Marine Geology, 116 (1994) 25–35
Elsevier Science B.V., Amsterdam

A possible triple junction at 14°50′S on the North Fiji Basin Ridge (Southwest Pacific)?

Jean-Marie Auzende[a,1], Eulalia Gràcia-Mont[b], Valerie Bendel[b], P. Huchon[c], Yves Lafoy[d], Yves Lagabrielle[b], Giovanni de Alteriis[e,2] and Manabu Tanahashi[f]

[a]*GDR: Genèse et Evolution des Domaines Océaniques, IFREMER/CB, B.P. 70, Plouzané, France*
[b]*GDR: Genèse et Evolution des Domaines Océaniques, Université de Bretagne Occidentale, 6, Avenue Le Gorgeu, 29287 Brest cedex, France*
[c]*ENS, 24 rue Lhomond, 75005 Paris, France*
[d]*Service des Mines et de l'Energie, B.P. 465, Nouméa, New Caledonia*
[e]*CNR-Geomare Sud, Naples 80138, Italy*
[f]*Geological Survey of Japan, Ibaraki, Tsukuba, Japan*

(Received November 14, 1992; revision accepted February 11, 1993)

ABSTRACT

Auzende, J.-M., Gràcia-Mont, E., Bendel, V., Huchon, P., Lafoy, Y., Lagabrielle, Y., De Alteriis, G. and Tanahashi, M., 1994. A possible triple junction at 14°50′S on the North Fiji Basin Ridge (Southwest Pacific)?. In: J.-M. Auzende and T. Urabe (Editors), North Fiji Basin: STARMER French–Japanese Program. *Mar. Geol.*, 116: 25–35.

Recent full coverage bathymetric and geophysical surveys (*Yokosuka* 90 and 91), carried out in the framework of the STARMER Japanese–French joint project, reveal details of the structure of the N160° segment of the North Fiji Basin Ridge. Despite its intermediate spreading rate this segment shows a "slow spreading" type morphology with steep 1000 m high walls reaching an axial depth of 4000 m. Its northern tip at 14°50′S is a complex area involving several plates boundaries. This domain can be interpreted either as a complex boundary between two plates, or as a new triple junction, symmetrical with the 16°50′S Triple Junction characterizing its southern tip. In either case, the complexity of the spreading ridge geometry in this area illustrates the instability of the accretionary geometry due to the deformation of the whole North Fiji Basin between the much larger Indo-Australian and Pacific plates.

Introduction

The North Fiji Basin Ridge (Fig. 1) has been intensively studied during the last ten years by both French and American programs or in the context of the bilateral Japanese–French STARMER project. During this five-year (1987–1991) program, 9 months have been spent at sea on Japanese and French ships. The central domain of the North Fiji Basin has been mapped using full coverage multibeam bathymetric systems for 800 km. After the *Seapso* program of the R/V *Jean Charcot* in 1985 (Auzende et al., 1986, 1988a,b) the geophysical and geological data acquired by surface ships during STARMER provided very detailed information concerning plate kinematics, structural evolution, accretionary processes and associated hydrothermal phenomena of the North Fiji Basin Ridge system (Honza et al., 1989; Auzende et al., 1990a; Lafoy et al., 1990; Grimaud et al., 1991; Bendel et al., in press). In addition 52 dives of the French submersible *Nautile* (Auzende et al., 1989, 1991a; Lagabrielle et al., 1994-this issue) and the Japanese submersible *Shinkai* 6500 (Auzende et al., 1992) provided a detailed in situ exploration of the active part of the ridge axis. These works commonly demonstrate that the North Fiji Basin is an excellent target for the study of the accretion and hydrothermal processes in a back-arc environment

[1]Present address: Orstom, UR 1F, BP A5, Nouméa cedex, New Caledonia
[2]Presently at Ifremer/CB

0025-3227/94/$07.00
SSDI 0025-3227(93)E0093-L

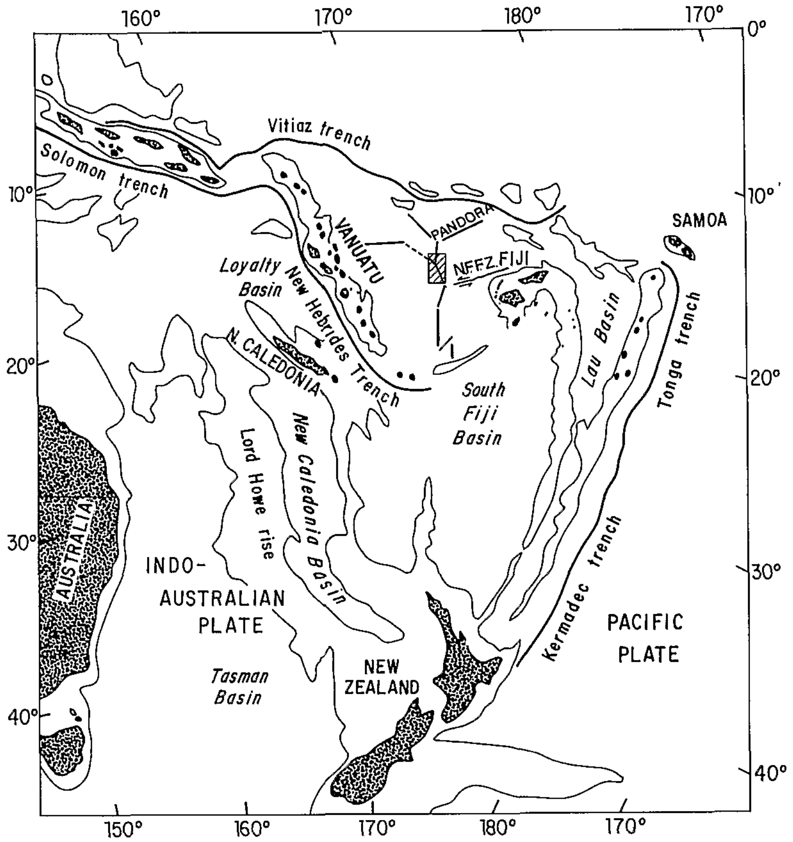

Fig. 1. Geodynamic setting of the North Fiji Basin. The ridge axis is indicated. *NFFZ* = North Fiji Fracture Zone.

as well as a representative setting for the study of the ridge segmentation and magmatic–amagmatic cyclicity.

