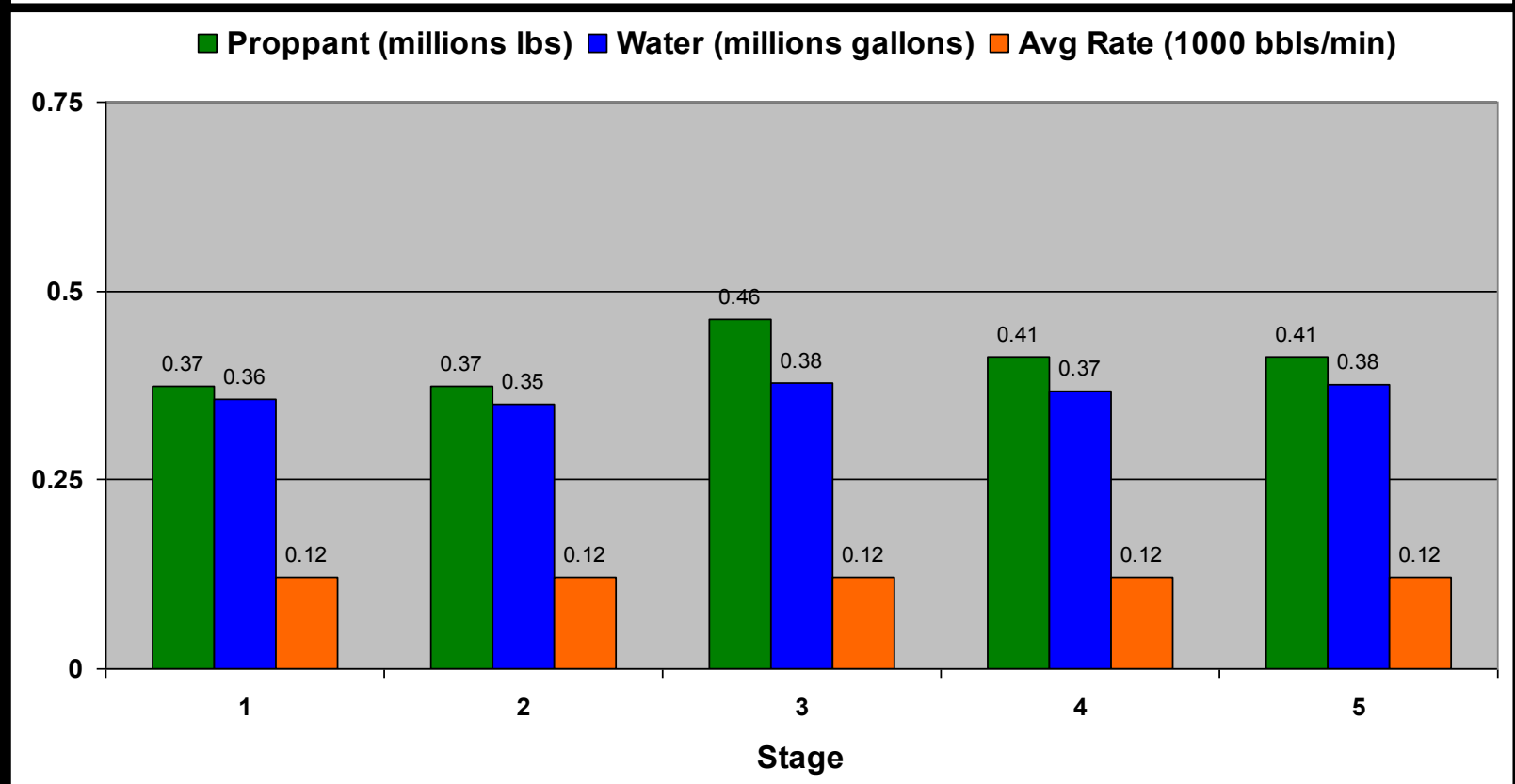
Microseismic of well in Area B (SRVs calculated with SNR>4)



