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# Mapping the Miocene Farallon Ridge jump on the Pacific plate: a seismic line of weakness

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Bathymetric and magnetic data are used to obtain estimates, on the Pacific and Nazca plates, of the boundaries separating lithosphere generated at the old Farallon Ridge from the more recent one created at the present-day East Pacific Rise. An excellent correlation is found with the sites of known teleseismically recorded intraplate seismicity, suggesting that these boundaries, which are lines of age discontinuity in the plate, must be zones of weakness of the lithospheric plate. In particular, the so-called Region C, identified by Okal et al. as a major site of seismic release, sits on a small piece of Farallon plate, in the immediate vicinity of the northern extension of the fossil Roggeveen Rise, cut across by the East Pacific Rise during the ridge jump.

## 1. Introduction

The present spreading pattern in the south-central Pacific Ocean has existed only since the Pacific-Farallon Ridge became inactive in the Miocene, around 20 m.y. ago, when spreading was reorganized largely along the present East Pacific Rise (EPR). On the basis of the recognition of the fossil ridge in the bathymetry, as well as of a detailed study of available magnetic anomalies, Herron [1] has identified the jump and reorientation of the ridge; more recently, Mammerickx et al. [2] have proposed a detailed model of the timing of the ridge jump, thought to have initiated shortly after the Farallon Ridge started subducting under North America.

As a result of this sequence of events, the bulk of the Pacific plate was generated at the fossil ridge, as characterized by its fracture zones presently oriented 250° in its south-central part; it is presently involved in relative motion away from the Nazca plate, about a pole located at 57°N and 88°W, nearly coinciding with its pole of absolute motion [3]. Pacific intraplate stresses, controlled largely by ridge-push forces [4], are thus directed at an azimuth of 290°, 40° away from the plate's original tectonic directions. The only exceptions to this pattern are: (a) the narrow band of lithosphere immediately to the west of the EPR and created since the ridge jump; (b) the extreme southern portion of the plate, south of the Louisville Ridge, since no reorientation was involved south of the Eltanin Fracture Zone System; and (c) other portions of the plate believed to have formed at ridges other than the Pacific-Farallon or the EPR (e.g. the Pacific-Phoenix or Pacific-Kula Ridges).

Significantly, the seismicity of the interior of the Pacific plate is characterized by the absence of magnitude 6 or greater earthquakes, routinely found in other oceanic plates [5], the only exceptions to this pattern being the Hawaiian hotspot and the above-mentioned areas (a) to (c). The favorable angle between the compressional tectonic stress and the geomorphological features could

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explain both the smaller events, and the occurrence of strike-slip faulting [6].

Despite the fact that the origin of the stress released in Pacific intraplate earthquakes is reasonably well understood as due to the relatively complex gravitational sliding known as ridge-push [6], the factors governing the occurrence of the seismicity at clearly preferential sites are not. Although his study was largely based on continental data, Sykes [7] has proposed that seismicity occur at preferential zones of weakness, such as sutured fracture zones outside their active transform segments. Okal [8] has given evidence that other suture lines, such as a line of maximum age in a plate, may also be weak zones of preferential seismicity. Similarly, in the vicinity of active propagating rifts, the pseudofaults defined by Hey and Wilson [9], separating lithosphere generated at the two rifts, have been documented as areas of increased seismic activity [10]. Because it is a line of suture, and represents a locus of age discontinuity, the boundary between Pacific lithosphere generated at the Farallon ridge before the jump, and at the EPR after the jump, could also be a line of weakness.

In order to test this hypothesis, as well as to investigate the factors controlling the different regimes of stress release in the plate, the precise mapping of this boundary on the present Pacific plate is necessary, and is the purpose of this paper. Hereafter, we will call this boundary line the J-(for jump) line. Our study will be limited to the latitudes 0 to 40°S, which grossly represent the present extent of the Pacific-Nazca plate boundary. The counterpart of the J-line in the Nazca plate will be called the K-line.

