ePSBasin Evaluation Comparison: Paradox, San Juan and Black Mesa Basins Utah, Colorado, New Mexico and Arizona, USA*

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Abstract

Subsurface technical studies conducted in the Four-Corners region of New Mexico, Utah, Colorado, and Arizona provide geoscientists a view of the tectonic history of the basins. The Paradox, San Juan and Black Mesa basins, although located adjacent to each other and separated by the Defiance Uplift, have different basin histories resulting in very different hydrocarbon productivity and prospectivity.

Gravity and magnetics (GM) geophysics, generally broad in coverage, provides a cost effective tool to guide interpretations. The integration of GM geophysical data with other available data (such as from wells and outcrops), provides an approach to evaluate the early history of each basin. We were able to construct a suite of maps and a regional cross-section stretching across basins from the Grand Canyon in the west to the Nacimiento Uplift in the east. The cross-section incorporates all the available data and allows for evaluation of the basins.

The Paradox and San Juan basins show late Paleozoic sediments (Mississippian-Pennsylvanian), primarily carbonates similar to those seen in the Paradox Basin to the northwest, while the Black Mesa Basin shows early Paleozoic sediments, similar to those seen in the Grand Canyon to the west. In fact, the Grand Canyon exposes Proterozoic Chuar Formation sediments that may have source rock potential deposited in an ancient rift basin. The extent of this rift basin is uncertain, but through the use of GM geophysics we were able to model the potential eastward extension of this source rock into the Black Mesa Basin.

The Mesozoic history of the basins also differ and impact the hydrocarbon richness of the basins. The San Juan Basin is filled with a thick sequence of sandstones, shales, and coals. Similar lithologies in the Black Mesa Basin are thin due to later uplift and erosion and are totally missing in the Paradox. Structurally the basins are also different due to early tectonic lineaments and later mechanical stratigraphy related to sedimentation. A magnetically-derived basement structure map represents the surface of the crystalline rock.

The exploration potential of the Black Mesa Basin was evaluated as high risk due to the generally low yield expected from potential Chuar-type source rocks. Through the integration of GM geophysical data with other existing data and comparison with neighboring basins, the need for a regional grid of 2D seismic data was down-graded.

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Basin Evaluation:

Paradox, San Juan, and Black Mesa Basins,

4-Corners Region,

Utah, Colorado, New Mexico, and Arizona U.S.A.

GM Geophysics

Tom Bulling BP America

Corine Prieto Integrated Geophysics Corp.

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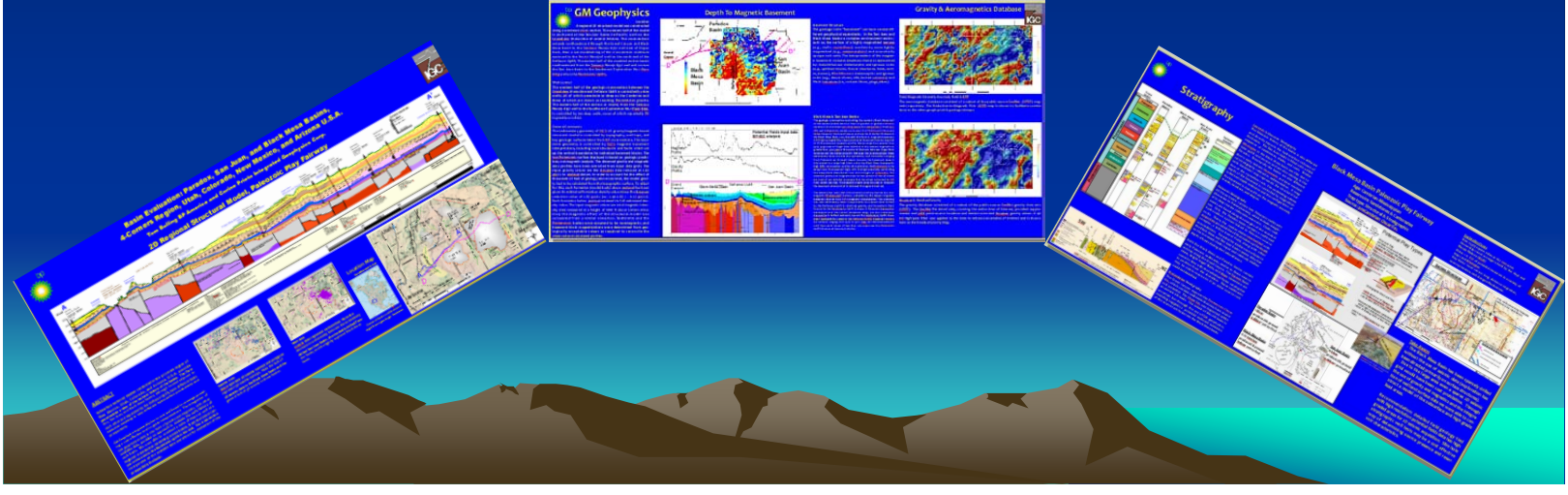
Theme 9: Geophysical Basin Evaluation Techniques in Volcanic, Fractured and Source Rich Areas

