Structural trends and basement rock subdivisions in the western Gulf of St. Lawrence: Reply

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We welcome the comments of St. Peter and Fyffe because one of the aims of our study in the Gulf of St. Lawrence was to provide offshore observations that could be related to onshore geology. Our correlations between the onshore and the offshore were based primarily on geophysical data, and a complete analysis requires a detailed knowledge of onshore geological relationships.

St. Peter and Fyffe argue that the Indian Mountain horst and the Egmont Bay high are part of one continuous structure. We define the Egmont Bay high as the basement structure observed on seismic data which extends beneath western Prince Edward Island, from the Northumberland Strait to the Gulf of St. Lawrence (Figs. 1, 2). It is bounded to the southeast by a fault that offsets pre-Carboniferous basement with the down side to the southeast. We feel that the arguments of St. Peter and Fyffe do not demonstrate the extension of this feature in New Brunswick, and we review them as follows: (1) the Indian Mountain horst is interpreted as a positive transpressive structure and we interpret a positive transpressive structure southeast of the Egmont Bay high northeast of Prince Edward Island. However, this does not necessarily imply that one is the continuation of the other; (2) the presence of thick Horton Group clastic rocks and Windsor Group evaporites southeast of the Egmont Bay high and thick Windsor Group evaporites east of Sussex does not require the presence of a continuous horst. These rocks merely indicate that deep basins developed on the south side of major faults. Furthermore, there are thick Horton Group clastic rocks and Windsor Group evaporites west of Sussex, and north of the Kennebecasis-Berry Mills Fault (Howie, 1988); (3) seismic data crossing the reverse fault southeast of the Egmont Bay high northeast of Prince Edward Island (Durling and Marillier, 1990, fig. 8, section E-F) show that this fault is a post-Horton Group and probably pre-Windsor Group fault, but it does not affect post-Windsor Group strata. The Kennebecasis-Berry Mills Fault is a pre-Early Hopewell (Canso) Group fault (Webb, 1969, p. 762), and for this reason it may not be necessarily the extension of our pre-Windsor Group fault.

St. Peter and Fyffe agree with Webb (1969) and van de Poll (1983) who suggested that the Egmont Bay high and the Indian Mountain horst are part of the same structure. Webb (1969, fig. 2, index number 8) terminated the Indian Mountain horst west of the New Brunswick coast. Van de Poll (1983) suggested that the Egmont Bay high is the continuation of the Indian Mountain horst based on the interpretations of Garland (1953), Howie and Cumming (1963), and Bhattacharyya and Raychaudhuri (1967) who used gravity, borehole and magnetic data, respectively. We review the results of Howie and Cumming (1963) and the gravity and magnetic data below. The northeasterly trending gravity maximum (Fig. 1), associated with the Egmont Bay high in Prince Edward Island becomes a two peaked gravity high along the New Brunswick coast. This gravity high does not continue farther southwest beneath the Indian Mountain horst. These detailed gravity anomalies are not shown on Garland's (1953) gravity anomaly map because of the sparseness of gravity measurements at that time. Thus, gravity data indicate that whatever is causing the gravity anomaly northeast of Prince Edward Island is not present beneath the Indian Mountain horst. Also, the magnetic data (Fig. 2) show that the Indian Mountain horst is associated with a narrow, high-amplitude, positive magnetic anomaly that decreases in amplitude near the New Brunswick coast. The magnetic high over northwestern Prince Edward Island and extending into the Gulf is on the same trend as the Indian Mountain horst as indicated by Bhattacharyya and Raychaudhuri (1967), but the anomaly is much broader, lower in amplitude, and centred north of our basement high. Howie and Cumming (1963, figs. 3, 4) and Howie and Barss (1975) did not connect the Horton and Windsor Group rocks in the Indian Mountain area with those beneath Prince Edward Island, and Howie and Cumming (1963, fig. 1) indicated that the Egmont Bay high is associated with the edge of the New Brunswick shelf (platform). These data suggest that the structures are not necessarily continuous across the Northumberland Strait as proposed by St. Peter and Fyffe.