The aim of the *Yokosuka* 90 and 91 cruises was mainly the geological and geophysical survey of the northwest trending N160° segment of the North Fiji Basin Ridge (Auzende et al., 1991b; Gràcia-Mont, 1991, 1992). In addition a multibeam coverage (Seabeam and Furuno systems) survey of the axial ridge was completed which included also water and rock sampling about every 20 km along the axis. Another goal of the *Yokosuka* 91 cruise was the in situ exploration of the active ridge axis with the Japanese submersible *Shinkai* 6500.

In this paper, we will particularly emphasize the results of the multibeam survey carried out on the N160° ridge during these cruises complementing the data acquired during the *Seapso* 3 cruise (Auzende et al., 1988a,b). Those surveys provide further constraints on the recent evolution of the North Fiji Basin Ridge between the 17°S Triple Junction and an area around 14°50′S where a new triple junction may exist.

Main structures of the North Fiji Basin Ridge

Detailed maps of the North Fiji Basin Ridge have already been published (Auzende et al., 1990b) and additional data will also be presented in this special issue. The characteristics of the ridge axis can be schematically summarized as shown in Fig. 2.

In the southernmost part of the basin between 20°30′S and 21°40′S the spreading axis is located at 174°E. It is characterized by a succession of parallel highs and depressions. From the bathymetry, the precise location of the present-day accretion axis is difficult to define, the seafloor in this area being complicated by numerous volcanic fea-

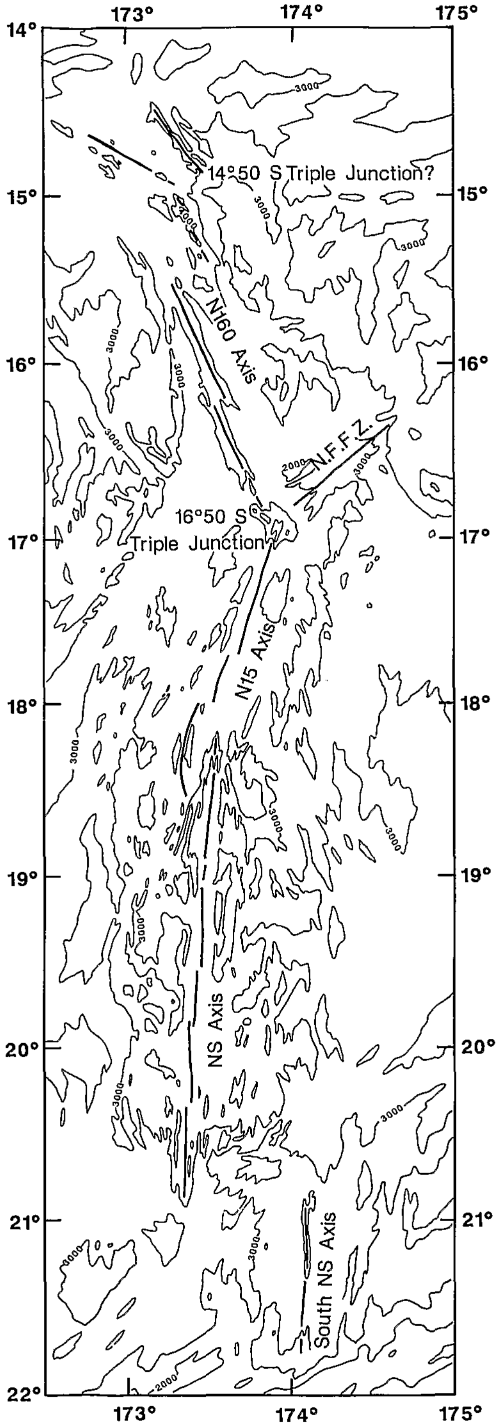

Fig. 2. Simplified bathymetric map of the Ridge axis south of 14°30′S. The present-day ridge axis and the *NFFZ* are indicated.

tures related to the Matthew-Hunter subduction zone. The ridge axis location is mainly estimated from a well-identified magnetic axial anomaly.

Between 20°30′S and 18°10′S, the second segment constitutes the morphologically simplest part of the ridge, with an axial dome at a depth of about 2800 m and with a width of 8 km, a morphology very similar to the East Pacific Rise. On both sides of the axis the seafloor morphology is complicated by oblique trending lineaments and volcanoes related to a recent phase of rearrangement of the axis geometry (De Alteriis et al., 1993).

From 18°10′S to around 17°00′S the ridge trend changes from N–S to N15°. This change is thought to be linked to the eastward migration of the spreading axis during the past one million years, synchronous with the development of a triple junction between the N15°, N160° ridge segments and the North Fiji Fracture Zone as previously described by Lafoy et al. (1987, 1990) (Fig. 3).

North of 17°00′S, the ridge trends N160° and shows a very peculiar aspect. The axial ridge can be divided into two main domains. The southern domain is characterized by a deep graben cutting a large volcanic massif. It lies between the 16°50′S Triple Junction and 16°10′S. In the northern domain, north of 16°10′S, the large volcanic domes which characterize the southern domain disappear. The present-day accretion seems to be located along a succession of "en echelon" N160° northwest trending elongated grabens.

