DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Cruise Report for EEZ-SCAN Cruise F2-87-AA
Western Aleutian Arc and Adjacent North Pacific
July 28 through August 26, 1987

by

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INTRODUCTION

M/V Farnella left Adak, Alaska on July 28, 1987 to conduct a geophysical survey (cruise F2-87-AA) of the western Aleutian arc and trench and adjacent North Pacific seafloor. The ship arrived at the study area on July 29 and operations began at 1219 hr local time (210/2019 GMT). The survey ended on August 24, all equipment was secured at 2400 hr LT (237/0800 GMT) and the vessel transited to Dutch Harbor. The Farnella arrived at Dutch Harbor on August 26 at 0800 hr LT. The cruise covered approximately 180,000 km^2 of seafloor from Amchitka Island westward to the U.S.-U.S.S.R. Convention Line of 1867 and from the 400 m isobath seaward 375 km (200 n.m.) to the boundary of the Exclusive Economic Zone. Table 1 is a list of the scientific staff on F2-87-AA.

The principal goal of the cruise was to collect overlapping long-range side-scan sonar images with the GLORIA III system. Other geophysical data collected included about 8400 line km of dual-channel 160 in^3 air-gun, 3.5 kHz high-resolution acoustic-reflection, 10 kHz bathymetry, magnetic gradiometer, and gravitational field. Track lines were nominally spaced 30 km apart in water deeper than 2000 m and as close as 15 km in shallow water (Fig. 1). The tracks were oriented parallel or subparallel to regional morphology and structures (the forearc slope and trench). Occasionally, severe weather conditions forced a different track orientation.

Scientifically the cruise was a resounding success. However, the cruise was plagued by bad weather and faulty GLORIA cables which caused the loss of 7.3 days of GLORIA survey time; operating time was reduced from 25 days to less than 18 days -- a loss of 28%. During part of the time that GLORIA was inoperative, dual-channel air-gun surveys were run. These short surveys were designed to investigate specific geologic phenomena and contributed significantly to our understanding of the geology of the area. The GLORIA images provided significant new data to interpret subduction tectonics and sedimentologic processes in this geologically complex area.

Table 1. List of cruise participants.

Karl, H.A. (USGS)	Chief scientist
Vallier, T.L. (USGS)	Chief scientist
Masson, D.G. (IOS)	Chief scientist
Bishop, D.G. (IOS)	Senior Gloria engineer
Heywood, C. (USGS)	Navigator/geophysicist
Jacobs, C (IOS)	Photographer/geologist
Nicholson, J. (USGS)	Electronics technician
Robinson, A. (IOS)	RVS software engineer
Underwood, M.B. (USGS)	Geologist
Walker, R. (IOS)	Gloria engineer
Wallace, R. (IOS)	Air-gun technician
Webb, E. (USGS)	Geologist

EQUIPMENT REPORT

The 10 kHz and 3.5 kHz systems functioned well throughout the cruise. The MassComp system (air-gun dual-channel seismic) functioned well with only occasional problems until the last two days of the cruise when it became inoperative and would not reboot with the available software on board. During this time the analog signal was recorded on the back-up Hewlitt-Packard system. The scientific staff of F3-87-AA brought a new software package with them to Dutch Harbor and the system was successfully rebooted in port between cruises. Both the magnetic gradiometer and gravitional field systems functioned well with only minor problems during the cruise.

Navigation depended heavily on GPS and transit satellites for accurate positioning because LORAN coverage was often unreliable in the survey area. The Northstar 7000 system in the geophysics lab functioned poorly. The LORAN systems on the bridge were more reliable. The track line following display was invaluable in aiding the ship's officers to steer a straight course.

Weather observations were transmitted every 6 hours using the GOES/XBT system. XBT casts were made at least once, and usually twice, daily. The deepest casts obtained data to 750 m. XBT casts were not made in heavy seas.

Faulty GLORIA cables caused major problems during the first part of the cruise. The first cable

failure, which occurred 52 hours after commencing operations, was the normal failure due to severe vehicle pitching. The splice failed in moderate seas. The replacement cable jumped the spool as the tow vehicle was being deployed and was severely damaged. This cable was replaced with a cable that had been repaired on the previous cruise, F1-87-BS. Eight hours after replacement, the splice leaked and the ship sailed to Kiska to shelter in the lee of the island while the cable was repaired. Splice repairs take between 24 to 48 hrs. GLORIA was retrieved twice more during the remainder of the cruise because of poor sea states.

PRELIMINARY SCIENTIFIC RESULTS

Data collected during this cruise not only confirm previous interpretations but also raise new and intriguing questions about the tectonics and sedimentology of the western Aleutian arc and adjacent North Pacific sea floor.

Major features along the arc margin are a canyon-indented insular slope, the Aleutian trench, a narrow accretionary prism with landward-dipping thrust faults, irregular and discontinuous forearc basins, and a thick accumulation of Middle Series (Oligocene (?) and Miocene) rocks south of Amchitka Island. Collision of the Stalemate ridge (extinct Kula-Pacific transform fault) with the arc margin has caused extreme deformation of the forearc including the formation of curvilinear ridges that are either large folds or the seafloor expressions of underlying thrust faults. The collision narrowed the trench floor and uplifted it more than 500 meters relative to other parts of the trench. The S-shape configuration of Stalemate ridge is attributed to a change in plate motion concurrent with asymmetric spreading from the extinct Kula-Pacific ridge. A trapped piece of the Early Tertiary Kula plate exists between the arc and Stalemate ridge south of Agattu Island. Uplift and bending of the outer trench wall have created NW-SE faults, the first tectonic expression on the oceanic plate of its subsequent subduction, that are parallel to the convergence direction between the Pacific and North American plates.

