

APPENDIX B

SEISMIC LINES AND STRUCTURAL CROSS SECTIONS THROUGH PROPOSED DEVELOPMENT WELLS

LIBERTY DEVELOPMENT PROJECT

APPENDIX B

Seismic Lines And Structural Cross Sections through Proposed Development Wells

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Discussion

The images in this appendix illustrate the planned trajectories for the development wells at Liberty. The slides from the 3D survey acquired in 1995 (figures 1 to 62) are focused on the reservoir penetration, while the slides from the 2014 high-res 2D data (figures 63 to 73) are focused on the shallow (<4000') intervals for hazards identification.

The inclusion of the “Pseudo WCD well” is intended to illustrate the basis for some of the reservoir assumptions in Hilcorp’s WCD modeling, specifically that this represents the thickest portion of the Kekiktuk zone 2 reservoir in the Liberty field.

General Comments on Appendix B

All seismic bins (ie, the distance between two inlines or crosslines) are spaced at 110’.

In all slides, the red horizon represents the LCU (a proxy for “top” Kekiktuk) and the light green horizon represents the base of the Kekiktuk Zone 2. For this discussion, Hilcorp does not differentiate between the subzones within the Kekiktuk Zone 2 (K2A and K2B).

There are duplicates of the map images – one with seismic section overlays and one without. The color-maps represent gross-Kekiktuk zone 2 thickness from the mapped LCU to the top Kekiktuk zone 1 – or – to the tar mat, whichever is shallower, thus defining a volume of gross-rock-volume.

Each well has 4 corresponding seismic lines: An inline that best depicts the well interesting the reservoir, a crossline (CDP) that best depicts the well interesting the reservoir, an arbitrary line (zoomed out) to depict the trajectory of that well from near-surface (~1000’) to TD, and the same arbitrary line (zoomed in) to depict the entirety of the well within the reservoir section. The vertical scale on the inline, crossline, and zoomed in arb line will be equal, but the vertical scale on the zoomed out arb line will vary from well to well (as the wells have different stepouts to display on a page).

“Liberty Unit” refers to the geographic outline of the defined Liberty Unit.

“Liberty Outline” refers to a polygon that encapsulates the entirety of the Liberty hydrocarbon accumulation.

On the seismic displays, a vertical black line represents the intersection with the corresponding inline or crossline. A vertical red line represents the intersection with the corresponding well-path traverse. Where the red line cannot be observed, it is projected behind the black line (ie, the well-path traverse and IL/CDP are in the same place on that plane).

Well-bore trajectories are projected onto the plane of the images observed. Dashes imply the well-bore is behind the plane and solid lines imply the well-bore is in front of the plane.

Figure 1. Liberty Field with well-trajectory spider plot.

The color bar represents gross Kekiktuk thickness map above the tar mat. Structure contours on the LCU at 100' intervals. Green polygon is an outline of the Liberty Unit. Blue polygon surrounding the color map is an outline of the extent of the Liberty hydrocarbon accumulation. Red polygon to the southwest represents the Liberty island.

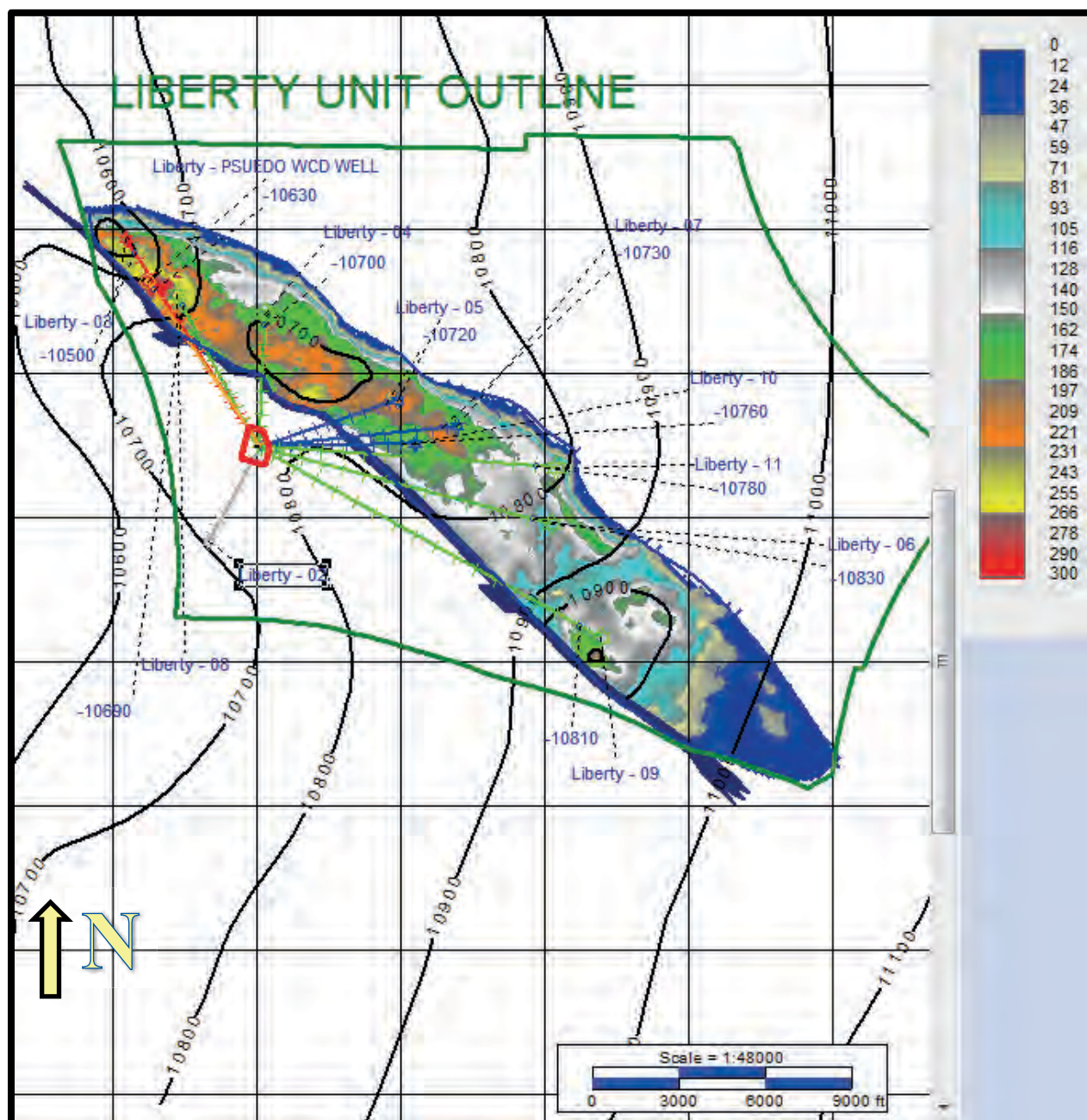


Figure 2. Liberty Field without proposed wells.

The color bar represents gross Kekiktuk thickness map above the tar mat. Structure contours on the LCU at 100' intervals. . Green polygon is an outline of the Liberty Unit. Blue polygon surrounding the color map is an outline of the extent of the Liberty hydrocarbon accumulation. Red polygon to the southwest represents the Liberty island.

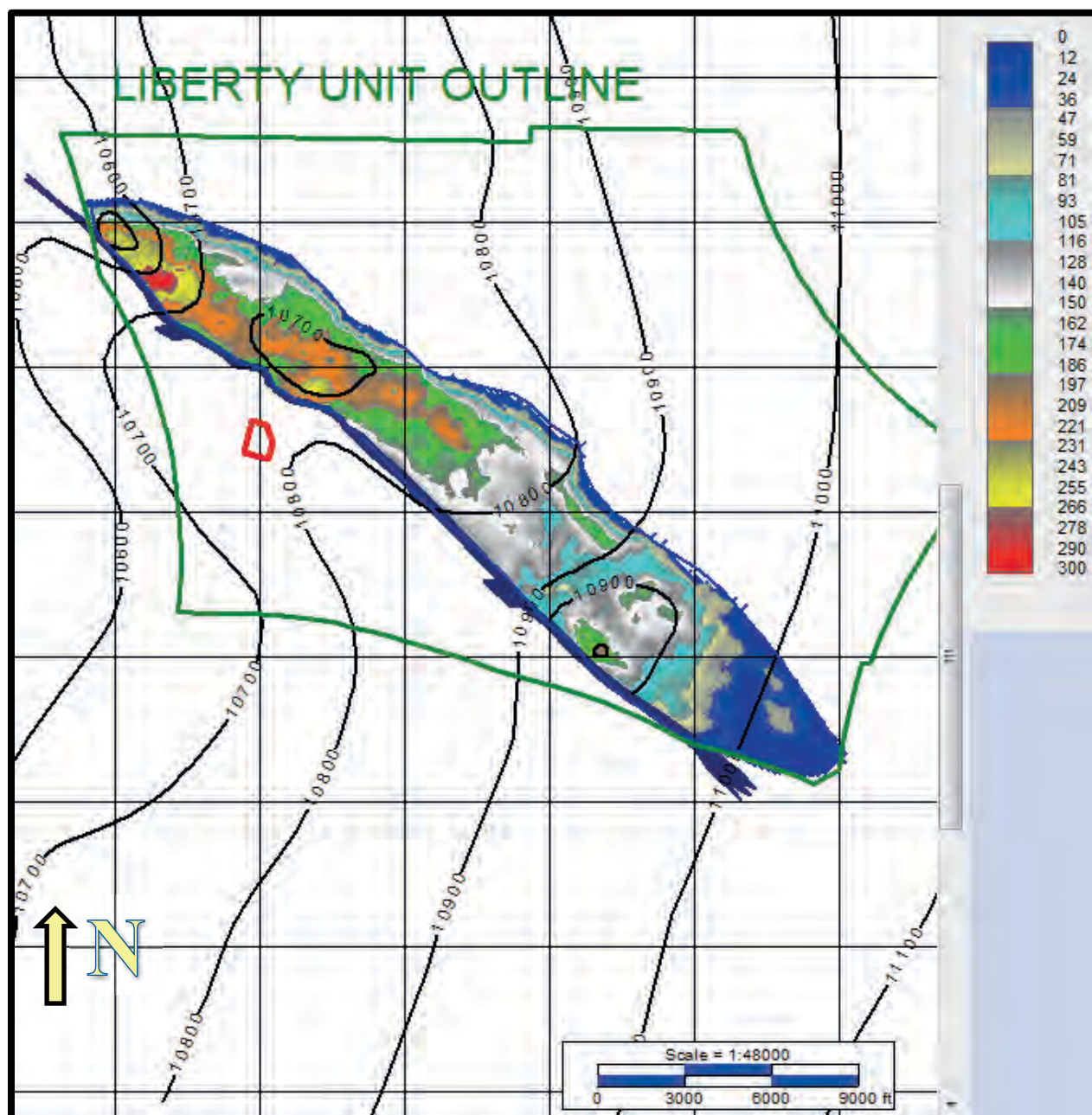


Figure 3. Liberty well slot 03 – far north gas injection well

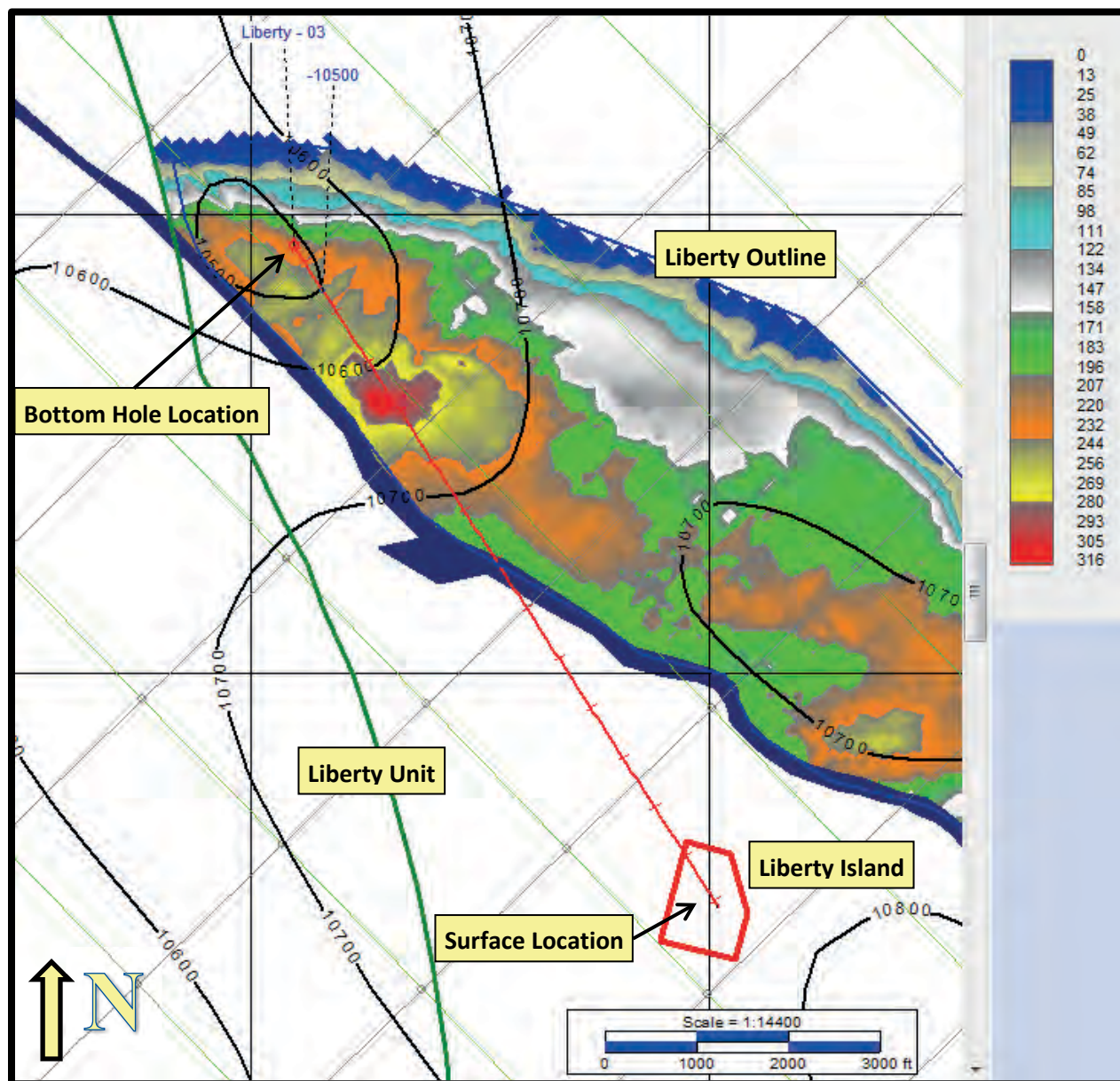


Figure 4. Liberty well slot 03 – far north gas injection well with line overlays

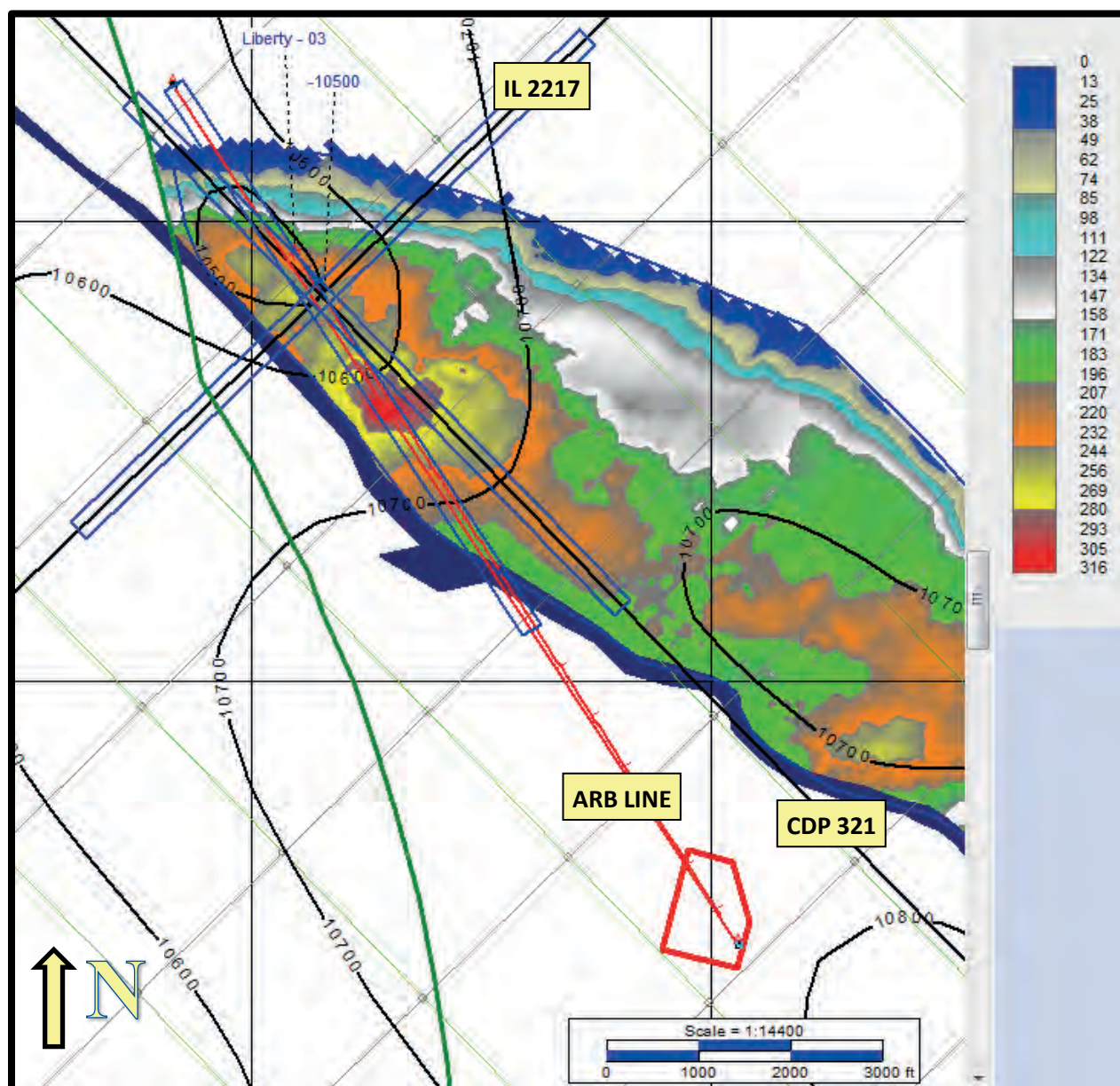


Figure 5. Liberty well slot 03 – far north gas injector, CDP 321

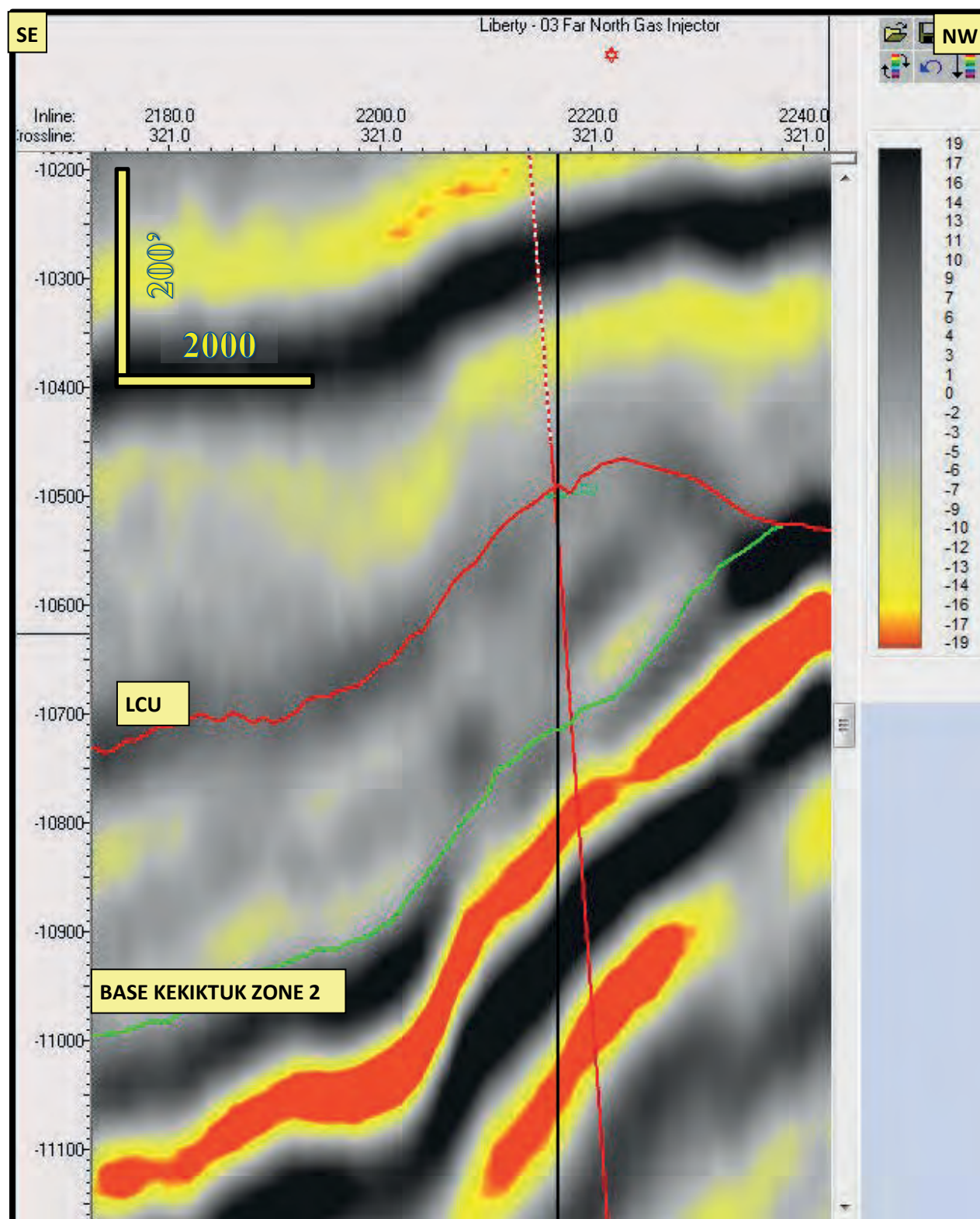


Figure 6. Liberty well slot 03 – far north gas injector, line 2217

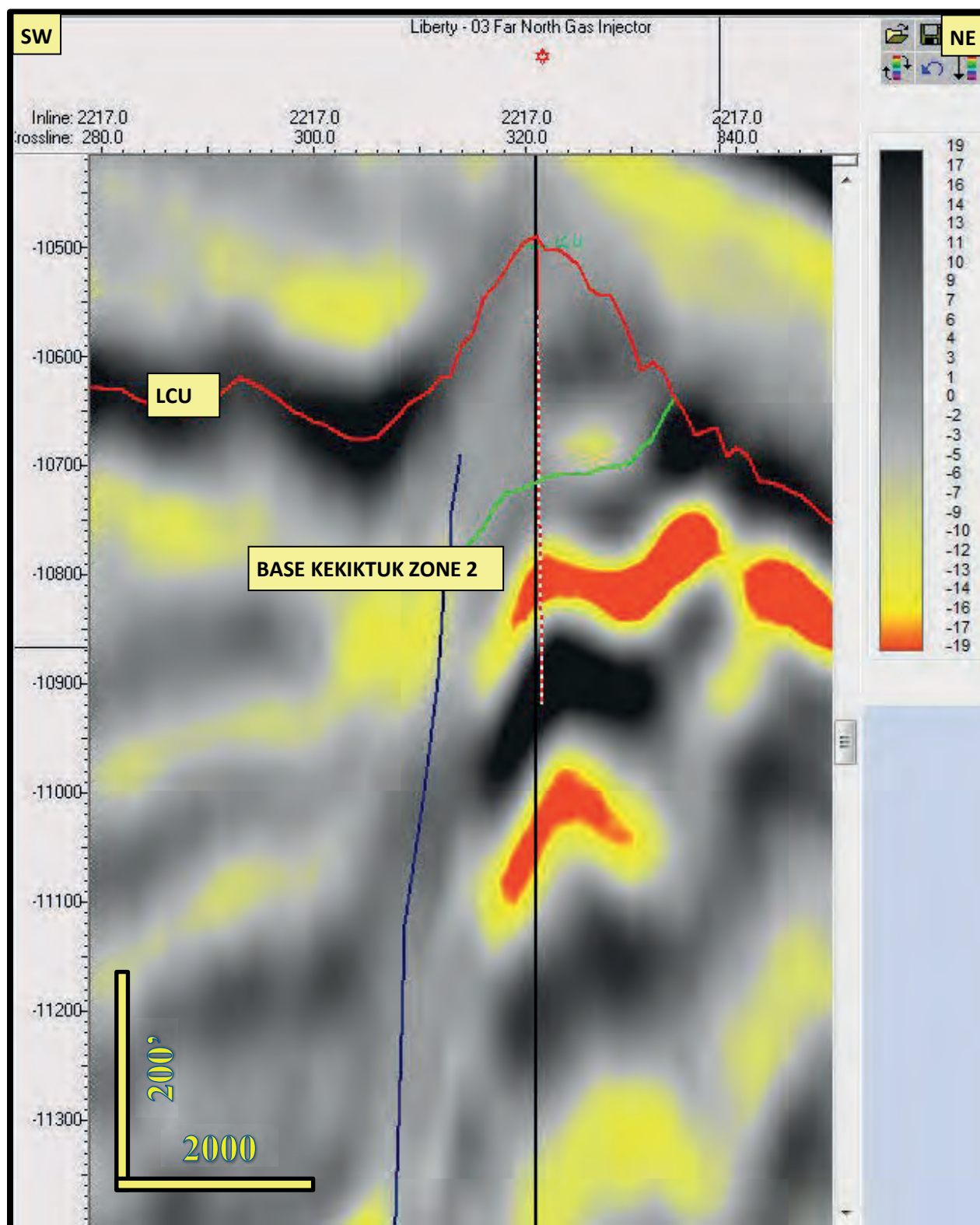


Figure 7. Liberty well slot 03 – far north gas injector, well-path traverse (small scale)

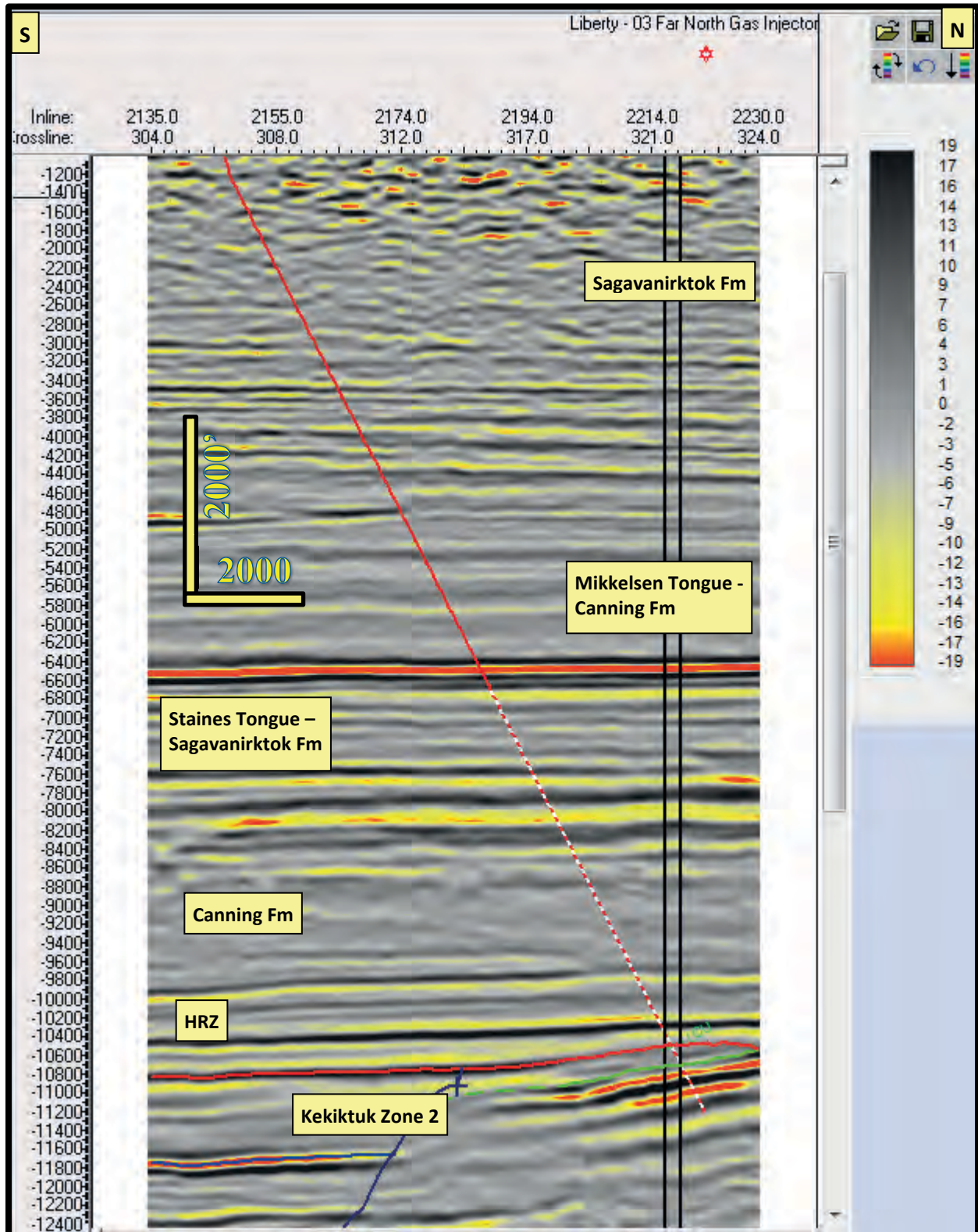


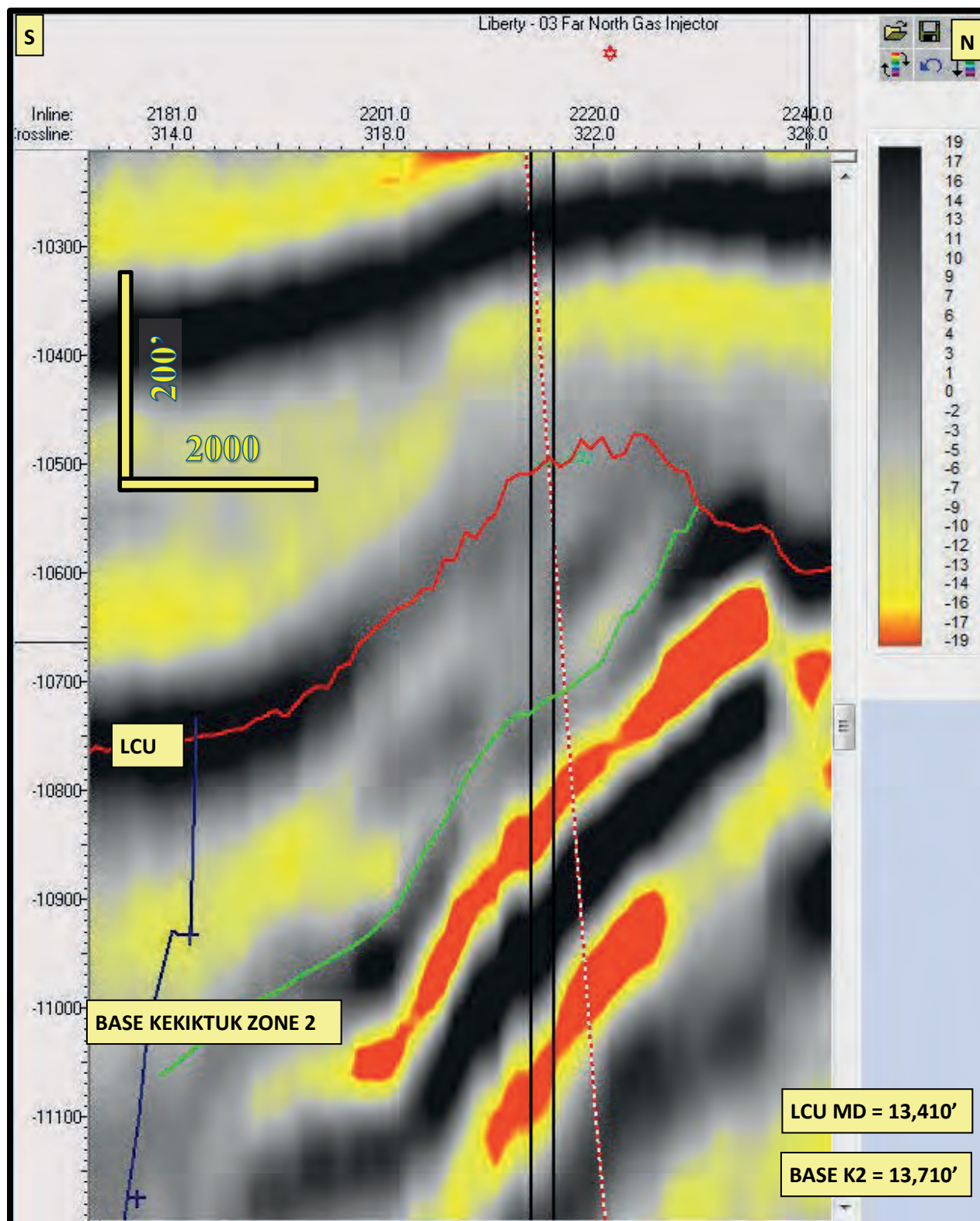
Figure 8. Liberty well slot 03 – far north gas injector, well-path traverse (big scale)

Figure 9. Liberty well slot 03 – far north gas injector, interpreted structural cross section

