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1986/47. Geology and exploration history of the west Tasmanian continental margin.

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Abstract

The continental margin of western Tasmania consists of the south-eastern sector of the Otway Basin and the northern sector of the Cape Sorell Basin. Development occurred as a result of rifting and continental separation following the break-up of eastern Gondwanaland in the Late Mesozoic.

Previous petroleum exploration is summarised.

INTRODUCTION

The continental margin of western Tasmania is part of a classic continental margin (*sensu* Eldholm and Montadert, 1981; Bally *et al.*, 1981) which formed as a result of the separation of the Australian and Antarctic Plates during the Mesozoic break-up of eastern Gondwanaland. Resultant extensional basins, which include the Otway and Cape Sorell Basins, began to form in Jurassic and Early Cretaceous times, and contain sedimentary infill up to eight kilometres thick extending in age from Late Mesozoic to Recent (Hinz *et al.*, 1986; Willcox *et al.*, 1985).

The distribution of the various structural units to be discussed in this report is shown in Figure 1. Also shown are the location of the five relevant offshore wells: Esso Prawn-A1, Esso Clam-1, Esso Whelk-1, Amoco Cape Sorell-1, and Deep Sea Drilling Project (DSDP) Site 282 (Culp, 1967; Lunt, 1969; Esso, 1968; Amoco, 1982; Kennett *et al.*, 1975). The stratigraphic sequences encountered in Prawn, Clam, Cape Sorell and DSDP-28 are summarised in Figure 2.

SEISMIC SURVEYS

Portions of the west Tasmanian continental margin have been held under permit at various times since the 1960's: T/2P (Magellan); T/8P (Esso); T/10P (Magellan); T/12P (Amoco); T/17P (Van Diemens Land Resources); T/20P (Van Diemens Land Resources). Several seismic surveys have been undertaken by the exploration companies, and include:

- (1) Tasman-Bass Strait Marine Seismic Survey (Magellan, 1969).
- (2) Esso T69A Survey (1969).
- (3) Esso T70A Survey (1970).
- (4) Marine seismic Survey T70C (Esso, 1970).
- (5) EE-68 Marine Seismic and Magnetic Survey (Esso, 1968).
- (6) Amoco 1981 Seismic and Magnetic Survey.
- (7) Marine Seismic Survey OMQ-81 (VDL, 1981).
- (8) Marine Seismic Survey OMQ82A (VDL, 1982).
- (9) Otway/King (Esso, 1964-1974).
- (10) Shell "Petrel" survey (Shell, 1974).

OTWAY BASIN

The main part of the Otway Basin is offshore and onshore in Victoria and South Australia. The southern portion of the basin is in Tasmanian waters west of King Island and trends north-westerly, its south-west margin being the base of the continental rise at about 4.5 km water depth. To the