Microseismic Area A





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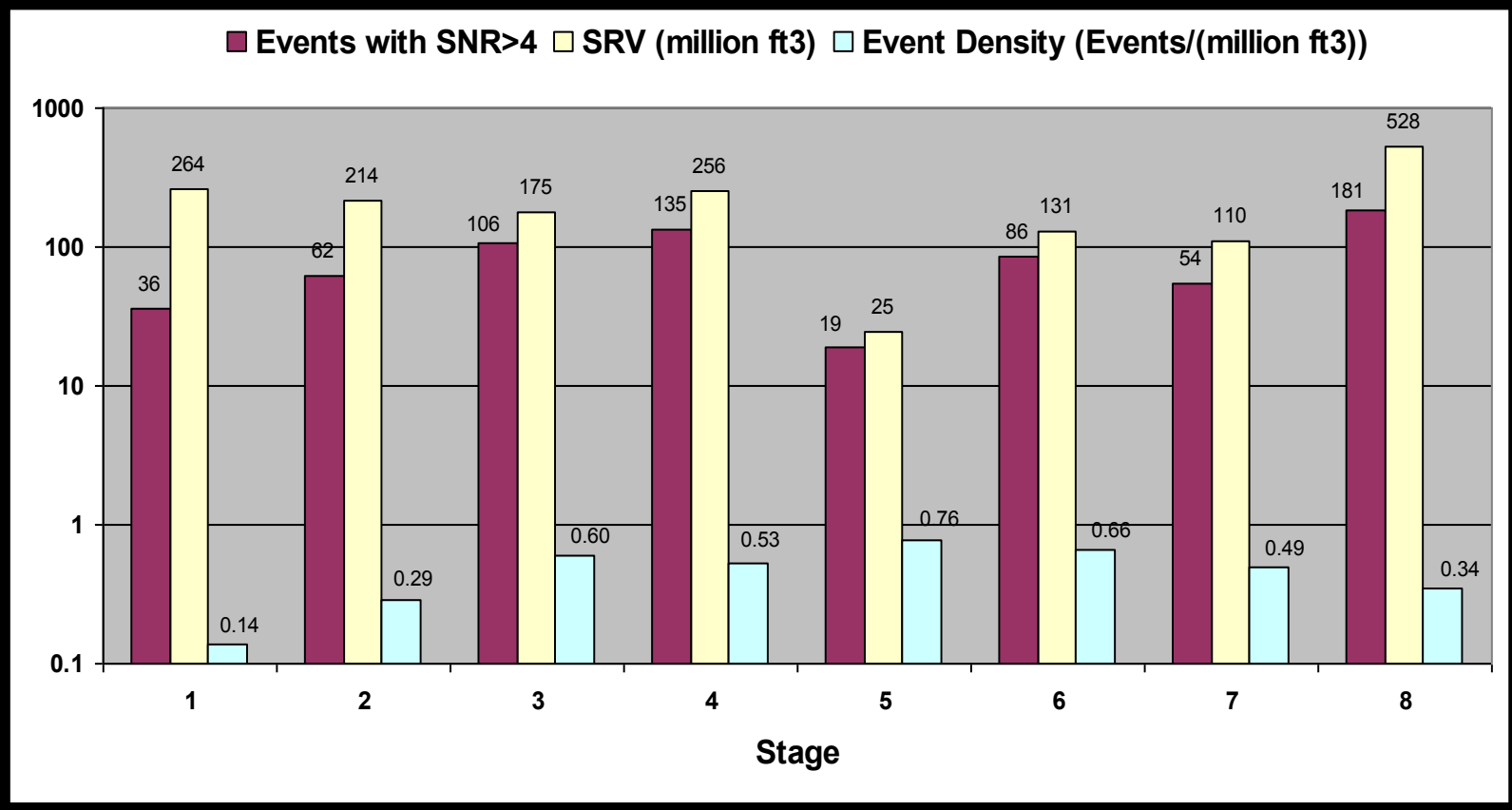
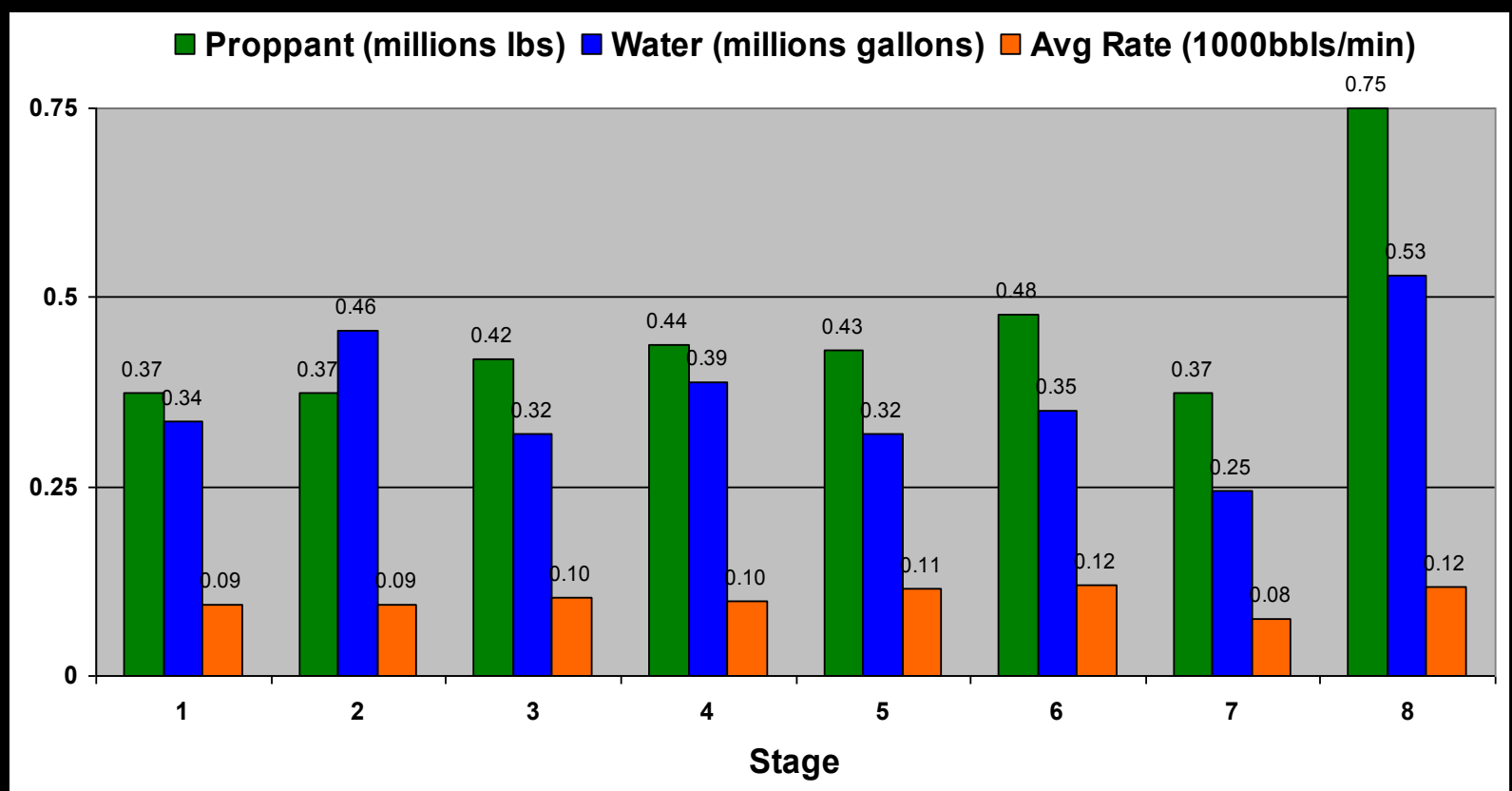
Microseismic Area B