Wednesday Morning Poster Session

Booth 19C



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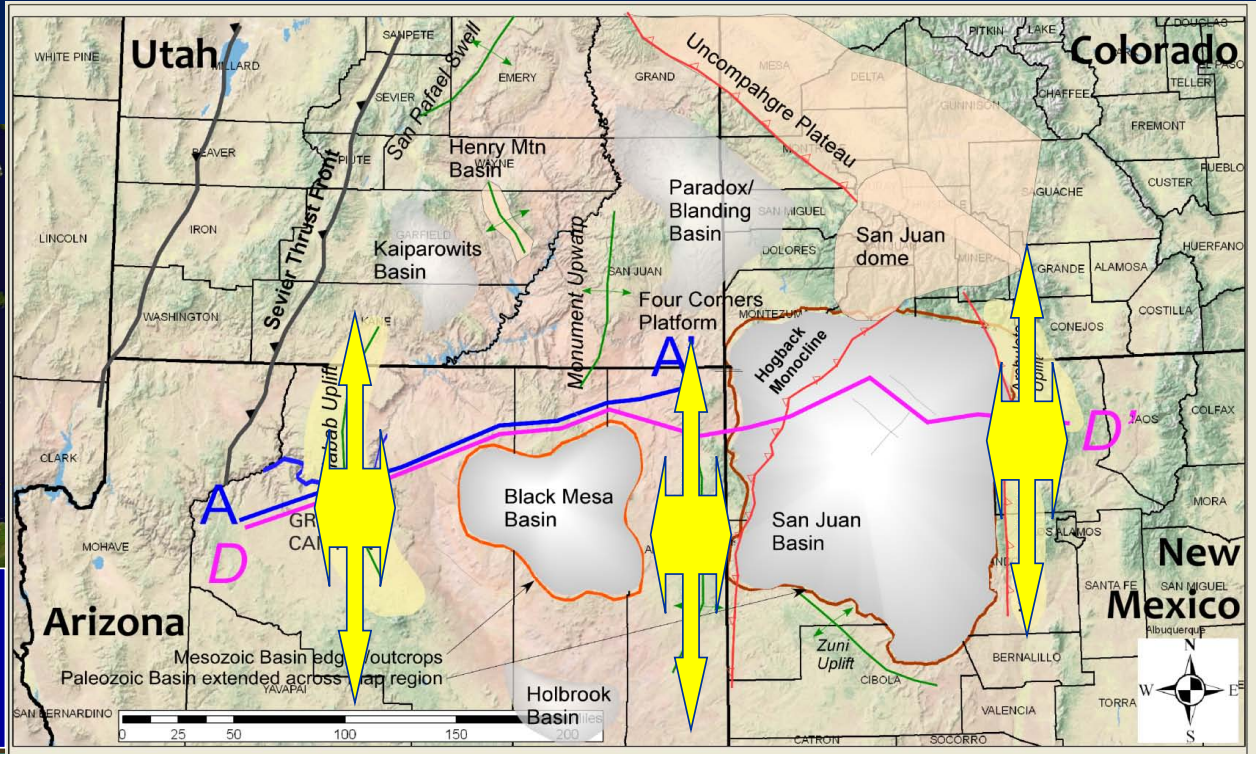
Location: Southwest U.S.A.

Black Mesa Basin is a frontier basin adjacent to the productive Paradox and San Juan Basins



Black Mesa Basin Analysis

- Pre-seismic exploration
  - No modern 2D or 3D seismic
  - It is costly to acquire new seismic
  - What's needed is to narrow the focus of an acquisition program in targeted areas
    - How?
- Using GM Geophysics
  - A low cost initial evaluation to determine prospectivity
  - Allows for high grading of target areas for reconnaissance 2D seismic acquisition

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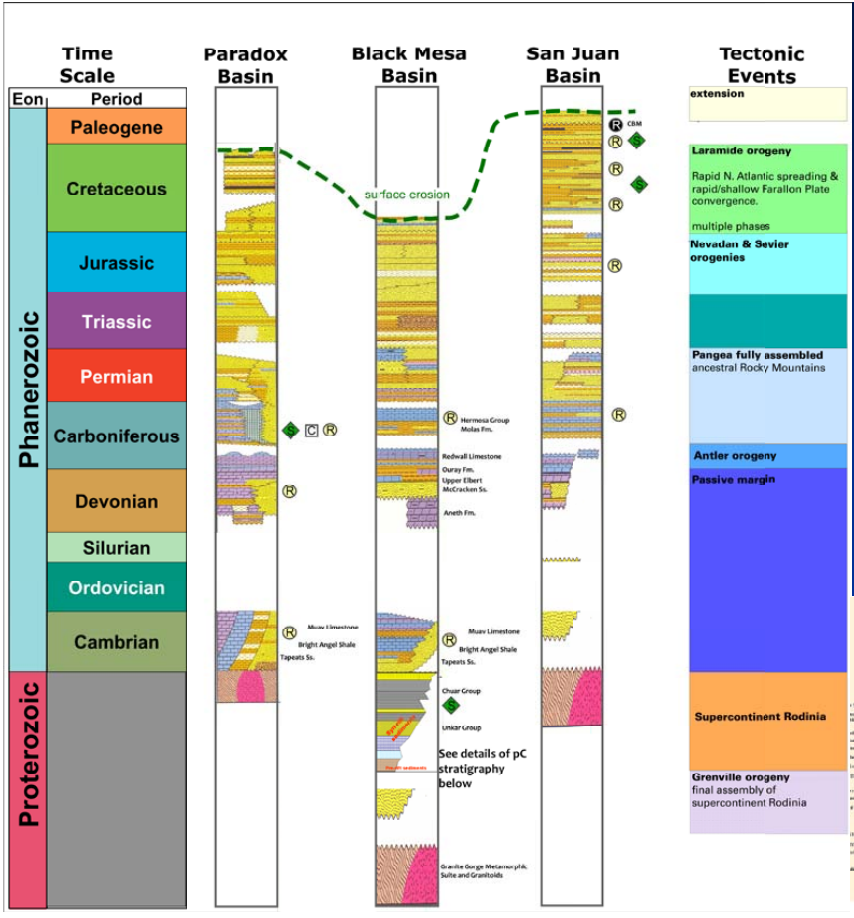