The exact mechanism by which the jump and reorientation took place is not clear at present. As mentioned by Herron [1] and Mammerickx et al. [2], and evident from the results of this paper, the lateral extent of the ridge jump was on the order of 400–500 km. This figure is constrained by the fact that nowhere did the jump leave two anomalies 7 on the same new plate. It is also comparable to the offset of the Blanco Transform Fault, in the northeastern Pacific, which has been undergoing a process of rift propagation for the last 20 m.y. [9]. Another process leading to eventual ridge jump is the development of a platelet, such as the Easter and Bauer plates [11,12], involving simultaneous accretion at two ridges, one of which becomes more active, and the other one fades with time. These two mechanisms are not necessarily exclusive, since Hey et al. [13] have given evidence of the slow death of the failed rift in the propagating rift model, while Macdonald et al. [14] have recognized localized episodes of "Sixty-nining" along the EPR. As discussed below, very little data, especially magnetic anomalies are available to constrain the detailed history of the ridge jump. Mammerickx et al. [2] have suggested that the whole episode took no longer than a few million years. In this paper, we will not try to model the mechanism of the jump, but rather consider it an instantaneous event, for the purpose of recognizing its signature on the ocean floor.

## 2. Data and methods

Precise mapping of the J-line is made difficult by the generally poor shipboard bathymetric coverage in the south-central Pacific. In the present study, we have made use of the 1975 bathymetric maps of the South Pacific by Mammerickx et al. [15], and of the more recent 1978 map of the southeast Pacific by Mammerickx and Smith [16]. Unfortunately, the lateral extent of major inactive fracture zones, such as the Austral, is not fully documented. These features would be expected to dead-end, take a sharp bend, or convert to pseudofaults [9] upon reaching the J- or K-lines.

An additional problem stems from the low resolution of the magnetic anomaly scale in the Miocene, with only three well-defined magnetic anomalies (7, 6 and 5) covering the entire period from 27 to 9.5 m.y. Magnetic anomaly 6 (21 m.y.) is itself poorly mapped in most of the south-central Pacific. This problem is further compounded by the fast rates of spreading involved in the area since the Eocene. This lack of detailed magnetic data also prevents an easy identification of the signature of the pseudofaults which may be remnants of the propagators involved in the jumps [9].

Nevertheless, the recognition of faint intraplate bathymetric features as remnants of the fossil, deactivated, Farallon Ridge, allowed Mammerickx et al. [2] to propose a relatively detailed time-table of the ridge jump, on the basis of the extrapolation of documented Oligocene spreading rates beyond anomaly 7. This model, and the original data from which it was obtained, will be the basis of our mapping. The following (and trivial) rules will govern our investigation:

(1) A piece of fossil ridge on the present Pacific plate is a westernmost limit for the J-line (and conversely, easternmost for the K-line in the Nazca plate).

(2) The oldest magnetic anomaly on the Pacific plate oriented along the new system is an easternmost limit for the J-line (and conversely, westernmost for the K-line in the Nazca plate).

(3) The youngest set of magnetic anomalies pre-dating the jump, of which one is found on the Pacific plate, and the other on the Nazca plate, constitute a westernmost limit for the J-line, and an easternmost limit for the K-line (in practice, this will apply only to anomaly 7). These limits will be better estimates of the J- or K-lines on the plate without the fossil ridge, than on the plate retaining it, where they will be too far out by twice the lateral extent of the ridge jump.

(4) The youngest part of any fracture zone segment on the Pacific plate whose azimuth, clearly documented in the bathymetry, identifies it as belonging to the old system, is a westernmost limit for the J-line (and conversely, easternmost for the K-line in the Nazca plate).

We want to emphasize that rules (1) to (4) do not involve the choice of spreading rates, or any assumption on the symmetry of spreading. They provide very conservative, but safe, error bars for the location of the J- and K-lines.

As shown in Fig. 1, the fundamental pieces of data used in our mapping can be divided into several large regions corresponding to intervals between major fracture zones of the old system: the Grijalva-Galápagos, Mendaña-Marquesas, Easter-Austral, Challenger-"A", and Mocha-Agassiz systems. Following the nomenclature of Handschumacher [17], we use the name "Agassiz" Fracture Zone for the feature at 38°S (this is consistent with Mammerickx et al.'s maps [15,16], and Fracture Zone "A" at 32°S (called the Agassiz Fracture Zone by Mammerickx et al. [2]); note also that the Gallego Rise is mislabelled in fig. 5 of Mammerickx et al. [2].

