GRAVITY AND SEISMIC REFLECTION PROFILES OVER THE SANDSPIT FAULT QUEEN CHARLOTTE ISLANDS (103G/1E)

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INTRODUCTION

Fieldwork on northeastern Moresby Island and eastern Graham Island was conducted in order to obtain more precise information on the timing, magnitude, and sense of displacement on the Sandspit fault (Sutherland Brown, 1968). On land, the fault and parallel subsidiary splays form the western edge of the Queen Charlotte Basin, separating Neogene nonmarine and marine sediments on the east from Mesozoic and Paleogene volcanic and plutonic rocks exposed to the west on the Queen Charlotte Islands.

In addition to the geophysical work reported here, limited geological mapping was done in order to supplement previously published (Sutherland Brown, 1968; 1975) and open access data (Grinsfelder, 1959; Sproule, 1967). A revised geological and structural map of the landward portion of the Queen Charlotte Basin is presently being prepared. Volcanic and granitic rocks, the distribution of which may have been controlled by the Sandspit fault, will be dated using K-Ar and Rb-Sr techniques (with R. L. Armstrong, University of British Columbia).

The study forms part of an M.Sc. thesis to be submitted by one of the authors (I. F. Young) to the University of British Columbia. Financial support came from the British Columbia Ministry of Mines and Petroleum Resources, Department of Energy, Mines and Resources, Shell Canada Limited, National Research Council, and the University of British Columbia.

DISCUSSION OF GEOPHYSICAL RESULTS

The major part of the study consisted of gravity and magnetic measurements across the fault zone and seismic reflection and magnetic profiling in Skidegate Inlet (Fig. 12). The offshore work, carried out aboard *C.F.A.V. Endeavour,* was part of a more extensive survey that investigated a possible submarine continuation of the Sandspit fault in southwestern Hecate Strait and northwestern Queen Charlotte Sound. Unequivocal evidence that the fault does extend southeast from Cumshewa Head was not obtained though gentle folds, rarely faulted, with axes parallel to the Sandspit fault, were seen in seismic profiles in a zone west of the presumed submarine fault trace. Preliminary results of this work will be published elsewhere (Young and Chase, in press).

