OCEAN DRILLING PROGRAM

LEG 103 PRELIMINARY REPORT

GALICIA MARGIN

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SCIENTIFIC REPORT

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INTRODUCTION

The Galicia Margin, northwest of the Iberian Peninsula (Figure 1A), is a starved passive ocean margin with only a thin (0-4 km) sedimentary cover above acoustic basement. Seismic and bathymetric studies, and dredge hauls, reveal many of the features considered typical of passive ocean margins (Montadert et al., 1974, 1979; Groupe Galice, 1979; Boillot et al., 1979, 1980; Mauffret and Montadert, in press). Rift structures, apparent on seismic profiles, control the present-day morphology (Laughton et al., 1975; Vanney et al., 1979; Lallemand et al., 1985). The continental basement is broken by normal, possibly listric faults into narrow (10-30 km), elongate (60-100 km) tilted blocks trending north and dipping gently east, forming a series of half-grabens. On the western, uplifted side of some blocks, basement and possibly pre-rift sedimentary rocks crop out. These conditions made this an attractive margin for drilling on ODP Leg 103 because we believed that the basement and the oldest sedimentary strata were within drilling reach of the D/V JOIDES Resolution. We anticipated that the results of coring and logging here would not only elucidate the history of rifting, subsidence and sedimentation on this margin and the relation of these processes to the initiation and progressive opening of the adjacent North Atlantic, but also shed light on the evolution of the more thickly sedimented--and hence less accessible--conjugate margin of North America.

The first scientific drilling on the Iberian Margin took place in 1976, when the GLOMAR CHALLENGER drilled Site 398 near Vigo seamount, off northern Portugal, during DSDP/IPOD Leg 47B (Sibuet, Ryan, et al., 1979). A thickness of 1750m of Cenozoic and Cretaceous sediments was cored. The sequence comprised both sediments deposited during rifting (syn-rift) and sediments deposited subsequently during seafloor spreading (post-rift). Pre-rift sedimentary rocks and basement, and the deeper portions of the syn-rift sequence, seen on seismic profiles, were not penetrated. A major result of Site 398 drilling was the dating of the boundary, or "break-up unconformity", separating uppermost Aptian, syn-rift and lower Albian, post-rift strata.

Leg 103 of the Ocean Drilling Program (ODP), which began on 25 April in Ponta Delgada, Azores, and ended in Bremerhaven, Federal Republic of Germany, on 19 June 1985, drilled a total of five sites (Figure 1B,C; Table 1). Three of these (Sites 638, 639 and 641) extended the results of DSDP/IPOD Leg 47B through the syn- and possibly pre-rift strata by drilling and coring through a total of 1200m of Lower Cretaceous (Albian-Valanginian) to Upper Jurassic (Tithonian) rocks to the top of basement on the deep western edge of the margin. At another site close to the boundary between oceanic and continental crust, coring recovered presumed upper-mantle peridotite (Site 637). An additional site was drilled on the summit of the ridge closest to the oceanic-continental crust transition (Site 640), over a deep reflector widely believed to represent the ductile-brittle boundary in continental crust, a boundary into which listric faults root. The results of drilling and coring at Sites 637-641 are summarized in a series of stratigraphic columns in Figure 2.

Despite our pre-cruise optimism, drilling on the Galicia margin proved to be a considerable challenge. A series of operational difficulties, caused in large part by the nature of the rocks through which we were attempting to drill, thwarted all attempts at deep penetration. Site 639, for example, consists of a series of six short holes which sampled different stratigraphic levels in the same sequence exposed at the edge of a fault block. Nevertheless, with the aid of seismic profiles, the results of Leg 103 can be assembled into a composite stratigraphic sequence which permits us to answer the major scientific questions regarding the history of the margin (Figure 2).

DRILLING RESULTS

Site 637: Exposure of the upper mantle during rifting

The Galicia continental margin is bounded to the west by a north-trending basement ridge, 10km wide and more than 60km long, close to the boundary between oceanic and continental crust. This ridge is buried beneath sediments along much of its extent, but crops out locally at Hill 5100 (Figure 3). Seismic data suggest that Lower Cretaceous syn-rift sediments, deposited just before seafloor spreading began in this part of the North Atlantic Ocean, occur in the basin immediately to the east of this basement ridge. Dredging along the west side of Hill 5100 recovered a large sample of serpentinized lherzolite believed to be derived from the upper mantle (Boillot et al., 1980).

Anticipating the recovery of peridotite by drilling the ridge, questions concerning the nature and emplacement of these upper mantle peridotites were to be addressed. Mineralogical, geochemical, petrofabric and structural studies of the cores would focus on the nature of the peridotite (i.e., is it sub-oceanic or sub-continental upper mantle, or neither?) and its subsequent structural deformation and alteration (timing, processes, and conditions of serpentinization and brecciation).

Drilling results on the east side of the ridge at Site 637 show that it consists, at least in part, of serpentinized peridotite, confirming the previous dredging results. 74m of peridotite were penetrated from 212 to 285.6m below seafloor (bsf) at Site 637, overlain by a 212m-thick cover of Neogene clay and turbidite sand (Figure 2). The peridotite is clinopyroxene-bearing harzburgite which has been more than 90 per cent serpentinized and is cut by veins of calcite and serpentine (Figure 4).

Thin sections of the peridotite show both porphyroclastic and mylonitic textures, the latter restricted to thin shear zones. The pervasive foliation dips about 30-45^{o} in the upper 50m of the section, increasing to about 65^{o} in the lower 20m. Lineation formed by elongate pyroxene and spinel crystals is down dip. Shipboard magnetic data show that the foliation dips to the east. Analysis of the mylonitic texture in the shear zones consistently shows a top-to-the-east sense of shear on surfaces which dip east. After shearing, the peridotite was intensively serpentinized, then fractured. During the late stages of alteration, calcite and serpentine replacement and infilling of fractures occurred.

The peridotite is conceivably part of a Hercynian peridotite slab which is included in a tilted block of the continental crust. Alternatively, it may represent suboceanic mantle, possibly less depleted than most oceanic peridotite, or subcontinental mantle. This may have been emplaced during late rifting of the margin as a result of the stretching and rifting of the lithosphere.

The Neogene sediments overlying the peridotite comprise three lithologic units. From oldest to youngest, these include: (1) Upper Miocene pelagic and hemipelagic brown and reddish clay (180-212m bsf), (2) Upper Miocene to middle Pliocene interbedded marl and calcareous turbidites, with lesser amounts of brown clay (135-180m bsf), and (3) Middle Pliocene to upper Pleistocene turbidites probably derived from the Iberian mainland (0-135m bsf).

Standard Schlumberger logs were obtained from an interval that includes about 35m of basement and 110m of the overlying sediments. In the sediments the sonic log measured a nearly constant sound velocity of 1.6km/s. In the basement, velocities increase downward from 1.6 to 3.5km/s. Laboratory measurements of sound velocity in the peridotite yielded values ranging from 2.9 to 4.7km/s, clustering around 3.7km/s. The differences in measured peridotite velocities appear to result from differences in the extent of serpentinization and calcite replacement; the peridotite that is most altered has the lowest velocity. Generally, velocities measured parallel to the foliation are higher than those measured normal to it.

Sites 638, 639 and 641: Timing and processes of rifting

The fundamental processes associated with the evolution of a passive continental margin, such as crustal thinning, faulting and subsidence, cannot be clearly understood without a knowledge of the timing of events. This was the broad objective of Sites 638, 639, and 641 (Figures 5 and 6), originally planned as a single deep hole. A summary compilation of the stratigraphic results of drilling at these three sites is shown in Figure 2; Figure 7 shows the geometrical/geological relationships among the total of 6 holes drilled at Site 639, used to construct the stratigraphic column shown in Figure 2.

Cores from Sites 638 and 639 were collected to yield reliable data on the very early history of the margin, on the timing of rifting, and on the timing of paleoenvironmental changes in this region of the North Atlantic. The purpose of drilling Site 641 was to complete the coring of the upper part of the syn-rift sediments and to core the lower part of the post-rift sequence, to supplement the cores from Site 638. The main objectives at Site 641 were: (1) to date the break-up unconformity on the Galicia margin, and document the timing of the cessation of rifting and (2) to recover the Upper Cretaceous-Albian interval, especially strata at the Cenomanian/Turonian boundary and Albian-Cenomanian black shales.

The sedimentary sequence, constructed from the results of drilling at these sites and summarized in stratigraphic order, includes:

(1) A conglomerate or breccia layer that may lie between the Tithonian beds (see below) and basement. The layer contains a great variety of low-grade metamorphic rocks of sedimentary origin, probably Paleozoic in age, and silicic volcanic or hypabyssal rocks of rhyolitic or rhyodacitic composition, which may be a part of the basement.

(2) About 400m of Upper Jurassic (Tithonian) and possibly lowest

Cretaceous limestone with lesser amounts of sandstone and claystone, probably resting directly on pre-platform basement and deposited in relatively shallow water prior to or in the earliest stages of rifting. The uppermost 250m(?) of the limestone section have been dolomitized to a rubbly, massive dolostone. The dolomitization may be related to possible subaerial exposure of this part of the carbonate platform prior to drowning, or to the normal faulting which broke up the platform. Except for the dolostone, many of the samples from this interval resemble dredge samples previously recovered from a steep escarpment located 6 km northwest of Site 638 (Figure 5B; Mougenot et al., in press).

(3) About 40m of lower Valanginian calpionellid-bearing marlstone, probably deposited at moderate depth not long after the onset of rifting and rapid subsidence, on the outer shelf or upper slope.

(4) 400m of upper Valanginian and Hauterivian interbedded turbidite sandstone and claystone rich in terrestrial plant debris, and Barremian and Aptian alternating clay, calcareous clay, marl/marlstone, and clayey limestone, including thin turbidites and debris flows, deposited in deep water during rifting.

(5) As much as 1500m of sediments deposited after rifting ceased and oceanic spreading commenced between Iberia and Newfoundland. Only some of the Cenozoic clay and calcareous ooze and the Albian-Maestrichtian black shale, clay and marl portions of this section were cored during Leg 103, as the post-rift section had already been cored continuously during DSDP Leg 47B.

The main results of drilling at Sites 638, 639 and 641 are as follows:

(1) The finding of Lower Cretaceous turbidite beds beneath the seismic reflector previously identified on seismic records as the top of the pre-rift carbonate platform, necessitates a reassessment of the regional seismic stratigraphy beneath the break-up unconformity, and throws new light on the history of the Galicia margin, extending the syn-rift period back to at least the Valanginian.

(2) The finding of Tithonian limestone resting either directly on basement, or on a thin basal conglomerate that rests in turn on basement, implies that this region remained a structural high, possibly even a source of sediments, until very late into the Jurassic. This implies that the locus of maximum thinning and rifting of the crust, where the first oceanic crust was later emplaced, was in a region that had been a structural high until the latest part of the Jurassic, and not in a region with a preceding history of rifting, subsidence and sedimentation.

(3) Comparison of the Leg 103 stratigraphic data with the seismic data indicates that tectonic distension and deepening of the margin occurred in several stages. Several hundred meters of subsidence occurred during the Tithonian to accommodate the shallow-water carbonate beds. Whether this was the beginning of rifting or a renewal or continuation of older subsidence is not known. The carbonate platform was faulted and drowned sometime during the latest Tithonian to earliest Valanginian interval. It was subsequently partially buried by syn-rift sediments which progressively filled individual basins formed by tilting of fault blocks along listric(?) normal faults. From

seismic stratigraphy and coring it is clear that faulting and tilting began at least as early as the very early Cretaceous and continued episodically for about 25 m.y. from early Valanginian through late Aptian times. The syn-rift sediments accumulated from the mid-Valanginian on, in deep water, probably mainly below or close to the CCD.

(4) The early post-rift sequence includes at least 50 m of Albian black and gray claystone ("black shales") conformably overlying Aptian turbidites and debris flows of the syn-rift sequence. Although there is an abrupt change in sedimentation, the "break-up unconformity" is not recognizable in the cores as an angular unconformity or a break in the biostratigraphy.

Downhole logs of gamma radiation, resistivity, sonic velocity, bulk density and neutron porosity were taken over the interval from about 105 to 270m bsf at Site 638, from about 168 to 260m bsf at Site 639, and from 130 to 196m bsf at Site 641. The log results from Site 638, in combination with laboratory measurements of velocity and density, provide an estimate of an undrilled thickness of about 40-75m between the bottom of Hole 638C and the top of the carbonate platform drilled at Site 639.

<u>Site 640: Structure of the deep margin</u>

Between the tilted block drilled at Sites 638 and 639 and the peridotite ridge drilled at Site 637, the deep margin of Galicia is about 50km wide. The seafloor, which slopes gently to the west, is broken by only one small seamount at $42^{\circ}09'$N, $12^{\circ}32'$W, which marks the outcrop of a buried north-trending ridge that brings "basement" (actually a zone of incoherent reflections) close to the seafloor (Figure 8). The two north-trending sedimentary basins that flank the ridge contain thick (2-3km) syn- and post-rift sedimentary sequences. Clearly, the buried basin-and-range topography of the "acoustic basement" is pre-Albian and probably Early Cretaceous in age (Montadert et al., 1979; Boillot et al., 1979; 1980; Groupe Galice, 1979; Mauffret and Montadert, in press).

This part of the margin is characterized by a deep, strong and almost continuous reflector beneath the "acoustic basement", designated 'S' by Montadert et al. (1979)(Figures 8 and 9). The S reflector is interpreted by Montadert et al. (1979) and Chenet et al. (1982) as the boundary between brittle and ductile continental crust, i.e., the fault surface where listric normal faults root. This interpretation implies that the upper part of the acoustic basement consists of several tilted crustal blocks, one of which constitutes the north-trending ridge close to the 12°30'W meridian. According to this interpretation, the acoustic basement above reflector S should be continental basement and/or pre-rift sediments. In this model, the margin would extend as far west as the east edge of the peridotite ridge, which is the interpretation we accepted for Site 637 (see above).

The S reflector is between 1.5 and 3 sec (2-way travel time) below the seafloor (Figure 8), and thus too deep for ODP drilling. But drilling into the upper part of the "acoustic basement" above reflector S should bring new data crucial for the interpretation of the S reflector and of the margin and the adjacent oceanic basin. The major hypothesis could be tested by drilling only a few cores into the acoustically incoherent unit.

The stratigraphic section recovered by drilling at Site 640 includes, in order from oldest to youngest: (1) Hauterivian gray nannofossil chalk and calcareous clay, grading downward to interbedded marlstone, turbidite sandstone, siltstone and claystone, slumped in some intervals (184-232m bsf); (2) Barremian gray clayey ooze and calcareous clay (160-184m bsf); (3) Upper Aptian-Albian gray nannofossil ooze (157-160m bsf); and (4) Brown clay, barren of fossils (145-157m bsf). The interval from 0-145m bsf was washed without taking any cores.

The finding of Lower Cretaceous, syn-rift turbidite sediments, similar to those at Site 638, in the acoustically-incoherent unit forces reassessment of the brittle-ductile transition interpretation of the S reflector, since the rocks above the S reflector consist of Early Cretaceous sediments, more or less tilted and slumped during rifting. Thus, the S reflector, lying 2 to 4 km below the seafloor, is probably the substratum of the syn-rift Cretaceous sedimentary rocks, formed either by the top of pre-rift platform carbonates or crystalline basement.

