SCORPION 2D SEISMIC SURVEY

SEISMIC INTERPRETATION

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1. Introduction

The Scorpion 2D Seismic Survey consisted of 449kms of 2D seismic and was conducted over the lower portion of VIC/P41 and the northern portion of the adjacent permit to the south (Figure 1). The survey was designed primarily to mature the Scorpion Prospect, which had been previously identified straddling the southern permit boundary of VIC/P41 (see Enclosure 1). Because previous permits had also been defined in a way that placed a permit boundary through the prospect, seismic mapping of the prospect had been limited by the inadequate coverage of seismic lines which did not extend far enough beyond the prospect, from the south or the north, to provide a satisfactory migration aperture. The Scorpion 2D Survey provided a relatively dense (half-kilometre spacing) 2D grid, over the whole prospect with sufficient line length in all four directions to ensure fully migrated 2D images of the Scorpion feature were achieved when processing the data.

The programme was also designed to provide in-fill coverage over two smaller leads, Huki and Lamprey, to the north of Scorpion. Additionally, lines were programmed to intersect the Shark-1, Whaleshark-1, Dart-1, and Hammerhead-1 well locations.

2. Data Quality

The quality of the final migrated time sections is very good in the shallow, post-Latrobe Group section. In this section event character is distinctive and event terminations at faults and erosional boundaries are sharp.

In the deeper pre-Latrobe section, while event standout is much better than on earlier seismic vintages, the overall data quality is inferior to that of the shallower section. The deeper section is much more heavily faulted than the shallow section, and event character is poor.

3. Horizon Identification

The Late Cretaceous-Early Tertiary Latrobe Group (see Stratigraphic Table in Figure 2) is the most continuous unit on the seismic sections, being the only unit which is present along the full length of all of the seismic lines. This stratigraphic unit was intersected in each of the wells encompassed by the survey, and so can be reliably identified at these well locations. Seismic reflection horizons from both the top and base of the Latrobe Group are relatively coherent events and can be picked with a fair degree of confidence.

Beneath the Latrobe Group the section is heavily faulted. This, together with more variable lithologies giving rise to many discontinuous reflection events, makes reliable mapping difficult. Over the central portion of the Scorpion Structure, a seismically bland zone is evident immediately beneath the Latrobe Group. An horizon marking the base of this bland zone has been carried over the entire prospect, and has been identified as an Intra Golden Beach horizon. In Shark-1, seismic events near the top and the bottom of the Kipper Shale were identified. However, because of the lack of distinctive seismic character and the lack of continuity to these reflection events, no mapping was carried out at these levels.

Above the Latrobe Group, the Mid-Tertiary Lakes Entrance Formation is present as a southward-thickening wedge north of the Scorpion feature. In the vicinity of the Scorpion Structure, huge submarine erosional episodes have removed the Lakes Entrance Fm. Where this unit is present on the seismic sections, the top of the Lakes Entrance Formation has been picked.

The erosional episodes took place during the deposition of the overlying Late Tertiary Gippsland Limestone. The good quality seismic data in this upper section makes it possible to define a large number of depositional units within the Gippsland Limestone. Generally, these units prograde towards the south. The major erosional events referred to above have removed much of the older Gippsland Lst in the Scorpion area. Younger depositional units have subsequently in-filled the scoured valleys. A number of seismic horizons marking the depositional and erosional boundaries have been carried on the sections. Because of the depositional complexity of this upper section, and the relatively sparse well control, it is not

possible to make specific correlations between the picking horizons and the lithologies observed in the wells.
The reason for picking these shallower horizons was to investigate the influence of these large depositional variations on the conversion of the time data to depth.

4. Structural Interpretation

Time structure maps were drawn at three levels: Top and Base Latrobe Group, and an Intra Golden Beach Formation horizon.

