DEPARTMENT OF
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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1975/32

SEISMIC REFLECTION PROFILES ACROSS THE TIMOR TROUGH.

LETTER TO NATURE

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The Timor Trough exists as an obvious bathymetric division separating Timor from the broad continental shelf off northern Australia. It has been proposed by Fitch[1], Warris[2], and others that the Trough is also the locus of a fundamental crustal plate boundary, now perhaps inactive. Audley-Charles et al.[3] consider that the plate boundary lies to the north of Timor but that the Trough downwarped as a result of collision of the Australian continent with a subduction zone at that boundary.

During October 1972 the Bureau of Mineral Resources surveyed lines across the Trough (Fig. 1) as part of the Continental Margin Survey of Australia, recording continuous seismic, gravity, and magnetic values. Positions were determined by interpolation of continuous sonar Doppler readings between satellite fixes, taken on average at two-hourly intervals. A 120-kilojoule sparker provided the seismic energy and six channels of seismic data were recorded in analogue form. No processing of the seismic data has yet been done so a single-channel recording was used for interpretation.

The bathymetry (Fig. 1) shows the trough to be an arcuate feature of fairly uniform width and a depth varying from about 2.4 km to a low of 3.2 km just east of Timor. Sections across the Trough as revealed by seismic reflections (Figs 2, 3) indicate that the bathymetric and seismic character of the Trough vary little along its length, but there is significant variation across its axis.

The bathymetry comprises three parts - the southern flank, the base, and the northern flank. The southern flank is characterized by a smooth convex slope dropping from the shelf to the base of the Trough where it reaches a maximum dip of about five degrees. There are some relatively sharp changes in slope which may be fault-controlled. The largest of these, on Line 18/035, is marked by a change in slope to ten degrees and may indicate a fault with downthrow to the north of about one kilometre. Sections along the tie-line running parallel to the Trough along its lower southern flank also show shallow channels 50-100 metres deep and about one kilometre wide, running down the dip of the flank. The base of the trough is flat and usually between five and ten kilometres in width, although in places much narrower. The northern flank rises more steeply than the southern, having a slope of up to ten degrees in many places. It reaches a narrow plateau of rugged and irregular topography more than a kilometre above the base of the Trough.

Sub-bottom stratigraphy may be divided as clearly into the same three parts. Up to 1.5 seconds of seismic reflections are recorded on the southern flank before multiples obscure the records. The seismic horizons on this flank show conformable bedding lying parallel to the sea bottom with little disturbance apart from signs of possible downfaulting on the lower slopes. These sequences continue their dip beneath the base of the Trough and can be followed to its northern edge where they appear to end. They may continue dipping undisturbed to greater depth, but masked by the rising northern flank.

At the base of the trough a lens of horizontally bedded sediments lying unconformably on these dipping sequences attains a maximum thickness of about 400 metres at the foot of the northern flank. Here there is also evidence on some seismic sections of features which may represent intrusion or simply heavy folding. They generally show some surface expression. Deep Sea Drilling Project hole No. DSDP 262 drilled in the base of the trough at its western end (Fig. 1), penetrated 414 metres of Pleistocene and Pliocene planktonic ooze overlying Upper Pliocene dolomitic mud and calcarenite, formed in shallow water[4]. From the seismic section along line 18/019 it seems that the horizontally bedded lens of sediments consists of planktonic ooze of deep water origin while the underlying dipping sequences are those sediments which have been laid down in a shallow marine environment. The salt content of the interstitial water in the recovered sediments was found to increase with depth to a maximum of 53 parts per thousand. This was thought to indicate the presence of a salt body somewhere beneath the calcarenite[4], which may explain the origin of intrusive features at the base of the trough.

The character of the seismic sections across the northern flank of the trough differs considerably from that to the south. Seismic horizons are apparent only to 0.5 seconds reflection time (500 m) beneath the rugged sea bottom, and they show considerable distortion of the sediments. The deepest of these reflections can scarcely represent the top of a crystalline basement since the magnetic field over the area is quite smooth. It seems more likely that the lack of discernible deeper seismic horizons is due to the highly disturbed nature of the rocks forming the northern flank of the trough. These rocks are probably sedimentary and may well be the same Bobonaro scaly clays which are found in a south-dipping formation along the south coast of Timor[5].

