DEPARTMENT OF MINES AND ENERGY

GEOLOGICAL SURVEY

SOUTH AUSTRALIA

REPORT BOOK 92/20

OFFSHORE EXTENSION OF THE EDEN-BURNSIDE FAULT

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Offshore Extension of the Eden-Burnside Fault

A P BELPERIO

The offshore extension of the Eden-Burnside fault has been mapped from shallow-penetration seismic reflection profiles. Between Hallett Cove and Port Noarlunga, the fault parallels the coastline 2 km offshore. The fault separates a coastal platform of thin, deformed Tertiary strata from a much thicker, undeformed sequence of Quaternary and Tertiary strata deposited within the St Vincent Basin.

Seismic profiles demonstrate an absence of topographic irregularities or surficial stratal displacement over the fault zone. This indicates that surficial dislocation as a result of fault activity has not occurred for at least the past 30,000 years.

INTRODUCTION

The Eden-Burnside fault zone is a prominent structure separating the Mt Lofty Ranges from a subsiding graben, the St Vincent Basin, in which over 500m of Cainozoic sediment has accumulated. Tertiary and Quaternary strata are thin to non-existent on the horst block, but thicken dramatically across the structure. For example, Quaternary sediments thicken from a few metres to 70m between Kingston Park and Seacliff. Displacement of Tertiary strata across the fault at this location indicates long-term relative subsidence of 0.01 - 0.04 mm/yr.

Shallow-penetration, high-resolution seismic profiling undertaken by SADME in 1989 has allowed the offshore extension of the fault to be accurately mapped. With subsurface penetration of up to 50m, and a reflector resolution of 0.5m, the seismic profiles also allow confident assessment of any recent near-surface movements to be made from displacement of reflectors. The seismic profiles were undertaken in February 1989 using an ORE Geopulse boomer and EPC 1600 analogue recorder. Survey details and subsurface interpretations of the records are presented in Belperio et al. (1990a,b).

OFFSHORE EXTENSION OF THE FAULT ZONE

The onshore location of the Eden and Burnside faults are well constrained from geological, drillhole, gravity and morphological evidence (Fig. 1). The fault zone occurs parallel to, and just north of, the prominent escarpment separating the Mt Lofty Ranges from the thick and essentially undeformed Cainozoic sequence within the St. Vincent Basin. Offshore, no such prominent escarpment exists, and there has hitherto been a dearth of information on the continuation of the structure. Previous geological interpretations have mostly assumed the fault continued directly offshore from Kingston Park (e.g. Forbes, 1983).

The seismic profiles confirm that no contemporary morphological expression of the fault exists on the sea floor, which is largely smooth and of consistent gradient (Fig. 2). Transect 5, which was specifically undertaken to cross the assumed offshore extension of the fault, reveals uniformly-flat Quaternary reflectors. Closer to Port Stanvac, however, a major change in subsurface structure is evident at the seaward ends of each of seismic profiles 6A-6E. A shallow shore-parallel platform of well-bedded but tilted and dislocated strata is evident on each of these profiles. Drilling at the Port Stanvac jetty (Webb, 1962) revealed that Tertiary and Permian strata overlying Proterozoic bedrock are present beneath a thin (< 7m) Quaternary veneer. The distinctively-bedded Tertiary strata can be traced in the seismic profiles and correlated with outcropping coastal "reefs" near Port Noarlunga. At the seaward end of traverses 6A-6E is developed a much thicker, flat-lying Quaternary sequence (confirmed by recent drilling by Coffey Partners). The termination of the coastal platform of dipping Tertiary strata, as a hinge zone or buried escarpment onto which the Quaternary strata either onlap or abut, is interpreted as the near-surface expression of the Eden-Burnside fault. In a situation analogous to that on land, the fault separates a thin, deformed Tertiary sequence with minimal Quaternary cover on the horst block from the thicker, flat-lying accumulation of Tertiary and Quaternary sediments in the graben. The same "termination of rocky basement" was recognised by Hails et al. (1982) in earlier high resolution seismic records taken in this area. Their records are used to further constrain the location of the fault between Port Noarlunga and Kingston Park (Fig. 1). Sprigg and Stackler (1963) also inferred the existence of a major "coastal fault" at this location from gravity profiles across the Gulf, but assumed it to be a continuation of the Para Fault south from Glenelg.

