An extensive seismic survey over a large area of the Barbados offshore has exposed considerable potential in this unexplored acreage. There is also encouraging evidence of a correlation with the producing areas of Trinidad & Tobago.

Virgin Offshore Acreage Off

Jane Whaley, Associate Editor

The spectacular coastline of Barbados is primarily composed of Quaternary coral limestone, but is underlain by steeply folded Tertiary basement and shallow marine sandstones and clays.

In July 2007 the Government of Barbados announced the country's first offshore licensing round, opening up large areas of virtually unexplored territory to the hydrocarbon industry.

In order to provide interested oil companies with background material on this little known area, Wavefield Inseis were commissioned to undertake an extensive 2D seismic survey over the offered acreage. More than 8,000 line kilometres were shot in two phases. The data have now been processed and interpreted, revealing some very interesting insights into the potential prospectivity of the acreage.

The offshore Barbados Licensing Round, which opened in May 2007, has been extended and is now due to close on 6th June 2008. Successful bids will be announced on 7th August 2008.

One producing onshore field

The geology of the Barbados region is dominated by being close to a convergent plate margin, as the Caribbean plate slowly moves eastwards across the westward moving South American Plate. At the centre lies the Barbados Ridge, of which the island of Barbados is the only emergent expression. The flexure of the Barbados Ridge produced a system of ridge-parallel normal faults trending roughly north to south. Although the area seems to be structurally complex, it contains several distinct geological provinces.

The island itself is capped with Quaternary coral limestone, except in the northeast where it has been eroded to reveal the underlying mélange (a mappable body of hetereogenous rocks) of steeply folded and deformed Palaeogene sediments, giving a clue to what underlies much of the area.

Since the early 1900's a number of wells were drilled on the exposed formation, but the only onshore producing field in Barbados was eventually discovered in 1966 in the southern part of the island. This is the Woodbourne Field, which produces more than 1,000 barrels of light sweet oil and 1.6 MMcfg per day from the Eocene Scotland Group sandstones. The traps probably evolved in the Neogene during a late stage of deformations and uplift.

Cretaceous source rocks proved

As part of an assessment of petroleum systems in the Caribbean, the U.S. Geological

ered by Barbados

Survey analysed hydrocarbons from this field and from offshore seeps and concluded that they originated from a Cretaceous marine shale. This proved to be a very significant outcome, as hydrocarbons from Barbados had previously been thought to have been sourced from Tertiary rocks. The presence of Cretaceous source rocks implies that the prolific petroleum systems of Venezuela and Trinidad can be extended to Barbados and adjacent areas and suggests that deeper petroleum potential is present for onshore and offshore Barbados.

As a consequence of this, the Tobago ForeArc Basin to the west of Barbados could be an exciting new frontier province. Bounded on the western side by the Caribbean volcanic island arc, which includes the islands of Martinique, St. Lucia, St. Vincent and Grenada, and on the east by the Inner Deformation Front, the Tobago ForeArc Basin is a deep trough filled with several thousand metres of Tertiary sediments. Within Barbados territorial limits this area is completely unexplored, with equally little exploration in the vicinity of the islands, but the presence of seeps shows that the area has a working petroleum system. Even more importantly, the new seismic, coupled with the Cretaceous source rock evidence, suggests that the ForeArc Basin could be an extension of the important Tobago Trough hydrocarbon province to the north of Trinidad and Tobago. The recent Cassra discovery (see Global Exploration Update), north of Tobago, has extended this play even nearer to Barbados.

Promising leads

East of the ForeArc Basin, Barbados' marine territory includes an extensive fold-thrust belt about 50 kilometres west of the island, known as the Inner Deformation Front. The water is deep, varying from 1,200 to 2,300m, but the seismic has identified a number

of very promising leads with both 4-way dip closures and 3-way dip and fault closure. The leads appear to be predominately found in Lower to Middle Tertiary sands, and 'bright spots' on the seismic are commonly associated with the Miocene unconformity in this area.