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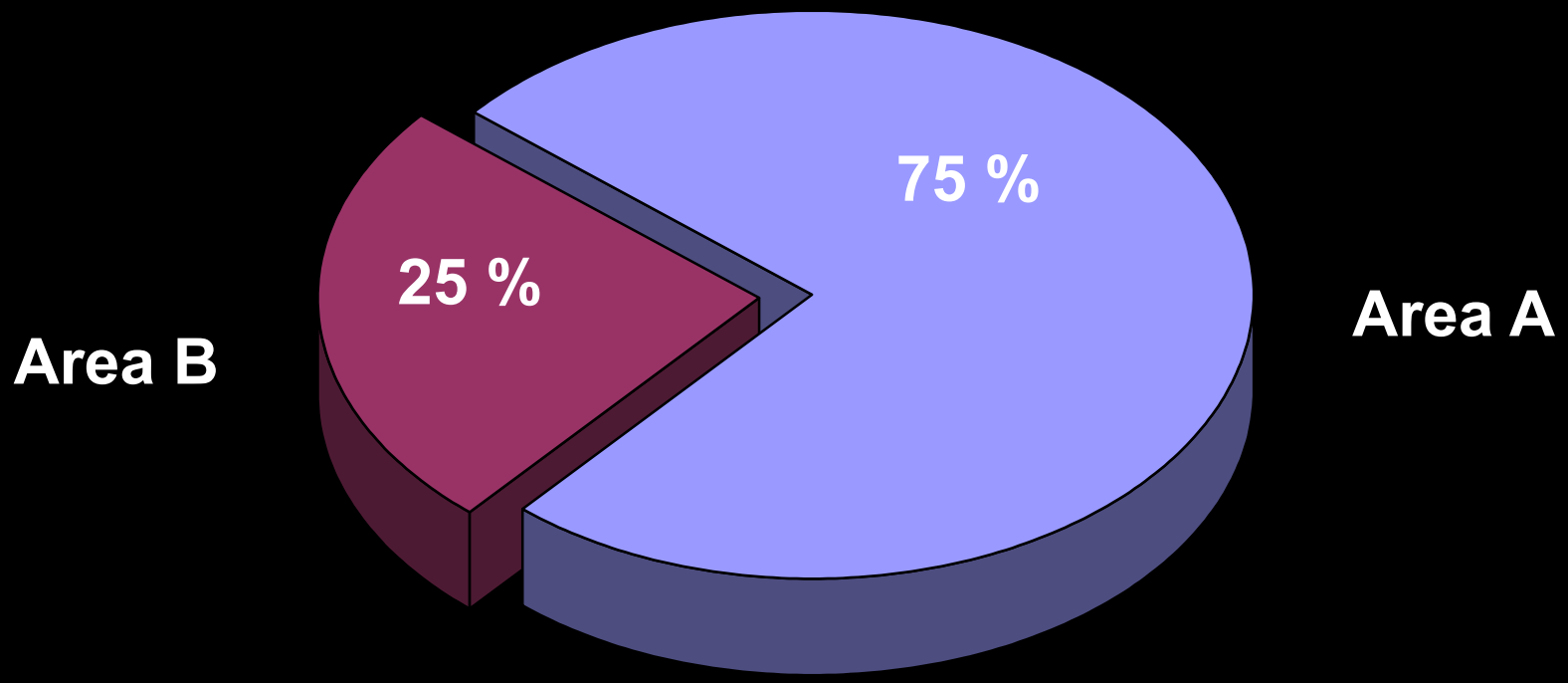
Microseismic Events Density (SNR>4)