SUMMARY

ODP Leg 103, which began on 25 April in Ponta Delgada, Azores, and ended in Bremerhaven, Federal Republic of Germany, on 19 June 1985, extended the results of DSDP Leg 47B through the syn- and pre-rift strata by drilling and coring through the break-up unconformity and then through a total of 1200m of Lower Cretaceous (Albian-Valanginian) to Upper Jurassic (Tithonian) rocks to the top of basement on the deep western edge of the margin (Sites 638, 639, and 641; Figure 1C). The occurrence of Lower Cretaceous turbidites beneath the seismic reflector previously interpreted as the top of the possible pre-rift carbonate platform, necessitates a reassessment of the regional seismic stratigraphy, extending the syn-rift period on the Galicia margin back to at least the Valanginian. Tithonian limestone, resting either directly on basement, or on a thin basal conglomerate overlying basement, implies that this region remained a structural high until very late in the Jurassic.

Site 637, located close to the boundary between oceanic and continental crust (Figure 1C), recovered peridotite of the upper mantle. This peridotite could be part of a Hercynian peridotite slab included in a tilted block of the continental crust or it may have been emplaced during late rifting of the margin as a result of the stretching of the lithosphere.

Site 640 was drilled on the summit of the ridge closest to the oceanic-continental crust transition, over the deep 'S' reflector widely believed to represent the ductile-brittle boundary in continental crust (Figure 1C). The finding of Lower Cretaceous, syn-rift turbidites in the acoustically-incoherent unit above the S reflector indicates that the reflector is probably a substratum of the syn-rift sediments, rather than the crustal ductile-brittle boundary.

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FIGURE CAPTIONS

Figure 1. A. Location map of Galicia Margin region northwest of the Iberian Peninsula. Bathymetric contours in meters. Blackened box indicates area of ODP Leg 103 drilling. Dot shows location of Site 398 drilled on DSDP Leg 47B south of Vigo seamount (v).

B. Bathymetric map showing location of sites drilled during ODP Leg 103. Modified from SeaBeam map; contour interval, 250m.

C. Schematic cross-section across Galicia Margin drawn from seismic data and drilling results. Reflector 'S' is discussed in text. P=peridotite ridge. Low-angle listric faults beneath half grabens are hypothetical.

Figure 2. Leg 103 schematic composite stratigraphic columns. B = Barremian; U.C. = Upper Cretaceous.

Figure 3. Location of Site 637 on (A) regional bathymetric map (contours in kilometers), (B) SeaBeam map (contours in meters) and (C) Seismic line. Courtesy of J.R. Vanney, J.C. Sibuet and L. Montadert.

Figure 4. Sample 637A-26-2, 87-107 cm. Altered and foliated peridotite typical of basement rocks recovered at Hole 637A. The foliation is defined by elongation of pyroxene crystals and

bands of serpentine. The veins are calcite and serpentine. They are generally sub-perpendicular or sub-parallel to the main foliation.

Figure 5. A. Bathymetric map of Galicia margin region. Contour interval, 500 meters. Heavy line across edge of Galicia Margin indicates location of Leg 103 drilling transect, shown in B.

B. SeaBeam map of the area near Sites 638, 639, and 641, showing location of Dredge Localities DR03 and DR01. Location of drilling transect shown in A. Contours in meters. Courtesy of J.C. Sibuet.

C. Multichannel seismic profile GP101, from shotpoint 2950 to 3400, showing the location of Sites 638, 639 and 641. 3, post-rift strata; 4 and 5, syn-rift strata. Vertical scale in seconds of 2-way travel time. Courtesy of L. Montadert.

Figure 6. Schematic cross-section across Galicia margin at the vicinity of Sites 638, 639 and 641, drawn from seismic data (Figure 5C) and drilling results. The east slopes of the half grabens are faulted, but the dip of the faults is uncertain.

Figure 7. Geologic cross section through holes drilled at Site 639. A uniform dip of 30 degrees is assumed, based on the average of measurements on cores. The regional dip, as estimated from

seismic data, is about 10 degrees. No faults are shown, although it is possible that some exist. Blank spaces in the cross section indicate parts of the section unsampled during coring, whose stratigraphic assignment cannot be made confidently. The brown clay, Unit II, is shown extending across the whole of the erosion surface that truncates the Mesozoic. The talus and rock-slide unit is drawn so that the displaced limestone at the top of the unit has a possible source farther up the slope, on limestone not covered by dolomitic talus. The rhyodacite drawn here as basement may be part of the basal conglomerate, and the basement may include many rocks besides rhyodacite.

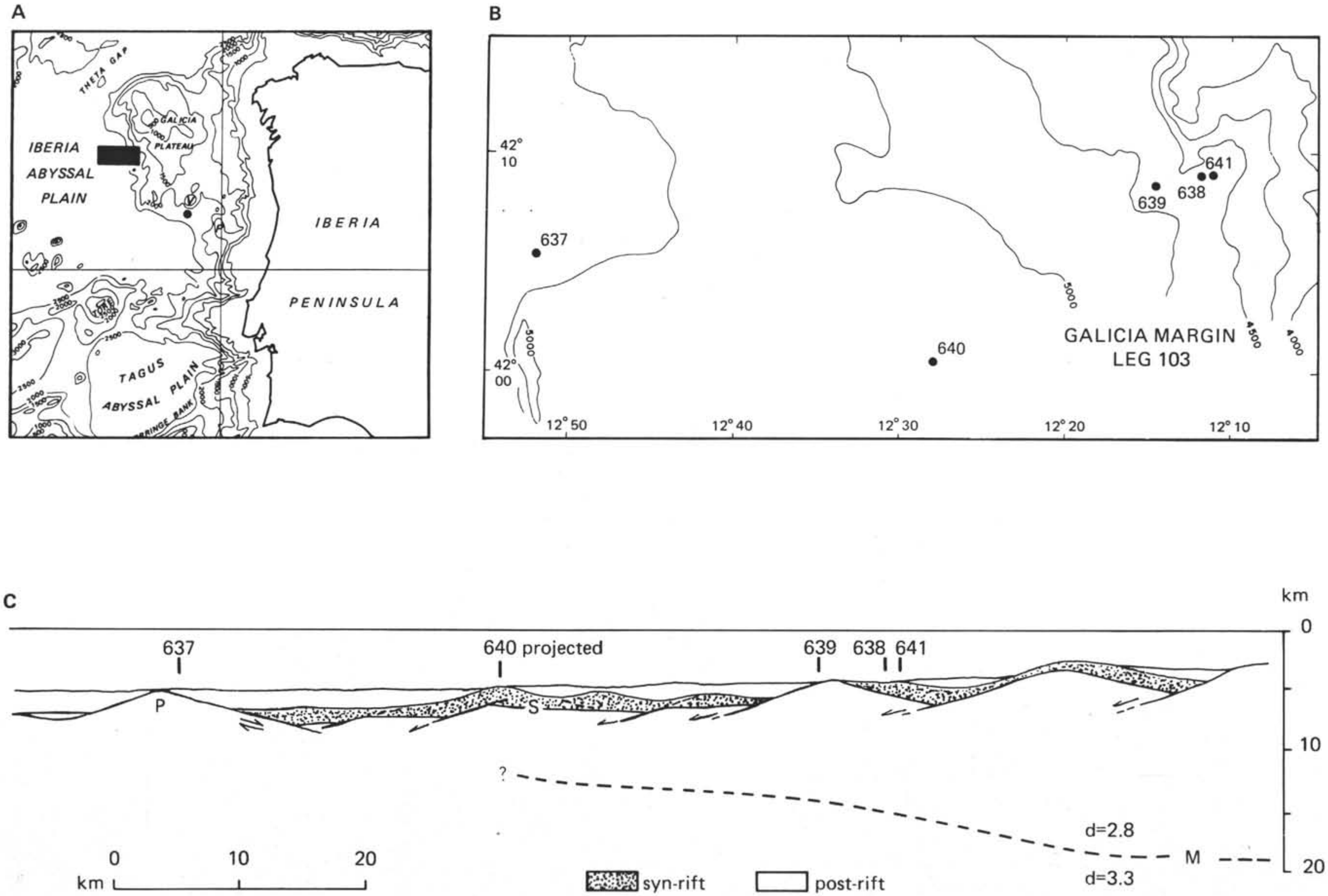
Figure 8. Multichannel seismic line GP102B, showing location of Site 640. (courtesy of L. Montadert). 1-3 = Albian-Recent post-rift sediments. S = deep reflector in "acoustical basement". Vertical scale = 2-way travel time in seconds.

Figure 9. Schematic cross-section across Galicia margin drawn from seismic data and drilling results. Reflector 'S' is discussed in the text.

Table 1. Summary of Leg 103 drilling.

HOLE	DATES (1985)	LATITUDE	LONGITUDE	WATER DEPTH*	PENETRATION	No. of CORES	METERS CORED	METERS RECOVERED	PERCENT of RECOVERY
637A	28 Apr - 4 May	42°05.3'N	12°51.8'W	5307	285.6	30	285.6	91.2	32
638A	5 May - 6 May	42°09.2'N	12°11.8'W	4661	44.0	none	0.0	0.0	00
638B	6 May -12 May	42°09.2'N	12°11.8'W	4661	431.1	45	431.1	210.5	49
638C	12 May -23 May	42°09.2'N	12°11.8'W	4661	547.2	14	135.3	37.7	28
639A	23 May -25 May	42°08.6'N	12°14.9'W	4720	89.8	10	89.9	35.43	39
639B	26 May -27 May	42°08.6'N	12°15.0'W	4735	80.0	4	80.0	12.6	16
639C	27 May -27 May	42°08.6'N	12°15.1'W	4756	99.8	2	21.8	4.8	22
639D	27 May - 3 Jun	42°08.6'N	12°15.3'W	4748	293.1	13	115.5	24.15	21
639E	6 Jun - 7 Jun	42°08.6'N	12°15.4'W	4754	234.9	4	35.5	1.8	5
639F	7 Jun - 8 Jun	42°08.6'N	12°15.5'W	4754	250.8	2	13.0	1.03	8
640A	4 Jun - 6 Jun	42°00.7'N	12°27.8'W	5196	232.2	9	86.8	15.6	18
641A	8 Jun -10 Jun	42°09.3'N	12°10.9'W	4636	63.6	7	63.6	40.34	63.4
641B	10 Jun -11 Jun	42°09.3'N	12°10.9'W	4639	35.0	none	0.0	0.0	00
641C	11 Jun -15 Jun	42°09.3'N	12°10.9'W	4640	305.2	16	154.3	112.52	72.9

* sea level; corrected m, echo-sounding



A
THETA GAP
GALICIA
PLATEAU
IBERIA
ABYSSAL
PLAIN
IBERIA
PENINSULA
TAGUS
ABYSSAL PLAIN
B
42°
10
42°
00
637
639
638
641
640
5000
4500
4000
GALICIA MARGIN
LEG 103
12°50
12°40
12°30
12°20
12°10
C
km
0
10
20
637
640 projected
639
638
641
P
S
?
d=2.8
d=3.3
M
0
10
20
km
syn-rift
post-rift

Figure 1

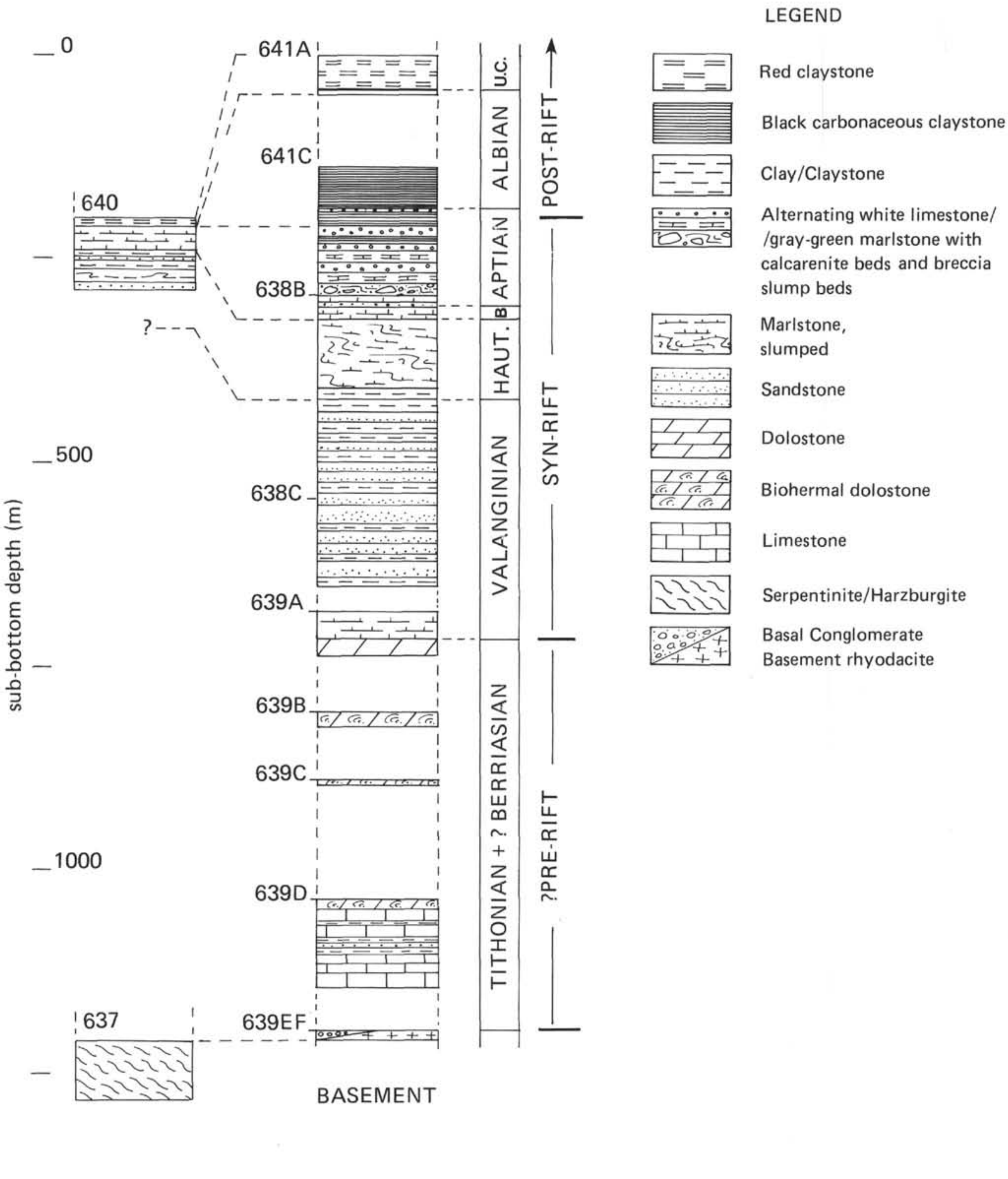

LEGEND
Red claystone
Black carbonaceous claystone
Clay/Claystone
Alternating white limestone/ /gray-green marlstone with calcarenite beds and breccia slump beds
Marlstone, slumped
Sandstone
Dolostone
Biohermal dolostone
Limestone
Serpentinite/Harzburgite
Basal Conglomerate Basement rhyodacite
0
500
1000
sub-bottom depth (m)
640
637
641A
641C
638B
638C
639A
639B
639C
639D
639EF
BASEMENT
U.C.
ALBIAN
APTIAN
B
HAUT.
VALANGINIAN
TITHONIAN + ? BERRIASIAN
POST-RIFT
SYN-RIFT
?PRE-RIFT

