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ISSN. 0110-0408

SOUTH PACIFIC MARINE GEOLOGICAL NOTES

TECHNICAL SECRETARIAT
CCOP/SOPAC ESCAP
SUVA

FJT

Vol. 3 No. 2
February 1986



PRESENT-DAY OPENING OF THE NORTHWESTERN PART OF THE NORTH FIJI BASIN (SOUTHWEST PACIFIC)

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ABSTRACT

The existence of an active spreading centre is indicated by magnetic lineations in the northwestern part of the North Fiji Basin. This spreading centre, and another one perpendicular to it, demonstrate the complexity of the opening of this basin. The age of the crust is at least 4 million years.

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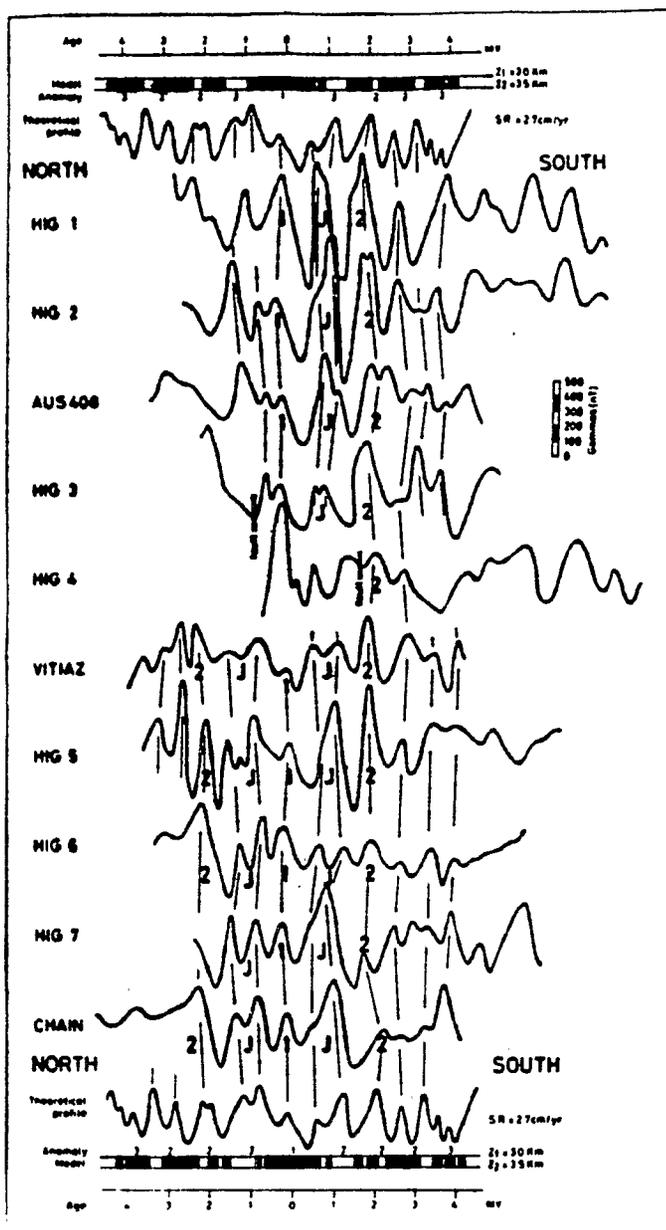


Fig. 2. Identification of magnetic anomalies from comparison with a theoretical model of anomalies due to reversals of the Earth's magnetic field.