The northern limit of the Golden Beach Formation is the large, east-west trending, down-to-the-south Rosedale Fault (Enclosure 1) immediately north of the Huki and Lamprey Prospects. At Huki and Lamprey the Golden Beach section has suffered some counter-regional rotation, resulting in north dip into the Rosedale Fault. Closure to the south on these two structures is therefore dependent on sealing across the additional down-to-the-south faults which splay off the Rosedale Fault.

Much of the faulting in the vicinity of the Scorpion Prospect is also east-west trending and down-to-the-south, however a series of antithetic, east-west trending, down-to the-north faults is also evident. The main down-to-the-north fault provides the counter-regional closure to the Scorpion Structure within the pre-Latrobe section. At the level of the Intra Golden Beach mapping horizon, this closure covers an area of approximately 20 sq kms.

Much of the tectonic activity had ceased by the time of the Latrobe Group deposition, and this unit was essentially draped over the faulted, and in places, heavily eroded Golden Beach Group. Reactivation has taken place on some of the faults, particularly the Rosedale, its associated splay faults, and the north-bounding fault of the Scorpion Structure. However, the structure mapped at Base Latrobe generally shows uniform south dip (Enclosure 2).

All of the faulting in the survey area failed to extend through the Latrobe section, hence mapped structure at the Top Latrobe level is without faulting in the area of the survey (Enclosure 3). A significant time closure is mapped at Top Latrobe above the deeper Scorpion Structure. This may be a result of drape of the Latrobe section across the older Scorpion high, or it may be induced by anomalous velocity variations in the depositionally complex overlying section.

5. Depth Conversion

Depth structure maps have been drawn over only the Scorpion Prospect. In an attempt to address the effects of the complex layering in the Teriary section, a six-layer model, including the water layer, was used initially to convert the time data to depth. Layer thicknesses were derived using smoothed stacking velocities, and these layers were summed to produce the overall depth to the relevant horizon. It was obvious however that there was excessive variation in the interval velocities derived from the stacking functions. This was the case even when the input functions were limited to just those associated with the dip lines, and even when the functions were further restricted by ignoring those where the values were markedly different from the regional trends. The process was repeated using fewer, thicker layers, but excessive velocity variation was still evident.

Ultimately, a smoothed interval velocity field for the full sedimentary section between the water bottom and each mapping horizon was derived. These velocity fields were then used to compute the depth to the horizon below the sea floor. Depth structure maps (Enclosures 4-6) were derived by adding the thickness of the water layer to the sedimentary thicknesses.

A dip-closed structure has been mapped in depth at Top Latrobe, however it is clear from the seismic sections that the critical north dip exactly underlies the northern flank of the major Tertiary erosional feature. Time sections flattened on the Top Latrobe highlight the horst-like nature of the Golden Beach structure, adding validity to the depth structure mapped at the Intra Golden Beach level. However, these flattened sections also provide a better representation of original Latrobe Gp, Lakes Entrance Fm, and scour channel geometries, suggesting the north dip at Top Latrobe level may be the result of a velocity gradient (not resolved by the stacking functions) associated with the wedge of younger, slower-velocity material in-filling the overlying scoured channel.

6. Attribute Mapping

Amplitude brightening of the Intra Golden Beach horizon is evident on some of the seismic sections over the Scorpion Structure. The nature of this brightening was investigated by analyzing a series of PSTM gathers along various lines across the structure. While these gathers showed the event to be generally one of the highest amplitude events on the gather records, there was no consistent evidence that the amplitude of this event increased with offset.

The areal extent of the amplitude brightening was investigated using the amplitude measurements associated with the mapping horizon within Landmark. These instantaneous amplitudes show a concentration of higher values coincident with the Intra Golden Beach high (Enclosure 7). The amplitudes were also analyzed by computing average and rms values within different time windows spanning the Intra Golden Beach picking horizon. Mapping these amplitude variations indicated similar concentrations of high values in the vicinity of the Scorpion Structure. The distribution of RMS amplitudes over a 36msec window is illustrated in Enclosure 8.