Analysis of magnetic anomaly and bathymetric patterns indicates that the N160° ridge axis recently propagated (less than 1 Myr ago) into old oceanic crust characterized by a N–S structural fabric created during the previous phase of opening of the North Fiji Basin, between 3.5 and 1.Ma (Auzende et al., 1988b; Huchon et al., 1994-this issue). This N160° branch also shows a polyphased evolution. In a first stage, it is represented at least in the southern part by the building of a large elongated volcanic massif. During the second stage, this volcanic accumulation was cut along its axis by deep grabens, at the same N160° trend, that constitutes the present-day accretion. These two successive phases indicate a progressive weakening of the magmatic budget up to nearly pure

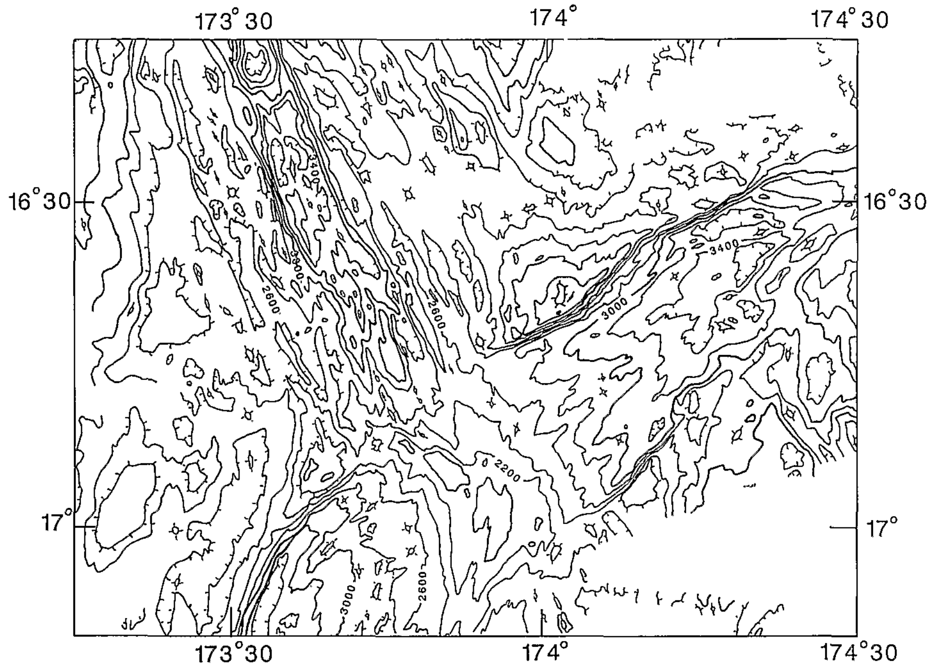

Fig. 3. Simplified bathymetric map of the 16°50′S. Triple Junction from Lafoy et al. (1990). Contour interval is 200 m.

amagmatic extension of the present-day (Auzende et al., 1992, in press).

Toward the east, the North Fiji Fracture Zone (NFFZ) constitutes the link between the North Fiji Basin and the Lau Basin (Fig. 1). Recent workers (Ruellan et al., in press) agree that the opening of the Lau Basin at 3.5 Ma coincides with the last N–S stage of opening of the North Fiji Basin (Auzende et al., 1988b). The NFFZ represents the trace of the left-lateral tectonic boundary linking the northern parts of both basins.

The N160° ridge between 16°50′S and 14°50′S

This segment is about 200 km long and was surveyed in great detail during the last *Yokosuka* 90 and 91 cruises. It is situated between two complicated morphological features which could be interpreted as triple junctions. The southern tip is located at the 16°50′S Triple Junction, corresponding to the convergence of the N15° and N160° branches of the North Fiji Basin Ridge with the NFFZ (Lafoy et al., 1990). The northern tip at 14°50′S (Fig. 4) is characterized by the junction, of two converging ridge segments (N135° and N120°) with the N160° ridge axis to the south. Below we discuss the arguments for and against the interpretation of this area in terms of a triple junction.

Based on the interpretation of the axial and J (Jaramillo) anomalies the estimated spreading rate of the N160° segment has varied between 4 and 5 cm/yr, which are representative of intermediate rate spreading ridges. On the whole N160° segment the present-day ridge axis is characterized by a morphology usually encountered at slow-spreading ridges (MacDonald et al., 1984). It is a succession of deep grabens reaching more than 4000 m deep, bounded by steep 1000 m high walls.

The detailed structure of the N160° segment can be described as follows (Auzende et al., 1991b; Gràcia-Mont, 1991, 1992) (Fig. 5):

From 16°50′S to 15°30′S, the spreading axis is located in a 4000–4500 m deep graben located between two subvertical walls. The average width of the graben is 8 km along the whole segment. In its axial part the graben is cut by a 2–3 km wide, 400–500 m high ridge very similar to the neovolcanic ridges described at slow-spreading (less than 4 cm/yr) ridges like the Mid-Atlantic Ridge

