New Potential in an Existing Giant Field: Teapot Dome, Wyoming*

By
Sandy Raeuchle[1], Dinesh Fernando[1], Erin Duffey[1], and Richard Talbert[1]

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[1]Electro-Seise, Inc., Fort Worth, Texas 76107 (sraeuchle@electro-seise.com)

General Statement

Teapot Dome Field, Natrona County, Wyoming, is listed in the top 100 largest fields in the United States with proven reserves of 42,515,000 bbl. The field has been exploited in the Upper Cretaceous Shannon, Second Wall Creek sandstones as well as the Pennyslvanian Tensleep. We at Electro-Seise (ESI) found additional potential in these developed producing formations. Considerable potential lies in the unexploited and fractured Upper Cretaceous Niobrara shales and the Lower Cretaceous Muddy sandstones. Several million barrels of oil remain in the subsurface yet to be drilled.

Airborne microgravity was used in this study to determine this potential. Acquisition techniques utilized a passive sensor similar to old torsion balance types used to define salt domes in the Gulf Coast. Total potential field signals are measured and the state-of-the-art digitally processed, producing a three-dimensional microgravity cube for the recognition of movable hydrocarbons at depth.

Three dimensional seismic was merged with the gravity data. Structural maps were derived matching the hydrocarbon "depth slices" through the prospective horizons. New potential pools conform to structure, giving the interpretation a good confidence level. The 3D seismic structure maps show doubly-plunging anticlines with very steep dips, particularly on the western flank. These structures are set up deep within the basement rocks by lateral and compressional movement, expressed as a flower structure.

Horizontal wells should be considered, particularly in the fractured Niobrara shales. An early DST in the Niobrara flowed 25,000 bopd. Clearly this sort of potential, combined with by-passed Muddy Sandstone pay, would provide economic wells with quick payouts.

Electro-Seise Microgravity

- The airborne data are collected at an altitude of 2000' AGL and at night, when the fields are less noisy.
- The measurements are taken by a passive sensor that measures the horizontal component of gravity and the electromagnetic field.

- The data are processed by proprietary algorithms and then converted to SEGY format. Interpretation is done in a 3D cube, much as seismic.
- Both the raw data and the processed data must be used to create a complete geological model.
- Movable hydrocarbons are measured and shown in the depth slices, similar to a horizon slice. The inlines and crosslines are analogous to viewing a seismic line.
- The warm colors (red, orange and yellow) represent movable hydrocarbons.

Merging Microgravity with Seismic

- The following display shows wiggle trace seismic merged with the microgravity data, shown in high resolution colors.
- It is evidenced that at the Niobrara reflector that movable hydrocarbons exist, yet to be drilled (red, orange and yellow colorization).

Teapot Dome Structure

- Teapot Dome is comprised of doublyplunging anticlines produced by compressive and lateral forces, evidenced by a flower structure.
- The west flank is very steep and sparsely drilled, the eastern flank is less steep.
- Many cross faults crosscut the structure and have been removed for simplicity sake.

Electro-Seise Depth Slices

- Depth slices from the Niobrara and Muddy illustrate movable hydrocarbons trapped both structurally and stratigraphically.
- We believe that there are several million barrels yet to be produced from this giant, old field.

Conclusions

- Potential, undrilled reserves exist at Teapot Dome as evidenced from micro gravity.
- Both the Cretaceous Niobrara and Muddy are excellent targets to drill horizontally.

The Department of Energy and RMOTC have recognized Electro-Seise technology as a stand-alone geophysical tool.