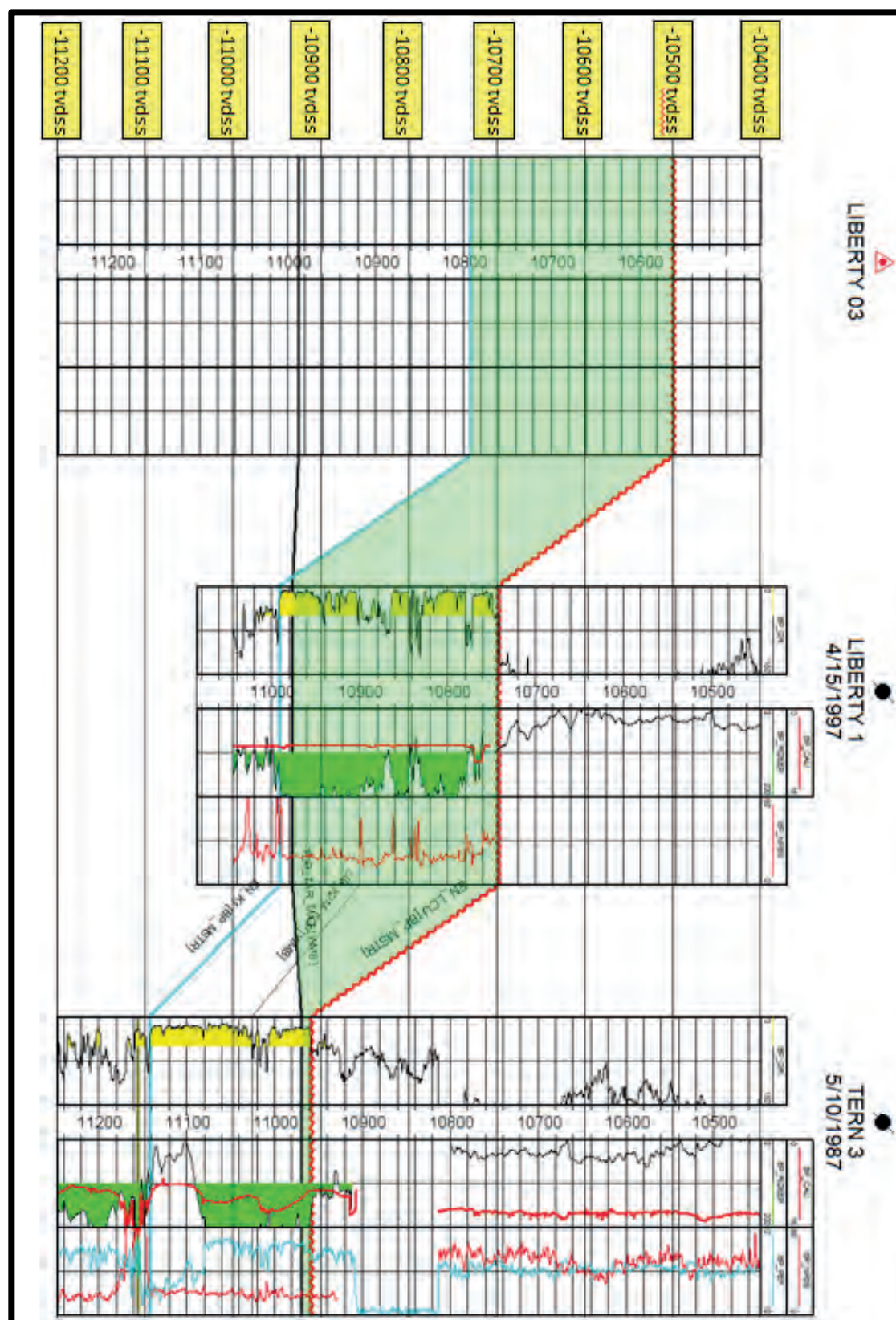


Figure 10. Liberty well slot 04 – central producer

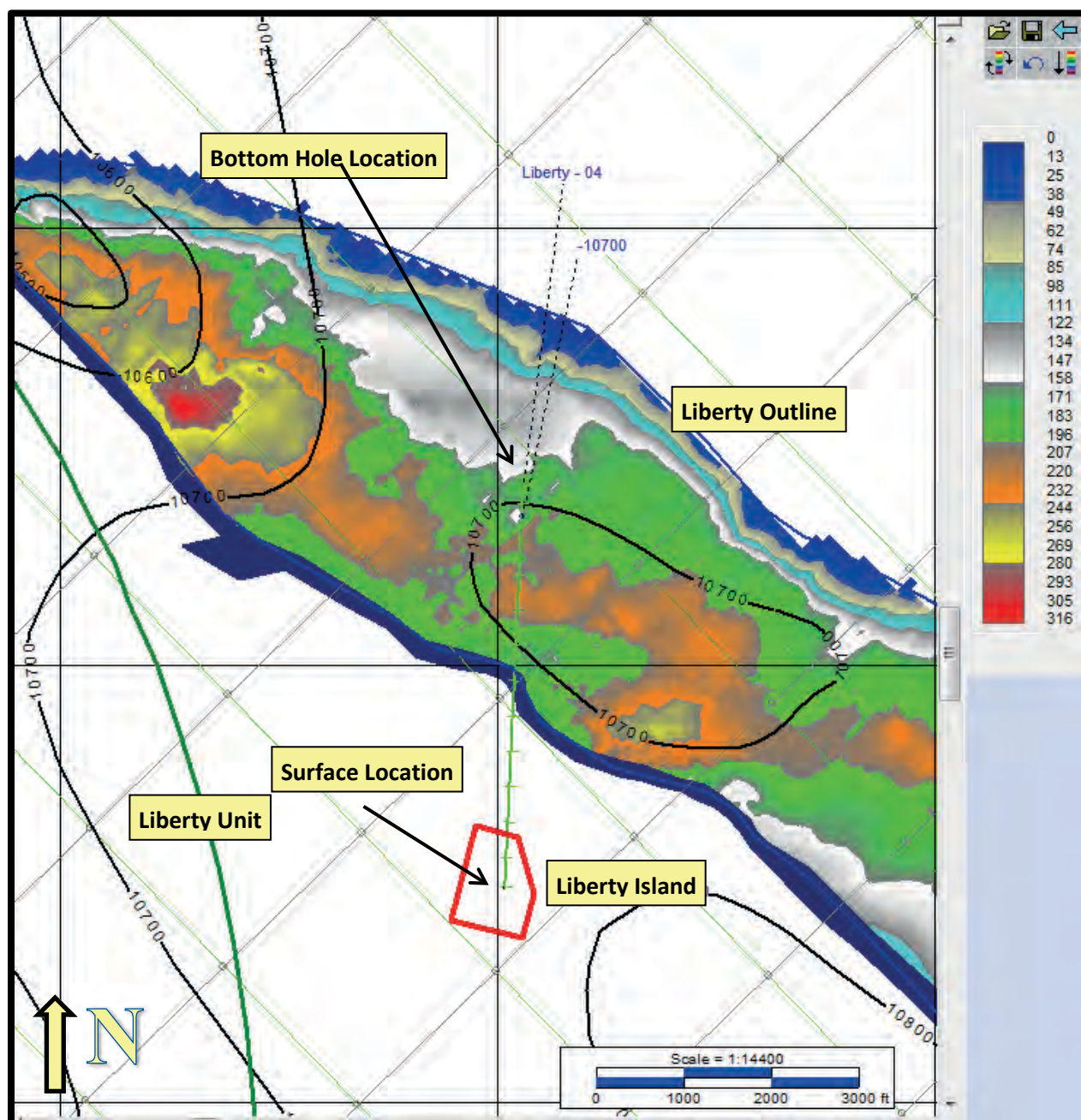


Figure 11. Liberty well slot 04 – central producer with line overlays

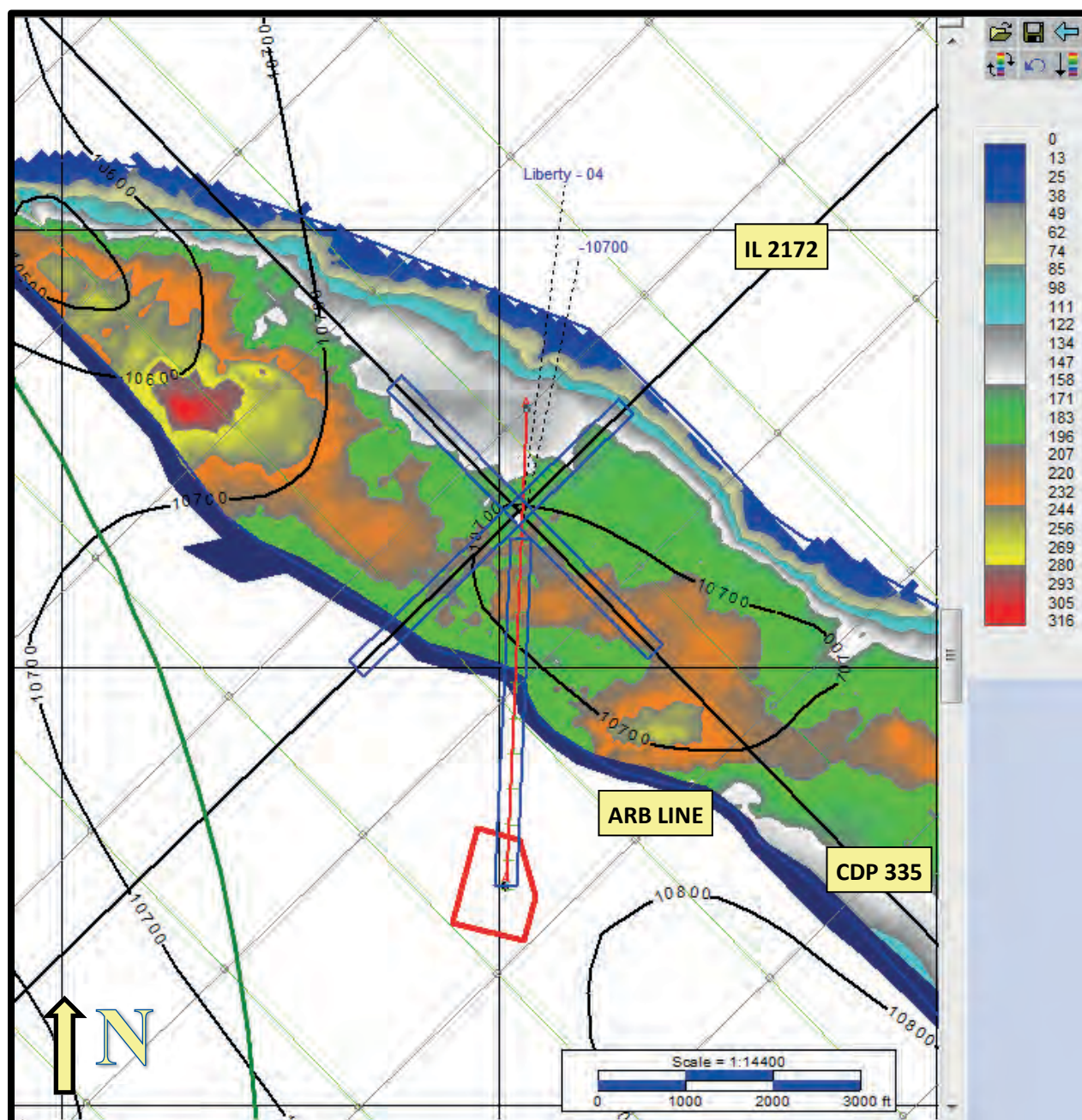


Figure 12. Liberty well slot 04 - central producer, CDP 335

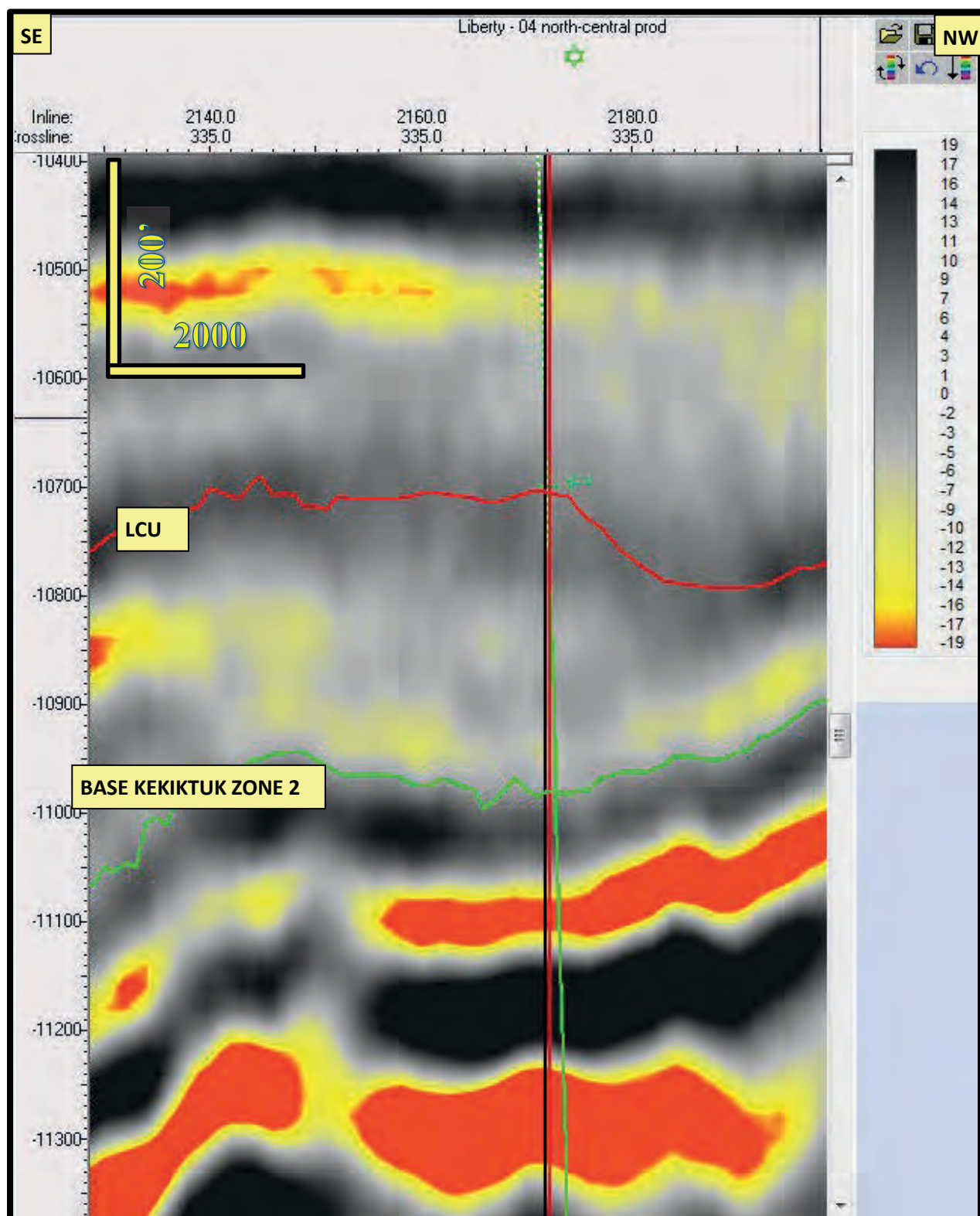


Figure 13. Liberty well slot 04 – central producer, line 2172

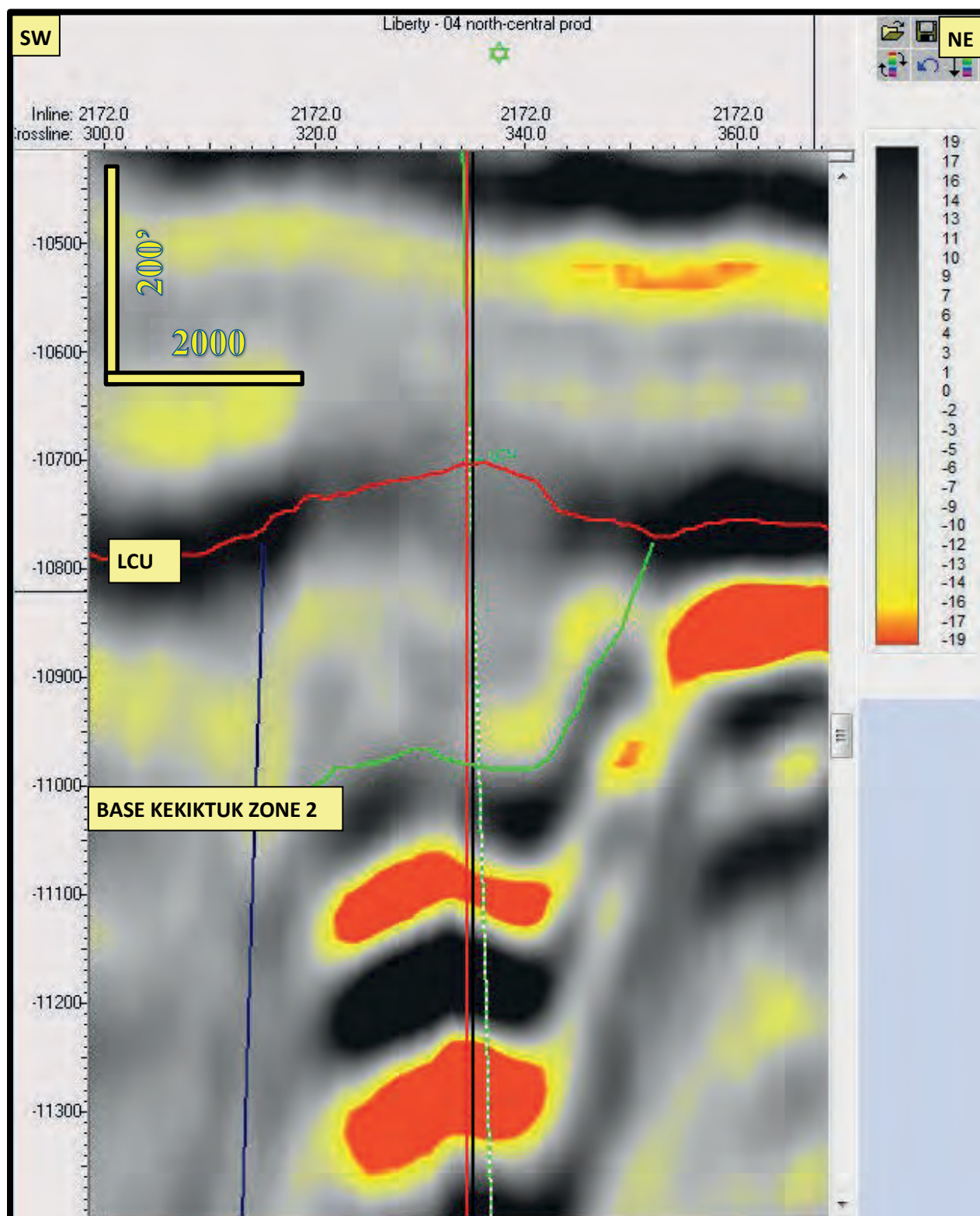


Figure 14. Liberty well slot 04 – central producer, well-path traverse (small scale)

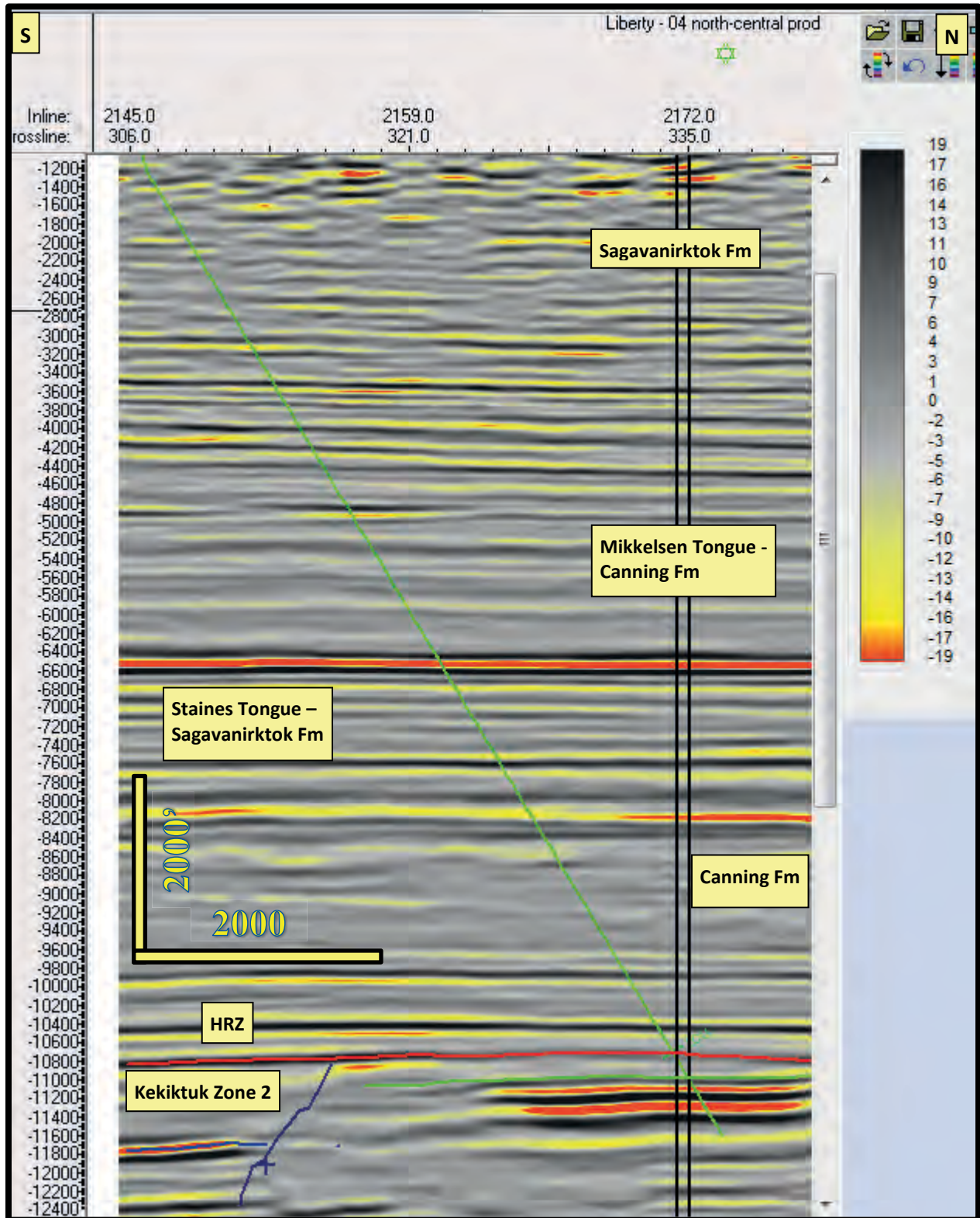


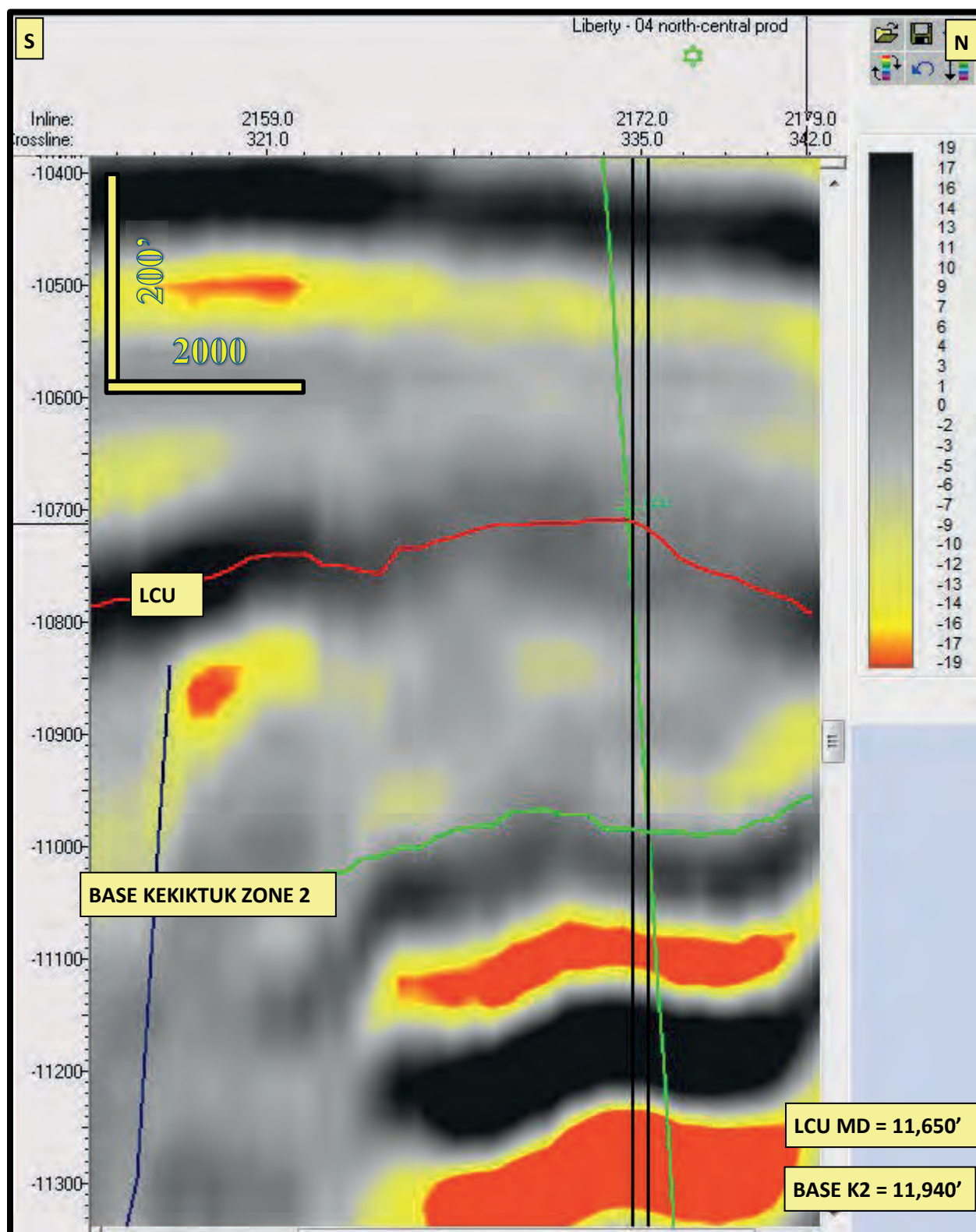
Figure 15. Liberty well slot 04 – central producer, well-path traverse (big scale)

Figure 16. Liberty well slot 04 – central producer, interpreted structural cross section

