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INTERPRETATION OF D'ENTRECASTEAUX ZONE (NORTH OF NEW CALEDONIA)

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INTRODUCTION

The Eastern part of Indo-Australian plate, between Australia and the active subduction zones : Tonga-Kermadec, New Hebrides and South Solomon, spreads along two or three thousand kilometers. South of the latitude 18° structures are more than two thousand kilometer long and quite well ordered : Lord Howe Rise, New Caledonia basin, Norfolk ridge, Norfolk basin, Three Kings ridge. North of the latitude 18° structural trends often change and structures are less extensive : Rennell ridge and trough, (RECY et al, 1975), South Rennell trough (LARUE et al, 1975), Louisiade Rise and the basin wrongly called New Hebrides basin. The boundary between these two areas is generally known as d'Entrecasteaux fracture zone, but this feature has never been clearly defined.

So, after NOVA expedition (MENARD, 1969) this fracture zone appeared to be an important feature in the South-West Pacific extending from the New Hebrides trench to the Coral Sea basin (Fig. 1). Nevertheless, it was not precisely mapped out on the first edition of the Bathymetric Chart of South Pacific (CHASE et al, 1968) and removed from the next editions. Afterwards, the same name d'Entrecasteaux was given to a smaller fracture setting in the West of Espiritu Santo island (LUYENDYK et al, 1974). This feature has been too interpreted as a fossil island arc (LAPOUILLE and DUGAS, 1975).

During the GEORSTOM I and II cruises carried out by ORSTOM, aboard N.O. " LE NOROIT " and "CORIOLIS", some bathymetric, magnetic and continuous reflection profiles were obtained across these proposed fracture zones (Fig. 2). On the new bathymetric chart drawn from the SCRIPPS chart, three main structural features can be seen (Fig.3) :

- the d'Entrecasteaux fracture zone (I,II,III)
- the triangular area limited by two fractures (IV et V)
- The d'Entrecasteaux fault (VI).

D'ENTRECASTEAUX FRACTURE ZONE

On the profile 102 located West of the New Caledonia ridge, we can observe the NOROIT seamounts whose summits are located 18°37' S, 161°01' E and 18°01' S, 160°42' E (see Fig. 4). They draw the boundary between the New Caledonia basin which is approximately 3300 m deep with a sediment thickness higher than 2 seconds t.w.t. and a basin, sometimes called the New Hebrides basin, whose depth is about 4200 m and thickness of sediments, shown on our records of 1 s.t.w.t.

On the profile 201 parallel with the previous one, the discontinuity is less evident but corresponds to rising of the basement.

East and North of the New Caledonia ridge (see II, Fig. 3), the same direction WNW-ESE can be obtained, in the morphology when

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aligning together the shift of the bathymetric contours West of d'Entrecasteaux reefs, the raising of the basement on the profile 109, the New Caledonia ridge northern extremity and the irregularities observed across profiles 215 and 217.

Going on North-East we observe an accident in the morphology shown by the profiles 207 and 208 (see III, Fig. 3), whose direction is the same as the previous ones.

All these en-echelon features give the d'Entrecasteaux fracture zone which is thus in agreement with that defined after the NOVA survey, however without proving that it spreads out to the Coral Sea basin.

WEST SANTO - WEST MALEKULA ZONE

Between the latitudes 15° and 16°, we find, west of Espiritu Santo and Malekula islands, a triangular zone with a depth lower than 3500 m while the average depth of the area is about 4500 m. This zone is limited by two accidents (see IV and V, Fig. 3) shown on the profiles 104, 207 and 206 (see Fig. 5). The accident IV, named by us West Malekula, corresponds to an offset of the isobaths and of this island West Coast and is marked by an uneven topography on the profiles 206 and 207. The second accident (V) is characterized by a serie of fractures shown by the profiles 104, 206 and 207 and by volcanic peaks which can be seen untill the profile 105.