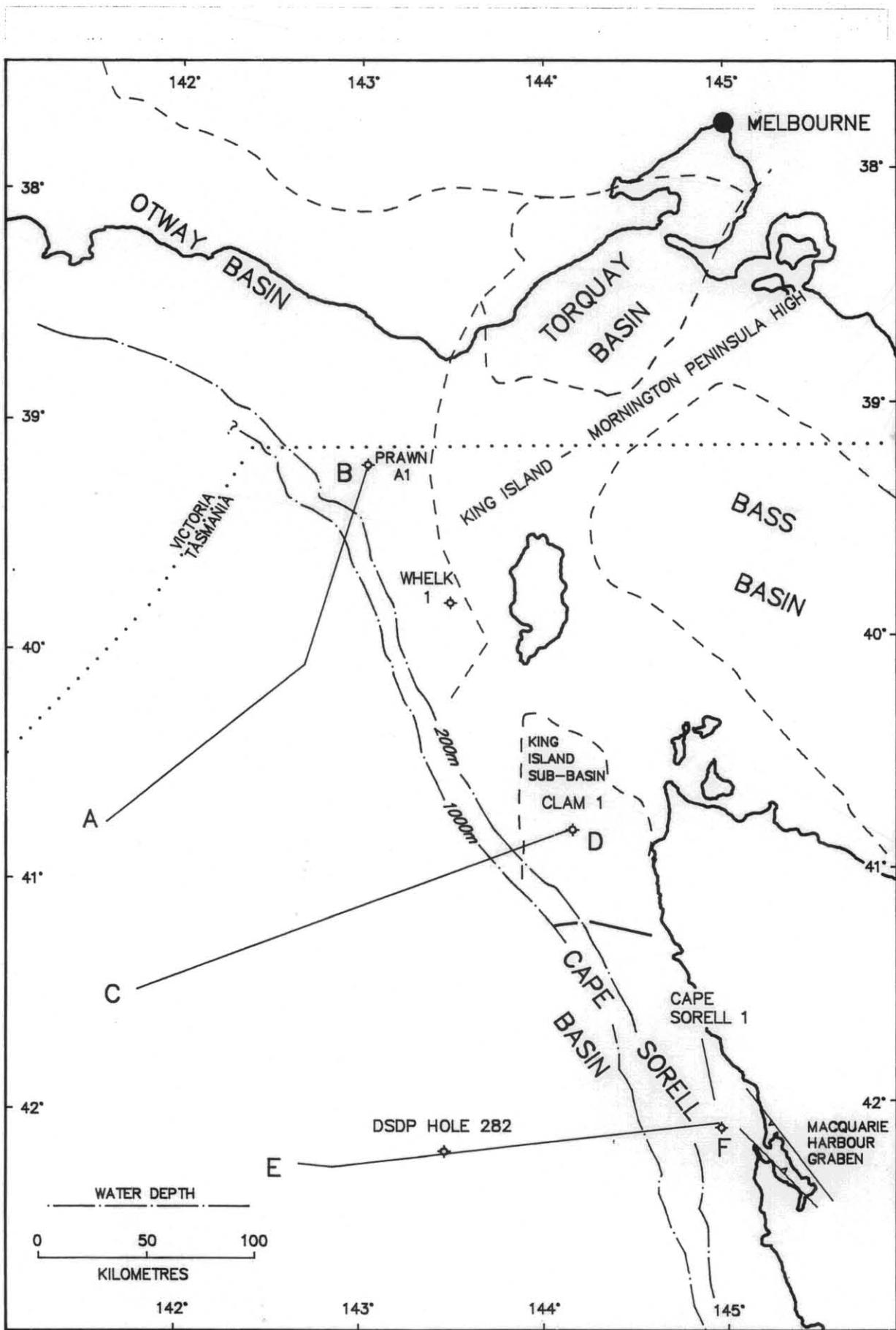


Figure 1. Locality map, showing major structural elements and location of Figure 3 section lines.

