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GEOLOGICAL SURVEY

PRELIMINARY DATA FROM THE PUGET SOUND MULTICHANNEL SEISMIC-REFLECTION SURVEY

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CONTENTS

ILLUSTRATIONS

TABLES

Preliminary Data from the Puget Sound Multichannel Seismic-Reflection Survey

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INTRODUCTION

As part of the ongoing earthquake-hazards research, a multichannel seismic-reflection survey was conducted in the Puget Sound program area of western Washington as a reconnaissance search for evidence of recent (Holocene) faulting and to achieve a better understanding of the geologic framework of the region. Here we summarize the logistics for recording, locating, and processing and present the preliminarily processed reflection profiles.

LOGISTICS

The seismic-reflection data were collected using a DFS V 24-channel recording system with a 24-channel Teledyne hydrophone streamer. A 15 in^3 watergun was used as a seismic source. The 24 hydrophone groups were spaced at 6.25-m intervals along the streamer which was towed at a depth of 3 m. The sample rate was 1 ms. The lo-cut filters were set at 45 Hz with a slope of 16 db/octive and the hi-cut filters set at 256 Hz with a slope of 72 db/octive. The data were recorded on SEG-B format and all lines were recorded to 2 s, except for lines 13, 14, and 15 which were recorded to 1 s. For lines 1 through 13, the source was set to fire evenly at 6.25-m intervals for a fold of 12, and for lines 14 and 15 the source was fired evenly at 3.12-m intervals for a fold of 24 (see table 1).

Table 1.--Shooting parameters

Line No.	Shot interval (meters)	Fold	Duration (seconds)	Common depth point (meters)
1	6.25	12	2.0	6.25
3	6.25	12	2.0	6.25
4	6.25	12	2.0	6.25
5	6.25	12	2.0	6.25
6	6.25	12	2.0	6.25
7	6.25	12	2.0	6.25
8	6.25	12	2.0	6.25
9	6.25	12	2.0	6.25
10	6.25	12	2.0	6.25
10A	6.25	12	2.0	6.25
11	6.25	12	2.0	6.25
12	6.25	12	2.0	6.25
13	3.08	12	1.0	6.25
14A	3.08	24	1.0	6.25
14B	3.08	24	1.0	6.25
15	3.08	24	1.0	6.25

METHOD OF SHOTPOINT LOCATION

Several shotpoint-location methods were used in tandem for this survey; they include:

1. Loran C was used to the extent possible, but was generally unsuitable in the inland waterways of Puget Sound because nearby land masses gave distorted locations.
2. Global Positioning Satellite System (GPS) (on loan from Motorola) was used during the limited periods that it was operational.
3. Periodic photographing of the onboard radar screen at regular time intervals in order to triangulate on known radar targets should the Loran C and GPS methods fail.

Approximate profile-line locations were initially determined by converting the Loran-C positions to longitude and latitude for shotpoints at 15-minute spacing. These approximate locations were then adjusted linearly to GPS positions and fixed land positions such as bridges and other known geographic positions. This method was adequate to locate the position of the lines to within 50 m.

PROCESSING OF SEISMIC-REFLECTION DATA

The collected data were processed using a Digicon software system (equipment belonging to the Branch of Petroleum Geology, Denver). The processing steps are as follows:

1. Demultiplexing
2. Recording gain removal
3. Geometry definition
4. Trace editing
5. CDP sort 12-fold
6. Velocity analysis (see table 2)
7. AGC 200-ms-gate spectral whitening
8. Normal moveout correction
9. Twelvefold stack (for lines 1 through 13) 24-fold stack (lines 14 and 15)
10. Gapping devonvolution with gap determined by water depth
11. Mute at bottom of water
12. Bandpass filter (30/45-180/200)
13. Vertical stack of 6:1 on all lines except 1, 3, 14, and 15 which are shown with a vertical stack of 3:1.