Within the limitations provided by the shallow penetration of the seismic profiles, a coast-parallel, high-angle normal or reverse fault is indicated (Fig. 3). A number of minor, landward-directed thrusts can be interpreted within the deformed Tertiary platform. These may represent reactivation and reversal of former synthetic faults under mild compression. The location of the main fault can be traced from traverse to traverse in a coast-parallel direction (Fig. 1). The "coastal fault" is assumed to continue into southern Gulf St Vincent where deep penetration seismic data indicate a high-angle reverse fault separating major tectonic provinces (Belperio and Flint, 1992).

FAULT MOVEMENT INFERRED FROM STRATIGRAPHIC DISPLACEMENT

Each of seismic profiles 6A-6E shows surficial strata continuous across the fault and clearly unaffected by any fault displacement. The age of these strata is critical to evaluating the recent history of fault movement. Drilling undertaken at the Port Stanvac jetty site (Webb, 1962) intersected a surficial veneer (7m) of Holocene and late Pleistocene marine strata, including calcrete layers, over the Tertiary platform. This surficial layer is clearly visible on seismic lines 6A-6E. Recent drilling undertaken by Coffey Partners for an offshore mooring facility at the seaward end of seismic lines 6B and 6C, intersected over 30m of late Pleistocene coastal and marine sediments. Cemented fossiliferous calcarenites at 7m and 14m below the sea floor can be correlated with prominent reflectors in these seismic records. The much thicker development of Pleistocene marine sediments at the mooring facility (-23m water depth) resulted from repeated marine transgressions that inundated the deeper parts of the gulf but did not reach present sea level (e.g. Table 1). The uppermost 7m thick package of Holocene and late Pleistocene reflectors can be traced without disruption along the seismic sections. Further surficial coring by Coffey Partners across the position of the fault confirms that pedogenically-altered late Pleistocene marine sediments are present beneath a thin (<0.7m) Holocene marine veneer. Clearly, late Pleistocene marine strata with a minimum age of 30,000 yrs BP, have not been affected or displaced by fault movement. This is consistent with onshore evidence that indicates a lack of displacement of late Pleistocene and Holocene alluvial sediments across the Para, Eden and Burnside faults, rather these blanket the inferred fault positions.

DISCUSSION AND CONCLUSIONS

The Eden-Burnside fault in Gulf St Vincent has been located from shallow-penetration seismic profiles. The fault parallels the coastline, 2km offshore, between Hallett Cove and Port Noarlunga. An absence of topographic features on the sea floor indicates a lack of any significant recent displacement along the fault. In addition, strata with a minimum age of 30,000 yr BP are not affected or displaced by fault movement (within the resolution provided by the seismic records of 0.5m), indicating no surficial vertical displacement for at least this length of time. These conclusions are in general accord with our knowledge of the Eden-Burnside fault on land, where no evidence of surficial displacement of Holocene and late Pleistocene strata is known.

Table 1. Holocene and late Pleistocene marine transgressions in the South Australian Gulfs (after Cann et al 1988)

Nominal Age	Maximum Elevation
7 kyr BP	Present sea level
30-40 kyr BP	-22 to -28 m
60 kyr BP	no data
80 kyr BP	-14m
100 kyr BP	- 8m
120 kyr BP	+ 2m

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FIGURE CAPTIONS

Fig. 1 Location plan showing onshore geology after Forbes (1983), marine seismic traverses and the offshore extension of the Eden-Burnside fault.

Fig. 2 Selected sections of seismic profiles 6A, 6B, 6C, and 6E.

Fig. 3 Interpreted seismic profiles 6A, 6B, 6C, 6D and 6E.