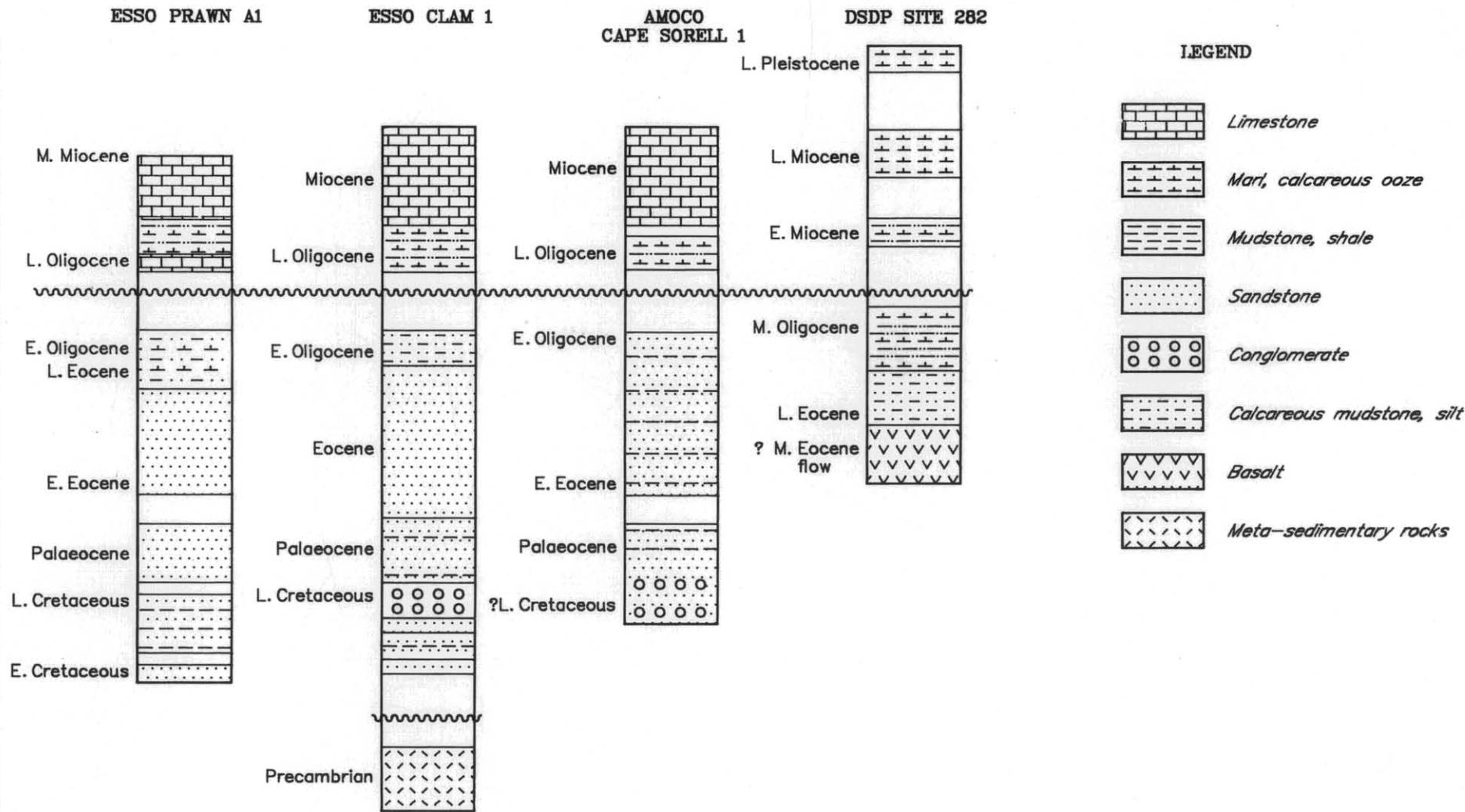


Figure 2. Stratigraphy of Prawn, Clam, Cape Sorell and DSDP wells (after Hinz et al., 1986)

north-east it is separated from the Bass Basin by the King Island - Mornington Peninsula Ridge which was probably uplifted in the Miocene. A summary of the geological development of the basin is given in Exon and Williamson (1985).

The most important Tasmanian well for correlative purposes is the Prawn-A1 well which was drilled by Esso/Hematite in 1968 and penetrated the following sequence (all depths below mean sea level):

<i>Depth (m)</i>	<i>Description</i>
81 - 725	Carbonate sequence: marl, limestone, calcareous sandstone (Miocene - Oligocene Heytesbury Group).
725 - 766	Marl (Late Eocene Nirranda Group).
1238 - 2917	Interbedded sandstone, mudstone, calcareous sandstone and conglomerate (Late Cretaceous Sherbrook Group).
2917 - 3166	Lithic sandstone sequence (Early Cretaceous Otway Group).

Figure 3a is a south-westerly - trending section through the Prawn well and was constructed from BMR seismic line 22/23 utilising stratigraphic control from the well (modified after Hinz *et al.*, 1986).

The major lithologic groupings within the Otway Basin have been related to four main transgressive/regressive cycles (Thompson, 1986), and these have been related to the world-wide sea level changes postulated by Vail *et al.* (1977).

