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THE CORIOLIS TROUGH

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The Coriolis Trough (Figure 4) is a submarine feature situated to the east of Erromango, Tanna and Aneityum. It lies therefore to the rear of the New Hebrides island arc.

The Trough was first recognised by de Chalvron *et al.* (1967) and Puech and Reichenfeld (1968, 1969). It was later described by Karig and Mammerickx (1972) as a narrow extensional zone of inter-arc basins in which the troughs and ridges are disposed *en échelon* at an angle to the general trend of the arc system.

A more recent survey (Dubois *et al.,* 1975), of which this article is a brief and selective summary, has shown that the *en échelon* troughs comprise a single structure, parallel to the line of active volcanoes and to the New Hebrides Trench, but displaced by transverse faulting.

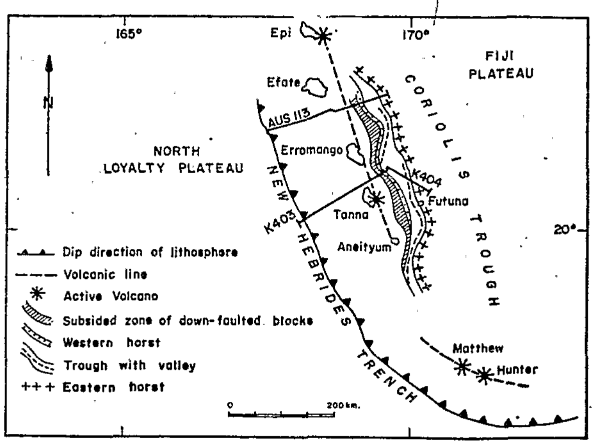

FIG. 4. Sketch map of the Coriolis Trough with transects.

Morphology

The Coriolis Trough is a narrow complex depression which corresponds to the active marginal basin and remnant arc of Karig and Sharman's (1974) model for typical island arcs. A section (see Figure 5) west-east across the Trough comprises:

1. A subsided zone of down-faulted blocks 20–45 km wide and 1.5–2.2 km (exceptionally 3 km) deep.
2. A narrow western horst, 2–10km wide, with a summit 0.8–1.5 km beneath sea level.
3. A graben 35 km wide and 2.5–3.3 km deep.
4. A narrow eastern horst the crest of which emerges at Futuna Island and has a maximum depth of 1.5 km.

Geology

Two stratigraphic units can be recognised from the seismic reflection profile (Figure 5), an upper unit, generally thin except in some depressions where it may be up to 1 sec. two-way time, which rests unconformably on a lower unit of very weak seismic penetration and unknown thickness.

The upper unit has accumulated in hollows and depressions, is acoustically transparent and has regular strata. Near possible intrusions however the strata are deformed which suggests that tectonism is still active. The lower unit is irregular with many lateral discontinuities. It possibly represents the topmost part of a volcanic basement.

The principal tectonic feature of the trough is tensional block faulting; high amplitude warping is absent. Two types of movement can be recognised, normal faults and faults transverse to the arc. The normal faulting is the more important giving rise to horst and graben structures. The western and eastern horsts are thought to result from dyke intrusions above which volcanic piles such as Futuna are developed.

The transverse slip faults occur where there is a change in trend of the trough. One between Erromango and Tanna marks a line of active sinistral faulting of some 35 km length.