D'ENTRECASTEAUX FAULT

This fault, directed North 20° East (see VI, Fig. 3) is crossed by four of our profiles (214, 212, 109 and 204, see Fig. 6). It affects a sedimentary basin and raises the layers in the North West area with an upthrow of about 1500 m. The fault is underlined by peaks whose magnetic characteristics are not constant, some of them giving high anomalies, and others no characteristical anomalies.

The basin axis, defined by the points of maximum sediment thickness is located in the North West fault block in a parallel direction with the fault. At this level, we can recognize 3 sedimentary units :

- the upper unit, not very thick, in disconformity with the underlying unit ; it can be seen neatly only on the profile 204.

- the unit 2 which constitutes the main part of the basin filling ; it dips toward North West and lies in disconformity with the unit 3 ; its thickness, which may reach 2 s.t.w.t., decreases swiftly toward North West.

- the unit 3 with an unknown thickness ; it dips toward South East into the basin and turns to be subhorizontal North West.

INTERPRETATION

The thickness and the disposition of the sedimentary layers of the d'Entrecasteaux basin lead us to emphasize an interpretation which would yield to reconstitute the structure and the history of the whole studied area.

The unit 1, subhorizontal, was probably deposited in its present position. The case is different for the units 2 and 3, highly affected by the fault which had acted between the unit 2 and the unit 1 deposits. If we take the North West fault block back to its assumed first position (as to bring the unit 2 layers back to the horizontal plane, in the prolongation of the South East layers), the dipping of the unit 3 layers would look then deeply marked toward South East. The unit 3 upper part then outlines a trench with a depth reaching 6000 m at least. The parallelism of the unit 2 layers which have filled up this trench leaves out the filling up, before the faulting, to have occured in a subsident basin. So great a depth for such a narrow basin and its way of filling suggest a similitude with the oceanic trenches (SCHOLL 1974) ; however the lack of seismicity (LOUAT, 1975), implies that structure to be presently inactive. But it is difficult to associate that trench to a fossil subduction zone, provided the isolation and the not very large dimension of the South East massifs which would then be the island arc.

The morphology looks rather like the connection zone between an island arc and a transform fault, where the motion evolves progressively from a subduction to a strike slip motion. A present sample of such a zone, we can name a "transition zone", is given by the southern extremity of the New Hebrides subduction zone and its connection which the Hunter Fracture Zone. We can observe, in this Hunter Zone, that the trench associated with the subduction stretches along to the very transform fault while the islands arc disappears more quickly and is no longer marked just by a small chain close to the inner side of the trench.

In the d'Entrecasteaux "transition zone" the disappearing toward North East of the trench, shown across the profiles 204, 109, 212 and 214 may be a similar evolution, the fossil transform fault (West Santo) being marked across the profiles 105, 206, 207 and 104, by a serie of peaks.

That structure, involving the d'Entrecasteaux transition zone and the West Santo transform fault, would represent the extension of the New Caledonia - Loyalty islands subduction zone whose existence has been assumed by several authors (GEZE 1963, DUBOIS 1971, DUBOIS et al 1974, LAPOUILLE and DUGAS 1975) to be upper Eocene in age (the peridotite settling by obduction being the latest phase).

During the subduction phase, or after its end, the trench had been acting as a collector toward the unit 2 sediments.

Later on, different deformations affected that structure : horizontal deformations along the preexisting fracture zones (d'Entrecasteaux, West Malekula) linked with the formation of oceanic zones on both sides of our transition zone, and vertical deformations (d'Entrecasteaux fault) which could be due to readjustments linked with the subduction end.

CONCLUSION

The survey of the d'Entrecasteaux zone has allowed to bring into evidence the remains of the "transition zone" and the transform fault which prolongated, at the Eocene age, the New Caledonia - Loyalty islands subduction zone. The transition zone was marked by a trench whose remains are presently the d'Entrecasteaux basin. Farther to the East, the West Santo transform fault which prolongs it, shown up by volcanic peaks, stretches to the New Hebrides trench which is the present boundary between the Indo-Australian and Pacific plates.