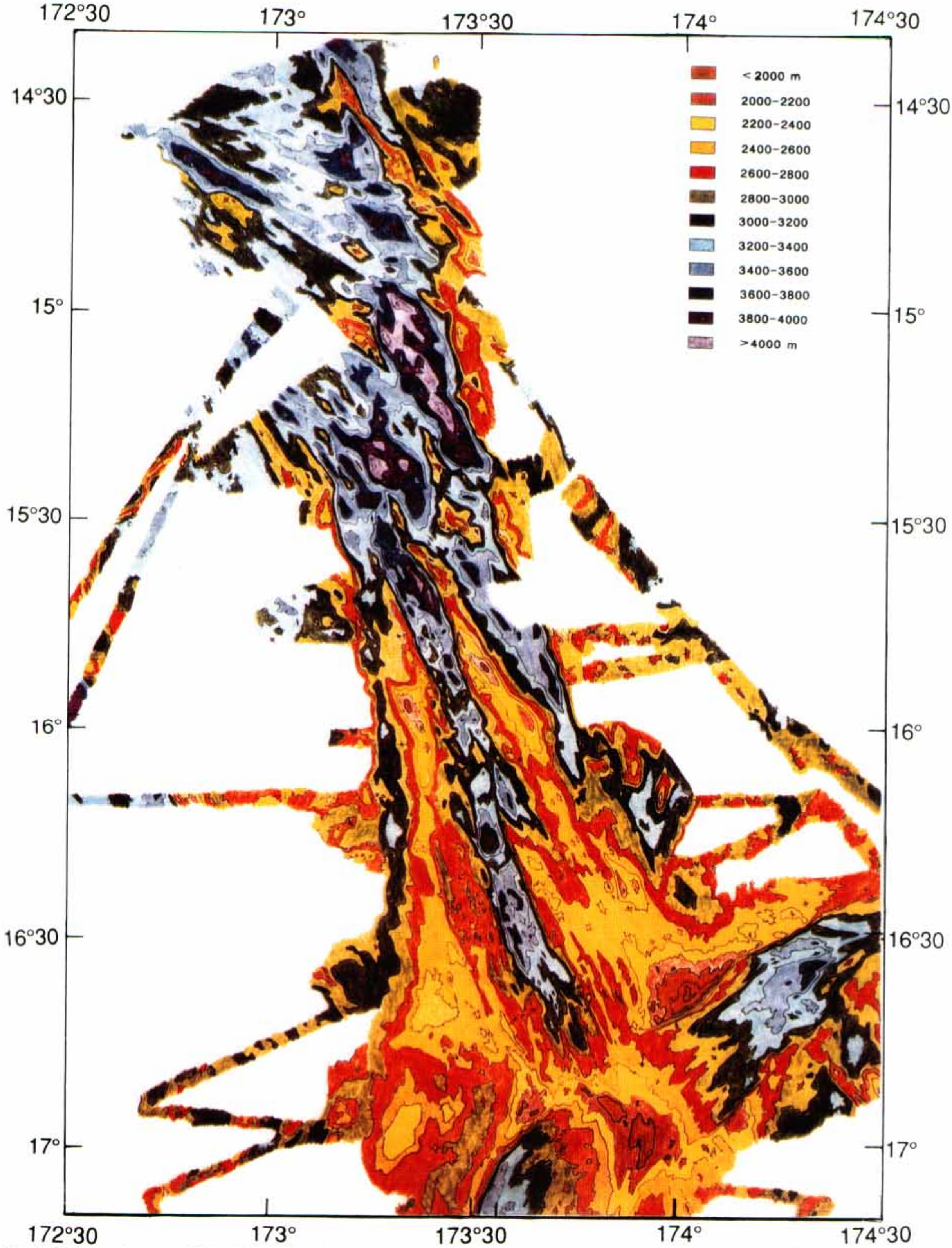

Fig. 4. Bathymetric map of the N160° ridge Axis. Contour interval is 200 m.

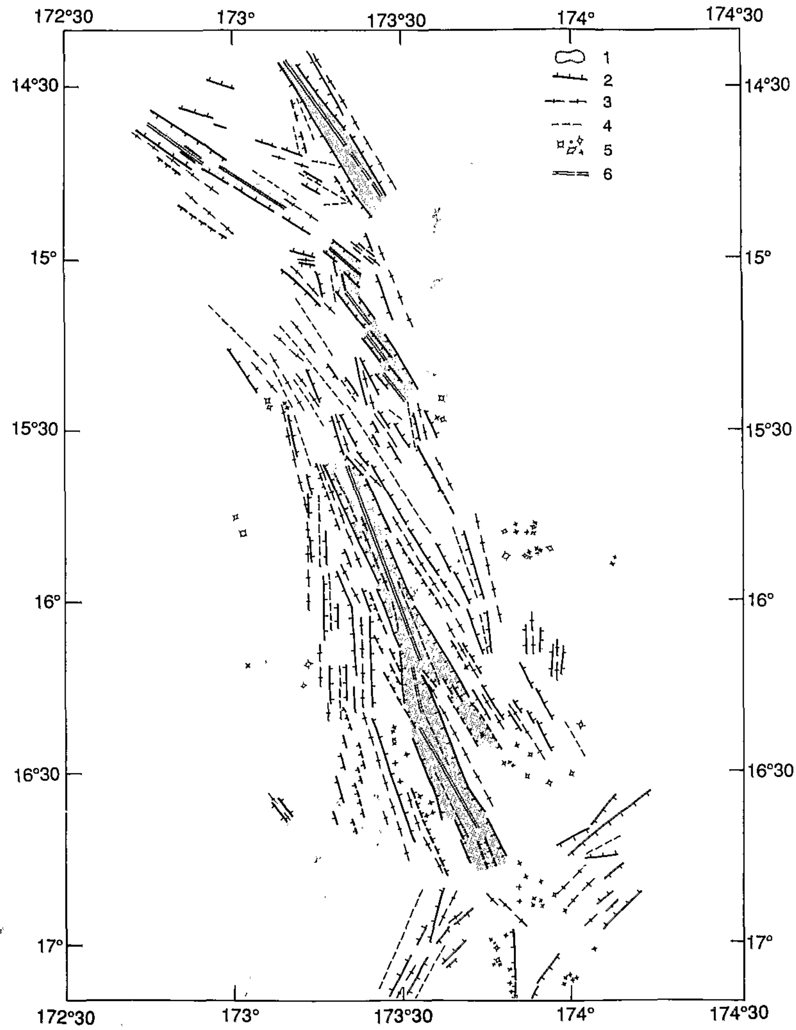

Fig. 5. Structural map of the N160° axis between 14°30'S and the 16°50'S Triple Junction. *1* = Axial domain deduced from bathymetry and magnetic anomaly; *2* = normal fault and scarp; *3* = crest; *4* = depression, *5* = isolated volcano, and *6* = ridge axis.

(Kappel and Ryan, 1986; Karson et al., 1987; Karson, 1990; Gente et al., 1990). Around 16°10'S, the remarkable linearity of the N160° axis is interrupted by a slight curve toward the north offseting the graben by about 4 km. On both sides the active domain is flanked by a very large volcanic massif reaching to a depth of less than 1700 m. The width of the volcanic massif decreases from 100 km in the south to few kilometers in the north until it disappears north of 15°30'S. The magnetic data analysis allows an estimate of the beginning of the volcanic construction and the massif uplift at about 1 Ma. This uplift affects an older oceanic crust as demonstrated by the age of the sediments sampled from the northern edge of the graben located east of the 16°50'S Triple Junction (Lagabrielle et al., 1994-this issue). The extension of the massif all around the 16°50'S Triple Junction suggests a direct relationship between the two phenomena. The radial shape of the volcanic accumulation implies that the thermal energy is focuzed at the triple junction and progressively decreases with the increasing distance from the triple junction. The same observation has been made around Iceland and the Azores (Olivet et al., 1984).