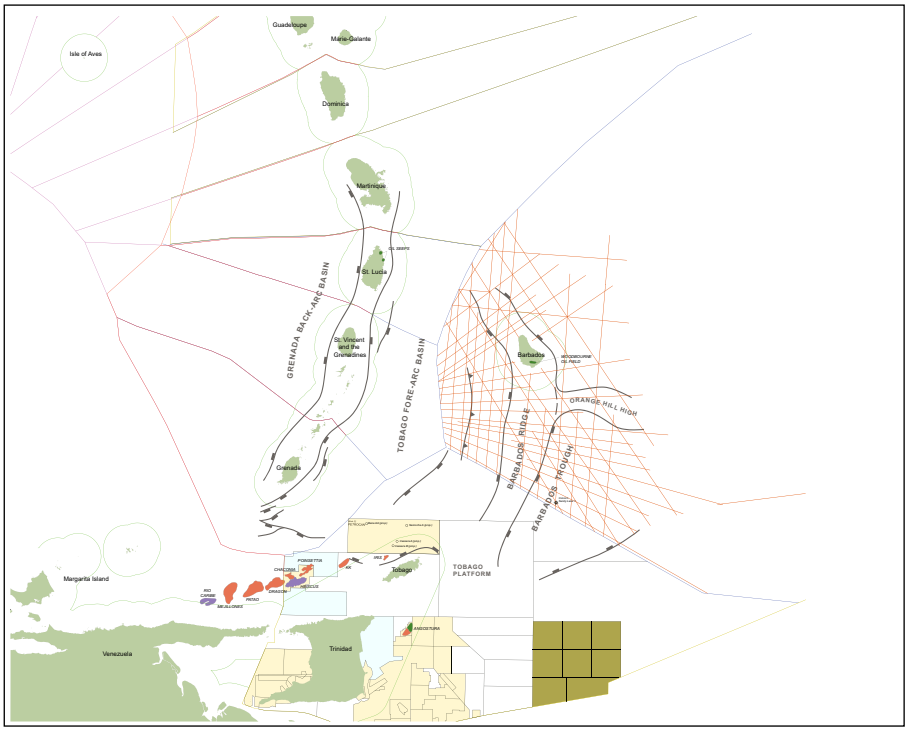
The Inner Deformation Front is bounded to the east by the Barbados Ridge, which is proven to be prospective by the presence of the Woodbourne Field. The ridge is composed of a basal complex of Eocene age rock which originates from the South American Plate as the Caribbean Plate pushed over it, overlain by marly forearc basin strata that was thrust over the basal complex, together with a mélange of rocks brought about by the movement of mud diapirs.

The new seismic has revealed a number of small sedimentary sub-basins within the Barbados Ridge, and clearly shows how it extends towards the Tobago petroleum province. Interestingly, the Bouguer anomaly interpretation shows that the north - south trending Ridge splits to the south of the island, allowing the accumulation of a deep layer of recent sediments.

The Only Offshore Well

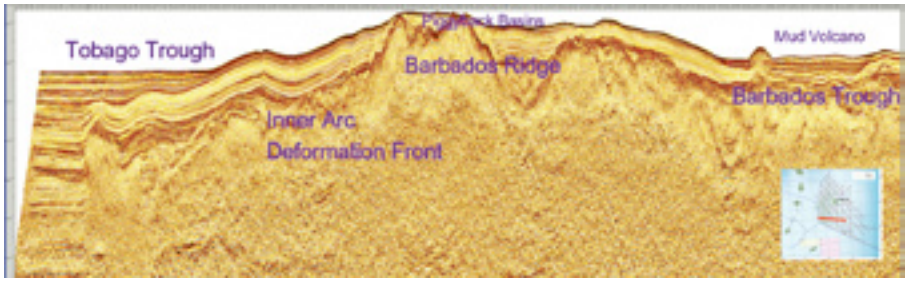
The Barbados Trough, which lies to the east of the Barbados Ridge and south and south-east of the island, appears to have all the elements necessary for an interesting exploration play. Quartz-rich sands have been shed into the basin from the Guyana shield, while compressional tectonics should provide multiple opportunities for trap formation. Surprisingly, therefore, only one well has been drilled in the Barbados Trough, in fact the only well to date in the whole Barbados offshore acreage. ConocoPhillips was the only previous operator offshore and in 2002 it drilled the Sandy Lane well, 130km south of Barbados in 2,100m of water. The well targeted seismic amplitude brightening in Palaeogene sediments, thought to be related to gas. Good gas shows were recorded and quality reservoir rocks identified, but no major accumulation of hydrocarbons was found.

However, oil and piston core sampling confirmed the existence of a good Cretaceous source rock, linking this source through biomarkers to the Late Cretaceous La Luna source rock, which is the origin of much of the oil further south in Venezuela and Trinidad. The Sandy Lane well was probably dry because the hydrocarbons had leaked out as a result of mud diapir activity and related faulting, as the well site can be seen to have a large mud overhang and also the possibility of faulting to the surface.



Cartography: Masaoki Adachi/Wavefield Inseis

The area on offer offshore Barbados includes 26 blocks and covers 70,191 sq km, equivalent to more than 11 UK North Sea Quadrants.



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Cross section through the Barbados Ridge to the south of the island, showing how it splits into two ridges separated by a sedimentary basin.

The recent successes in Trinidad and Tobago and in Venezuelan waters are encouraging oil companies to start to look northwards, and Barbados would appear to be a very promising place. Only the Barbados Trough has been tested with the drill bit, leaving huge untried acreage with exciting potential in the south and western parts of offshore Barbados, in the Barbados and Tobago Troughs and along the Barbados Ridge. Also completely untested to date are the underlying basement pre-deformation basins, which show evidence of hydrocarbon accumulation in a number of places.