Three northwest-southeast oriented industrial seismic reflection profiles (Chevron Canada Resources Limited) from southeastern New Brunswick (Figs. 1, 2) provide important information. The seismic profiles that cross the Indian Mountain horst clearly show truncated reflections (of possible Windsor Group and younger age) beneath the surface location of the Smith Creek Fault and a disturbed zone between the surface locations of the Smith Creek and the Kennebecasis-Berry Mills faults. However, the seismic profile adjacent to the New Brunswick

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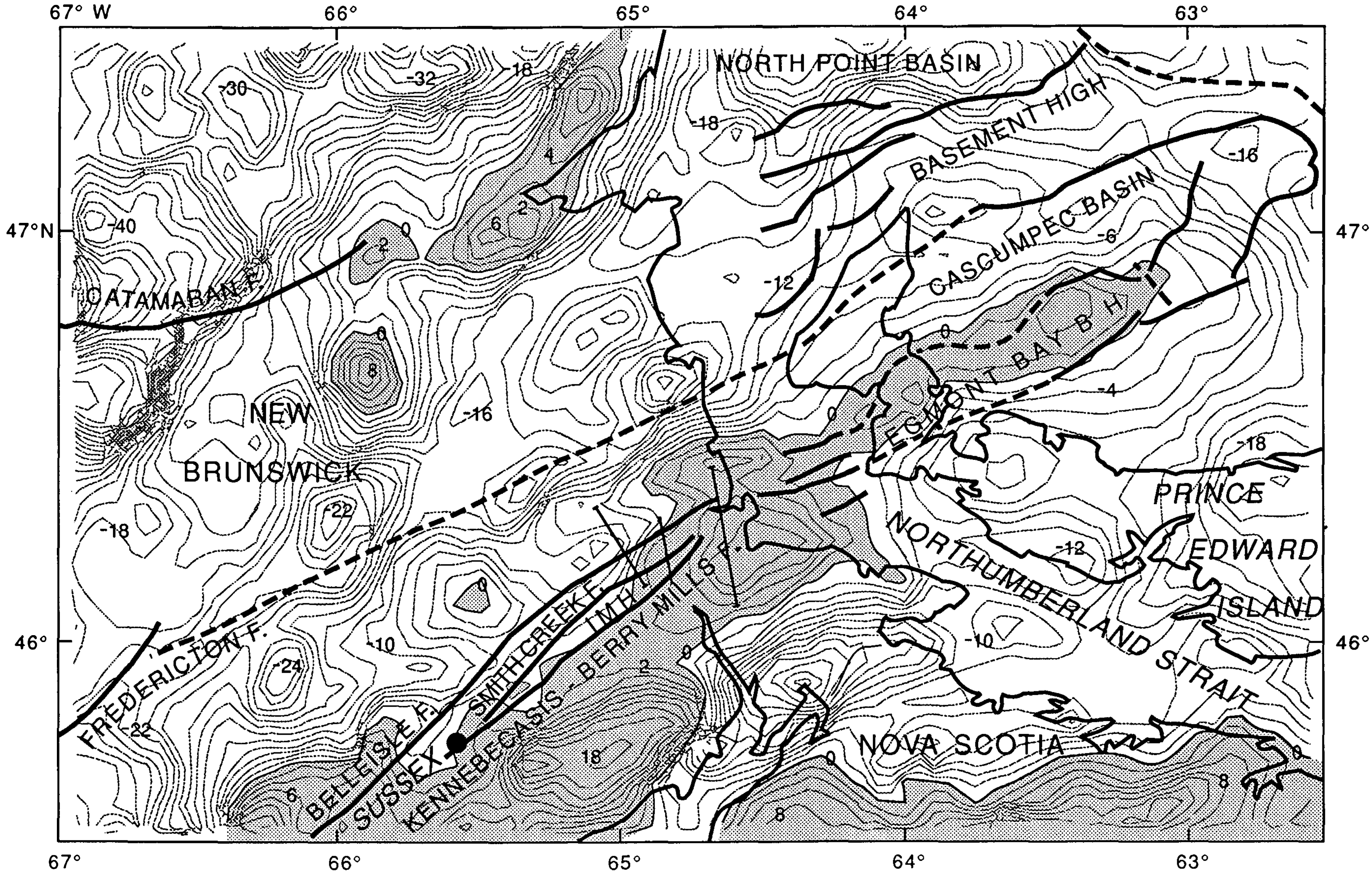

