INTRODUCTION

The Tertiary Queen Charlotte Basin in the Hecate Strait and Queen Charlotte Sound region of Canada's western continental shelf was the site of petroleum exploration in the 1960's and early 1970's, prior to establishment of an exploration moratorium in 1971. Exploration by the petroleum industry principally Shell Canada Ltd. and Chevron Canada Resources Ltd. included acquisition of a regional grid of multi-channel reflection seismic data and drilling of eight offshore wells. The seismic and well data provided the basis for initial descriptions of the regional geology of the offshore Queen Charlotte Basin (Shouldice, 1971; Yorath and Chase, 1981). The industry seismic data was acquired with seismic sources and record lengths which provided only limited and often poor quality images of the deeper portions of the basin fill and underlying basement. To provide new information on the structure and stratigraphy of the basin fill and crustal structure down to Moho, a regional deep reflection seismic survey was carried out in July, 1988. This report describes the acquisition and processing of the deep reflection data. Detailed interpretations of the complete data set are continuing (Rohr and Dietrich, 1990) and more comprehensive accounts of the regional geology and tectonic history of the basin will be incorporated into future publications.

ACQUISITION

One thousand kilometres of 40-fold marine reflection data were collected under contract by Geophoto Services Ltd. using the seismic vessel M/V E.O. VETTER. The seismic source consisted of a 6358 in^3 (106L) tuned airgun array towed at 12 m depth. Shotpoints were spaced at 45 m intervals and 14 seconds of data were recorded at a sample rate of 4 milliseconds. The streamer was 3600 m long and contained 240 groups of hydrophones with a group length of 15 m. Field data were recorded with a 8-90 Hz filter. Data were acquired along 8 lines crossing Hecate Strait and Queen Charlotte Sound (Fig. 1). The lines were oriented to run across and parallel to the main NW-SE trend of the basin, with direct ties to the locations of 5 of the 8 offshore wells; the southern lines QC88-02 and -03 cross the present day plate boundary adjacent to Queen Charlotte Sound. In Hecate Strait data were collected on lines QC88-05 and QC88-06 within 3 km of the eastern shoreline of the strait but the western extent of data collection was limited to about 20 km offshore from the Queen Charlotte Islands due to shallow water depths for line QC88-06 and an excluded marie gark area for line QC88-05. The lack of data collected closer to the Queen Charlotte Islands hinders correlation between the exposed geology onshore and the reflection data offshore.

PROCESSING

The reflection data were processed under contract by Geophoto Services Ltd., Calgary. True amplitude recovery was applied to the first 3.5 s of data at 6 db/s with a constant gain of 21 db for the remaining 10.5 s. First breaks were muted and an f-k filter (-3 to 7 ms/trace) was applied to the shot records. The effect of the f-k filter on the stacked data is illustrated in Figure 2. The stacked data without the filter are dominated by seafloor-generated diffractions and linear noise which are effectively removed by the filter. The shot records were then deconvolved using both a source signature deconvolution and gap deconvolution. Mean amplitudes of the traces were equalized and the shot records were decimated from 240 to 120 traces per shot. This eliminates every other common-depth-point (CDP) gather so our CDP spacing is 15 m. Velocity analyses of the CDP gathers were carried out every 3 km. Below 6 s little difference in the CDP stacks were observed for a wide range of velocities (Fig. 3); stacking velocities of 6000 to 7000 m/s were used to stack data below 6 s. Note reflection events at 4, 6.5 and 7.2 s. Following normal move out and 40-fold stack, another deconvolution filter was applied to the data to further attenuate water bottom multiples. A filter was applied to remove random noise in the f-x domain, followed by time variant filtering and scaling. The data were filtered 10-45 Hz from 0 to 4.0 s and the filter below 8 s was reduced to 10 - 15 Hz. The frequency filter was not varied laterally and some high frequency noise remains in areas where high velocity basement rocks occur at shallow depths. The final step in the data processing involved f-k migration using smoothed stacking velocities. Migration improved the imaging of structures within the sedimentary basin, but did little to resolve the structurally complex reflections sub-basement. Improved imaging of specific areas and features may result from advanced or specialized processing techniques, such reprocessing is currently planned or in progress for portions of the data set.

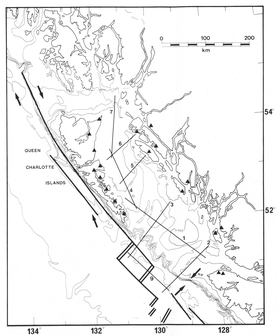

Figure 1. Map of multi-channel seismic reflection data collected in 1988.

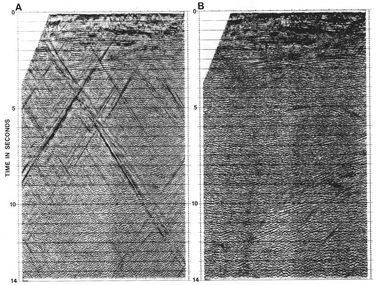

Figure 2. Brute stack of data (A) before and (B) after f-k filter. Note that the steeply dipping diffractions in (A) have been eliminated by the filter.