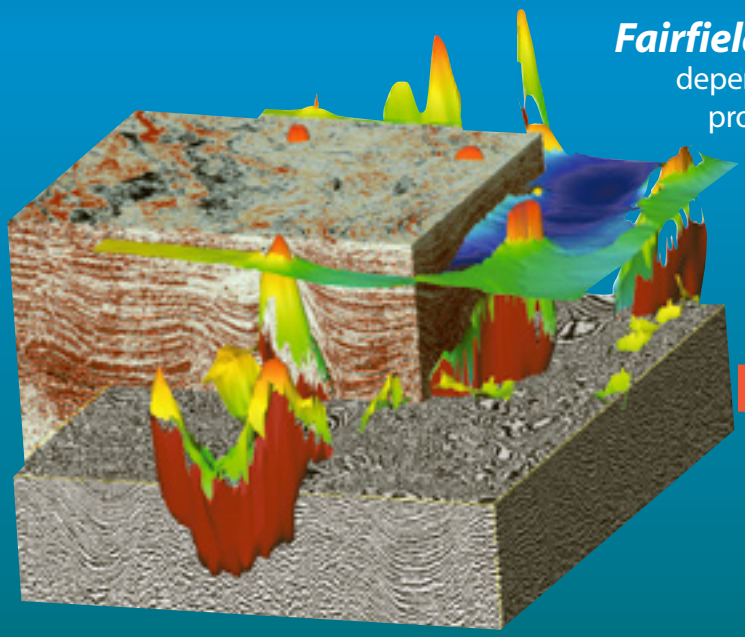
Excellent untested potential

The Wavefield Inseis 2D seismic survey confirmed the potential of the Palaeogene play and traps with good four-way closure. While mud diapirism and faults to the surface are a potential risk, it is easy to identify areas on the seismic where these events are not present.

The recent 2D survey has helped delineate the structural relations between the Tobago Fore-Arc Basin, the Barbados Ridge and Barbados Trough and has defined the eastern edge of the Tobago Basin. It also confirmed the correlation with the producing areas of Trinidad and Tobago which had been suggested by the discovery that hydrocarbons in Barbados were sourced from oils from the Cretaceous La Luna family.

Major hydrocarbon prospective trends and potential large prospects have been highlighted, suggesting that offshore Barbados could have a promising future for the hydrocarbon industry.

Just who *is* Fairfield?



Fairfield is the resource explorationists can depend on for the acquisition and processing of proprietary and multi-client data. For 30 years Fairfield's seismic knowledge and understanding has brought major advances to the seismic industry.

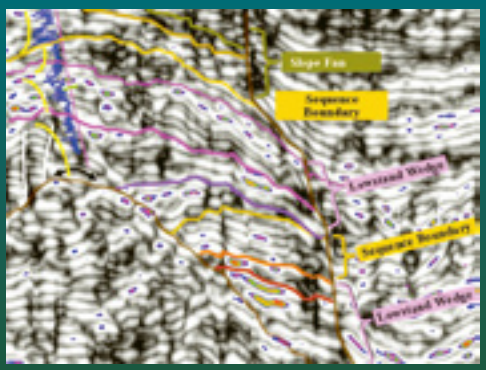
Multi-client Seismic Data

Fairfield's multi-client seismic library includes over 22,000 square kilometers of 3D GOM data, imaged to 12,200 and 15,250 meters using Fairfield's Tomographic Depth MVA.

Processing

SPICE

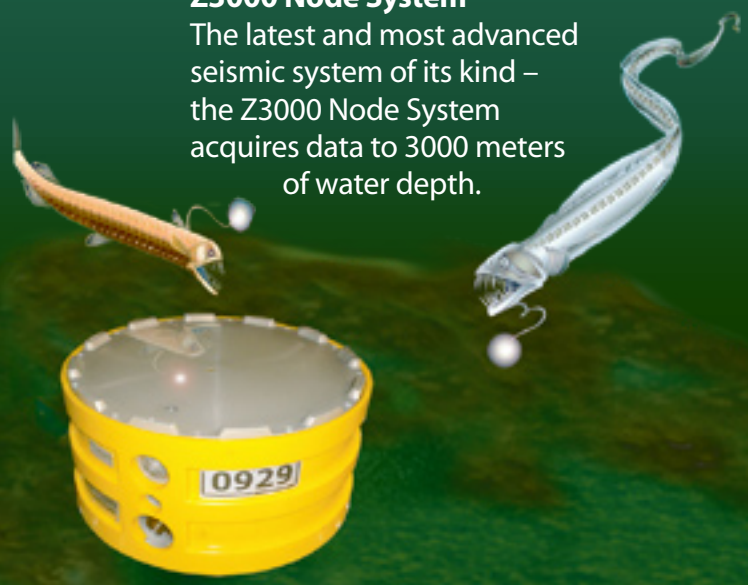
Fairfield's ongoing research and development efforts bring new technologies to the marketplace. For example, Fairfield's new SPICE technology shows critical structural and stratigraphic detail extracted from the seismic wavelet.



Acquisition

Z3000 Node System

The latest and most advanced seismic system of its kind – the Z3000 Node System acquires data to 3000 meters of water depth.



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