CAPE SORELL BASIN

The Cape Sorell Basin (fig. 1) is separated from the Otway Basin by a ridge of shallow basement which extends in a south-westerly direction from King Island. The northern part of the basin has been termed the King Island Sub-basin (e.g. Culp, 1967). Structural nomenclature for the basin has been confused in the past; the Cape Sorell Basin has previously been referred to as part of the Otway Basin, the Sorell Sub-basin, and the West Tasmania Basin.

Stratigraphic control for the King Island Sub-basin is provided by the Esso Clam-1 well which encountered the following succession (all depths below mean sea level):

<i>Depth (m)</i>	<i>Description</i>
102 - 387	Carbonate sequence: limestone, marl, mudstone (Miocene - Oligocene Heytesbury Group correlate).
387 - 513	Quartz sandstone.
513 - 925	Interbedded sandstone and mudstone sequence with basal conglomerate (Palaeocene - Late Cretaceous Wangerrip Group correlate).
925 - 1462	Sandstone, mudstone with basal ferruginous sequence (Late Cretaceous Sherbrook Group correlate).
1462 - 1592	?Palaeozoic/Late Proterozoic basement.

The "red beds" encountered from 1272-1462 m have previously been regarded as Devonian-?Carboniferous (Lunt, 1969); a correlation made with Victorian rocks because of a lack of known similar rocks in Tasmania. There are, however, similarities between these rocks and the Cretaceous rocks of the

onshore part of the Durroon Sub-basin (Moore *et al.*, 1984), which were unknown at the time Clam was drilled. It seems reasonable, therefore, that the "red beds" are of Cretaceous rather than Devonian age.

Figure 3b is a stratigraphic/seismic section constructed in a west - south-westerly direction from the Clam well.

The Cape Sorell Basin has a shallow onshore extension known as the Macquarie Harbour Graben which contains sedimentary infill having a thickness of approximately 500 m immediately west of Strahan (Baillie and Corbett, 1985). The oldest known sediments exposed onshore are Eocene in age and were deposited in a marginal marine environment (Forsyth, *in* Baillie and Corbett, 1985). An unconformity is present between the Eocene sediments and overlying Plio-Pleistocene sediments.

The Cape Sorell-1 well, drilled by Amoco Australia Petroleum Company in 1982, is located about 13 km north-west of Cape Sorell, and shows a remarkable thickening of the Tertiary sequence as exposed onshore. The following is a log of the sequence penetrated (all depths below mean sea level):

<i>Depth (m)</i>	<i>Description</i>
94 - 412	Carbonate sequence: limestone, sandstone, mudstone, minor dolomite (Miocene - Oligocene Heytesbury Group correlate).
412 - 1759	Dominantly sandstone, minor mudstone, limestone (Middle - Early Eocene).
1759 - 3528	Interbedded sandstone, siltstone, conglomerate, with minor coal and tuff (Palaeocene - ?Late Cretaceous).

The thick Eocene section contains glauconite, dinoflagellates, and foraminifera, suggesting that the depositional environment was marine. Rare arenaceous forams are also present in parts of the Palaeocene section (Amoco, 1982).

DSDP Hole 282 was drilled in the Magnetic Quiet Zone west of Tasmania in 4202 m of water, and penetrated 192 m of Pleistocene to Oligocene ooze which was underlain by 103 m of Late Eocene organic-rich silty clay to clayey silt. The sediments were deposited upon fine-grained pillow basalt (Kennett *et al.*, 1975). Figure 3c is a seismic stratigraphic section constructed along an approximate line between Cape Sorell-1 and DSDP-282.

PETROLEUM OCCURRENCES

Hydrocarbons in commercial quantities have not yet been discovered in either the Tasmanian part of the offshore Otway Basin or the Cape Sorell Basin. Only four hydrocarbon exploration wells have been drilled in the region and only one of these, Cape Sorell-1, recorded minor oil shows (Amoco, 1982). The hydrocarbon potential of the west Tasmania margin is discussed by Hinz *et al.* (1986), who conclude that mature source rocks may be present beneath the continental margin and that areas of thick section and potential traps are present.