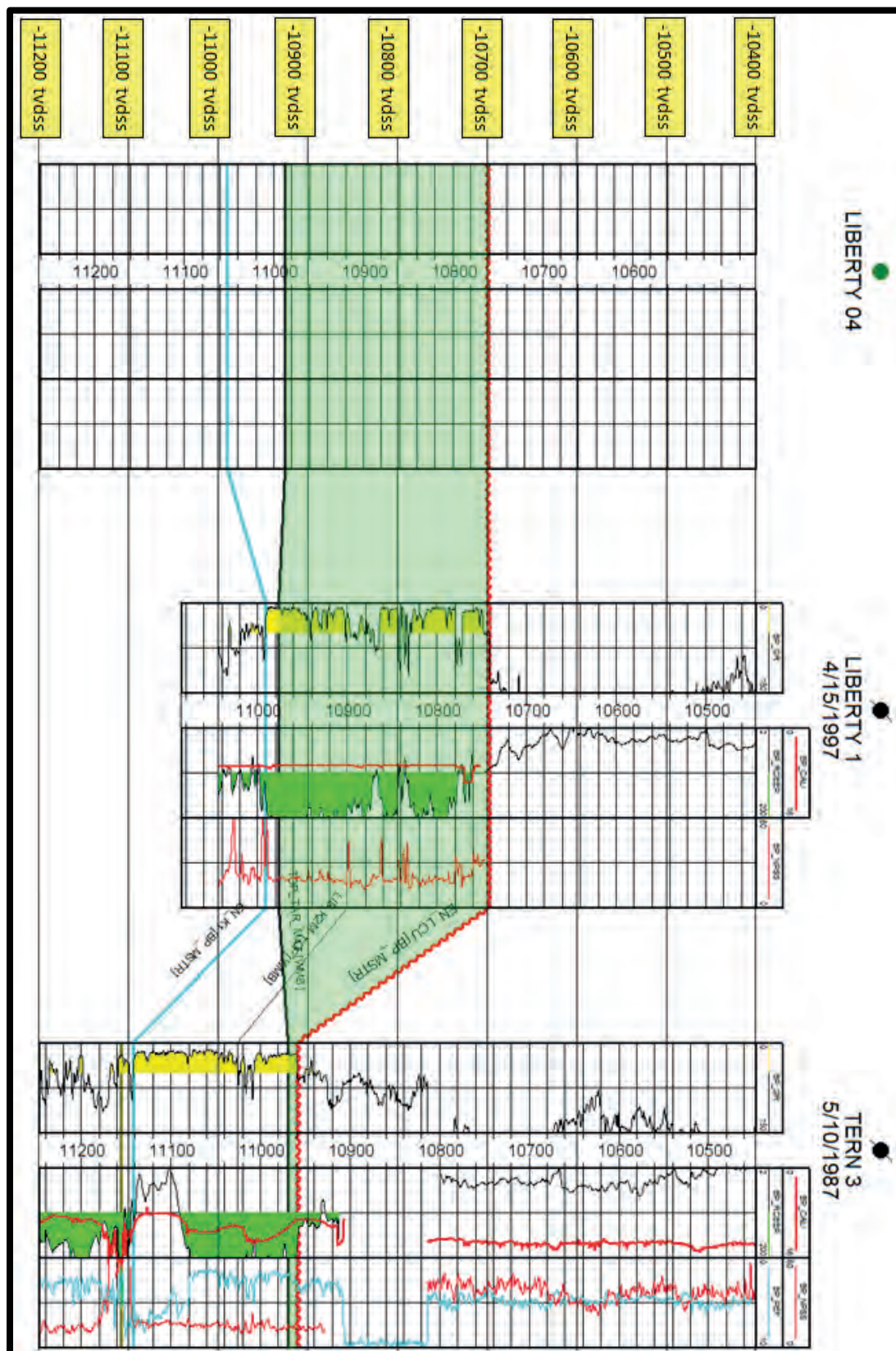


Figure 17. Liberty well slot 05 – northern water injector

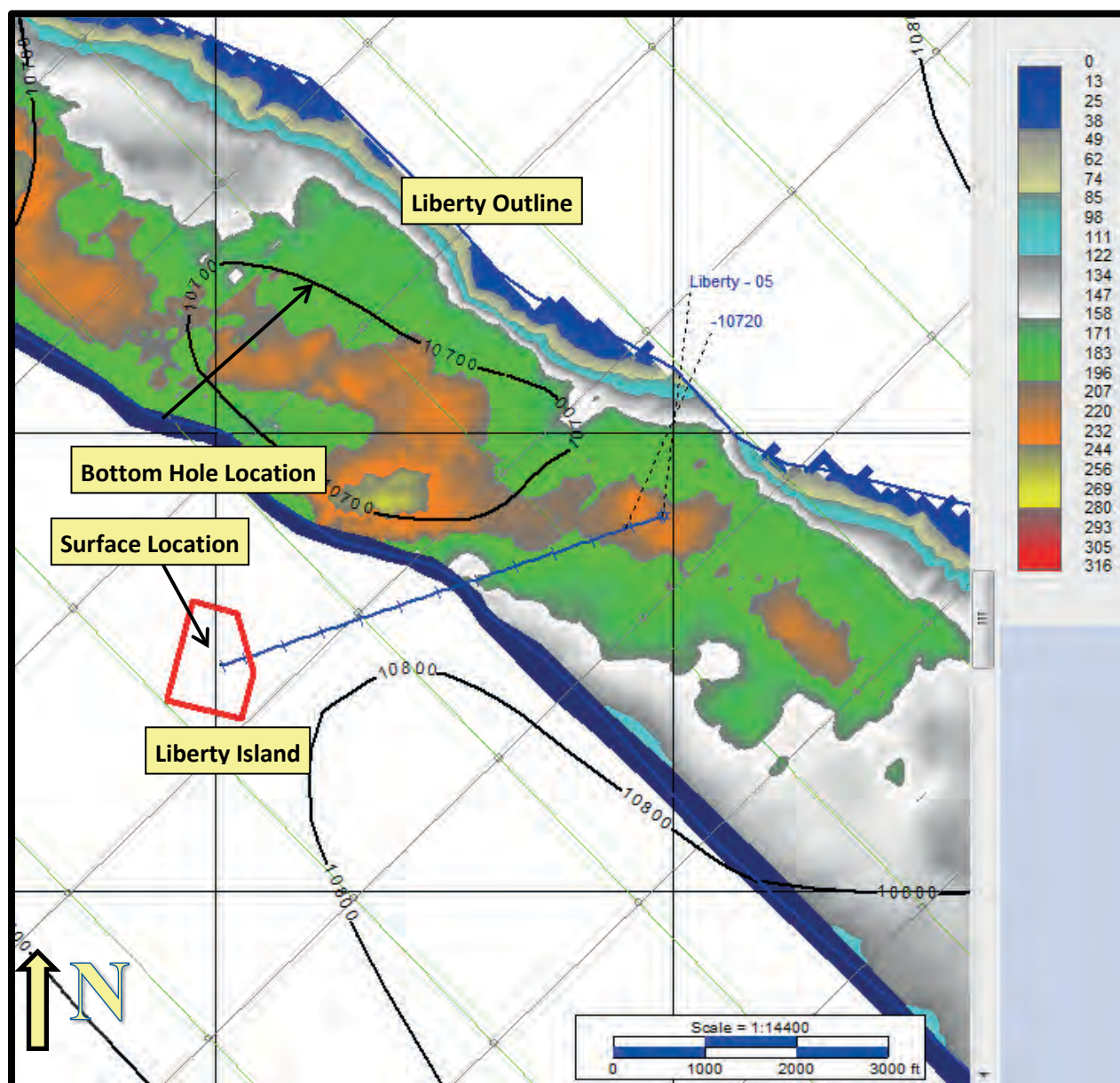


Figure 18. Liberty well slot 05 – northern water injector with line overlays

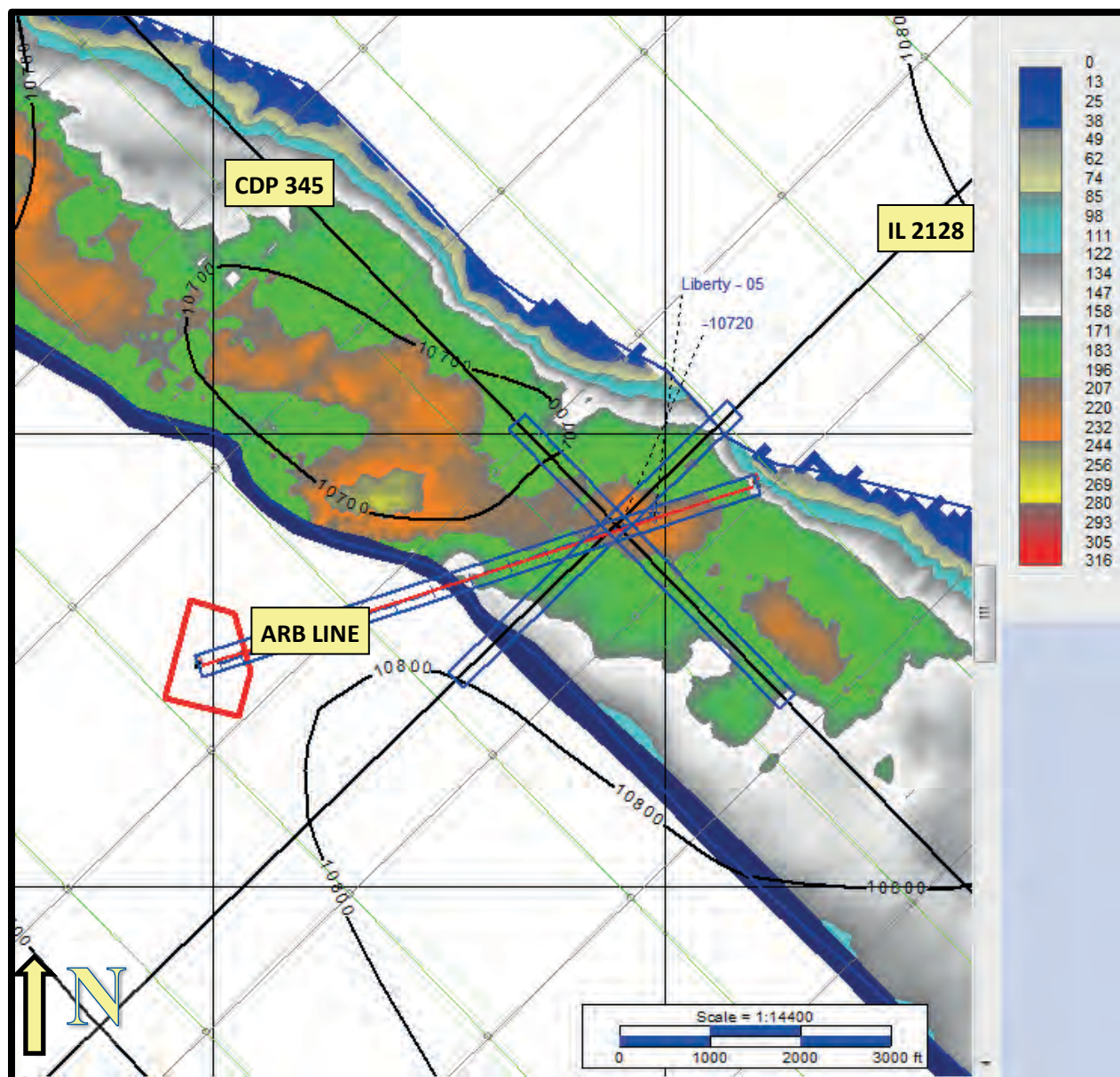


Figure 19. Liberty well slot 05 – northern water injector, CDP 345

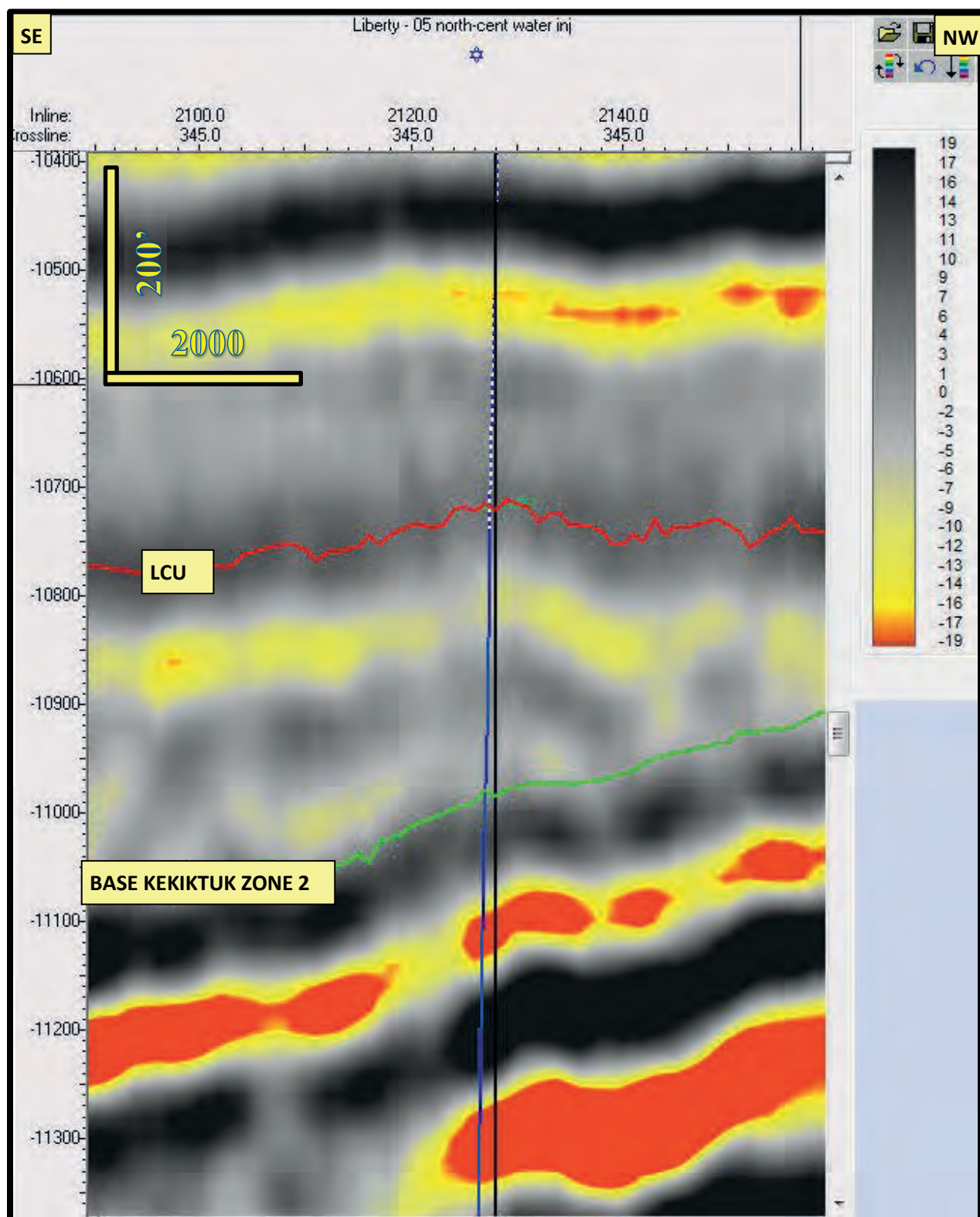


Figure 20. Liberty well slot 05 – northern water injector, Line 2128

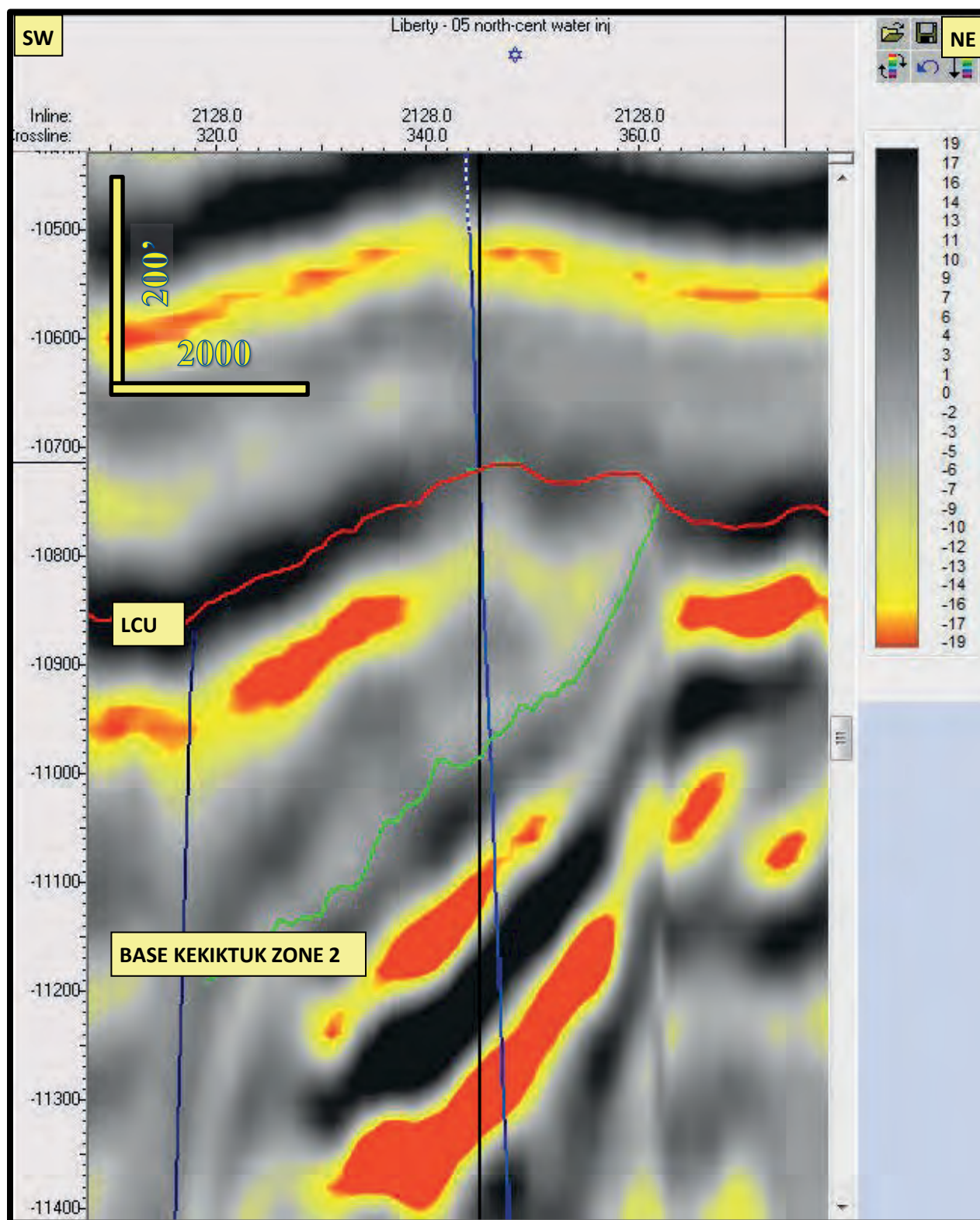


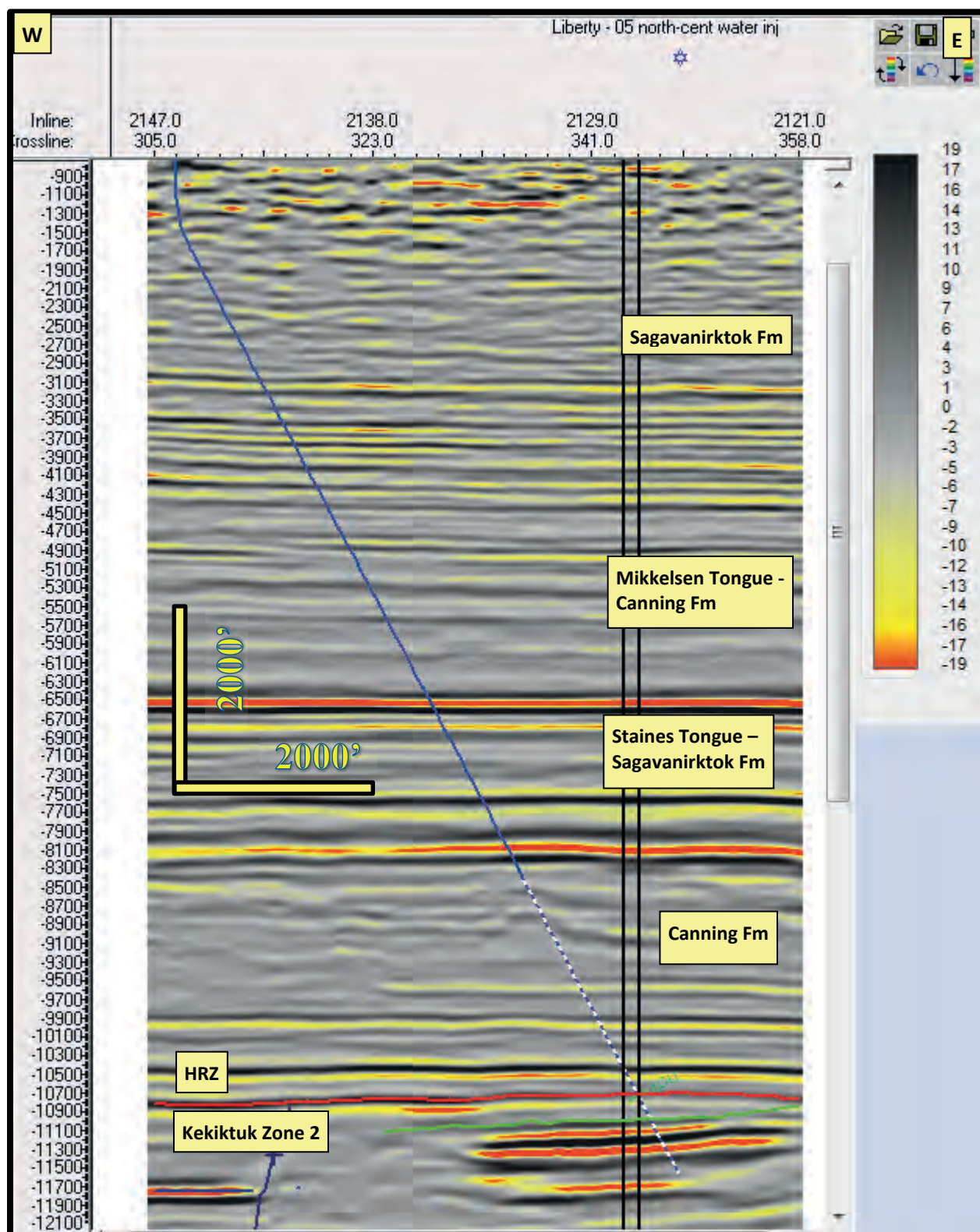
Figure 21. Liberty well slot 05 – northern water injector, well-path traverse (small scale)

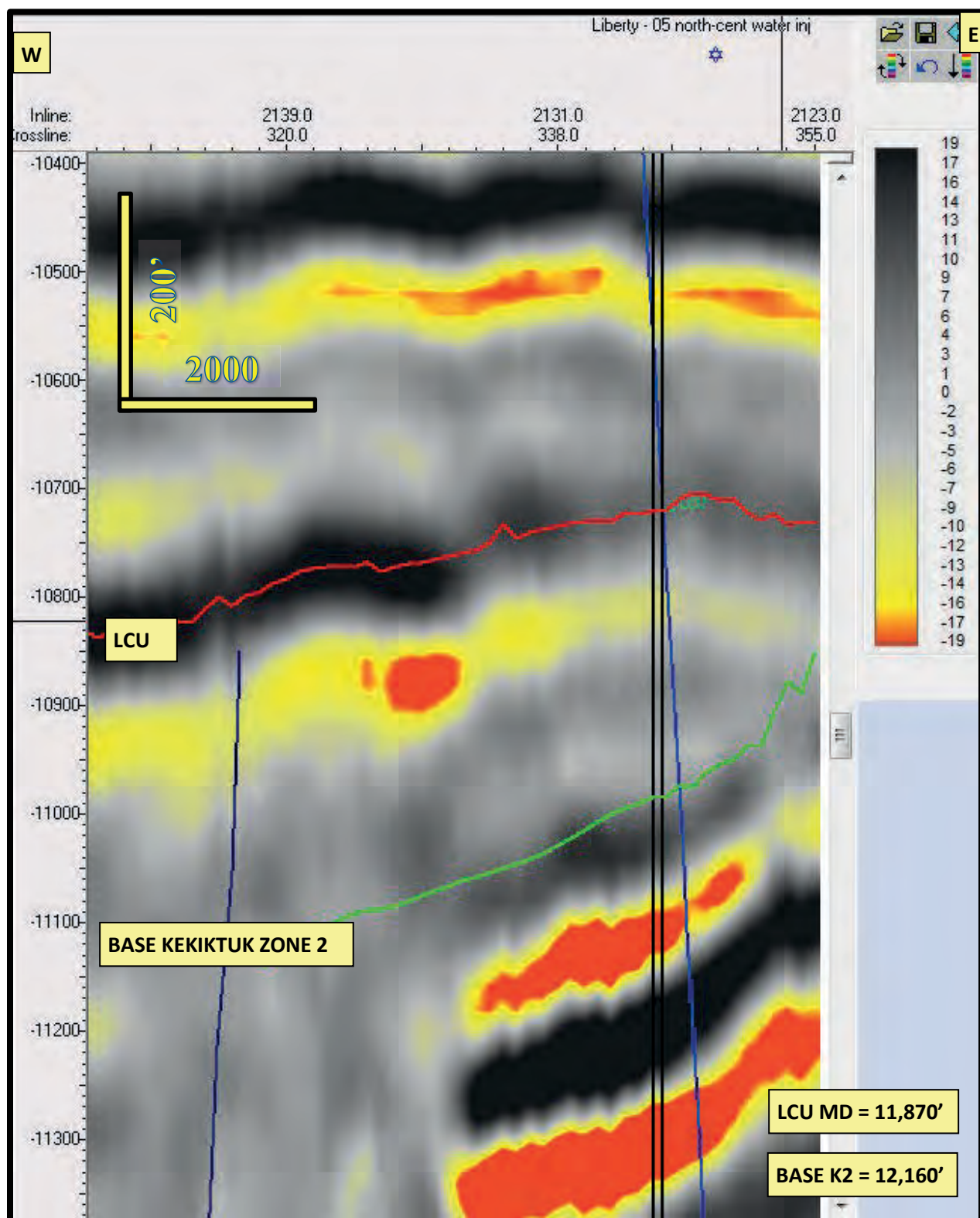
Figure 22. Liberty well slot 05 – northern water injector, well-path traverse (big scale)

Figure 23. Liberty well slot 05 – northern water injector, structural cross section

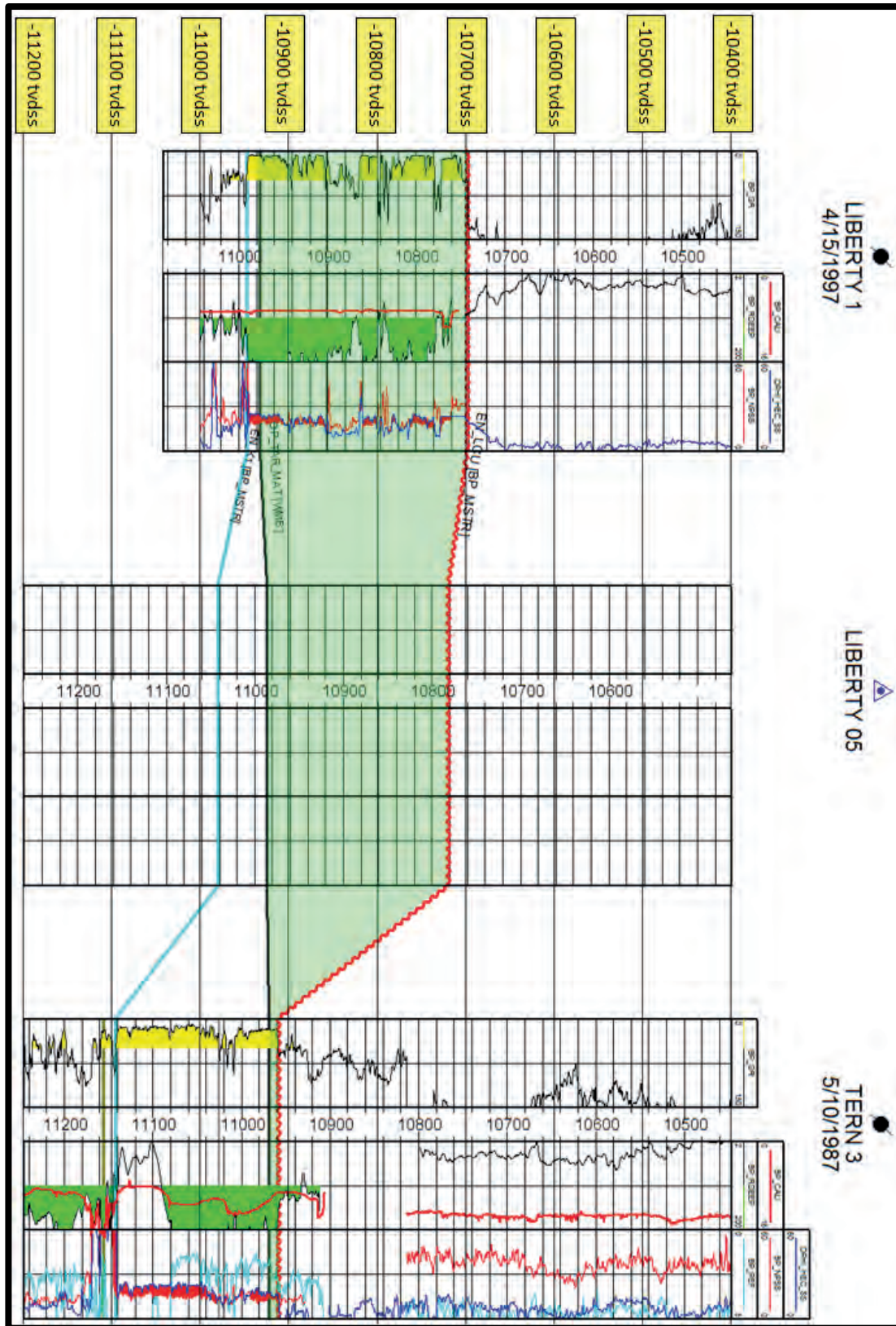


Figure 24. Liberty well slot 06 – south central producer

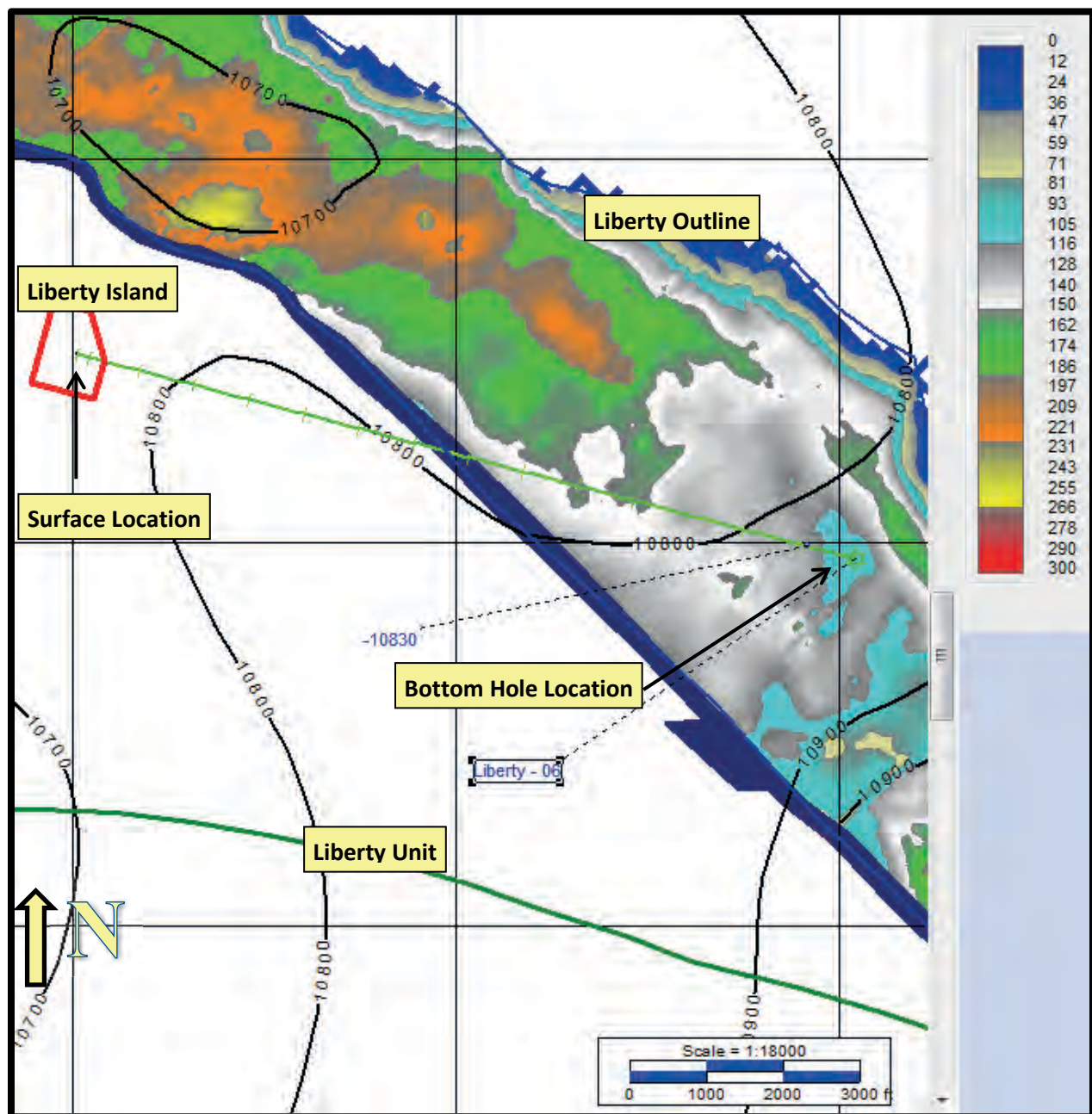


Figure 25. Liberty well slot 06 – south central producer with line overlays

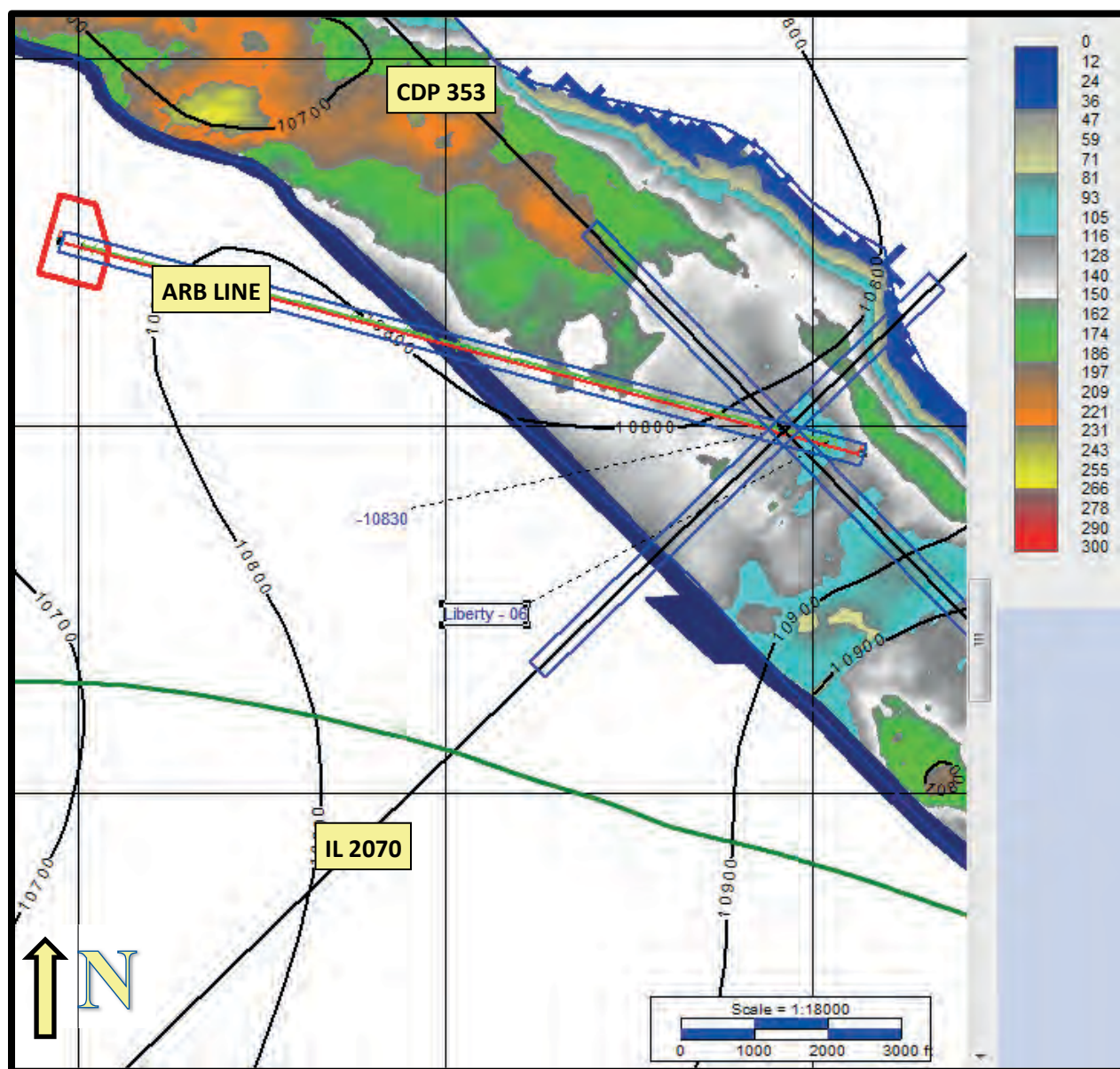


Figure 26. Liberty well slot 06 – south central producer, CDP 353

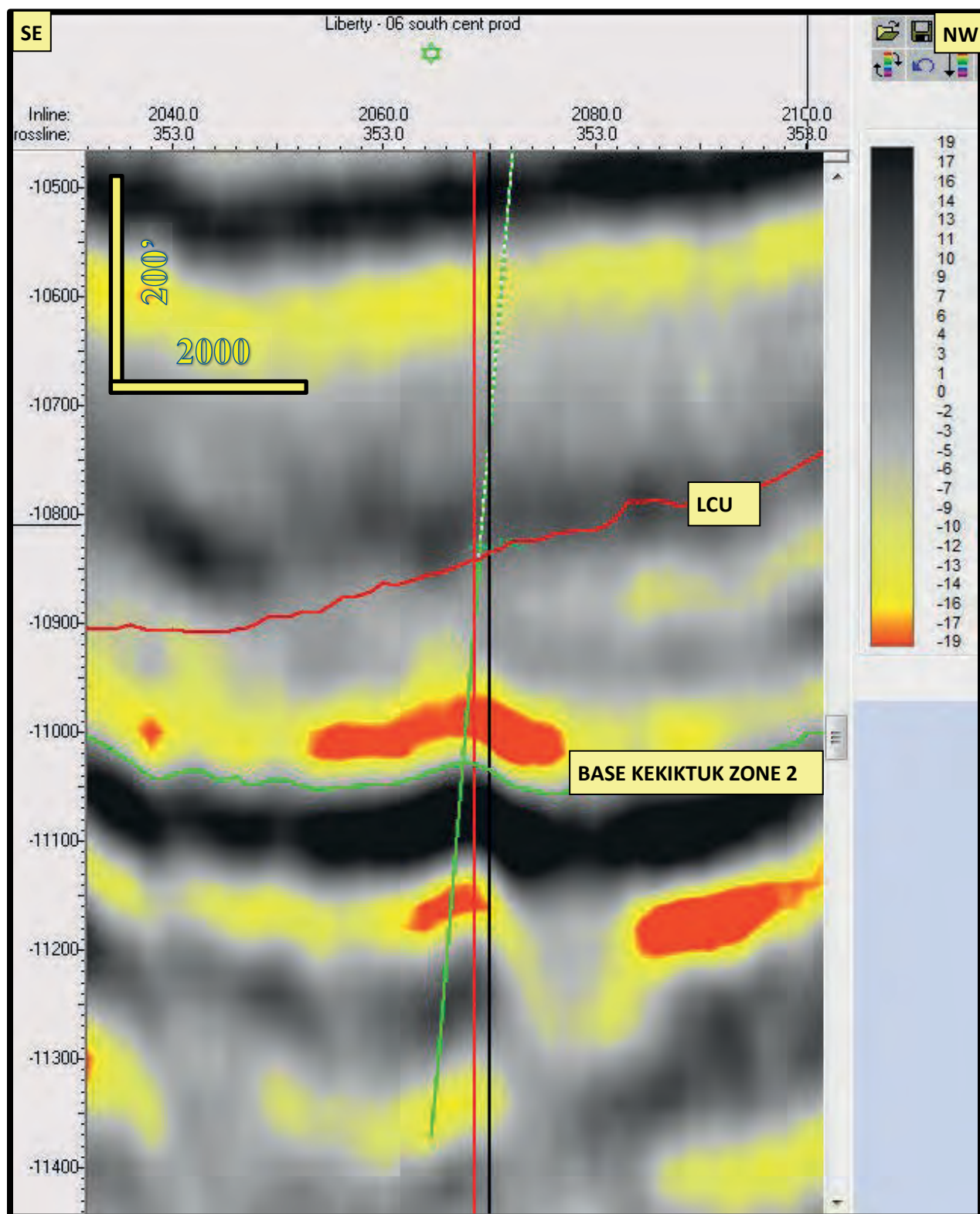


Figure 27. Liberty well slot 06 – south central producer, line 2070

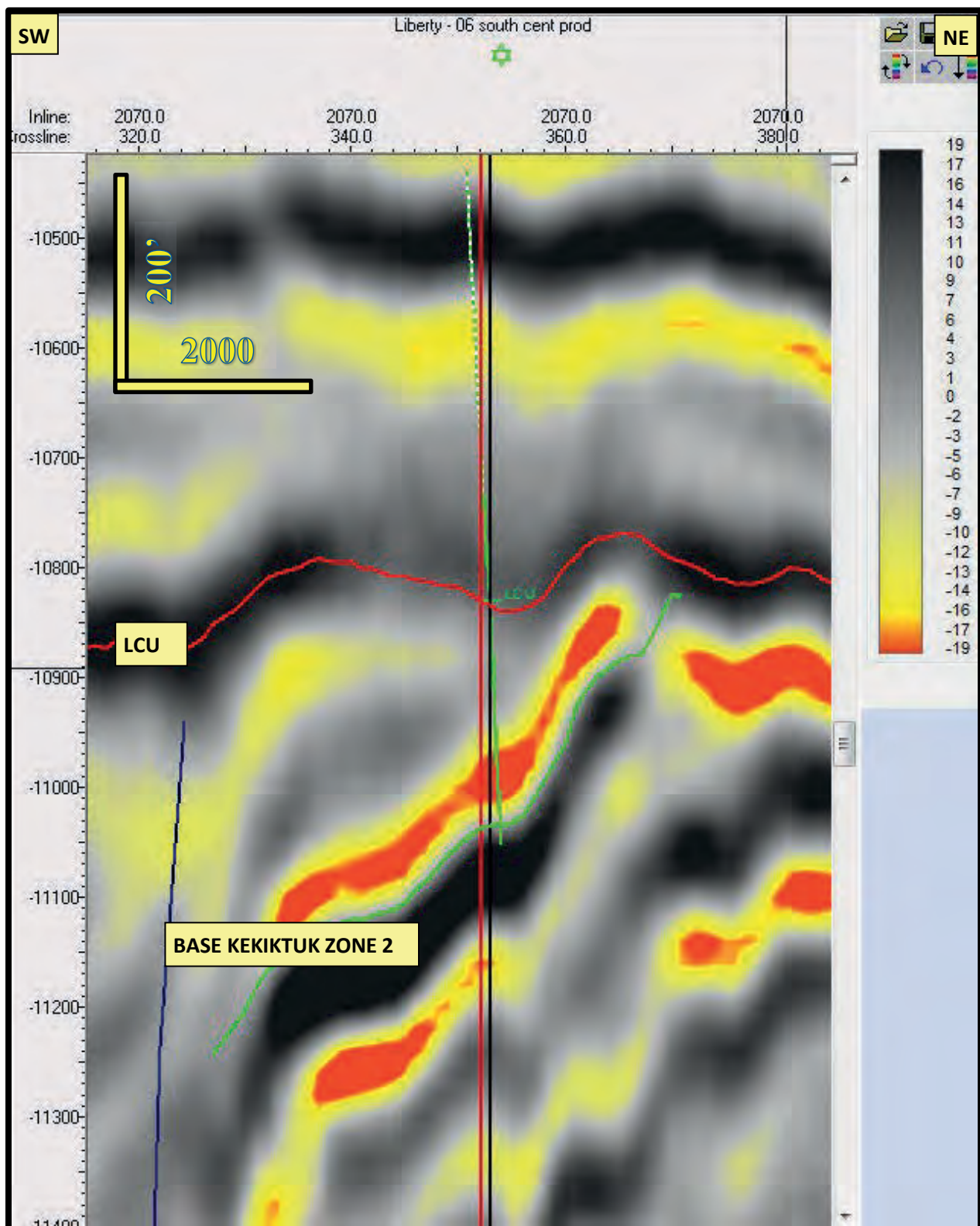


Figure 28. Liberty well slot 06 – south central producer, well-path traverse (small scale)

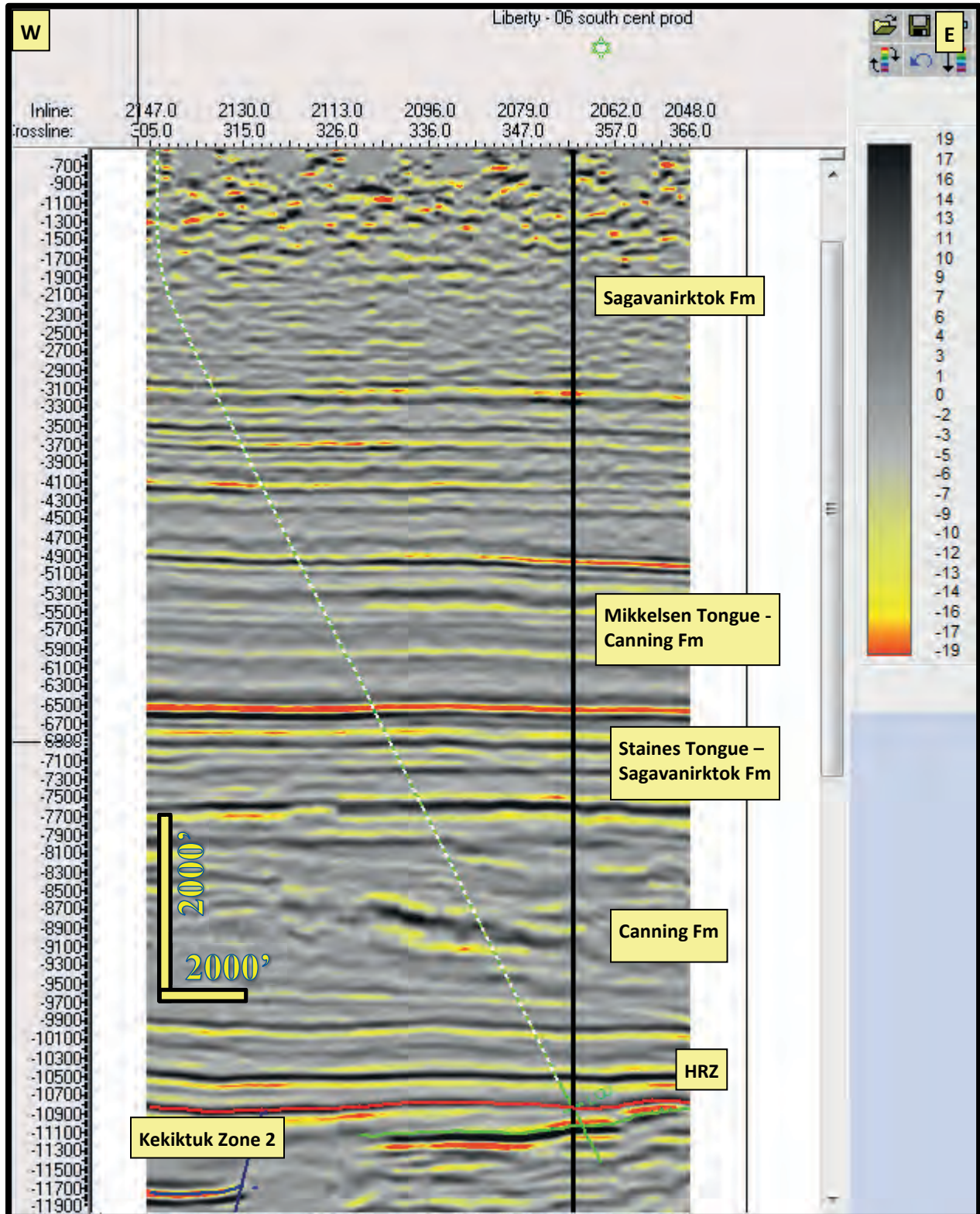


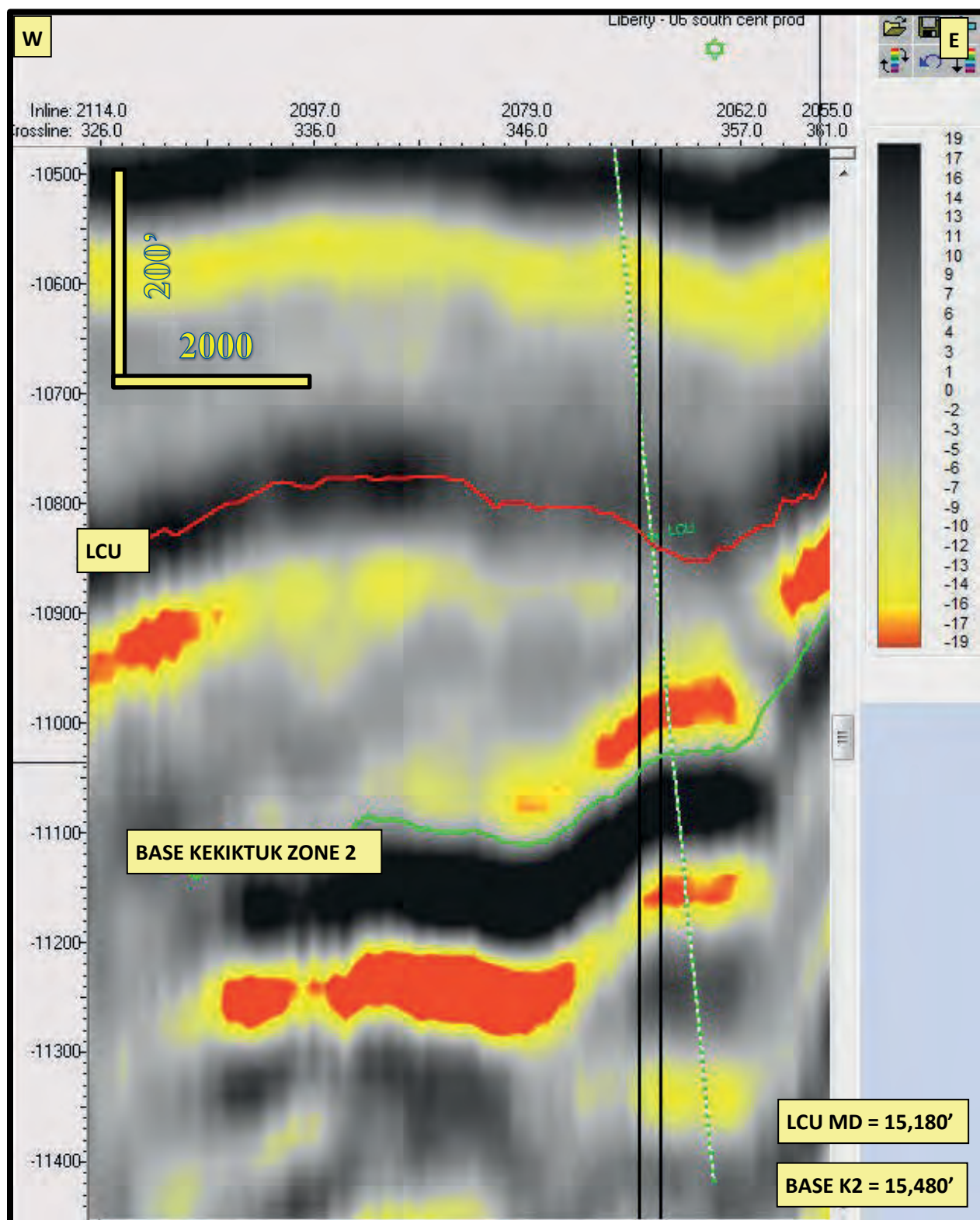
Figure 29. Liberty well slot 06 – south central producer, well-path traverse (large scale)

Figure 30. Liberty well slot 06 – south central producer, structural cross section

