

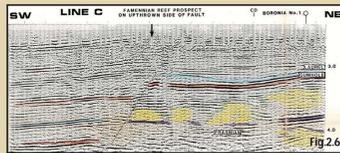
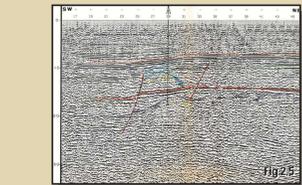
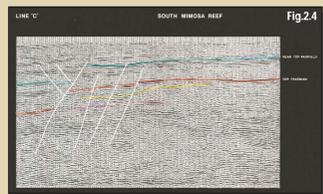
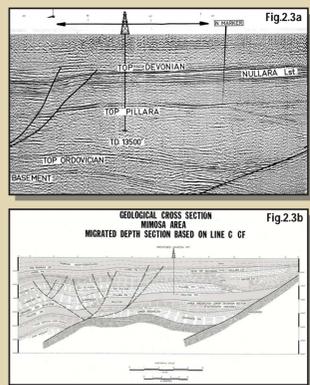
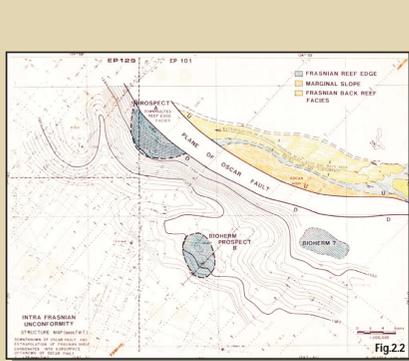
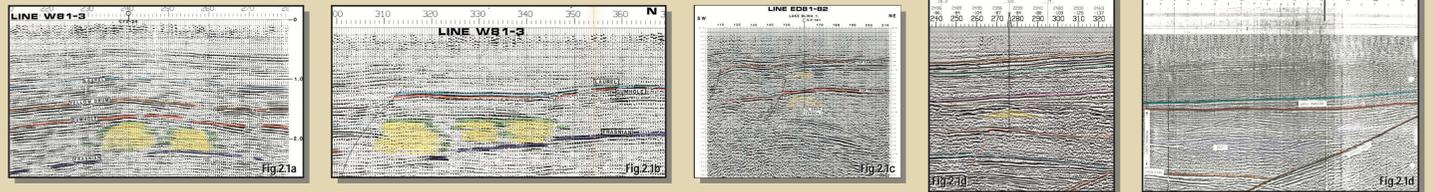
PANEL 2: HOT SPOTS AND THE PERSISTENCE OF BELIEF

A number of themes emerge easily from any reading of the history of exploration for Devonian reefs in the Canning Basin. These include:

- the influence of the outcrop models on the geophysical imaging and imagining of the reef in the subsurface;
- the importance of improvements in seismic acquisition and processing techniques;
- the difficulty of defining reef bodies on seismic in many areas and the many 'shapes' that proved misleading;
- the persistence of belief that certain areas and structures offered the best chance of finding the Devonian reef complex in the subsurface.
- the persistence of belief in certain concepts, regardless of evidence to the contrary; for example: the presence of Devonian reefs on high basement blocks in the Fitzroy trough; and finally,
- the fact that, even when the geophysicists get it right, the Devonian reef play in the Canning Basin remains challenging, with major problems with both reservoir and sourcing – though those issues are not part of this review.

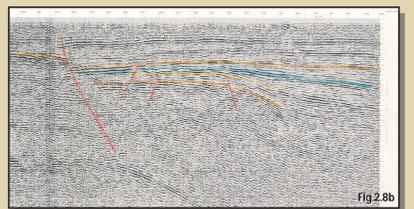
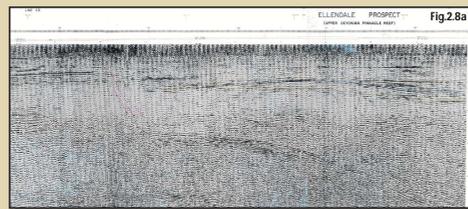
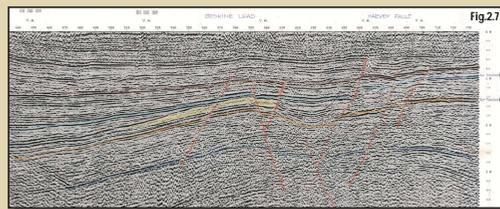
Laurel Downs Embayment