Structurally-controlled submarine canyons head on the shelf of the summit platform, but do not debouch sediment onto the trench floor; instead they terminate in forearc basins that are filled with

thick accumulations of sediment. Subtle pathways of sediment dispersal are seen on the sonographs where sediment has spilled over the sediment-filled forearc basins onto the the trench floor. A small canyon that has developed on the accretionary wedge south of Amchitka Island, possibly by mass wasting, shows an active channel that appears to be feeding a fan on the trench floor. A debris apron about 15 km wide on the trench floor at about 171° 30°° E evinces mass wasting on the seaward wall of the trench. No longituidinal channels have been recognized on the trench floor. Therefore, it appears that sediment enters the far western part of the Aleutian trench transverely and not via longitudinally flowing turbidity currents.

ACKNOWLEDGEMENTS

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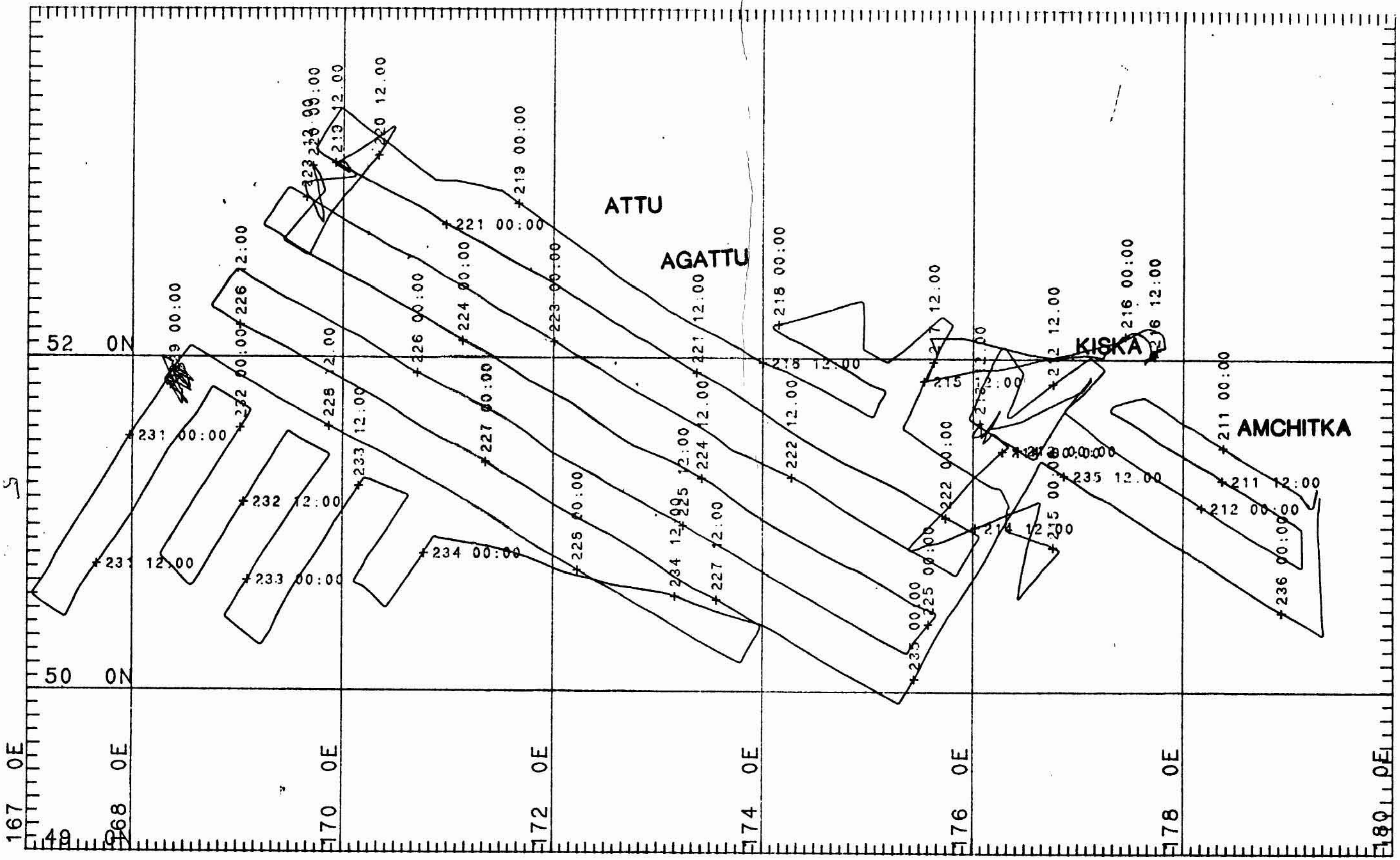

MERCATOR PROJECTION

SCALE 1 TO 3000000 (NATURAL SCALE AT LAT. 56)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 56

GRID NO. 1
TRACK NO. 1

— Track plotted from bestnav

F2-87-AA