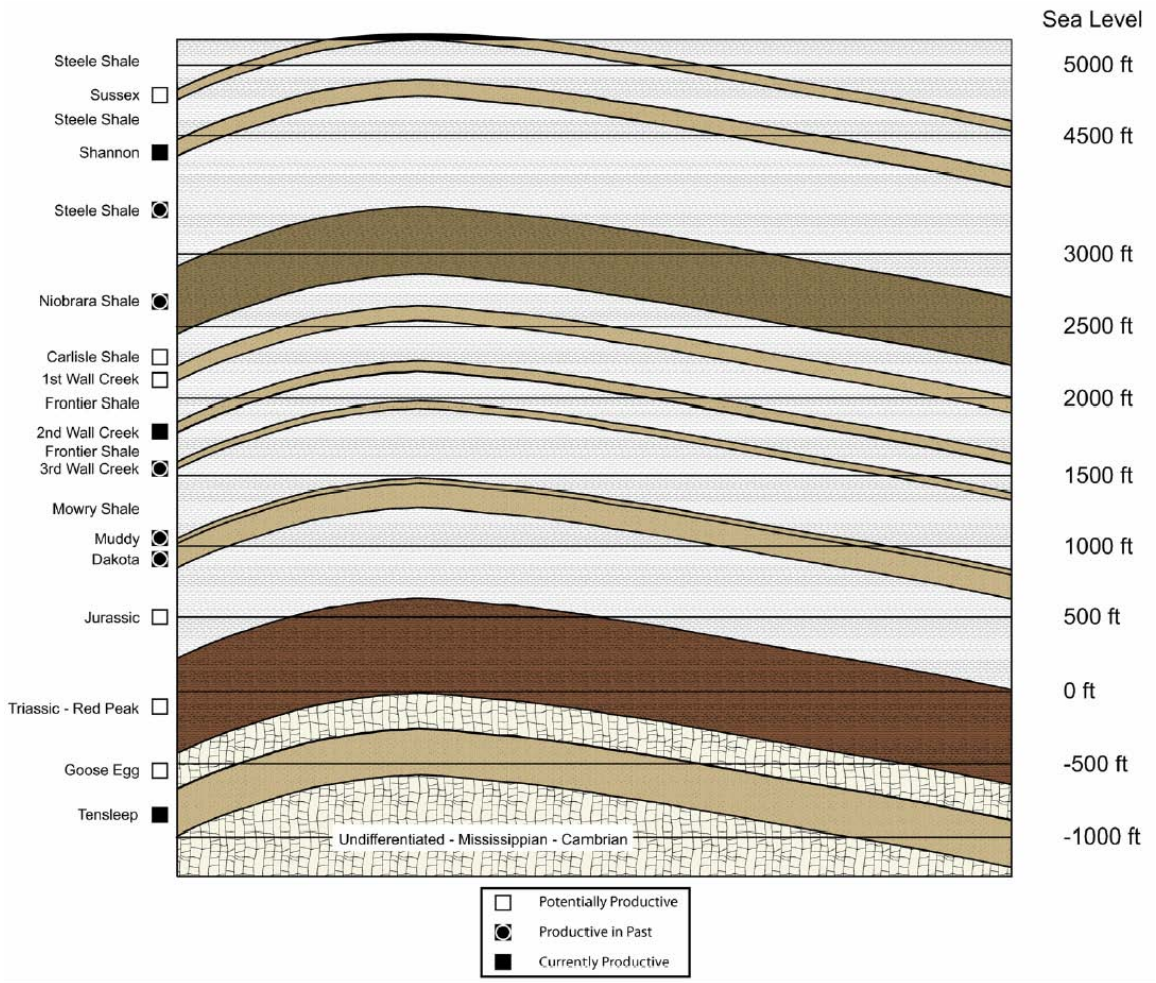

Figure 1. Generalized east-west section, Teapot Dome, Wyoming, showing elevations of stratigraphic units.