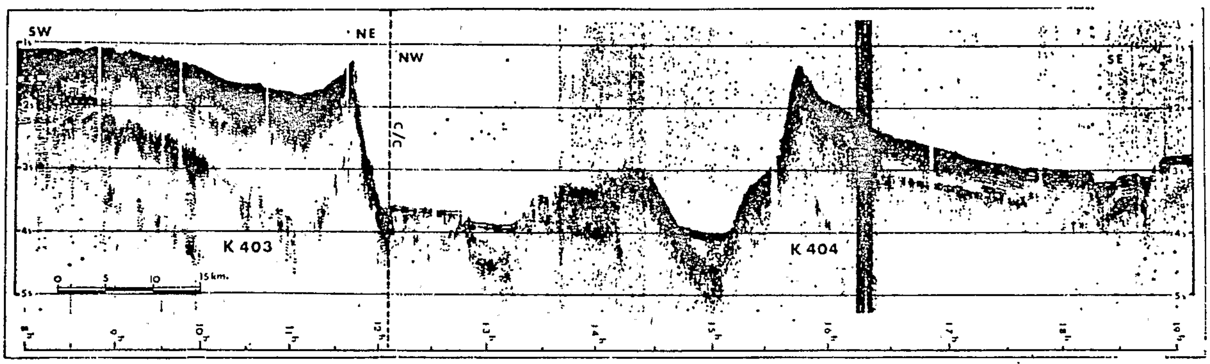

FIG. 5. Seismic reflection profile of K403 and K404 transects.

Seismicity

There is good correlation between seismicity and the Trough although it is uncertain whether or not the earthquake hypocentres, because they are imprecisely located, are associated with the faults which appear to bound the structure. Between Tanna and Erromango the earthquakes are concentrated about the sinistral transverse slip fault referred to in the preceeding section. They appear to lie along an E-W line (Figure 6) which traverses the arc from the New Hebrides Trench to the Fiji Plateau.

Magnetics

The magnetic field over the Trough (Figure 7) is very variable and is characterised by anomalies of short wavelength and high amplitude (500 gammas; exceptionally 2,000 gammas) which indicate source bodies with high magnetic susceptibility at shallow depth. These are characteristics of a young region marked by recent vertical movements which create magnetic field variations. These variations appear as a succession of symmetrical and sinusoidal curves with 20 km wavelengths. The seismic reflection data indicate that the Trough has

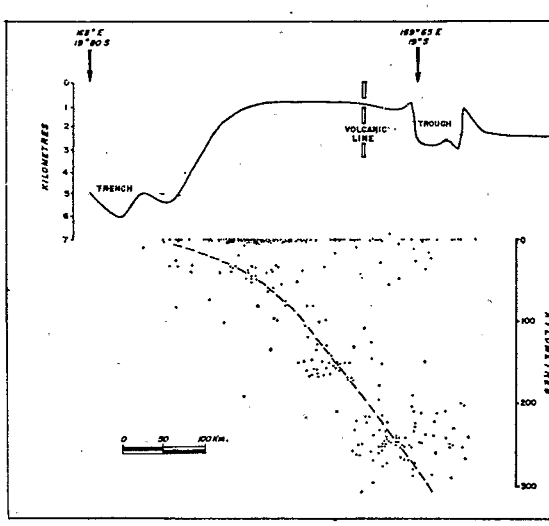

FIG. 6. Bathymetric and seismic profiles along transect K403 with hypocentres (ISC determinations) projected from 50 km on either side of the profile.

an approximate axial symmetry which is also shown by the magnetic anomalies.

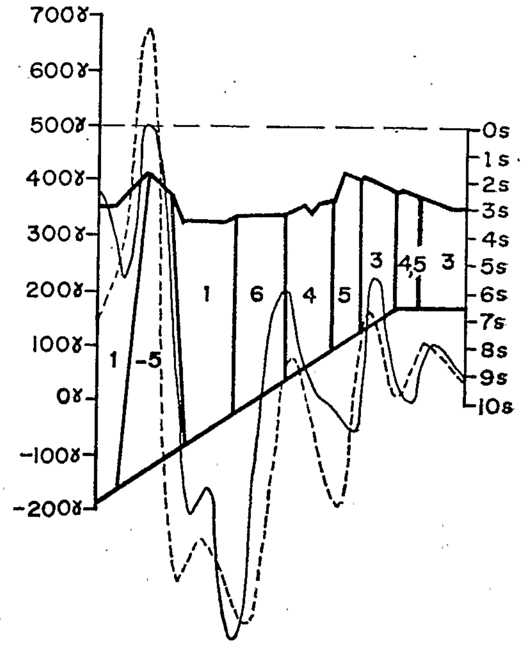

FIG. 7. Magnetic susceptibility model (in 10^{-3} c.g.s) along transect AUS 113 with anomalies both calculated (dashed line) and observed (solid line).