Identified segments of anomaly 7 are labelled *7* in Fig. 1. The fossil ridge segments are the ones identified by Mammerickx et al. [2]: the Gallego (*GL*), Mendoza (*MZ*), Roggeveen (*RG*) and Selkirk (*SK*) Rises.

The simple assumption of symmetric spreading prior to the jump (but still no assumption on the rates) allows to transfer constraints from the J- to the K-line, and vice-versa: for example, the presence of anomaly 7 on the Pacific plate, between the Marquesas and Austral Fracture Zones, means that the new ridge, immediately after the jump, was located between this line and the Mendoza Rise. Assuming symmetric spreading, we find a western limit for the K-line by taking the mirror image of the Nazca plate's anomaly 7 with respect to the Mendoza Rise (labeled *7′* in Fig. 1). Similarly, the presence of the Mendoza Rise on the Nazca plate provides an eastern limit for the J-line in the same area: a line located east of anomaly 7 on the Pacific plate, at the same distance separating the Mendoza Rise from anomaly 7 on the Nazca plate. We label such images of the fossil rises on the other plate *GL′*, *MZ′*, etc. They have the following simple interpretation, given for example in the case of *RG′*: had the jump at this latitude been eastward rather than westward, the present-day location of the fossil ridge would be *RG′* on the Pacific plate, rather than *RG* on the Nazca plate.

Following Mammerickx et al. [2] and referring to the detailed bathymetry of Mammerickx and Smith [16], we note that the Roggeveen Rise is not identified north of 30°S. Therefore, we stop its image on the Pacific plate at a latitude of 23.5°S. Similarly, we use the limits of identification of the Mendoza, Selkirk, and Gallego Rises to safely define their images in the Pacific plate (the Nazca plate in the case of the Gallego Rise).

Additionally, and just as the knowledge (or estimation) of spreading rates predating the jump allowed Mammerickx et al. to time it, post-jump rates should in principle enable us to locate the J- and K-lines, using the ages proposed in their model. However, as noted by many authors [2,17,18],