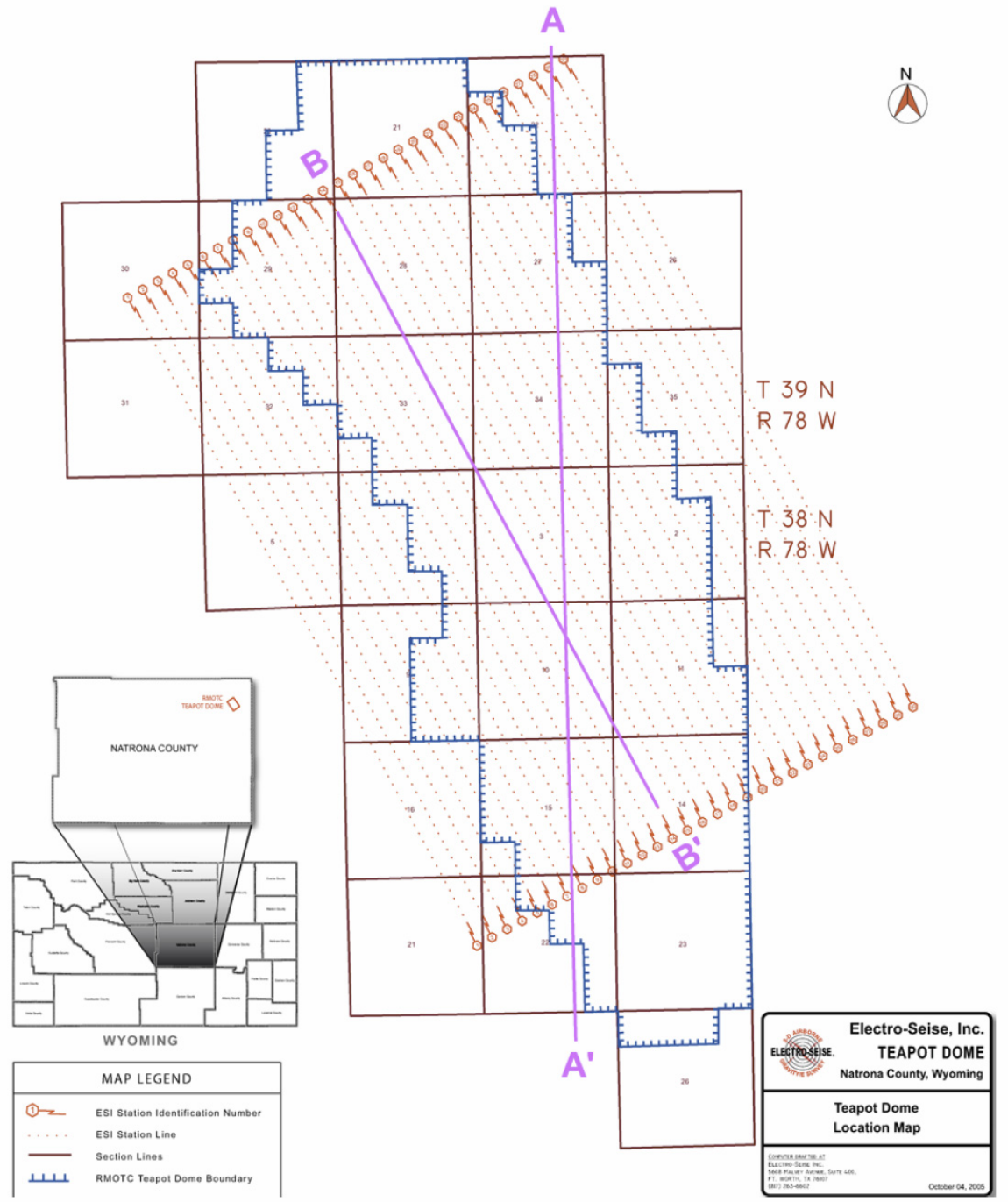

Figure 2. Location map. ESI Teapot Dome survey area.