Three things are apparent from this evidence. First, the gently downwarped and downfaulted but otherwise undisturbed nature of the sediments on the southern flank of the Trough indicates that they are under tension. Second, the highly contorted nature of the sediments to the north suggests the action of compressive stress or slumping. Finally it is clear from the DSDP drill hole results that the Trough downwarped to its present depth during Pliocene-Pleistocene time.

The origin of the Trough is not clear, but the theory that it represents the surface expression of a northward dipping subduction zone[1,2] can not be discounted on this seismic evidence. The disturbed nature of the rocks to the north of the Trough and the fact that they appear to overlie to some extent the downward dipping beds of the southern flank may be due to overthrusting from the north but may also be caused by gravity sliding of the scaly clays, perhaps as a result of the uplifting of Timor since the Miocene[6]. If the distortion of the Pliocene oozes at the base of the trough is the result of folding, and not intrusion, however, either or both of these processes have continued since the downwarp.

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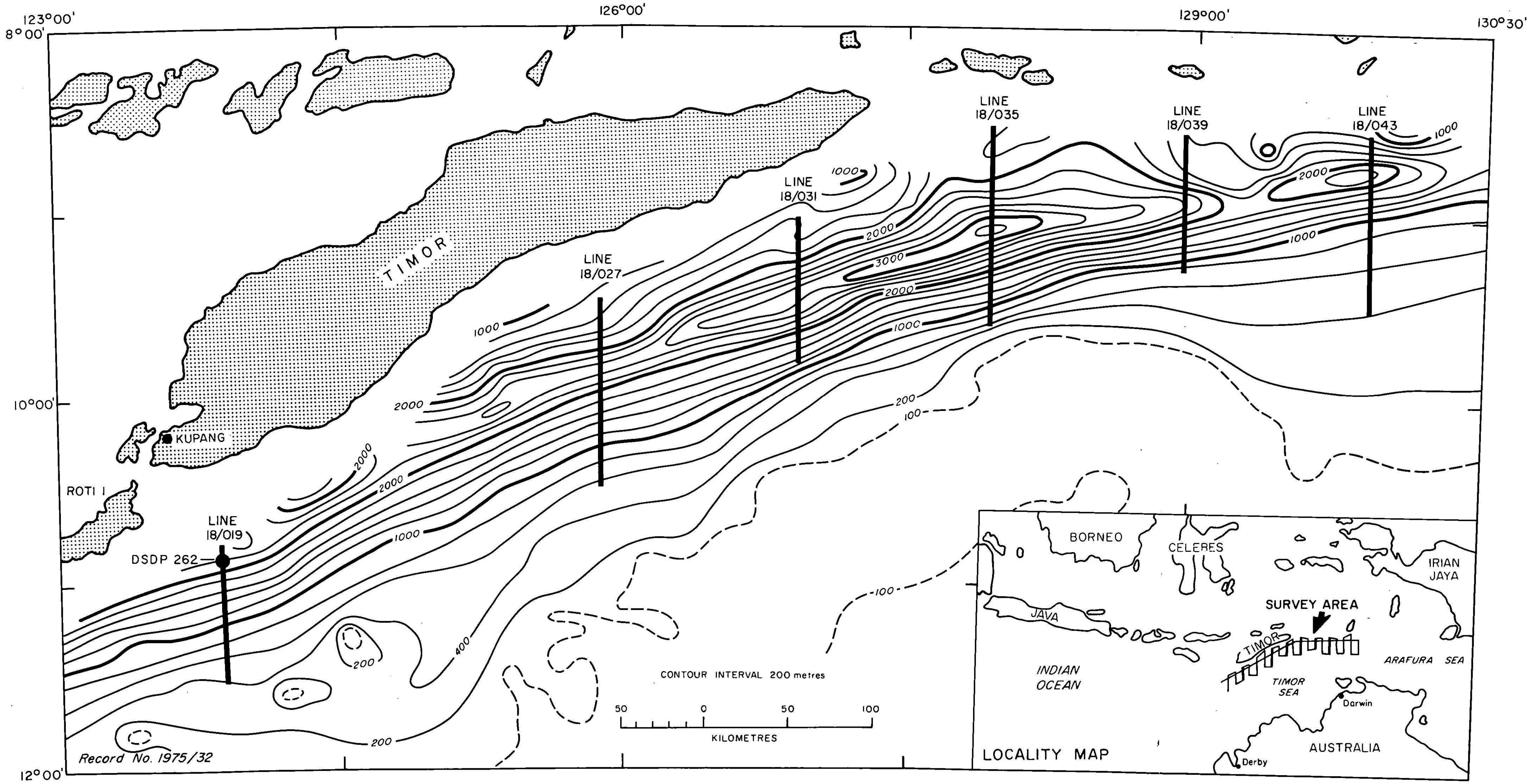