Fig. 1. Gravity data for the eastern New Brunswick area with the main structural features superimposed (dashed and solid lines). Data are free-air anomaly offshore and Bouguer anomaly on land, with contours every 2 mGal (Committee for the Gravity Anomaly Map of North America, 1987). Abbreviations: BH - Basement high, IMH - Indian Mountain horst. The locations of the seismic profiles in southeastern New Brunswick are approximated by three straight line segments.

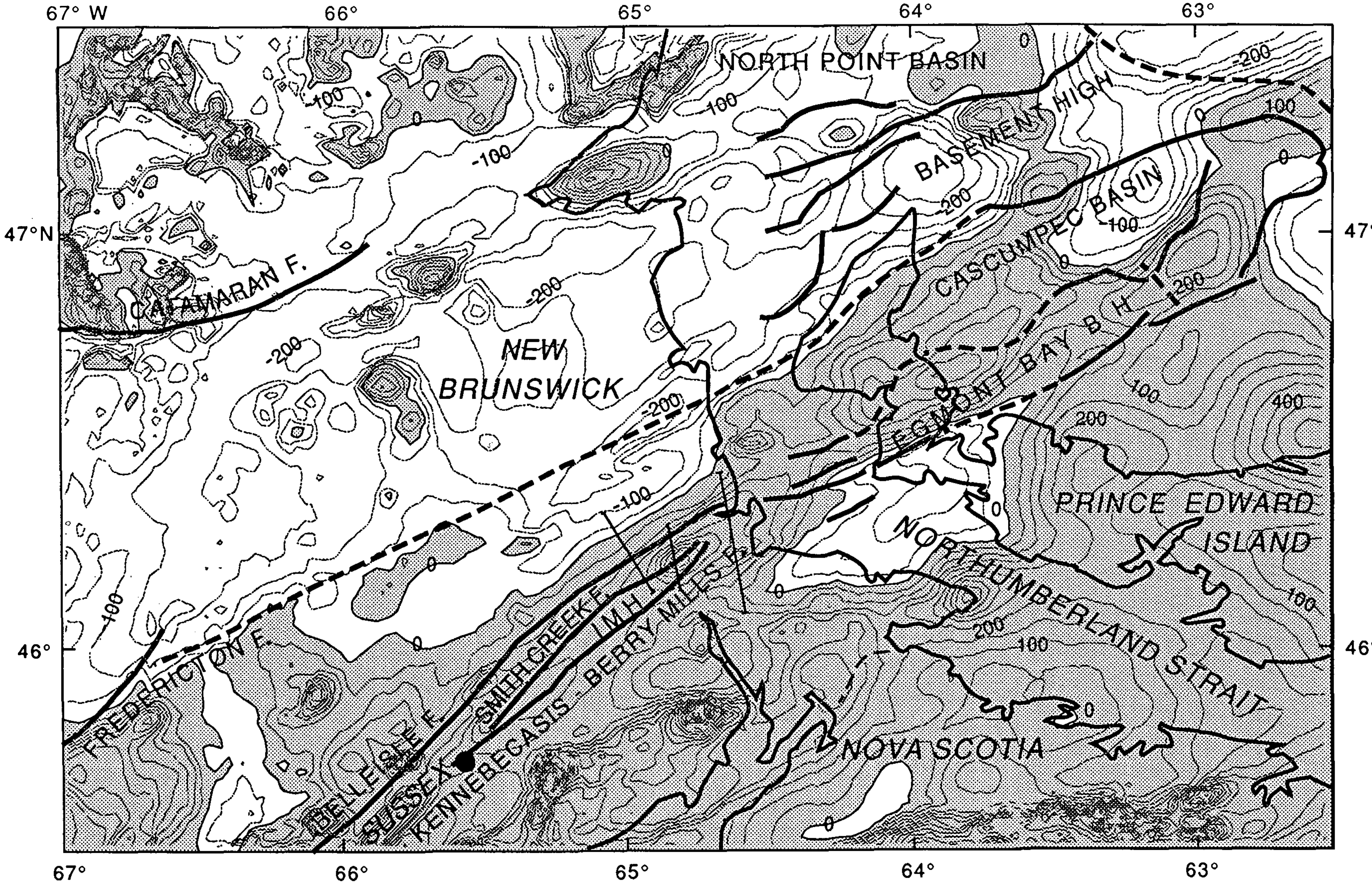

Fig. 2. Magnetic data for the eastern New Brunswick area with the main structural features superimposed (dashed and solid lines). A geographical grid of approximately 2 by 2.5 km was used to produce these contours (Shih *et al.*, in press). The contour interval is 50 nT. Abbreviations and locations of the seismic profiles are explained in Figure 1.

coast crosses the proposed northeastern extension of the horst and shows a basin-like feature but none of the seismic characteristics of the horst. Thus, the seismic data suggest that the Indian Mountain horst does not extend to the New Brunswick coast.

The presence of a horst near Egmont Bay is not required by magneto-telluric data collected by Jones and Garland (1986) over the Egmont Bay basement high. They defined a south-dipping resistive layer southeast of the high but showed a horizontal resistive layer northwest of the Egmont Bay high.

St. Peter and Fyffe argue that the Belleisle Fault cannot cross the northeastern extensions of the Smith Creek and Kennebecasis-Berry Mills faults. However, the geophysical data suggest that the Smith Creek and Kennebecasis-Berry Mills faults die out before reaching the Northumberland Strait and that the Indian Mountain horst does not continue to Prince Edward Island. Therefore, we defend our location for the Belleisle Fault for the following reasons: (1) there are no seismically defined structures in the Northumberland Strait that support the location of the Belleisle Fault proposed by St. Peter and Fyffe; (2) the correlation of the Belleisle Fault with the normal fault along the northern margin of the Horton half-graben in the Cascumpec Basin is very speculative as this fault is limited to a small area; and (3) our location of the Belleisle Fault along the southeast edge of the Egmont Bay high is consistent with the interpretation that the boundary between the New Brunswick platform and the "Fundy epieugeosyncline" coincides with the Belleisle Fault (Ball *et al.