

Open File 2391

**Multichannel Seismic Reflection Profiles  
Across the Vancouver Island  
Continental Shelf and Slope**

G.D. Spence, R.D. Hyndman, S. Langton,  
C.J. Yorath and E.E. Davis

**Abstract**

Approximately 700 km of multichannel seismic reflection lines were obtained across the continental shelf and slope off Vancouver Island during September-October, 1989. Data were also obtained from several sonobuoys and by recording the airgun source at land stations. Along with previous data (Yorath et al., 1987, GSC Open File 1661), a total of 9 lines are now available across this subduction zone margin. A regional interpretation of the structure and Tertiary tectonic history of the margin based on previous marine data and adjacent LITHOPROBE land seismic reflection data across Vancouver Island is given in Hyndman et al. (Can. J. Earth Sci., 27, 313-329, 1990), and interpretation of the previous continental slope data in Davis and Hyndman (Geol. Soc. Am. Bull., 101, 1465-1480).

The objectives of the new survey included:

1. Determination of the structure and of the processes of sediment accretion and deformation along this convergent margin. It provides an example of a "live" fold and thrust belt in process of formation.
2. Delineation of the deep thrust plane beneath the slope and shelf along which very large "megathrust" earthquakes could occur. Constraints are sought on which part of the fault plane is in the "brittle" seismogenic regime.
4. Definition of methane hydrate ice-like layers that have formed beneath the continental slope. Since methane is a very strong greenhouse gas, it may play an important role in global climate change. Seafloor hydrate within sedimentary accretionary wedges is the largest global reservoir of methane, and thus studies of the nature, distribution and mechanism of formation of such hydrate are important.
5. The seismic reflection data is a critical component of the site survey required for proposed shallow scientific drilling on the lower continental slope off Vancouver island in 1992 to address the above problems.

The new data provide excellent definition of the downgoing oceanic plate beneath the slope and shelf that corresponds well to that from Benioff-Wadati seismicity and seismic refraction. The two narrow terranes that provide the backstop to the sediment accretion are imaged beneath the inner shelf on several lines. At the deformation front, several lines exhibit particularly clear landward dipping thrusts that extend through the entire ~3km sediment section to near the crustal basement. Midway up the continental slope, a bottom-simulating-reflector (BSR) is interpreted as the base of the frozen methane-hydrate layer.

- |   |  |
|---|--|
| <b>SEISMIC ACQUISITION:</b>   | <b>SEISMIC PROCESSING:</b>   |
| Contractor<br>Digicon Geophysical   | Contractor<br>GSI-Haliburton Geophysical   |
| Source<br>7800 cu.in. airgun array  | Processing<br>True amplitude recovery  |
| Hydrophone array<br>3600 m; 144 channel   | Designature<br>Velocity analysis   |
| Recording<br>DSS 240<br>sample rate 4ms<br>freq. 3 - 80 Hz<br>shot interval 50 m<br>hydrophone group interval 25m | FK demultiple<br>Deconvolution<br>Equilization<br>Statics<br>Normal moveout<br>Common depth point stacking<br>Deconvolution<br>FK migration<br>Time varying filter<br>Time varying scaling |
| navigation Star Fix   | Sections<br>Stack, migration and depth   |