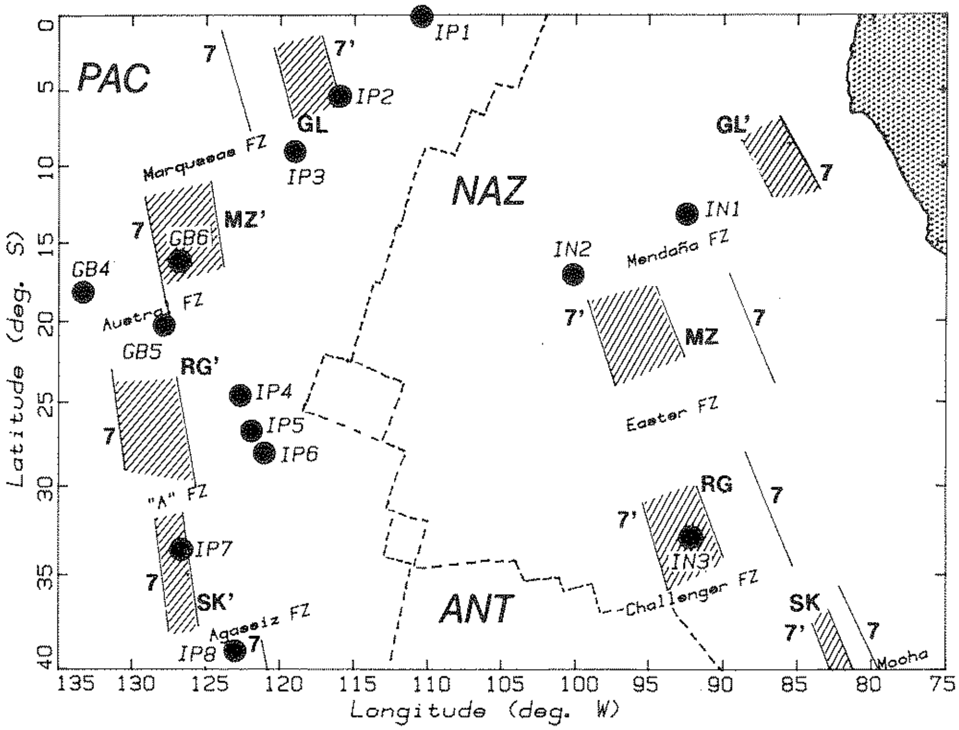


Fig. 1. Mercator projection of the area under study. The dashed lines delimit the present plate system, including the two platelets identified by Herron [12]. Identified sections of anomaly 7 are shown as full lines and labeled *7*. *GL*, *MZ*, *RG* and *SK* are segments of the following respective fossil ridges: Gallego, Mendoza, Roggeveen, and Selkirk. *7'* denotes segments symmetric of anomaly 7 with respect to the fossil rises. *GL'*, *MZ'*, *RG'* and *SK'* denote images of the fossil rises on the other plate, assuming symmetric pre-jump spreading (see text for detailed interpretation). Hatched areas are error bars for the J- and K-lines. Individual dots, with code referring to Table 1, are foci of teleseismically recorded Pacific and Nazca intraplate earthquakes.

there are practically no means of constraining spreading rates for the period 18.5 to 12 m.y.: estimates could in principle be obtained from the separations between couples of post-jump magnetic anomalies. Unfortunately, this method cannot be reliably extended past the time of anomaly 5. Additionally, Herron's [1] reconstruction of magnetic anomalies in the new portion of the plate shows the need for a substantial spreading rate change (from 5 to 8 cm/yr) around latitude 29°S at the time of anomaly 4 (6 m.y.); a secondary ridge jump, which resulted in deactivation of the Galápagos ridge is well documented between 8.2 and 6.5 m.y. One cannot exclude the existence of similar phenomena in the unknown window 12–18.5 m.y., and extrapolation of spreading rates at the time of anomaly 5 all the way to 18.5 m.y. is unwarranted. In other words, our lack of knowledge of spreading rates for this time period does not allow us to narrow down the uncertainty areas of Fig. 1.

## 3. Results

On the basis of these data points, we obtained the areas hatched in Fig. 1, which can be interpreted as error bars, surrounding the J- and K-lines. It should be emphasized that, while the general orientation of the hatched areas follows the old spreading trend, and under the assumption of instantaneous jumps, the J- and K-lines are expected to follow the orientation of the new spreading system, immediately following the jump. As a first approximation, this orientation should be close to the present one, but one cannot bar changes in the spreading configuration subsequent to the jump. Further episodes of ridge jump are indeed well documented in the area of the now deactivated Galápagos Rise, or thought to be ongoing in the area of the Easter platelet [11,12]. Additionally, if the jump occurred through rift propagation, the J- and K-lines would be oriented along oblique "pseudofaults". If, however, the propagation was very fast (as suggested in Mammerickx et al. [2]), the lines would be parallel to the new system.

Offsets in our error areas simply indicate that, immediately following the jump, substantial fracture zones existed in the new spreading system. This is in agreement with the detailed model of Mammerickx et al. [2], involving their "13°S Fracture Zone", which developed in the area of the Marquesas-Mendaña system. In areas where no identification of the fossil rises is possible, their images in the other plate have been truncated.

Pacific and Nazca intraplate earthquakes located in the area of interest during the period 1944–1980 are listed in Table 1 and plotted in Fig. 1. In compiling this catalogue, we kept only events of magnitude at least 4.5, in order to maintain a homogeneous detection level throughout our region of study; this level would be considerably lowered in the western portion of Fig. 2 by the presence of the Polynesian network. As a result, we eliminate the known seismicity at locations