- The Laurel Downs Embayment has seemed to many explorers to be an ideal setting for reef development.
- The persistence of this belief is illustrated on Figure 2.1 above, a geoseismic 'cross section' of that sub-basin constructed from seismic profiles interpreted by different explorers in the IEDC/Whitestone/Amex JV in 1979-1982
- The interpreted lines extend from the Oscar Range Fault in the northeast to the Pinnacle Fault trend in the southwest (Figure 1.3), with their locations shown on Figure 2.2. The lines are relatively close to each other and the same features can be seen on adjacent lines.
- The sections show the remarkable consistency with which different geoscientists have interpreted reefs across the sub-basin, in quite different settings and stratigraphic levels, and often contradictory, one to the other.
- Figure 2.2 show reefs down-faulted in front of the Oscar Fault, Frasnian reefs at different stratigraphic levels and both Frasnian and Fammenian reefing along the Pinnacle Fault trend.



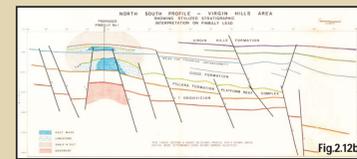
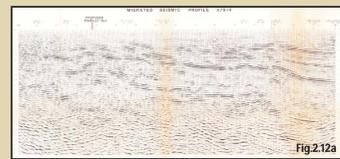
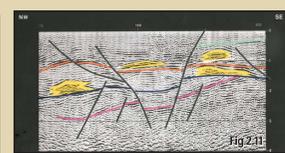
- The leading edge of the tilted Laurel Downs Embayment along the Harvey Fault Zone has been a particularly favoured location with interpreters looking for reefal development.
- WAPET interpreted a major Pillara carbonate platform in the Embayment and drilled the Mimosa-1 well in 1972 to test the faulted crest of that platform, as shown on Figure 2.3. The well encountered a Frasnian basinal sequence with no platform carbonates.
- In the late 1970s, Whitestone interpreted reports of coral debris in the Frasnian shales in Mimosa-1 as evidence of reefing nearby. A 1981 reprocessing of Wapet's Line C showed steep dips within the Frasnian sequence immediately southwest of the Mimosa-1 location and this was interpreted as a Frasnian reef, as shown on Figure 2.4.
- IEDC also interpreted a Frasnian reef at this location. Their 1981 interpretation, on a different version of Line C, showed a similar anomaly to Whitestone, but with an overlying Fammenian reef complex (Figure 2.5).
- IEDC's 1982 interpretation of the reprocessed Line C (of Figure 2.3) shows a different location for the Frasnian reef (Figure 2.6).
- Boronia-1 drilled to test the interpreted Frasnian reef encountered a Frasnian basinal sequence identical to Mimosa-1.

- Whitestone's W. T. (Bud) Stillely proposed a quite different interpretation of the Harvey Fault Zone, suggesting that the fault might have been downthrown-to-the-north during the Devonian, with the widely-accepted down-to-the-south faulting related only to the Permian collapse of the Fitzroy Trough. His interpretation of line W78-4 is shown as Figure 2.7
- Despite this radical re-interpretation, the Harvey Fault Zone was still seen as a major reef trend, with a seismic wedge on pre-Permian palaeo-high block to the south interpreted as a Fammenian reef.
- This Erskine Lead, as Whitestone called it, was along trend with Amex's 1979 Ellendale-1 well, drilled in 1979 on a seismic mound also interpreted as Fammenian reefing, as shown on Amex interpretations on Wapet 1968 data (Figure 2.8a) and Amex 1978 data (Figure 2.8b).
- This mound proved to be a fine-grained Tournaisian carbonate within the Fairfield Group, post-dating the main reef system.