Figure 2

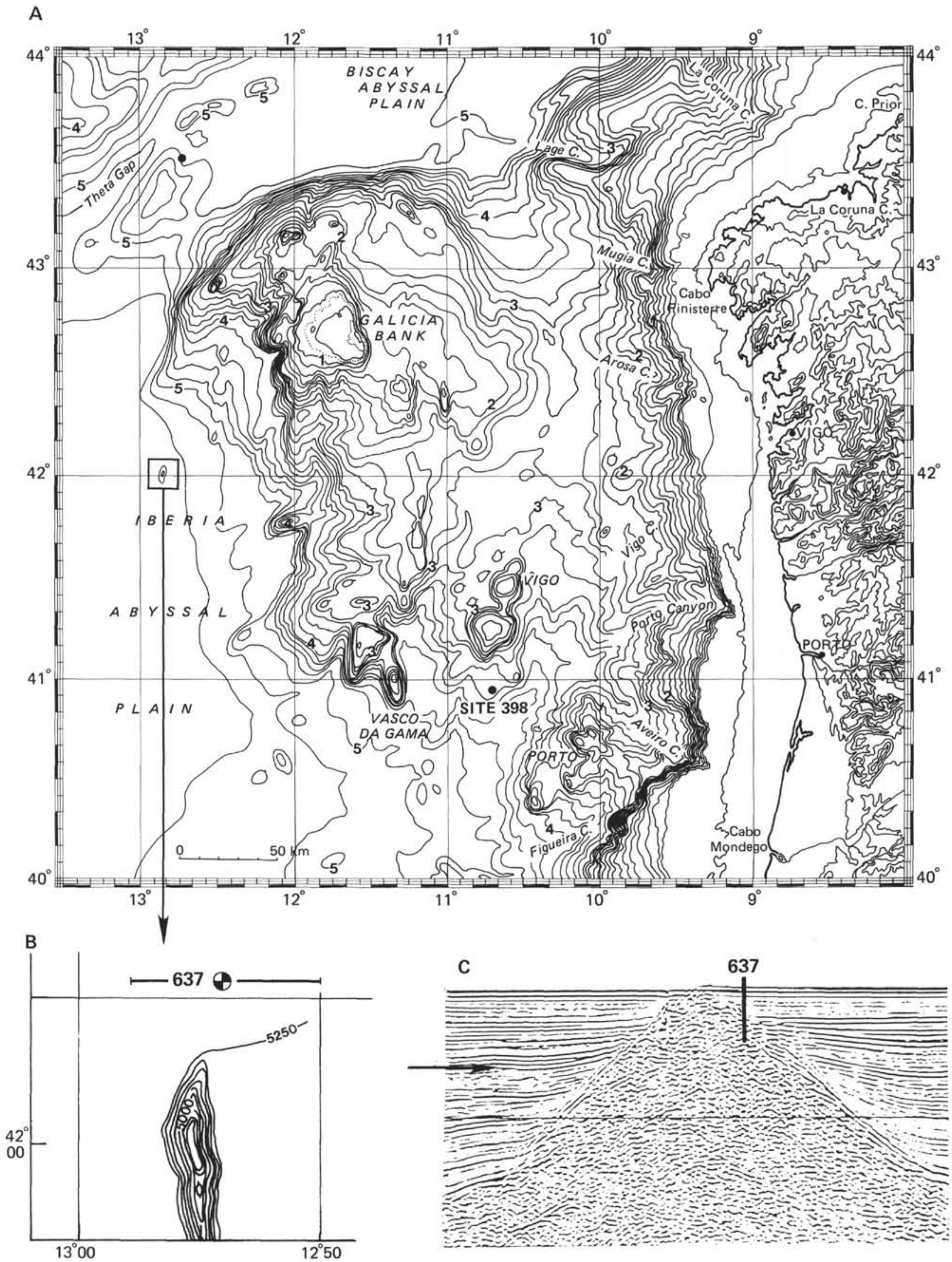

A
13°
12°
11°
10°
9°
44°
43°
42°
41°
40°
BISCAY
ABYSSAL
PLAIN
La Coruna C.
C. Prior
Lage C.
Theta Gap
Mugia C.
Cabo
Finisterre
GALICIA
BANK
Arosa C.
VIGO
IBERIA
ABYSSAL
PLAIN
Vigo C.
Porto Canyon
PORTO
SITE 398
VASCO
DA GAMA
Aveiro C.
Figueira C.
Cabo
Mondego
0
50 km
B
637
5250
5000
42°
00
13°00
12°50
C
637

Figure 3

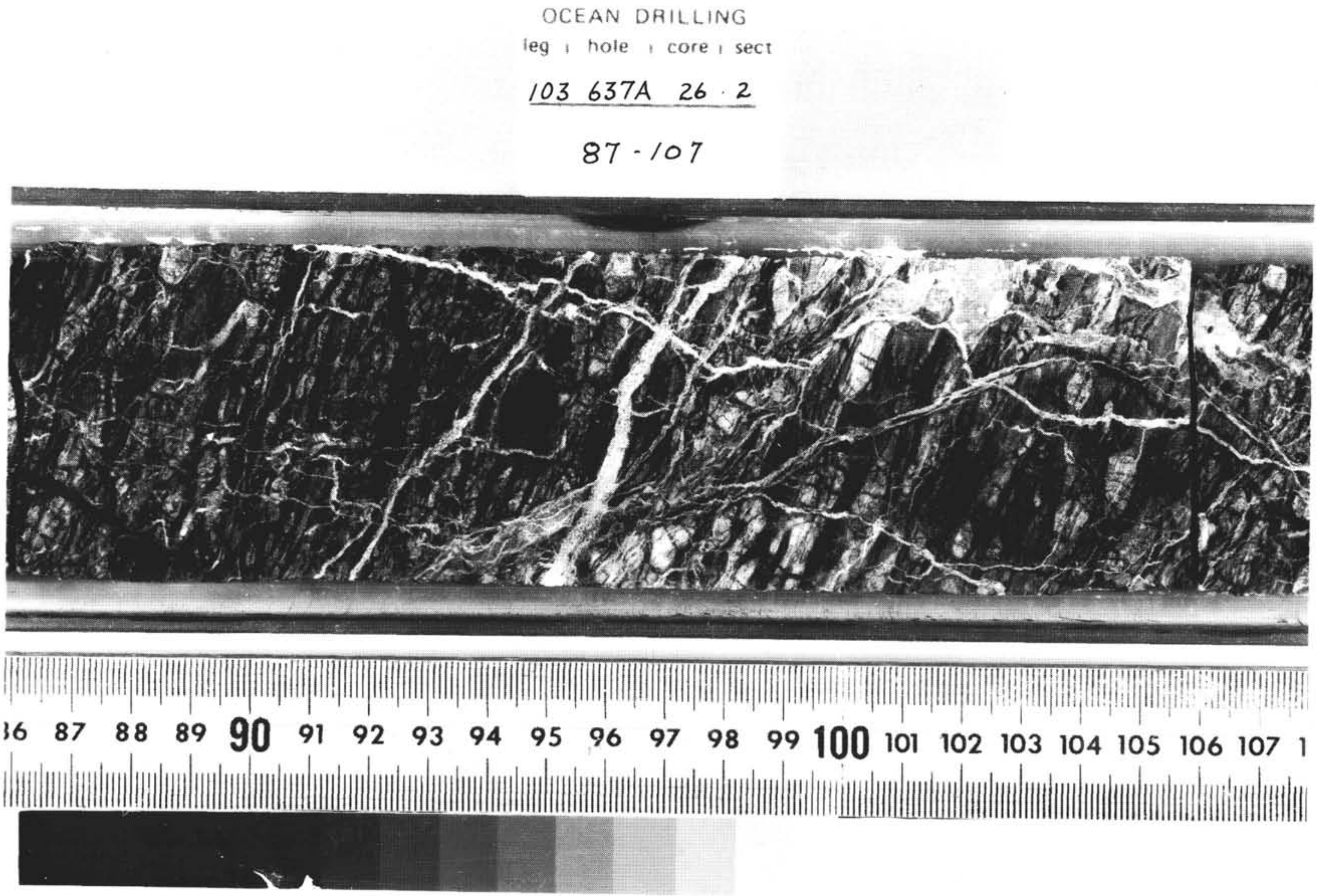


Figure 4

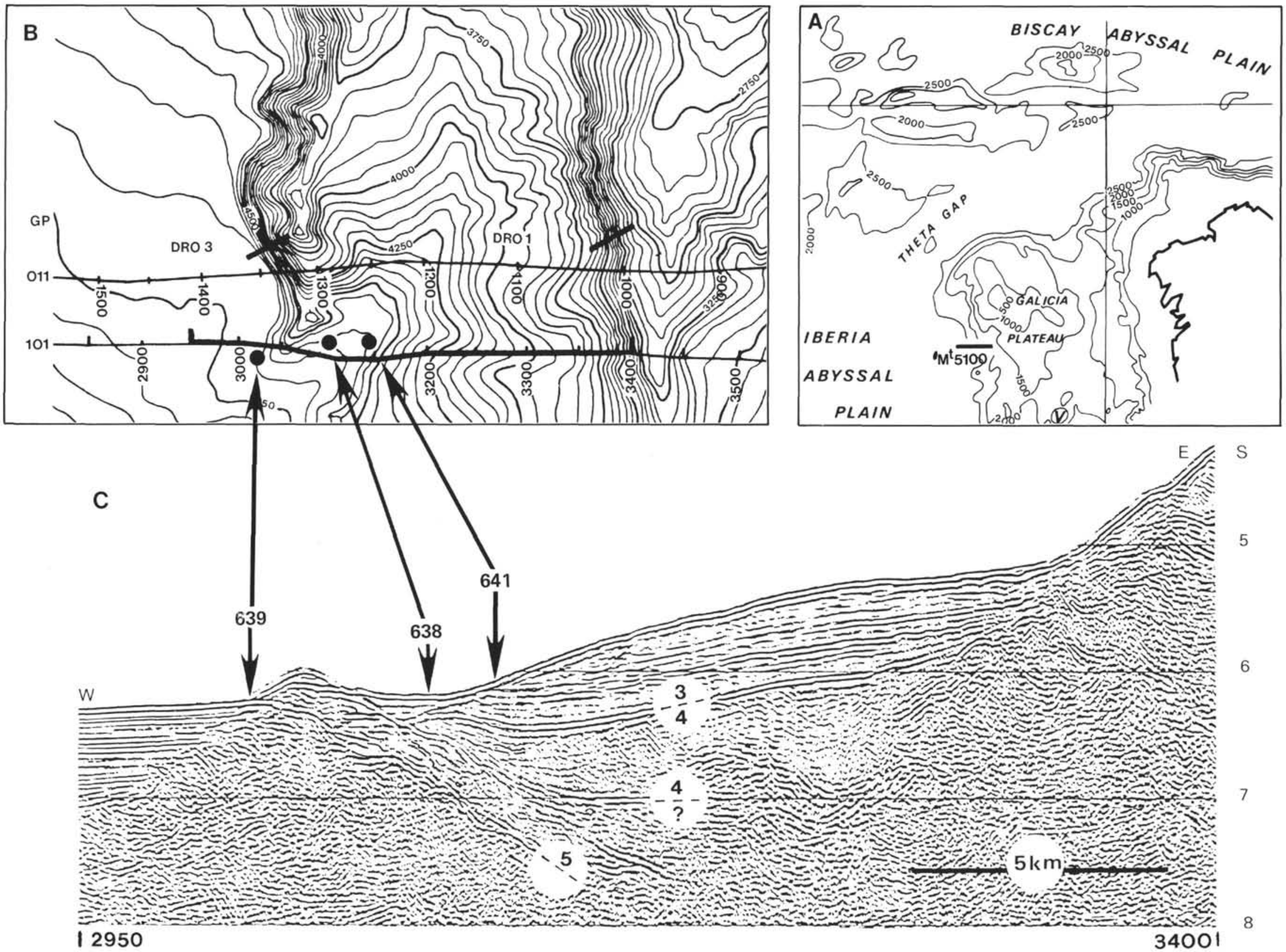
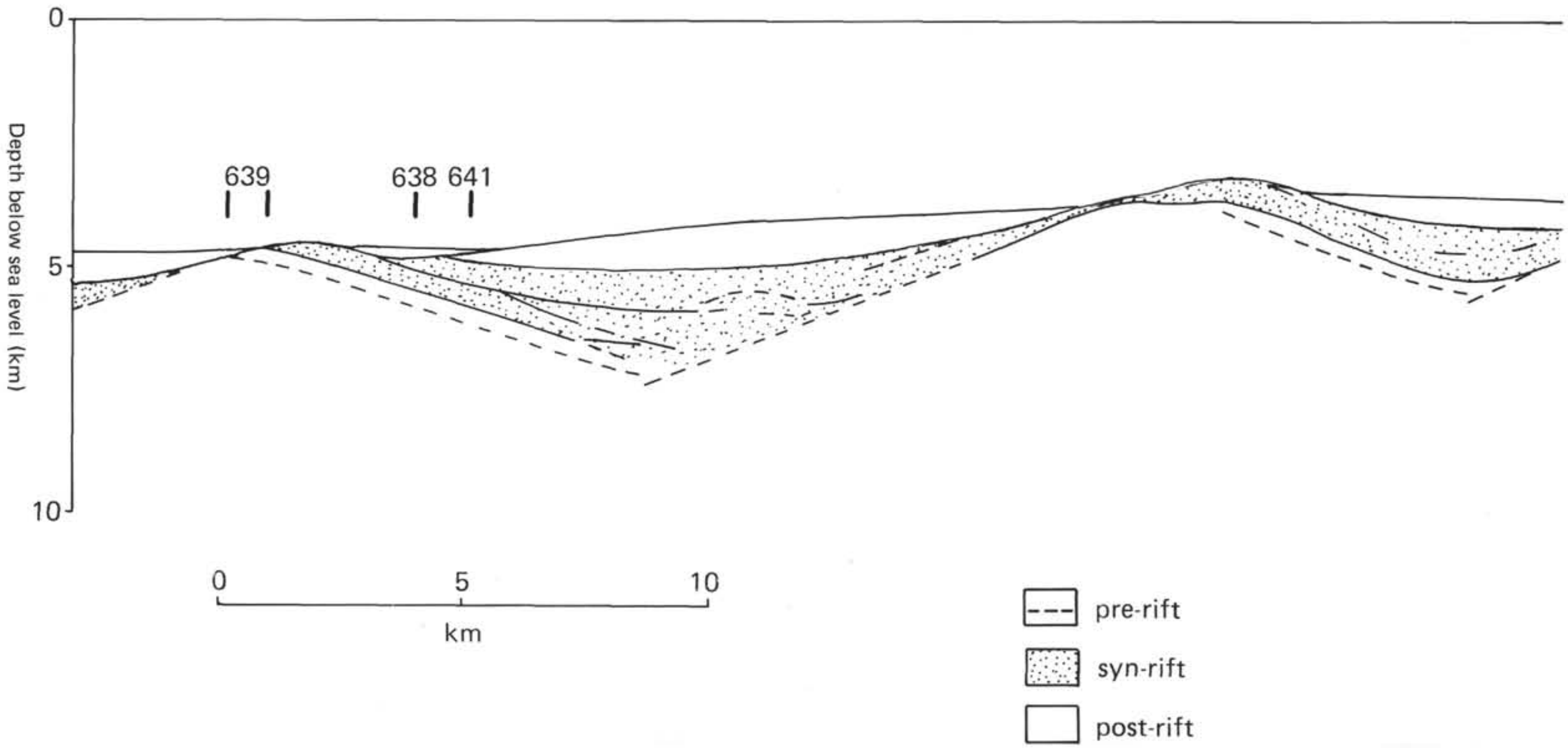