Thence the d'Entrecasteaux zone may be defined as a fossil structure which seems to have acted the same way as the Hunter Fracture Zone, which connects the New Hebrides and the Tonga subduction zones, is presently acting. The reconstruction of the West Santo transform fault eastern end is not easily made because of, on one hand, the present activity of the New Hebrides subduction zone and, on the other hand, because of the formation of the North Fiji Plateau. At most, we can observe (PASCAL and ISACKS, personnal communication), in the presently dipping lithosphere of the New Hebrides subduction zone, a high seismicity line in the prolongation of the West Santo transform fault. This seismic line could determine the perennality of a lithospheric weaker zone as a result of the ancient active transform fault.

South of the studied area, the linking with the New Caledonia - Loyalty subduction zone is getting more complex by the d'Entrecasteaux fracture zone.

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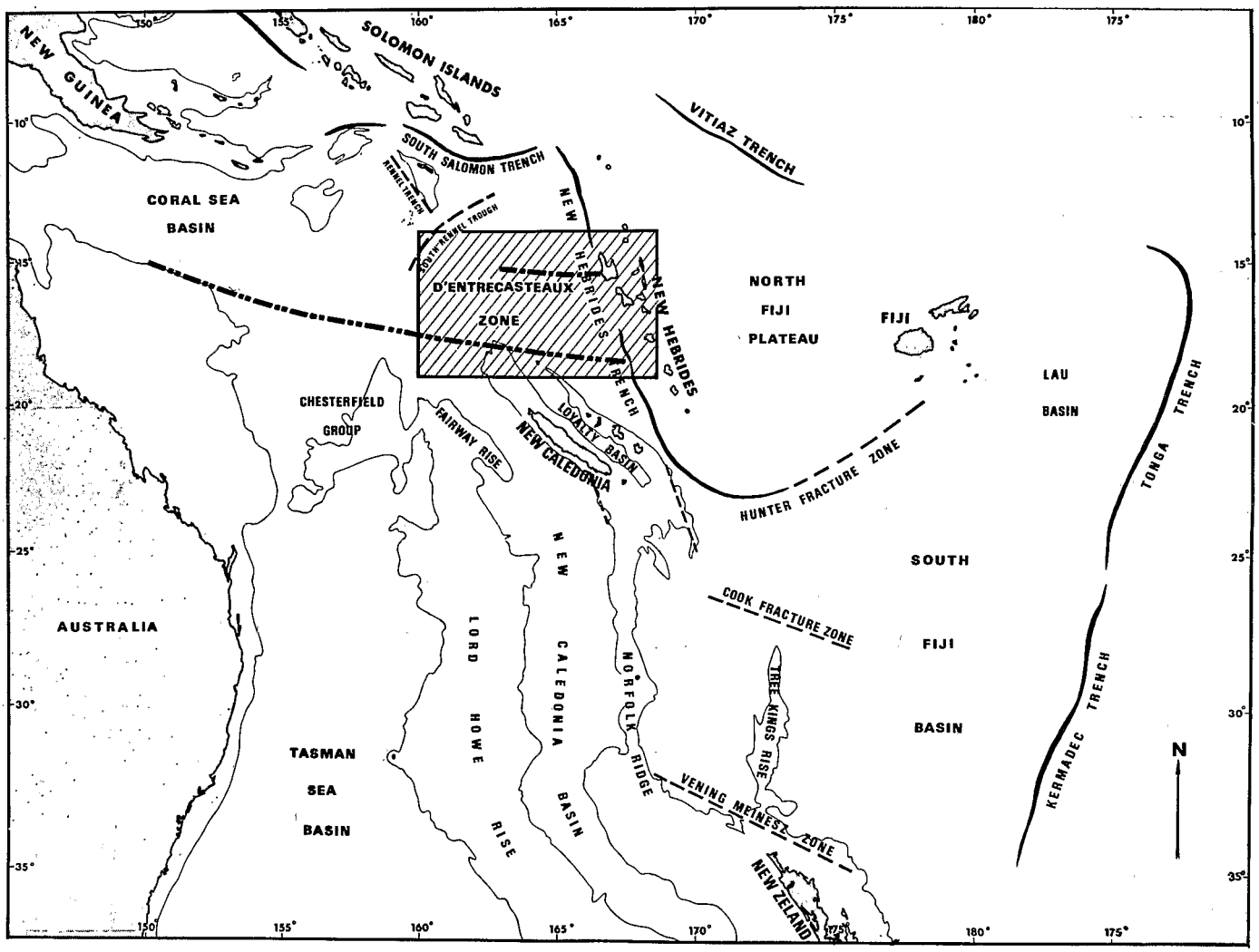


Fig. 1 - Location map of the studied area in the Southwest Pacific.

