Trinidad Southern Basin Phase 10 Study - Unlocking the Deeper Onshore Reservoirs

The Play: Trying to unlock a new field in a “widely explored” basin can be a difficult idea to get comfortable with. For inspiration we looked back at our 20-year experience exploring fold belts globally and relooked at the deeper horizons exploration elements in Trinidad’s onshore Southern Basin. Acknowledging the complexity of imaging and mapping the deeper horizons, we consider with the correct tools and a robust solution to fault timing, the evidence tells us large structures exist and the big one is still waiting to be found.

Elements for Success: Enabled with **new numerical** techniques, global active margin experience and learning from the past Trinidad onshore exploration programs, Bifrost Energy considers it is the right time to drill and unlock this onshore deeper horizon oilfield.

- New tools and an evolutionary 2021 plate tectonic model developed by Bifrost Energy integrating the ideas of many past workers
- The subsurface data clearly tells us there is oil and porosity in the Cretaceous - Miocene rocks.
- The onshore surface geology maps clearly show us **Cretaceous cored structures exist and they are large**. Rock Dome (Fig. 1) is an example of the size of folds that can develop in the Southern Basin.
    - Such a structure filled with very conservative reservoir properties of 8% porosity and a 50-foot oil column can discover >**750 million barrels of oil in place** (Table 1).

Rock Dome Fold size example	Oil in Place by the Volumetric Method
Size	28,000 acres
Porosity	8%
Reservoir Thickness	50 feet
Oil Saturation	90%
Bo factor	1.68
Volume (MMBO)	750

Table 1 What a conservative 28,000-acre field looks like

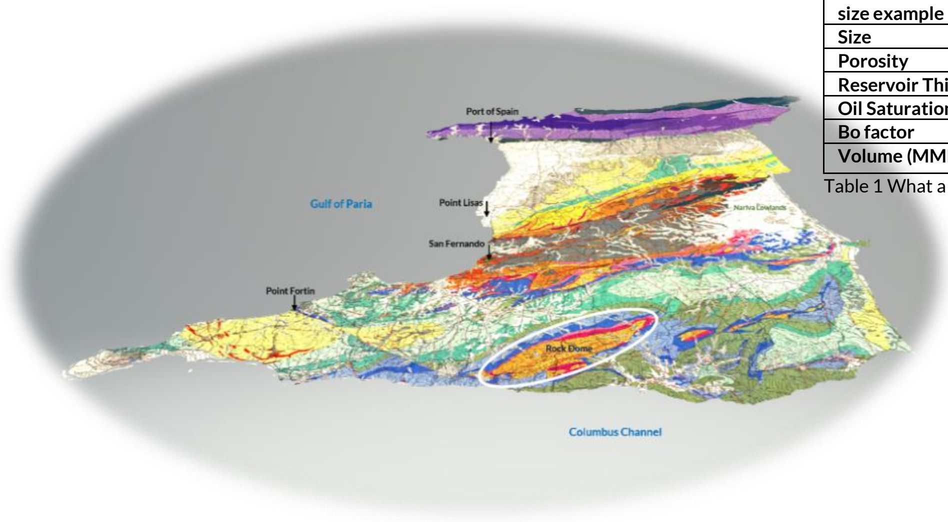

Fig. 1 Kugler map showing Rock Dome outline in white.

Innovation and Integration

Trishear: Bifrost Energy have employed Trishear analysis to calculate fault timing proving Out-of-Sequence Thrusting (OOST) is a dominant style of faulting in the onshore thrust fold belt. **This is a groundbreaking discovery.** It tells us prior exploration campaigns mis-timed their trap formation which led to the drilling of breached structures finding non-commercial oil. These earlier campaigns did not use techniques like trishear analysis.

Full Tensor Gravity: In addition to the Trishear method we will use full tensor gravity methods to create more accurate vertical resolution of the mapped structures. These methods greatly enhance the valuable Southern Basin 2D seismic dataset moving it towards the 3D domain. Fortunately, the Southern Basin of Trinidad has an available Full Tensor Gravity survey.