B
GP
DRO 3
DRO 1
O11
101
A
BISCAY
ABYSSAL
PLAIN
THETA GAP
GALICIA
PLATEAU
IBERIA
ABYSSAL
PLAIN
C
639
638
641
W
E
S
5
6
7
8
5km
2950
3400

Figure 5



0
5
10
Depth below sea level (km)
639
638 641
0
5
10
km
pre-rift
syn-rift
post-rift

Figure 6

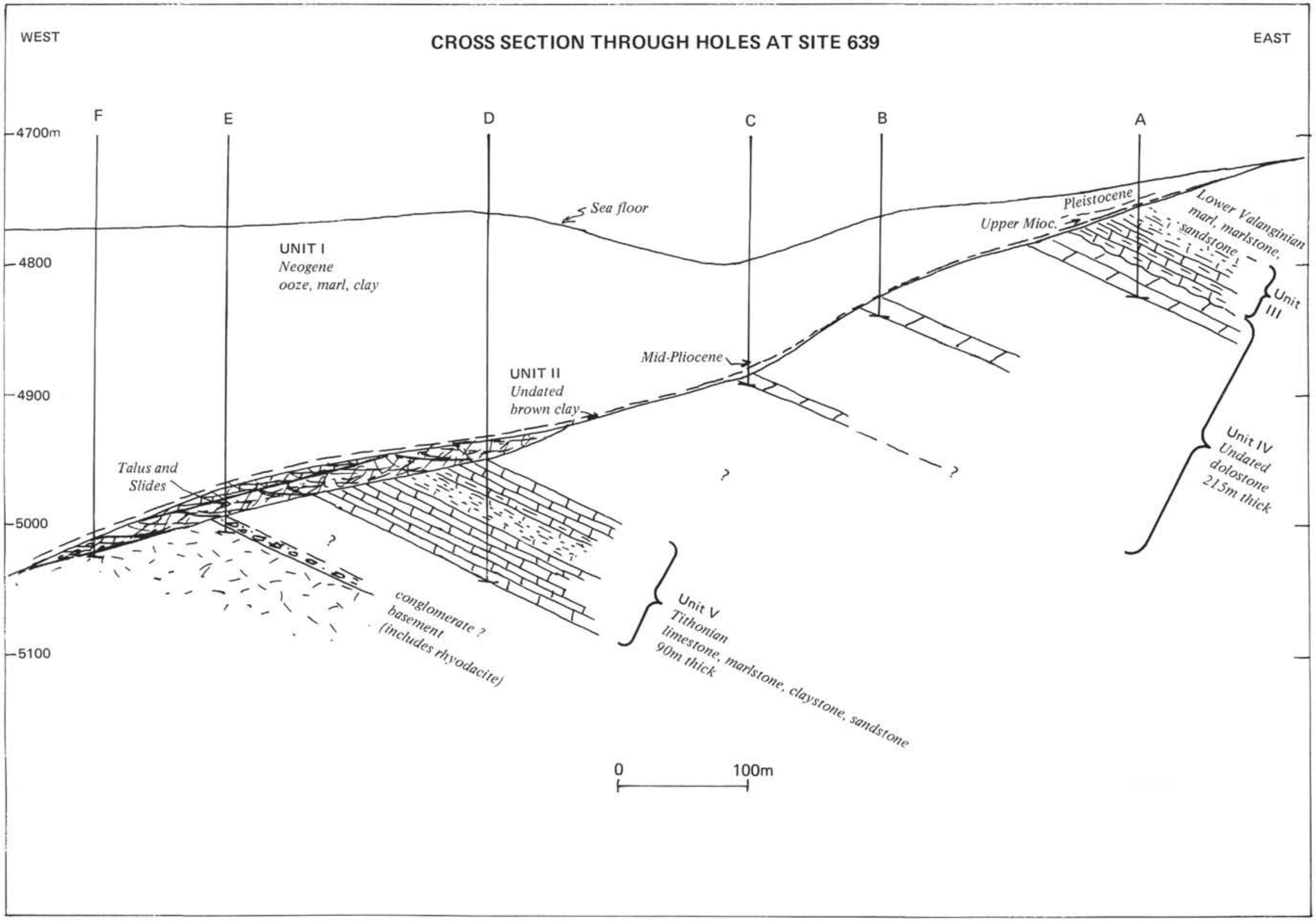

WEST
CROSS SECTION THROUGH HOLES AT SITE 639
EAST
F
E
D
C
B
A
4700m
4800
4900
5000
5100
Sea floor
UNIT I
Neogene
ooze, marl, clay
Pleistocene
Upper Mioc.
Lower Valanginian
marl, marlstone,
sandstone
Unit
III
Mid-Pliocene
UNIT II
Undated
brown clay
Unit IV
Undated
dolostone
215m thick
Talus and
Slides
?
conglomerate ?
basement
(includes rhyodacite)
Unit V
Tithonian
limestone, marlstone, claystone, sandstone
90m thick
0
100m

Figure 7

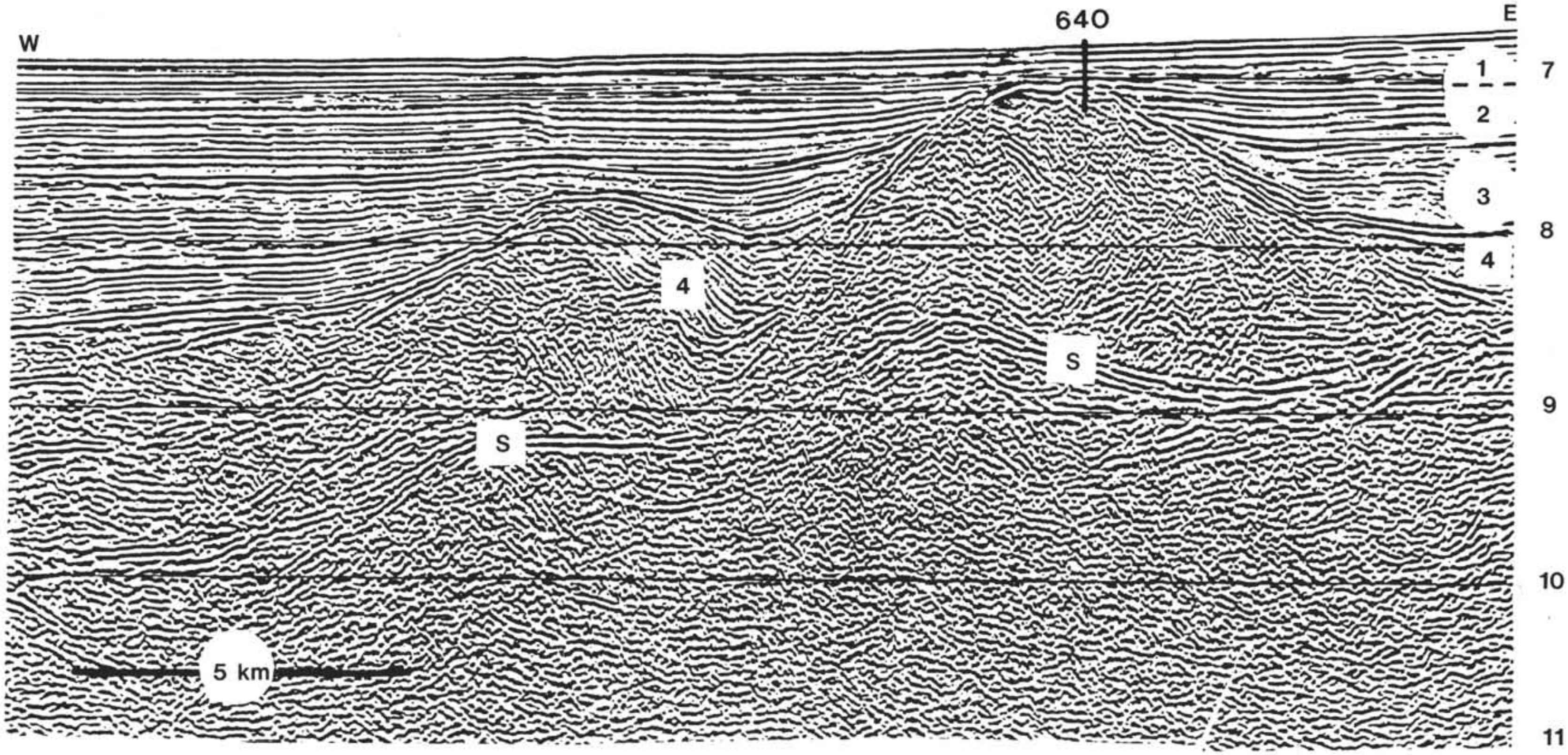
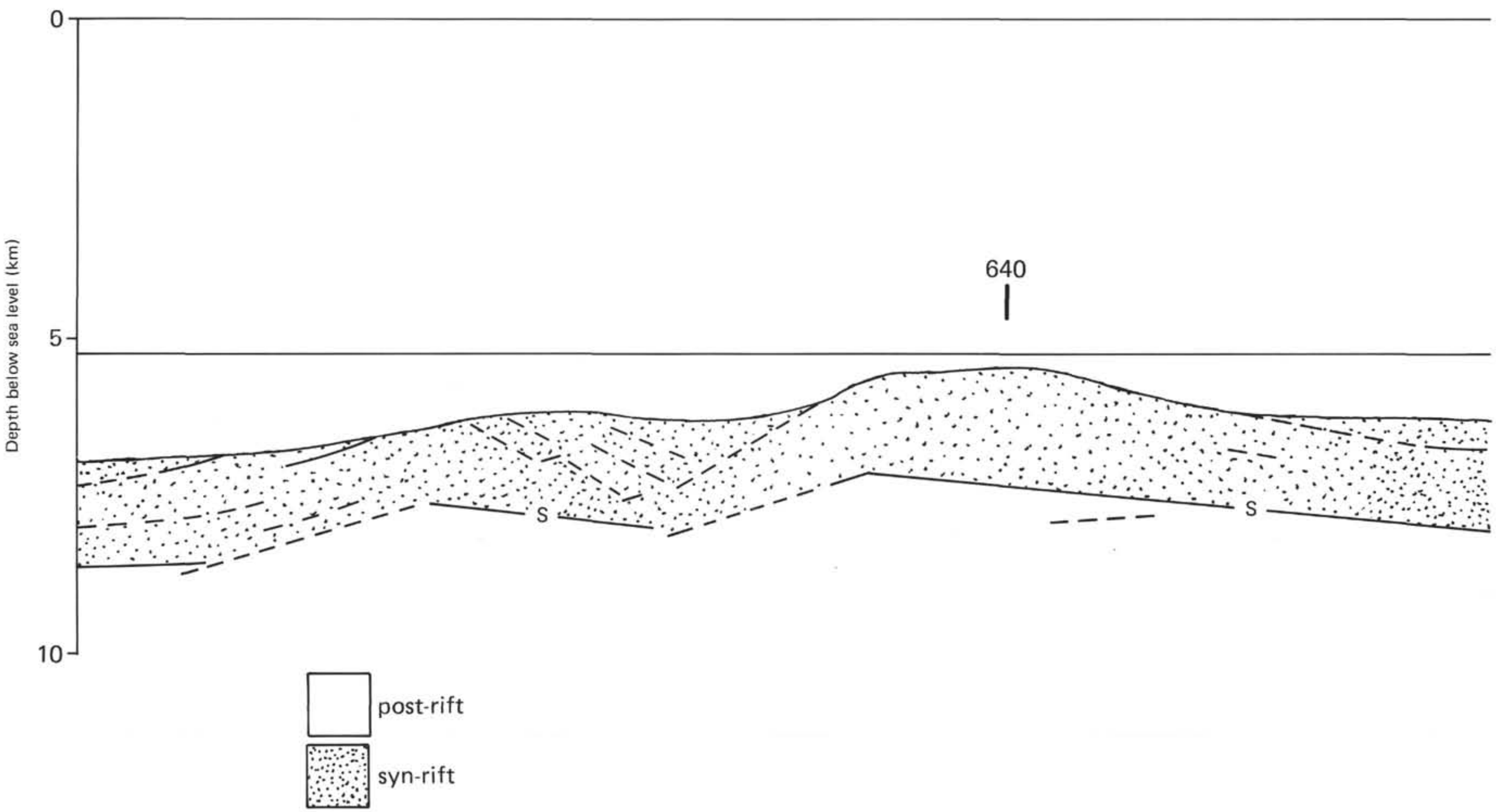


Figure 8

Figure 9



OPERATIONAL REPORT

The ODP Operations personnel aboard JOIDES RESOLUTION for Leg 103 of the Ocean Drilling Program was:

Cruise Operations Manager: Lamar Hayes

Other Operations personnel aboard JOIDES RESOLUTION was:

Lee Geiser, Schlumberger Logger (Schlumberger Offshore Service, Houston, Texas)

OCEAN DRILLING PROGRAM
OPERATIONS REPORT
LEG 103

Leg 103 of the Ocean Drilling Program was devoted to the investigation of the continental margin of Galicia, located approximately 170 miles off the west coast of Spain, in order to understand the early geologic history of this area and the opening of the North Atlantic Ocean between the once-connected landmasses of the Iberian Peninsula and Newfoundland.

The voyage commenced May 25, 1985, at Ponta Delgada, Azores and terminated at Bremerhaven, Federal Republic of Germany, on June 19, 1985, at 1530 hours. The leg required 55.2 days, of which 46.8 days were spent on site, 0.4 days in a scheduled port of call, and 8 days in transit.

PONTA DELGADA PORT OF CALL

A brief port of call was planned to change out crews including the scientific staff. The port call was extended a few hours more than we had planned, because June 25 was Independence Day, and Customs was not available to clear the offgoing crews luggage until 1700 hours. At 1930 hours, the RESOLUTION was underway to the first drill site located approximately 170 miles west of the Spanish Coast.

SITE 637

The RESOLUTION commenced the 645 mile trip to Site 637 at 1930 hours. After cruising 63 hours in a northeasterly direction, the heading was changed to due east, speed was reduced to six knots, and the survey gear was deployed. A Datasonics beacon was dropped at 1800 hours, 28 April. All survey gear was retrieved by 1830 hours, and the RESOLUTION positioned over the beacon in D.P. mode in 5321 meters of water.

Hole 637A

The typical rotary coring bottom hole assembly (BHA) was modified by adding three bumper subs. This change was necessary because a four-inch diameter air hose to the heave compensator was damaged beyond use during the trip from Ponta Delgada. Bumper subs were added to the BHA to absorb the vessel motion in case the heave compensator did not function properly.

Hole 637A was spudded at 1545 hours, 29 April, after off-setting 200 meters to the east from the beacon. Apparently the mudline consisted of a silty ooze that caused core recovery to be nothing more than a trace in each of the first four cores attempted. Both the 10-finger and the flapper soft-formation core catchers were tried during the first four coring attempts, but neither system recovered more than a trace.

While cutting Core No. 6, pump pressure was increased to 100 strokes per minute (420 gpm) to side track or dislodge a rock that might have been stuck in the throat of the bit. The last four meters of Core No. 6 were cored with the normal 30 spm. Either the high pumping rates or a change in formation -- we don't know which -- caused recovery of 4.5 meters of clay. Penetration rate averaged a little over 10 minutes per core through the rest of the sedimentary section.