One important feature is the positive anomaly in the Trough centre between a positive anomaly on each of the bounding ridges. The lateral anomalies can be correlated with the marginal horsts; the central anomaly however cannot be explained in this way and the shallow emplacement of basic magma, which has ascended from the upper mantle post the faulting, is invoked.

A geological model has been constructed with magnetic susceptibilities (Figure 7) extending from 1.10^{-3}–6.10^{-3} c.g.s. (basic rock susceptibilities), the most usual values being 5.10^{-3}–3.10^{-3} i.e. an average contrast of 50%. The bottom topography is chosen for the model's upper surface because of the thin sedimentary cover; the lower surface which represents the Curie Point isotherm, is taken as either generally constant at 5–6 km or variable with increasing depths westwards in the trough east of Efate.

The model suggests the presence of intrusions at the Trough centre and beneath the lateral ridges. The magma emplacement is thought to have been facilitated by the tensional faulting.

Proposed mechanism

A sequence of events leading to the formation of the Coriolis Trough is postulated as follows:

1. Initiation of transcurrent faults in zones of crustal weakness (following Fitch, 1972) behind the volcanic line and parallel to the arc.
2. Creation of convection cells above the Benioff Zone by subduction of lithospheric material into the asthenosphere.
3. Tensional faulting in the crust above the vertically ascending hot asthenospheric material produced by the convection cells (Figure 8).
4. Formation of a graben or rift valley structure along the line of active transcurrent faulting and vertically above the end of the subducted plate.
5. Intrusion of basic magma beneath the graben and volcanism on the bounding ridges. A slow rate of opening of the trough and the irregular emplacement of the intrusions would explain the variations in the magnetic lineations.

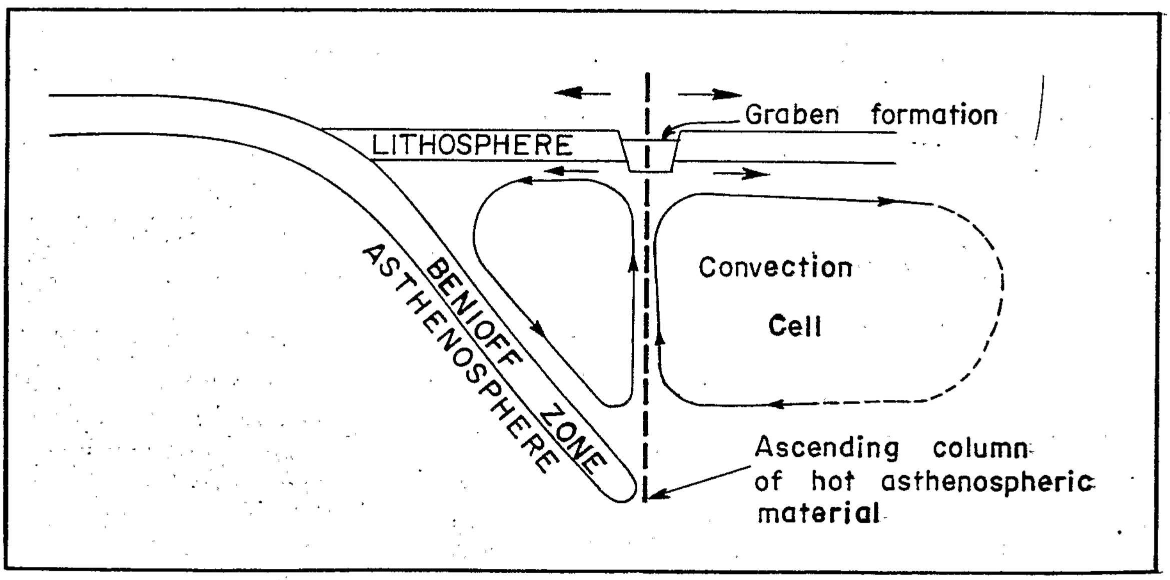

FIG. 8. Proposed model for the formation of the Coriolis Trough.

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