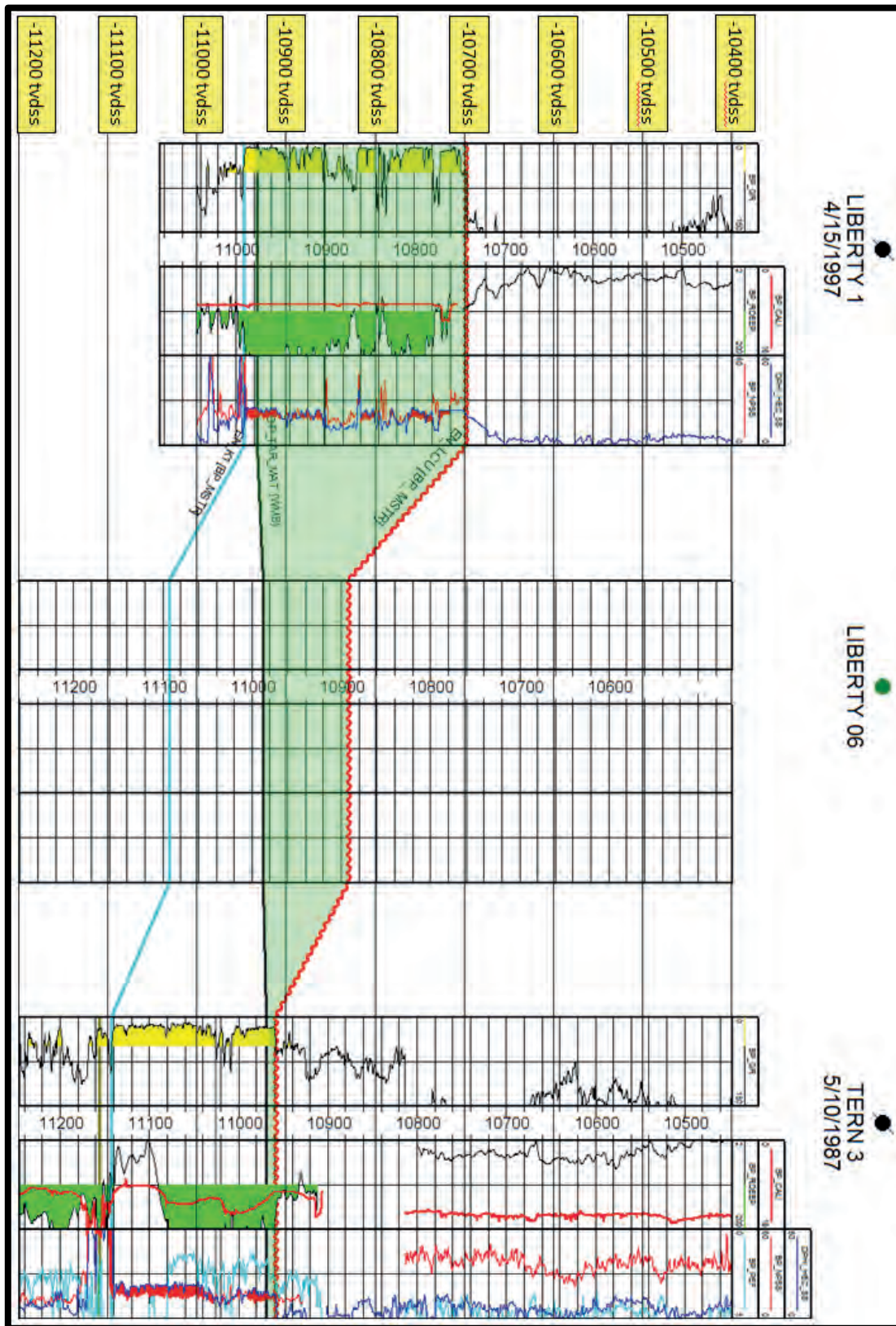


Figure 31. Liberty well slot 07 – central water injector

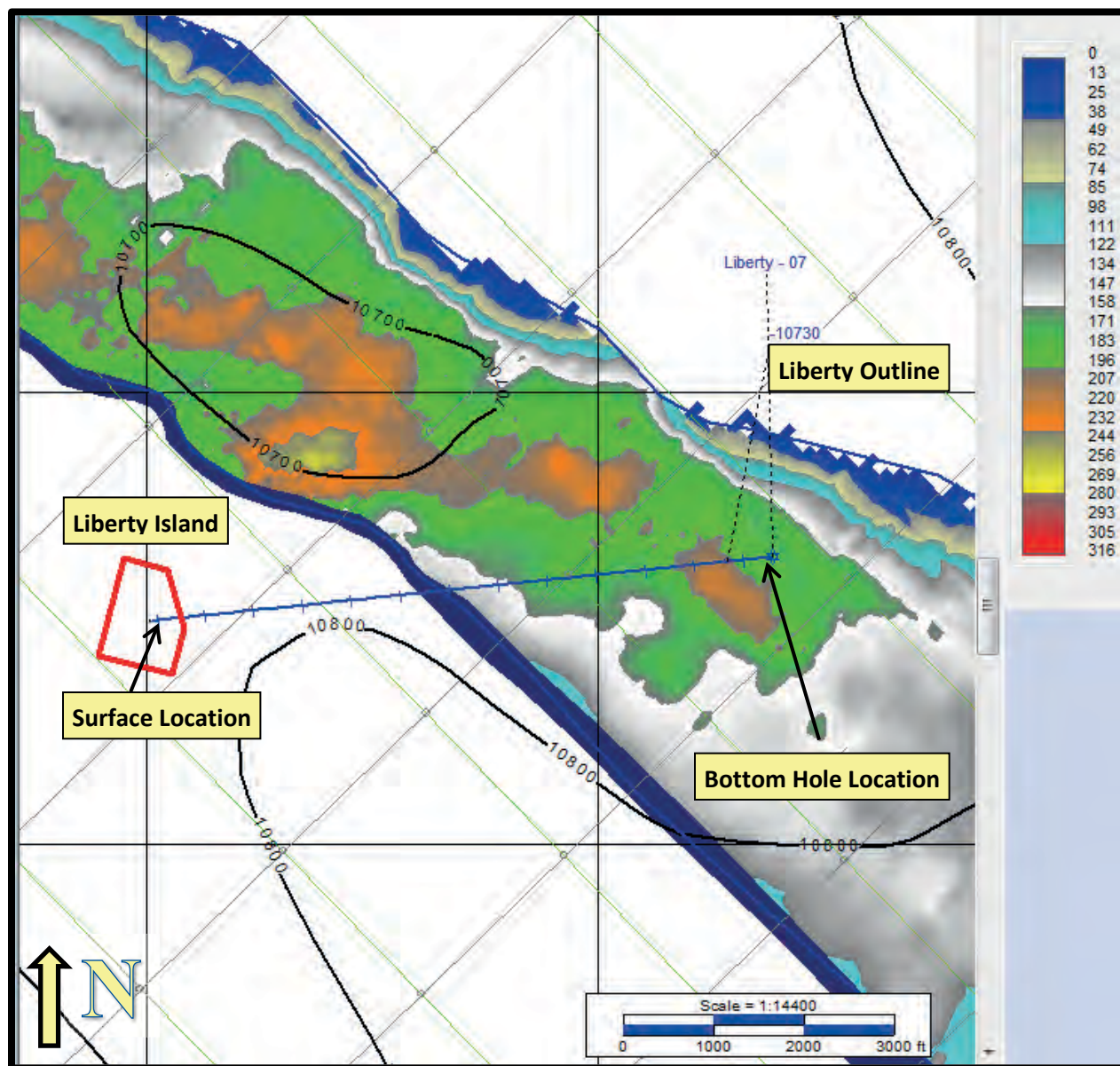


Figure 32. Liberty well slot 07 – central water injector with line overlays

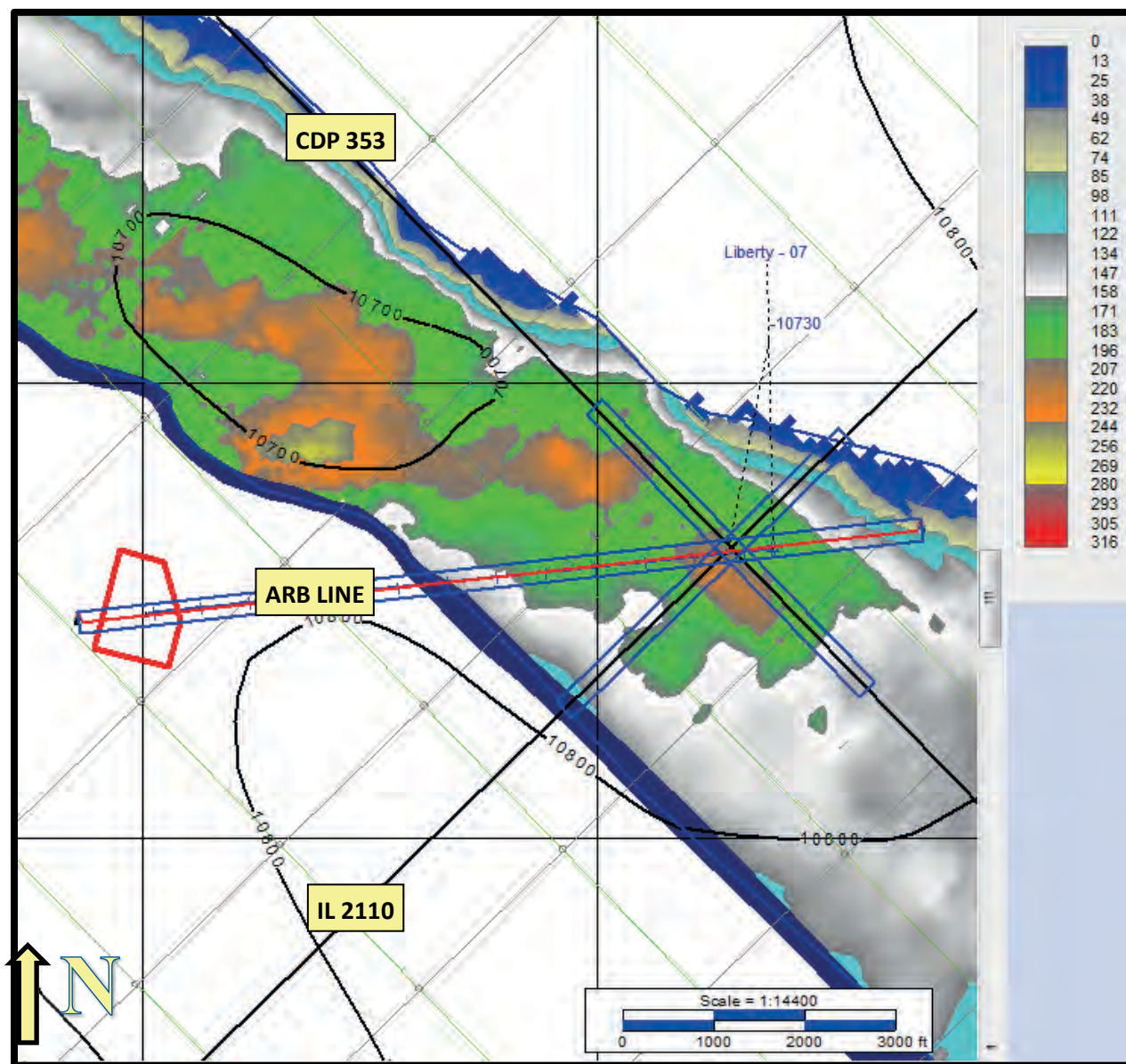


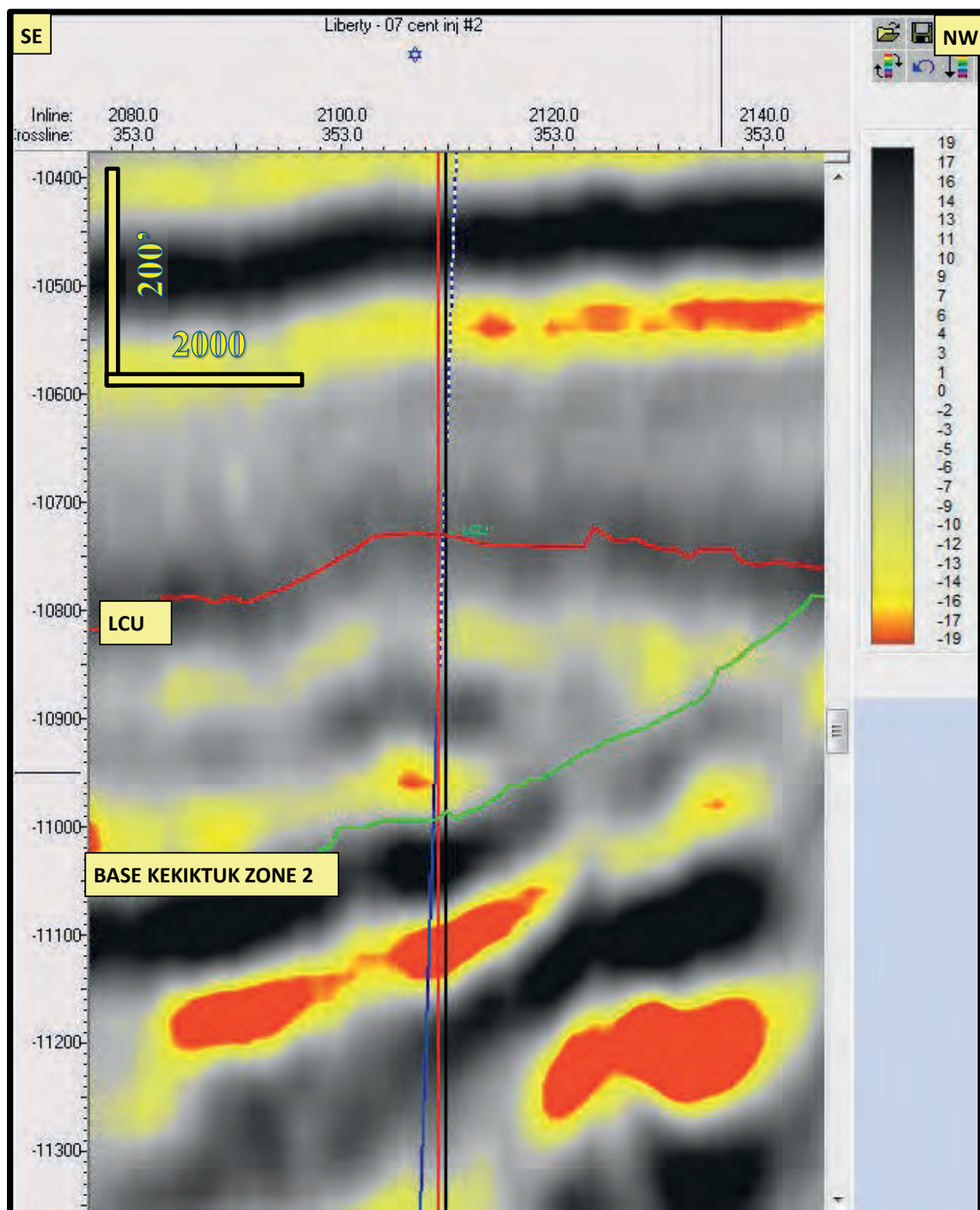
Figure 33. Liberty well slot 07 – central water injector, CDP 353

Figure 34. Liberty well slot 07 – central water injector, line 2110

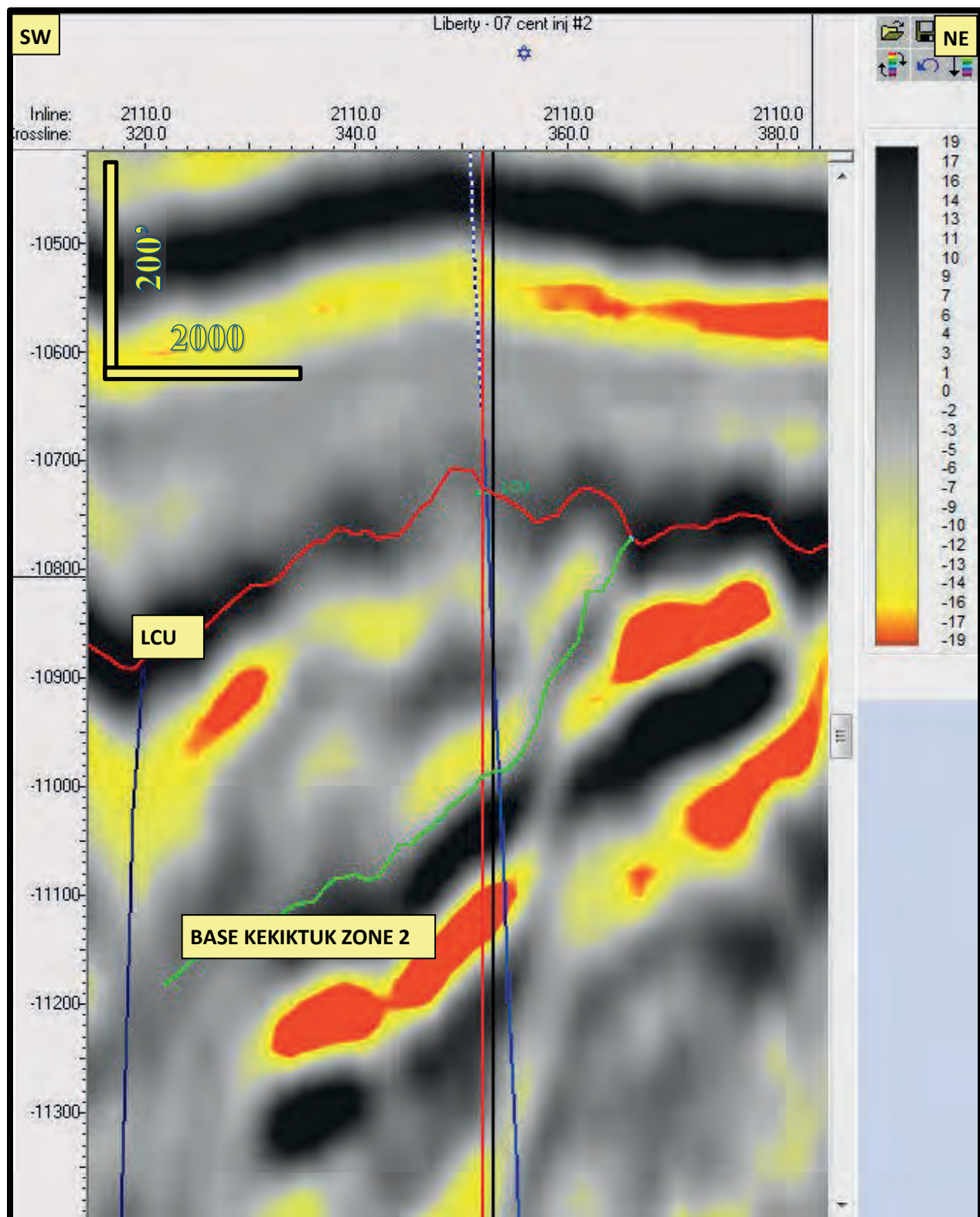


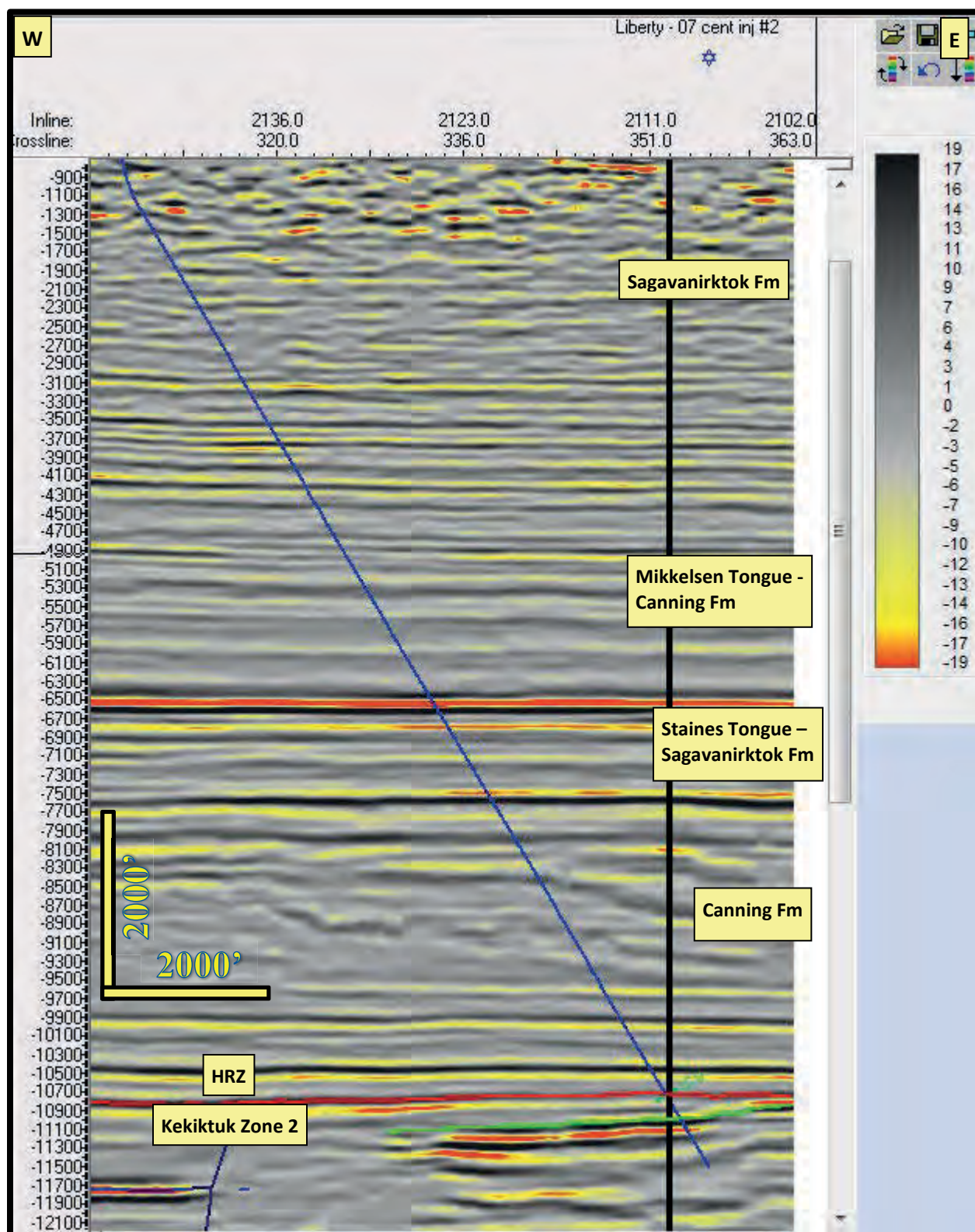
Figure 35. Liberty well slot 07 – central water injector, well-path traverse (small scale)

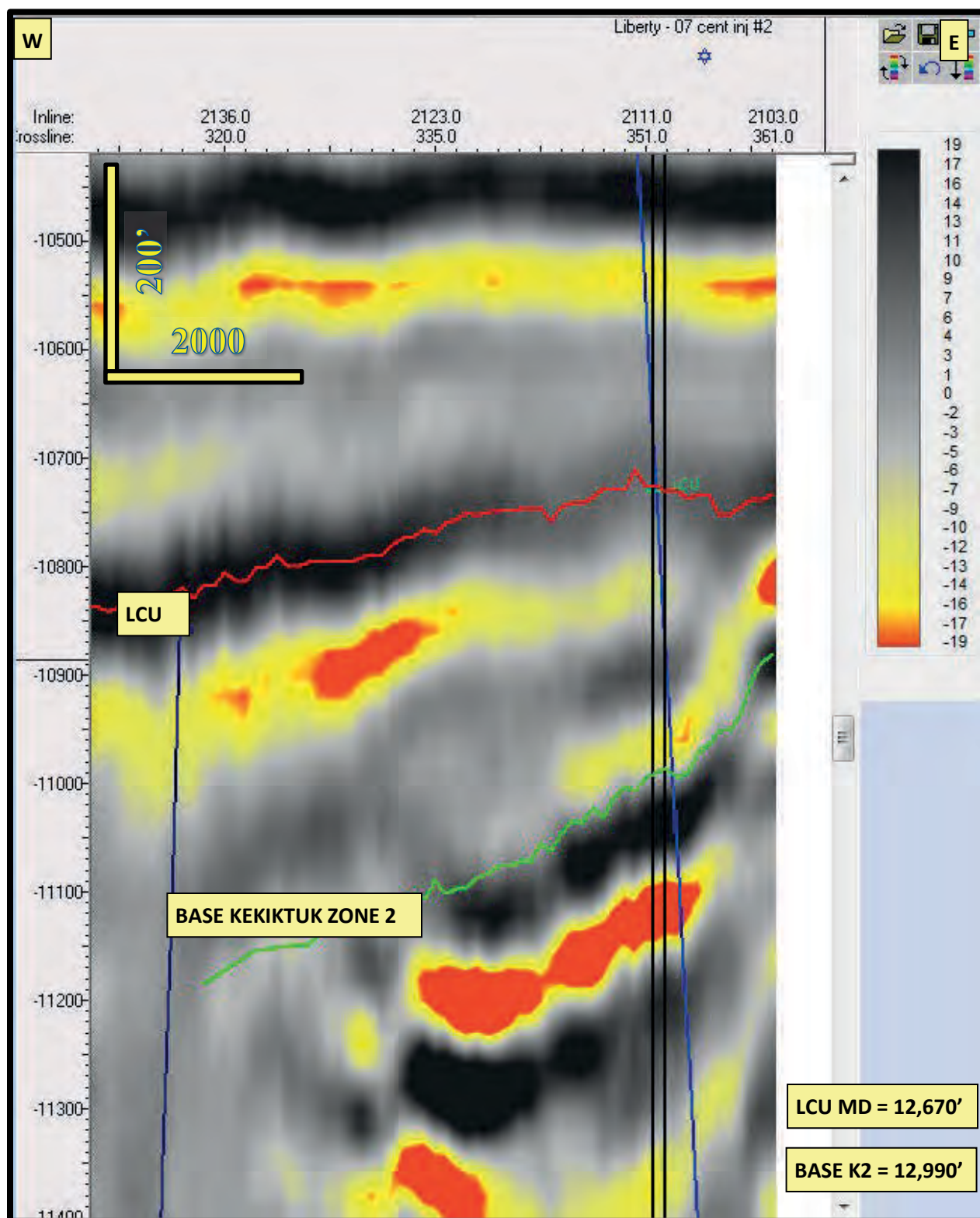
Figure 36. Liberty well slot 07 – central water injector, well-path traverse (big scale)

Figure 38. Liberty well slot 08 – northern producer

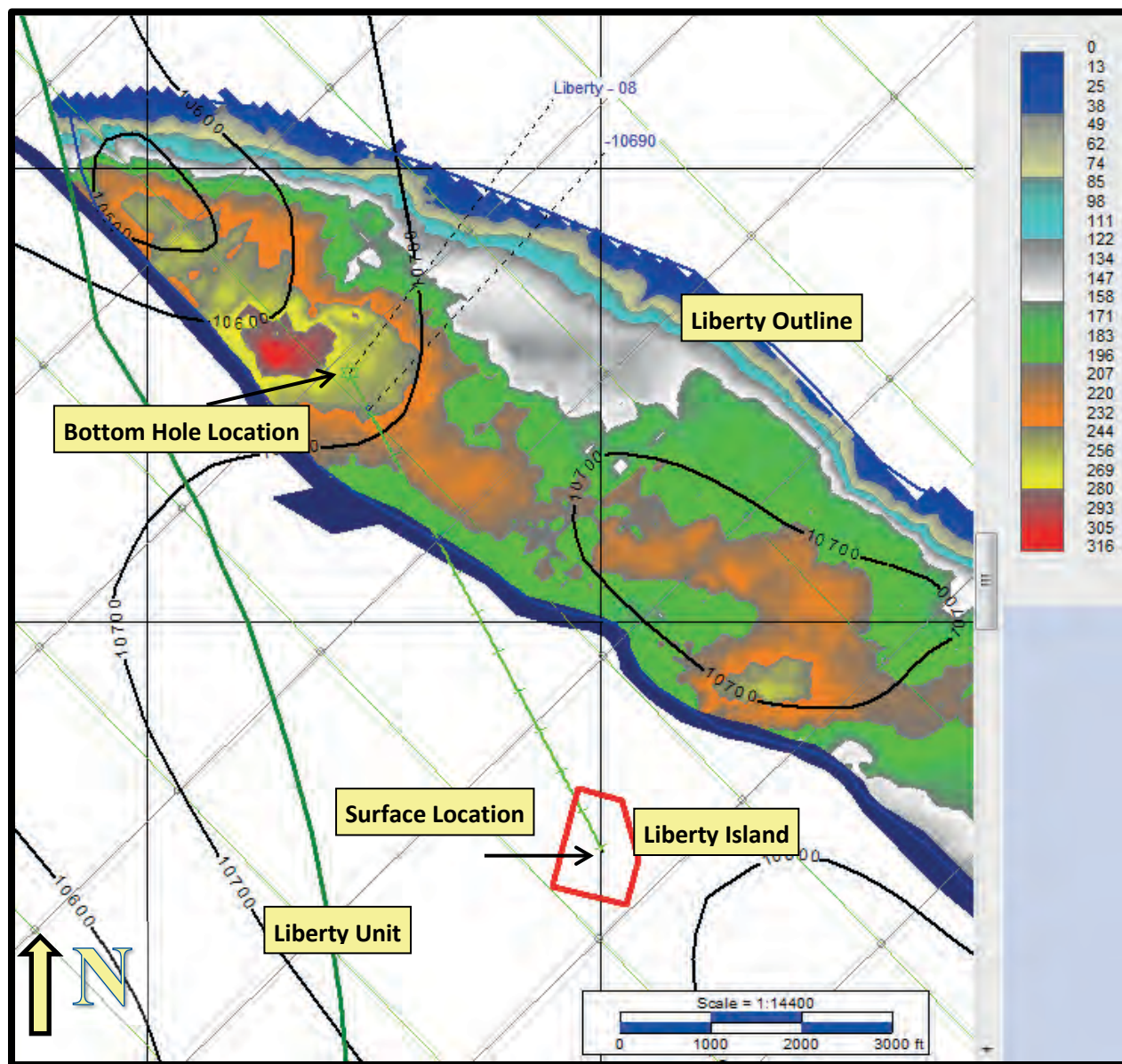


Figure 39. Liberty well slot 08 - northern producer with line overlays

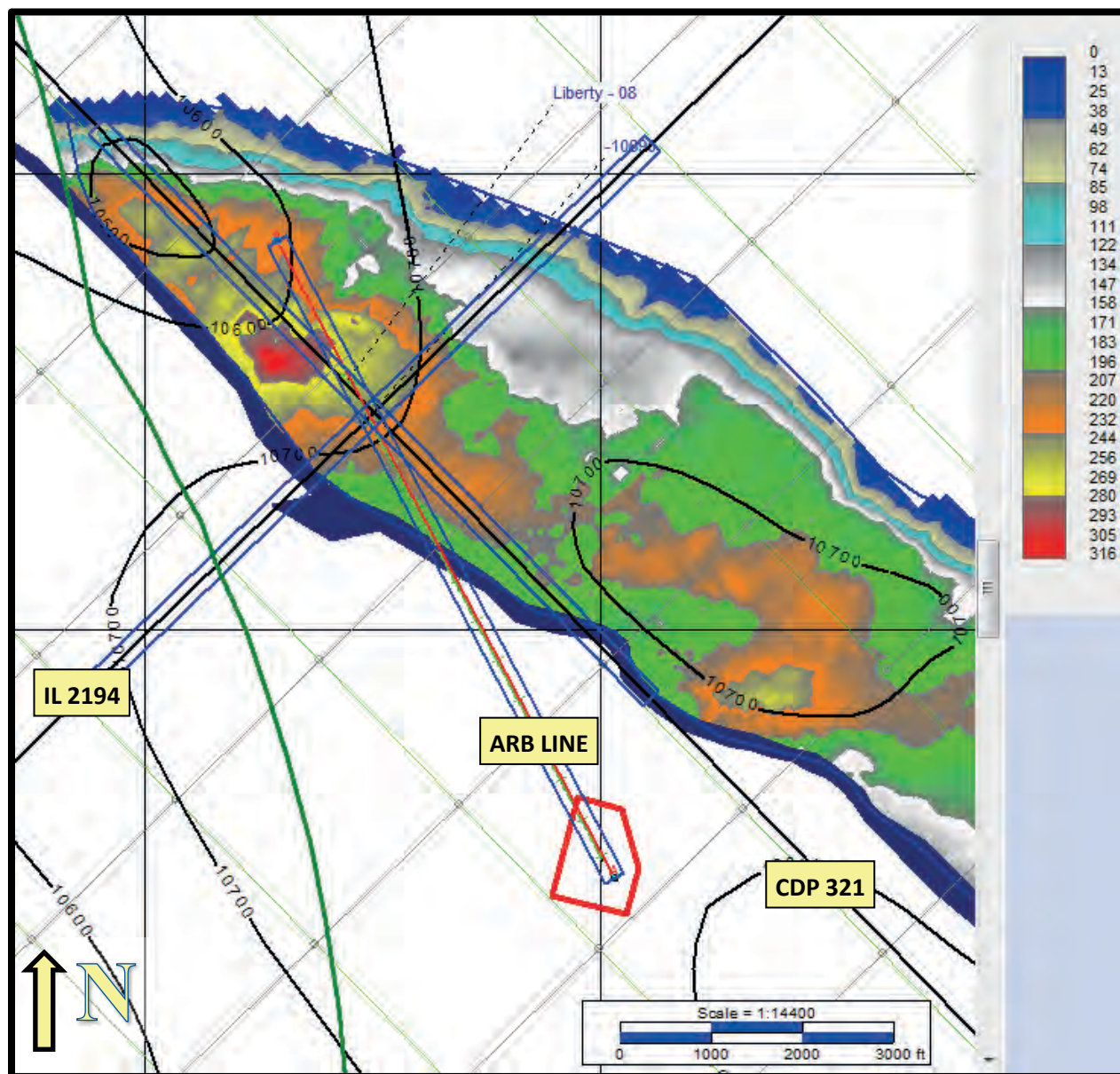


Figure 40. Liberty well slot 08 – northern producer, CDP 321

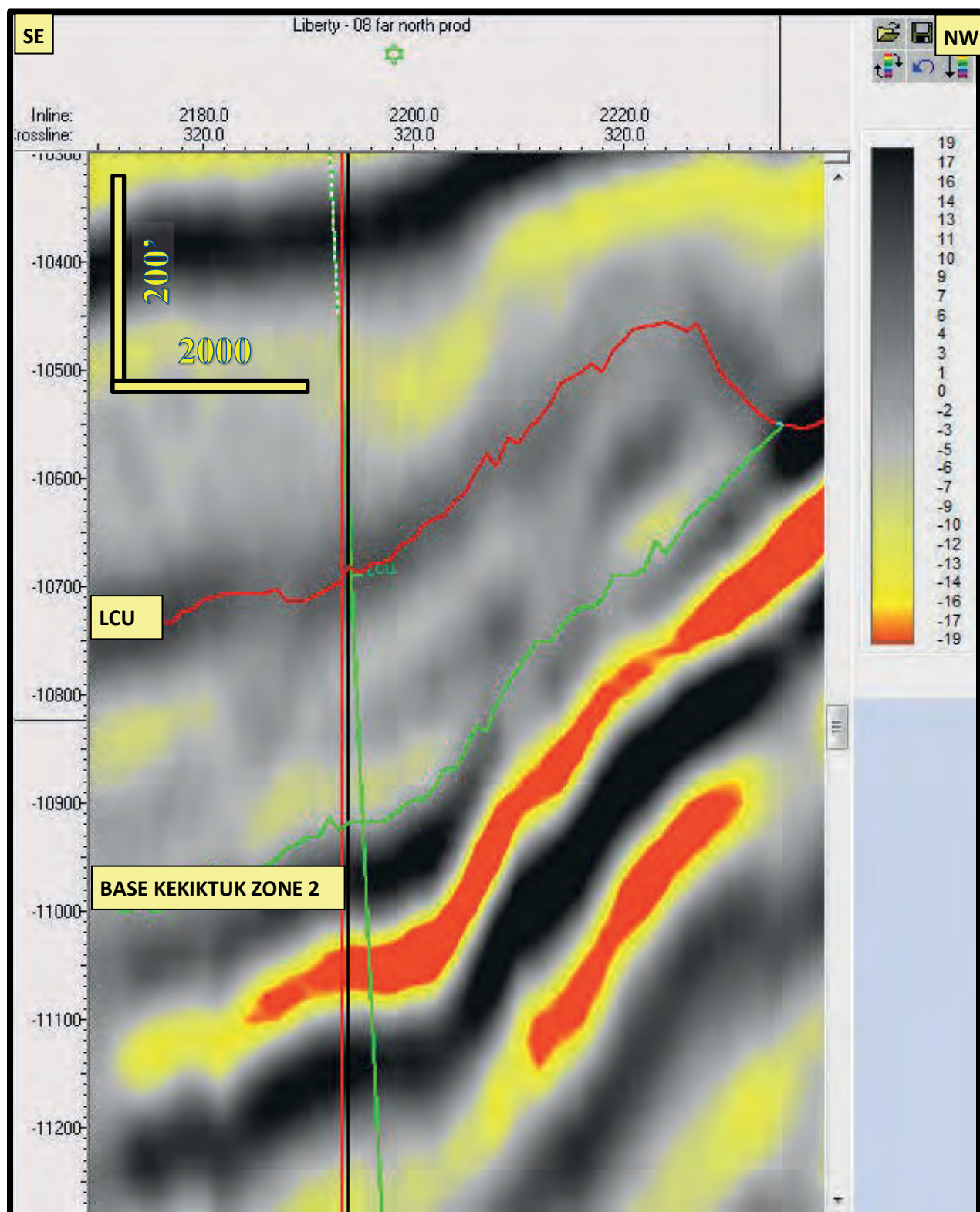


Figure 41. Liberty well slot 08 – northern producer, line 2194

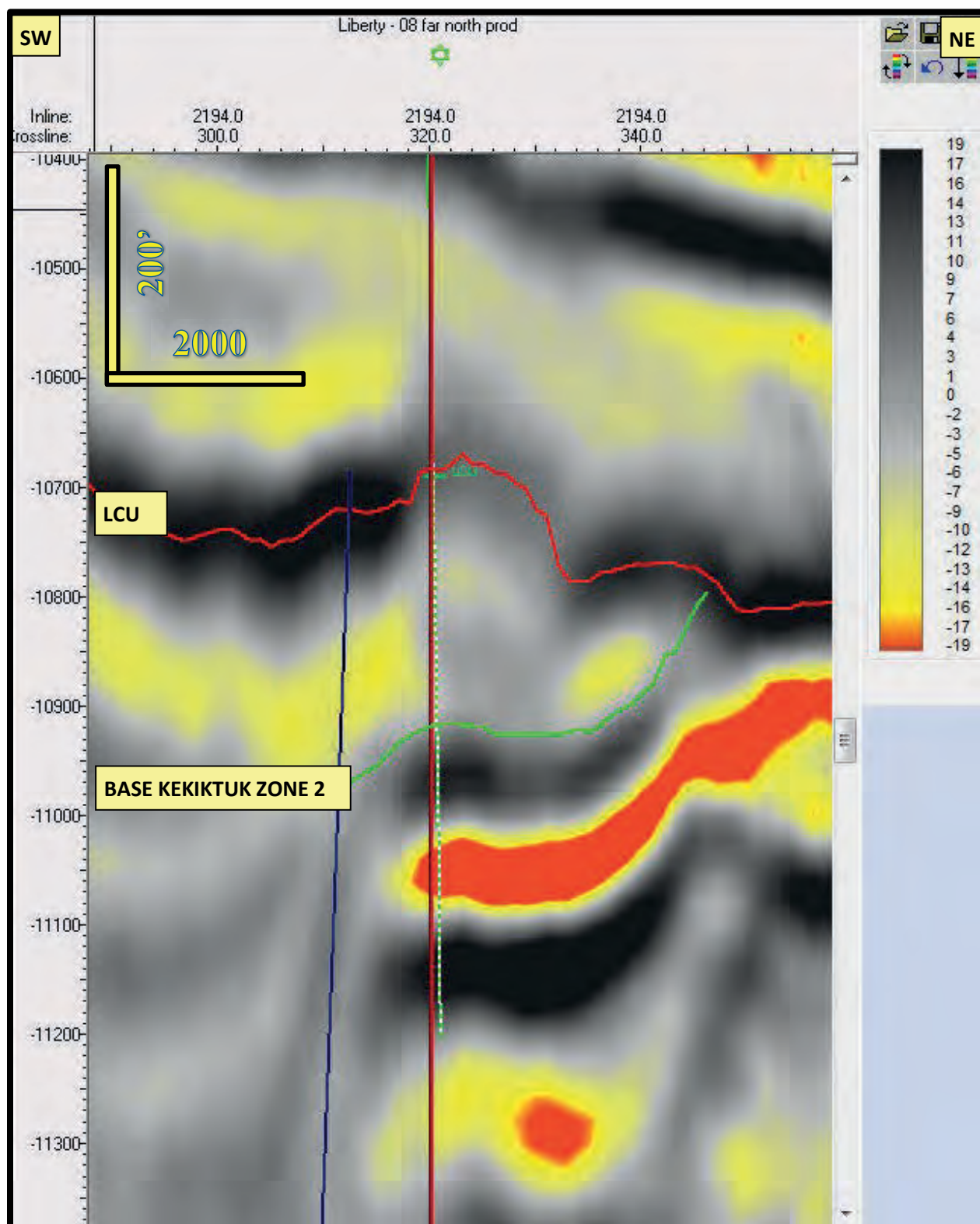


Figure 42. Liberty well slot 08 – northern producer, well-path traverse (small scale)