LINE 89-03A  
S.P. 1081 TO 100

PACIFIC GEOSCIENCE CENTRE  
WEST COAST MARGIN  
1989

FINAL STACK

FIELD DATA

SPREAD DIAGRAM

DIGITAL PROCESSING

DISPLAY

WEST COAST MARGIN

18 SEP 1990

GEOPHOTO INC  
A HALIBURTON COMPANY

---

LINE 89-03A  
S.P. 1081 TO 100

PACIFIC GEOSCIENCE CENTRE  
WEST COAST MARGIN  
1989

F-K MIGRATION

FIELD DATA

SPREAD DIAGRAM

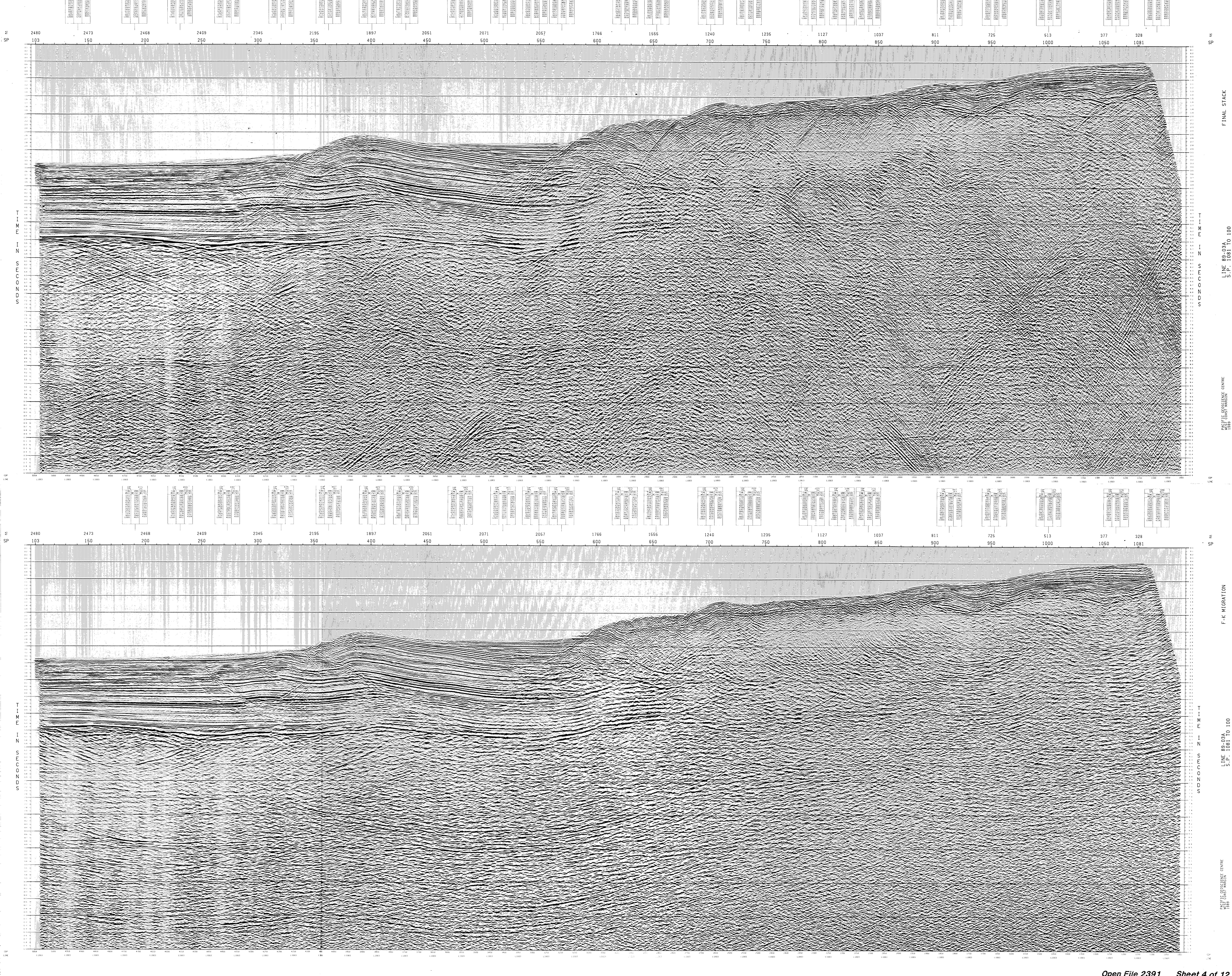
DIGITAL PROCESSING

DISPLAY

WEST COAST MARGIN

18 SEP 1990

GEOPHOTO INC  
A HALIBURTON COMPANY



This map has been registered from a scanned version of the original map. Reproduction of coordinates does not guarantee accuracy.

Prepared at the Pacific Geoscience Centre