A number of cascading deconvolution passes were conducted in order to eliminate or at least subdue the strong bathymetric multiples. The data were significantly improved with a combination of spectral whitening preceded by a narrow AGC operating length. The application of the AGC operator tends to subdue the first-break spectra and focuses the operator more on the incoming signal from the deeper reflectors. A gapping deconvolution with the gap determined by the water depth helped eliminate the bathymetric multiples for water depth to about 150 ms. Dip movement was tried on line 15 and resulted in some improvement in clarity of the data, as shown on plate 17.

Table 2.--Stacking velocities

Line No.	Common depth point	Two-way time	Velocity m/sec
1	40	0	1400
		100	1400
		500	1610
		700	2900
		1000	3000
3	3660	0	1400
		100	1400
		200	1450
		350	1700
		850	2100
		1000	2900
	3860	0	1400
		80	1450
		200	1500
		800	2050
		1000	2700
	4060	0	1450
		70	1450
		320	1700
		800	2500
		1000	2800
	4260	0	1450
		130	1650
		600	2000
		1000	2700
	4460	0	1200
		60	1200
		230	1800
		380	1850
		1000	2800

Table 2.--Stacking velocities
--Continued

Line No.	Common depth point	Two-way time	Velocity m/sec
3	4660	0	1450
		86	1450
		160	1600
		220	1630
		360	1850
		400	1900
		470	2000
		1000	2800
	4860	0	1450
		100	1550
		380	1900
		1000	2800
	5060	0	1450
		100	1450
		200	1500
		380	1650
		575	1900
		700	2100
		1000	2750
	5260	0	1450
		100	1450
		220	1650
		380	2000
		500	2100
		1000	2700
	5460	0	1450
		65	1450
		150	1450
		250	1900
		450	2000
		500	2100
		1000	2800
4	40	0	1500
		280	1500
		300	1800
		500	2300
		1000	3000

Table 2.--Stacking velocities
--Continued

Line No.	Common depth point	Two-way time	Velocity m/sec
5	40	0	1500
		280	1500
		300	1800
		500	2300
		1000	3000
6	40	0	1500
		100	1500
		300	1800
		500	2300
		100	3000
7	40	0	1500
		280	1500
		300	1800
		500	2300
		1000	3000
8 and 9	40	0	1500
		280	1500
		300	1800
		500	2300
		1000	3000
10, 10A and 11	40	0	1500
		280	1500
		300	1800
		500	2300
		1000	3000
12	40	0	1500
		280	1500
		300	1800
		500	2300
		1000	3000
13	40	0	1500
		100	1500
		300	1800
		500	2300
		1000	3000

Table 2.--Stacking velocities
--Continued

Line No.	Common depth point	Two-way time	Velocity m/sec
14A	40	0	1500
and		280	1500
14B		300	1800
		500	2300
		1000	3000
15	40	0	1500
		120	1500
		150	1800
		300	2300
		500	2800
		1000	3000
	140	0	1500
		150	1500
		300	2300
		500	2800
		1000	3000
	240	0	1500
		150	1500
		200	1800
		300	2300
		1000	3000
	340	0	1500
		150	1500
		200	1900
		400	2300
		1000	3000
	440	0	1500
		180	1500
		200	1700
		300	2000
		1000	3000
	540	0	1500
		250	1500
		500	2400
		1000	3000

Table 2.--Stacking velocities
--Continued

Line No.	Common depth point	Two-way time	Velocity m/sec
15	740	0	1500
		250	1500
		350	1550
		400	2500
		1000	3000
	840	0	1500
		250	1500
		300	1700
		1000	3000
	940	0	1500
		200	1500
		300	1700
		1000	3000
	1040	0	1400
		250	1500
		300	1700
		1000	3000
	1240	0	1500
		250	1500
		400	1600
		450	1800
		1000	3000
	1340	0	1500
		250	1500
		300	1700
		600	2500
		1000	3000
	1440	0	1500
		250	1500
		400	1900
		500	2500
		1000	3000