While coring Core No. 23 at 5536 meters (93 meters BSF), the penetration rate decreased to 10 minutes per meter. The bottom 30 cm of the two meters recovered contained serpentine. We continued to core serpentine to 5587 meters. One core, No. 29, contained two meters of serpentine and gravel. Core No. 30 from 5606 meters (285 meters BSF) was similar to Core No. 29, containing serpentine gravel with a little clay. The gravel encountered in the last two cores indicated that we had reached the point when hole conditions were starting to deteriorate, and we also had used the time alloted for coring at Site 637.

We circulated the hole for logging and dropped a go-devil to activate the hydraulic bit release. The bit release required 2500 psi while bumping the bit on bottom before separation. The hole was displaced with 65 barrels of mud, and then the bottom of the drill string was pulled up to 5420 meters (112 meters BSF).

The first logging tool run was a Caliper, Natural Gamma, and Sonic Velocity tool. The tool stopped 39 meters above bottom, so the hole was logged from 5567 meters (208 meters BSF) to 5420 meters (112 meters BSF). The second logging run consisted of Gamma Ray Spectrometry and Lithodensity tools. Apparently, the well bore was still caving and the logging started at 5532 meters (218 meters BSF) and continued up to 5420 meters (112 meters BSF). A third logging run was cancelled due to poor hole conditions and time constraints. The logging equipment was rigged down and the pipe pulled out of hole (POOH). Site 637 was abandoned at 2100 hours, 5 May, 1985.

SITE 638

This second site drilled on Leg 103 was located 29 miles due east of Site 637. Actual survey distance from 637 to beacon drop was 39 miles. Since 638 was a planned re-entry hole, the RESOLUTION surveyed over the drill site several times to make sure that adequate sediment was available to wash in the 16-inch casing to support the re-entry cone.

Hole 638A - Jet In Test

A beacon was dropped at 0615 hours on 5 May, 1985, in 4671 meters (PDR) of water. As this was a planned re-entry site, the establishment of the exact depth to the sea floor was of particular importance. The drill bit with a center bit was lowered until the heave compensator stroke position indicator reflected that contact with the sea floor was made at 4673 meters. A "jet in" test was conducted to determine how much 16-inch casing could be successfully washed in while setting a re-entry cone. Two and one half hours were required to jet down 44 meters BSF. The last 4 meters washed in much slower and it would have been a gamble to attempt to go any deeper with 16-inch casing. The center bit was retrieved and the ship was offset 20 feet to spud Hole 638B.

Hole 638B

Hole 638B was spudded at 0145 hours on 6 May, 1985. The first four cores consisted of the usual nannofossil ooze with good recovery, but the fourth and fifth cores produced no recovery. However, fine sand was discovered between the core catcher fingers. This was of particular importance because Core No. 4 was recovered from 35 to 44 meters BSF, the same depth that the "jet in test" on Hole 638A encountered firm resistance. Clay with a few sand stringers was cored to 4860 meters (187 meters BSF) without experiencing any hole problems, although core recovery was a little less than we had expected. Core No. 20 from 4854 meters to 4863 meters (190 to 181 meters BSF) revealed that we had encountered a marlstone. A multishot survey was taken at 4796 meters and indicated 2 deviation from vertical. Another survey indicated 4-1/4 at 4969 meters. Due to poor hole conditions only one additional survey was attempted: at 5017 meters (344 meters BSF), deviation was 4-3/4 . Hole conditions started deteriorating at 5000 meters and required flushing the hole with slugs of mud after each core. The scientists projected basement to be between 1100 and 1300 meters BSF, and one bit had no chance of penetrating that depth on this site. While retrieving the core barrel to condition the hole for logging, the drill string became stuck and required 1-1/2 hours to work the pipe free.

To condition the hole for logs, the well bore was well circulated with seawater, then flushed with 40 barrels of high viscosity mud. A hole conditioning trip up to 4900 meters (228 meters BSF) was made by doubling out with the power sub and then the drill string was lowered by washing and reaming back to bottom at 5104 meters. Very little fill was found on bottom. The hole was flushed with 40 BBls of mud.

A go-devil was dropped down the drill pipe to activate the hydraulic bit release. To release the bit we again had to bounce the bit on the bottom while holding 2700 psi of pressure. After 45 minutes the bit was released. The hole was displaced with high viscosity mud and the pipe pulled up hole to position the bottom of the BHA 100 meters below the mudline. Logging attempts were as follows:

Log No. 1. Resistivity (Caliper) Gamma Ray Sonic hit bridge and stopped at 4958 meters (295 meters BSF).

Prior to running Log No. 2 the drilling assembly (without a bit) was lowered to 5004 meters (388 meters BSF) to clean out bridges.

Log No. 2. SL Sonic tool hit bridge and stopped at 4834 meters, only 60 meters below the drill string.

Plans to continue logging Hole 638B were abandoned and the pipe POOH. The ship was offset 50 feet, and preparations to run a re-entry cone at Hole 638C were begun.

<u>Hole</u> <u>638C</u>

The re-entry cone had been completely assembled and was resting on the moonpool doors. The top section of the drill pipe guide was removed and was not installed again until the re-entry cone was jetted in place. Three joints of 72 pound per foot, 16-inch casing totaling 40 meters were assembled with a double J hanger housing on the top joint of 16-inch casing. The casing assembly was guided through the re-entry cone until the housing latched into the cone. A 14-3/4 inch bit was carefully spaced to extend six inches below the 16-inch casing shoe. The double J system was function tested for J-ing down and up while the cone was setting on the moonpool doors.

The drillers were instructed to lower the re-entry cone at no more than 1500 feet per hour. The double J system had never been used on any deep ocean coring projects although it is routinely used in the oil industry at water depths less than 2000 meters.

Assembly of the 16-inch casing, spacing out, and testing -- including trip to the sea floor at 4673 meters -- required 21 hours.

The 16-inch casing was jetted in but at a much slower rate than had been anticipated. After 12 hours of jetting, the casing shoe was at 40 meters BSF. This meant the 8' x 8' mud skirt was four meters above the mudline. With the flexible double J tool, left-hand torque was applied (one turn) to the drill string, releasing the running tool from the re-entry cone. Four meters were drilled below the 16-inch casing shoe by rotating the drill string. The drill string was raised up until the double J running tool reengaged the companion J in the housing. Attempts to wash the 16-inch casing to the bottom of the 14 3/4 inch bit at 44 meters BSF were not successful. The running tool was released by applying right-hand torque to the drill string and POOH. The pipe was RIH with a rotary coring system to the top of the re-entry cone at 4666 meters. A Mesotech Scanning Sonar was rigged and run on the logging line. We failed to achieve re-entry on the first two attempts. The Mesotech tool was retrieved in favor of an EDO Western Sonar. After 3-1/2 hours of scanning, re-entry was achieved.

The bit was washed from 44 meters to 411 meters BSF (5084 total depth). Unfortunately, on Core No. 2 from 5104 meters (431 BSF), the overshot was retrieved without the core barrel. The quick release on top of the core barrel released while retrieving the core barrel. This left the top of the core barrel open. A fishing tool was lowered on the sandline to latch into the core barrel. A bridge was hit with the fishing tool 1000 meters above the bit. The pipe was POOH to investigate obstruction in the drill pipe and to retrieve the core barrel.

A drill pipe drift mandrel (RABBIT) was dropped through each stand of drill pipe to make sure that any obstruction in the drill string was removed. Three pieces of hard sand core had formed a bridge inside the drill pipe about 1000 meters above the bit.

We installed a new bit, ran in hole (RIH) to 4666 meters, and achieved re-entry with the Mesotech Sonar after scanning 3-1/2 hours. The hole was flushed with 30 barrels of mud. Recovery was poor (25%) from 5104 meters to 5178 meters. From 5178 meters (514 meters BSF) to 5190 meters we had a very fast penetration rate and no core recovery. From all indications this 12 meter interval was a loose sand. For the remainder of this hole we flushed the hole with 20 barrel slugs of mud after each core. Prior to retrieving each core barrel the bit was positioned at least 30 meters above the bottom of the hole. The hole was cored to 5220 meters (547 meters BSF), and we started in to retrieve the core barrel. When the pump pressure started increasing, we were unable to circulate because the hole was packed off above the bit. However, we were able to pump seawater through the bit and into the formation at 1000 PSI. After working the stuck drill string for three hours with no movement at the bit, we assembled a 62-pellet severing charge to sever an 8-1/4 inch drill collar. Drill string stretch tests indicated that the drill pipe above the BHA was free, and also that the bumper sub located between the seventh and eighth drill collar above the bit had some movement.

The severing charge was detonated in the middle of the fifth drill collar above the bit. Explosion was confirmed, but the drill string remained firmly stuck. However, pump pressure dropped from 1000 psi to 200 psi. Either the drill collar was not completely severed or the stuck point was below the shot point. While preparing severing charge No. 2, the drill pipe came free with no loss of drill weight. POOH, all downhole tools were recovered. The shot drill collar had cracks and splits over the middle four foot section of the drill collar, but had failed to separate. Apparently the split section of the drill collar provided an outlet for circulation at the stuck point and the pipe was circulated free. The hole was filled with mud prior to POOH.

SITE 639

Site 639 was located 2.3 miles west-southwest of Site 638. This single bit hole was located on the edge of a sediment-covered tilted block with structural outcrops on the southern side. The plan was to core to basement at a depth of 400 to 600 meters.

Hole 639A

A beacon was dropped at 0945 hours on 23 May, 1985, in 4690 meters (PDR) of water. RIH with a rotary coring system to the mudline at 4735 meters.

The first three cores consisted of firm nannofossil ooze; cores 4 thru 6 contained hard sandstone interbedded with clay. When coring No. 9 at 80 meters BSF, the drill string began torquing severly and became very sticky. Cores No. 9 and 10 consisted of sandstone and a very hard weathered dolostone. The bit stuck several times while cutting core No. 10. We picked up off bottom and flushed the hole with mud three times while coring No. 10. The pipe became stuck with the bit four meters off bottom. After 1-1/4 hours of working the stuck drill string the pipe came free, but two attempts to recover the stuck core barrel failed. We flushed the hole with mud and made a third run to retrieve the core barrel; unfortunately, the bit plugged while trying to retrieve the core barrel. POOH to clear mudline and made one last attempt to recover core No. 10 without having to trip the drill pipe. The core barrel remained stuck so the trip was required to release the core barrel.

We found the core barrel latch bolt partially backed out and bent, thus preventing the core barrel latch from releasing.

Hole 639B

The ship was offset 200 feet west of Hole 639A and the mudline established at 4707 meters. The mudline was too firm to penetrate. The bit was raised 200 meters above the mudline and the ship offset 300 feet to the west. The mudline was established at 4758 meters with a mudline core, then washed with the center bit to 4821 meters (63 meters BSF). A multishot survey at 4821 meters (66.5 meters BSF) revealed a 1 deviation. At 4834 meters (80 meters BSF) sticking and torquing problems were too severe to continue coring. Hole conditions were the same as were encountered in Hole 639A. We POOH to clear the mudline and offset 300 feet to the west to spud Hole 639C.

Hole 639C

The ship was offset to the west on both Holes 639B and 639C in an attempt to move down the sediment covered slope to a point that we could spud in below the troublesome fractured dolostone.

The mudline was encountered at 4792 (DPM) and washed to 4870 meters (78 meters BSF). Two cores were recovered while coring to 4892 meters (100 meters BSF) and again the fractured dolostone forced abandonment of Hole 639C. Again we POOH to clear the mudline and offset 300 feet west in search of an area without fractured dolostone.

Hole 639D

The drill string was lowered until the bit encountered the mudline at 4753 meters (DPM), and washed to 4930 meters (177 meters BSF).

We cored to 4940 meters and again the hole became sticky, causing high torques in the drill string. We started reaming just cored sections two and three times and flushing with 20 to 30 barrels of high viscosity mud. On Core No. 4 from 4959 meters the bit plugged. The pipe was doubled out with the top drive to 4930 meters and circulation was re-established. We reamed back to bottom and flushed the hole with 60 barrels of mud in an attempt to circulate out three meters of fill (probably dolostone cuttings).

We recovered limestone in the bottom of Core No. 4 and hole conditions were somewhat improved. The multishot was run at 4985 meters (242 meters BSF) with a 3/4 deviation, and coring was continued to 5046 meters. Core No. 13 consisted of 3.7 meters of under gauge limestone and sandstone. It was evident that the drill bit was completely worn out, but we dropped core barrel No. 14 anyway. After cleaning out two meters of fill, it was evident that one or more cones had fallen off the core bit.

We circulated and conditioned the hole for logs and flushed the hole with 30 barrels of mud. We doubled the drill pipe out with the power sub to 4940 meters, and then washed and reamed back to bottom at 5046 meters (293 meters BSF).

The go-devil was pumped down to release the bit. Pressures of 800 psi to 3400 psi were applied for 1-1/2 hours while bouncing the bit on the bottom numerous times in an attempt to release the bit. While pounding bottom, the drill pipe slapped against the sides of the hole, breaking off exposed ledges of dolostone and sandstone that accumulated around the BHA. As was expected, the drill string became stuck while trying to release the bit. With the go-devil seated in the HBR sub there was no chance of circulation without a wireline trip to retrieve the go-devil. The drill pipe was pressured up to 3400 psi numerous times while pulling 100,000 pounds of overpull. After 3 hours of working the stuck pipe it was evident that the drill string could not be worked free and we started preparing to sever the BHA when the drill string literally jumped a few inches and started circulating with normal pressure. Apparently the bit was stuck and the rest of the BHA was free. The HBR had partially released hydraulically to the point where the 100,000 pound overpull separated the HBR completely. We flushed the hole with 30 barrels of mud then displaced hole with mud, POOH to 4946 meters (202 meters BSF), and rigged up to log.

Log No. 1. LSS, GR, CAL, and ILD, log stopped at 4981 meters (238 meters BSF). Retrieved logging tools.

Double in hole with top drive, clean out bridge and ream to 5026 meters (283 meters BSF) and circulate, then displace hole with mud.

Log No. 2. LDT, CNL and NGT. Test logging tools, log down from 4947 to 5017 meters (273 meters BSF).

Log No. 3. Multi-channel sonic log, logged from 4947 meters down to 4998 meters (254 meters BSF).

Rig down logging tools and POOH. Underway to re-entry hole 638C to run logs.

HOLE 638C - LOGGING

We moved the ship 2-1/2 miles from Site 639 back to Site 638. Tripping operations continued while underway with the thrusters down. We received a good beacon signal from both commandable beacons one mile from Hole 638C.

We positioned over the beacon and continued RIH with a shortened BHA and a clean out bit. The bit was lowered to 4660 meters and the Mesotech scanning sonar tool run in on logging line and scanning for the re-entry cone began.

The cone was located 200 feet from the scanning sonar. Several moves were introduced to close the gap between clean out bit and the cone. On several occasions the drill string moved across the rim on the cone, but not close enough for re-entry. The Mesotech tool presented a target in color and at a distance of 50 feet or more the four reflectors are easy to locate, but 180 from the target there is a ghost reflector that is apparently a back side lobe. This ghost reflector is a little confusing from 10 feet out to "stab in". The scanning scope was displaying two sets of reflectors and caused the bit to miss the cone. After 5-1/2 hours of scanning and maneuvering the ship re-entry was accomplished. A small microphone had been installed inside the sonar case prior to this re-entry. The microphone picked up the metal to metal scraping and rattling and there was no doubt that the re-entry was accomplished.