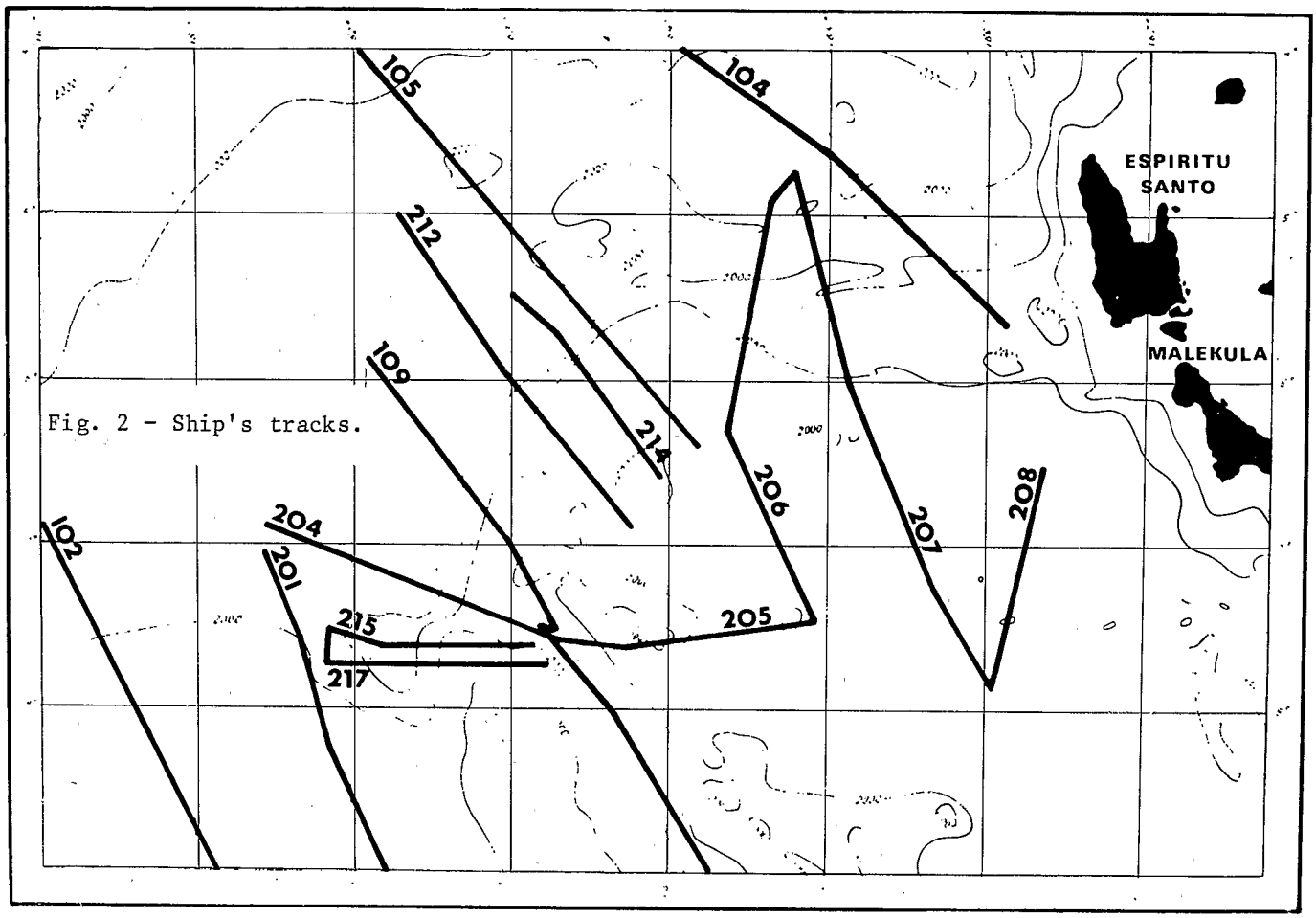


Fig. 2 - Ship's tracks.