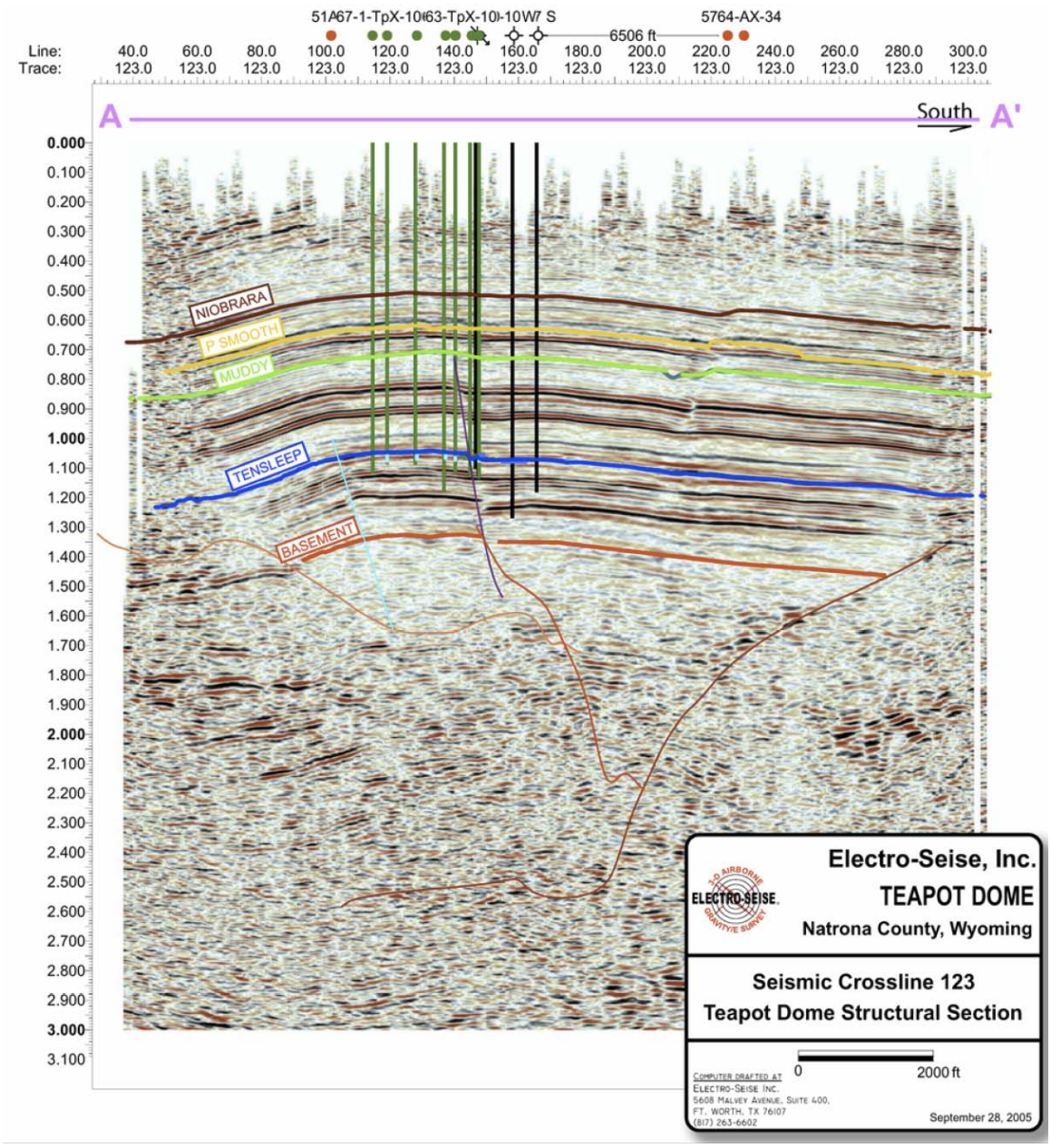

Figure 3. Teapot Dome seismic structural section (seismic crossline 123).