TABLE 1

Intraplate seismic events with magnitude ⩾ 4.5 recorded in the area shown in Fig. 1

| Date (year month day) | Origin time (GMT) | Epicenter (°S, °W) | | Magnitude | Location code | Reference [a] |
|---|---|---|---|---|---|---|
| *Pacific plate* | | | | | | |
| 57 7 18 | 15:24:20 | 0.0, | 110.5 | | IP1 | NOAA |
| 80 1 30 | 00:31:14 | 5.3, | 116.0 | 5.3 | IP2 | ISC |
| 49 11 11 | 10:57:36 | 9.0, | 119.0 | | IP3 | NOAA |
| 78 1 30 | 18:34:20 | 16.2, | 126.9 | 5.0 | GB6 | [6] |
| 77 10 31 | 08:19:13 | 20.8, | 126.9 | 5.1 | GB5 (Region C) | [6] |
| 78 1 5 | 03:23:25 | 20.9, | 126.9 | 5.5 | GB5 (Region C) | [6] |
| 78 2 4 | 12:59:58 | 20.8, | 126.7 | 4.5 | GB5 (Region C) | [6] |
| 78 2 19 | 23:58:00 | 20.8, | 126.7 | | GB5 (Region C) | [19] |
| 78 3 11 | 03:32:10 | 20.8, | 127.0 | 4.8 | GB5 (Region C) | [6] |
| 78 7 13 | 18:04:20 | 20.7, | 127.0 | 5.1 | GB5 (Region C) | [6] |
| 78 7 25 | 07:54:08 | 20.8, | 126.9 | 5.4 | GB5 (Region C) | [6] |
| 78 10 18 | 02:03:56 | 21.0, | 126.9 | 5.1 | GB5 (Region C) | [6] |
| 79 2 2 | 17:35:53 | 20.8, | 127.2 | 4.8 | GB5 (Region C) | [6] |
| 79 2 26 | 06:31:53 | 20.8, | 127.0 | 5.0 | GB5 (Region C) | [6] |
| 79 5 21 | 15:34:02 | 20.8, | 126.7 | 4.8 | GB5 (Region C) | [6] |
| 55 11 22 | 03:24:00 | 24.4, | 122.6 | 6.7 | IP4 | [21] |
| 51 9 29 | 18:15:00 | 26.6, | 122.0 | | IP5 | TS |
| 51 8 3 | 19:20:15 | 28.0, | 121.0 | | IP6 | NOAA |
| 63 9 14 | 16:16:52 | 33.6, | 126.7 | 4.9 | IP7 | NOAA |
| 76 7 31 | 05:11:20 | 39.0, | 123.1 | 4.5 | IP8 | ISC |
| *Nazca plate* | | | | | | |
| 44 8 5 | 00:57:21 | −13.1, | −92.5 | | IN1 | TS |
| 44 8 5 | 01:24:11 | −13.1, | −92.5 | | IN1 | TS |
| 65 [illegible] 25 | 10:50:40 | −17.1, | −100.2 | 5.8 | IN2 | [20] |
| 72 5 28 | 08:38:52 | −32.8, | −92.2 | 4.9 | IN3 | [29] |

[a] Key to references: NOAA = NOAA Tape of Epicenters; ISC = Bulletin of the International Seismological Center; TS = relocated as part of this study.