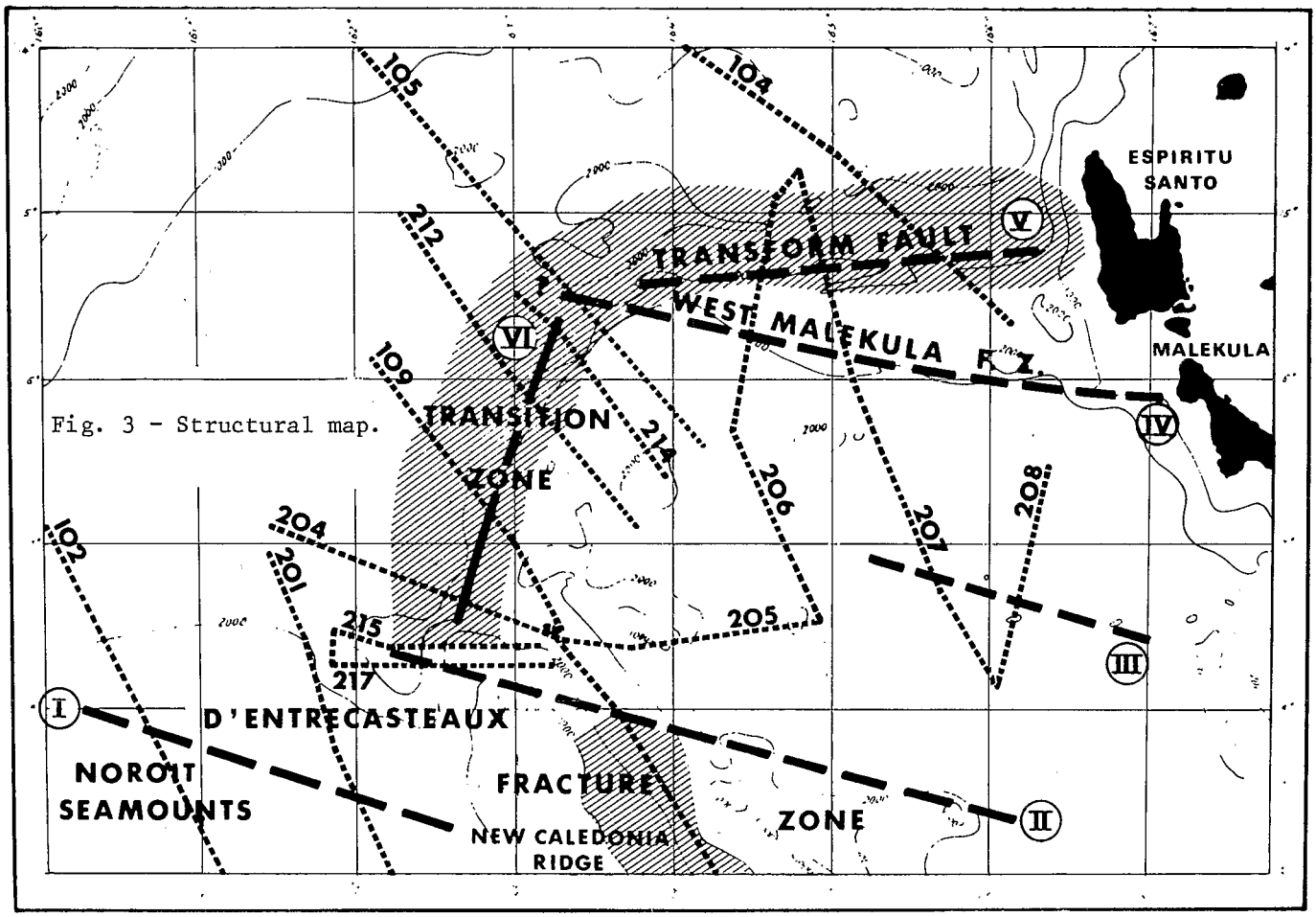


Fig. 3 - Structural map.