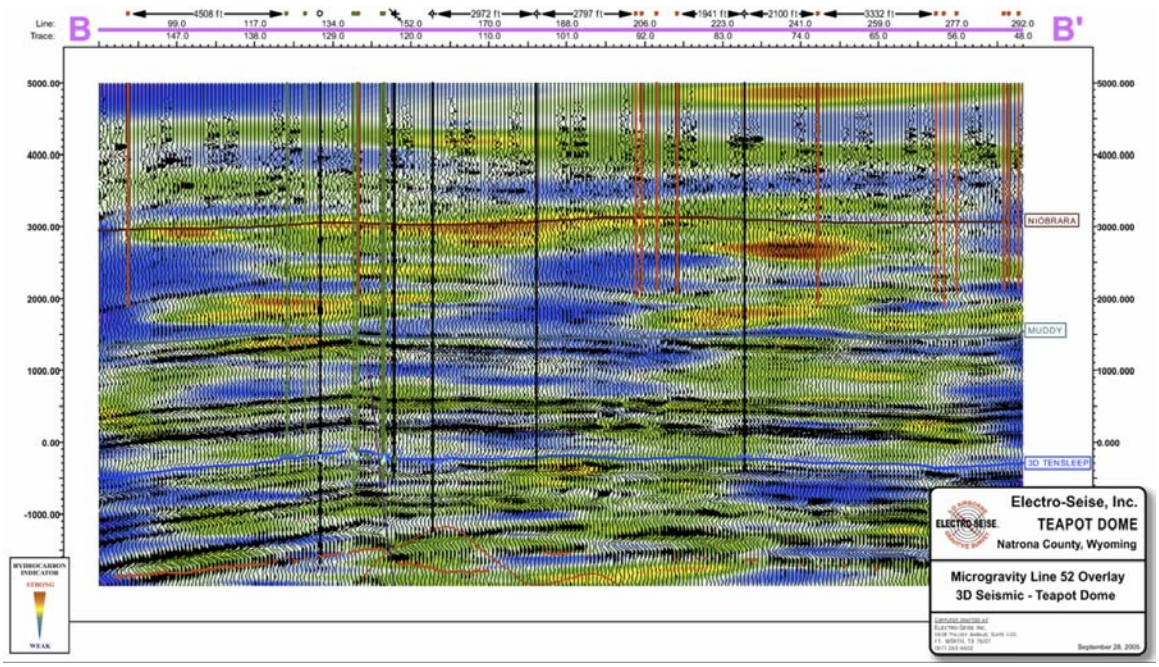

Figure 4. Microgravity line 52: overlay on 3D seismic line (B-B').