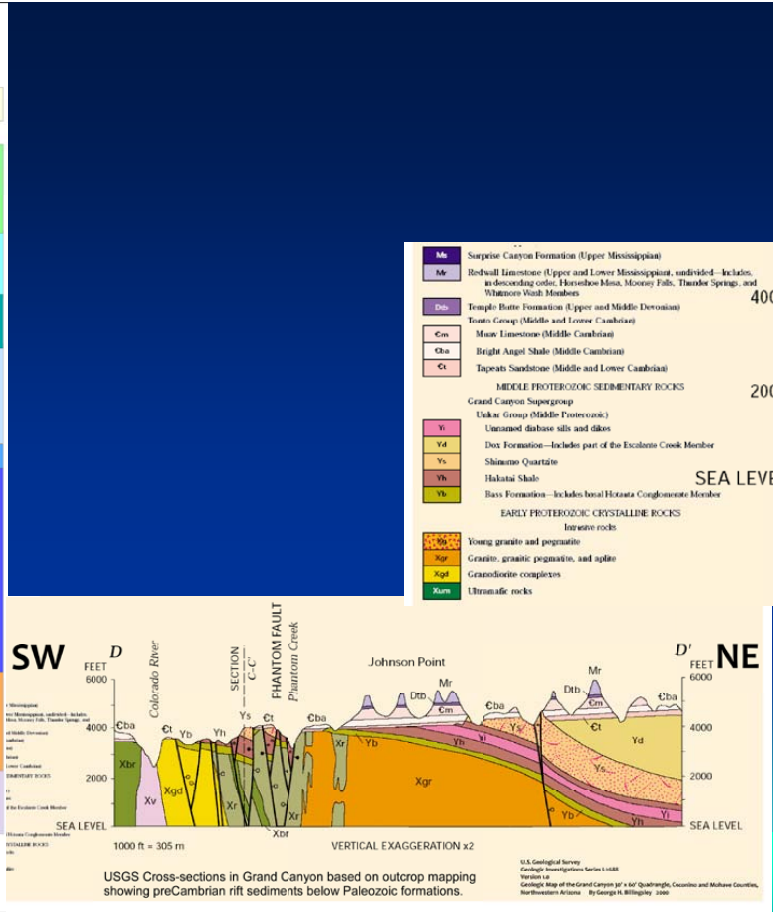

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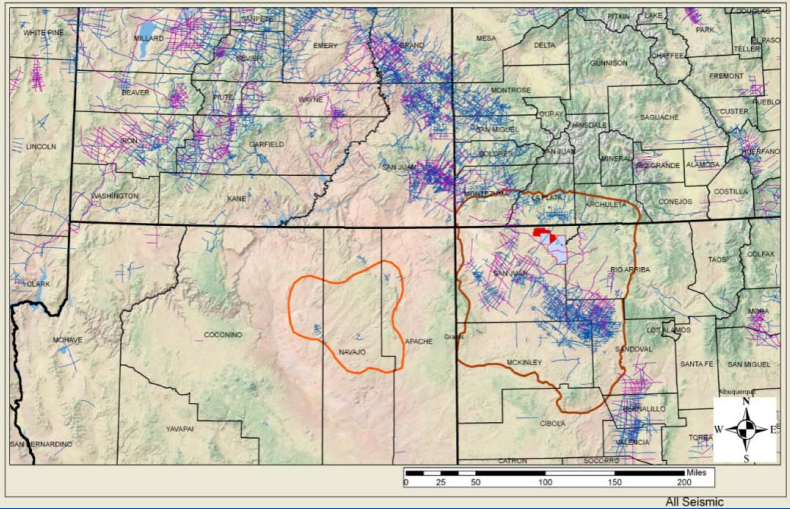
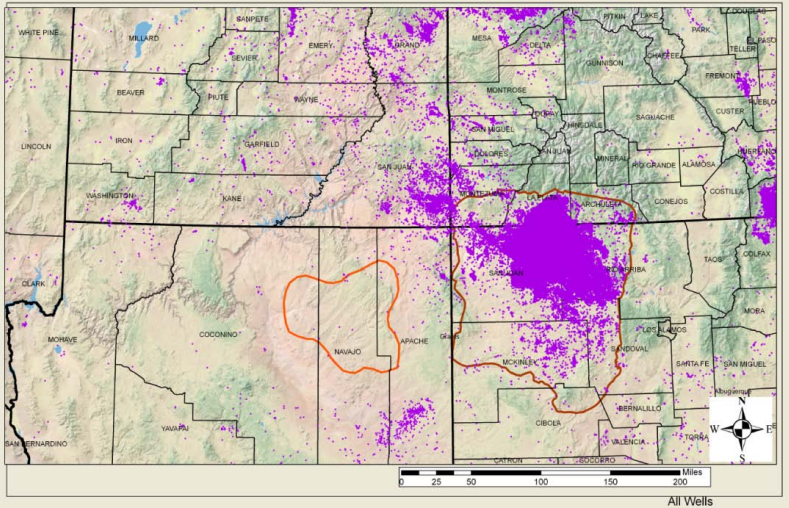
Subsurface Database