Remnant magnetization :

$$|\vec{M}| = 0.008 \text{ c.g.s.e.s.u.}$$

$$D = 0^\circ$$

$$I = -34^\circ \text{ (positive magnetization : dark blocks)}$$

$$+34^\circ \text{ (negative magnetization : light blocks)}$$

Present-day magnetic field :

$$|\vec{F}| = 42000 \text{ nT}$$

$$D = 11^\circ \text{E}$$

$$I = -34^\circ$$

The oceanic nature of the crust of the basin was demonstrated by gravimetric and seismic refraction surveys in the southern and central parts of the basin (Solomon and Biehler, 1969; Shor *et al.*, 1971; Larue *et al.*, 1982). An aeromagnetic survey in these southern and central parts (Cherkis, 1980) showed the existence of a spreading centre stretching north-south approximately along the $170^\circ 30' \text{E}$ meridian between latitudes 21°S and 17°S , which has been active for about the last 5 m.y. (Malahoff *et al.*, 1982).

EXISTENCE OF AN ACTIVE SPREADING CENTRE IN THE NORTHWESTERN PART OF THE BASIN

We used ten magnetic anomaly profiles, or segments of profiles, restricted to the north-western part of the basin between the Vitiaz Trench and Hazel Hoime Fracture Zone, and whose directions form a maximum angle of 45° with the north-south direction. Seven of these profiles (HIG 1 to HIG 7) were carried out by the Hawaii Institute of Geophysics (Halunen, 1979), one (the Chain profile) by the Woods Hole Oceanographic Institution (Luyendyk *et al.*, 1974), one (the Vitiaz profile) by the USSR Academy of Sciences (Kurentsova and Shreyder, 1971), and the last (AUS 408) by the Institut Francais de Recherche Scientifique pour le Développement en Coopération (ORSTOM) and the Centre d'Etudes Pétrolières Marines (CEPH) in 1976. A number of additional profiles, directed approximately east-west, show few variations, or very long wave anomalies, and thus, associated with the profiles used here, confirm the east-west structural trend of the crust in the area investigated; they have therefore not been reproduced.

On comparing the sequences of magnetic anomalies of these ten profiles, projected north-south, with the sequence of anomalies produced by reversals of the earth's magnetic field over the past 4 m.y., we are able to identify some of the anomalies recorded with those of a theoretical model we constructed. The anomalies thus identified are numbered on Fig. 2. They form lineations that are shown on Figs 3 and 4.

The magnetic anomalies provide evidence for the presence of an active spreading centre extending approximately east-west at latitude $13^\circ 30' \text{S}$ between longitudes 170°E and 172°E , and at $13^\circ 15' \text{S}$ between 172°E and $173^\circ 30' \text{E}$. There would appear to be a transform fault separating the spreading centre into two portions. This discontinuity can be seen on profile HIG 4 between anomalies J and 2 on the southern side. In the absence of further profiles, it is not possible to determine the eastward and westward extensions of this spreading centre.