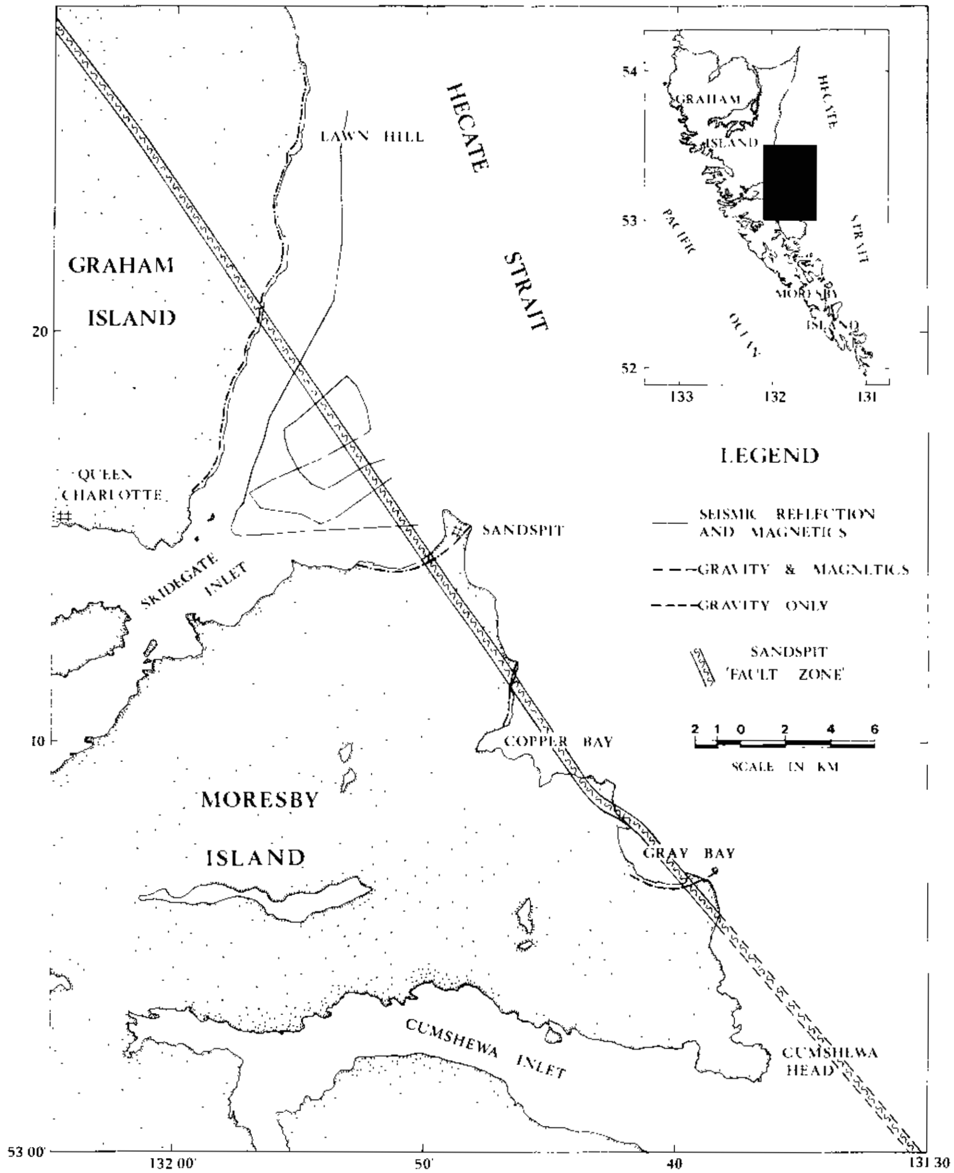

Figure 12. Sandspit fault study area.