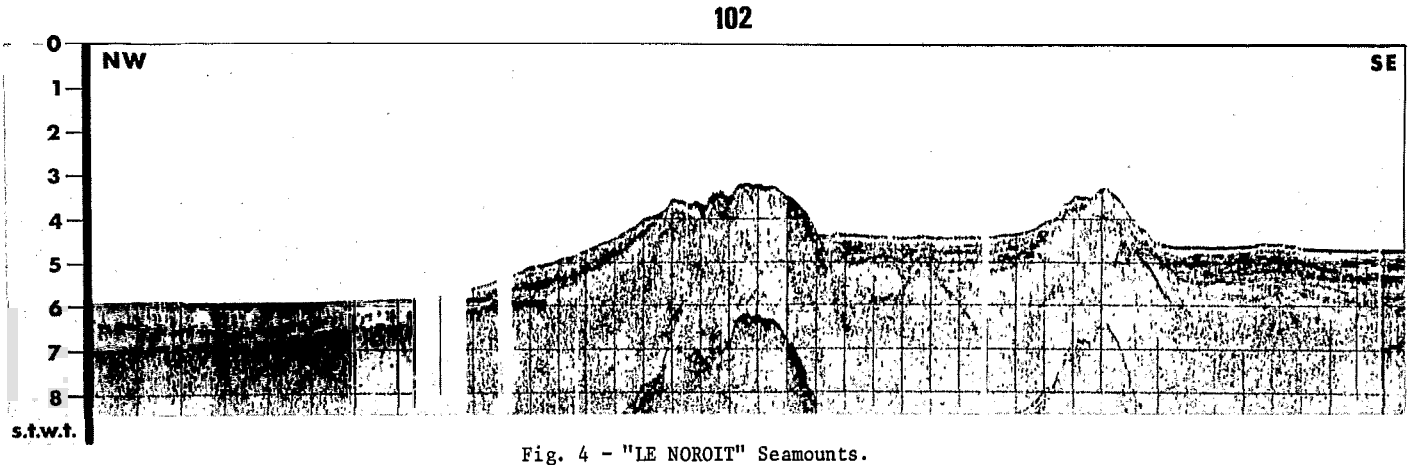


Fig. 4 - "LE NOROIT" Seamounts.