FIG. 1 BATHYMETRIC MAP OF TIMOR TROUGH

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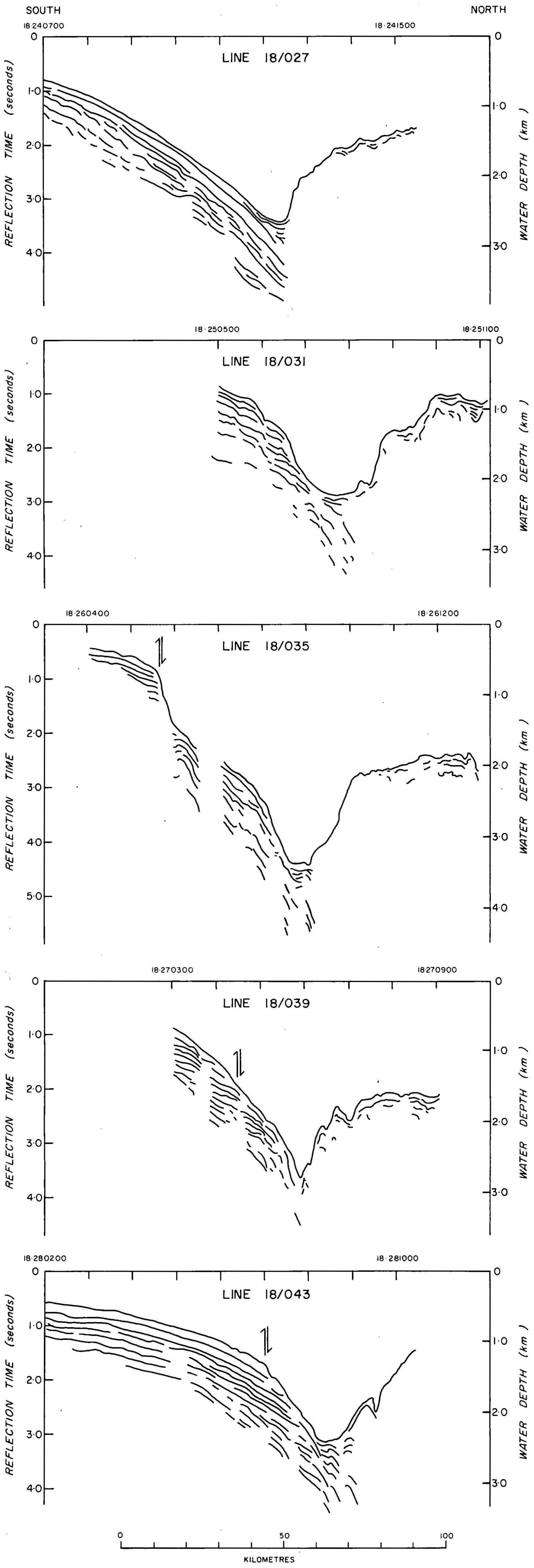