We RIH with the clean out bit to a depth of 4981 meters where the bit encountered a firm bridge. The top drive was picked up and we reamed and washed to bottom at 5220 meters (547 meters BSF), then flushed the hole with 45 barrels of high viscosity mud. We POOH to 4950 meters then reamed and washed through four or five bridges before touching bottom. Again the hole was flushed with 40 BBls of mud, then circulated with seawater. Before POOH to logging depth the hole was filled with high viscosity mud. From all indications the hole was not in good shape to get logs to bottom, but there was no way to condition the hole any better.

The clean out bit was positioned at 4772 meters (110 meters BSF) and the logging unit prepared to log. Logging summary:

Log No. 1. LSS, GR, CAL, and ILD log hit bridge and would not pass 4960 meters (287 meters BSF).

Log No. 2. LDT, CNTC, NGT, Log hit bridge at 4923 meters (150 meters BSF).

We abandoned plans to spend any more time trying to log Hole 638C. POOH, and inspected the BHA by magnaflux.

SITE 640

After a 21-mile move from Hole 638C, a beacon was dropped at 1255 hours on 3 June, 1985, in 5249 meters of water.

Permission had been received to wash/drill from the mudline to 5346 meters. We commenced washing this section at 1015 hours on 4 June. The center bit was retrieved and we rotary cored to 5433 meters (232 meters BSF). The coring objectives were achieved on this hole and the trip out with the drill string was completed at 0200 hours on 6 June, 1985.

Hole 639E

From previous experiences at Site 639, the score stood at three to one in favor of the dolostone rubble that had forced abandonment of Holes 639A, B, and C. Now we tried again.

We established the mudline at 4770 meters then washed with the center bit through the soft nannofossil ooze to 4969 meters. Rotary coring began at 4969 meters (209 meters BSF) and almost immediately we started having the same problems of the bit sticking that we had experienced on all the 639 holes. Our theory that we could move down structure and start coring below the dolostone outcrop was certainly in question.

After being stuck several times and requiring 150,000 pounds of overpull on each occasion to free the bit, we were convinced that there was no way that we could continue challenging the dolostone rubble in this particular hole without losing a bottom hole assembly. Coring operations were abandoned at 5004 meters (234 meters BSF) after retrieving Core No. 4. We cleared the mudline and offset the ship 100 meters west for one final try at reaching the basement that had eluded us so far.

Hole 639F

We washed from the mudline at 4771 meters through the ooze and clay to 5008 meters (237 meters BSF) and retrieved center bit. After coring only four meters on Core No. 2, we had reached a point where we could apply no weight on the bit due to severe torquing. Even after reaming the 4 meter section several times and flushing with mud, we had reached a point we were unable to get back to bottom. To continue coring on 639F was out of the question. We conceded that this particular tilted outcrop cannot be drilled using seawater for circulation.

Operationally we never succeeded in penetrating through the massive dolostone section, but most of the scientific objectives were achieved by coring the series of holes along the edge of the slope.

We POOH and moved three miles to Site 641 located 1100 meters east of Site 638.

SITE 641

Hole 641A

At Hole 641A we deployed a Datasonics beacon in 4590 (PDR) meters of water and RIH with an APC/XCB coring system. This hole was scheduled to be continually cored to approximately 300 BSF. The formation should be ideal for coring with the XCB.

The bit was positioned at 4590 meters and the piston core was shot with 1700 psi, but apparently the PDR was in error and we recovered a water core. To minimize the chances of another water core, the drill string was lowered until bottom was established at 4610 meters. Again the piston core was shot with 2700 psi, but the pressure didn't bleed off. We recovered the core barrel and found the core catcher sub broken off the bottom of the core barrel.

The XCB core barrel was deployed and the mudline was confirmed at 4610 meters. Core No. 1 was recovered and no reason was found for the APC piston corer not to penetrate the mudline. The core consisted of the usual soft ooze and clay.

We cored with the XCB with excellent recovery through Core No. 7. While coring Core No. 8 at 4708 meters (62 meters BSF) we had a drop in pump pressure and lost 23,000 pounds of drill string weight. There was no question as to what had happened; the BHA had broken and the loss of 23,000 pounds indicated that the bumper sub had failed. POOH to determine the losses and make up a new BHA.

The bumper sub that was added to the BHA prior to coring Hole 639E had failed at the upper service break and resulted in the loss of seven drill collars.

Hole 641B

We replaced the lost components of the BHA and spaced out a RCB coring system and started to RIH. The center bit was inadvertently left out of the BHA and was dropped down the drill pipe with the bit about 1500 meters below the drill floor. Apparently the center bit was deployed in dry drill pipe and the velocity of the core barrel when it hit the float valve was enough to break the float flapper at the hinge pin. A glass rod (used to prop the flapper open to let water pass into the drill string as the pipe is lowered into the water) apparently fell out or broke as the trip in the hole started. Unaware that the flapper was broken, we continued to RIH and wash 60 meters to overlap with Hole 641A. We retrieved the core barrel less the center bit. No time was lost trying to fish for the center bit. We POOH to investigate the failure. We replaced the float valve and center bit after POOH.

Hole 641C

We RIH with the RCB and washed/drilled from 4649 meters to 4703 meters. Started coring at 4800 meters (150 meters BSF) with excellent recovery while coring the black shales and hard sandstone to a total depth of 4955 meters (305 meters BSF). The hole was circulated for about 20 minutes then flushed with 40 barrels of mud. To check the hole conditions, a wiper trip up to 150 meters (BSF) was made and then run back to bottom, finding a surprising 11 meters of fill on the bottom. We cleaned out the fill and flushed the hole with another 40 barrels of mud.

We POOH and positioned the bottom of the BHA at 4749 meters (101 meters BSF) and rigged to run logging tools.

The first logging attempt using the LSS tool was stopped at an impassable bridge at 127 meters (BSF), which was only 27 meters below the BHA. The logging tools were laid aside. We lowered the BHA and cleaned out firm bridges to 4955 meters (214 meters BSF), circulated the hole, and then displaced the hole with high viscosity mud. POOH and then positioned the BHA at 4778 meters (128 meters BSF) for logging attempt number two.

The second logging attempt using the LDT, NGT, and CNL tool was stopped at an impassable bridge at 196 meters BSF. An NGT log was run through the drill pipe from the sea floor to 95 meters BSF. Due to the poor hole conditions between 150 meters and 250 meters BSF, further logging attempts were cancelled. This hole was officially terminated at 1330 hours on 15 June, 1985, as the ship got underway to Bremerhaven, Germany.

DRILLING AND CORING EQUIPMENT

A standard DSDP bottom hole assembly was used on the first site. This consisted of a bit, bit release (HBR), head sub, one 8-1/4" drill collar, top and head sub, three 8-1/4" drill collars, one 5' stroke bumper sub, three 8-1/4" drill collars, two 5' bumper subs, one 8-1/4" drill collar and one 7" drill collar.

This BHA was selected because a 4" x 85' long air hose to the heave compensator was damaged beyond use while in transit to the first drill site. We were not sure if the heave compensator response to vessel motion would be affected or not. These concerns were not warranted because the heave compensator functioned as well with one air hose as it had with two. Sites 638 and 639 were drilled with the same BHA as described for site 637, less the lower two bumper subs. One bumper sub remained between the top two 8-1/4" drill collars. The one bumper sub was not used to eliminate vessel motion but to help free the BHA if it became stuck.

The complete BHA was inspected by magna-flux prior to drilling Holes 639E and F. The bumper sub that had been in use since Site 637 was replaced with a new one.

Seven drill collars were lost when the bumper sub broke at the service connection. It is believed that the bumper sub was weakened while working stuck pipe on Holes 639E and F.

All holes were drilled with the rotary coring (RCB) system except Holes 641A and B.

On Hole 641A we used the APC/XCB coring system. Apparently the PDR was in error and the piston was shot above the mud line and resulted in a water core. The second attempt did contact the mud line but the bleed of pressure was too slow. We retrieved the piston core barrel less the core catcher sub. The three soft shear pins that were used should have sheared at 1750 psi, but required 2700 psi. It is believed that the additional 1000 psi required to shoot the piston core is what caused the failure at the catcher sub.

Hydraulic Bit Release

The hydraulic bit release was deployed on five holes. On one hole no bit release was required. The first two were released after much working and pounding bottom on varying pump pressure. The third attempt to release the bit was the most difficult of all. The BHA became firmly stuck on Hole 639D after trying for

2-1/2 hours to release the bit. While working the stuck BHA without any pump pressure the bit released while holding 150,000 pounds of overpull on the drill pipe.

Shop test of the HBR indicated that we may be packing too much grease in the HBR and causing it to lock up before shifting. On our last site number 641 the bit released with only 800 psi of pressure and required only 15 minutes.

The HBR is fast becoming a dependable tool to release the bit. With one or two minor modifications the bit ought to be releaseable regardless of the drilling conditions that may have been encountered.

Core Bits

Five HSMSDS F94CK core bits were used on Leg 103; three of the five bits were released on bottom. One bit lost one or more cones after penetrating very hard dolostone for 35.2 hours. The bit was released to bottom also.

Four RBI coring bits were used on five holes. Due to logging obligations that required the bit to be released there was no opportunity to evaluate the performance of the bits. From all indications the RBI manufactured bits are equal to our expectations.

LOGGING

At Site 637, Schlumberger LSS, GR, CAL, ILD, NGT, CNL, and LDT logs were obtained over an interval that included about 35 meters of serpentinite basement and 110 meters of the overlying sediments. An attempt to obtain a MCS log was cancelled because of cavings that buried virtually the entire basement interval. In the sediments, low gamma ray and density values correspond to intervals of nannofossil marl where high values correspond to clay. In general agreement with laboratory measurements, the serpentinite has high density (2.3 g/cc) and velocity (3.4 km/s) values and yields a good preliminary correlation with the seismic data.

At Site 638, Schlumberger LSS, GR, CAL, and ILD tools were run from 100 to 285 meters BSF in Hole 638B. Hole conditions were generally poor due to alternating clay and calcareous layers. An MCS log was run from 100 meters to 164 meters BSF where an impassable bridge limited further penetration. Compressional velocity ranges from 2 to 2.2 km/s above 185 meters BSF and is unreliable below. The gamma ray log correlates well with clay content in the core recoveries. Repeat LSS, GR, CAL, and ILD, plus NGT, CNL, and LDT logs were obtained over same interval in re-entry Hole 638C. Hole conditions were again poor, but velocity and density values are more reliable and significantly improved the seismic correlation.

In Hole 639D, LSS, GR, CAL, and ILD logs were obtained from 180 meters to 238 meters BSF; LDT, CNL, and NGT from 168 meters to 264 meters BSF; and MCS log from 168 meters to 245 meters BSF. Fractured Mesozoic dolostone and washed-out clay intervals in the underlying limestone degrade the hole conditions, but NGT log shows strong correlation with lithology. Velocity and density values are approximately 7 km/s and 2.7 g/cc in dolostone, 3.5 km/s and 2.5 g/cc in limestone, and 2.0 km/s and 1.7 g/cc in claystone. These values are in reasonable agreement with the laboratory measurements. MCS velocities can not be determined without shorebased processing.

In Hole 641C, the first logging attempt using the LSS tool was stopped at an impassable bridge at 127 meters BSF, and measurements were not obtained in open hole. LDT, NGT, and CNL logs were obtained in the following two runs in open hole. LDT, NGT, and CNL logs were obtained in the following two runs in open hole between 130 meters and 196 meters BSF. Bridges again stopped penetration at 174 meters and 196 meters BSF, respectively. An NGT log was run through drill-pipe above the BHA from sea floor to 95 meters BSF. In the open hole interval, the logs correspond to a relatively homogeneous lithologic unit of clay-rich sediments. In the interval logged through drill-pipe, changes in uranium content can be correlated to lithologic changes from core recovered in Hole 641A. The black zeolitic clay probably corresponds to a two meter thick layer at 53 meters BSF.

WEATHER

Leg 103 started off with rough seas and strong winds. The normal position of the Bermuda High during the months of May and June is the Mid-Atlantic, with surface ridging northeasterly, over northern Europe. This season the high was slow in setting up, thus allowing extratropical lows to be south of their normal track. This produced several prolonged periods of inclement weather.

No lost drilling time was attributed to weather conditions. However, two incidents of gale (34-40 kts) to strong gale (41-47 kts) conditions occurred while on Sites 638 and 639, respectively. In the first incident, on May 6, a weak low over the Iberian Peninsula moved off shore southwest of Portugal. This low deepened rapidly and troughed to the north, dropping our pressure eight millibars in a 12 hour period. The resultant strong pressure gradient high to the north and the deepening low produced northeasterly winds to near 40 kts. Within 12 hours the low had weakened and moved to the east into the Mediterranean Sea.

The second storm occurred between May 23 and May 26 at Site 639. A low pressure system moved off the North American continent near 40 north latitude and moved in an easterly direction. As the system continued toward the east, it continued to deepen and finally veered to the northeast after coming to within 200 miles of our position. This storm produced winds to 45 kts and seas to 20 feet.

While there was no lost time due to the weather, there were several periods of discomfort. In these incidents, where our winds and seas were affected by migratory lows, the swell would lag behind the prevailing winds. This would produce a cross flow and cause the ship to roll. We also experienced a seven day period of daily rain and fog during the last of May and first part of June.

The APT3B Satellite Receiver was activated during Leg 103. The two polar orbital satellites (NOAA 6 and NOAA 9) were received with the omnidirectional antenna. NOAA 9 crossed our position around 1200Z daily. This was the pass we collected most often, in the visual mode. NOAA 6 didn't have the clarity of NOAA 9. Also, because we could seldom receive the predict message, we relied on land features to grid the chart.

COMMUNICATIONS

All communications with the ODP Headquarters and other parties went through the satellite terminal and no problems or delays were encountered during this leg from the shipboard end.

The terminal and radio station equipment were fully operational one hundred percent of the time.

The only problem which should be solved is the faxlink and computerlink with ODP. For some reason it is nearly impossible to fax to the ODP office while we don't have any problems with the UDI fax on shore. This option is very useful when sending drawings or diagrams. Also the datalink was not very successful but this should be tested on a landline link first.

PERSONNEL

It was very evident at the start of Leg 103 that the training period was over for the SEDCO "A" crew. From the first to the last drill site our SEDCO crews demonstrated that they were professionals and had adapted quickly to deep ocean coring. Only two hours of mechanical down time were experienced on Leg 103. This is a tribute to each crew member for a job well done.

The scientific staff was very cooperative and understanding for the entire 55.2 days at sea. It was a pleasure to work with them on Leg 103. The ODP technical staff dispatched their duties with enthusiasm and efficiency. Morale remained high throughout the ship for the entire leg. There were no injuries or illnesses.