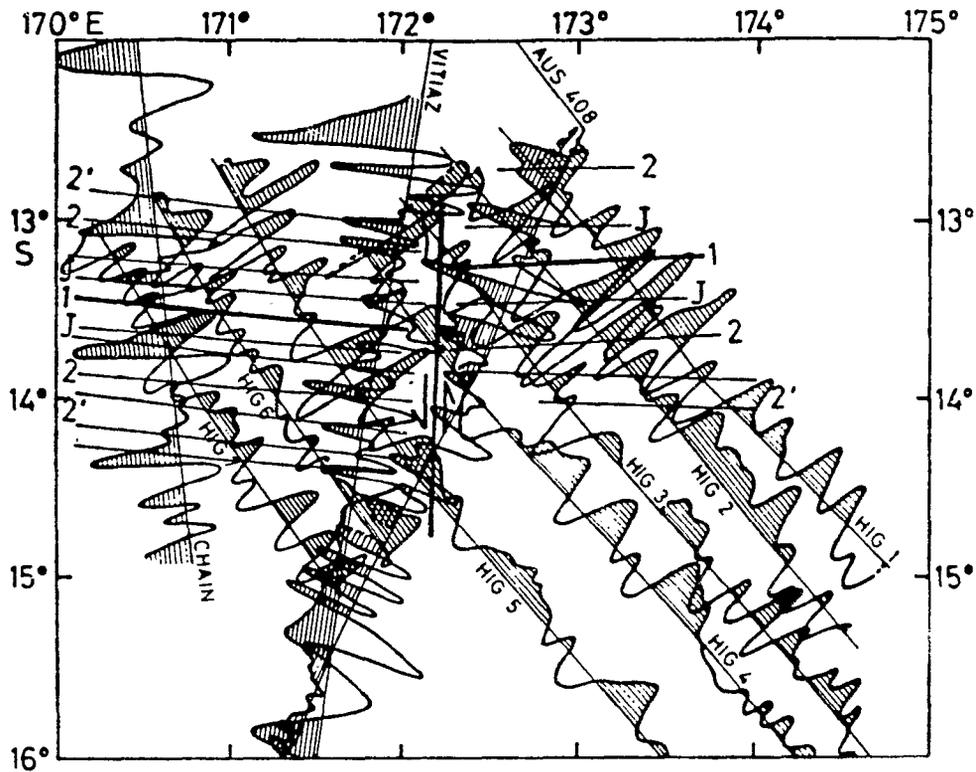


Fig. 3. Magnetic anomaly profiles and magnetic lineations in the northwestern part of the North Fiji Basin.

A seismic section in the spreading area (Fig. 5) shows the morphology of the spreading centre indicated by its magnetic signature.

On the basis of the magnetic lineations obtained, we estimate that the creation of the crust between longitudes 170°E and 174°E and latitudes 12°30'S to 14°10'S dates to about 4 m.y. with a half-spreading rate of 2.7 cm/y.

Some of the magnetic anomalies are difficult to identify due to topographic irregularities and faults affecting the basement which is only 2.5 km deep here. These superimpose their magnetic variations on the field reversal anomalies. Strains exerted by pre-existing crustal structures may also have inhibited regular spreading in this area. While this can happen in back-arc basin spreading, it does not happen in the larger ocean basins because they tend to be homogeneous over long distances.

INTERPRETATION

We have shown the existence of a spreading centre, situated to the north of, and perpendicular to the one

previously known on the North Fiji Basin. The opening of this basin must therefore have occurred from at least two centres of crustal dilatation, of which only part of each has been identified as yet: the full extent of these spreading centres and their possible point of contact (RRR point) remain to be determined.

The Hazel Holme Fracture Zone, which trends diagonally through the study area, appears to be the boundary between crusts originating from each of the two perpendicular spreading centres. Both these crusts however seem to be of the same age, i.e. from 4 m.y. to the present for the area investigated and 5 m.y. for the southern area (Malahoff et al., 1982). It can therefore be inferred that both these spreading centres began their activity around the same time.

The North Fiji marginal basin would, in this type of opening process, result from changes in the relative movements between the Pacific and Austral-India Plates; the formation of this basin, as of all marginal basins in the Southwest Pacific, is in response to such strains (Lapouille, 1982). Evidence for change in the relative movement of the Pacific and Austral-India Plates is found in the polarity reversal of the subduction which has moved from the Vitiavz Trench to the New Hebrides Trench (Gill and Gorton,