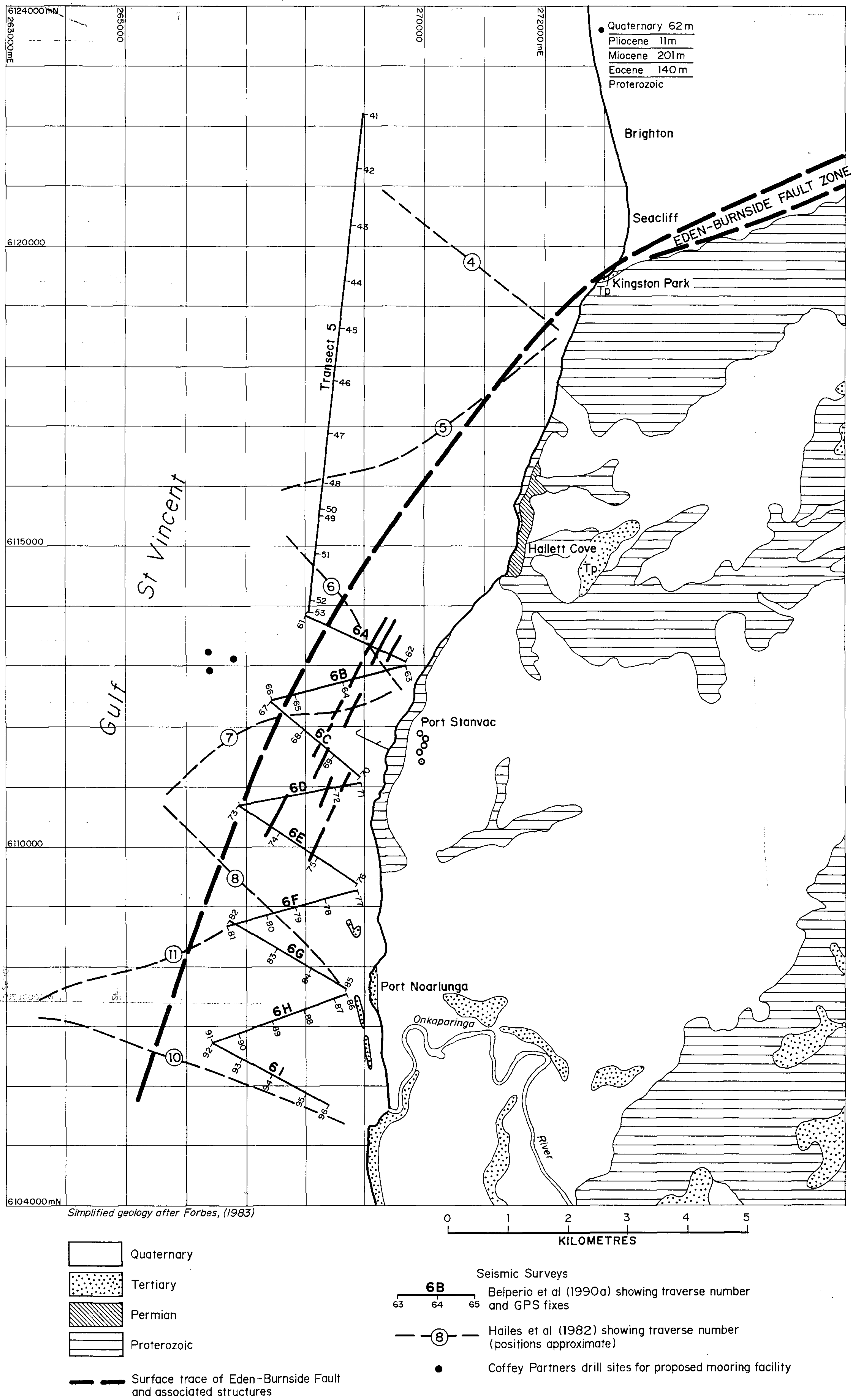

Figure 1 Location plan showing onshore geology after Forbes (1983), marine seismic traverses and the offshore extension of the Eden-Burnside Fault.

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Figure 2 Selected sections of seismic profiles 6A, 6B, 6C, and 6E.

