1. INTRODUCTION

BACKGROUND AND OBJECTIVES

Leg 18 originated in Honolulu, Hawaii, on 29 May, 1971, and terminated in Kodiak, Alaska, on 20 July. Along the route, 15 holes were drilled at 11 sites, recovering a total of 1215 meters of sedimentary and volcanic rock cores. Drilling was conducted in three geographical regions in the northeast Pacific Ocean, viz., the region between the Murray and Molaki fracture zones, Cape Mendocino off northern California, Oregon, and British Columbia margins, and in the Gulf of Alaska off Kodiak Island. Table 1 summarizes the statistics for each hole. Routine bathymetric, magnetic, and seismic reflection profiles were made while the ship was underway between sites.

The Deep Sea Drilling Project expressed an interest in drilling a hole in shallow water just prior to the departure of the *Glomar Challenger* from Hawaii. It was decided that, if the weather was good, an attempt would be made to drill a hole on the outer edge of the northern Oregon continental shelf. The unscheduled site was selected so that penetration of the sedimentary column would not exceed 300 feet, according to the guidelines established by the U.S. Department of Interior for shallow-water drilling, and yet accomplish the scientific objective. Site 176 is located in a water depth of 193 meters, the shallowest depth the *Challenger* has drilled to date.

Some objectives were outlined by the Pacific Advisory Panel for Leg 18 in the northeastern Pacific Ocean. The primary scientific goal was to study the presumed subduction zones on both sides of the actively spreading Gorda, Juan de Fuca, and Explorer ridges. This could be done by comparing sediment samples of continental margin off Oregon and Kodiak Island with samples of the adjacent trench and abyssal plain to see if oceanic material is incorporated into these continental margins. Other objectives were to determine the provenance and nature of lithologies in upper Delgada Fan so that provenance might be related to the lateral displacement along the San Andreas Fault, and, to determine the nature of the underlying acoustic basement which is postulated to be Franciscan in character. Because of unforeseen geology we failed to drill Delgada Fan, but the hole established a well-documented biostratigraphic column for the northeastern Pacific Ocean, particularly in the middle- and high-latitude regions which was another objective. Finally, the panel suggested a site to determine the nature of the sediments and acoustic basement of Paul Revere Ridge, which is situated at the triple junction of the Juan de Fuca, American, and Pacific plates. The scientific staff of Leg 18 was primarily interested in the first objective, which set a theme for the leg, and also in extending the biostratigraphic column in high latitudes. The continental margins off Oregon and Alaska have been relatively well studied and, despite the presumed influence of a single spreading center, each margin has its individual character and unknowns.

TABLE 1
Summary of Holes Drilled on Leg 18

Site Hole	Position Latitude	Position Longitude	Dates of Drilling	Water Depth (corr. m)	Penetration (m)	No. Cores Cut	Total Cored (m)	Total Core Recovered (m)	Recovery %
172	31°32.23'N	133°22.36'W	5 June 1971	4768	23.0	4	23.0	26.5[a]	100.0
172A	31°32.23'N	133°22.36'W	6 June 1971	4768	23.0	1	1.0	Trace	–
173	39°57.71'N	125°27.12'W	10-12 June 1971	2927	333.5	38	333.5	196.0	58.8
174	44°53.38'N	126°20.80'W	14 June 1971	2815	19.0	3	19.0	3.0	15.8
174A	44°53.38'N	126°21.40'W	14-18 June 1971	2799	879.0	43	404.5	200.0	49.4
175	44°50.2'N	125°14.5'W	19-20 June 1971	1999	271.0	25	233.0	121.5	52.1
176	45°56.0'N	124°37.0'W	21-22 June 1971	193	41.0	5	41.0	41.0	100.0
177	50°28.18'N	130°12.30'W	24 June 1971	2006	9.0	1	9.0	9.0	100.0
177A	50°28.18'N	130°12.30'W	25-27 June 1971	2006	507.0	26	233.0	136.5	58.5
178	56°57.38'N	147°07.86'W	1-5 July 1971	4218	794.5	59	519.5	212.5	40.9
179	56°24.54'N	145°59.32'W	6-7 July 1971	3781	109.0	13	109.0	69.5	63.8
180	57°21.76'N	147°51.37'W	8-11 July 1971	4923	470.5	25	237.5	81.5	34.3
181	57°26.30'N	148°27.88'W	11-15 July 1971	3086	369.0	30	259.5	106.5	41.0
182	57°52.96'N	148°42.99'W	16 July 1971	1419	123.0	6	54.0	11.5	21.3
182A	57°52.88'N	148°43.39'W	17 July 1971	1434	195.0	1	7.5	Trace	–
				Totals	4166.5	280	2484.0	1215.0	48.9

[a]Repeated coring above basalt.