All Seismic



All Wells

Seismic coverage

Well control

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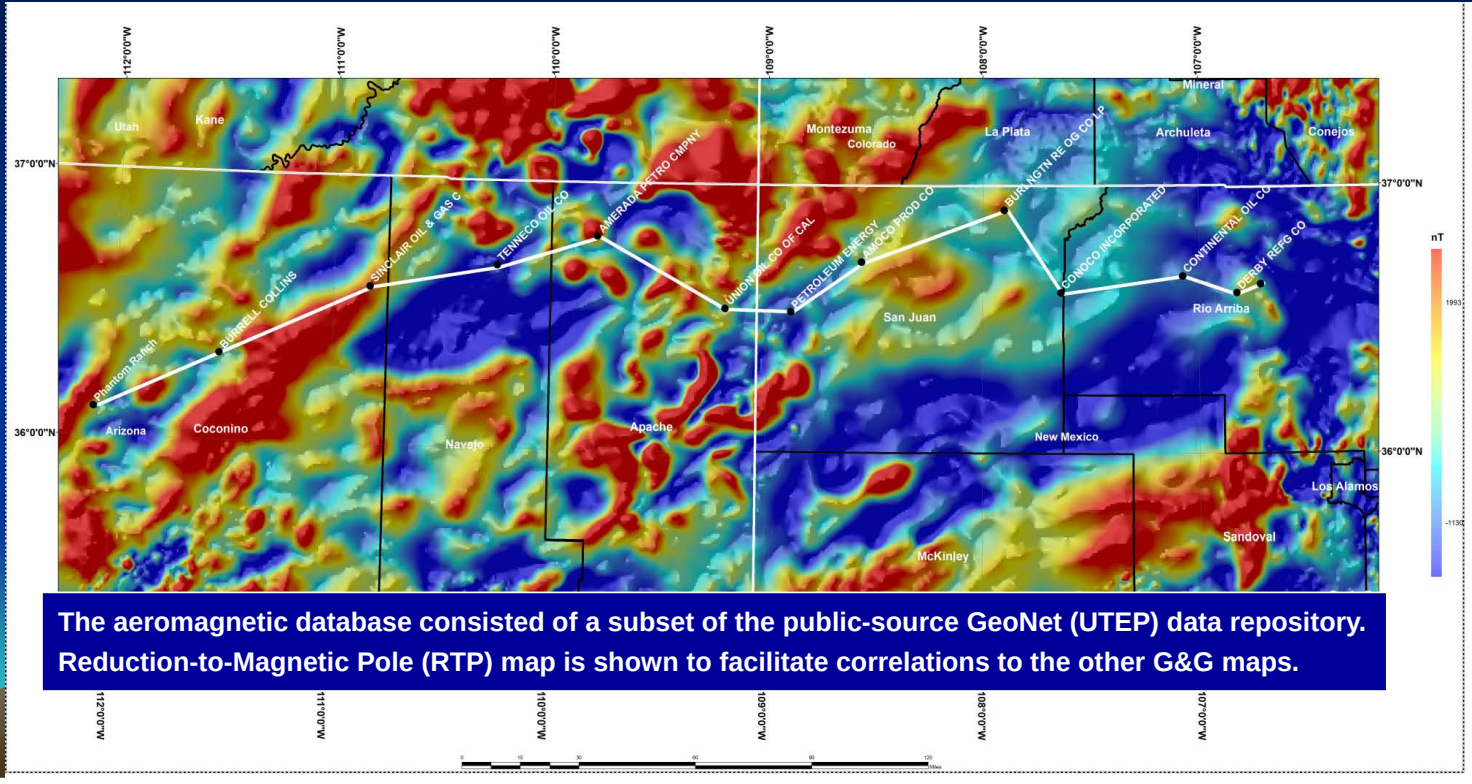
Reduction-to-Magnetic Pole



The aeromagnetic database consisted of a subset of the public-source GeoNet (UTEP) data repository. Reduction-to-Magnetic Pole (RTP) map is shown to facilitate correlations to the other G&G maps.