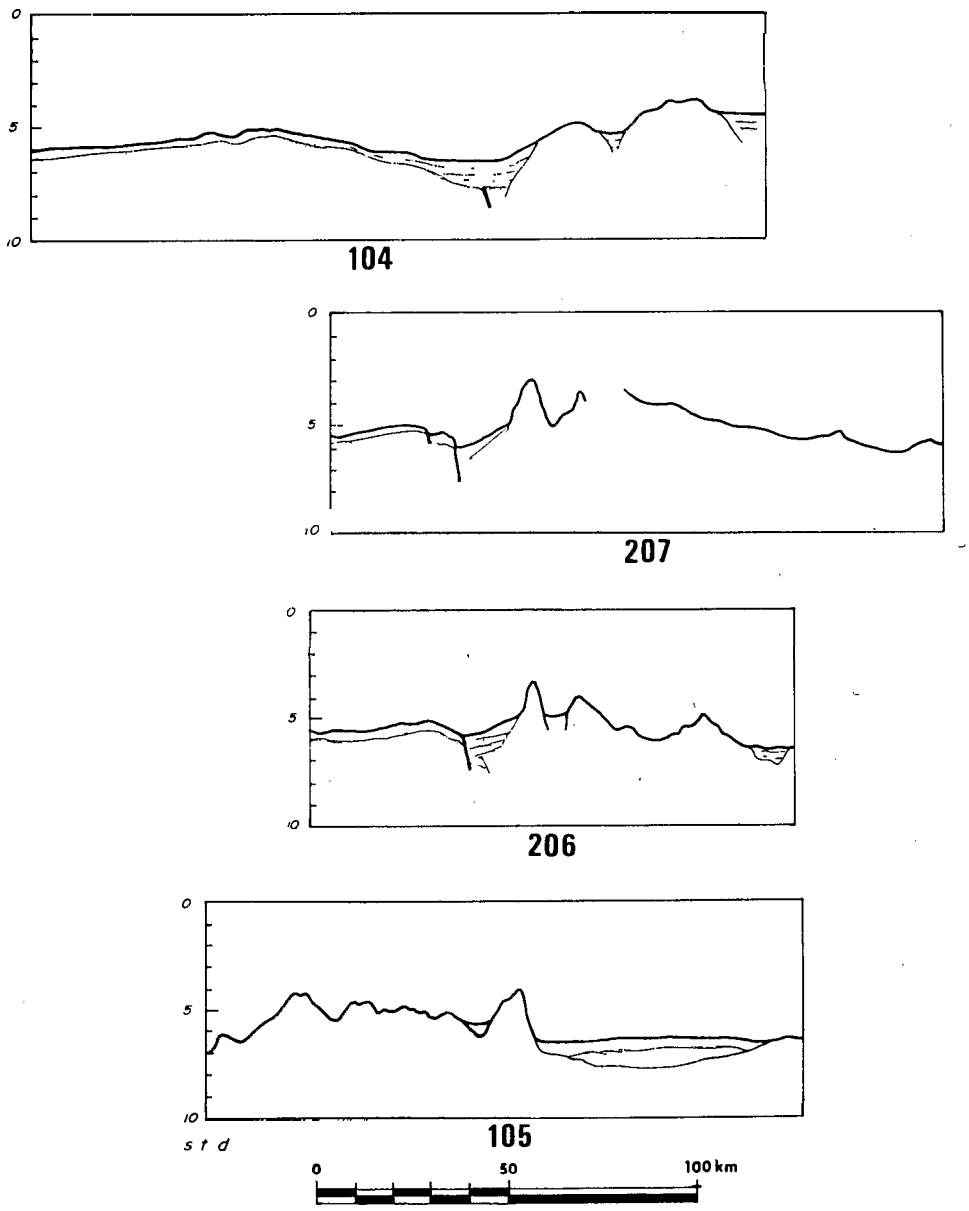


Fig. 5 - PROFILES 104, 207, 206, 105 across the west-Santo Fracture Zone.