GEOLOGIC SETTING

The Oregon continental margin, which is located 380 km east of the Juan de Fuca spreading ridge, is surprisingly atypical for what is presumed to be an active subduction zone (Atwater, 1970; Silver, 1971). There is no landward-dipping zone of deep focus earthquakes, and the Astoria deep sea fan occupies the position of the trench normally found at the oceanic-continental juncture (Figure 1). The fan is composed of Columbia River detritus funneled across the continental slope through the Astoria submarine canyon. Development of the fan has been thought to signify an increase in the rate of sedimentation during Pleistocene glaciation and/or a period of no subduction. Landward on the lower continental slope, the Astoria Fan is bounded by prominent ridges and troughs that trend subparallel to the continental margin. Evidence from parts of the Oregon margin indicate that the ridges are uplifted and folded sediments of Pliocene or Pleistocene age (Fowler, 1966; Byrne et al., 1966) that suggest rapid subduction. However, the best evidence for subduction is the North Pacific magnetic anomaly pattern produced by the spreading ridge system. Prior to Leg 18 it was difficult to reconcile the rates of spreading determined from magnetic anomaly patterns with the amount of shortening represented by such folds on the lower slope. It was also difficult to explain how the Astoria Fan and its source channel could have maintained their relative horizontal positions across the boundary between the Pacific and American plates in light of the large Quaternary shifts deduced from the studies of the magnetic anomaly patterns.

In contrast to the Oregon continental margin on the east flank of the spreading ridge system, the Alaska continental margin on the western flank is a more typical subduction zone (Figure 2). The hypocenters of numerous earthquakes form a landward-dipping zone, and first-motion solutions indicate underthrusting. A 900-meter-thick section of uniformly stratified sediment plunges from the Alaska abyssal plain into the Aleutian Trench, where it is covered by a wedge of turbidites that fills the trench (Figure 3). According to the subduction hypothesis, trench sediment is carried beneath the continental slope or is scraped off at the shoreward trench wall and is folded into ridges along the lower continental slope. On reflection records the trench sediments locally extend under a gently dipping continental slope for more than 10 km (von Huene, 1972). Commonly, however, they cannot be traced beyond the