*, 1981). The presence of the New Brunswick platform northwest of our extension of the Belleisle Fault is suggested by seismic data in Prince Edward Island and in the Gulf showing thin, flat lying Carboniferous strata overlying a shallow basement surface.

Our location of the Fredericton Fault is questioned by St. Peter and Fyffe. Its location approximately follows the northern edge of positive magnetic anomalies (Fig. 2) and a linear gravity gradient (Fig. 1). These features extend across the northern tip of Prince Edward Island rather than "well offshore of P.E.I." as mentioned by St. Peter and Fyffe. The granitic pluton referred to by St. Peter and Fyffe is probably responsible for the small deviation from the general trends of the gradients. We concede that this evidence may not be strong enough to locate a fault beyond any doubts. However, the changes of the general characteristics of the gravity and magnetic fields in this area do suggest a major crustal boundary that is probably the extension of the one identified on deep seismic profile 86-1 (Durling and Marillier, 1990, fig. 9).

St. Peter and Fyffe connect the northeastern extension of the Basswood Ridge-Pendar Brook Fault (their fig. 1) with the fault that bounds the Cascumpec Basin to the north. However, the latter fault separates deformed basement rocks to the north from a pre-Carboniferous basin to the south. This is not consistent with the structural relationships seen along the Basswood Ridge-Pendar Brook Fault (Fyffe, 1990). If the North Point Basin represents the offshore equivalent of the Fredericton trough, the Basswood Ridge-Pendar Brook Fault should be correlated with one of the faults along the southern margin of the North Point Basin. Alternatively, the basement high between the Cascumpec and North Point Basins may represent an uplifted horst within the Fredericton Trough.

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