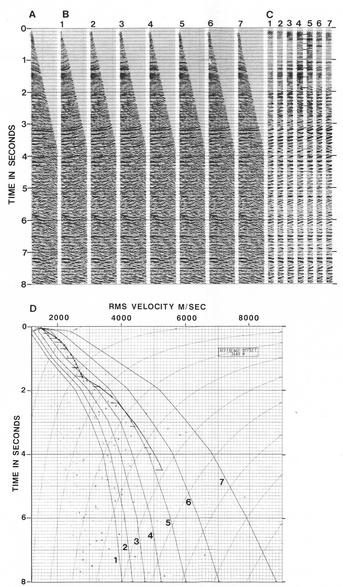

Figure 3.
(A) Gather #364 from line QC88-06.
(B) Moved-out gather at velocity functions 1-7 on (D). Note that below 6 s there is little difference between the different velocities used.
(C) Stacks of gather plus 5 adjacent gathers using velocity functions in (D).
(D) Velocity functions used to move-out and stack data.

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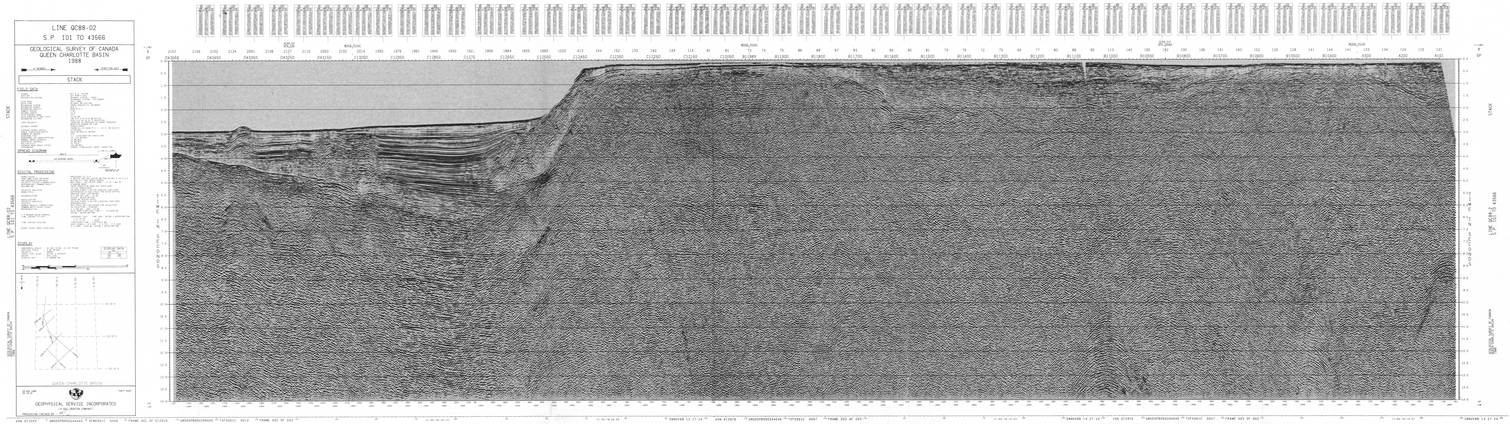

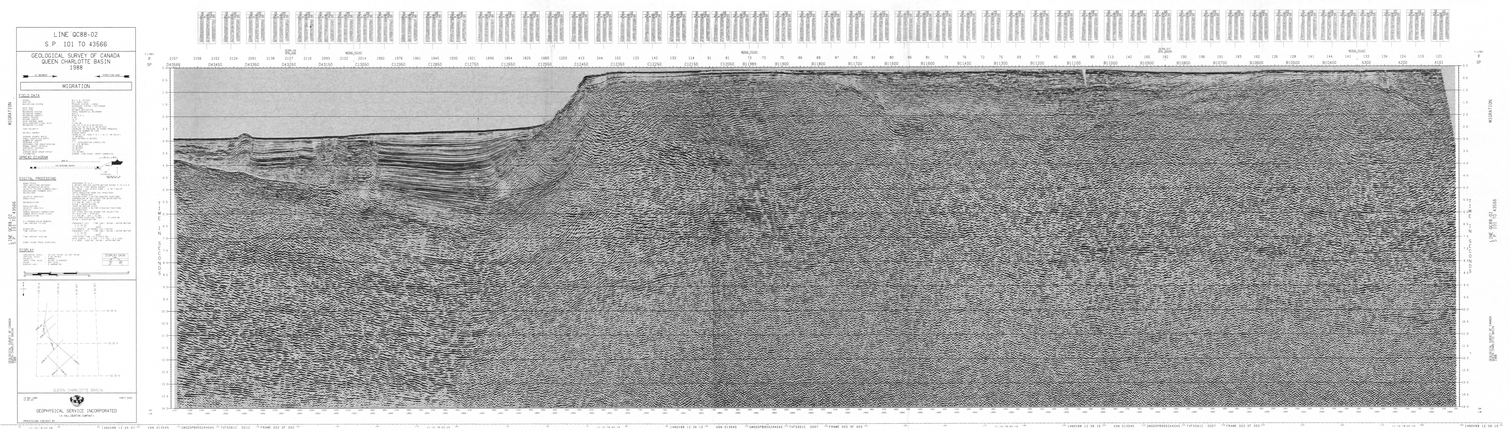

Line 2

DEEP SEISMIC SURVEY OF QUEEN CHARLOTTE BASIN

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