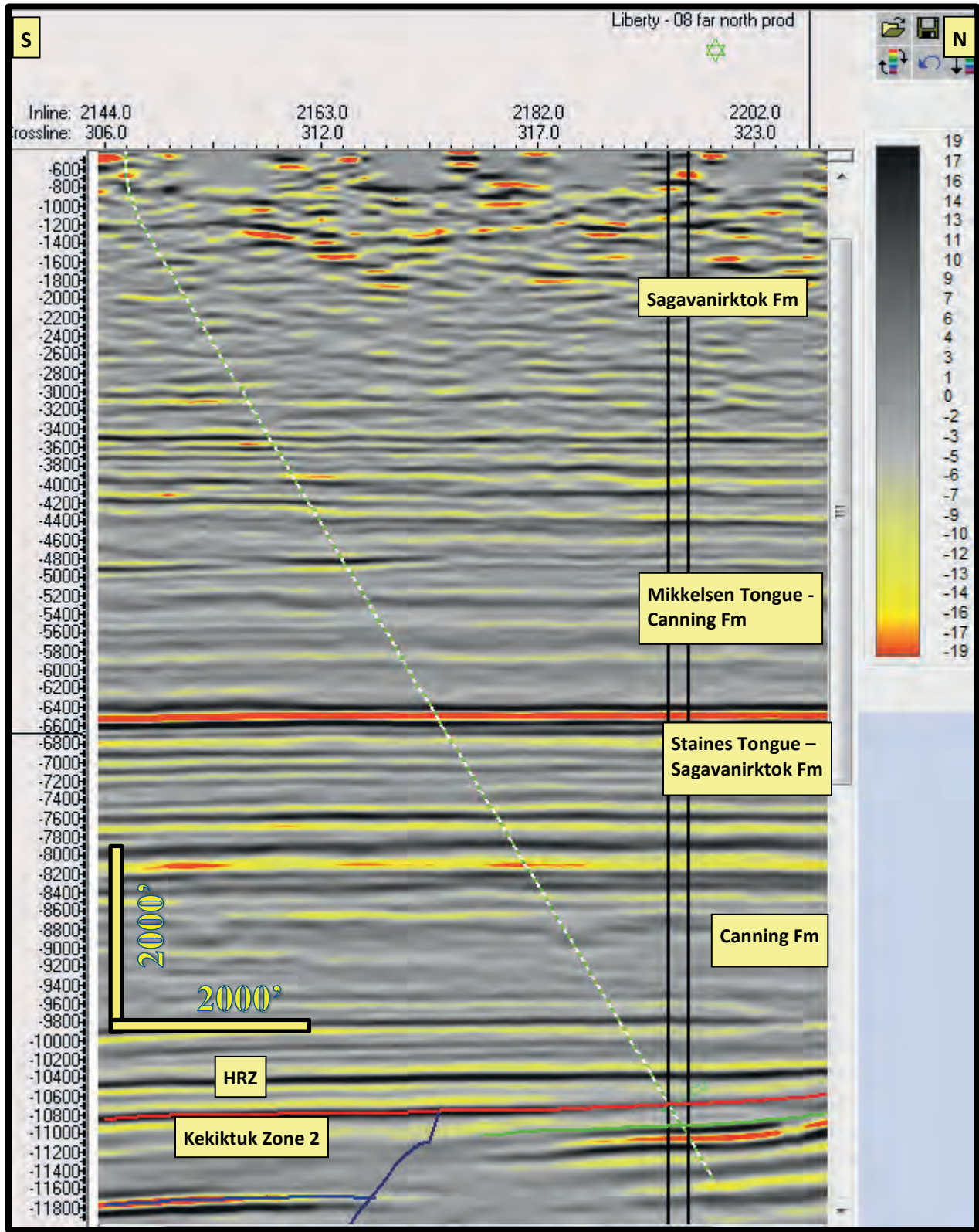


Figure 43. Liberty well slot 08 – northern producer, well-path traverse (big scale)

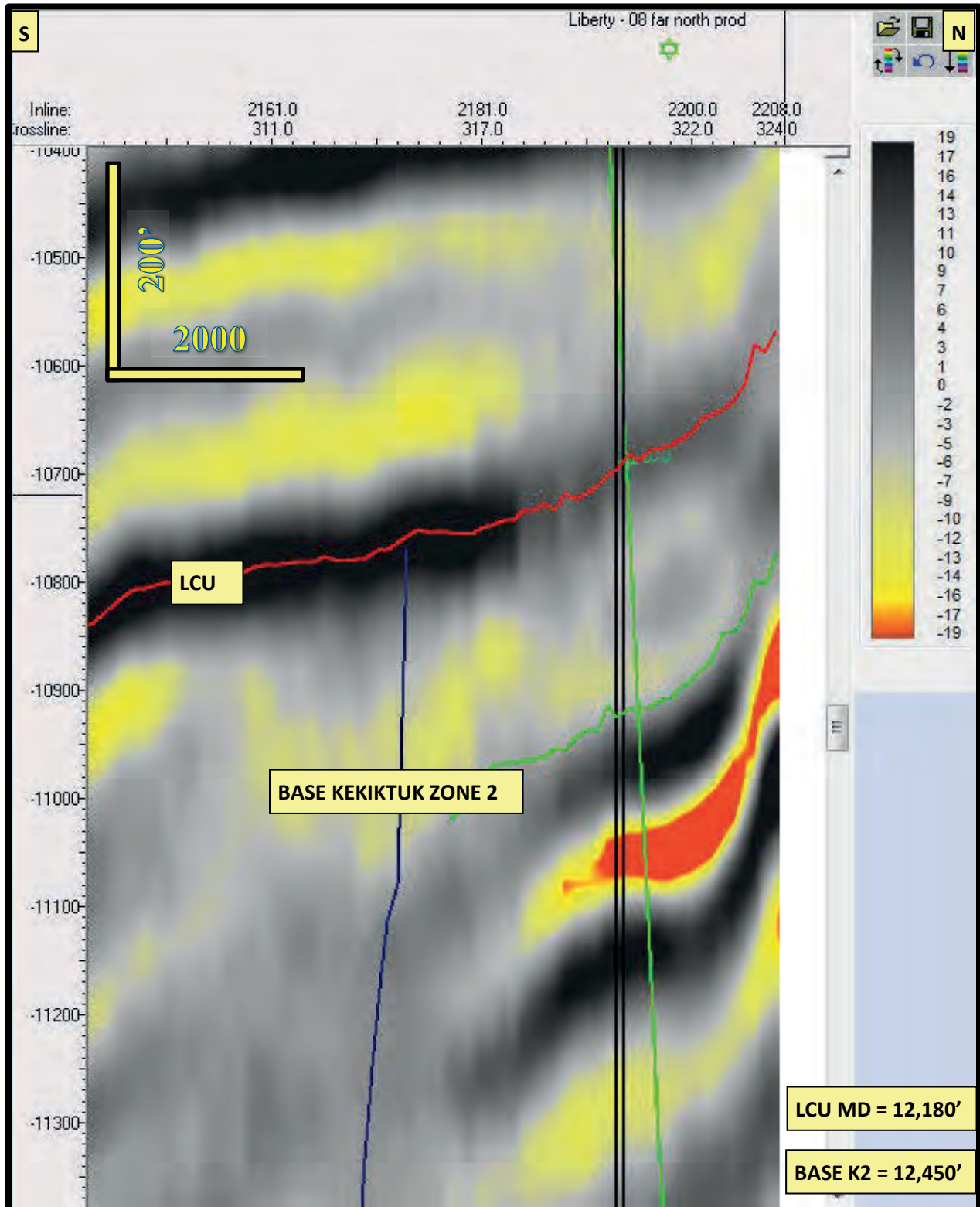


Figure 44. Liberty well slot 08 – northern producer, interpreted structural cross section

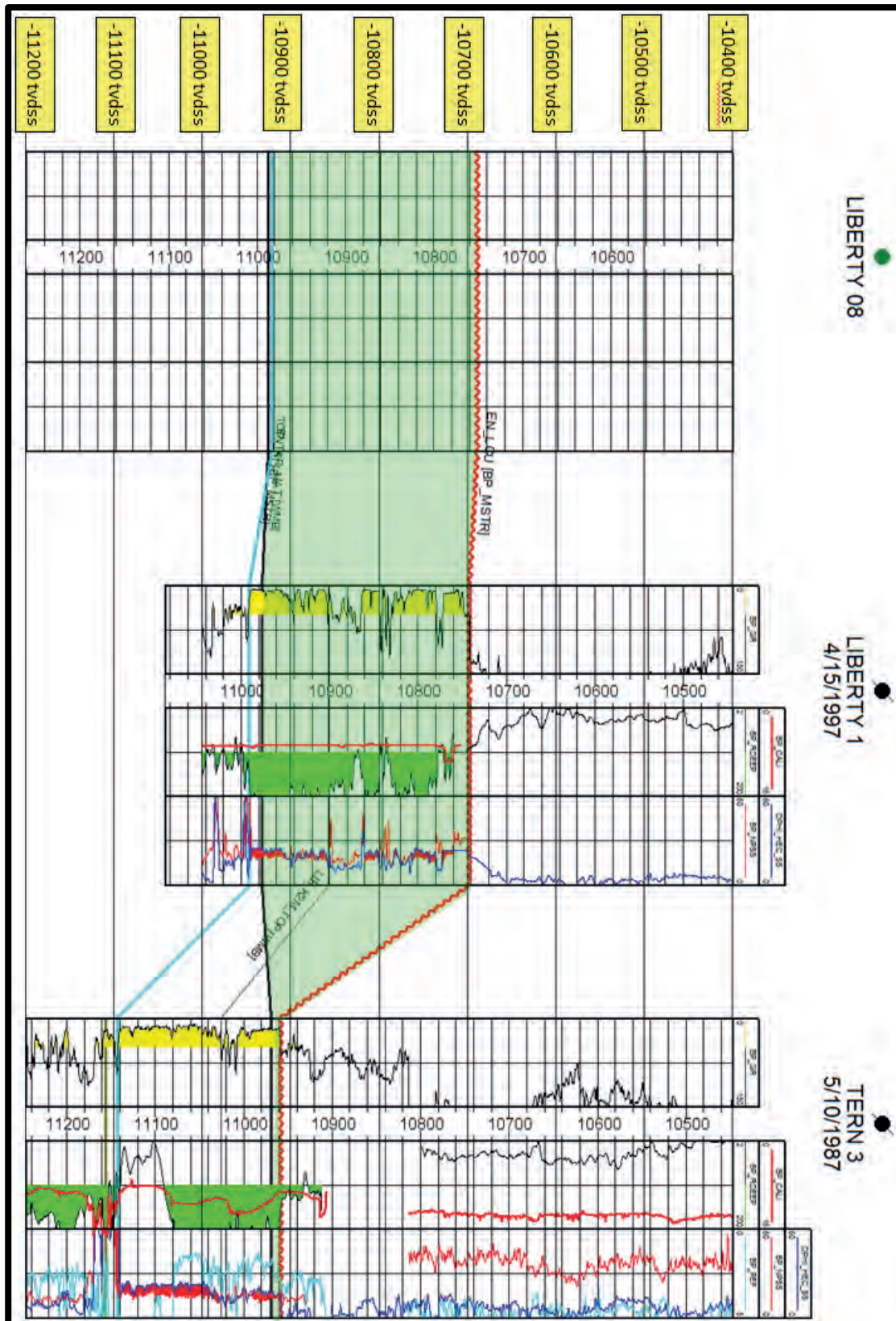


Figure 45. Liberty well slot 09 – far south producer

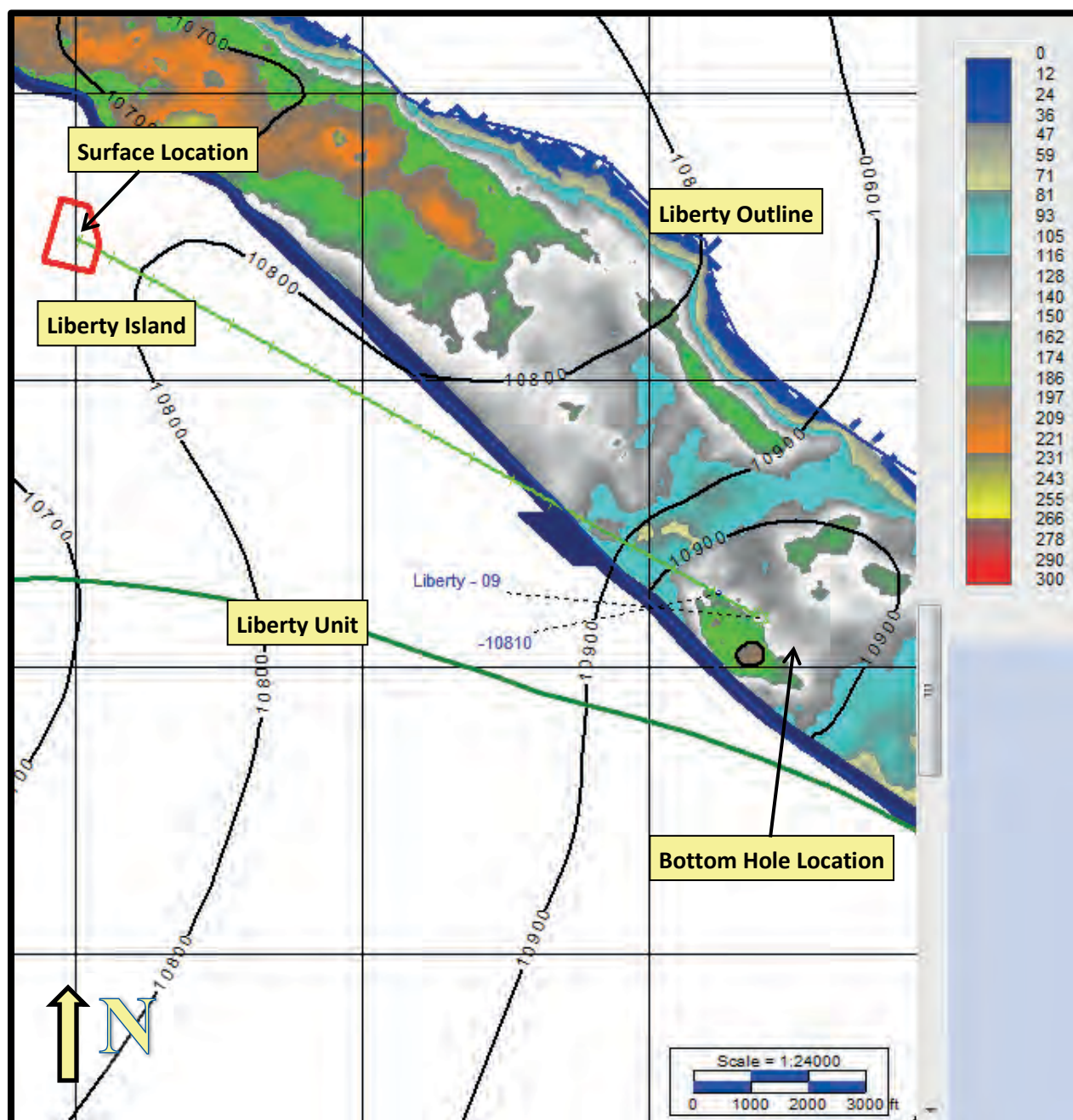


Figure 46. Liberty well slot 09 – far south producer with line overlays

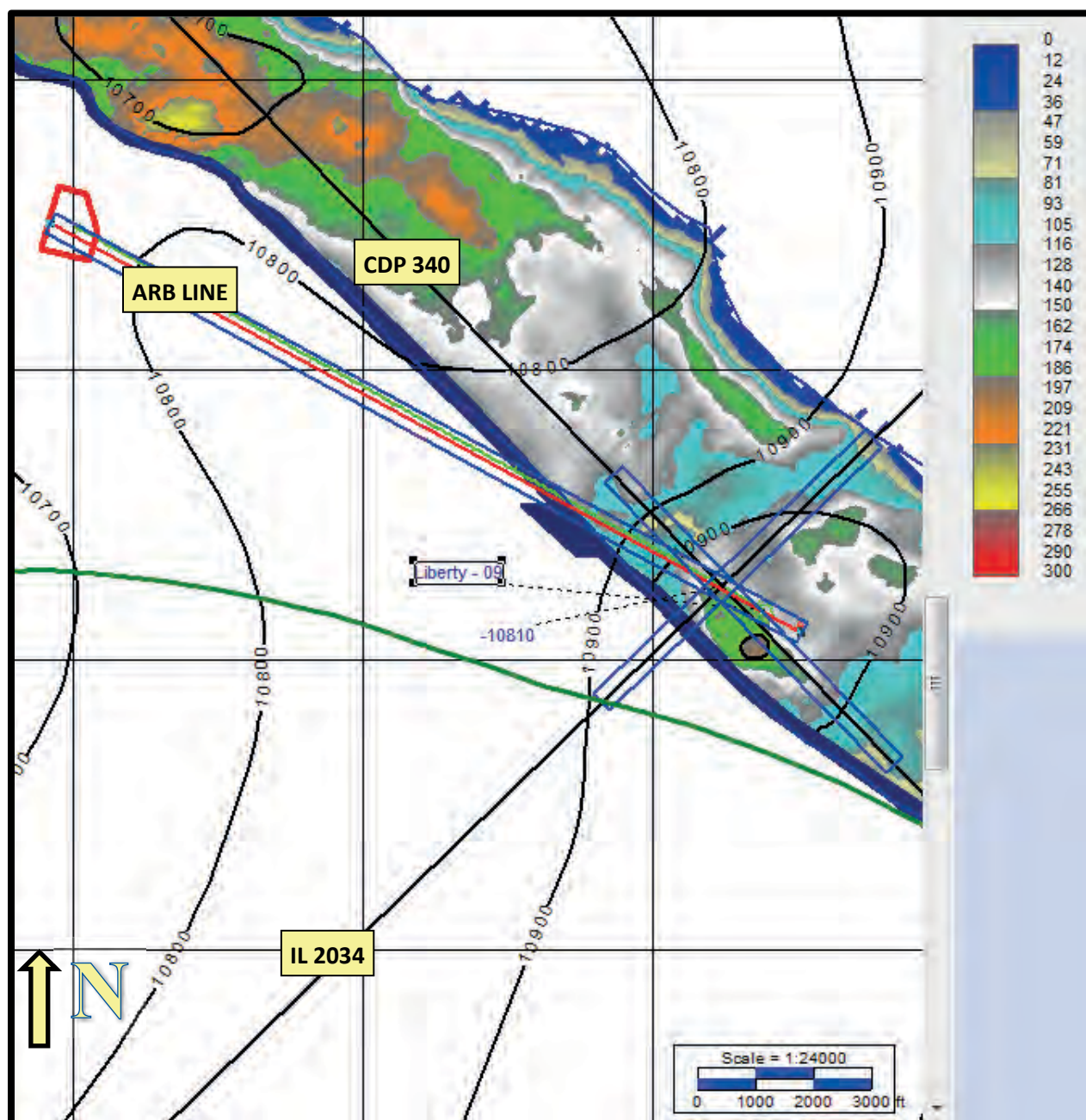


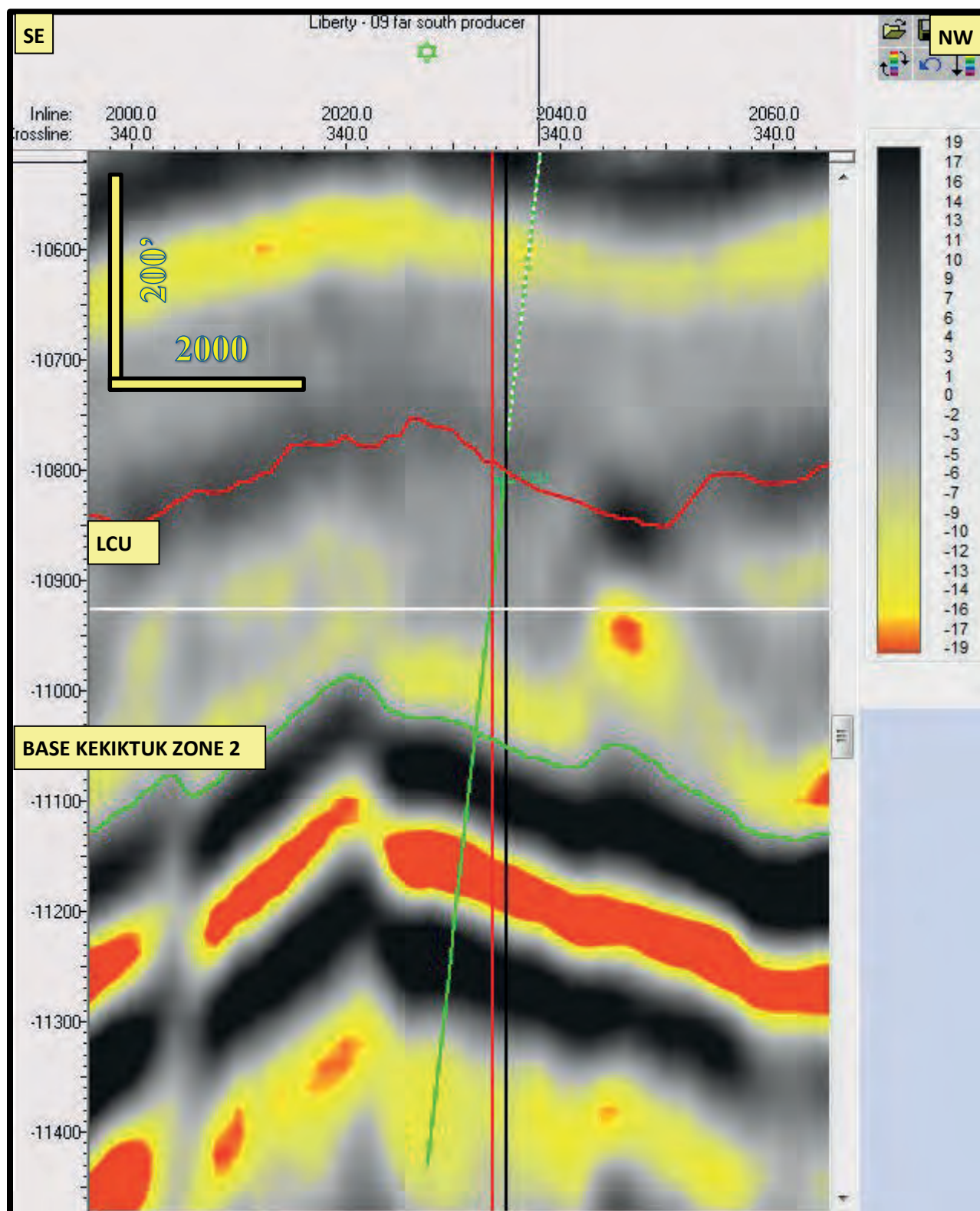
Figure 47. Liberty well slot 09 – far south producer, CDP 340

Figure 48. Liberty well slot 09 – far south producer, line 2034

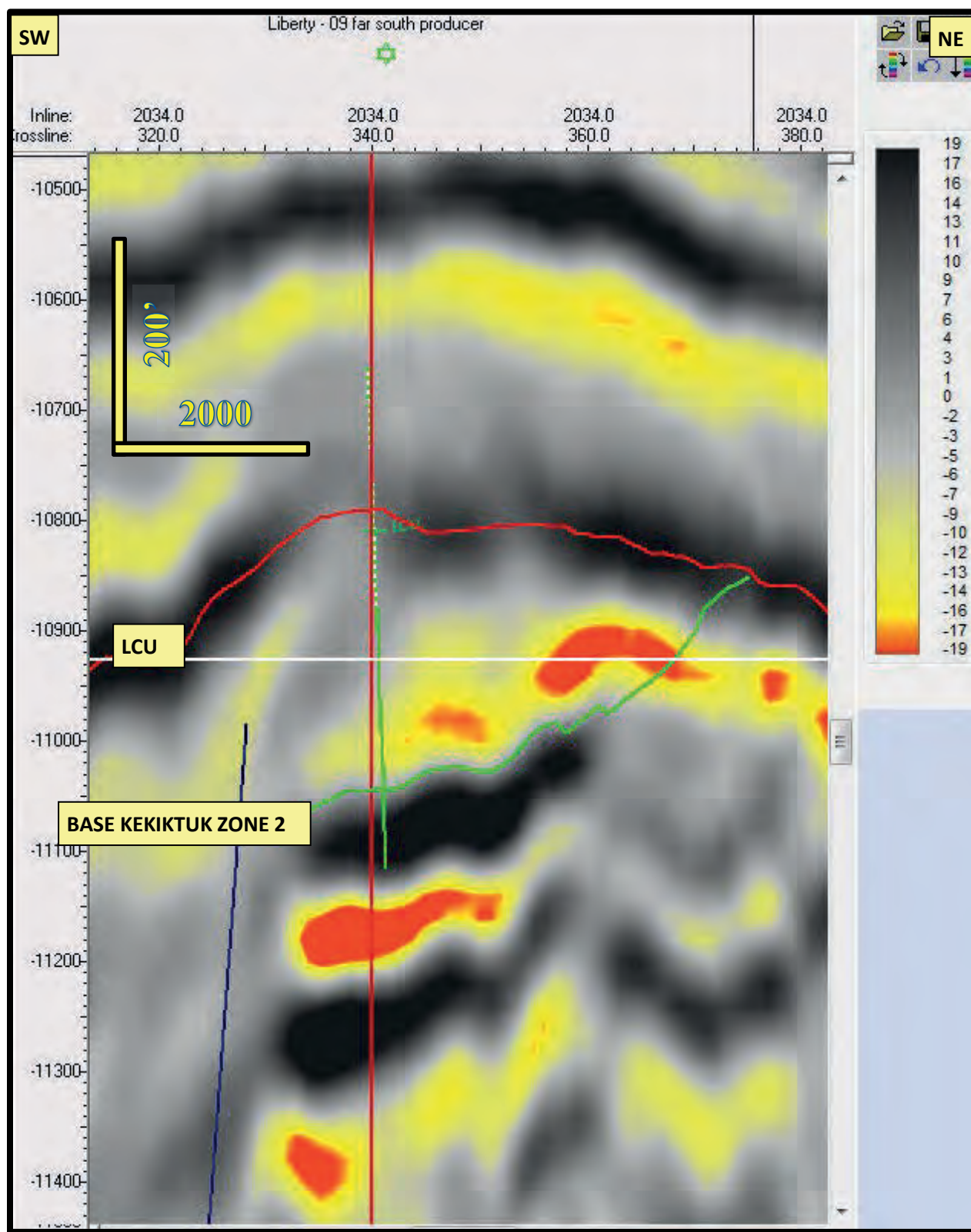


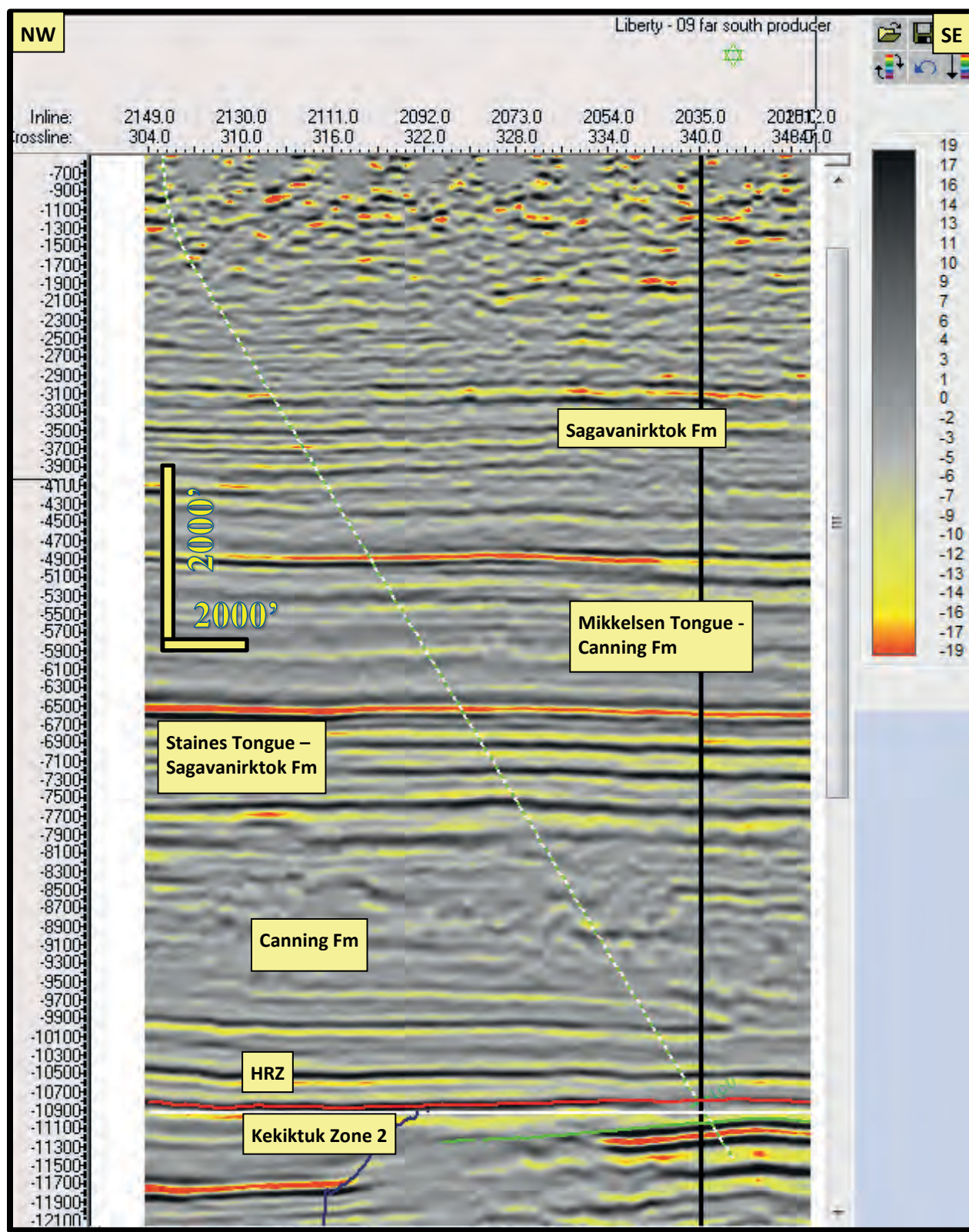
Figure 49. Liberty well slot 09 – far south producer, well-path traverse (big scale)

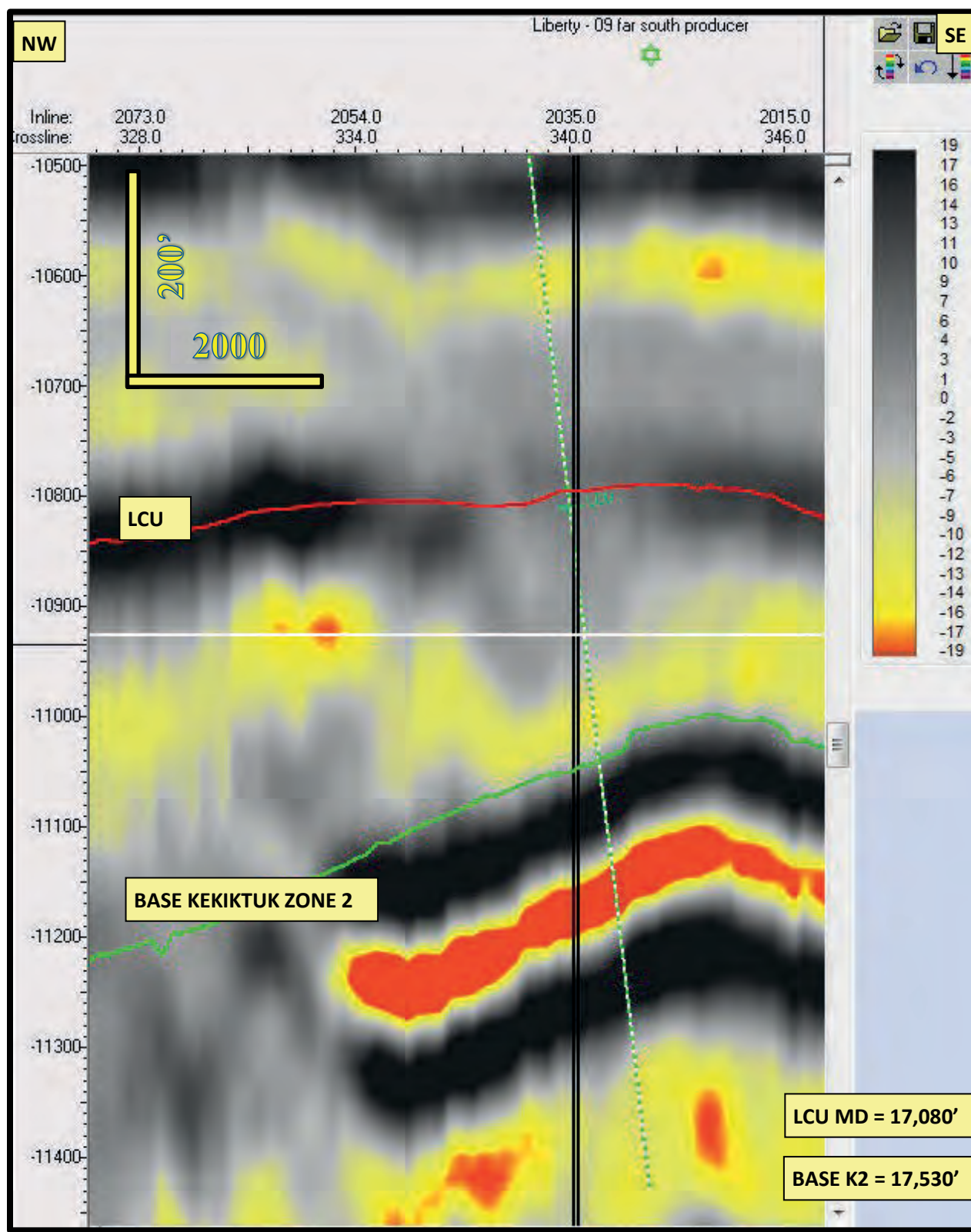
Figure 50. Liberty well slot 09 – far south producer, well-path traverse (small scale)

Figure 51. Liberty well slot 09 – far south producer, interpreted structural cross section