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Two Orthogonal Fracture sets in Upper Devonian Geneseo Shale, , Taughannock Falls, July, 07

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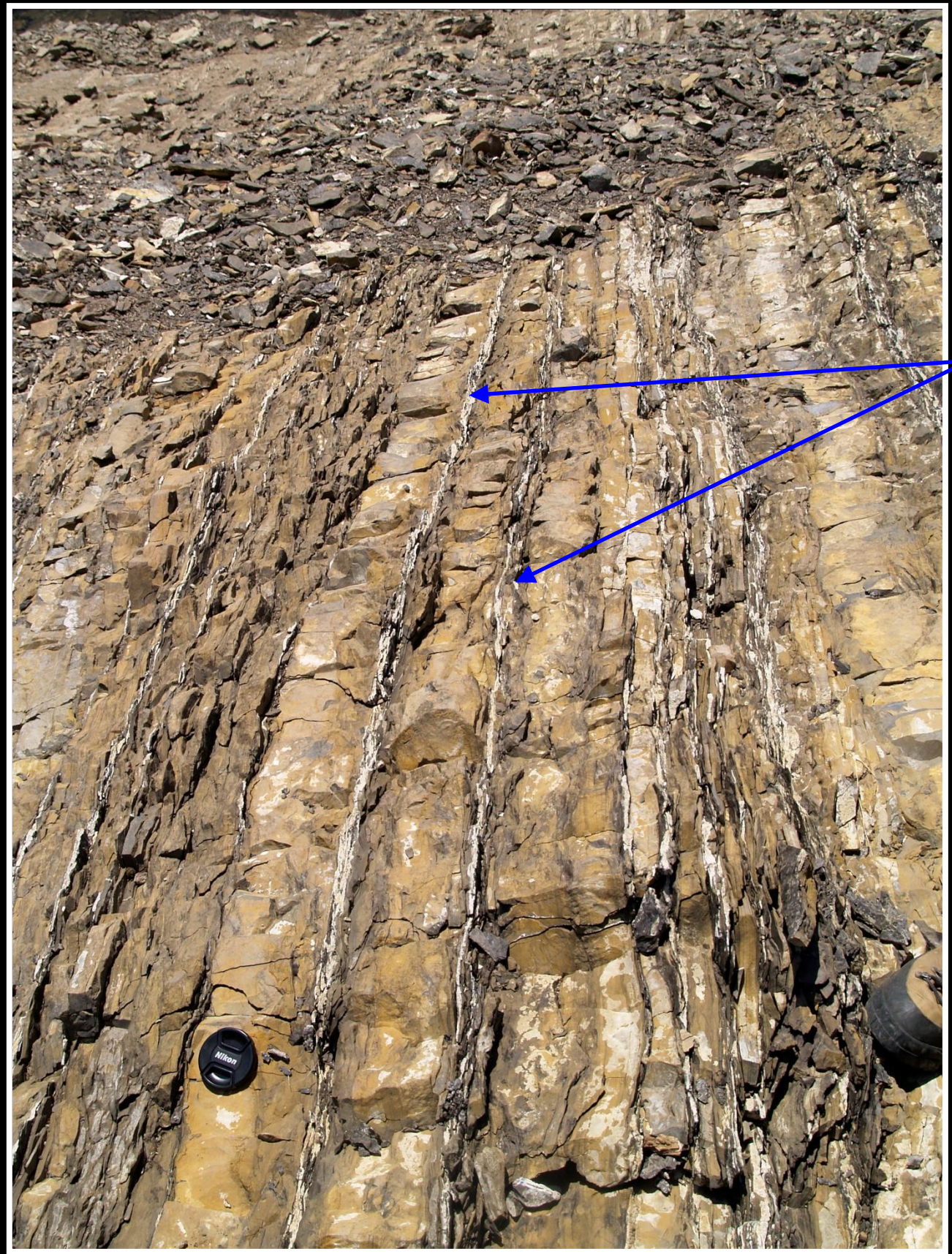