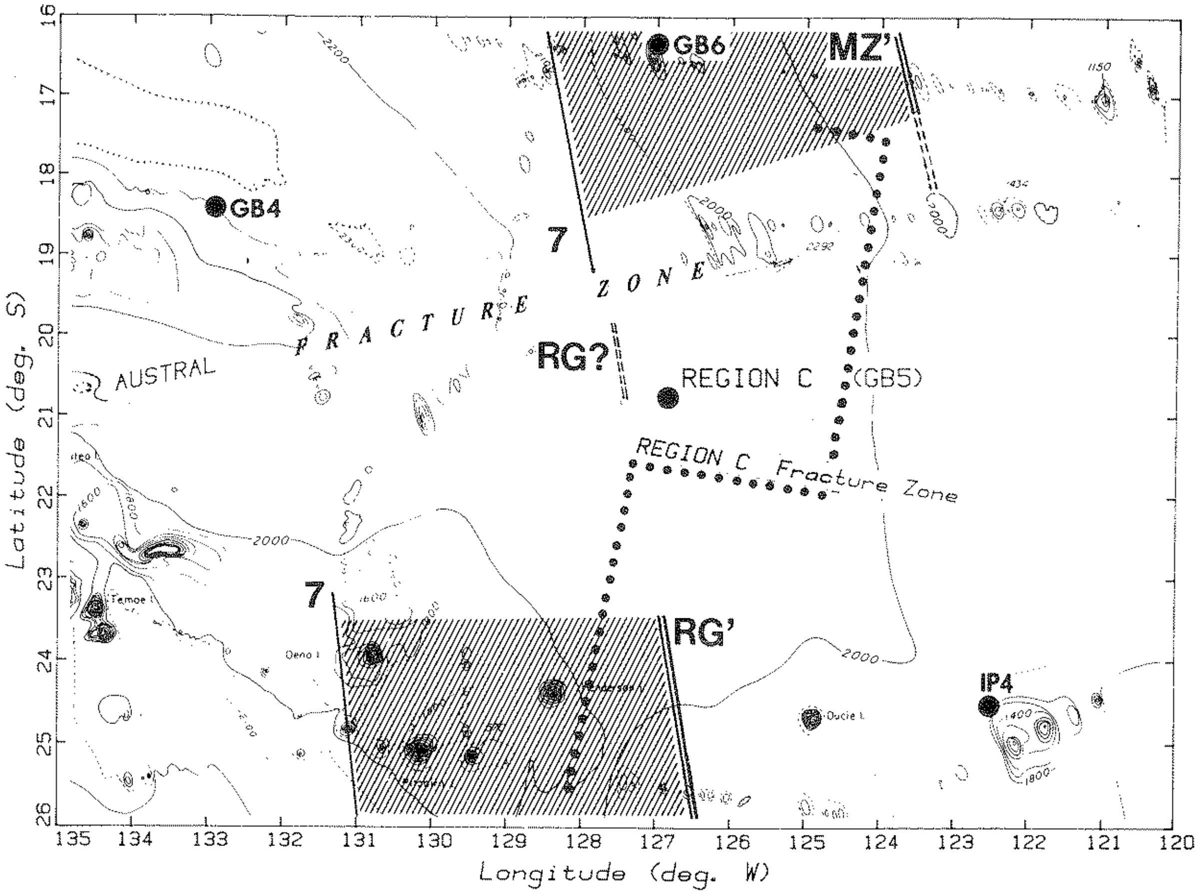


Fig. 2. Close-up of the Region C area, superposed on Mammerickx et al.'s [15] bathymetric map. Symbols as in Fig. 1. Additionally, *RG*? denotes northern segment of Roggeveen Rise, probably present in the immediate vicinity of GB5. The dotted line, including a 200 km offset along the Region C Fracture Zone, is the modeled location of the J-line. The slightly shaded area surrounding Region C is a piece of Farallon plate cut away from the Nazca plate during the jump. Note also seamounts in vicinity of epicenter IP4.

GB2 and GB3, defined in Okal et al. [6], which reaches only magnitude 3.5. We also eliminate the $M_L = 4.5$ single event at GB7 [6], since it was detected only in Polynesia, and its magnitude could thus be overestimated. Reference is made to Okal et al. [6] for a more complete catalogue of the known seismicity, including 98 events recorded by the French Polynesia Seismic Network at the so-called "Region C" (GB5); details on location procedures and estimates of epicentral accuracy are given by these authors and by Jordan and Sverdrup [19]. In the Nazca plate, only four events are known: the large 1965 shock studied in detail by Mendiguren [20], a doublet of 1944 shocks to the north, and an isolated 1972 event to the south.

It is at once evident that a good correlation exists between the location of these seismic epicenters and the regions allowed for the J-line: the Pacific plate epicenters IP2, GB6, IP7 and the Nazca plate's IN3 lie within the hatched regions; IP3, GB5, IP8 and IN2 are located in the areas of large offsets of these regions, which may, as we said earlier, represent substantial transform faults of the new ridge system immediately after the jump. Exceptions to the pattern are GB4, IP4, IP5, IP6 and IN1, discussed in detail below, and IP1, whose location must be controlled by factors not presently understood.