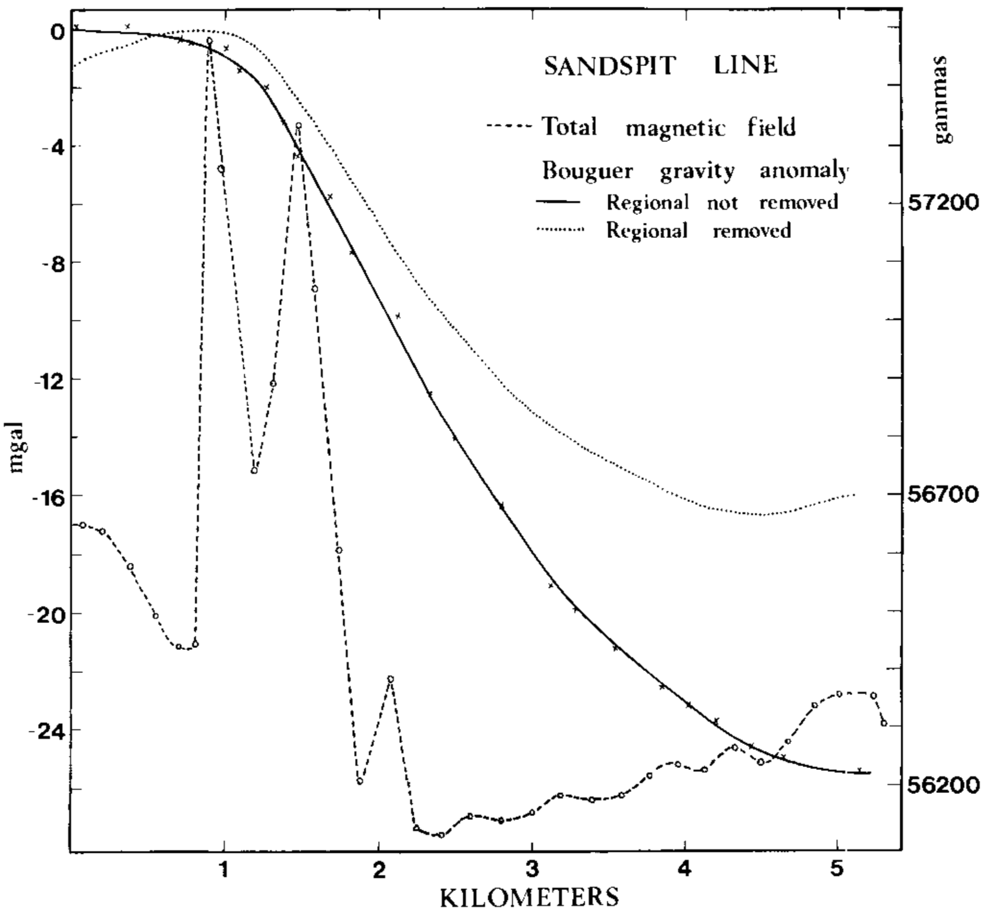

Figure 13. Gravity and magnetic intensity profiles – Sandspit line.

Gravity Measurements

A total of 70 gravity stations at spacings of 0.2 to 2.5 kilometres were occupied along four lines across the Sandspit fault zone. Gravity measurements, using a Worden gravimeter, have been corrected to mean sea level assuming a vertical gravity gradient equal to 0.09406 mgal/ft. and a crustal density of 2.67 g/cm^3. Reduced gravity values are estimated to be accurate within ±0.5 mgal. The detailed gravity survey supplements earlier work of the Earth Physics Branch which defined regional gravity gradients for the west coast (Stacey and Stephens, 1969).

An example of one of these profiles, the 'Sandspit line,' is shown on Figure 13. The observed Bouguer anomaly curve shows a 'mass deficit' below the east block of −25 mgal and a gradient of 12 mgal/km across the fault zone. The more relevant residual Bouguer curve, obtained by subtracting a linear regional gradient of +2 mgal westward (Stacey and Stephens, 1969), shows a deficit of −17 mgal and a gradient of 8.0 mgal/km. Analysis of the latter profile, using characteristic curves (Grant and West, 1965, pp. 283-286) gives a dip for the Sandspit fault of 50 degrees to 70 degrees east and a vertical displacement of approximately 1 500 metres (east block down). A uniform density contrast of -0.4 g/cm^3 for sediments infilling the Queen Charlotte Basin (compared to granitic and volcanic rocks of the western block) has been assumed in the above calculation. The total magnetic intensity profile over the Sandspit fault (Fig. 13) distinguishes clearly between buried magnetic source rocks and sediments.

Two-dimensional multidensity computer modelling of the gravity curves will be used to provide possible geological representations of the crustal structure in the vicinity of the fault zone. Inflection points, or mean values between gravity 'lows' and gravity 'highs,' are coincident on all lines with the surface trace of the fault indicated by topography and continuous seismic profiles obtained in Skidegate Inlet in our survey and by Grinsfelder (1959).

Continuous Seismic Profiles

Fifty-six kilometres of continuous seismic reflection, bathymetric, and magnetic profiles were run in Skidegate Inlet across the presumed submarine trace of the Sandspit fault between Graham and Moresby Islands. Discussion of the equipment and means of data collection are given in Young and Chase (in press).

Line drawings of selected portions of the seismic profiles (Fig. 14) show possible evidence of Quaternary (Pleistocene ?) faulting along subsidiary splays parallel with the main fault trace. An acoustically opaque unit terminates abruptly against poorly to well-stratified sediments, interpreted to be of Pleistocene and Holocene age respectively. The presumed fault surface is steeply dipping to near vertical. On three of the four profiles (Nos. 2, 3, and 4) the vertical component of movement appears to be east block up.