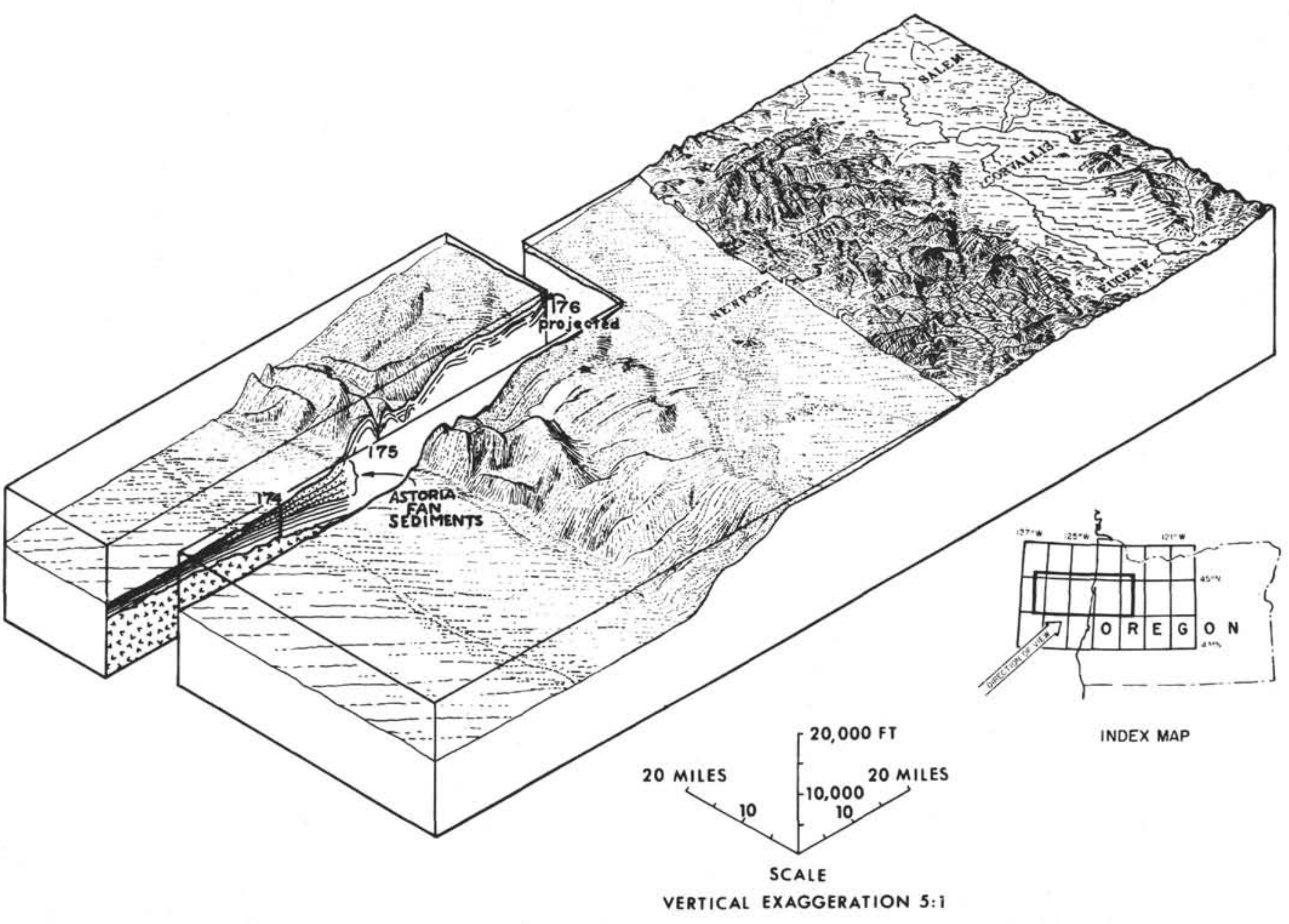

Figure 1. *Orthographic diagram and geologic setting off central Oregon showing location of drill holes. Hole 176 is projected from its position north of the diagram.*