Lamar Hayes

Lamar Hayes
Operations Superintendent
Ocean Drilling Program

OCEAN DRILLING PROGRAM
TIME DISTRIBUTION
LEG 103

TOTAL DAYS (APRIL 25, 1985 - JUNE 19, 1985)		55.2
TOTAL DAYS IN PORT		.4
TOTAL DAYS CRUISING INCLUDING SITE SURVEY		8.0
TOTAL DAYS ON SITE		46.8
TRIP TIME	11.48	
DRILLING TIME	3.46	
CORING TIME	20.85	
LOGGING TIME	3.92	
RE-ENTRY TIME	2.18	
CONDITION HOLE	1.15	
OTHER TIME	2.69	
REPAIR TIME	.09	
STUCK PIPE	.98	
	46.80	

TOTAL DISTANCE TRAVELLED (NAUTICAL MILES)	1741 Miles
AVERAGE SPEED KNOTS	11.3 Knots
NUMBER OF SITES	5
NUMBER OF HOLES DRILLED	15
TOTAL METERS CORED	1455.7
TOTAL METERS RECOVERED	590.4
PERCENT RECOVERY	40%
TOTAL METERS DRILLED	1542.5
TOTAL CORES ATTEMPTED	156
TOTAL METERS OF PENETRATION	2998.2
MAXIMUM PENETRATION DRILLED	547 Meters
MINIMUM PENETRATION DRILLED	35.4 Meters
MAXIMUM WATER DEPTH	5321 Meters
MINIMUM WATER DEPTH	4646 Meters

OCEAN DRILLING PROGRAM
TIME DISTRIBUTION
LEG 103

DATE		SITE NO.	CRUISE	TRIPS	DRILL	CORE	STUCK PIPE	DOWNHOLE MEASURE.	MECH. REPAIR	PORT TIME	RE-ENTRY	COND. HOLE	OTHER	TOTAL TIME	REMARKS
Apr.	25	637	5.00							9.75				14.75	
	26		24.00											24.00	
	27		24.00											24.00	
	28		18.00	4.00								2.00		24.00	
	29			15.00		8.25							.75	24.00	
	30					21.50							2.50	24.00	
May	1					24.00								24.00	
	2					24.00								24.00	
	3			1.00		15.00		4.75					3.25	24.00	
	4			10.50				10.00						20.50	
	4	638	3.50											3.50	
	5		8.75	11.50	2.25								1.50	24.00	
	6			1.75										1.75	
	6	638B				22.25								22.25	
	7					24.00								24.00	
	8					24.00								24.00	
	9					24.00								24.00	
	10					24.00								24.00	
	11			5.75		1.75	1.50	9.25					5.75	24.00	
	12			9.50				8.25					6.75	24.00	
	13	638C		24.00										24.00	
	14			12.00	12.00									24.00	
	15			8.00							16.00			24.00	
	16			2.00							22.00			24.00	
	17				21.00								3.00	24.00	

DATE	SITE NO.	CRUISE	TRIPS	DRILL	CORE	STUCK PIPE	DOWNHOLE MEASURE.	MECH. REPAIR	PORT TIME	RE-ENTRY	COND. HOLE	OTHER	TOTAL TIME	REMARKS
May 18	638C		3.75	5.50	7.25							7.50	24.00	CB quick release
19			13.50							5.75		4.75	24.00	
20			1.50		18.00					2.50		2.00	24.00	
21					24.00								24.00	
22			6.50		.50	16.25						.75	24.00	
23			6.50										6.50	
23	639		12.00		5.50								17.50	
24					22.75							1.25	24.00	
25			10.25		9.75	1.25						3.25	24.00	
26	639B		8.50		14.25							1.25	24.00	
27			1.25		6.00								7.25	
27	639C			3.00	7.00							3.00	13.00	
27	639D			1.50	2.25								3.75	
28				7.00	13.25							3.75	24.00	
29					24.00								24.00	
30					18.50	1.25						4.25	24.00	
31							24.00						24.00	
June 1			7.00				.50						7.50	
1	638C		7.00				3.00			5.75		1.25	16.50	
2			2.00							.75	21.25		24.00	
3			7.00				9.25					4.00	20.25	

DATE	SITE NO.	CRUISE	TRIPS	DRILL	CORE	STUCK PIPE	DOWNHOLE MEASURE.	MECH. REPAIR	PORT TIME	RE-ENTRY	COND. HOLE	OTHER	TOTAL TIME	REMARKS
June 3	638C	3.75											3.75	
4	640		8.75	5.75	8.00							1.50	24.00	
5			6.00		18.00								24.00	
6			2.00										2.00	
6		4.75											4.75	
6	639E		6.00	4.50	6.75								17.25	
7			1.00		6.50	2.00					4.25		13.75	
8			8.25											
8	641	5.75											5.75	
8			7.00					1.00					8.00	
9			1.00		23.00								24.00	
10			7.50		2.00								9.50	
10	641B		10.15	3.75									14.50	
11			9.75					1.00					10.75	
11	641C		8.75	3.25								1.25	13.25	
12				7.00	17.00								24.00	
13					24.00								24.00	
14					5.50		18.50						24.00	
15			7.00				6.50						13.50	
15		10.50											10.50	
16		23.00											23.00	Time change
17		23.00											23.00	Time change
18		24.00											24.00	Time change
19		15.50											15.50	

OCEAN DRILLING PROGRAM
SITE SUMMARY
LEG 103

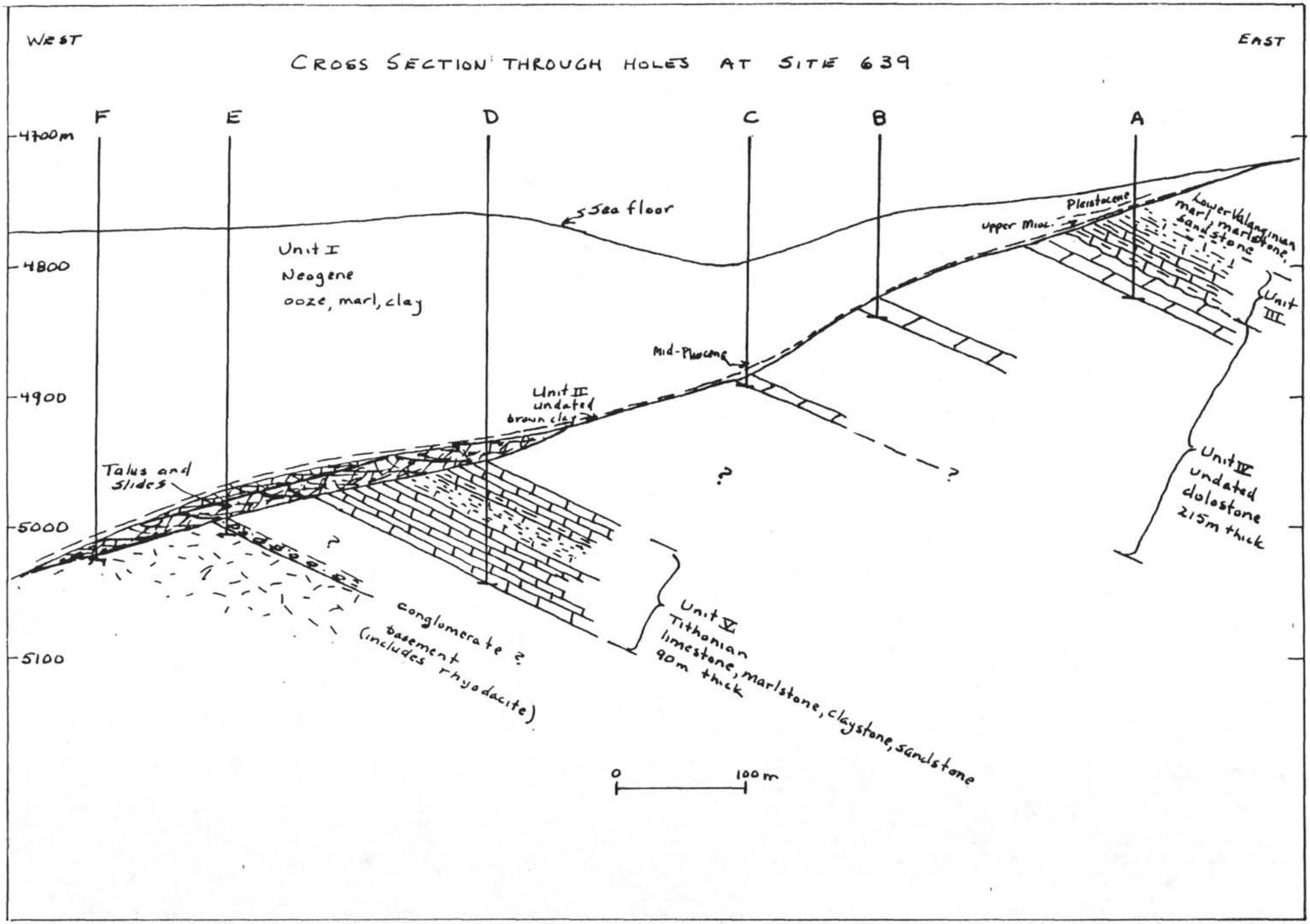
HOLE	LATITUDE	LONGTITUDE	DEPTH METERS	NUMBER OF OF CORES	METERS CORED	METERS RECOVERED	PERCENT RECOVERED	METERS DRILLED	TOTAL PENET.	TIME ON HOLE	TIME ON SITE
637	42°05.285N	12°51.813W	5321	30	285	95.1	33.3	-----	285	146.50	146.50
638	42°09.191N	12°11.820W	4673					44	44	29.50	
638B	42°09.191N	12°11.820W	4673	45	431	208.50	48.3	----	431	166.25	
638C	42°09.191N	12°11.820W	4673	14	135.30	37.60	27.8	411.90	547	246.50	704.50
639			4735	10	89.80	35.50	39.50		89.8	65.50	
639B			4758	4	23.50	12.6	53.60	56.50	80	31.50	
639C			4792	2	22.40	4.8	21.40	78	100	13.00	
639D			4753	13	115.50	25.40	21	177.60	293.10	107.00	
638C	42°09.191N	12°11.820W	4673						61	61.00	61.00
640	42°00.729N	12°27.884W	5201	9	86.8	15.60	18	145.4	232.20	50.00	50.00
639E			4770	4	35.5	1.7	5	199.4	234.90	31.50	
639F			4771	2	13	.8	6	237.8	250.80	20.50	
641A	42°09.243N	12°10.943W	4646	7	63.6	40.30	58	5.60	69.2	41.50	
641B	42°09.243N	12°10.943W	4649					35.40	35.40	25.25	165.50
641C	42°09.243N	12°10.943W	4649	16	154.3	112.50	73	150.9	305	98.75	

OCEAN DRILLING PROGRAM
BIT SUMMARY
LEG 103

HOLE	MFG	SIZE	TYPE	SERIAL NUMBER	METERS CORED	METERS DRILLED	TOTAL PENET	CUMULATIVE METERS	HOURS THIS HOLE	TOTAL HOURS	CONDITION	REMARKS
637	MSDS	9-7/8	F94CK	S-63	285	----	285	285	15	15	Unknown	HBR
638	MSDS	9-7/8	F94CK	S-64		44	44		2			Rerun on 638B
638B	MSDS	9-7/8	F94CK	S-64	431		431	475	21	23	Unkown	HBR
638C	Reed	14-3/4	S136-J	D05627		44		44	10	10	New	Wash in 16" rsg
638C	RBI	9-7/8	C-4	A5002	19	366	431	431	22		B1-T2-G	
638C	RBI	9-7/8	C-4	A5002	115.8		115	115	16	16	B1-T2-G	
639	RBI	9-7/8	C-4	A5003	89.9		89.9	89.9	7.5	38	B1-T2-G	
639B	HSMSDS	9-7/8	F94CK	S-62	23.5	56.5	80	80	5.5	5.5		
639C	HSMSDS	9-7/8	F94CK	S-62	22.4	78	100	180	1.2	6.7		
639d	HSMSDS				115.5	177.6	293	473	23	35.2		Lost cone
640	RBI	9-7/8	C-4	A5005	86.8	145.4	232	347	5	21	B1-T2-6	
639E	HSMSDS	9-7/8	F94CK	S-58	35.5	199.4	240	240	6			
639F					13	237.8	250	490	4	10	B1-T2-6	
641	HSMSDS	11-7/16	F94RR	S-10	69.2		69.2	69.2	3.5	3.5		Lost in hole
641B	RBI	9-7/8	C-4	A5005		69	69	416	1.5	23.5		Broken bit guide
641C	HSMSDS	9-7/8	F94CK	S-58								HBR

OCEAN DRILLING PROGRAM
BEACON SUMMARY
LEG 103

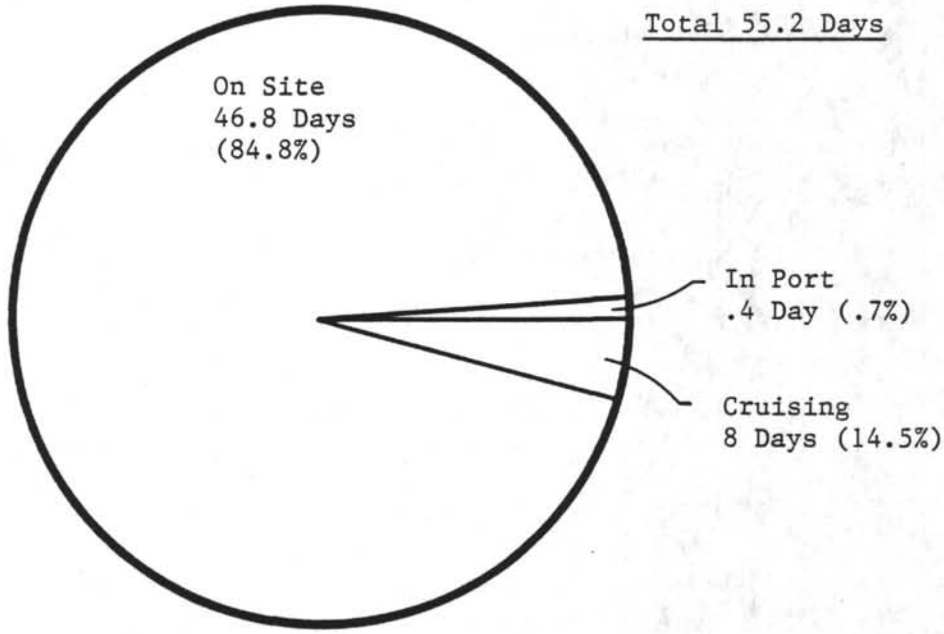
SITE NUMBER	MAKE	FREQUENCY KHZ	SERIAL NUMBER	MODEL	OPERATING DAYS	REMARKS
637	Datasonics	14.5	181	351DC	6.1	Seas were rough and experienced occasional loss of acoustics
638	Datasonics	15.5	173	352DC	21.00	Signal strength not quite as strong as the other beacons, but gave out signal
638	Datasonics	16.5	186	351DC	28.00	Strong/signal
639	Datasonics	15.5	187	352	15.8	Good signal
640	Datasonics	15.5	184	351DC	2	Good signal
641	Datasonics	14.5	198	352	6.8	Good signal


WEST
EAST
CROSS SECTION THROUGH HOLES AT SITE 639
F
E
D
C
B
A
4700m
4800
4900
5000
5100
Sea floor
Unit I
Neogene
ooze, marl, clay
Pleistocene
Upper Mioc.
Lower Valanginian
marl, marlstone,
sandstone
Unit III
Mid-Pliocene
Unit II
undated
brown clay
Talus and
slides
?
Unit IV
undated
dolostone
215m thick
Unit V
Tithonian
limestone, marlstone, claystone, sandstone
90m thick
conglomerate ?
basement
(includes rhyodacite)
0
100m