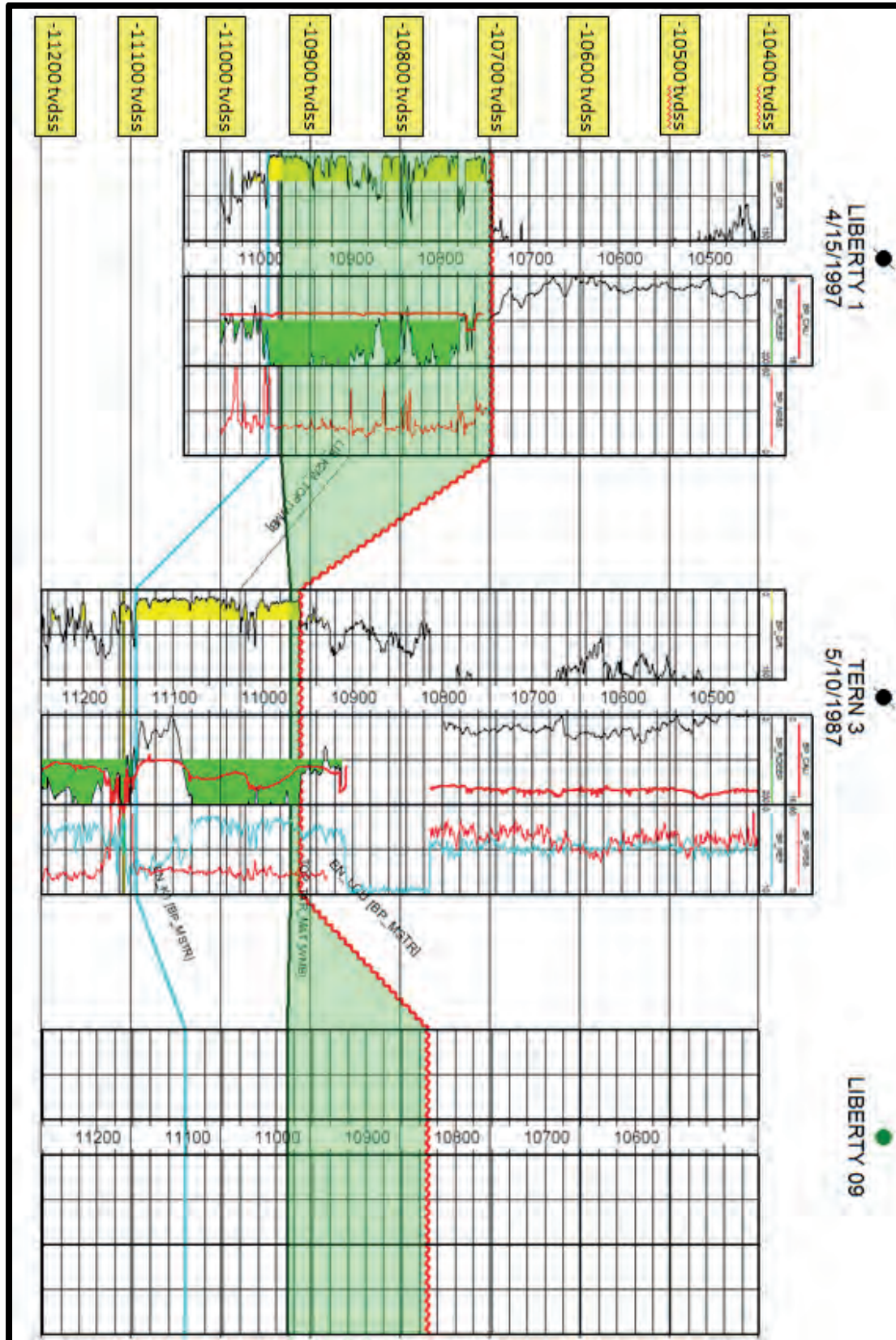


Figure 52. Liberty well slot 10 – southern water injector

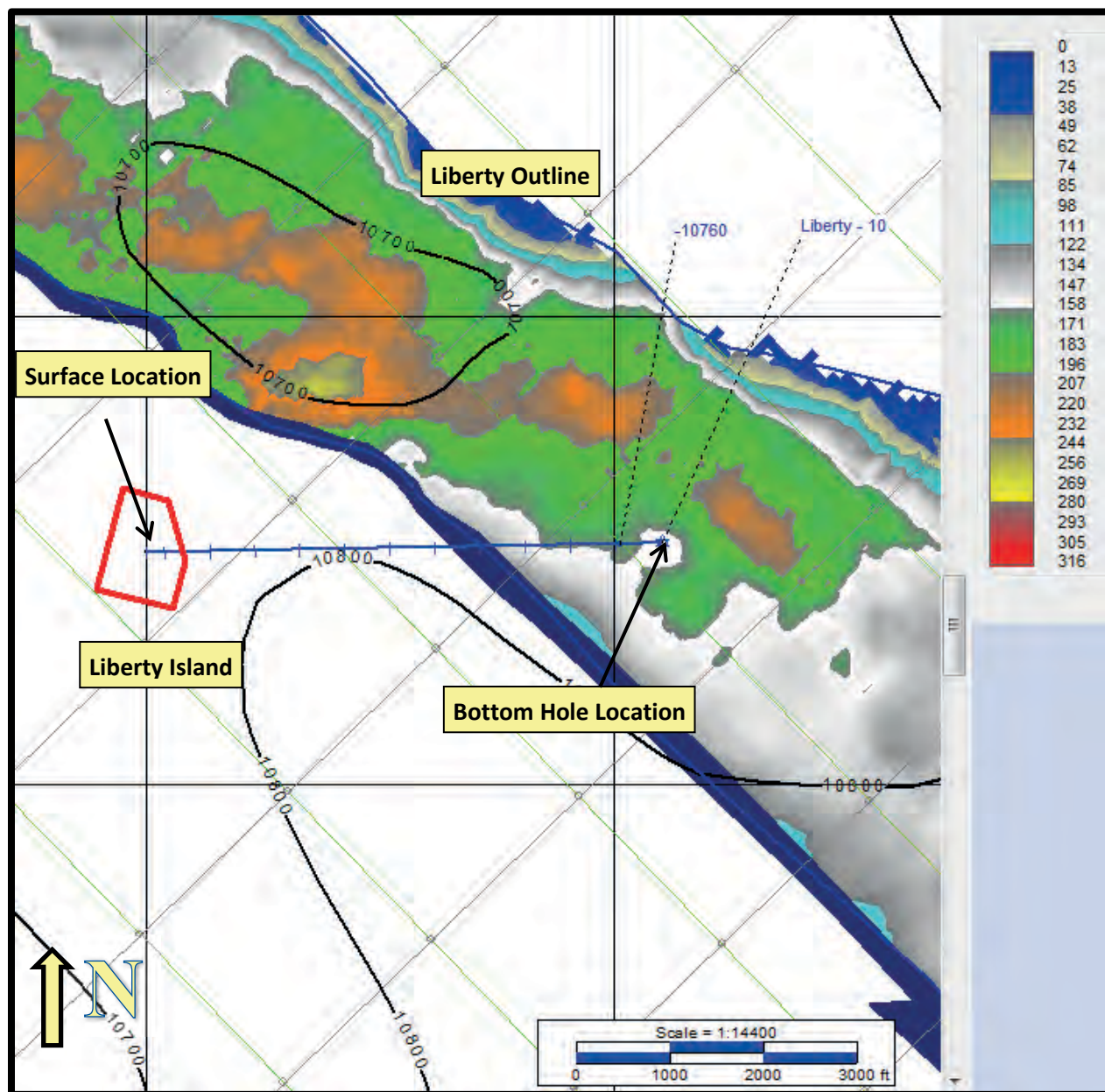


Figure 53. Liberty well slot 10 – southern water injector with line overlays

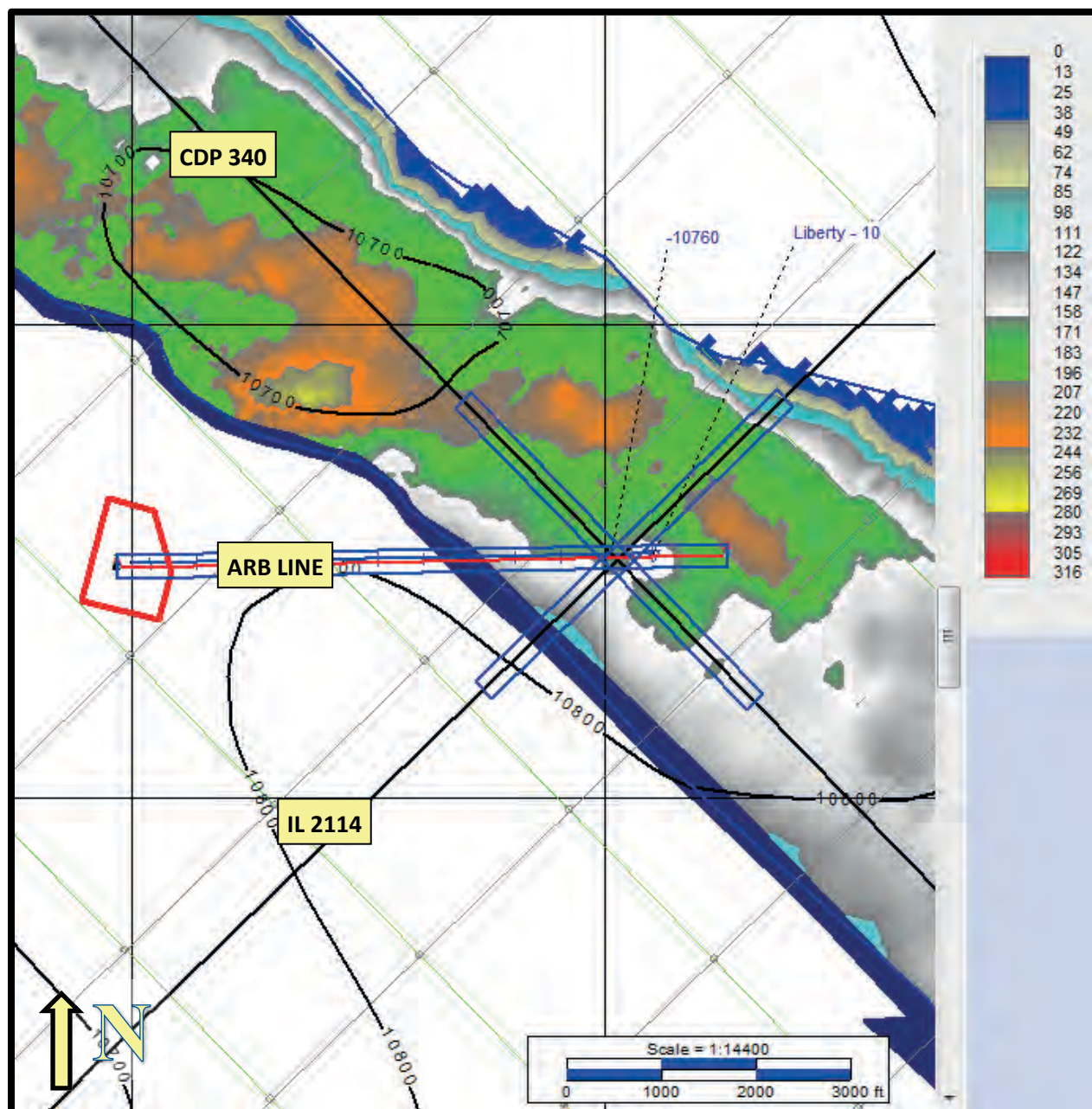


Figure 54. Liberty well slot 10 – southern water injector, CDP 340

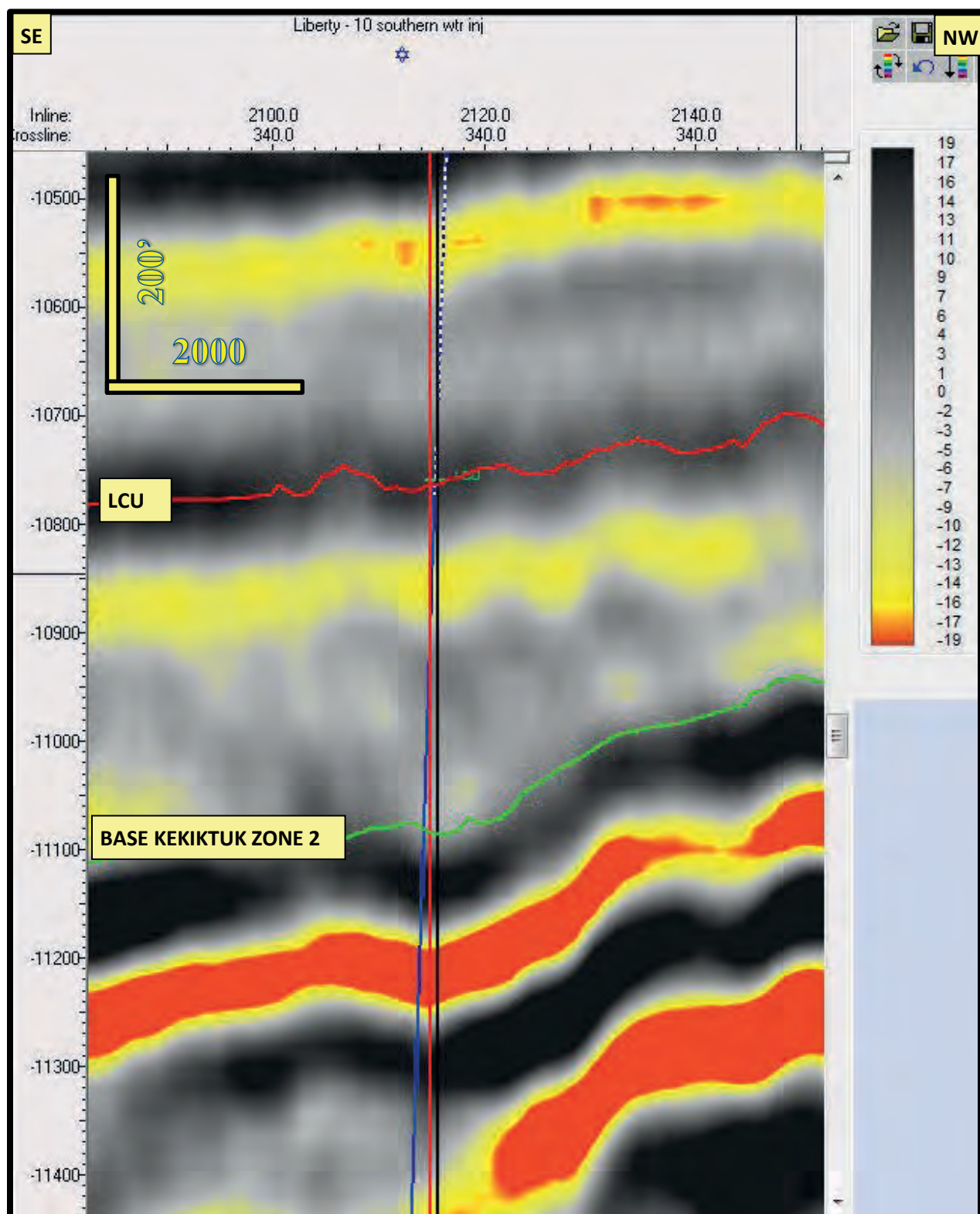


Figure 55. Liberty well slot 10 – southern water injector, line 2114

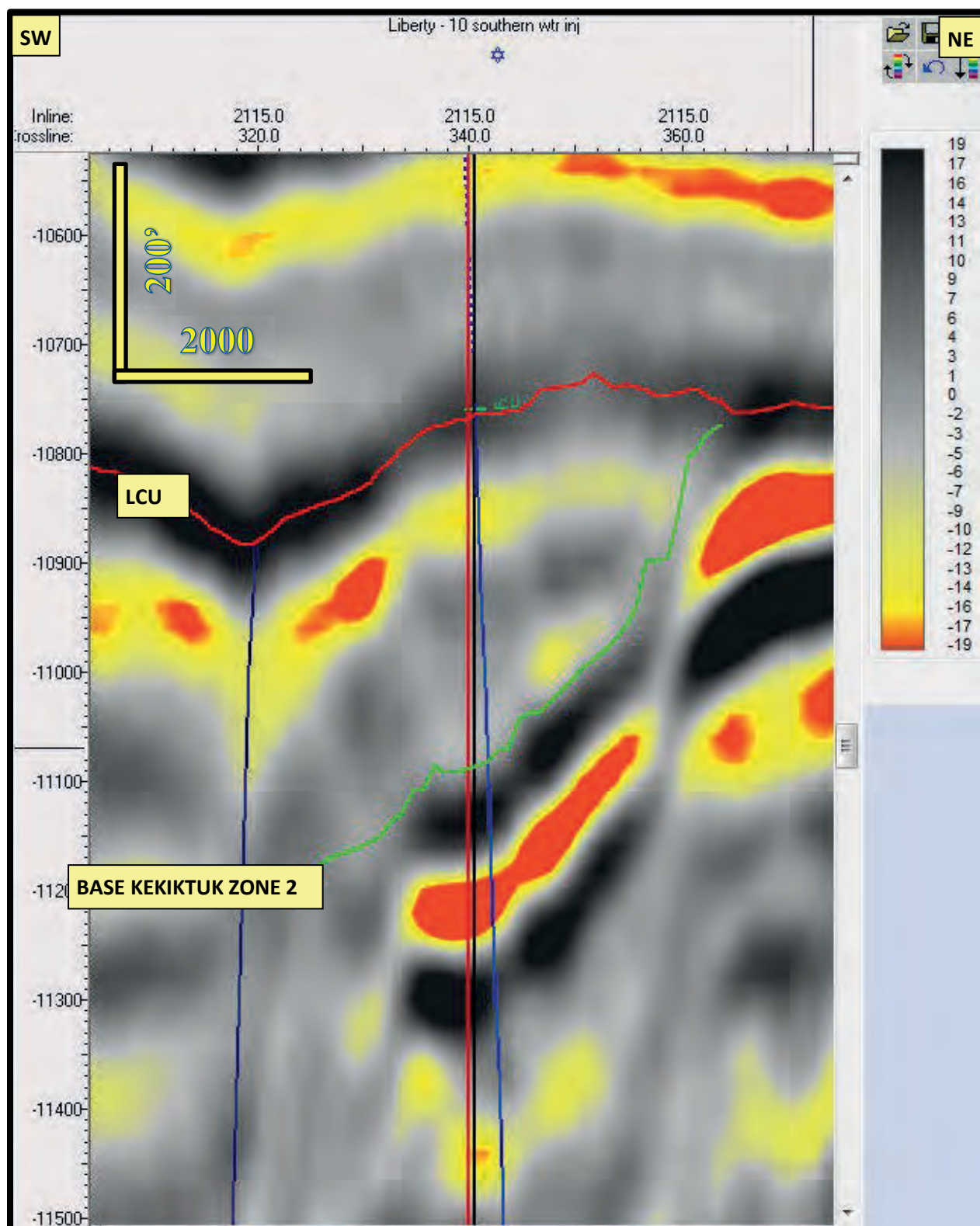


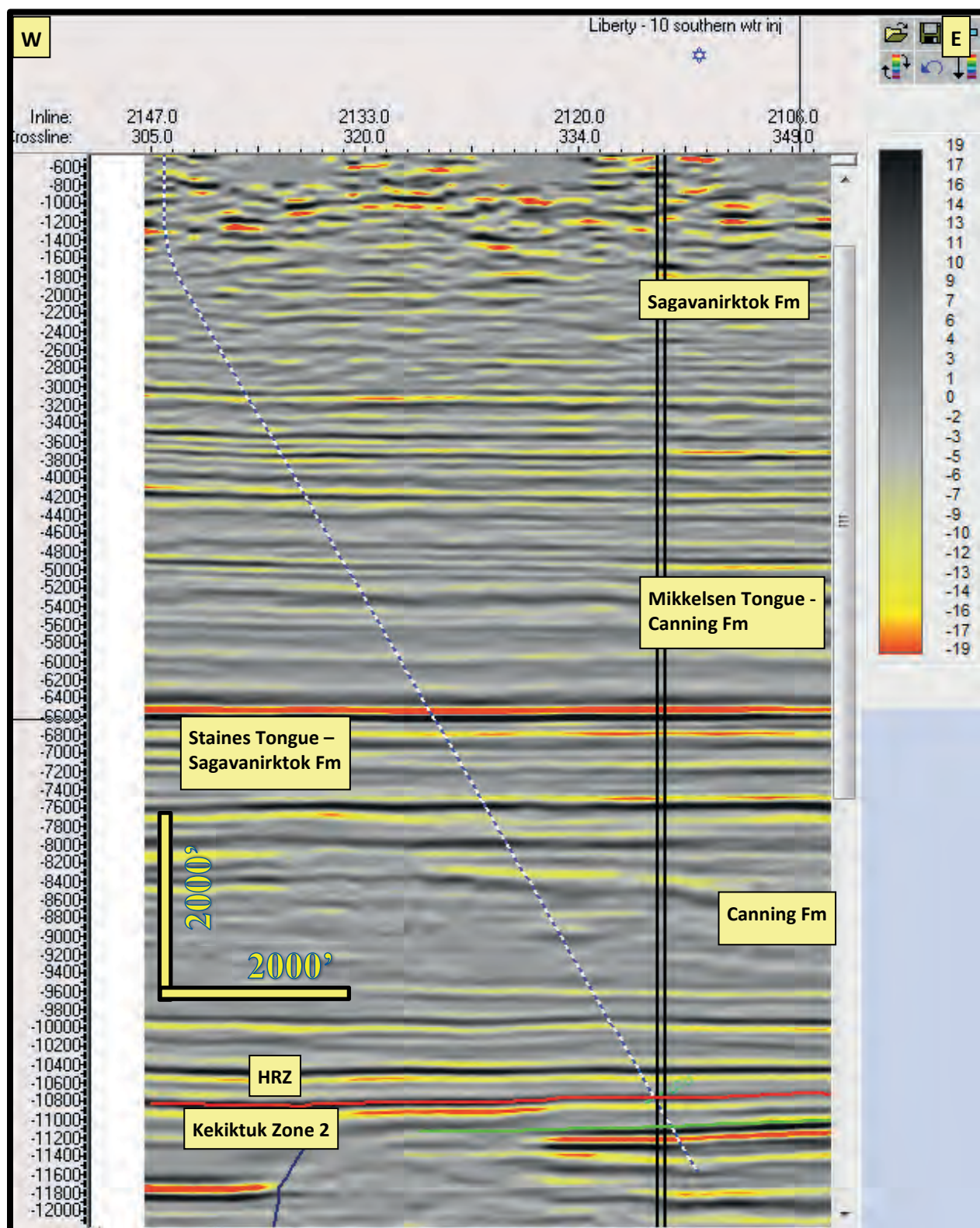
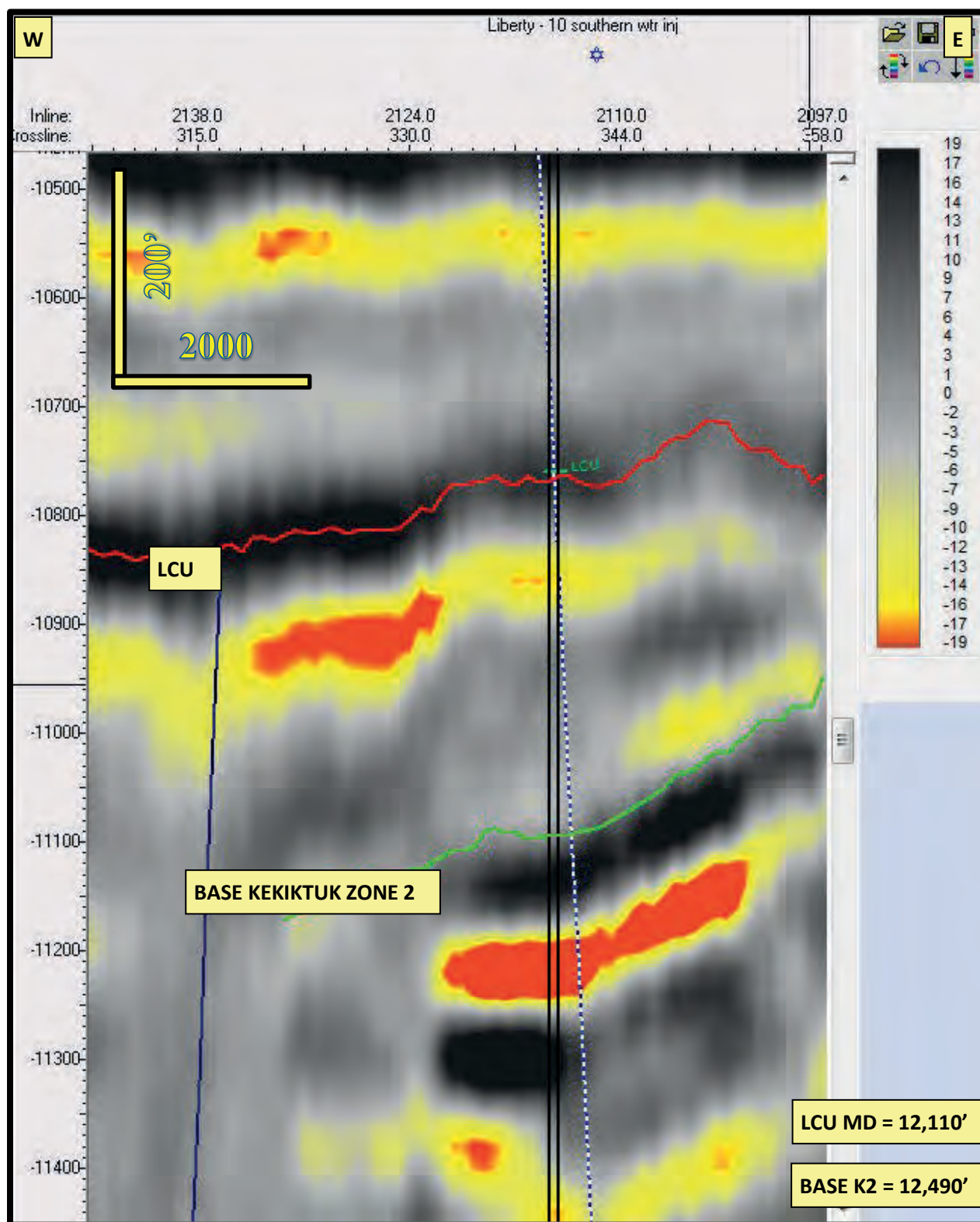
Figure 56. Liberty well slot 10 – southern water injector well-path traverse (small scale)

Figure 57. Liberty well slot 10 – southern water injector well-path traverse big scale)



LIBERTY 1
4/15/1997

LIBERTY 10
5/10/1987

TERN 3
5/10/1987

Figure 59. Liberty well slot 11 – south central producer

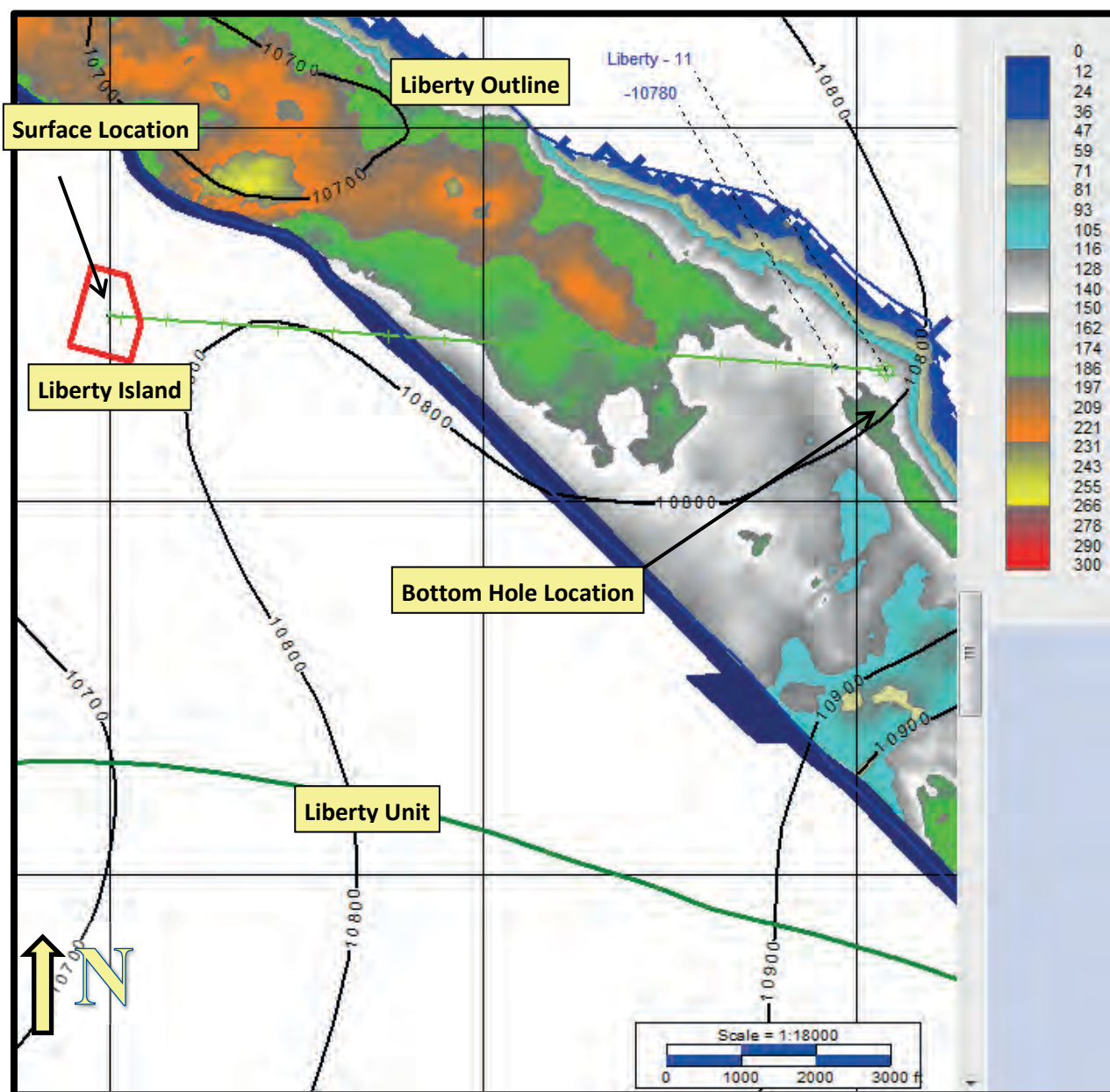


Figure 60. Liberty well slot 11 – south central producer with line overlays

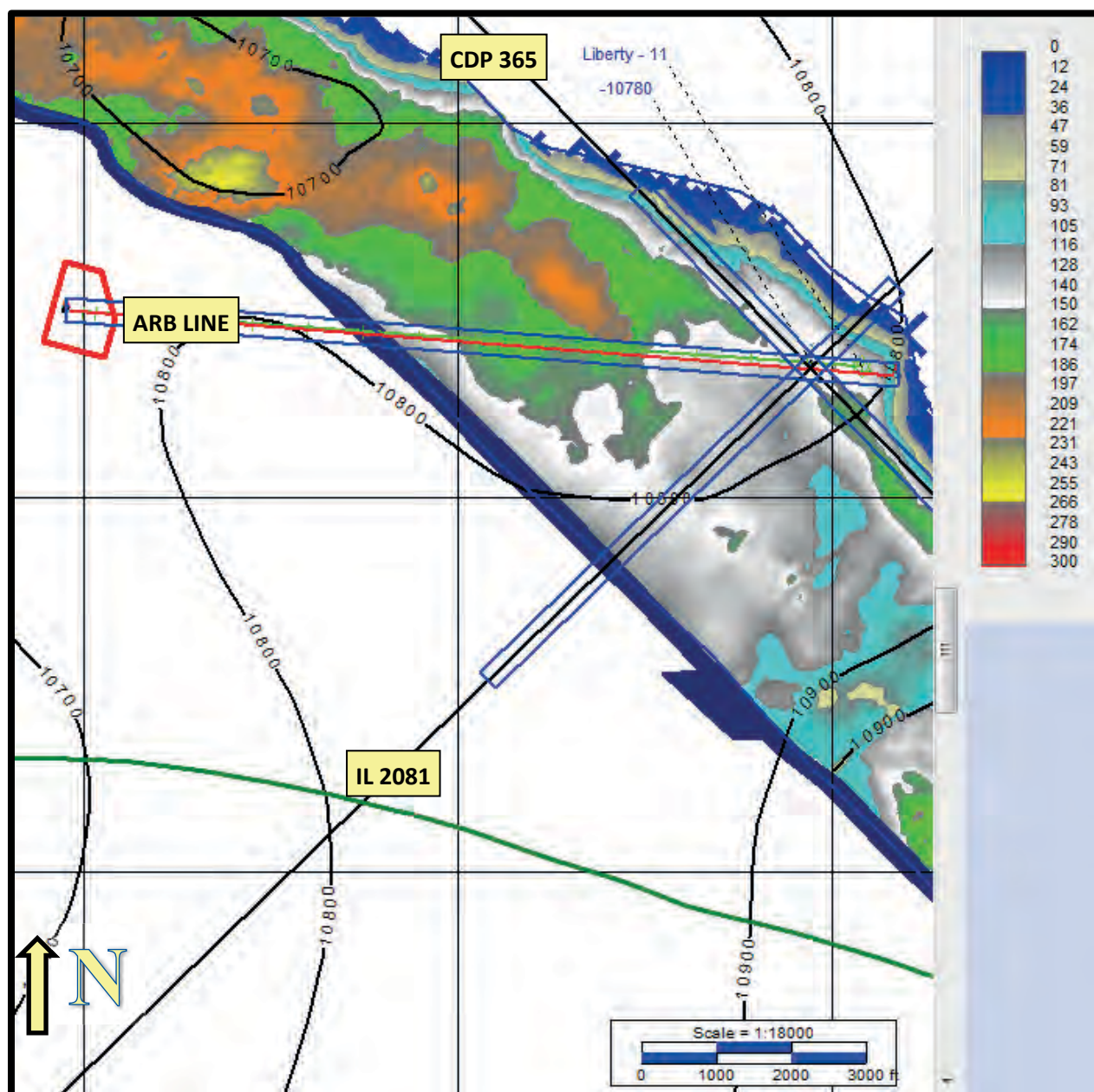


Figure 61. Liberty well slot 11 – south central producer, CDP 365

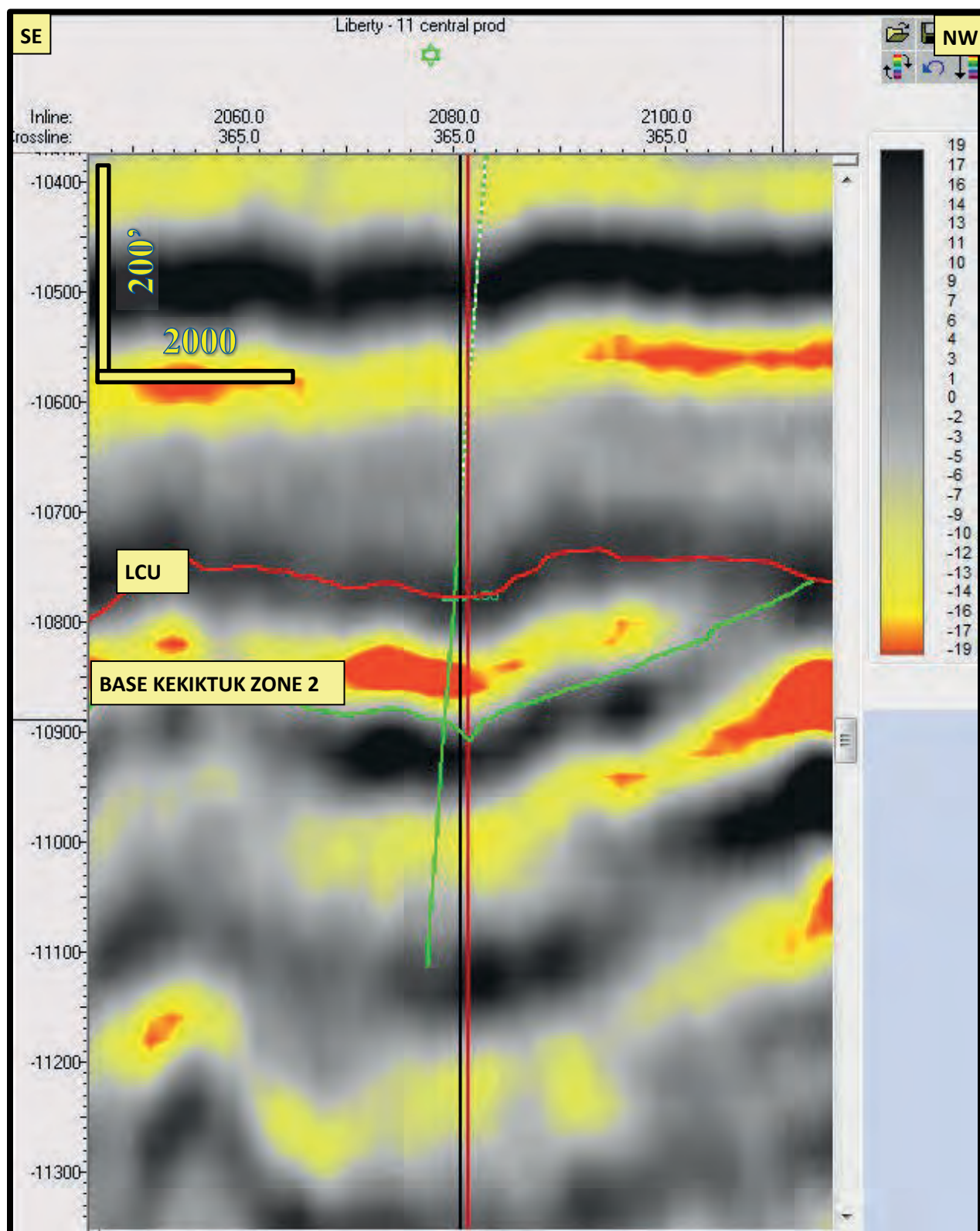


Figure 62. Liberty well slot 11 – south central producer, line 2081

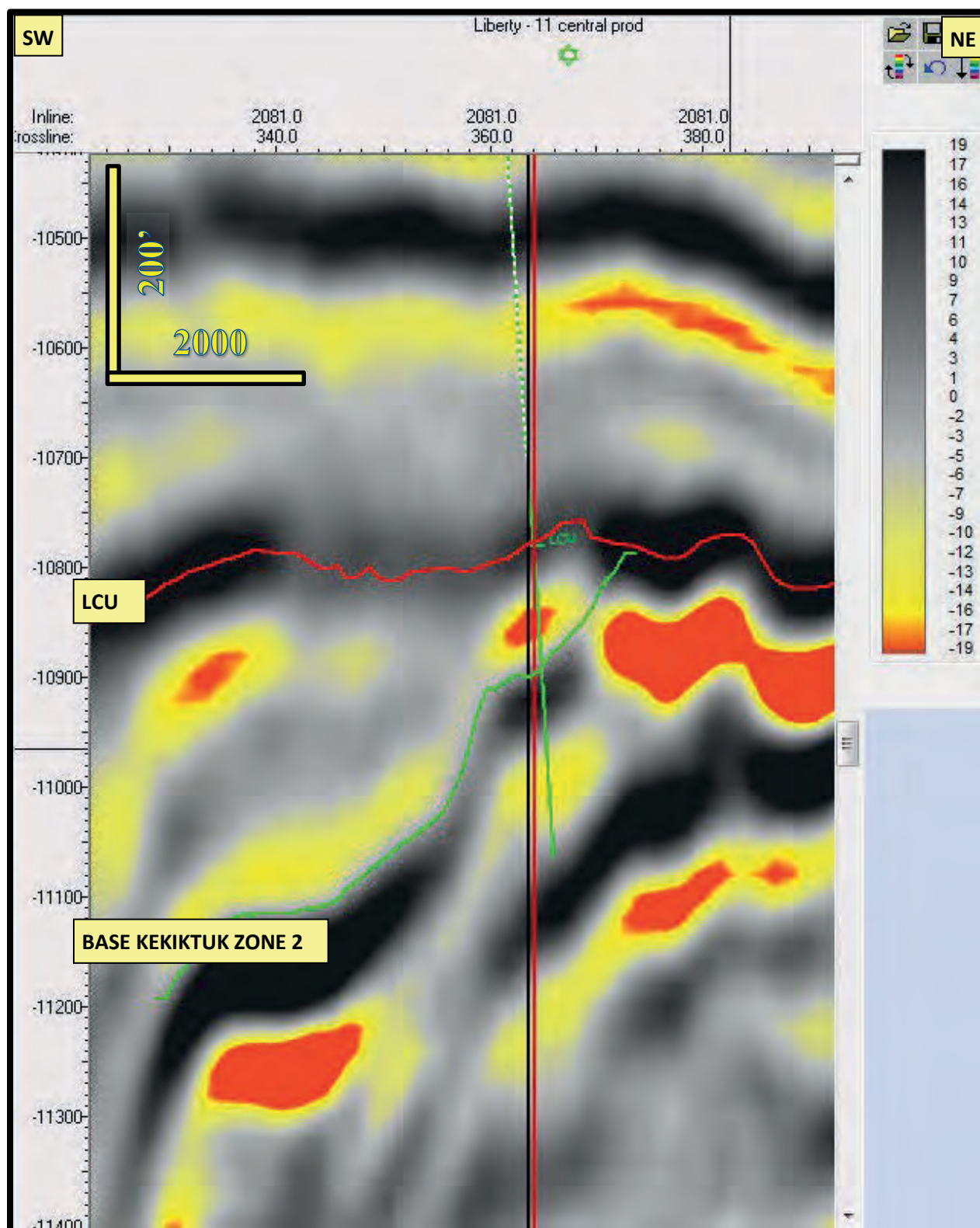


Figure 63. Liberty well slot 11 – south central producer, well-path traverse (small scale)