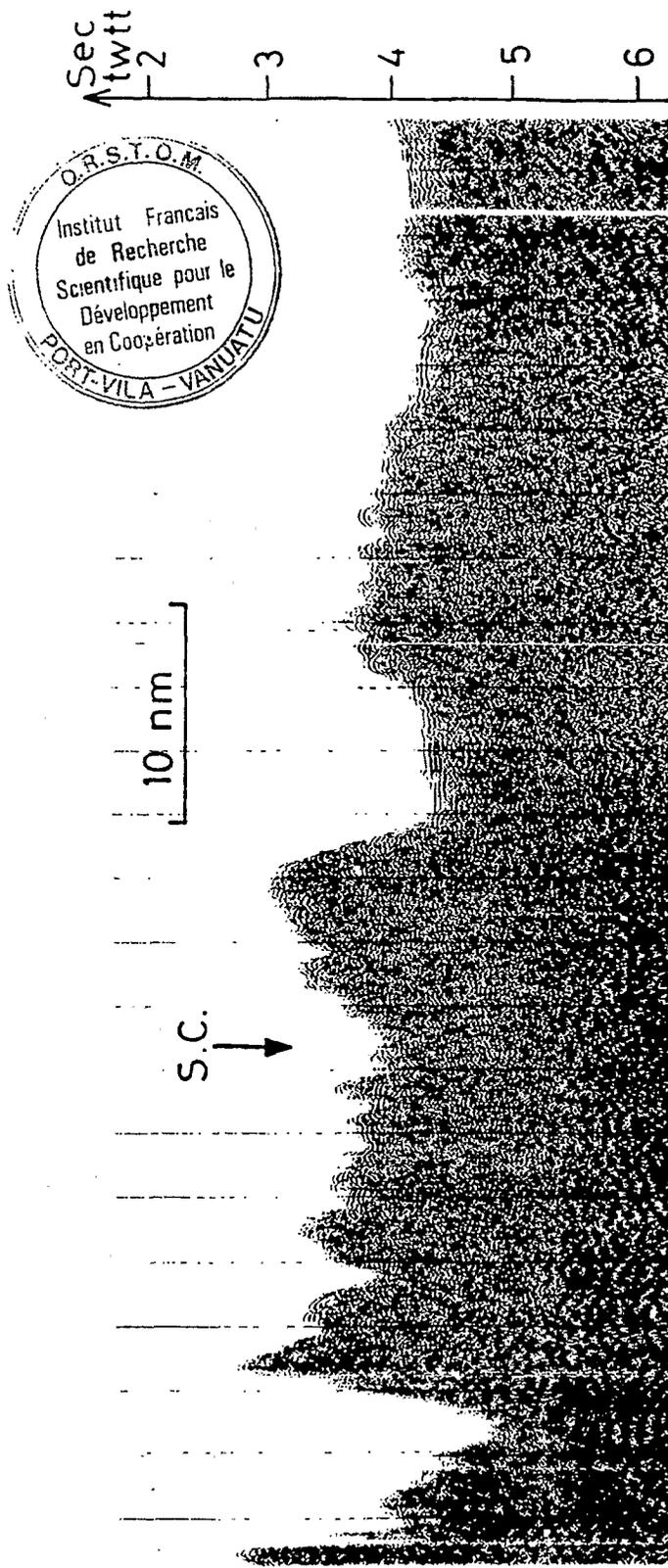


Fig. 5. Seismic section AUS 408 showing the morphology of the spreading centre area.

1973). The existence of a band of deep earthquakes parallel to the Vitiaz Trench is evidence of this ancient subduction (Pascal et al., 1978). Paleomagnetic measurements on the New Hebrides Island Arc also show a 30° clockwise rotation of the arc since 8 m.y. (Falvey, 1978).

CONCLUSION

The opening of the northwestern part of the North Fiji Basin could logically have resulted from a scissors-like spreading extending from a centre located along the bisector of the angle formed by the Vitiaz and New Hebrides Trenches, i.e. in the NW-SE direction. However, the identification of north-south spreading, segmented by a transform fault with about 20 nautical miles relative displacement, as well as the previously known east-west spreading, shows the opening mechanism to be rather more complex. Further investigations to the north and the west of the area surveyed so far, are required to obtain a more complete understanding of the origins of this basin.

ACKNOWLEDGEMENTS

The author thanks warmly Dr Don L. Tiffin for his many comments and corrections of the manuscript.

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Publications in this series of Notes are intended to include results of local studies, brief reports dealing with field observations, and short summaries and data relevant to the aims of CCOP/SOPAC.