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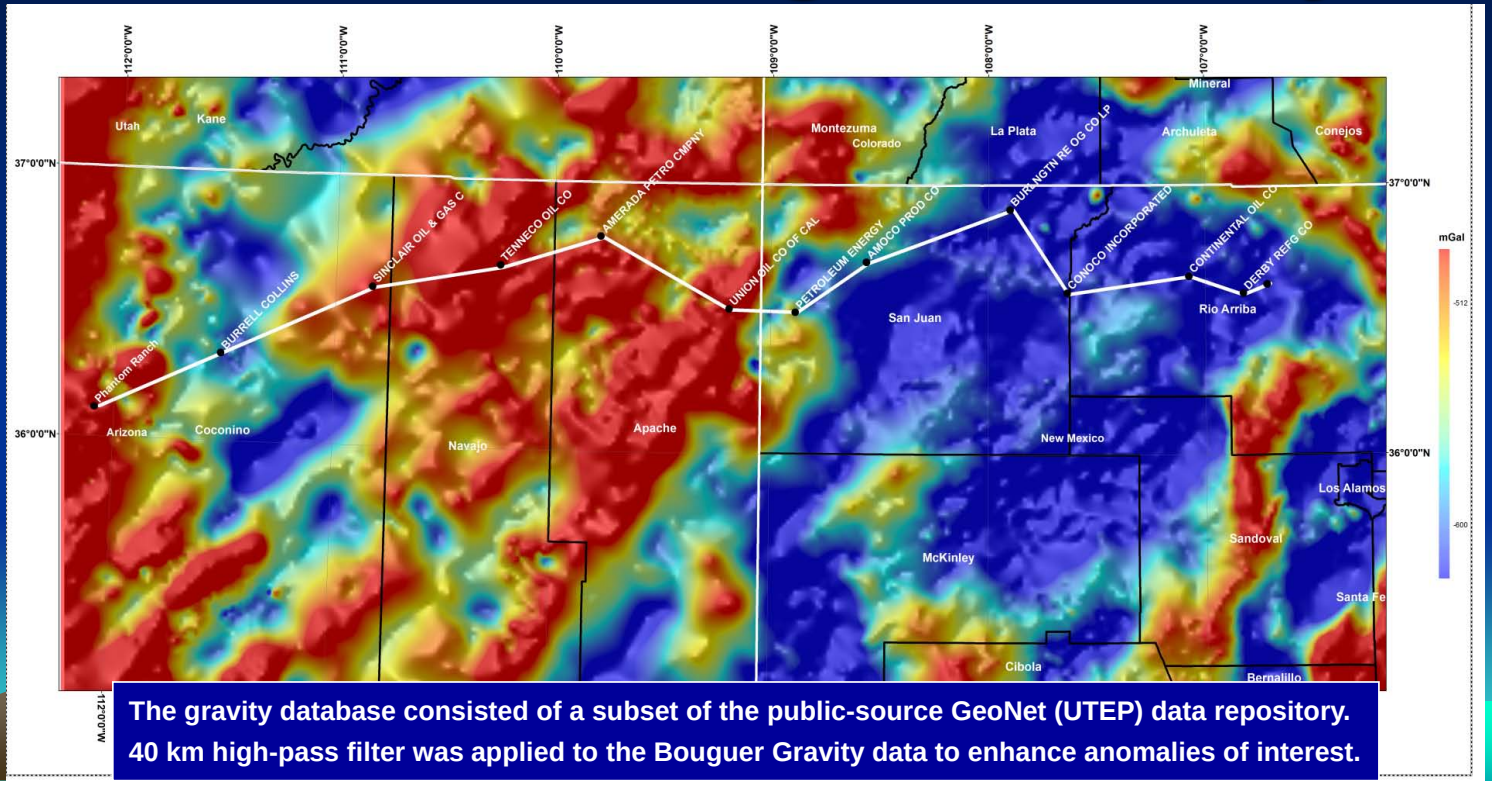
Residual Bouguer Gravity



The gravity database consisted of a subset of the public-source GeoNet (UTEP) data repository. 40 km high-pass filter was applied to the Bouguer Gravity data to enhance anomalies of interest.