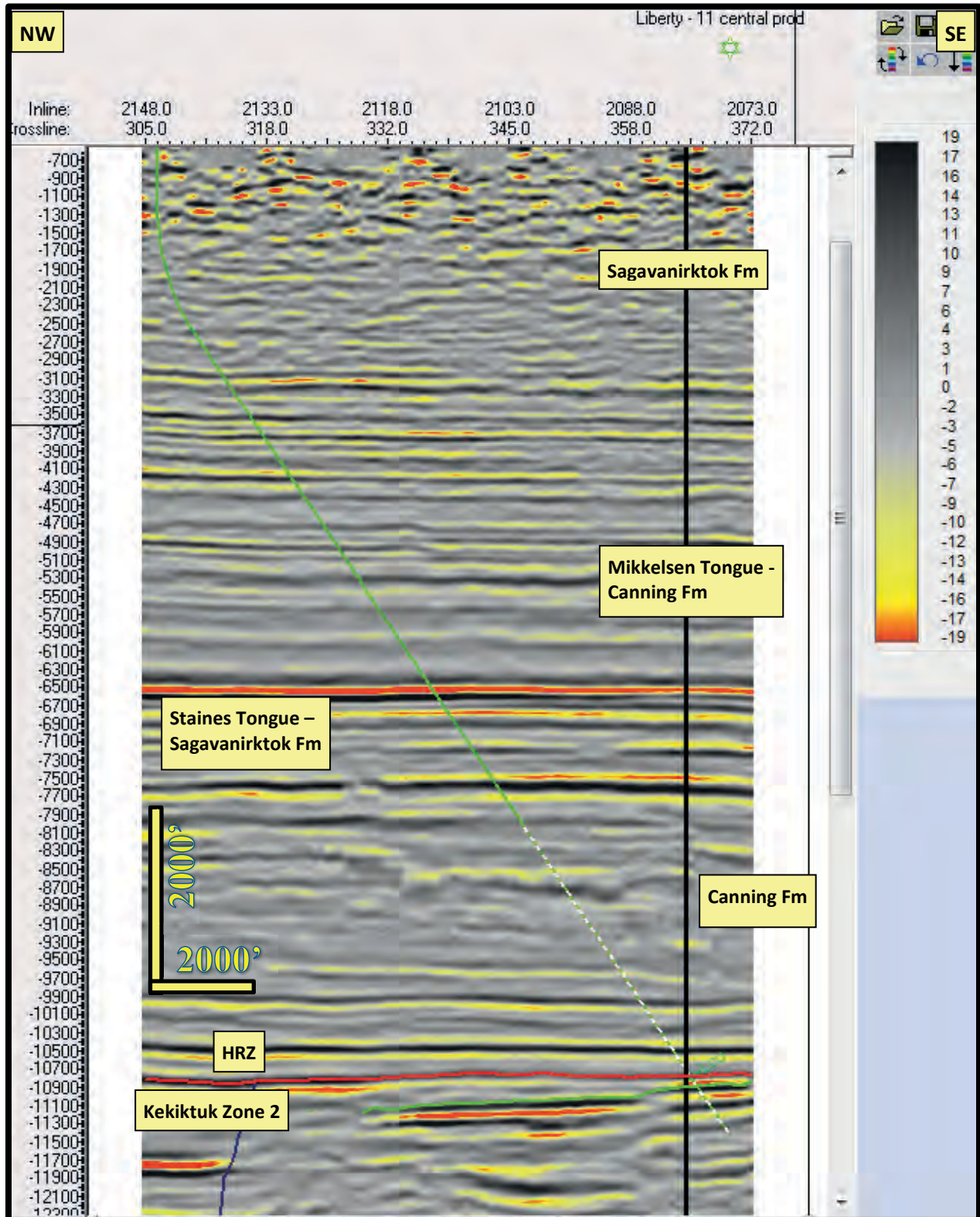


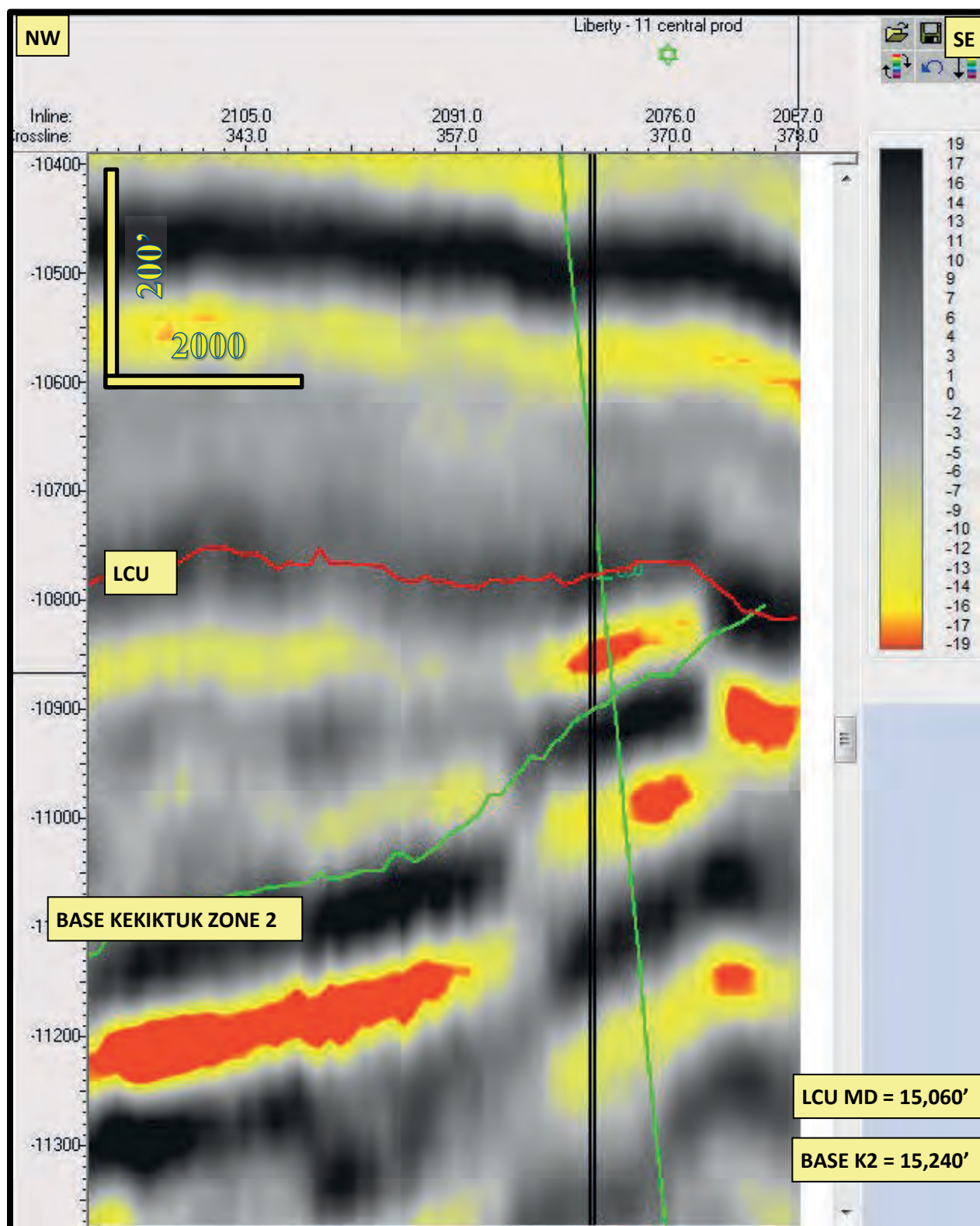
Figure 64. Liberty well slot 11 – south central producer, well-path traverse (big scale)

Figure 65. Liberty well slot 11 – south central producer, structural cross section

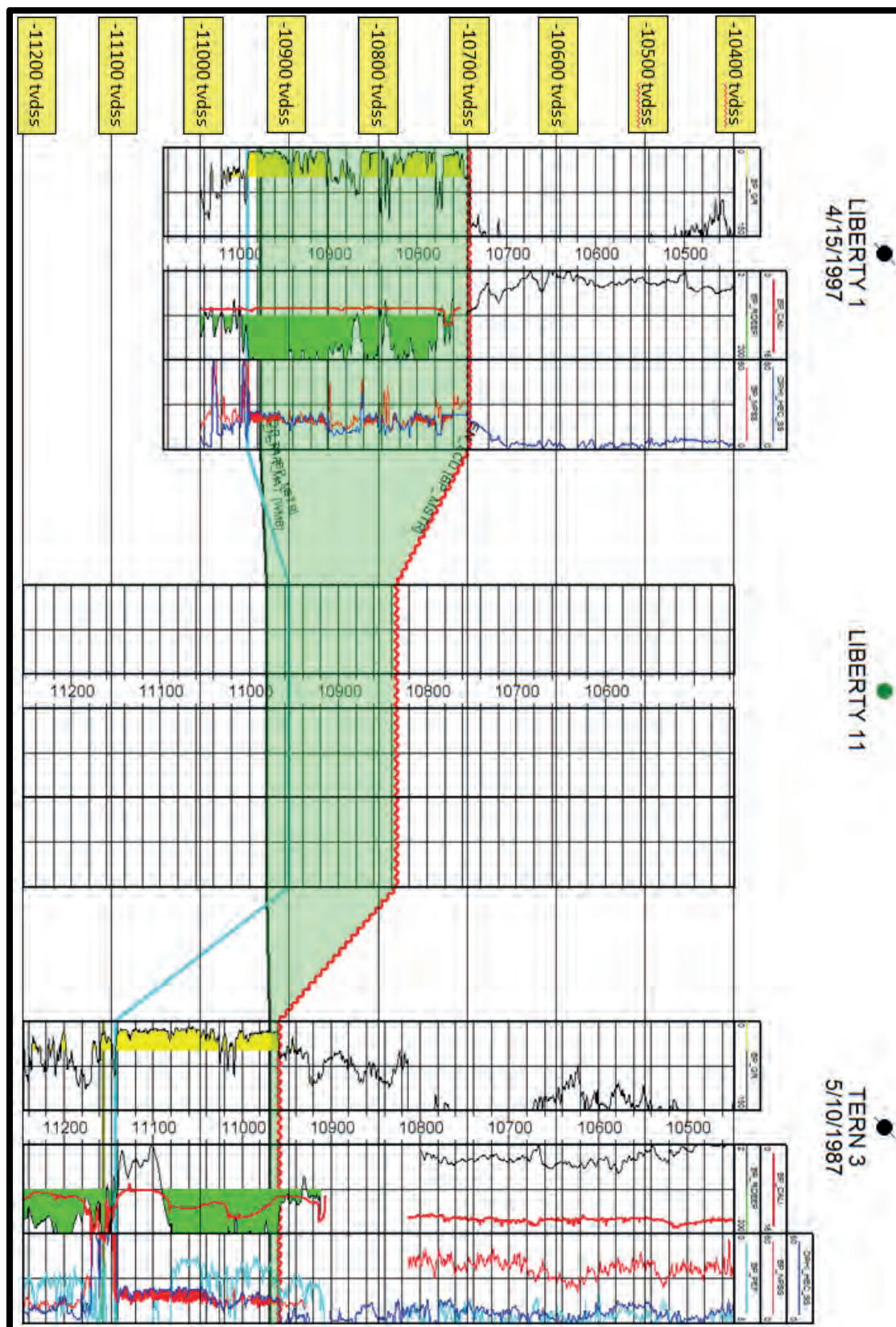


Figure 66. Liberty pseudo worst-case discharge well

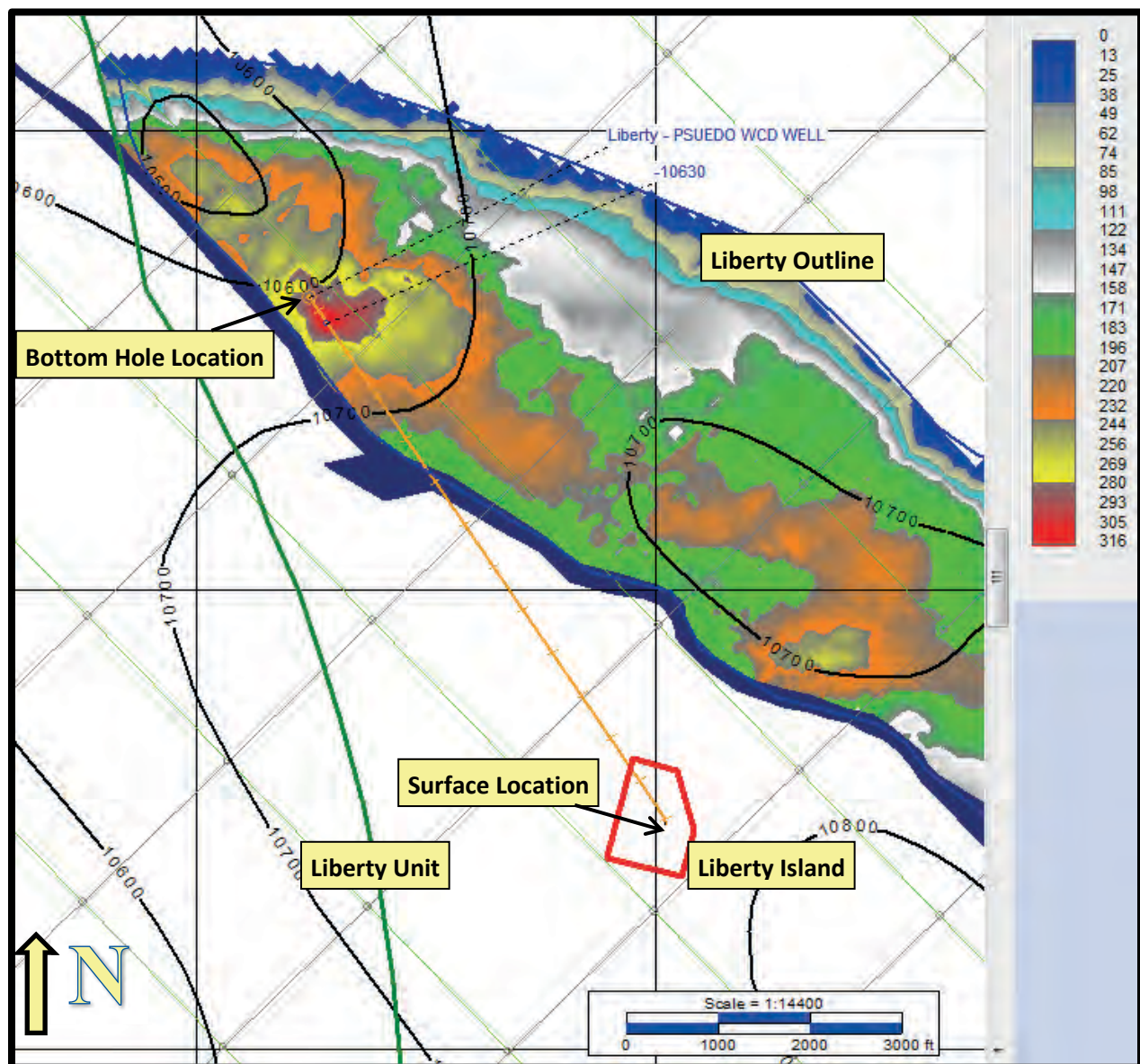


Figure 67. Liberty pseudo worst-case discharge well with line overlays

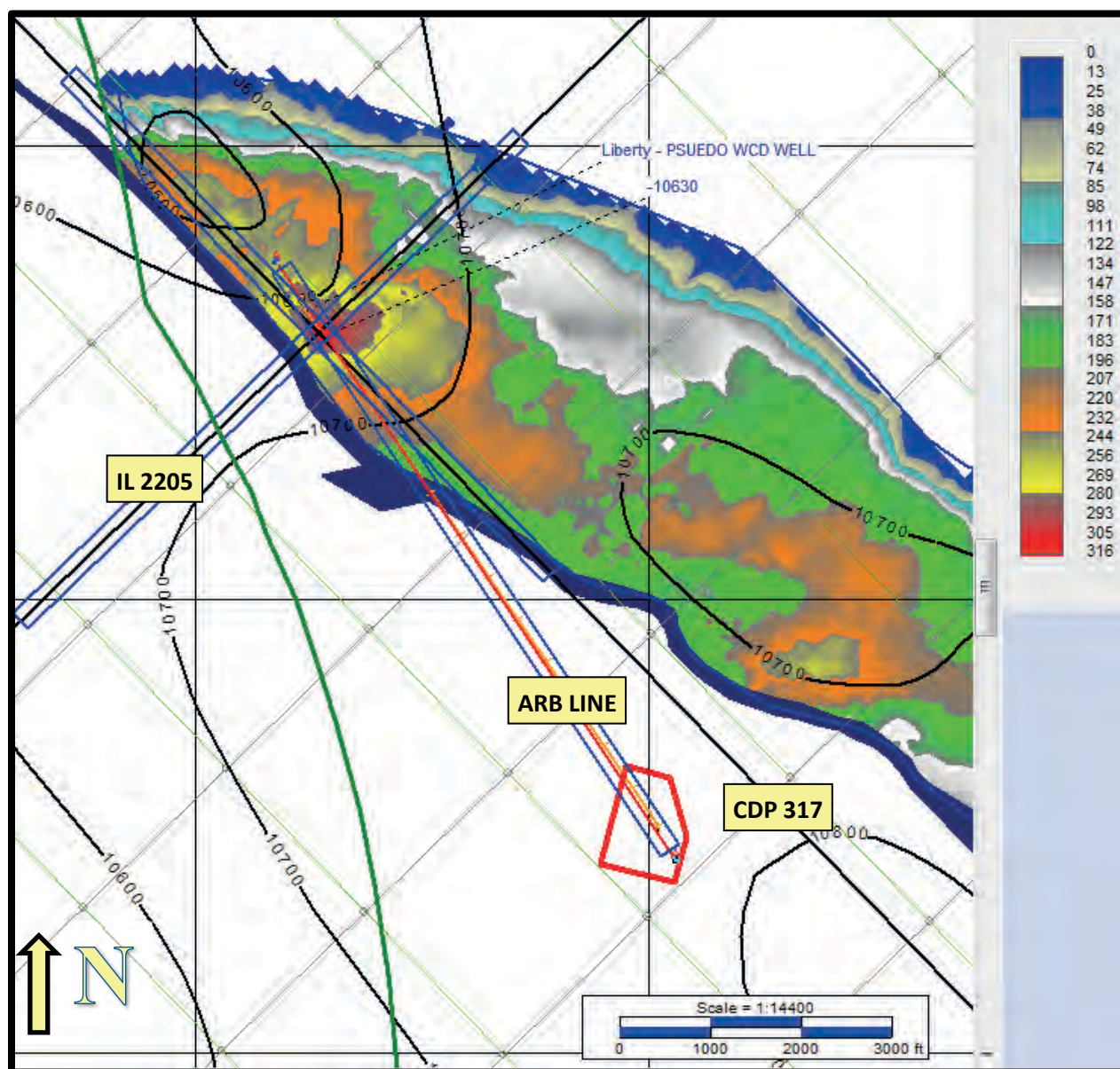


Figure 68. Liberty pseudo WCD well, CDP 317

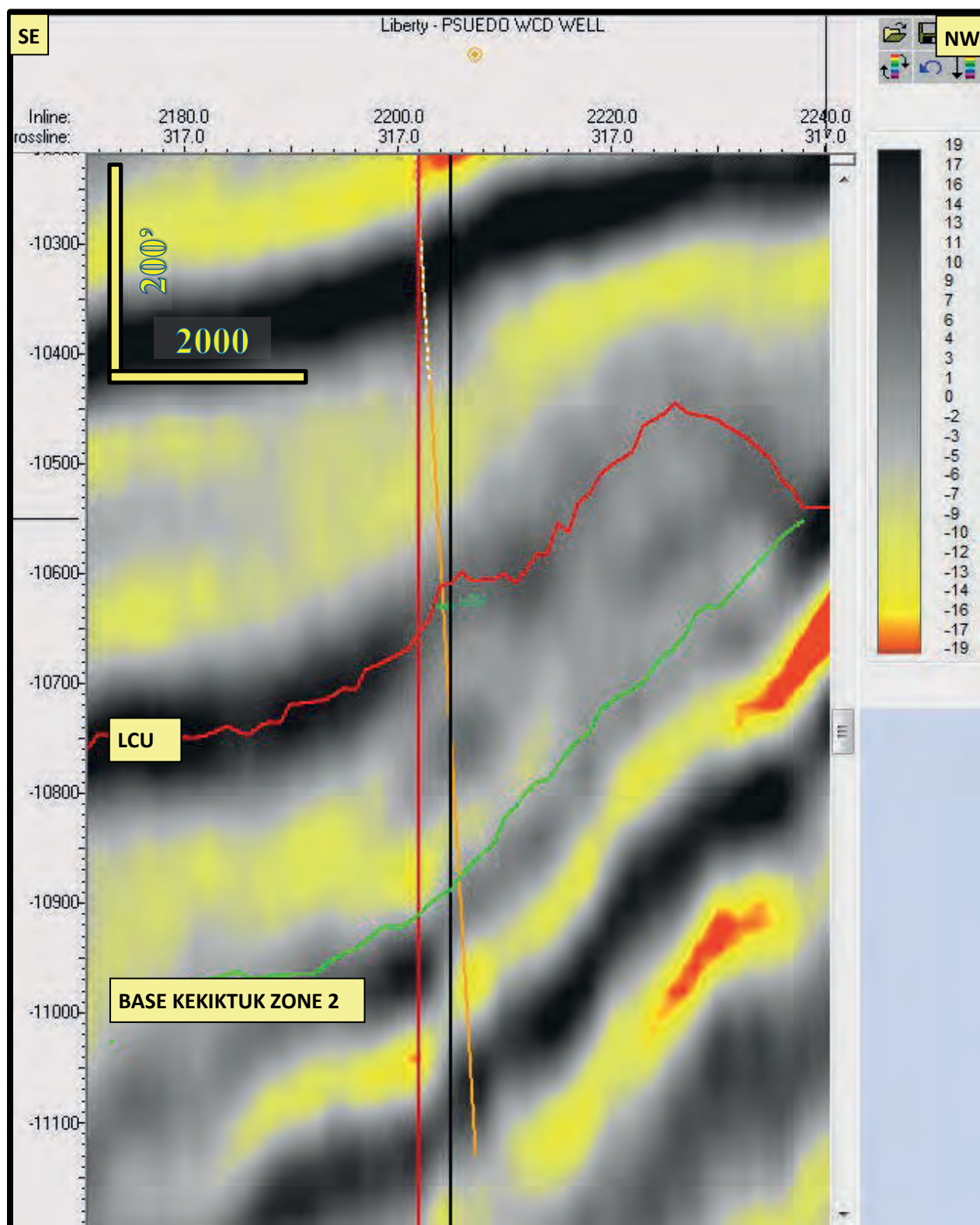


Figure 69. Liberty pseudo WCD well – line 2205

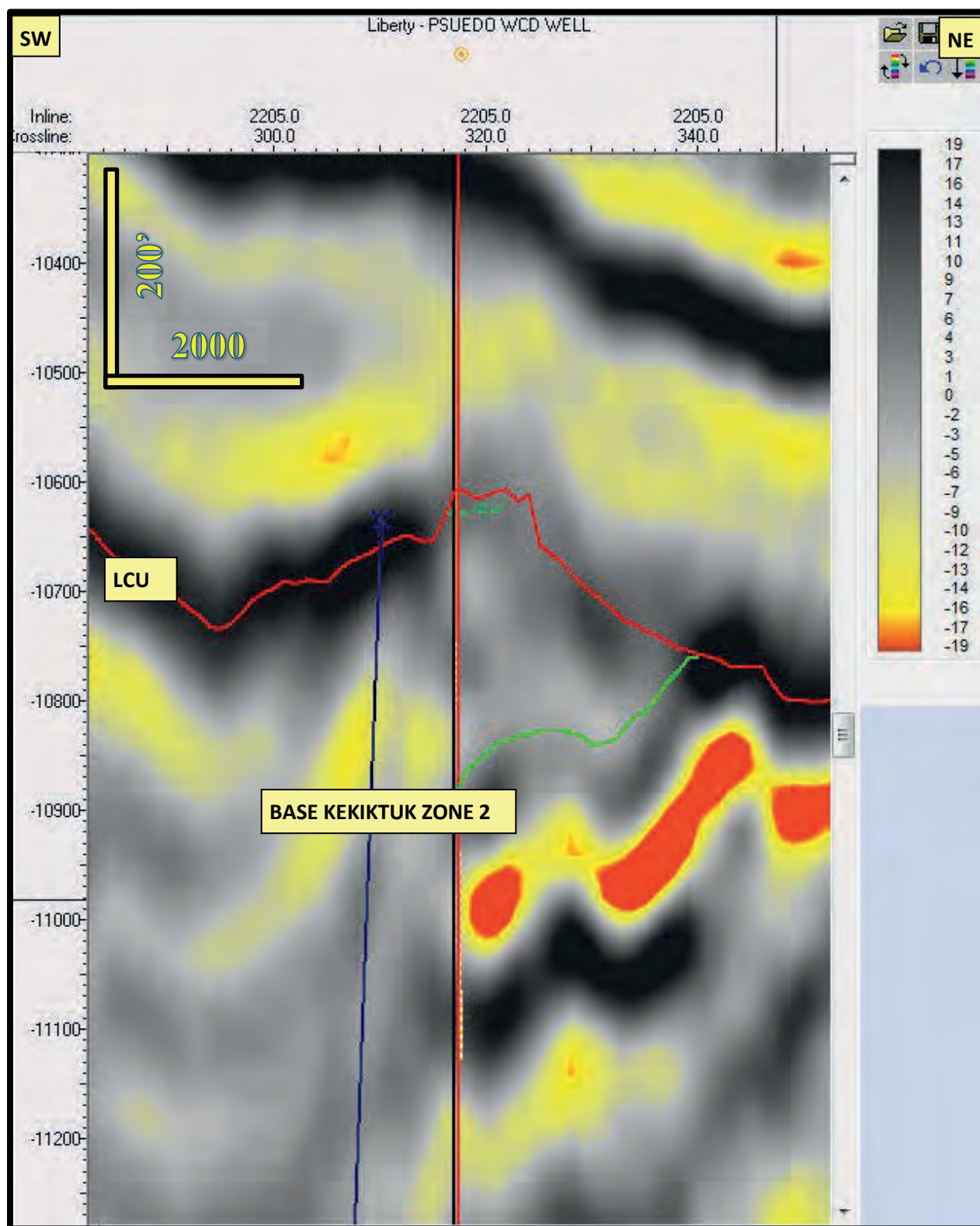


Figure 70. Liberty pseudo WCD well – well-path traverse (small scale)

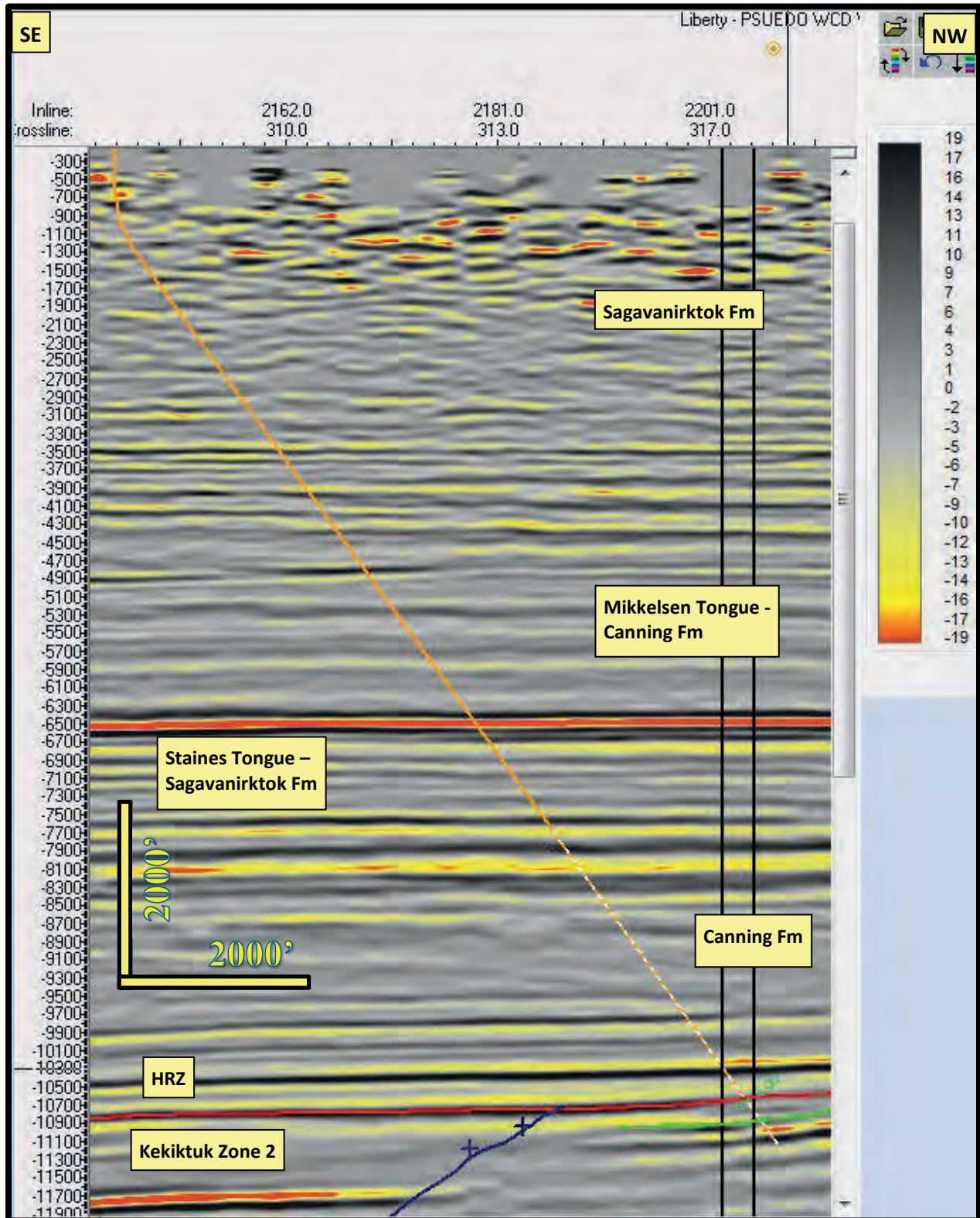


Figure 71. Liberty pseudo WCD well – well-path traverse (big scale)

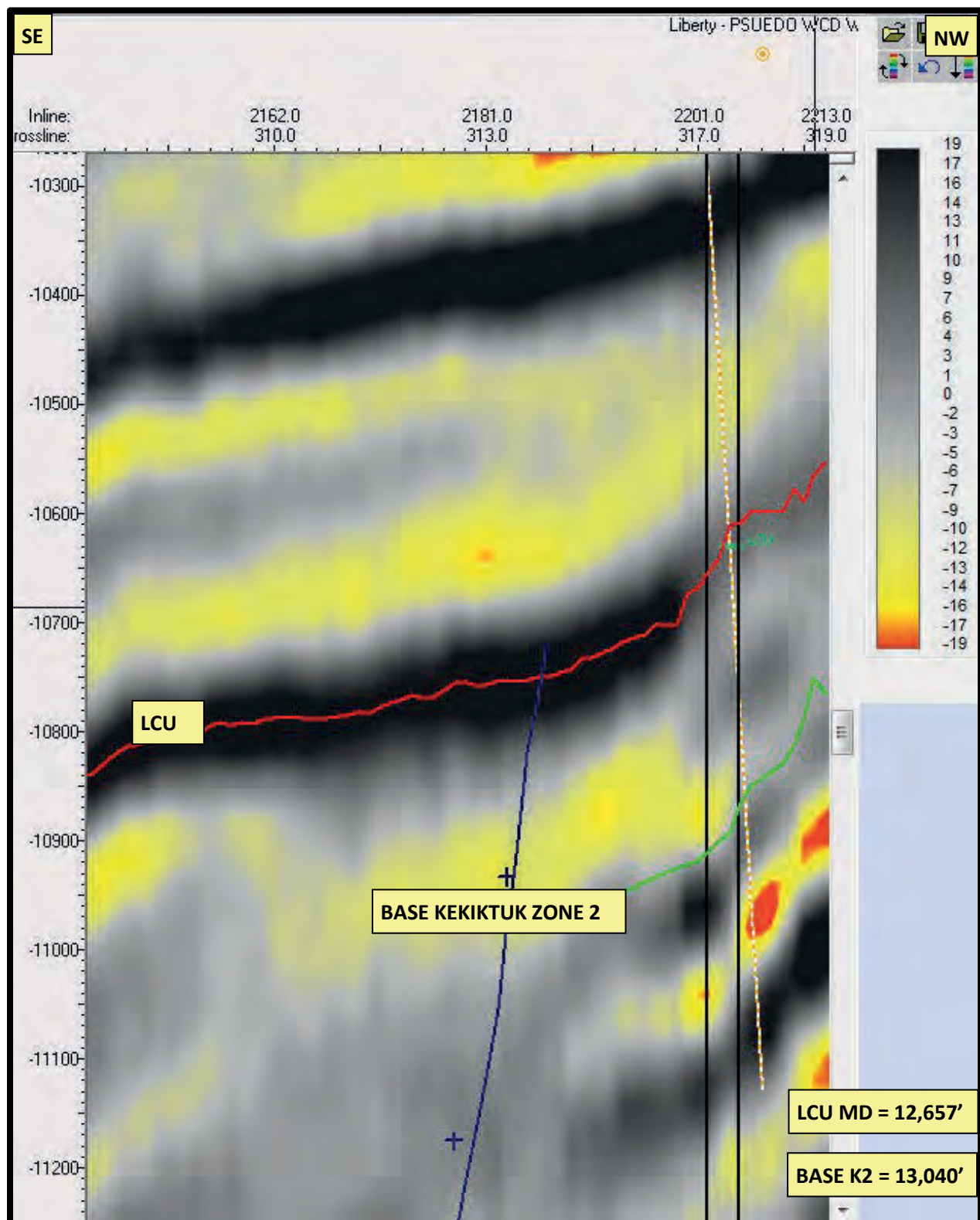


Figure 72. Liberty pseudo WCD well, interpreted structural cross section

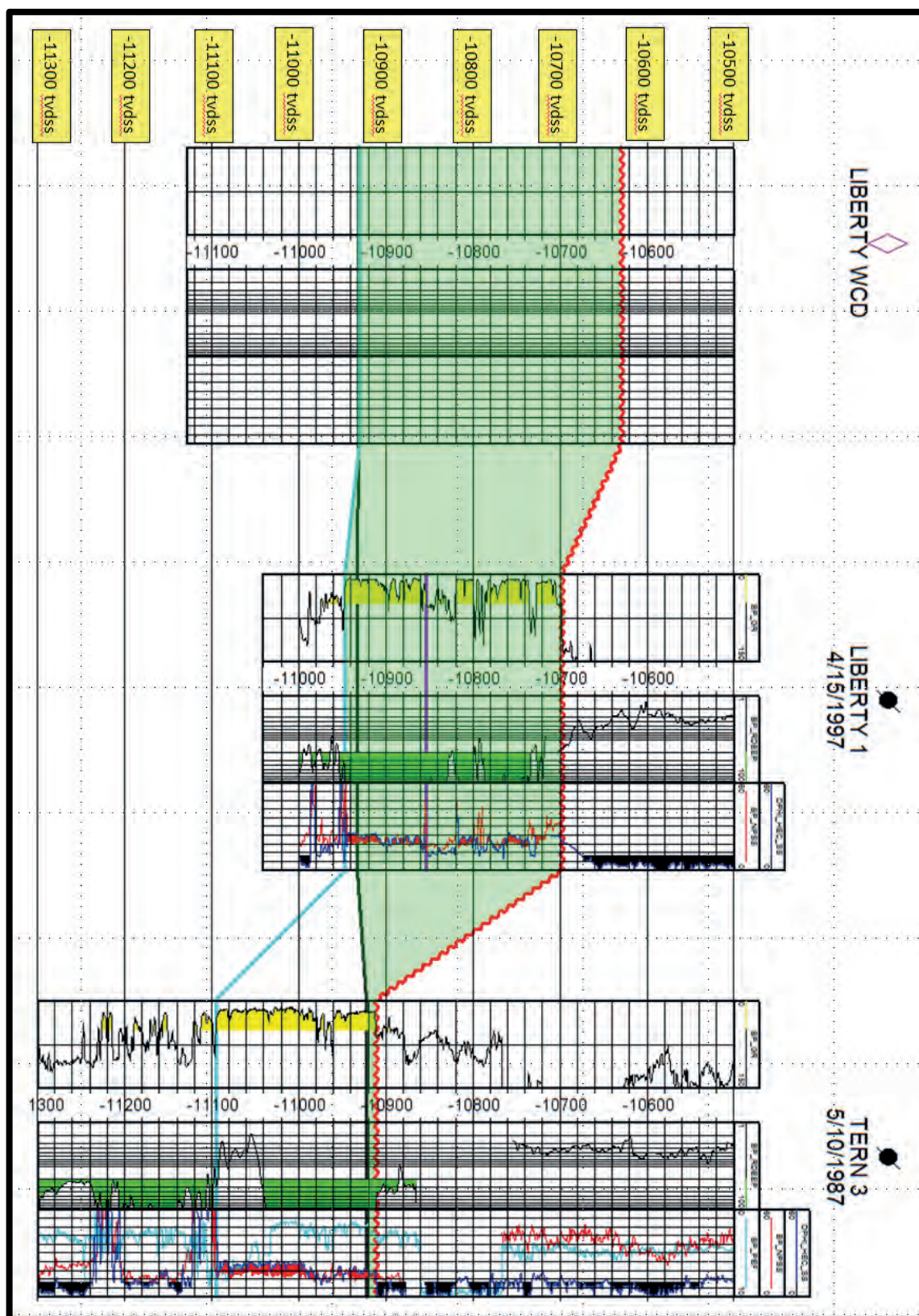


Figure 73. High resolution seismic - Liberty well slot 01 – back-up disposal well