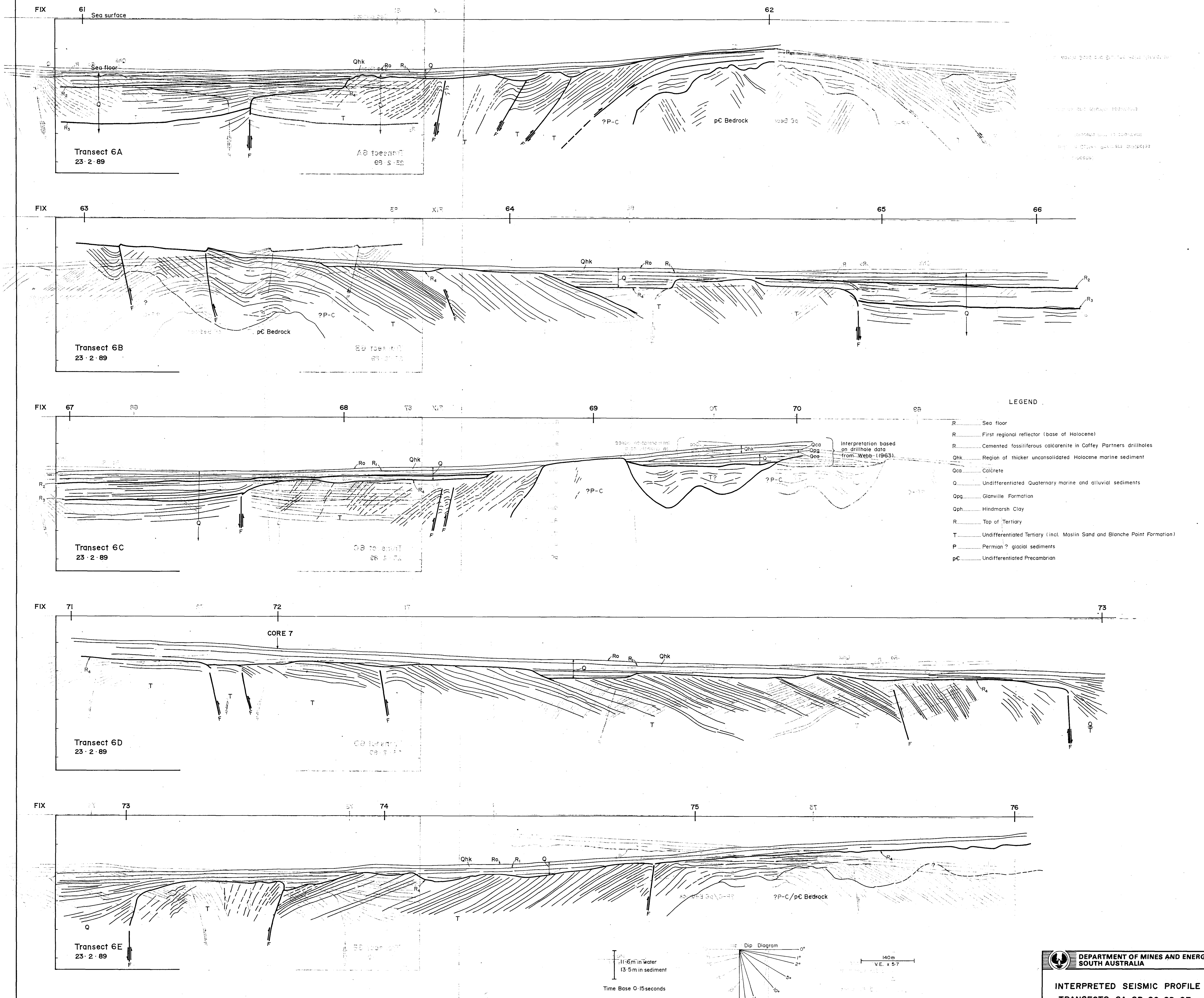

Fig. 3

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INTERPRETED SEISMIC PROFILE
TRANSECTS 6A, 6B, 6C, 6D, 6E

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