Exploration Philosophy

We do not discount past work with blind optimism but instead ensure prior results are effectively integrated in a holistic manner leading to a better answer. **For us hope is not a strategy.**

Commercial:

The Bifrost Energy approach calls for flexible commitments such as low or no-cost entries where Bifrost can work with current and future leaseholders to develop deeper horizons exploration targets across the Southern Basin. During this phase Bifrost Energy will work with our capital partners to secure funding for our working interest.

Now is the Time:

We all recognize the challenges of global warming and the carbon neutral objectives for hydrocarbon producers. Some estimate another 5-7 years for finding new oilfields. Left too late this asset will become stranded adding no value to Trinidad and Tobago. We have brought together the history of the Miocene-Cretaceous exploration in Trinidad and placed it into new and innovative models to guide us to the best locations onshore Trinidad for discovering a Cretaceous oilfield **-and we can do this with the existing data, no need to wait.**

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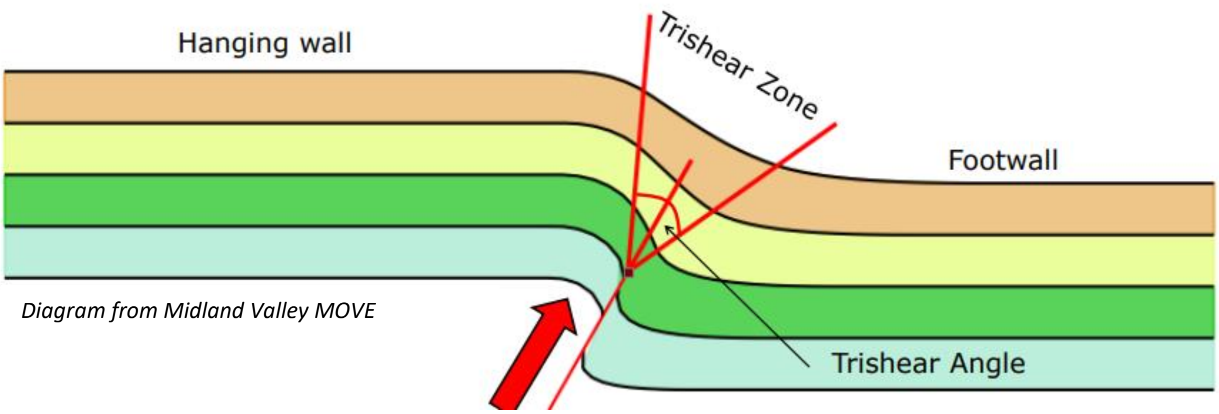
Trinidad Southern Basin Phase 10 Study TRISHEAR QUICKLOOK

A kinematic modeling method which allows simulation of the heterogeneous ductile deformation associated with a propagating fault tip. The trishear method of fault-propagation folding was initially developed as a 2D alternative to the kink-band technique (Erslev 1991) where the hanging wall moves at a constant velocity relative to a fixed footwall while within a triangular zone above the fault tip (or "trishear zone") velocity decreases towards the footwall. **It is a numerical solution** and cannot be modelled by hand-drawing.



Allmendinger (1998) presented a numerical inverse grid search, providing a quantitative, scientifically objective way of applying trishear to real structures. In 2000 Zehnder and Allmendinger presented a generalized velocity model for tip propagation that adequately deals with material heterogeneity and does not require the trishear zone to be symmetric. This basic formulation is the foundation of trishear algorithms in several structural reconstruction software packages. Due to its heavy computation requirements trishear software is only now becoming more user friendly with faster computers. Like reservoir simulation it requires some amount of training and experience for parameter selection and so is more commonly used in an academic setting or by experts in the operating oil companies.