Horizontal Fractures fill: Triassic Outcrop, Williston Lake, BC

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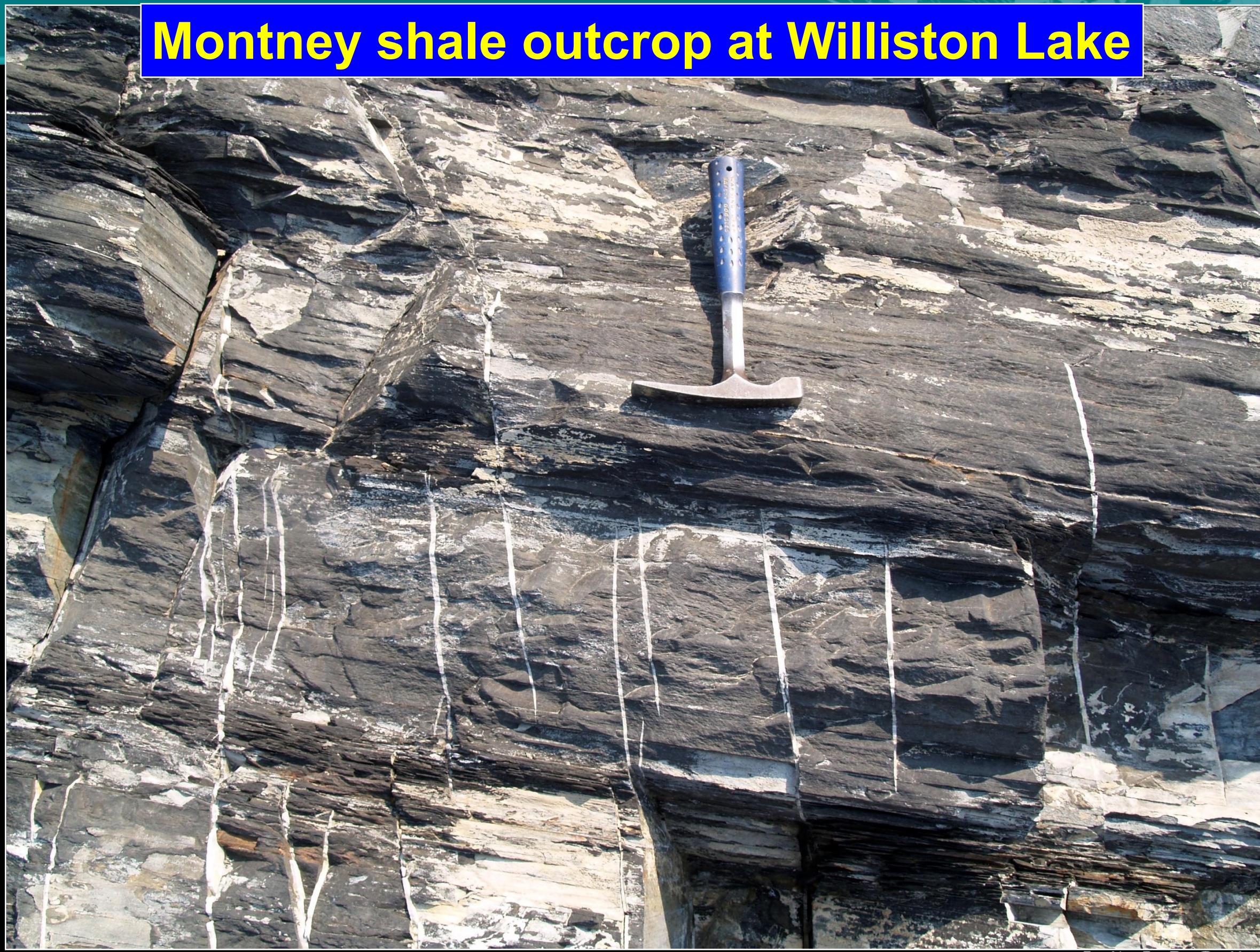
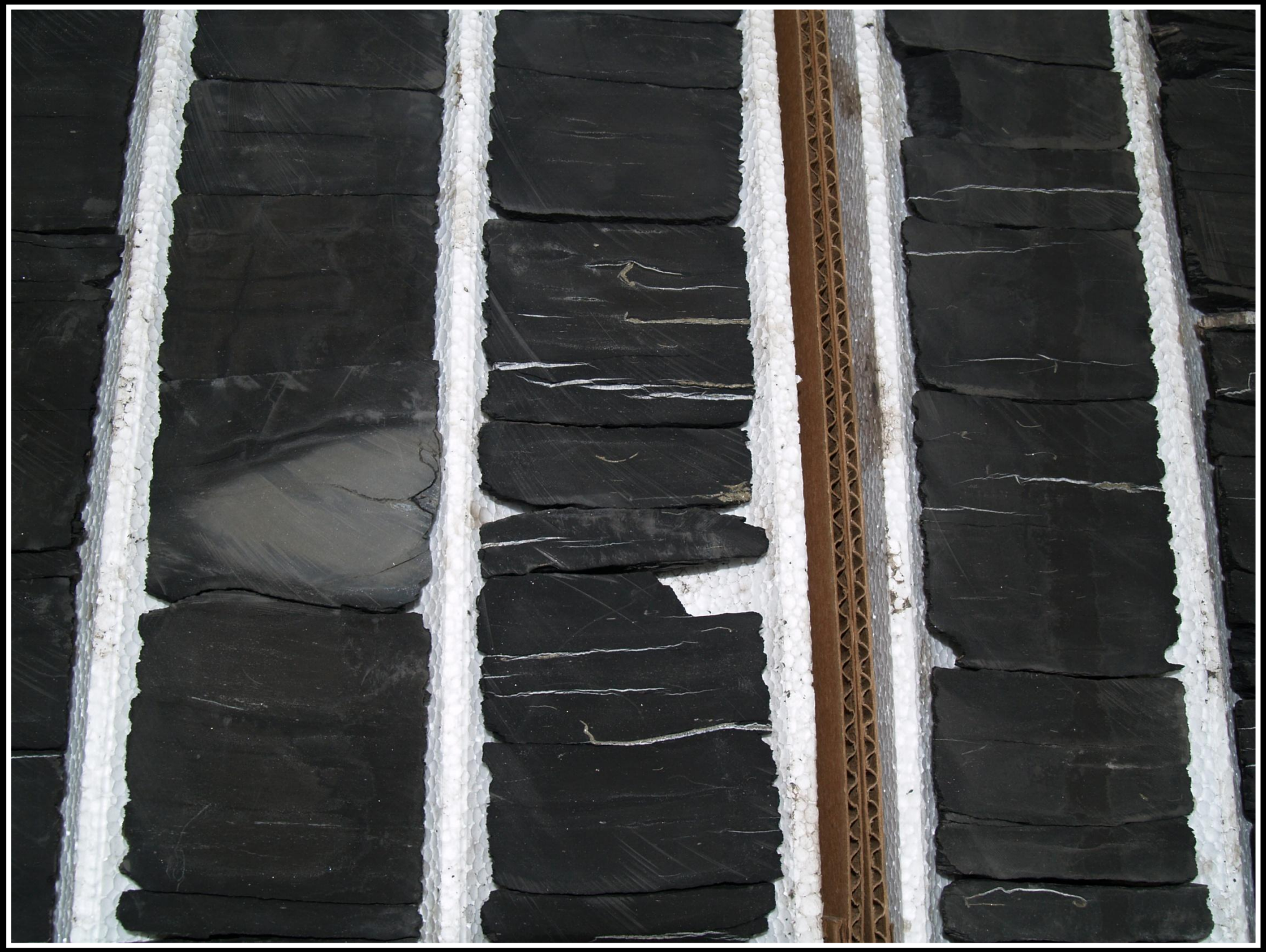
Montney shale outcrop at Williston Lake