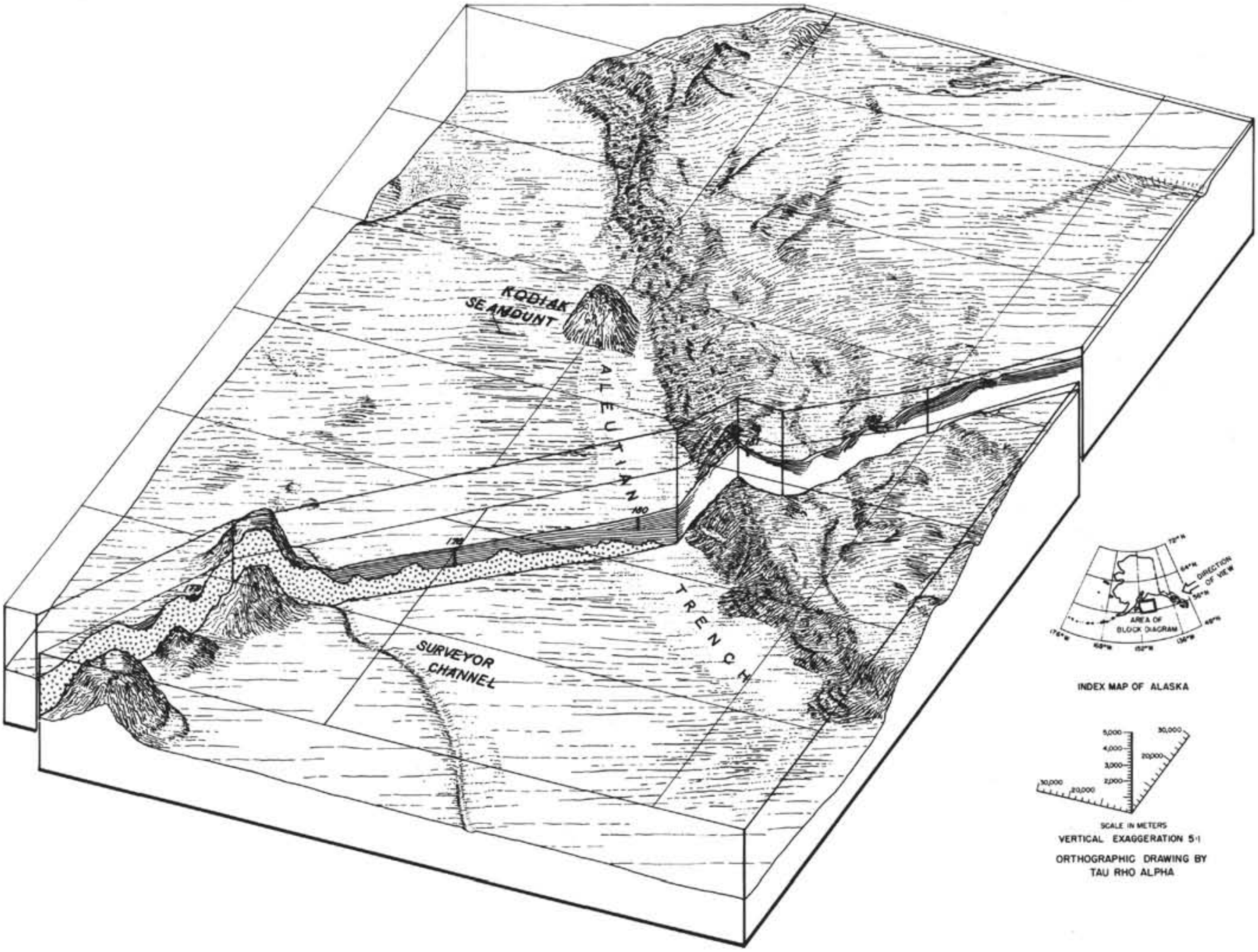

Figure 2. *Orthographic diagram and geologic setting of the eastern Aleutian trench off Kodiak Island showing location of drill holes.*

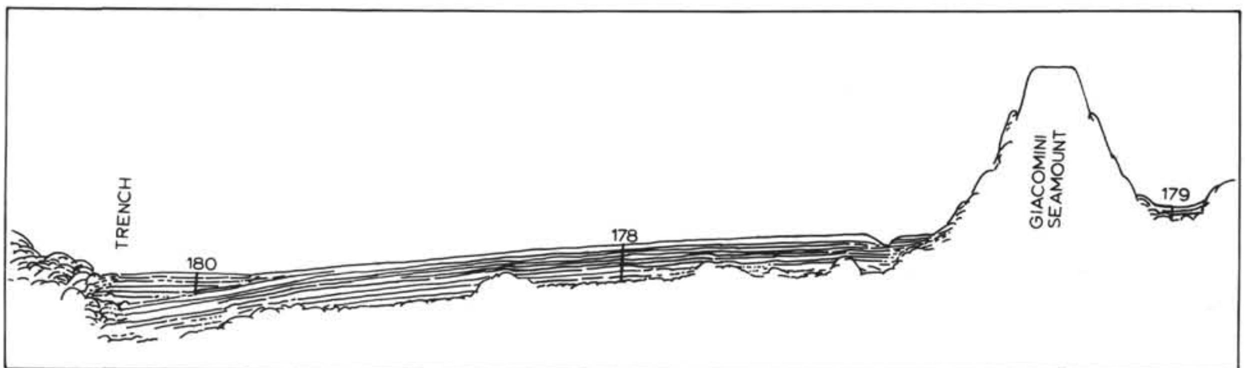

Figure 3. *Diagrammatic section across the Aleutian Trench and adjacent abyssal plain showing setting of Sites 178-180.*

base of the slope, and the lower slope is instead formed by the steep seaward flank of a ridge that lacks coherent internal seismic reflections. The reflections form patterns more characteristic of lithified sediments than young deformed unconsolidated trench sediments. It can be argued that seismic records are inadequate to identify complexly deformed young trench sediments; nevertheless, it seems unlikely that young trench sediments could be arched into a ridge 2000 meters high with flanks steeper (as much as 40°) than the failure angle of such sediments and that deforming stresses could be transmitted through trench sediments without deforming them.

The information from drill cores off Oregon and Alaska reconciles some of the apparent discrepancies between the rapid subduction hypothesis and observational data although it suggests that the rates may not be quite as rapid as has been proposed. Rates of tectonism are high despite the observation that most sediments are relatively undisturbed. This occurs because the sediments of Astoria Fan and the sediments filling the Aleutian Trench are younger than previous estimates had indicated. The unexpectedly high rates of sedimentation found in the northern latitudes have resulted from glaciation and also from increased erosion as the mountains circling the Gulf of Alaska were uplifted.

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