Between 15°30′S and 15°00′S, the accretion is distributed on a wide domain mainly constituted by two en echelon grabens 60 km long and more than 4000 m deep, offsetting the axis by about 40 km to the northeast. Each of these grabens is made by a succession of 10 km long en echelon segments (Fig. 5). In this area the magmatic supply appears to be concentrated along a narrow ridge that separates the grabens. Since 1 Ma the accretion seems to be mainly amagmatic (Auzende et al., in press).

North of 15°00′S, the spreading axis becomes more complex and is located within two distinct areas. The southern part, trending N120° is characterized by a 4 km wide and 4000 m deep graben which crosscuts an older oceanic crust showing different trends from N160° to N120°.

The northern spreading axis consists of a 2400 m deep N140° trending ridge that connects with the N160° graben system at an approximately 4000 m deep depression located at 14°50′S. This depression can be interpreted as representing a triple junction. It is clearly shown on the along-strike profile of Fig. 6 between the 16°50′S Triple Junction to the extremity of the N120° graben. This profile also illustrates the along-strike morphological variability related to the presence or absence of an axial neovolcanic ridge within the active graben.

The magnetic map (Fig. 7) allows us to determine the present-day location of active accretion.

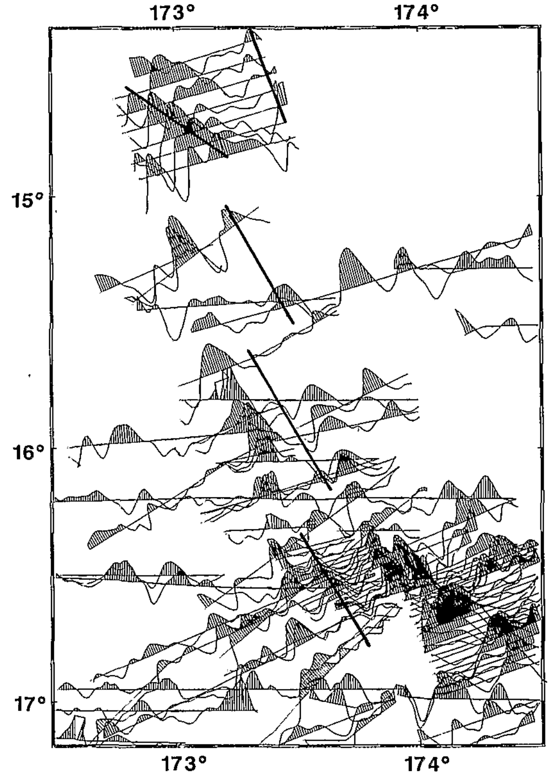

Fig. 7. Magnetic map of the N160° segment. In the lower part, an example can be seen of the correlation between the magnetic and bathymetric transverse profiles at 16°30′S and 14°30′ S. The interpretation of the J (Jaramillo) anomaly in the southern segment remains speculative. The thick lines give the ridge axis deduced from the bathymetry and structure.

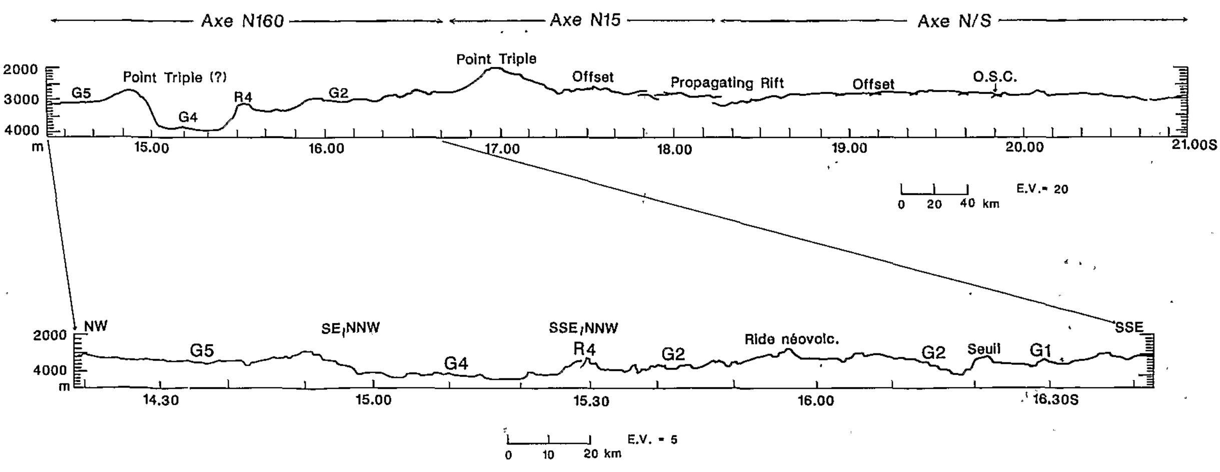

Fig. 6. Along strike profile from 21°′S to 14°30′s. In the lower part of the figure, enlargement of the N160° segment along strike profile.

South of 15°S it is relatively easy to follow the axial anomaly with a N160° trend and centered on the topographic axial graben. The existence on both sides of the axial anomaly of a possible J (Jaramillo) lineation remains controversial. To the north, the axial anomaly clearly corresponds to the N120° graben while the not very well identified northeastern lineation could be related to the N140° ridge. This difficulty in defining the magnetic lineations precisely in the whole domain, is certainly due to the fact that the emplacement of the whole system occurred in the last million years when there were no reversals.

Existence of a 14°50′S triple junction?

We now discuss the question of the existence of a typical Ridge–Ridge–Ridge (RRR) type of triple junction at 14°50′S. In a previous publication (Lafoy et al., 1990) it was shown that a RRFZ triple junction was functioning in the vicinity of 16°50′S and they also suggested that it has an age of about 1 Ma. It seems that a chronological link could exist between the initiation of the 16°50′S Triple Junction and the proposed 14°50′S Triple Junction. The ridge rearrangement, at 1 Ma, related to the left lateral motion along the NFFZ, is marked by the eastward migration of the previously N–S spreading axis and the initiation of the 16°50′S Triple Junction. To the south, the axis trends N15° and to the north N160°. The plate deformation resulting from this rearrangement implies the development of a new boundary system, which would be partly accommodated by plate boundary rearrangement near 14°50′S.