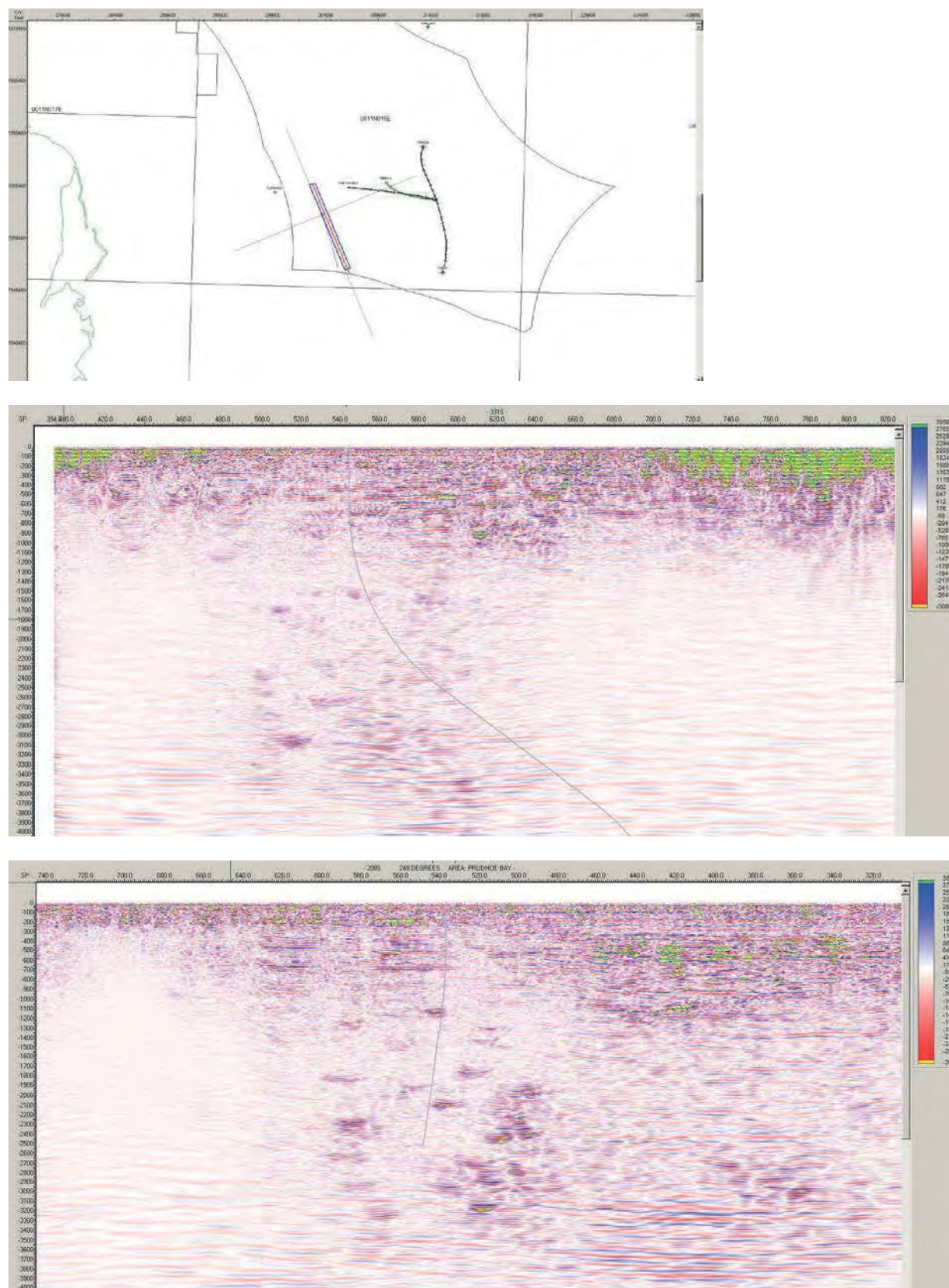


Figure 74. High resolution seismic - Liberty well slot 02 – disposal well

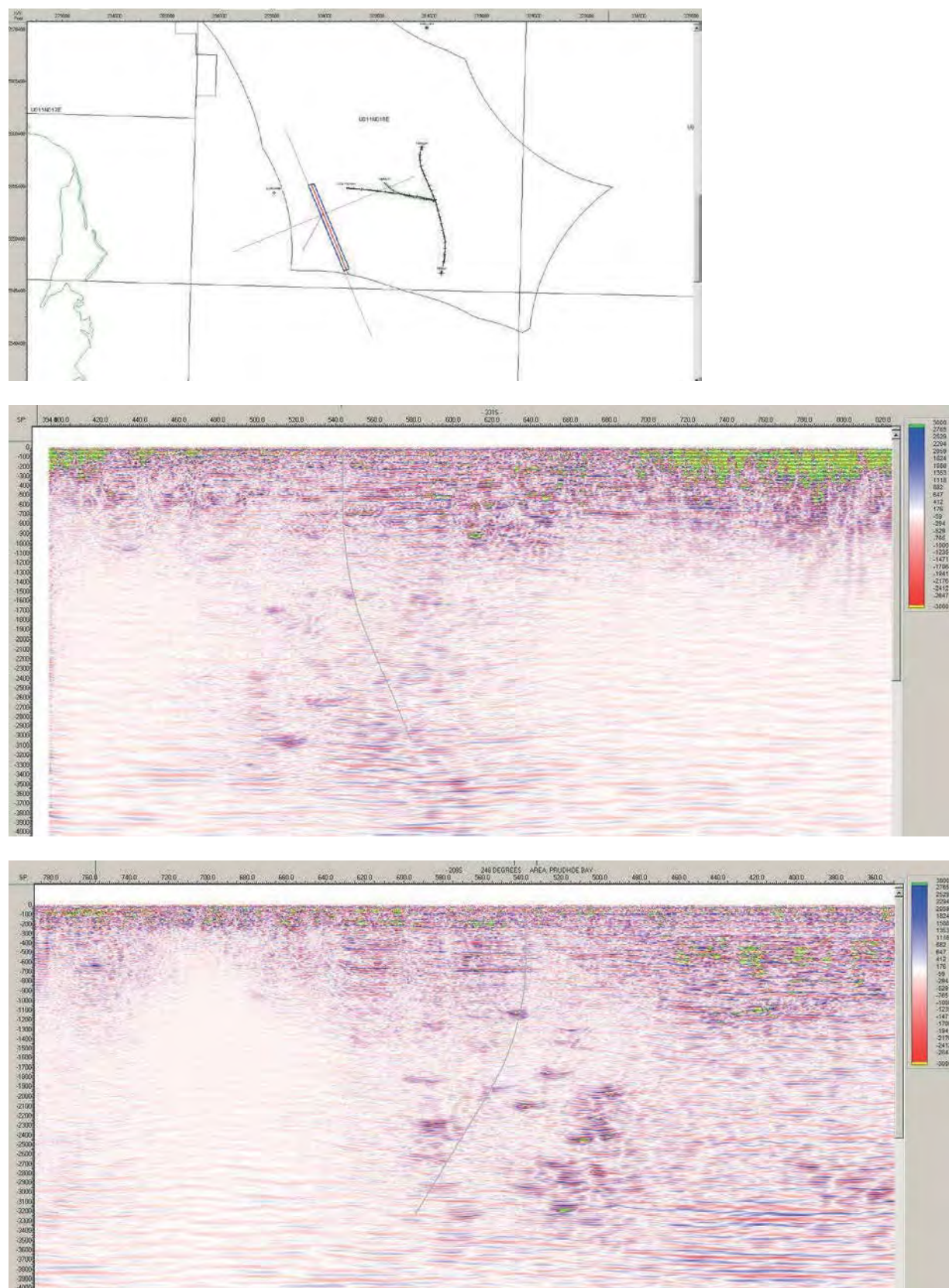


Figure 75. High resolution seismic - Liberty well slot 03 – far north gas injector

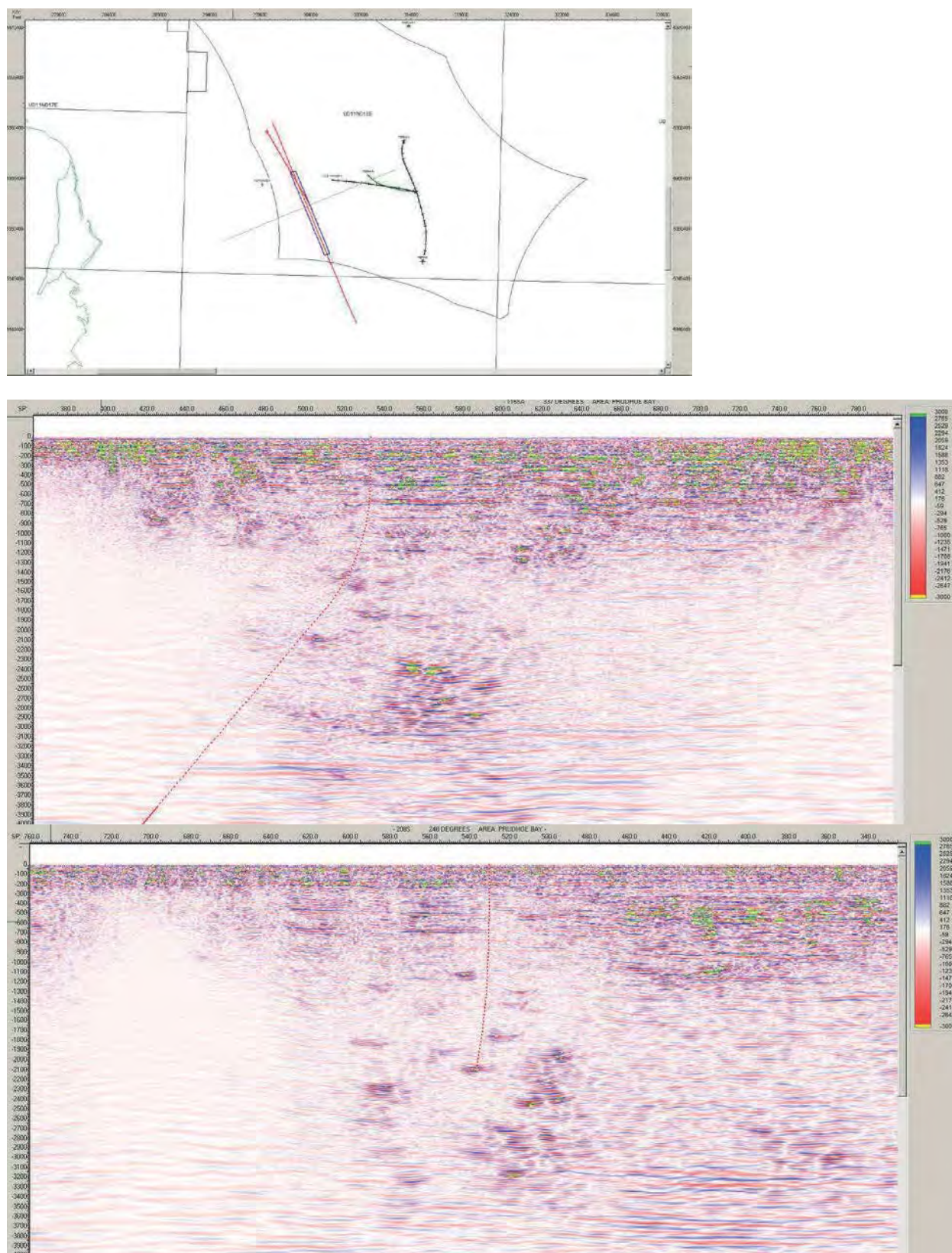


Figure 76. High resolution seismic - Liberty well slot 04 – central producer

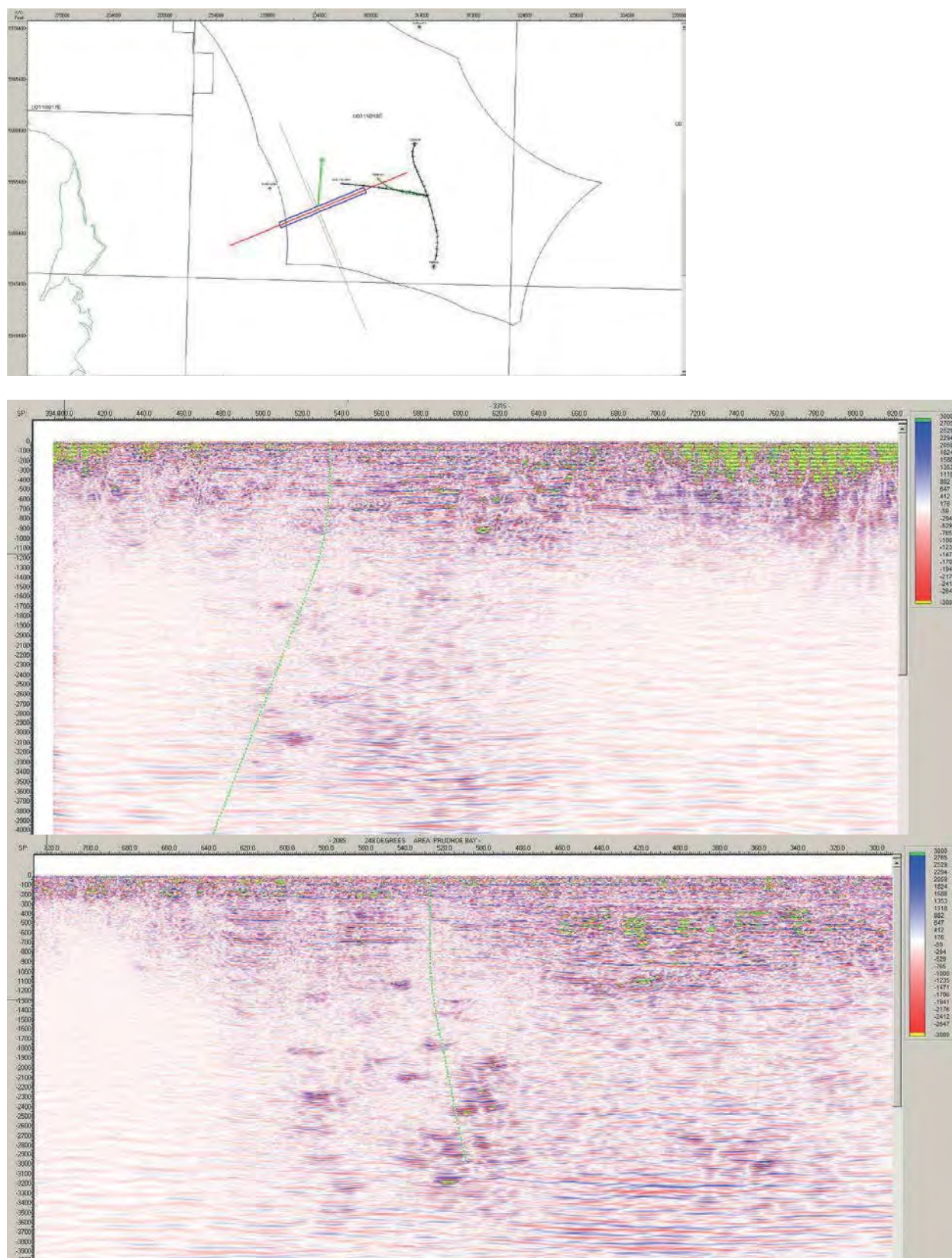


Figure 77. High resolution seismic - Liberty well slot 05 – northern water injector

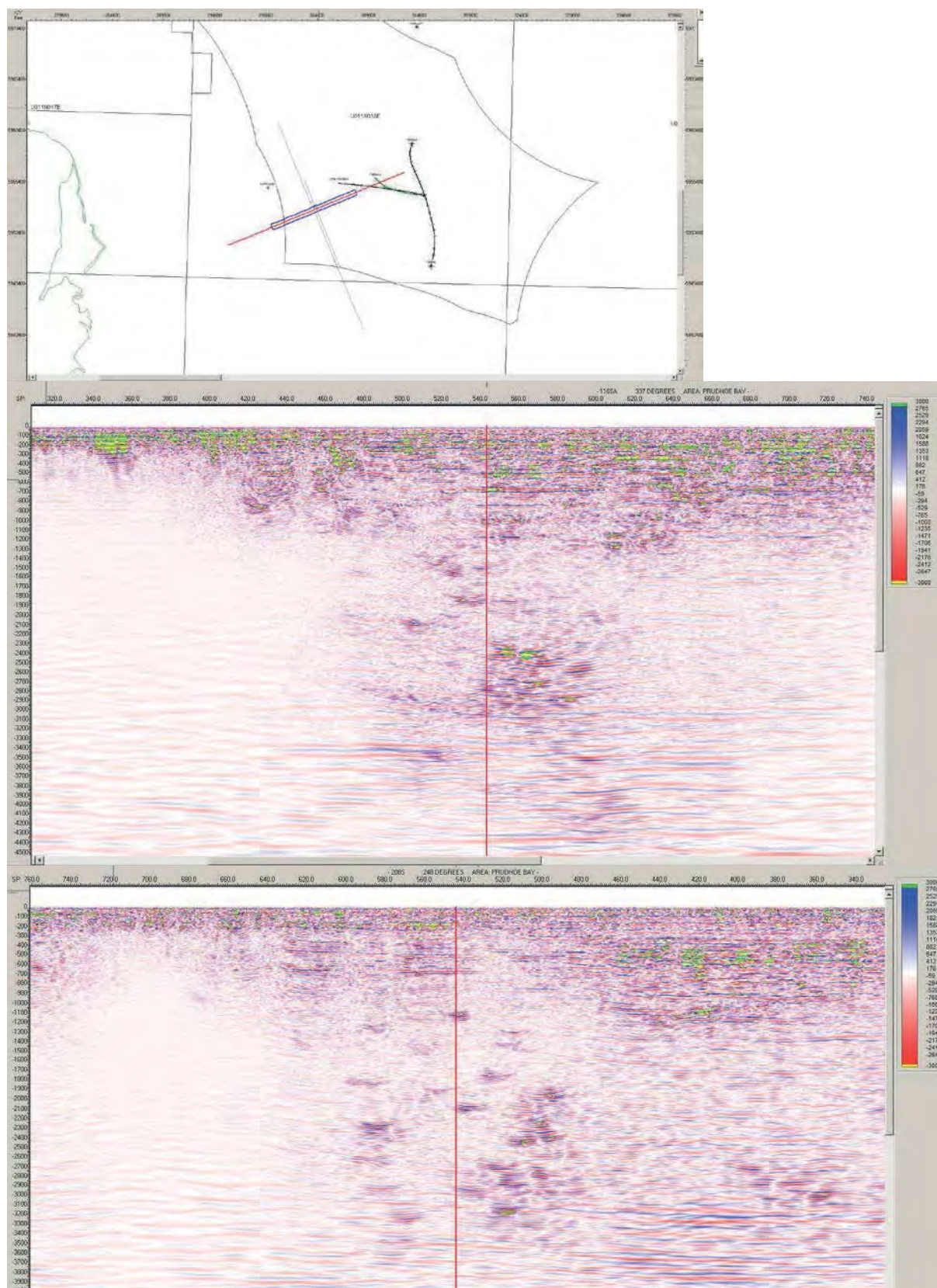


Figure 78. High resolution seismic - Liberty well slot 06 – south central producer

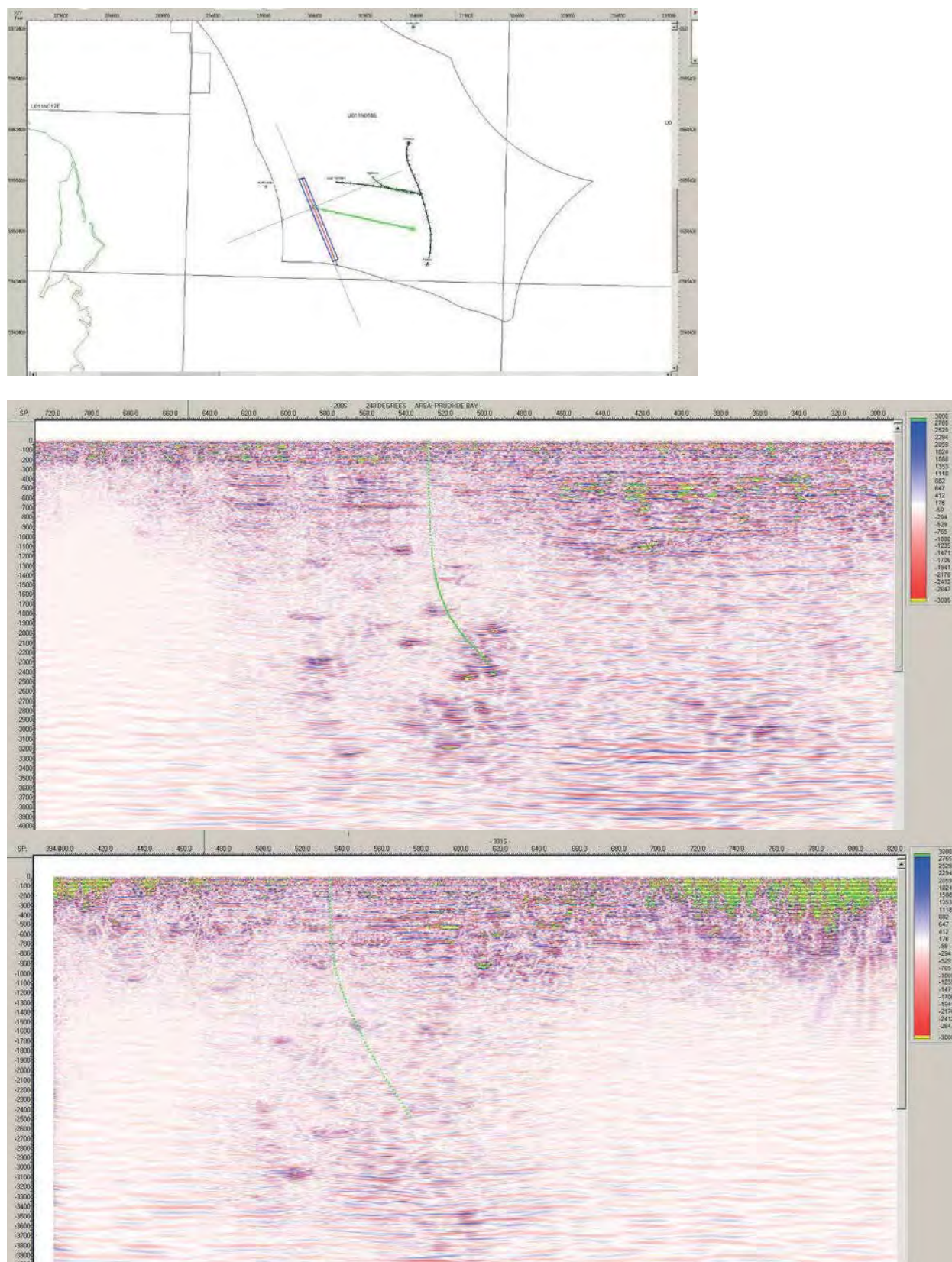


Figure 79. High resolution seismic - Liberty well slot 07 – central water injector

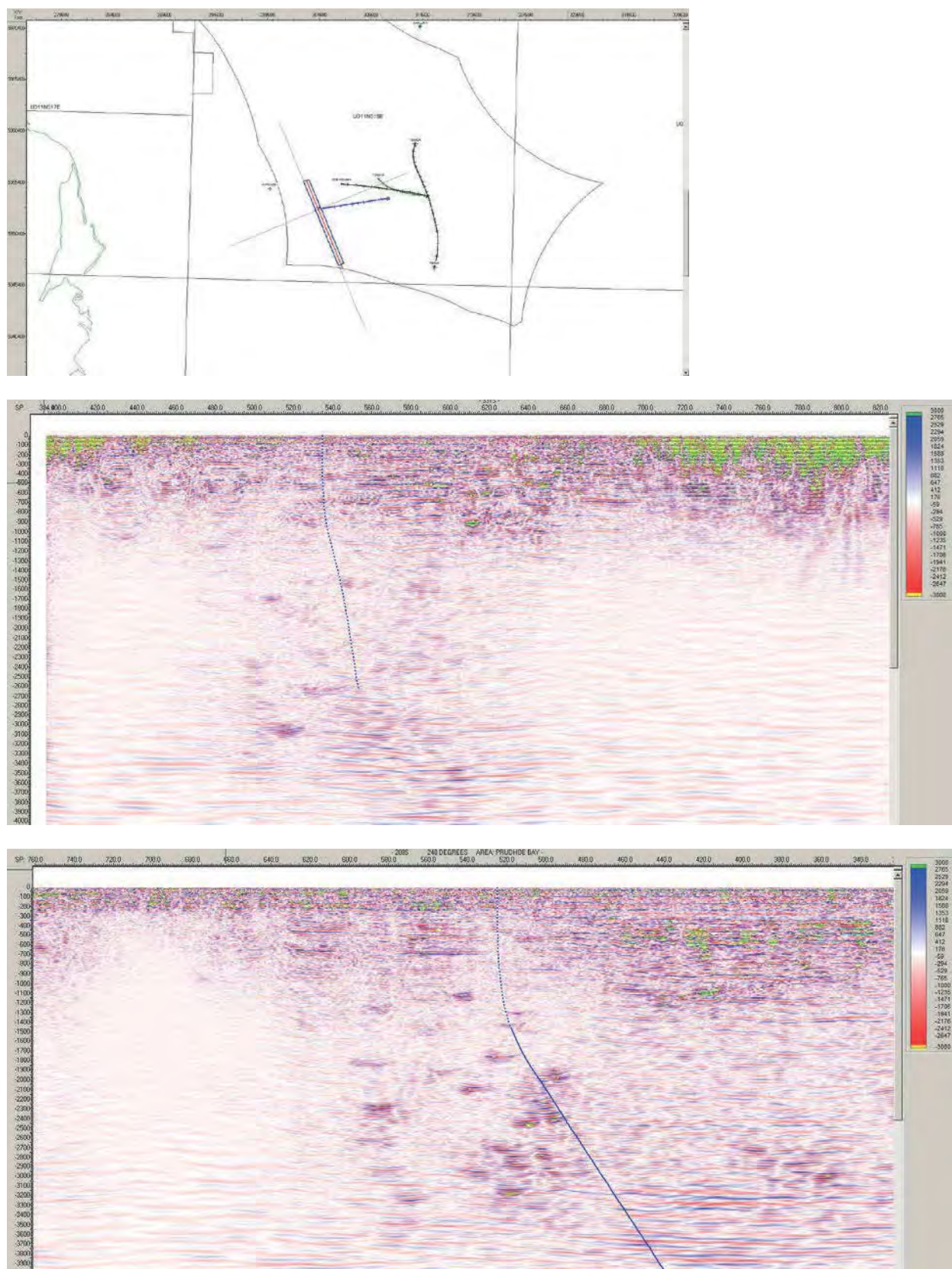


Figure 80. High resolution seismic - Liberty well slot 08 – northern producer

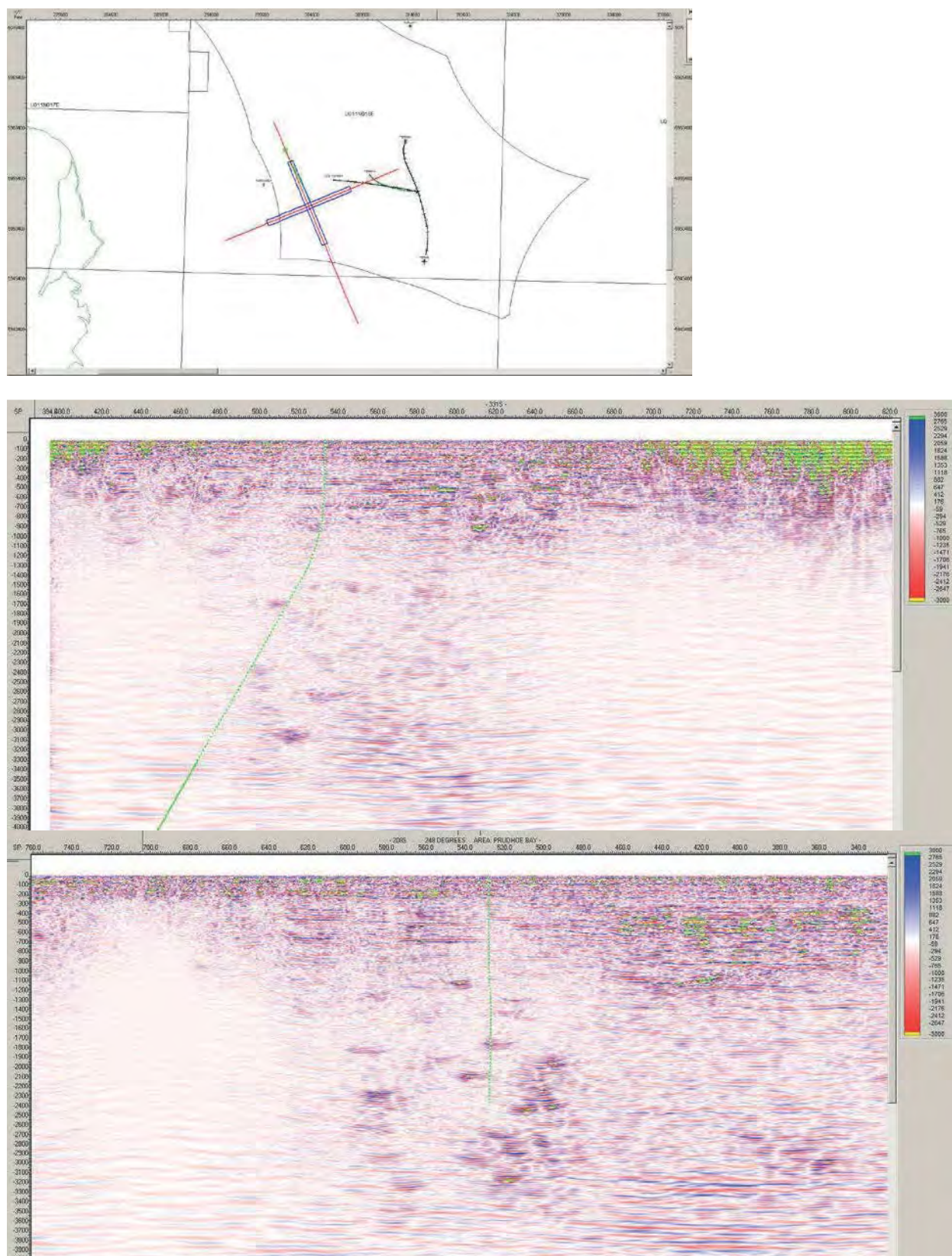


Figure 81. High-resolution seismic – Liberty well slot 09 – far south producer

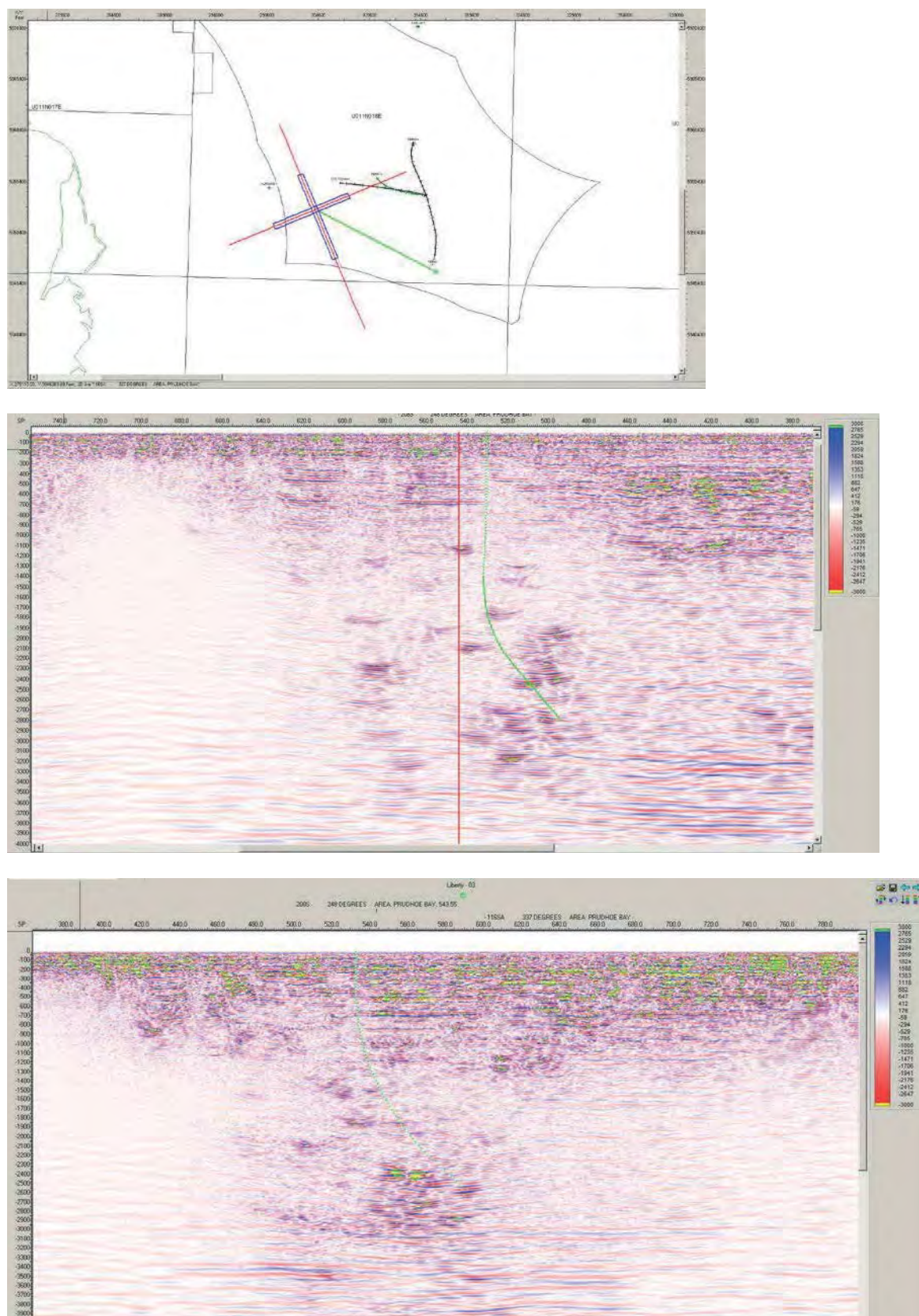


Figure 82. High resolution seismic - Liberty sell slot 10 – southern water injector

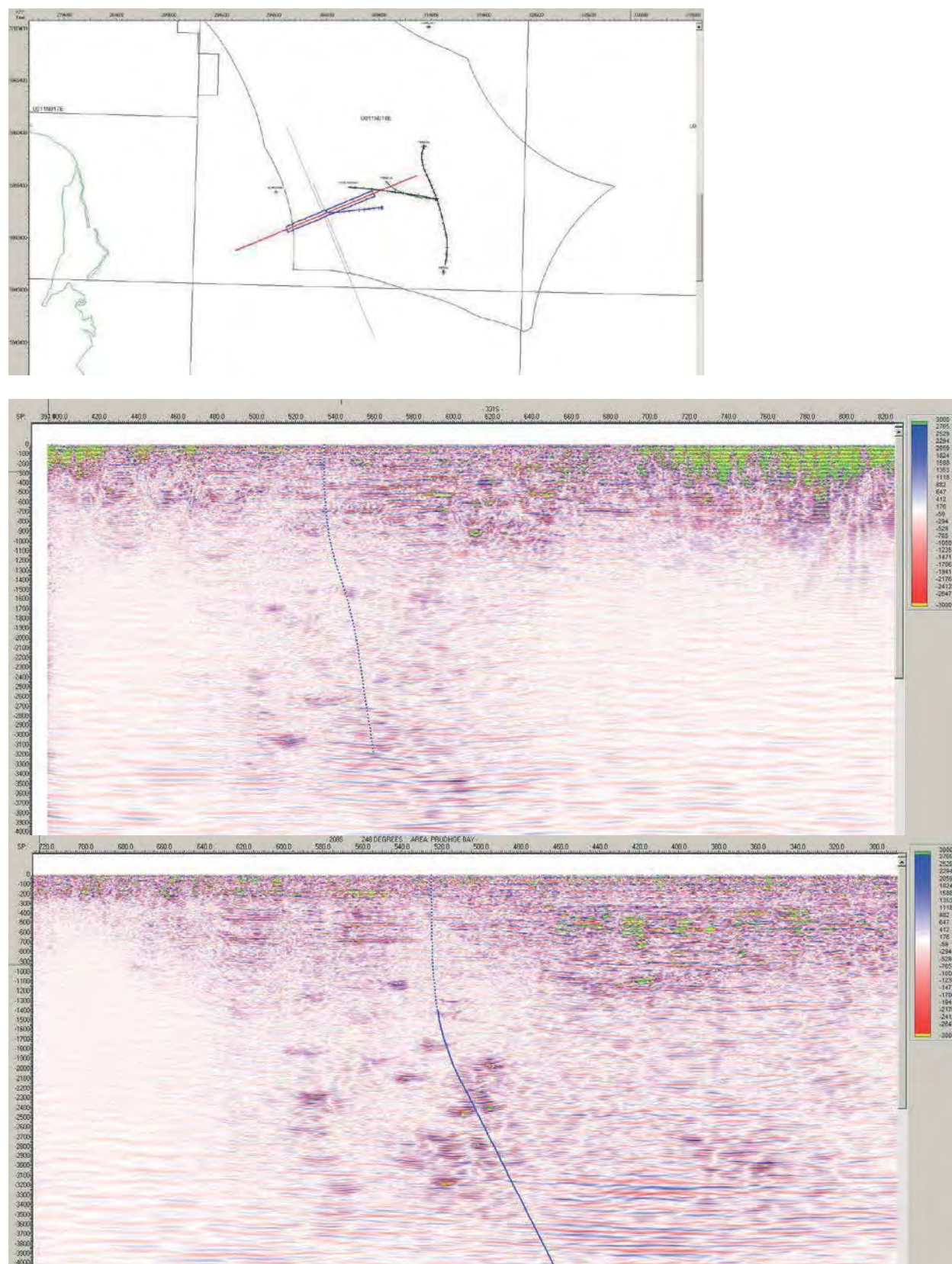


Figure 83. High resolution seismic - Liberty well slot 11 – south central producer