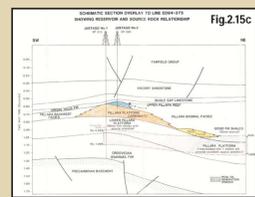
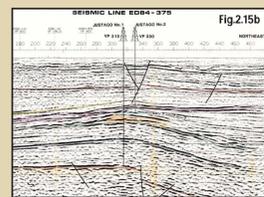
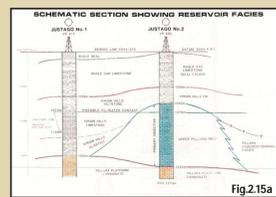
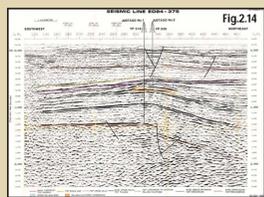
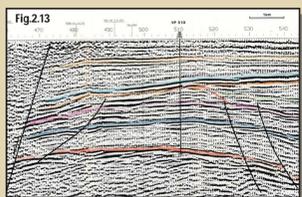


Gogo Block

- The 'Gogo Block' is another area of the basin that attracted exploration focus over several decades. The location is shown on Figure 2.9, reproduced from a Whitestone 1980 slide.
- Wapet recognized this tilted basement block on seismic in the 1960s but were never able to demonstrate closure and the 'prospect' went undrilled. The structure is shown on Figure 2.10, an IEDC-reprocessed version of Wapet's Line B (The 'reef-like' anomaly in the lower section at SP 25-40 proved to be within the Ordovician section)
- In 1978, in new permit EP 102, Whitestone and Amex saw the Gogo block as an ideal location for Frasnian atoll development, being adjacent to, and down-faulted from, the reefs in outcrop.
- Seismic profiles in 1978/9 revealed numerous seismic 'shapes' that were interpreted as potential reefs. An example is shown on Figure 2.11, taken from a Whitestone 1980 presentation to investors.



- The first well drilled on the Gogo Block was farminee IEDC's Grevillea-1 in 1982.
- This had been called the Pinbilly Prospect (after nearby Pinbilly Hills) by Whitestone whose interpretation of Amex line A79-4 is shown on Figure 2.12.
- The well encountered a Fammenian slope facies without any indication of reefing
- Frasnian slope facies overlay a Pillara reef/platform complex, as predicted.
- However, the reef lacked any intergranular or intercrystalline porosity, with the only hydrocarbon shows being in calcite-cemented fractures.
- Reasonable oil shows were recorded in the Frasnian talus slope sequence, but the porosity was low and no oil was recovered on testing.
- Grevillea was the best of the reef anomalies on the Gogo Block, and none of the similar anomalies was drilled



- The Justago reef prospect in the Gogo area is interesting for the changing interpretation seen on successive vintages of seismic data, and the re-interpretation of those profiles after the drilling of Justago-1 by IEDC in 1984/5.
- Figure 2.13 shows the interpretation of a pinnacle reef on line 81-26 while Figure 2.14 shows the interpretation on 1984 vintage data, from the IEDC well proposal. The well encountered clastics and limestones of marginal slope to basinal origin, with no indication of an Upper Pillara reef. The underlying Lower Pillara platform facies was correctly predicted but was not an objective.
- IEDC's post-well re-interpretation of Line 84-375 is shown on Figure 2.15 and illustrated on related cross-sections: a small pinnacle reef is interpreted immediately northeast of Justago-1. This was considered for drilling but ultimately dropped because potential reserves were too small.

- Kufpec's Brooking Reef Prospect on the Gogo Block is a geophysical success story.
- In 1984 Kufpec and JV partners recognized the presence of north-filled 'embayments' between the Pinnacle Fault and the basement outcrops, with their fringing reefs. (Exploration in these embayments, and the spectacular seismic reef anomalies mapped there, is discussed further on Panel 5.)
- Line 84-379 is shown on Figure 2.16, with the reef interpreted by geophysicist Jack Rosser. This must have seemed a courageous interpretation then, after the many failed 'reef' wells of the previous five years, but it was to prove an excellent insight.
- Figure 2.17 shows line 85-465 from the follow-up survey, revealing a very good reef anomaly. The location of the two seismic profiles are shown on Figure 2.18.
- The idealized reef interpretation prognosed for the Oscar Hill-1 well is shown on Figure 2.19
- The well did not encounter a pinnacle reef. An upper unit with fresh-water filled vuggy porosity was a possible reef unit but the rest of the section was a very thick Pillara platform sequence, with no significant porosity. The overlying unit was multicoloured clastics and carbonates of the Virgin Hills fm, not the predicted source/seal Gogo Fm shales.