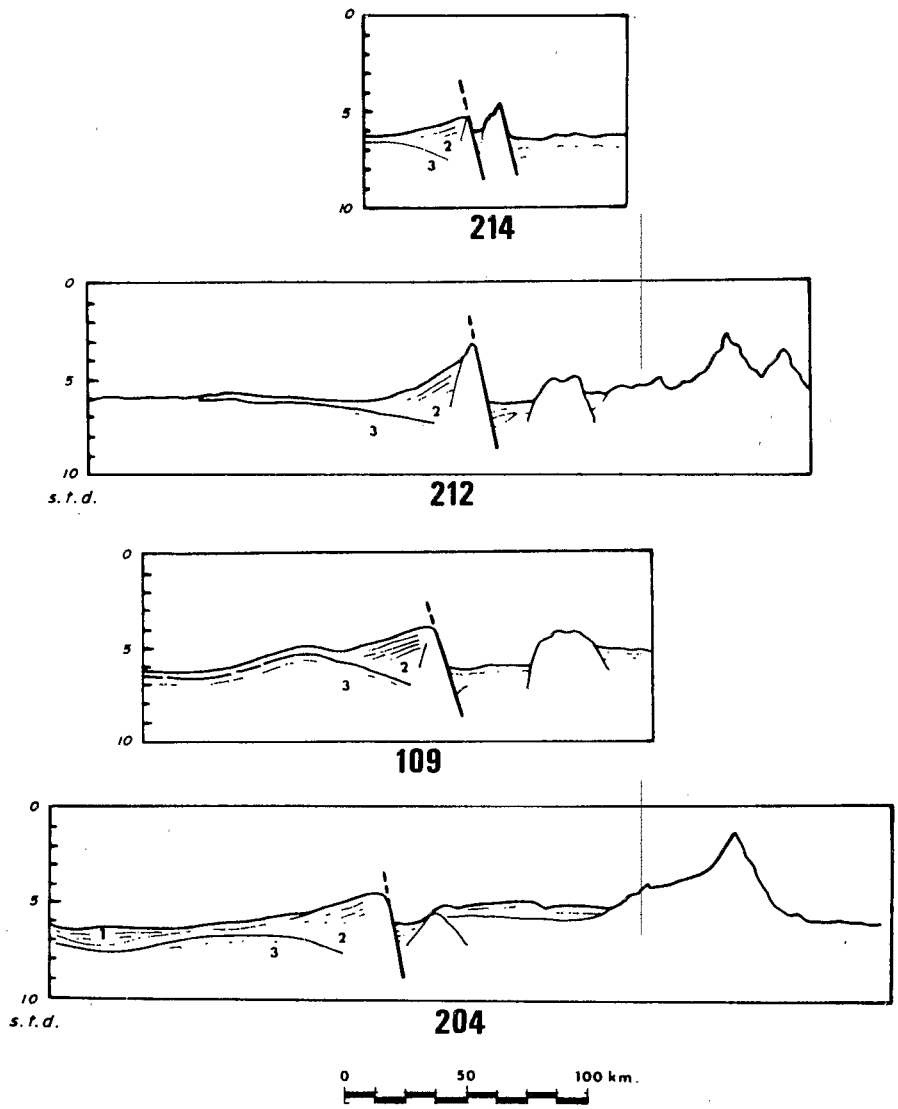
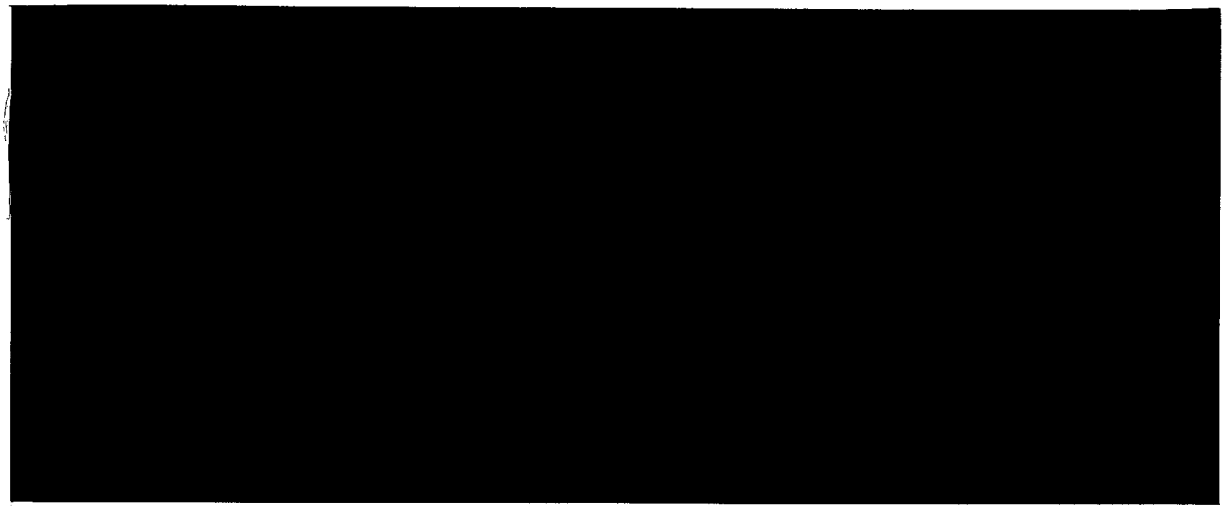


Fig. 6 - PROFILES 214, 212, 109, 204 across d'Entrecasteaux transition zone.



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