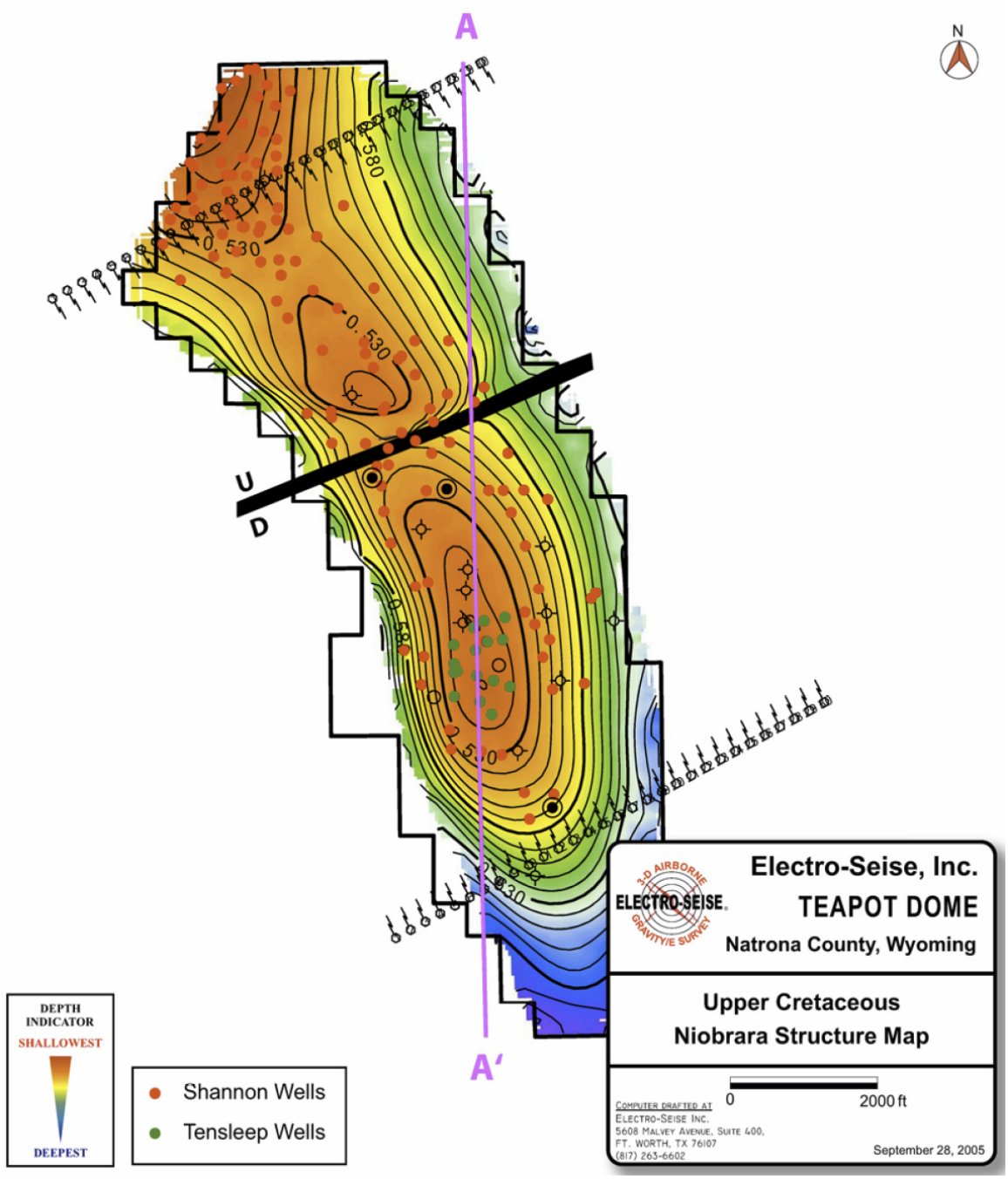

Figure 5. Upper Cretaceous Niobrara structure map.

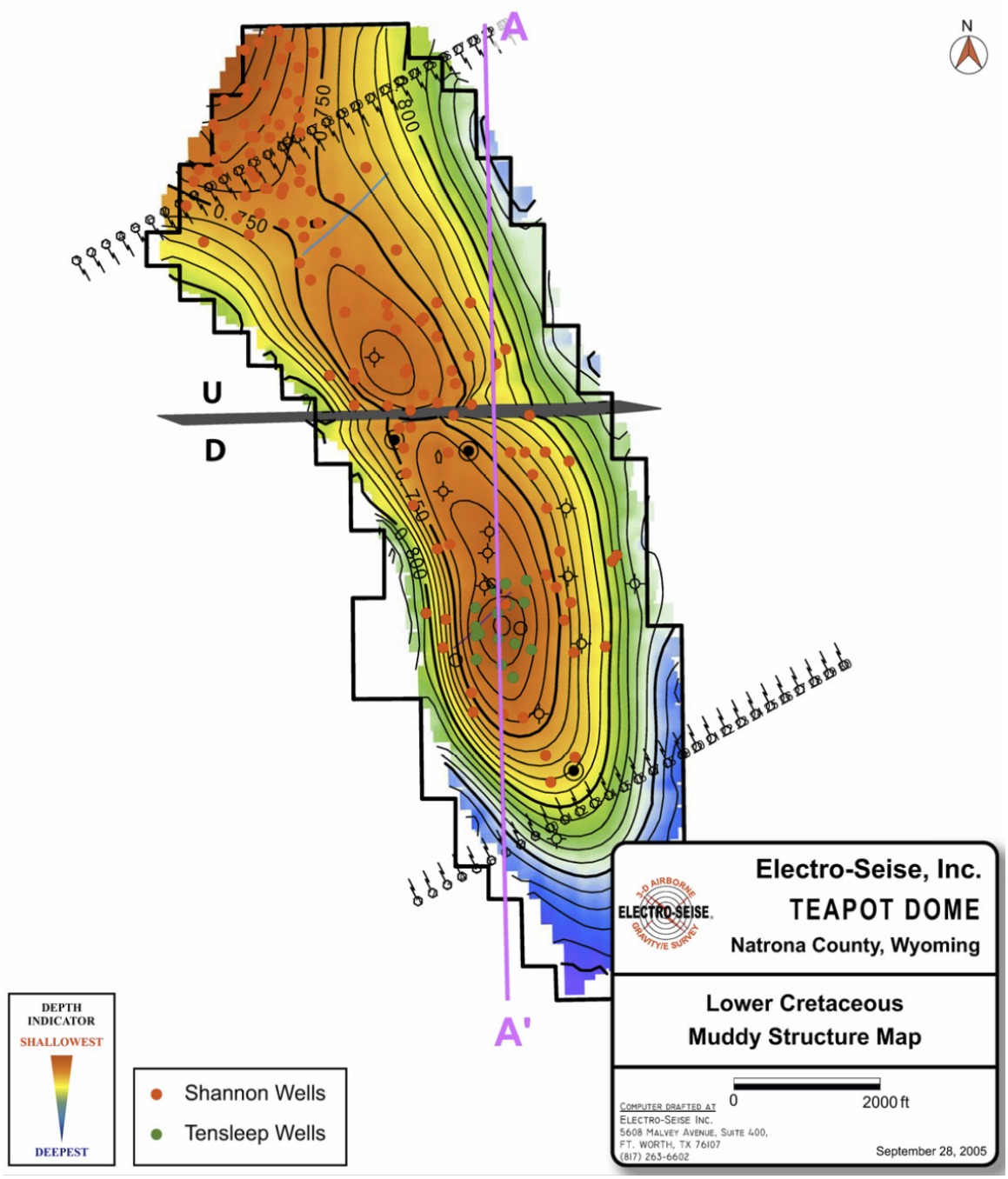

Figure 6. Lower Cretaceous Muddy structure map.