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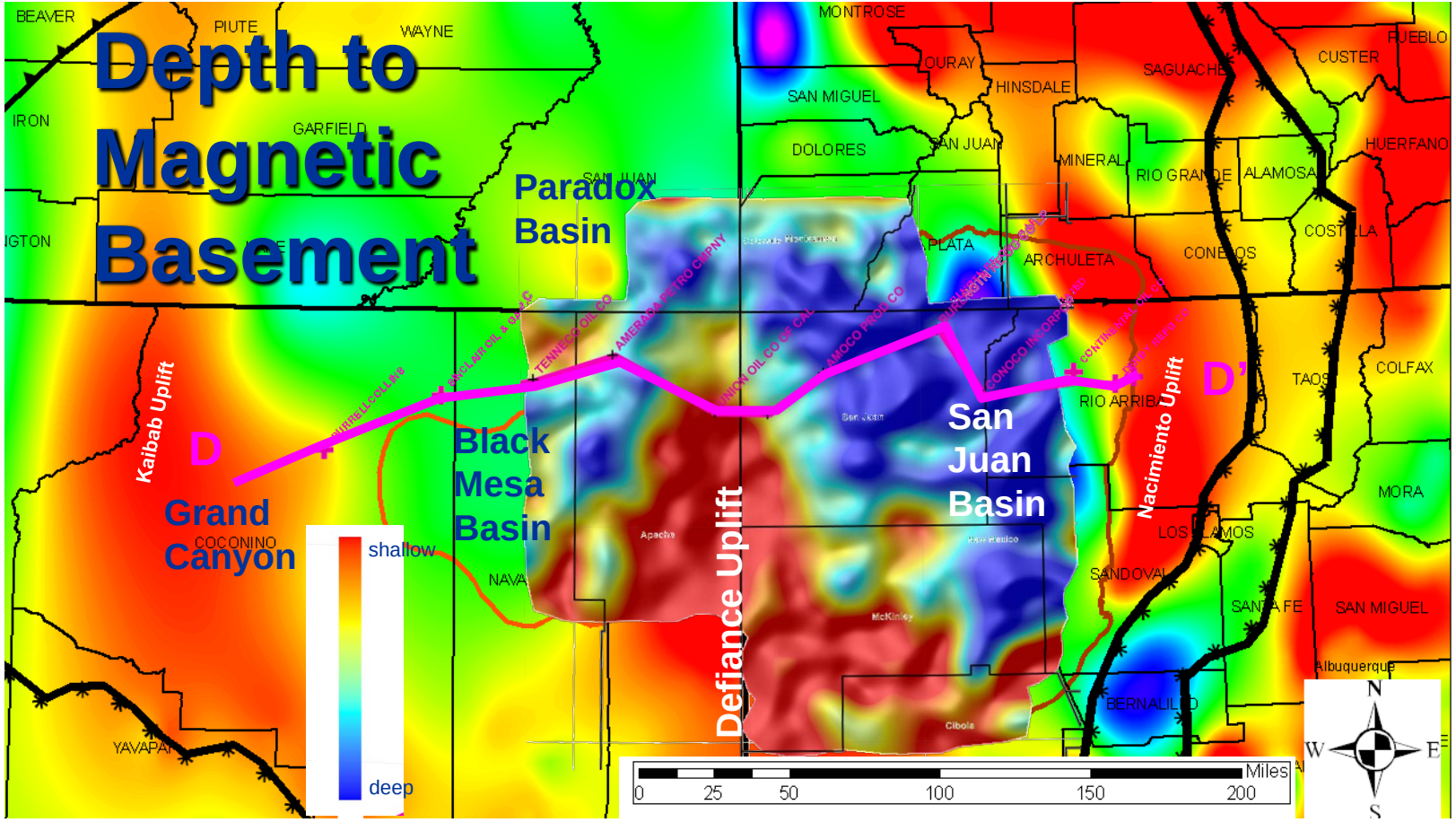