The large 1955 shock at IP4 is a rare example of a normal fault intraplate event. It was used by Sykes and Sbar [21] to propose that regions in the immediate vicinity of spreading ridges are in a tensional state of stress. A new investigation of its mechanism [22] has confirmed this character, and constrained the tension axis to a generally NE-SW direction. Bathymetry is poorly known in its general area, but, as shown in Fig. 2, Mammerickx et al. [15] report shallow structures topping at less than 1000 m b.s.l. in its immediate vicinity, conspicuously aligned with Oeno, Henderson and Ducie Islands. The two 1951 events at IP5 and IP6 are poorly documented; while the IP5 event was relocated to a good precision, about 130 km south of IP4, no first arrival data is readily available for IP6, and one cannot exclude the possibility that IP5 and IP6 share a common epicenter. Their relation in time and the presence of the seamounts also suggest that they could be the only events detected during an episode of intraplate volcanism, similar to the ones known at Macdonald [23], Mehetia [24], or Teahitia [25]. Large-magnitude normal faulting following intraplate volcanic activity has also been described near Deception Island in Antarctica [26]. Thus, the origin of the seismicity at IP4, IP5 and IP6 could be controlled by local structures, possibly an active hotspot related to the nearby islands, rather than by the general state of stress in the plate.

As for GB4, three of its events were studied in detail by Okal et al. [6], who concluded that stress release is representative of ridge-push. The location of GB4, as well as that of the smaller events at GB1, GB2, GB3 described by these authors, is possibly controlled by the action on the lithosphere of the nearby Tuamotu Ridge.

In the Nazca plate, the site of the two 1944 events, IN1, is located in an area of complex history: as described by Mammerickx et al. [2], this portion of the plate was generated at the Galápagos Rise, a section of the "new" ridge system, which was active only between 18.5 and 8.5 m.y. B.P., when the ridge jumped back to its present location on the EPR. Relocation of the 1944 events give two indistinguishable foci at 13.1°S and 92.5°W. This area is also in the immediate vicinity of the Dana Fracture Zone, identified by Mammerickx et al. [2] as an offset of the Galápagos Rise. The location of IN1 could be controlled by the Dana Fracture Zone.

## 4. The Region C area

The GB5, or Region C area, identified by Okal et al. [6], has been the subject of several subsequent investigations: Jordan and Sverdrup [19] conducted a detailed study of the relative location of seven shocks, and concluded that the extent of the seismic region is probably no larger than 12 km. Sailor and Okal [27] used SEASAT radar altimetry over the area, concluding that no major seamount, comparable to Macdonald volcano, is present, but discovered a fracture zone (which they referred to as the Region C Fracture Zone) 70 km south of Region C. Their findings were corroborated by bathymetry along a recent shiptrack (J. Mammerickx, personal communication, 1982) and by a local SEABEAM survey by the R/V "Jean Charcot" in the vicinity of Region C (J. Francheteau, personal communication, 1981). The Region C Fracture Zone was also identified by Sandwell [28], in a general study of the horizontal gradient of the geoid over the southern Pacific. Because they tracked it only for a small distance, Sailor and Okal were not able to constrain its azimuth precisely, but Sandwell's data, relative to a much longer stretch of fracture zone, clearly identifies it as oriented along the "new", post-jump, spreading regime. Sailor and Okal have shown that the younger material is to the south and proposed a figure of 3 m.y. for the age offset: this would be compatible with a right-lateral offset along the J-line; assuming half spreading rates immediately after the jump in the range of 6–8 cm/yr, this offset should be about 180–240 km in length.