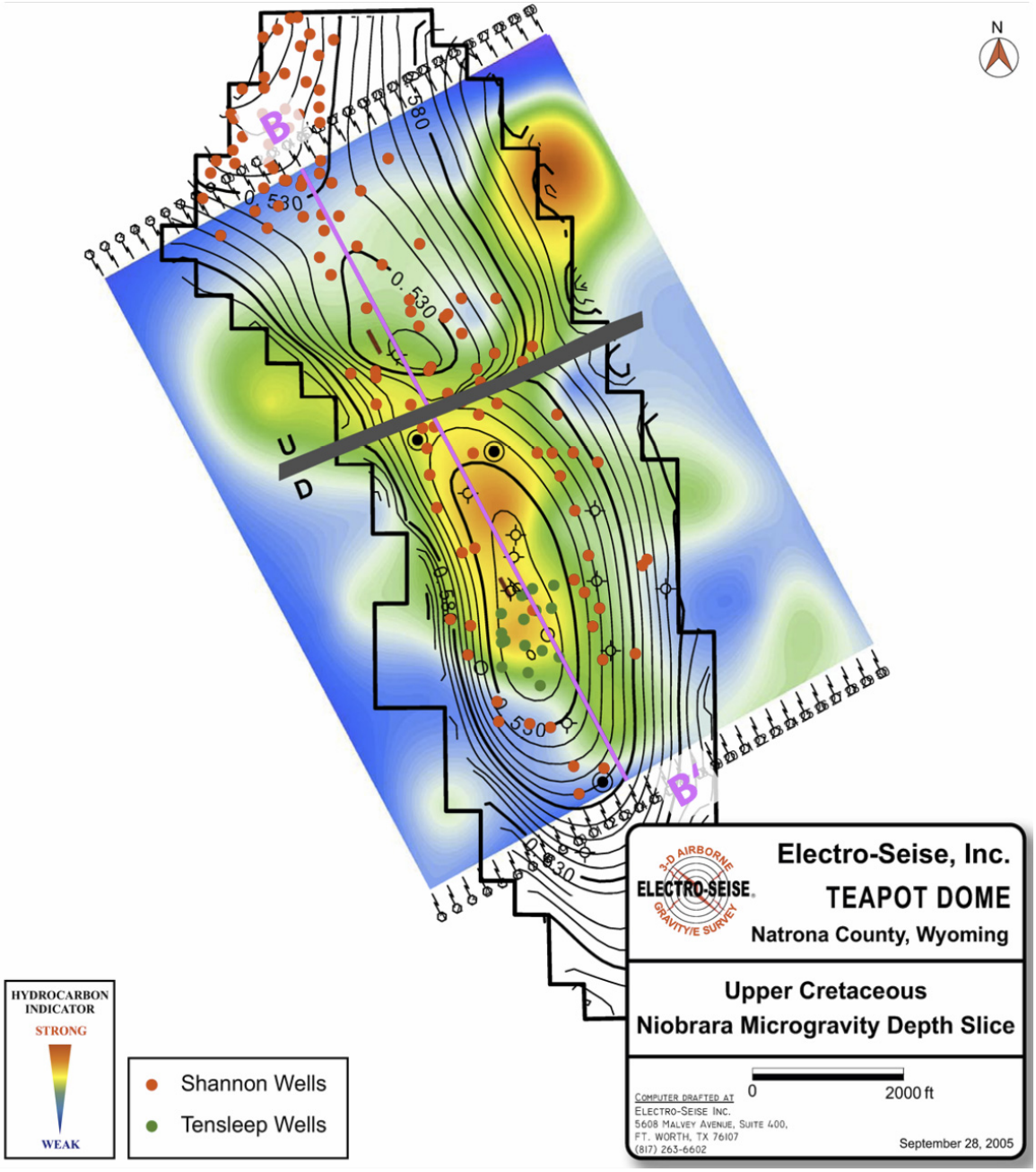

Figure 7. Upper Cretaceous Niobrara hydrocarbon microgravity depth slice.