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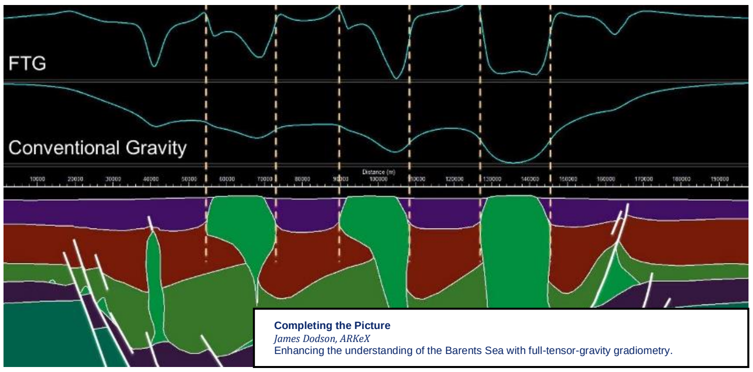
Trinidad Southern Basin Phase 10 Study Full Tensor Gravity QUICKLOOK

Full Tensor Gradiometry (FTG) measures the rate of change of gravity in all directions of the field, caused by subsurface geology. **FTG directly measures all components of the gravity field.**



Since the early 20th century, gravity exploration has been extensively used in hydrocarbon exploration. Most gravity surveys have used gravity meters designed to differentially measure the vertical component of the gravity vector g_z. Historically the common approach was to express the gravity gradient tensor field in terms of its Cartesian representation – a complex task which is dependent on the choice of coordinate system. This complexity led interpreters to simplify the task by only using the vertical gravitational acceleration and its first vertical gradient (Pedersen and Rasmussen, 1990). But the gravity gradient tensor has a physical and geometrical meaning, which is independent of any coordinate representation and is not simply a mathematical construct. The gravity gradient reprsents the curvature of the gravitational potential. This axiom gives us a powerful tool in Trinidad where the structural rearrangement of strata with varying densities lends itself to shape variations (curvature) which are mappable in the gravity field. It is a great tool to validate shapes in the subsurface which is needed in the hunt for deeper structures onshore Trinidad. Cevallos et. al. (2013) addresses the curvature solutions using FTG. Barnes (2008) and Claderon-Magallon et. al. (2016) addresses the resolution and interpretive value of FTG surveys. Modern software gives us the ability to more completely use this powerful data type and integrate with well and seismic datsets.

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Trinidad Southern Basin Phase 10 Study Cretaceous Stratigraphy QUICKLOOK

Cretaceous Stratigraphy: Incorporating a wider margin area- Venezuela, Trinidad, Guyana