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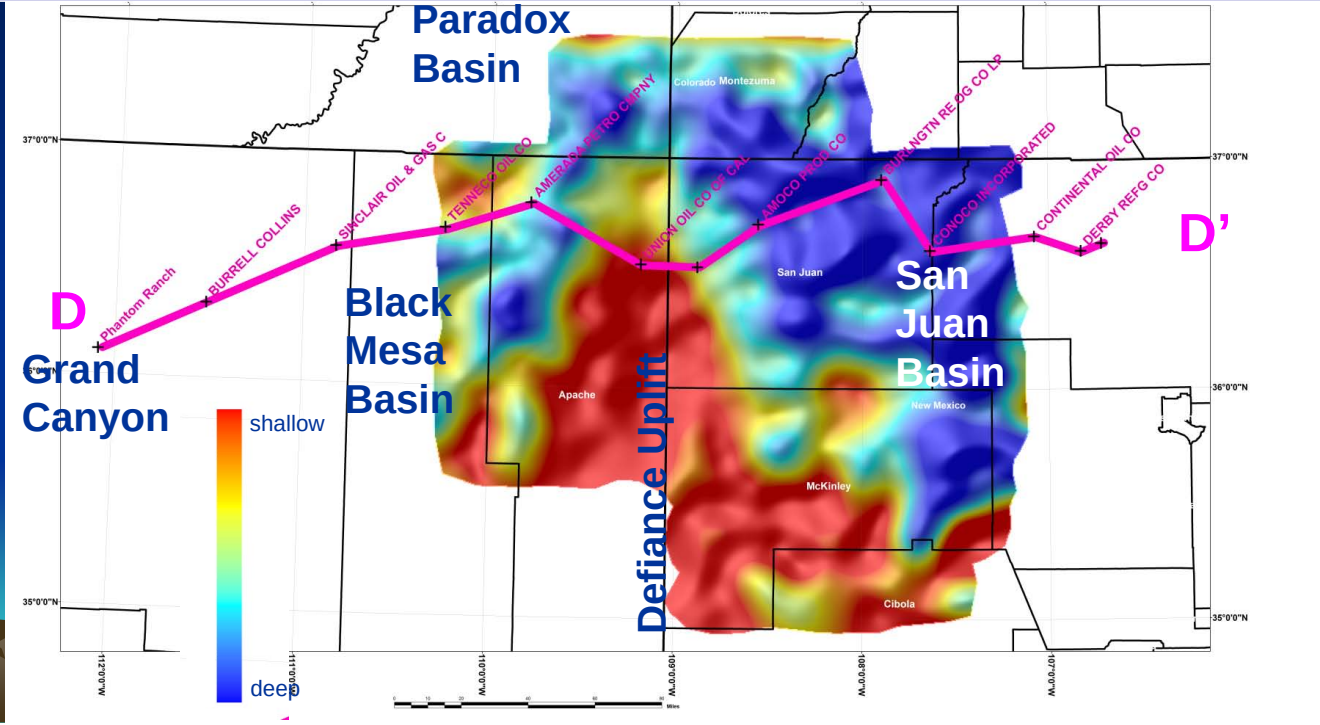
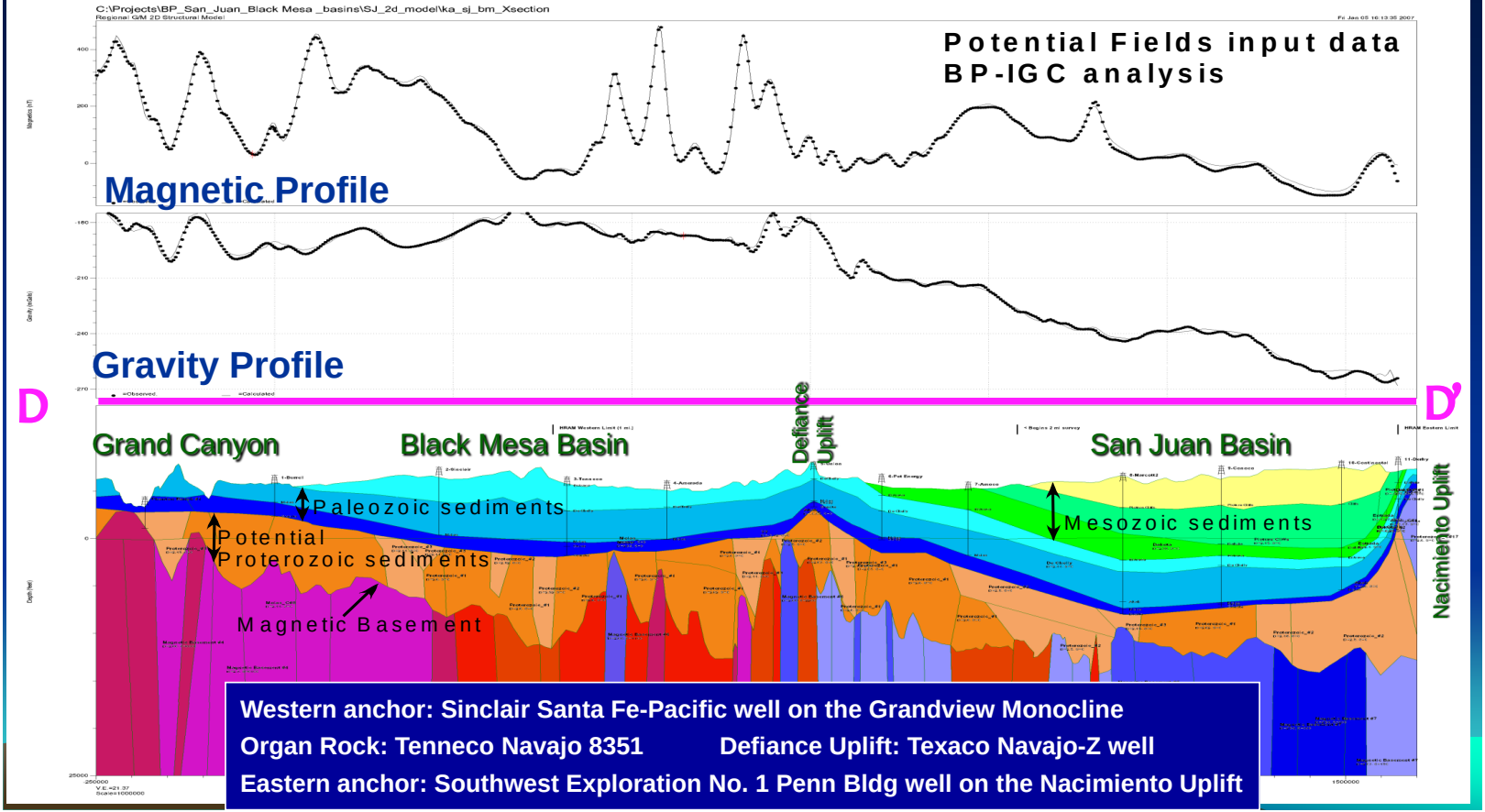
Magnetically-derived basement structure includes:

- **Autochthonous metamorphic and igneous rocks (i.e., upthrust blocks, flower structures, folds, arches, domes),**
- **Allochthonous metamorphic and igneous rocks (i.e., thrust slivers, sills, buried volcanics)**
- **Thick intrusives (i.e., volcanic flows, plugs, dikes).**