As described above, the 14°50′S zone could be interpreted either in term of a simple plate boundary or in terms of a triple junction.

In the first hypothesis (Fig. 8a), only the grabens are representative of the active boundary between the two plates A and B. The eastern N140° ridge is not considered as a present-day accretion zone. It could be a reactivated block belonging to the plate B or an older abandoned spreading ridge. From the magnetic data (Fig. 7), however, since all these changes must occur within the last million years only the axial anomaly can be identified in the area occupied either by the N140° or N120° features. Another problem arising from this hypothesis is that it does not explain the change in the trend of the axis from N160° to N140°.

The second hypothesis (Fig. 8b), involves the interaction of a RRR triple junction synchronous with the one located at 16°50′S. In this case, the N160° ridge segment, the N120° graben and the N140° ridge must be considered as active spreading plate boundaries converging toward the 14°50′S deep graben. The N120° graben could be the link between the axial North Fiji Basin spreading system with the western Hazel-Holme E–W accretionary ridge (Pelletier et al., 1993). The only objection to this hypothesis is the age of the Hazel-Holme ridge, which is considered older by Pelletier et al. (1993) taking into account the magnetic lineations interpretation. The N140° ridge could also be the link with the northern Pandora Ridge spreading system (Auzende et al., 1988b). This triple junction implies the existence of a third plate C (Fig. 8b). One can notice that the angle between the northern branch of the proposed triple junction is very sharp (about 20°) and also that, as shown on Fig. 8b, the convergence between the three branches is not a single point but a line trending N45° parallel to the spreading flow lines. This line could be interpreted as a fracture zone and at a small scale the triple junction will be of Ridge–Ridge–Fracture Zone type which are known to be very instable (MacKenzie and Morgan, 1969). The evolution of this triple junction will also depend on the northern system of plates boundaries partly represented around 14°30′S by the Pandora Ridge interpreted as active spreading zone by Kroenke et al. (1991). The opening rates calculated for the functioning of such a triple junction implies a very slow spreading rate (about 2 cm/yr) between plates B and C.

Conclusions

In conclusion, the geometry of the accretion system in the northern part of the North Fiji Basin is strongly dependent on the interaction of the subduction west of the New Hebrides and east of the Tonga island (Pelletier and Louat, 1989), the NFFZ (Auzende et al., 1986) and the deformation due to the shearing motion between Indo-Australia

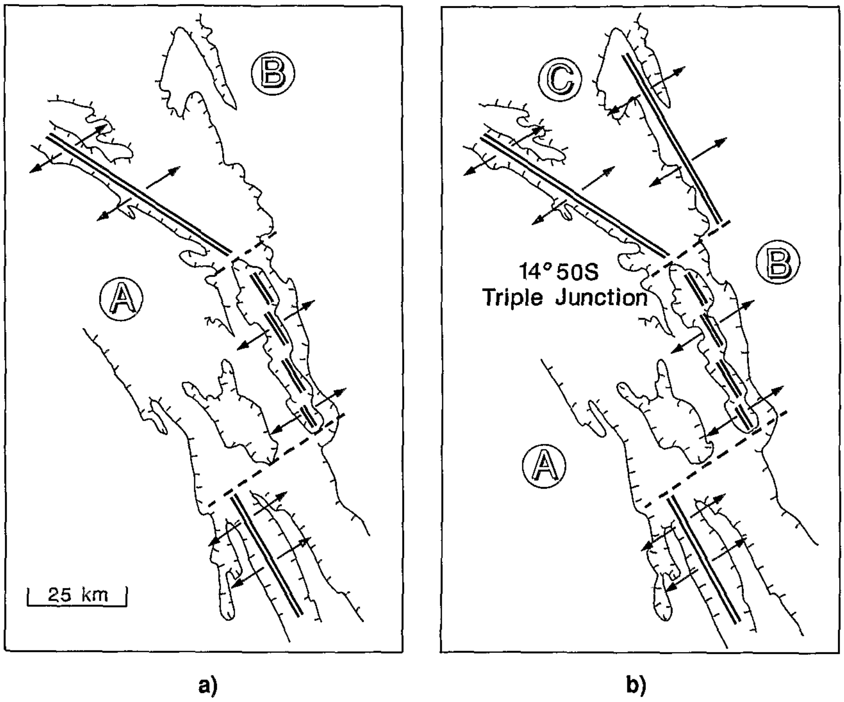

Fig. 8. (a) The two plate hypothesis. (b) The 14°50′S Triple Junction hypothesis.

and Pacific plates (Hamburger and Isacks, 1988). The result is a geometrically very complex spreading axis that accommodates these different effects by continuously rearranging itself through time. The existence of a succession of triple junctions at 16°50′S, 14°50′S and probably another one northward, is one of the most remarkable manifestation of the extreme instability of the spreading system. In fact, a triple junction constitutes a transient stage (McKenzie and Morgan, 1969; Patriat and Courtillot, 1984) marked in particular by the migration of the ridge segments implied in their functioning until they could reach new and more stable arrangements. Out of these triple junctions the instability of the spreading axis in the North Fiji Basin is also illustrated by numerous along-strike discontinuities such as: overlapping spreading centers, small transforms, offsets and propagating ridges, accommodating the axis deformation. Similar features are also evident in bathymetric and magnetic patterns off-axis, suggesting that such complex processes took place during most of the basin evolution.

Acknowledgments

We thank all the scientists and the technical teams involved in the STARMER project. We thank also the captains and crews of the Japanese and French ships for their invaluable help during the data acquisition. The STARMER project was funded by the Science and Technology Agency of Japan and by IFREMER, ORSTOM and INSU on the French side. We finally thank J. Karson and M. Tivey for their fruitful review of the first draft of the manuscript.