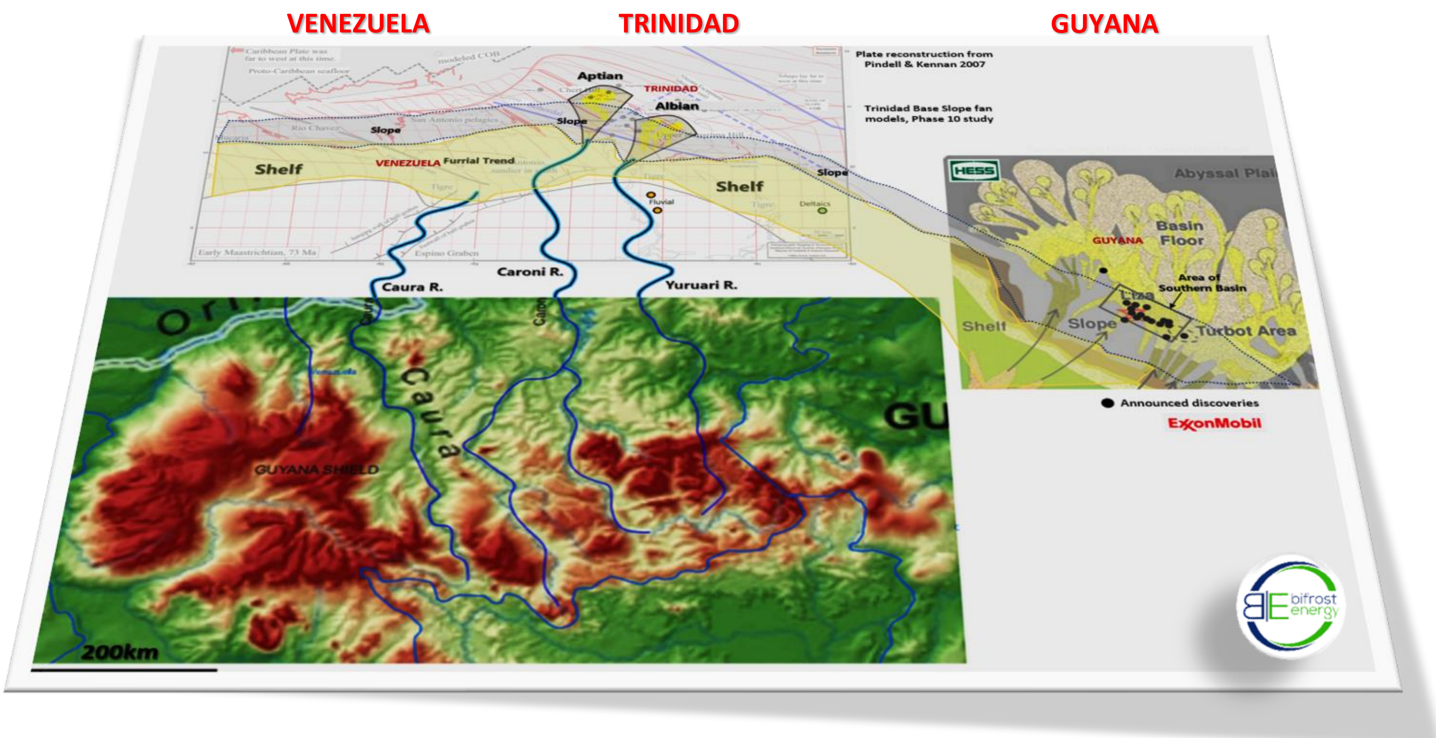

Figure 1 Collage of regional elements with focus on reservoir quality

Bifrost Energy undertook a regional review of Cretaceous sedimentation across Venezuela/Trinidad and Guyana. As the North Atlantic opened from north to south, a passive margin was created along the northern and eastern edges of South America. The Caura, Caroni and Yuruari Rivers in Venezuela, and the Proto-Essequibo and Demerara Rivers in Guyana originated on the Pre-Cambrian Guiana and Amazonian Shields flowing northward, depositing sediments on the shelf, slope, and basin floor. Later, during the Tertiary period and powered by the insertion of the Caribbean plate, hinterland topography changed, and the Orinoco River began capturing the outflows of the Caura/Caroni/Yuruari rivers to form the larger Orinoco system. Meanwhile, because the Guyana margin remained mostly passive, the flow positions of its ancient rivers were retained. The key point here is Guiana Shield drainage generated the sediments for the Furrial Cretaceous reservoirs, a multi-billion-barrel oil trend, and the Guyana Cretaceous reservoirs, another multi-billion-barrel oil play. However, in Trinidad, while several wells have found similar amounts of sand compared to Cretaceous reservoirs in Furrial and Guyana, none of the 90+ Cretaceous penetrations have found a productive oilfield.

The main difference between Trinidad and its western and eastern clastic cousins lies in its tectonic history. Trinidad's plate boundary phase has created more complexity that has added structural overprinting, masking unexplored structural trends. **Coupled with areas of incomplete stratigraphic tests, several unexplored opportunities remain. The results of earlier exploration programs have guided Bifrost Energy into focusing on techniques that enhance structural signal, offering an improved outlook for successful discoveries located in part by our stratigraphic knowledge of deep-water slope reservoir systems.**

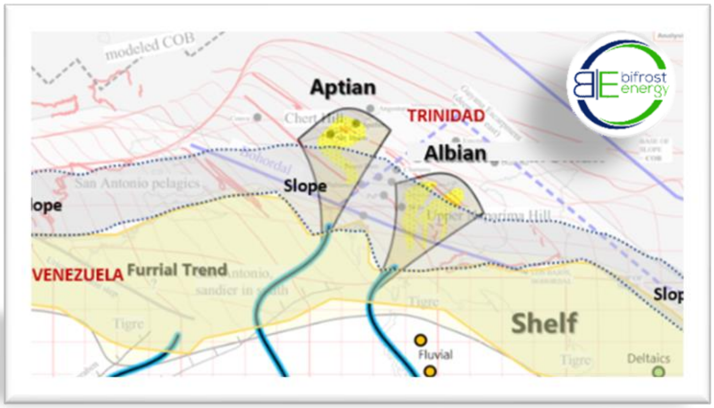

Figure 2 Close up view of Trinidad fan systems Gautier Fm.

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