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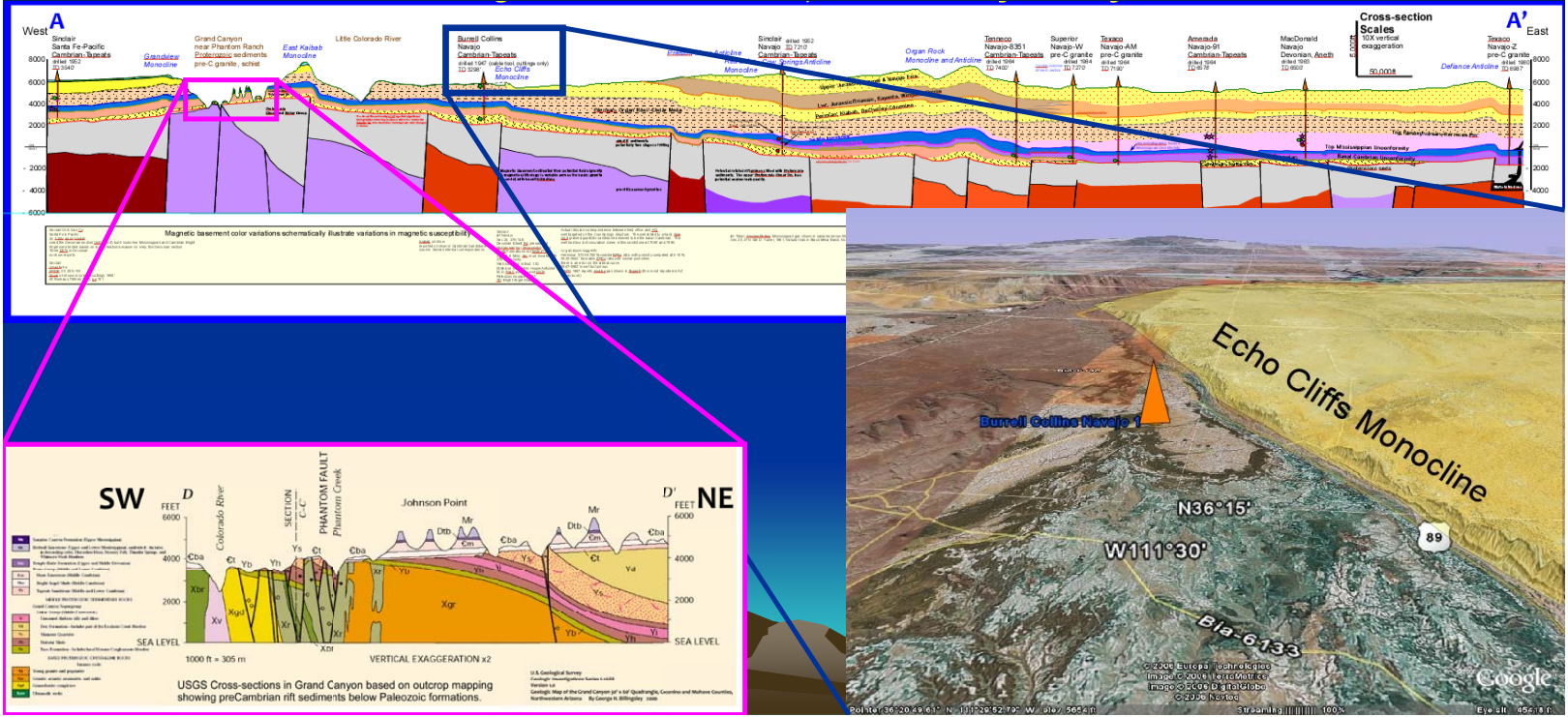
A-A’ X-section



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Take Aways

- The Black Mesa Basin represents a true pre-seismic basin that has been sparsely drilled. Exploration has historically been directed to surface anticlines.
- Due to the large area a recon 2D seismic grid would be cost prohibitive.
- Through the use of gravity and magnetics integrated with well and surface data we identify target lead areas.
- The potential source rock interval (Chuar Fm.) thins from the Grand Canyon to Defiance Uplift.

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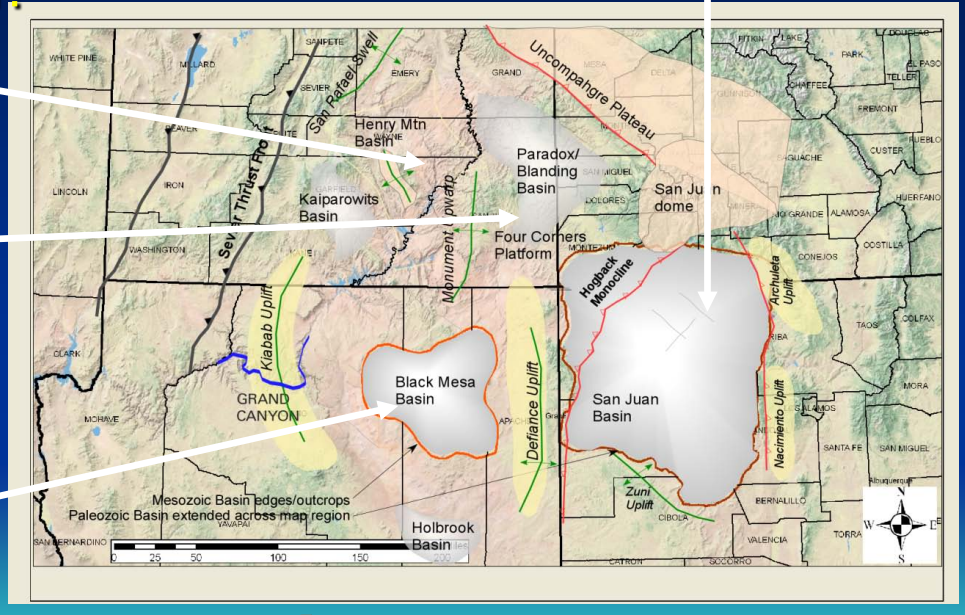
Pre-seismic US basins?
Yes, they still exist.
Why explore them?

San Juan Basin
11bboe produced & proved

Tar Sand Triangle
>10bboe tar sands

Paradox Basin
1bboe
produced &
proved

Black Mesa Basin
???boe yet-to-find



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Acknowledgements

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- Many thanks to everyone at IGC for their insistence on accuracy and quality.