References

Auzende, J.M., Eissen, J.P., Caprais, M.P., Gente, P., Gueneley, S., Harmegnies, F., Lagabrielle, Y., Lapouille, A., Lefevre, C., Maillet, P., Mazé, J.P., Ondréas, H., Schaaf, A. and Singh, R., 1986. Accrétion océanique et déformation dans la partie méridionale du Bassin Nord-Fidjien: résultats préliminaires de la campagne océanographique SEAPSO III du N.O. Jean Charcot (Décembre 1985). C. R. Acad. Sci. Paris, 303: 93–98.

Auzende, J.M., Eissen, J.P., Lafoy, Y., Gente, P. and Charlou, J.L., 1988a. Seafloor spreading in the North Fiji Basin (Southwest Pacific). Tectonophysics, 146: 317–351.

Auzende, J.M., Lafoy, Y. and Marsset, B., 1988b. Recent geodynamic evolution of the North Fiji Basin (SW Pacific). Geology, 16: 925–929.

Auzende, J.M., Urabe, T., Deplus, C., Eissen, J.P., Grimaud, D., Huchon, P., Ishibashi, J., Joshima, M., Lagabrielle, Y., Mevel, C., Naka, J., Ruellan, E., Tanaka, T. and Tanahashi, M., 1989. Le cadre géologique d'un site hydrothermal actif: la campagne STARMER 1 du submersible Nautile dans le Bassin Nord-Fidjien, C. R. Acad. Sci. Paris, 309(2): 1787–1795.

Auzende, J.M., Honza, E., Boespflug, X., Deo, S., Eissen, J.P., Hashimoto, J., Huchon, P., Ishibashi, J., Iwabuchi, Y., Jarvis, P., Joshima, M., Kisimoto, K., Kiuwahra, Y., Lafoy, Y., Matsumoto, T., Mazé, J.P., Mitzuzawa, K., Mamma, H., Naganuma, T., Nojiri, Y., Ohta, S., Otsuka, K., Okuda, Y., Ondréas, H., Otsuki, A., Ruellan, E., Sibuet, M., Tanahashi, M., Tanaka, T. and Urabe, T., 1990a. Active spreading and hydrothermalism in North Fiji basin (SW Pacific). Results of Japanese–French cruise Kaiyo 87. Mar. Geophys. Res., 12: 269–283.

Auzende, J.M. et al., 1990b. Bathymetric maps of the North Fiji Basin Ridge between 16°10'S and 21°40'S. 6 Colored Maps. Ifremer–DRO/GM.

Auzende, J.-M., Urabe, T., Bendel, V., Deplus, C., Eissen, J.P., Grimaud, D., Huchon, P., Ishibashi, J., Joshima, M., Lagabrielle, Y., Mevel, C., Naka, J., Ruellan, E., Tanaka, T. and Tanahashi, M., 1991a. In situ geological and geochemical study of an active hydrothermal site on the North Fiji Basin ridge. Mar. Geol., 98: 259–269.

Auzende, J.M., Okuda, Y., Bendel, V., Ciabrini, J.P., Eissen, J.P., Gràcia, E., Hirose, K., Iwabushi, Y., Kisimoto, K., Lafoy, Y., Lagabrielle, Y., Marumo, K., Matsumoto, T., Mitsusawa, K., Momma, H., Mukai, H., Nojiri, Y., Okuda, Y., Ortega-Osorio, A., Ruellan, E., Tanahashi, M., Tupua, E. and Yamaguchi, K., 1991b. Propagation "en échelon" de la dorsale du Bassin Nord Fidjien entre 16°40 et 14°50S (Yokosuka 90—Starmer). C. R. Acad. Sci. Paris, 312(II): 1531–1538.

Auzende, J.M., Bendel, V., Fujikura, K., Geistdoerfer, P., Gràcia-Mont, E., Joshima, M., Kisimoto, K., Mitsuzawa, K., Murai, M., Nojiri, Y., Ondreas, H., Pratt, C. and Ruellan, E., 1992. Résultats préliminaires des plongées du "Shinkaï 6500" sur la dorsale du Bassin Nord-Fidjien (SW Pacifique)—STARMER. C. R. Acad. Sci. Paris, 314(II): 491–498.

Auzende, J.M., Gràcia-Mont, E., Bendel, V., Lafoy, Y., Lagabrielle, Y., Okuda, Y. and Ruellan, E., in press. Amagmatic extension at intermediate spreading ridge (North Fiji Basin). In: P. Kapezinskhas (Editor), Oceanic Lithosphere. Spec. Issue. Wiley, New York.

Bendel, V., Auzende, J.M., Lagabrielle, Y., Grimaud, D., Fouquet, Y. and Urabe, T., in press. The White Lady hydrothermal site in the north Fiji Basin (STARMER). Econ. Geol.

De Alteris, G., E., Auzende, J.M., Ondreas, H., Bendel, V., Gràcia-Mont, E., Huchon, P., Lagabrielle, Y., Ruellan and Tanahashi, M., in press. Propagating rifts in the North Fiji Basin, Southwest Pacific. Geology, 21: 583–586.

Gente, P., Mével, C., Auzende, J.-M., Karson, J.A. and Fouquet, Y, 1991. An example of recent accretion on the Mid-Atlantic Ridge: the Snake Pit neovolcanic ridge (MARK area, 23°22'N), Tectonophysics, 190: 1–29.

Gràcia-Mont, E., 1991. Etude morphostructurale du segment N160 de la dorsale du Basin Nord-Fidjien. Analyse des données de la campagne Yokosuka 90. Rapport de D.E.A. Univ. Bretagne Occidentale, Brest, 65 pp.

Gràcia-Mont, E., 1992. El segment N160 de la Conca Nord-Fijiana (Pacific Sud-Oest): Morfoestructura d'un eix d'acrecio oceanica d'edat quaternaria dins una conca marginal. Tesi de Licenciatura. Univ. Barcelona, 143 pp.

Grimaud, D., Ishibashi, J.I., Lagabrielle, Y., Auzende, J.M. and Urabe, T., 1991. Chemistry of hydrothermal fluids from the 17°S active site on the North Fiji Basin ridge (SW Pacific). Chem. Geol., 93: 209–218.

Hamburger, M.W. and Isacks, B.L., 1988. Diffuse back-arc deformation in the Southwest Pacific. Nature, 332: 599–604.