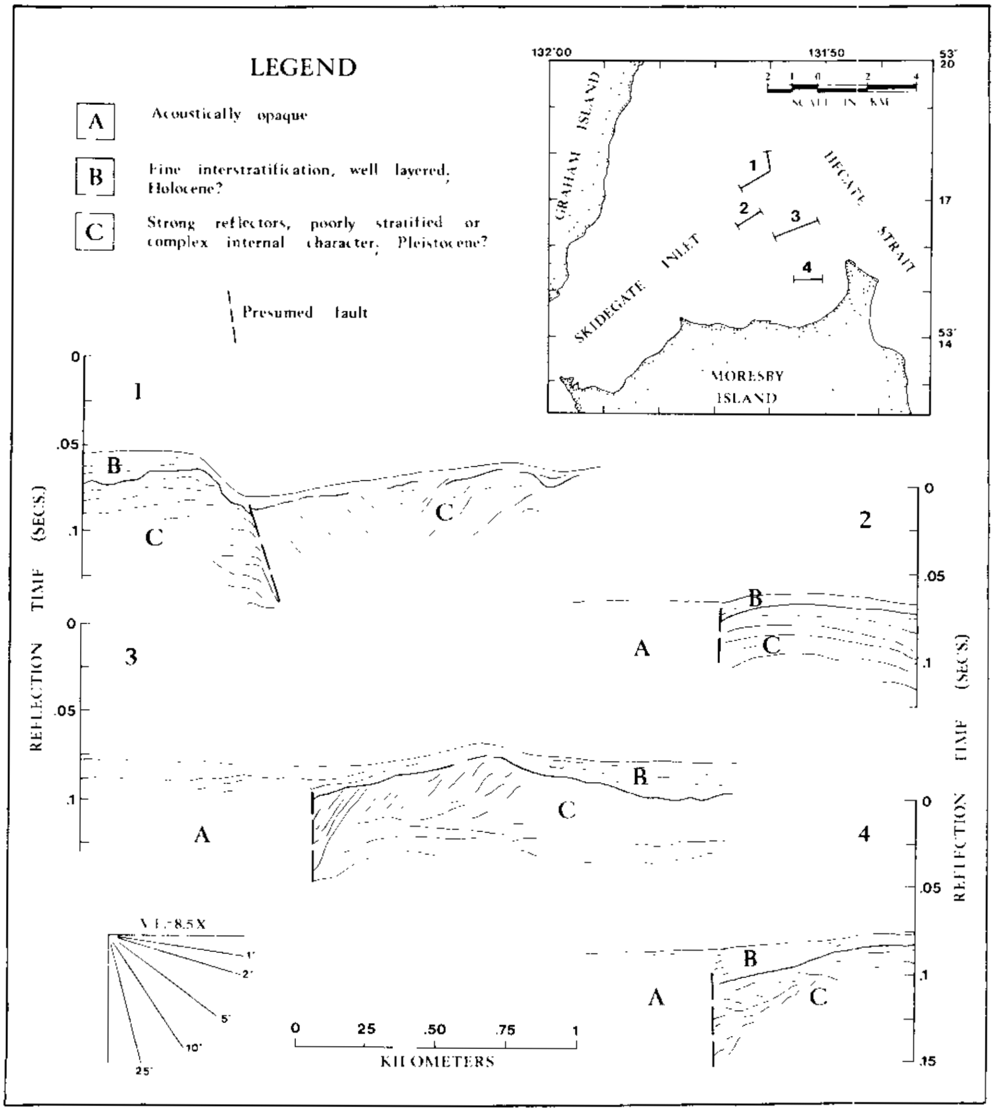

Figure 14. Seismic profiles – Sandspit fault.

Low magnetic intensity on profiles run in Skidegate Inlet suggests that sedimentary rocks (possibly the Cretaceous Haida Formation exposed on both north and south sides of the Inlet) underlie the Quaternary cover.

CONCLUSIONS

Analysis of gravity profiles suggests that in northeastern Moresby Island and southern Graham Island a major down-to-basin dislocation of up to 1 500 metres has occurred on the Sandspit fault. South of Cumshewa Head, below the waters of Hecate Strait, the western edge of the Queen Charlotte Basin does not appear to be fault controlled but is probably represented by an onlap of Neogene sediments on Mesozoic-Paleogene basement rock. Seismic profiles from Skidegate Inlet provide evidence for movement on subsidiary splay faults after the Pleistocene. The possibility exists however that such movement may only be related to local isostatic adjustments in the area.

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