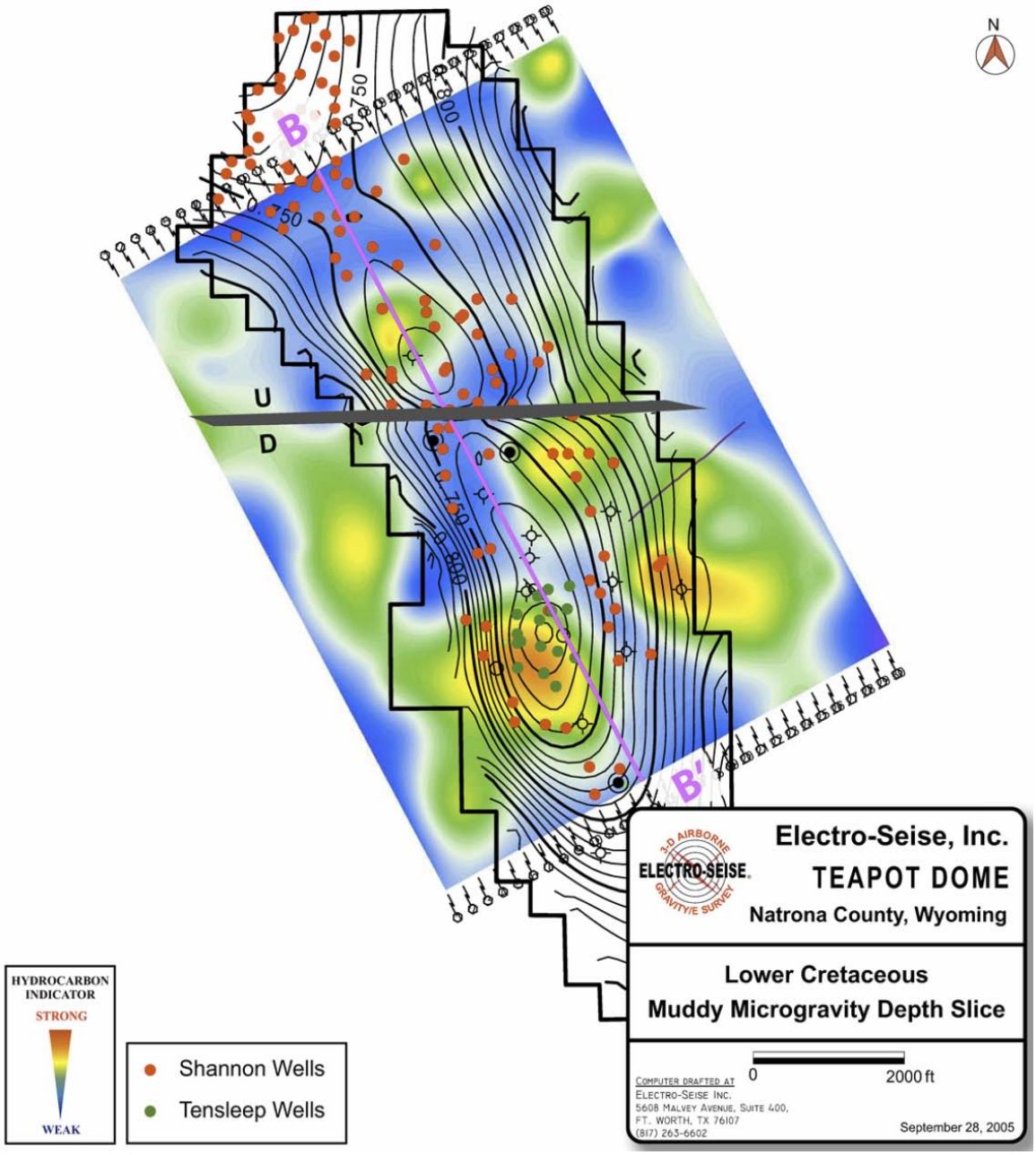

Figure 8. Lower Cretaceous Muddy hydrocarbon microgravity depth slice.