Any interpretation of the tectonic history of Region C, located just south of the Austral Fracture Zone, must involve the Roggeveen Rise, in the Nazca plate, which is the remnant of the fossil ridge in this portion of the old system. However, the Roggeveen Rise disappears north of 30°S in the Nazca plate (this point can be rotated to its image on the Pacific plate, at about 23.5°S on the right margin of the hatched area in Fig. 2). Thus, a segment of fossil ridge about 300 km long is unaccounted for between the northern end of the Roggeveen Rise and the Easter Fracture Zone. There are two possibilities to explain this situation: either the Roggeveen Rise was originally offset by a fracture zone in the "old" system prior to the jump, or it was cut across by the new spreading ridge at the time of the jump. Since there is no clear evidence of a major fracture zone immediately northeast of the Roggeveen Rise in the Nazca plate [16], we prefer the second alternative. This means that, in the northern section of the Roggeveen Rise, the jump was actually *eastward* rather than westward (a similar pattern is known to have taken place at the Gallego Rise which is found nowadays on the Pacific rather than on the Nazca plate). This model requires a sharp right-lateral offset of the J- and K-lines in this area, also made necessary by the offset between the two hatched areas shown in Fig. 2. Additionally, the Austral Fracture Zone is well documented in the bathymetry at 125°W [15], and this requires the J-line to pass east of this point. Thus, several pieces of evidence strongly suggests that the J-line takes a right-lateral offset of about 300 km between latitudes 20.5 and 23.5°S. We propose that the Region C Fracture Zone is the expression of at least a substantial part of this offset. Since it is located at 21.5°S, about 200 km north of the image of the termination of the Roggeveen Rise, it is possible that a somewhat more complex system was involved in truncating the Roggeveen Rise; in particular, this system may have involved a temporary platelet. In any case, it is probable that the northern section of the Roggeveen Rise should be lying in the present Pacific plate, around 20.5°S, 127°W. We tentatively map this feature as *RG*? in Fig. 2. The offset of the Region C Fracture Zone suggests that the J-line is east of Region C. The shaded area in Fig. 2, including Region C, would then be a small piece of Farallon plate which became part of the new Pacific plate during the jump. This small area, bordered by four zones of weakness (two sutured fracture zones, a fossil ridge and the J-line) may be a weak spot of preferential seismic release. In particular, it is not impossible that Region C might be located on the northern portion of the Roggeveen Rise. Preliminary data from a few SEABEAM tracks in the area show a very complex geomorphology (J. Francheteau, personal communication, 1981), but are insufficient to propose a clear model. A further, systematic, exploration of the Region C area is clearly warranted.

Additionally, the question arises of the possible influence of the Easter hotspot on the tectonics of Region C. Pilger and Handschumacher [30] have shown that the Austral Fracture Zone played a fundamental role in controlling the output from the Easter hotspot, believed to have created the Nazca and Tuamotu Ridges (on-ridge volcanism), the Sala-y-Gomez seamount chain (off-ridge volcanism), and present-day Easter Island. We do not think, however, that the Easter hotspot directly influenced Region C in any way, since at the time of the ridge jump, and according to these authors' model, it was located immediately south of the Mendoza Rise, and thus at least 450 km from Region C; this distance then increased with time, since the activity at the East Pacific Rise (believed to be practically fixed with respect to the Easter hotspot [30]) kept inserting new material between the two of them.

## 5. Conclusion

We have shown that available magnetic and bathymetric data allow the construction of uncertainty areas for the lines separating lithosphere generated at the Farallon and East Pacific Ridges. Unfortunately, and despite the precise timetable for the jump proposed by Mammerickx et al., our ignorance of spreading rates between 12.5 and 18 m.y. prevents us from further constraining their positions. With a few exceptions, probably controlled by localized stress conditions, it is found that teleseismically detected intraplate seismicity is preferentially emplaced within the error areas, suggesting that the boundary lines, known to involve a discontinuity in the age of the ocean floor, and to be preferential sites of seismicity in the early stages of ridge jumps [10], remain permanent lines of weakness in the plate.

In the case of Region C, identified earlier as one of the most active seismic foci in the Pacific plate, the presence of a fossil fracture zone 70 km to the south, combined with the absence of the Roggeveen Rise in the Nazca plate north of 30°S, suggests that it sits on a small piece of Farallon plate, cut away from the Nazca plate at the time of the ridge jump. This hypothesis predicts the presence of a fossil ridge in the immediate vicinity of Region C, and could be tested by a detailed bathymetric study.

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