FIG. 2 FIVE SEISMIC SECTIONS ACROSS TIMOR TROUGH

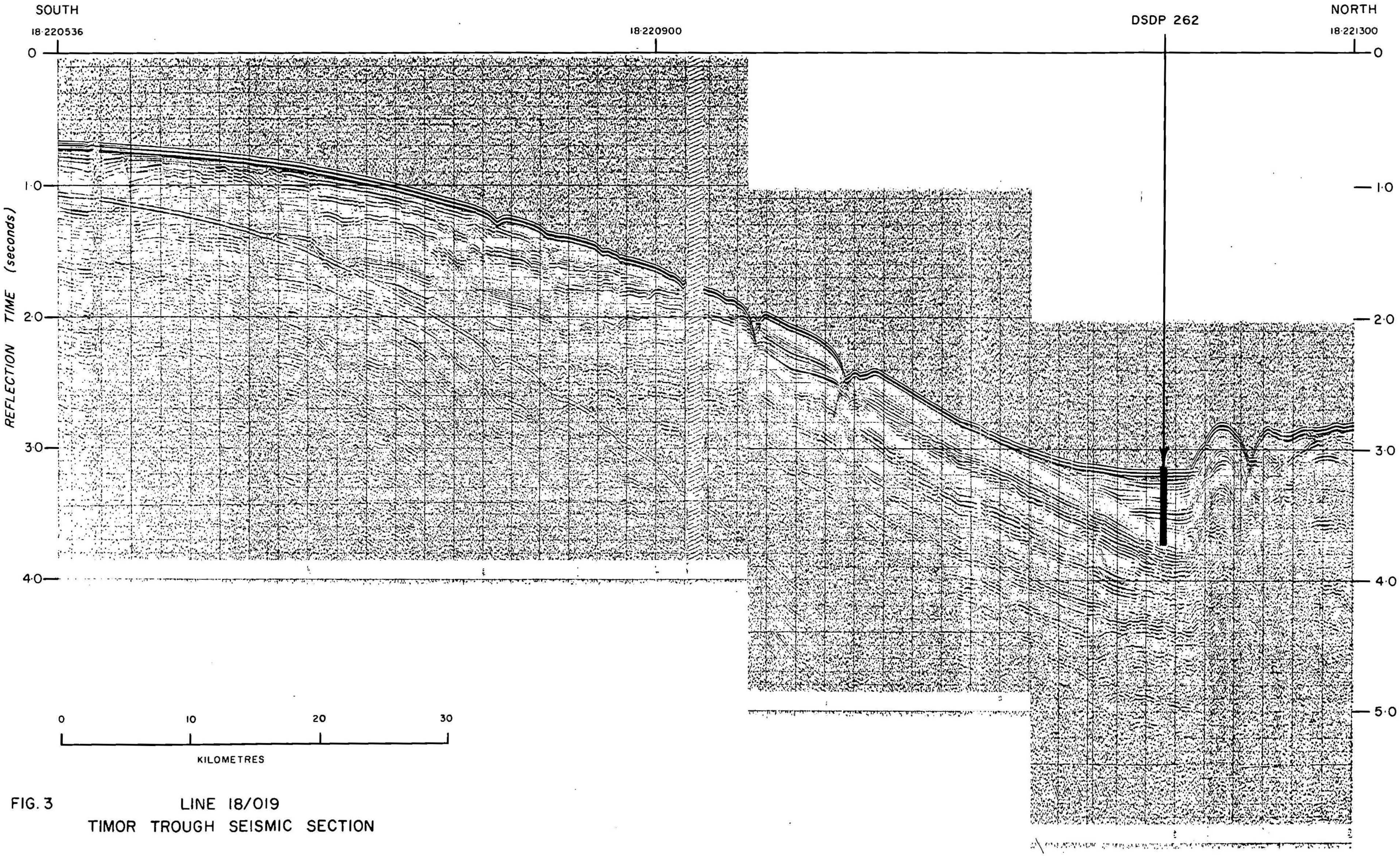

FIG. 3 LINE 18/019

TIMOR TROUGH SEISMIC SECTION