Haynesville Shale Horizontal Fractures



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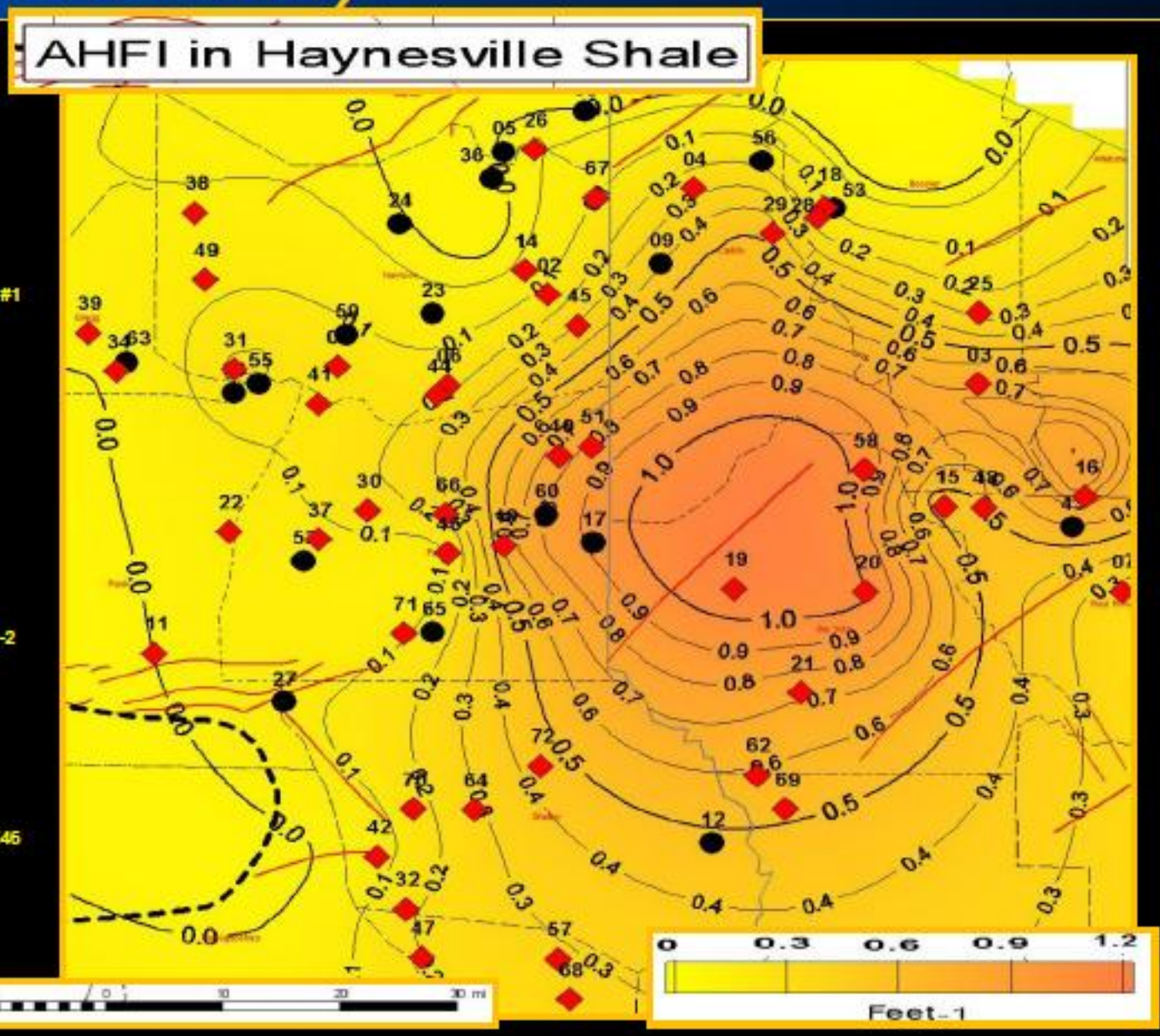
Average Horizontal Fracture Intensity Map (Haynesville Shale)