Hey, R., 1977. A new class of "pseudofaults" and their bearing on plate tectonics: a propagating rift model. Earth Planet. Sci. Lett., 37: 321–325.

Honza, E., Auzende, J.M. and Starmer Group, 1988. Rift system in the North Fiji Basin: results of Japan–France cooperative research on board Kaiyo 87. Umi, 26: 36–46.

Huchon, P., Gracia E., Ruellan, E., Joshima, M. and Auzende, J.-M., 1994. Kinematics of active spreading in the central North Fiji Basin (Southwest Pacific). In: J.-M. Auzende and T. Urabe (Editors), North Fiji Basin: STARMER French–Japanese Program. Mar. Geol., 116: 69–87.

Kappel, E.S. and Ryan, W.B.F., 1986. Volcanic episodicity and a non-steady state rift valley along Northeast Pacific spreading centers: evidence from SeaMarc I. J. Geophys. Res., 91(13): 13925–13940.

Karson, J.A., Thompson, G., Humphries, S.E., Edmond, J.M., Bryan, W.B., Brown, J.R., Winters, A.T., Pockalny, R.A., Casey, J.F., Campbell, A.C., Klinkhammer, G., Palmer, M.R., Kinzler, R.J. and Sulanovska, M.M., 1987. Along axis variations in seafloor spreading in the MARK area. Nature, 328: 681–685.

Karson, J.A., 1990. Seafloor spreading of the Mid-Atlantic Ridge: Implications for the structure of ophiolites and oceanic lithosphere produced in slow-spreading environments. In: J. Malpas, E.M. Moores, A. Panayiotou and C. Xanophontos (Editors), Proc. Symp. "Troodos 1987". (Nicosia, Cyprus, 1990.) Geol. Surv. Dep.

Kroenke, L.W., Jarvis, P. and Price, R.C., 1987. Morphology of the Fiji Fracture Zone: Recent reorientation of plate boundaries in the vicinity of the North Fiji Basin. EOS Trans. Am. Geophys. Union, 68(44): 1445.

Kroenke, L.W., Smith, R. and Nemoto, K., in press. Morphology and structure of the seafloor in the northern part of the North Fiji Basin. In: L.W. Kroenke and J.V. Fade (Editors), Basin Formation, Ridge Crest Processes, and Metallogenesis in the North Fiji Basin. Circum Pacific Counc. Energy Mineral Resour., Houston, Tex., Earth Sci. Ser., 12: 15–25.

Lafoy, Y., Auzende, J.M., Gente, P. and Eissen, J.P., 1987. L'extremité occidentale de la zone de fracture Fidjienne et le point triple de 16°40S. Résultats du Leg III de la campagne SEAPSO du N.O. Jean Charcot (Décembre 1985) dans le bassin Nord Fidjien, SW Pacifique. C. R. Acad. Sci., Paris, 304: 147–152.

Lafoy, Y., Auzende, J.M., Ruellan, E., Huchon, P. and Honza, E., 1990. The 16°40S Triple Junction in the North Fiji Basin (SW Pacific). Mar. Geophys. Res., 12: 285–296.

Lagabrielle, Y., Eissen, J.P., Auzende, J.-M., Janin, M.C. and Cotten, J., 1994. Geology and geochemistry of a 800 m continuous section through young upper oceanic crust in the North Fiji Basin. In: J.-M. Auzende and T. Urabe (Editors), North Fiji Basin: STARMER French–Japanese Program. Mar. Geol., 116.

Macdonald, K.C., Sempéré, J.C. and Fox, P.J., 1984. The East Pacific Rise from the Siqueiros of the Orozco fracture zone: Along strike continuity of the neovolcanic zone and the structure and evolution of overlapping spreading centers. J. Geophys. Res., 89: 6049–6069.

McKenzie, D.P. and Morgan, W.J., 1969. Evolution of triple junctions. Nature, 224: 125–133.

Olivet, J.L., Bonnin, J., Beuzart P. and Auzende, J.M., 1984. Cinématique de l'Atlantique Nord et Central. Publ. CNEXO, 54, 108 pp.

Patriat, P. and Courtillot, V., 1984. On the stability of the triple junctions and its relation to episodicity in spreading. Tectonics, 3: 317–332.

Pelletier, B. and Louat, R., 1989. Mouvement relatif des plaques dans le Sud-Ouest Pacifique, C. R. Acad. Sci. Paris, 308: 123–130.

Pelletier, B., Lafoy, Y. and Misseque, F., 1993. Morphostructure and magnetic fabric of the Northwestern North Fiji Basin. Geophys. Res. Lett., 20: 1151–1154.

Ruellan, E., Lafoy, Y., Auzende, J.M., Foucher, J.P. and Dupont, J., in press. Circum Pacific Counc. Energy Mineral Resour., Houston, Tex., Earth Sci. Ser., 6.

Reprinted from

MARINE GEOLOGY

INTERNATIONAL JOURNAL OF MARINE GEOLOGY, GEOCHEMISTRY AND GEOPHYSICS

Marine Geology, 116 (1994) 25–35
Elsevier Science B.V., Amsterdam

A possible triple junction at 14°50′S on the North Fiji Basin Ridge (Southwest Pacific)?

Jean-Marie Auzende[a,1], Eulalia Gràcia-Mont[b], Valerie Bendel[b], P. Huchon[c], Yves Lafoy[d], Yves Lagabrielle[b], Giovanni de Alteriis[e,2] and Manabu Tanahashi[f]

[a]*GDR: Genèse et Evolution des Domaines Océaniques, IFREMER/CB, B.P. 70, Plouzané, France*
[b]*GDR: Genèse et Evolution des Domaines Océaniques, Université de Bretagne Occidentale, 6, Avenue Le Gorgeu, 29287 Brest cedex, France*
[c]*ENS, 24 rue Lhomond, 75005 Paris, France*
[d]*Service des Mines et de l'Energie, B.P. 465, Nouméa, New Caledonia*
[e]*CNR-Geomare Sud, Naples 80138, Italy*
[f]*Geological Survey of Japan, Ibaraki, Tsukuba, Japan*

(Received November 14, 1992; revision accepted February 11, 1993)