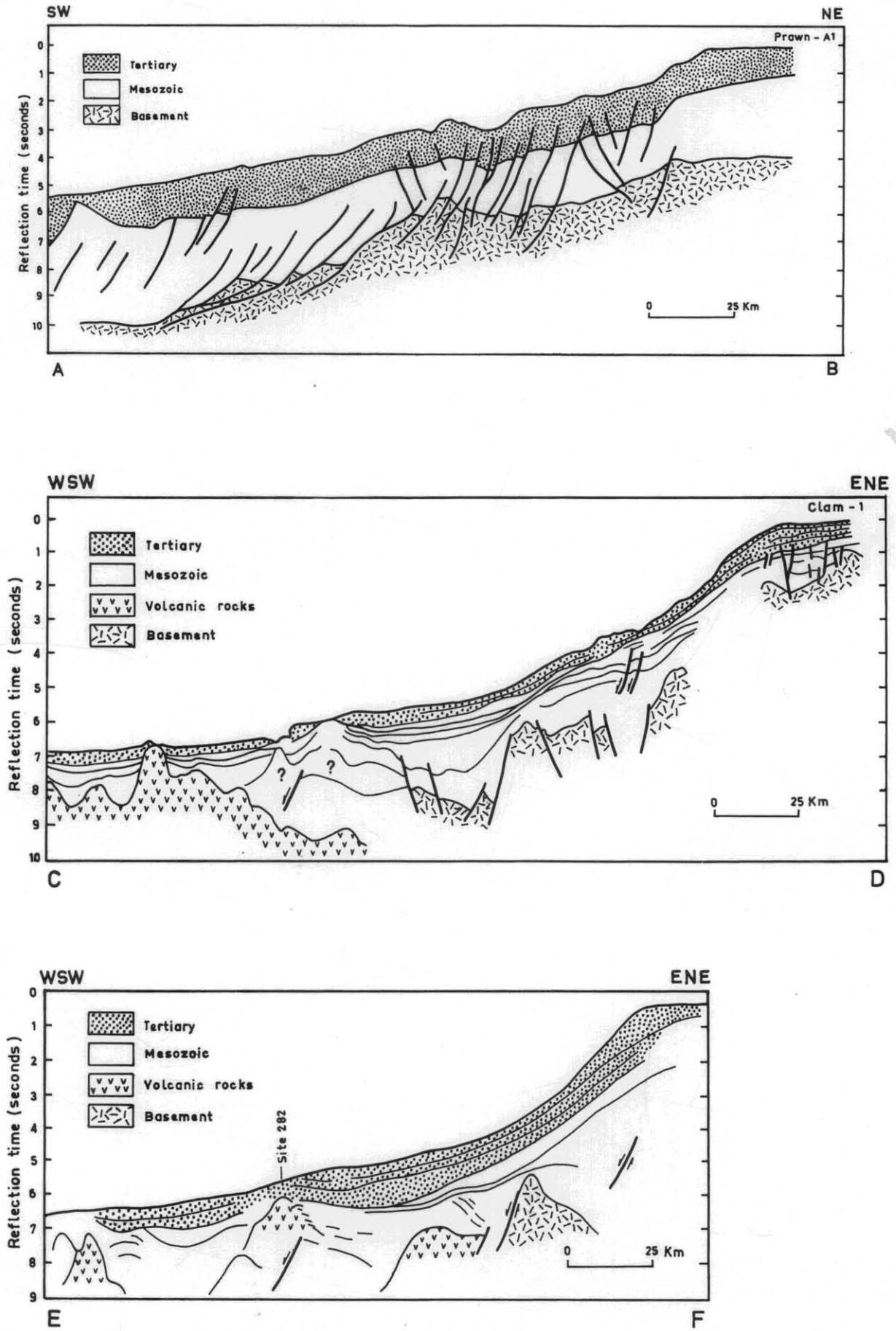


Figure 3. Sections across the west Tasmanian continental margin (modified after Hinz et al., 1986). For location of Section lines refer to Figure 1.

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