WELL LIST
1. T.W. George "A" 8H
2. North Jonesville 17 A
3. Elm Grove Plantation # 63
4. Hall 5 # 1
5. Beaird # 3
6. Huffman # 1
7. J. W. Adcock
8. Stiles Trust
9. Wages # 12-1
10.Frost Unit 5 # 11
11. James G. Anderson # 2
12. Humble Oil Pickering Lumber #1
13. George Henderson # 1
14. Coleman Gas Unit 1 # 6
15. Waerstad # 3ALT
16. Wiggins 36H # 1
17. Travis Lynch 4H
18. Atkins Lincoln 17-2
19. Gamble H-24 # 1
20. Sustainable Forest 24-1
21. Johnson Trust 1-2H
22. McRae #4
23. Brown # 1
24. F C Green 13H
25. Cyrus 4-1
26. Jerry Jones #1
27. Mitchell Trust 1A
28. A. S. Burt 20 #1
29. Tri-State Realty Company 28 -2
30. CGU 16-19
31. Letourneau GU 2-17
32. Red River 877
33. Major Kennedy Est GU 26
34. Patsy Johnson
35. Shell W. C. Jones #1
36. T J Taylor #15
37. T. J. Ross Unit 1H
38. United Resources GU # 1
39. WSCGU (Horton Dickson) # 546
40. Floyd Gas Unit No. 22
41. New Horizons No. 1H
42 . Hughes GU # 4
43. J. Carlisle et al 14 - 1A
44. George Foreman GU 2H
45. Fields-Isaacs 15
46. Hull A 102
47. Red River 164 # 1

WELL LIST (cont...)
48. Sample 10 H # 1
49. Unit Lawrence # 1H
50. Southwestern Morby & Walsh #1
51. Chevron T. C. Adams NCT 1-54
52. Anadarko CGU 30 - 12
53. Southern Star Boyce Pate 16-1
54. Petroquest Travis GU #4
55. Anadarko Bailey Sheppard #30
56. J. W. Resources Rumbauch III 21-1
57. St Mary Blandlake #1H
58. J. W. Operating Whitaker 23 #1
59. Comstock H. Woods #1H
60. El Paso Hunt Oil #1
61. Berry Alton Sims #28
62. Comstock BSMC LA 17 #1HZ
63. Unit Falvey GU #1
64. Petrohawk Mary Harris #1H
65. Anadarko William-Wall #11
66. BP Carthage GU #13-17H
67. GMX Snider 'A' #1H
68. Devon S Kardell GU #1H
70. Unit Sickle #1
71. Conoco Phillips Naomi 3 Unit #16
72. EOG Watkins # 1
73. St. Mary Blackstone PB #1

(Core lab Consortium)

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Summary

- Shale heterogeneity is variable (in magnitude and scale)
- Natural fractures (cemented or open) impact heterogeneity to shale
- These sites most likely act as loci for creating a more dense fracture network during shale stimulation
- The increase in network surface area results in better production
- Shale exploitation strategies (drilling, completion, well spacing, perforation etc.) should take into account the heterogeneous nature of shale reservoirs
- Work in progress to quantify various aspects of heterogeneity

Acknowledgments

- We would like to thanks Talisman Energy for permission to present

- Thanks also to our colleagues John Logel and Heath Pelletier for their help with the seismic interpretation

- We also thank Divestco, CGGVeritas and Core Lab

- We also would like to thank Muki and Dan Jarvie for the invitation to present this work

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May The Shale be with you!

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