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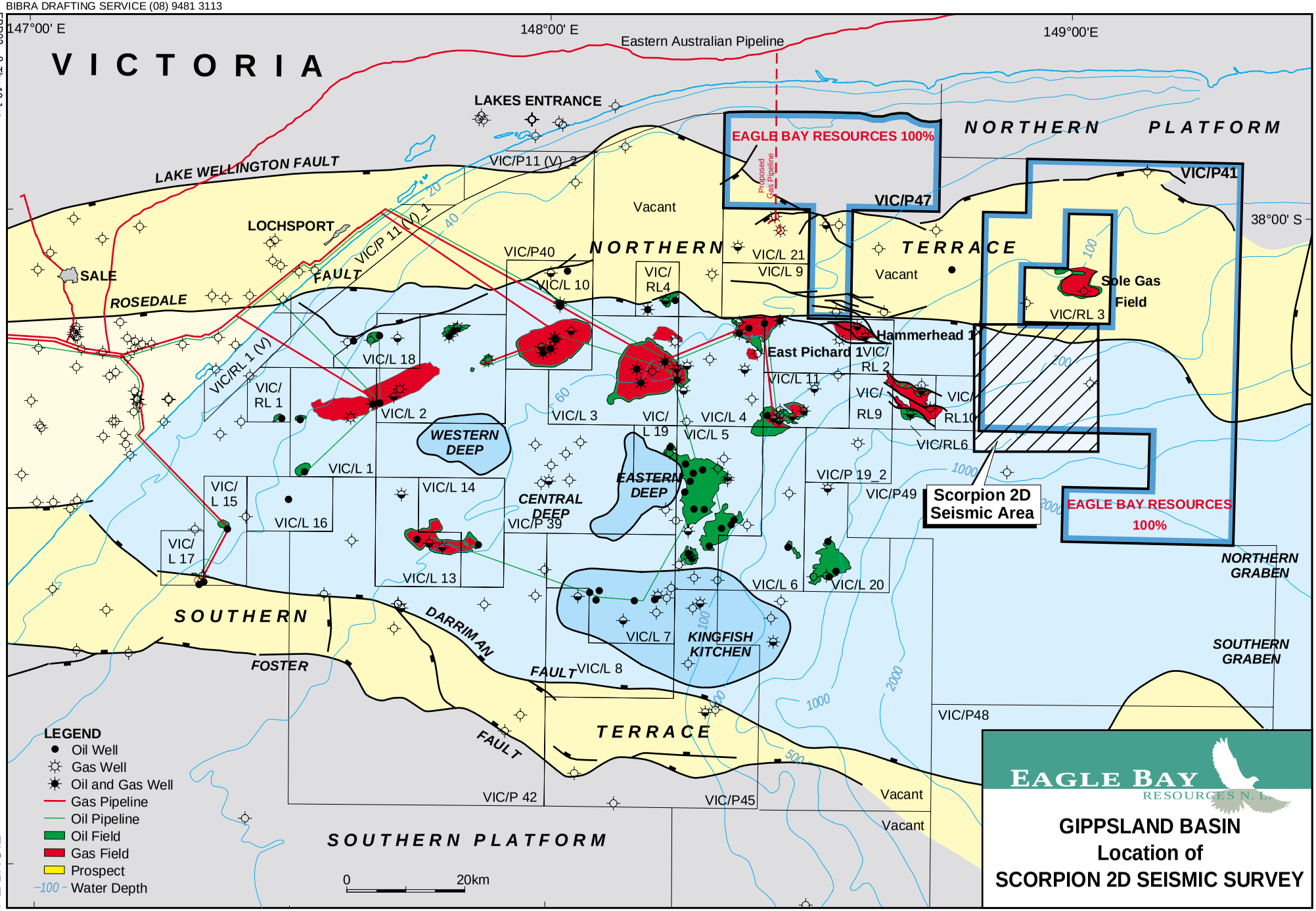
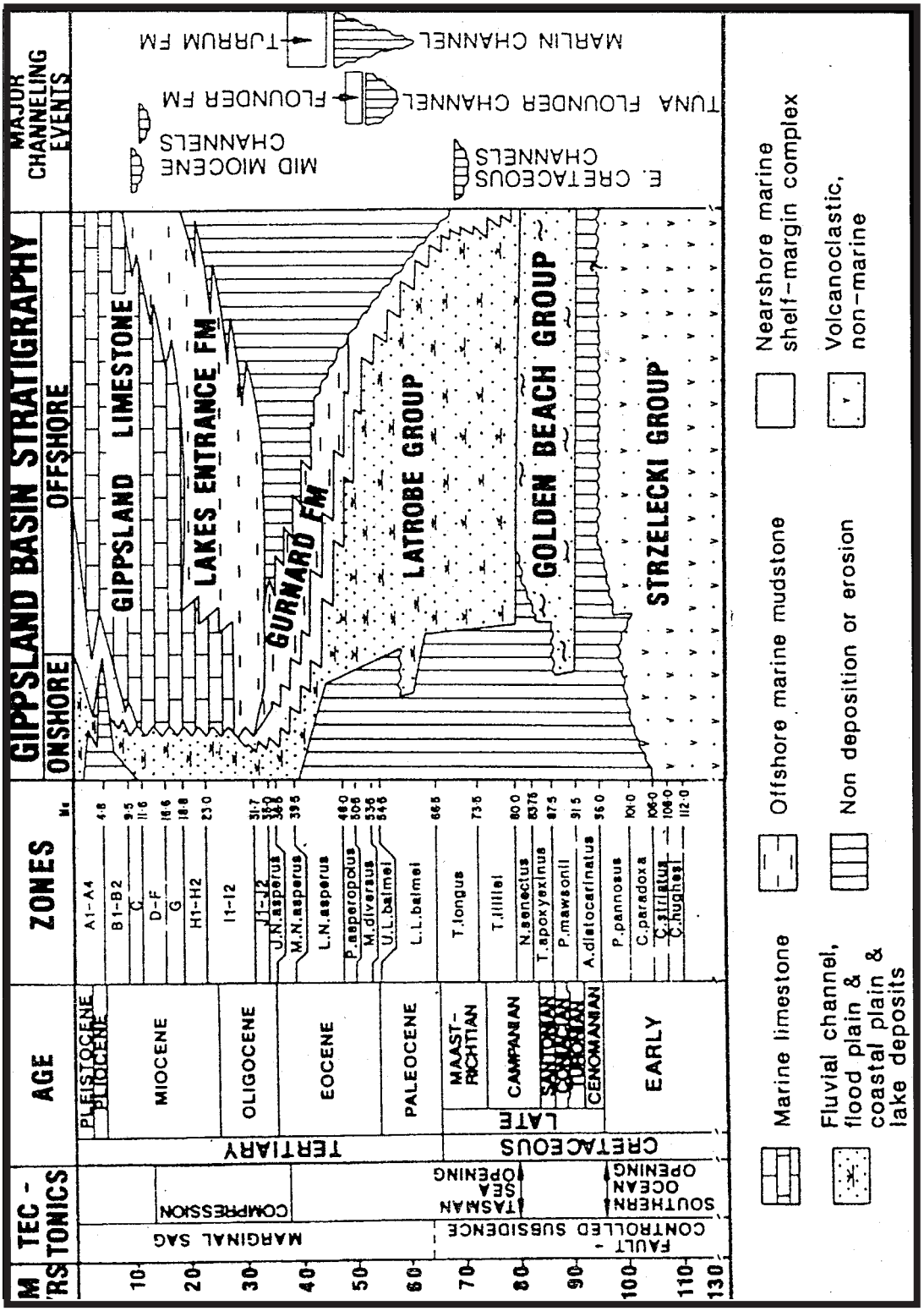


FIGURE 1



Gippsland Basin Stratigraphy and Tectonics (after Rahmanian et al., 1990)

Figure 2