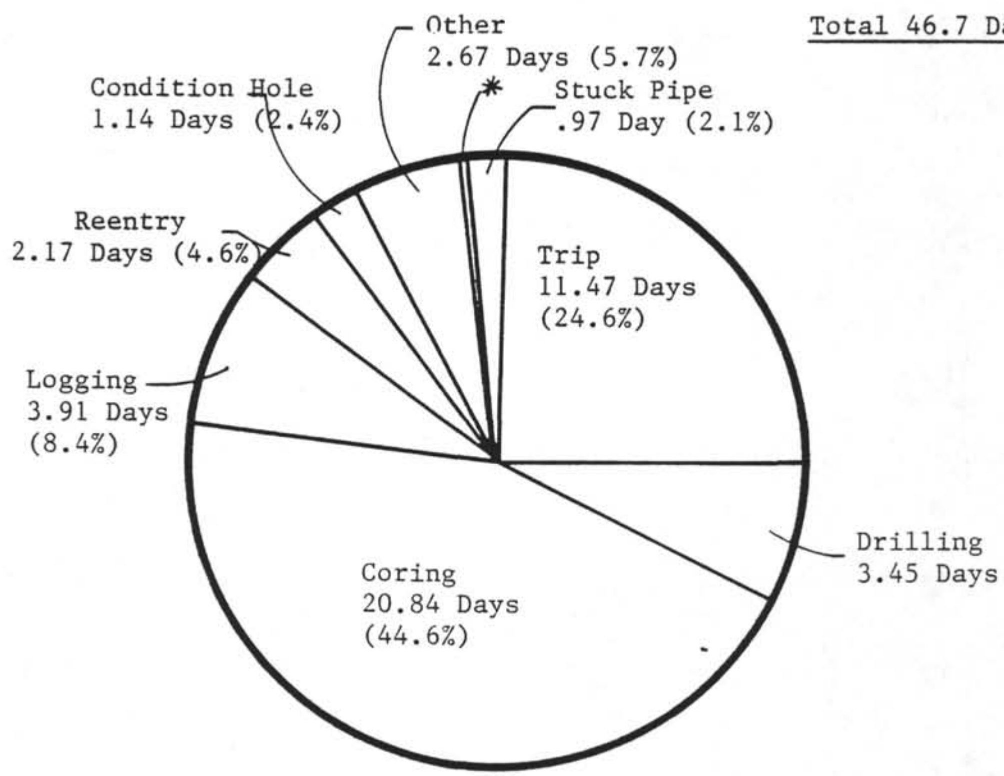
OCEAN DRILLING PROGRAM

TOTAL TIME DISTRIBUTION

LEG 103



ON SITE TIME DISTRIBUTION



* Repair Time
.08 Day (Less than .2%)

TECHNICAL REPORT

The ODP Technical and Logistics personnel aboard JOIDES RESOLUTION for Leg 103 of the Ocean Drilling Program were:

Laboratory Officer:	Ted "Gus" Gustafson
Laboratory Officer:	Dennis Graham
Curatorial Representative:	Paula Weiss
System Manager:	Daniel Bontempo
Chemistry Technician:	Bradley Julson
Chemistry Technician:	Tamara Frank
Electronics Technician:	Randy Current
Electronics Technician:	Dwight Mossman
Yeoperson:	Wendy Autio
Photographer:	Roy Davis
Marine Technician:	Larry Bernstein
Marine Technician:	Mark Dobday
Marine Technician:	Bettina Domeyer
Marine Technician:	Henrike Groschel
Marine Technician:	Harry "Skip" Hutton
Marine Technician:	Jessy Jones
Marine Technician:	Mark "Trapper" Neschleba
Marine Technician:	John Weisbruch
Student Technician:	James Holik
Weather Observer:	Vernon Rockwell

Other Technical personnel aboard JOIDES RESOLUTION was:

David Roach, Logging Specialist Technician
(Lamont Doherty Geological Observatory, Palisades, New York)

TECHNICAL REPORT

LEG 103

Leg 103 sailed on April 25, 1985 following a brief crew change in Ponta Delgada, Azores. The general scientific objectives for Leg 103 were to drill a transect of holes to the northwest of the Iberian Peninsula on the Galicia Margin in order to study the history of rifting, subsidence and sedimentation of the area. Over 590 meters of core were recovered from 13 holes drilled at 5 site locations. Approximately 3500 samples were taken from the cores for shipboard and shorebased studies. Downhole logging was attempted at 4 sites. Re-entry operations were conducted at Hole 638C. Underway geophysical data were collected while on the Galicia Margin in the vicinity of all drilling locations. Weather and XBT observations were conducted throughout the cruise. Leg 103 was terminated on June 19, 1985 in Bremerhaven, Federal Republic of Germany, after completing 55 days at sea.

Ponta Delgada Port Call

During a brief 10-hour port call, ODP and SEDCO crews were changed out. There were no shipments to or from the ship. Xerox paper was obtained locally through the agent.

Cruise Activities

Drilling operations began on April 28, 1985 after steaming from Ponta Delgada, Azores to the Galicia margin. Drilling at Site 637 was uneventful and the hole terminated when scientific objectives were reached. Logging attempts were for the most part successful. Deteriorating hole conditions forced the cancellation of the Multichannel Sonic tool run. At Sites 638 and

639, difficult drilling conditions caused by flowing sands and brecciated dolostones forced reevaluation of operational plans. It was obvious that in a single hole it would be impossible to obtain the desired scientific objectives without sticking the pipe and compromising the BHA and drill string. The decision was made to drill a series of holes adjacent to Site 638 where dipping reflectors subcrop under pelagic oozes. At Site 639, 6 holes were drilled in a progressively westward direction across a subcrop of eastward-dipping reflectors enabling shipboard scientists to obtain a cross sectional sampling of the section. It was difficult to log at Sites 638 and 639 due to generally poor hole conditions. Hole 638C was re-entered several times for bit changes and logging operations. Both E.D.O. and Mesotech re-entry tools were utilized. It has become apparent that several improvements are required with the Mesotech tool and re-entry cone sonar reflector shape to optimize tool use and help eliminate reflector ambiguities. In spite of the difficulties encountered thus far, the Mesotech re-entry tool has great potential. Scientific objectives were quickly realized at Site 640; washing and coring to 232 meters below sea floor proceeded uneventfully. Leg 103 drilling operations were terminated after Site 641. This site was located up slope of Site 638. Three holes were drilled at this location. Holes A and B were prematurely terminated due to B.H.A. and coring equipment failures. The third, Hole 641C, was successfully washed and drilled to 305 meters and was terminated when scientific objectives were achieved. Logging was attempted.

Although Leg 103 was operationally difficult, most if not all scientific objectives were realized through close cooperation between the Co-Chief Scientists, Cruise Operations Superintendent, and SEDCO personnel.

Weather observations were made throughout the cruise at regular daily intervals. Most satellite weather equipment worked well with the following exceptions. The Alden APT tape recorder is inoperable. Troubleshooting attempts to date have been unsuccessful. The directional dish antenna normally used for receiving APT predict bulletins and obtaining geostationary weather satellite pictures is also inoperable. The antenna has a bent dipole feed assembly. The damage is thought to have occurred when the antenna was relocated to make room for additional personnel accommodations following Leg 101. Replacement parts have been ordered.

Laboratory Operations

Laboratory operations are beginning to settle down and become somewhat normalized and routine. Deep water, poor drilling conditions, and low core recovery all combined to make for easy laboratory work conditions as compared to Leg 101. Adequate time was available to begin training various technicians in areas outside of their assigned responsibilities. These areas included the Multishot Survey tool, thin sections, XRD, chemistry, and digital seismic system as well as the cryogenic magnetometer and XRF unit which were both recently installed for Leg 102B.

Introductory computer system classes were provided for interested scientists and technicians. The classes covered the VAX system, PRO operating system, CT*OS word processing, and sample management. A trial advanced CT*OS word processing class was offered to volunteers with good results. These will be offered again on Leg 105. The computer facility operated well with few serious problems. The VAX system fell off line on 4 occasions. In one instance, the problem was traced to a faulty A.C. power connection which feeds the lab temperature sensor. The connection was repaired and the problem eliminated. The remaining three problems were traced to unscheduled shutdown of the HVAC system while the auxiliary air conditioning was manually turned off. The unit was intentionally secured due to extremely cool temperatures in the users area. Several peripheral items such as monitors, printers, and plotters required repair or replacement in Bremerhaven. Work is progressing on CSG (Computer Services Group) and non-CSG programs. There are CSG programs that are as yet incomplete or troublesome. The sample management and material management programs are as yet incomplete; however, they are expected to be fully operational in the near future. The corelog program has several design problems which are troublesome. These problems are presently being worked on. The use of non-CSG developed programs is growing in various areas such as physical properties, paleomagnetics, weighing, thin section lab, and satellite fix position data. Attempts at 2400 Baud synchronous data transmission to ODP headquarters via MARISAT have thus far been unsuccessful. The cause of the difficulty is unknown. Asynchronous transmission at 1200 Baud was accomplished. Experimental attempts at running XRD software on the VAX computer shows great potential. Further experimentation is planned for upcoming legs.

The recently installed 2-G cryogenic magnetometer and ancillary equipment is operational. Computer software provided by 2-G was improved during the Leg 102B transit. On Leg 103, software and procedures were set up to process and archive magnetometer data files and also generate data plots on the VAX computer. Problem areas encountered thus far with the cryogenic magnetometer are as follows: occasional unexplained drifts of sensor electronics, magnetometer noise level is an order of magnitude higher than expected, R.F.I. was present at times, software problems hamper basic operation and data manipulation, only limited sensitivity ranges are available for the diverse sediment and rock types encountered, tight clearance between O.D. of core liner cap and I.D. of sensor housing, inoperative helium flow gauge, and lastly, system documentation is presently inadequate. The magnetics laboratory workload has the potential to become overwhelming from a sampling as well as operator point of view, and whole core measurements on high recovery legs may create a bottleneck affecting all other laboratory operations.

The XRF unit installed in Norfolk can be considered operational. The unit is presently set up to analyze for 10 major elements. The trace element program is set up to analyze for 9 elements; however, it needs further development to correct trace element intensities. The correction models supplied by A.R.L. with their software do not appear useful for our work. Efforts to use SCRIPPS Institution of Oceanography correction program with the VAX computer have thus far been unsuccessful in giving concentration results in PPM. It appears that it will take several legs to fine tune XRF programs and set up sediment standards. The XRF was used to analyze sediments from pore water squeezing and compare results with carbonate bomb and pore water results. With the addition of the XRF, temperature in the laboratory was constantly 80° F or greater. If the HVAC system of the Foc'sle deck is not brought up to specifications, we can anticipate major problems as the ship goes south into tropical regions.

The XRD unit was operational for all but a few days this leg. Software functions were speeded up by the addition of extra computer memory. The addition of a PRO-350 for use as a video display enhances operating efficiency and allows the graphics terminal to analyze data full time. Troublesome noise spikes were traced to a faulty detector. The detector was scheduled for replacement in Bremerhaven.

The SEM was used throughout the leg with only routine maintenance and alignments required. As on Leg 101, the quality of higher magnifications deteriorated with vessel motion. 1500X magnifications were possible in all but severe sea conditions. Drilling operations also affected image quality at times.

The chemistry lab saw moderate to heavy use at times during the leg. The HP-86 computer was returned to ODP for repairs from Bremerhaven. Considerable efforts were made to program the HP-150 computer to handle plotting and titration work previously done on the HP-86 and the weighing program is now done on a PRO-350. The main vacuum pump seized up. Repair and gasket kits have been ordered. A portable vacuum pump is temporarily in use until the main unit can be overhauled. A new carbonate bomb data program was installed on the L.A.S. A catalog of downhole contaminants was compiled for reference. Air flow measurements were conducted in the hydrofluoric acid hood in preparation for Leg 104 work and found to be more than adequate. Smoke candles and portable air flow meters have been ordered for future tests.

Over 300 thin sections were prepared for shipboard use and 50 prepared for the East Coast Repository. There were no problems in this lab.

Shipboard microscopes performed satisfactorily, without major problem and required only routine adjustments to retain their performance capabilities. Several requests for additional microscope attachments were made this leg by members of the scientific party. The specifics have been given to the Staff Scientist for consideration.

It is standard practice on all legs to discuss ODP sampling policies and sampling techniques along with generalized core handling procedures and core flow with shipboard scientists prior to arrival at the first drilling site and during the early stages of each successive site. Core laboratory activities were normal in the sense that each leg settles down into a work routine based on core recovery and sampling strategy. Shipboard curatorial and sampling responsibilities were very demanding and time consuming on Leg 103 and several marine technicians assisted with various aspects of sampling duties during sporadically heavy sampling periods. Sampling policies and procedures were modified to accomodate shipboard requirements as much as possible. The use of acetone to bond core liner caps was occasionally discontinued at the request of the geochemist. This was to help reduce the possibility of contamination of gas and organic geochemistry samples. There were no major mechanical problems with core laboratory equipment. Problems did occur with software for various physical properties equipment.

The photo lab ran well with only minor problems. Early in the leg, the potable supply was again contaminated with rust and particulate matter. The problem was somewhat resolved by not pumping the potable water holding tanks below half full. The film dryer heating elements were also a problem causing rust contamination of several rolls of negatives. The heating element sheaths were found to be made of iron rather than stainless steel. A suitable stainless steel replacement has been ordered. Until the replacements arrive, aluminum foil is being used over the steel to help avoid further contamination. Requests for core black and white close-up photographs is near to being out of control. It was obvious this leg that the close-up work and prints requested were excessively high and far beyond that required for Initial Reports. This also has an impact on shipboard supplies and the photographers workload. A more definitive ODP policy regarding close-ups and prints supplied should be developed and included in the shipboard science handbook. Routine P.R. photographs, video work, and specialty photo requests were also taken. The black and white film processor floor drain developed a major leak into the lower tween deck refrigerated space. Temporary repairs have been made pending arrival of replacement pipe ordered by SEDCO.

Equipment on the fantail and in the underway geophysics lab is in basically the same conditions as reported on Leg 101. The Masscomp suffered down time due to a faulty logic gate and tape write problems. Seismic records were generally acceptable at survey speeds of 6 to 7 knots. Both sonar systems are still marginal or poor at speeds over 6 knots or in heavy seas. The magnetometer sensor did not work at all and is being returned to the vendor for repair. Satellite navigation data is being currently displayed on a monitor which is driven by a "CRT display driver interface" card presently on loan from ODP to SEDCO. Also on loan to SEDCO is a "speed and heading interface" card. This was used to replace their inoperative card. Satellite fix data is also routed to a PRO-350 and being stored on diskette. A program has been set up to average fixes when on site. Gun maintenance was normal.

Storekeeping

All items contained in MATMAN were updated from physical counts taken on the Leg 102B transit. Fantail spares for the gun systems were added to MATMAN. MATMAN was again updated during the leg. Storage areas were cleaned up and reorganized to make more efficient use of space. This will continue to be an ongoing job for the next several legs. In the casing hold, decking was completed, lighting rearranged, and a shop area completed. All supplies in the hold were consolidated to help generate space for bulk supplies being shipped to Bremerhaven. Considerable time was spent in streamlining MATMAN software to simplify the task of generating storeroom checkout sheets and catalog reports as well.

Safety

A marine technician emergency squad (METS) was formed this leg. The squad consisted of four marine technicians. The squad worked and trained with SEDCO personnel on emergency safety procedures during fire and boat drills. The development of emergency procedures for various situations in the lab stack were addressed during joint ODP/SEDCO training sessions. It is planned to rotate all technicians through the "METS" program. Shore training recommended on Leg 101 is again recommended.

Problem Areas

Major problems still exist in the following areas.

A. Inadequate ventilation of Foc'sle deck.

B. Air in lab stack drill water lines.

C. Dedicated communication from U/W Geophysical lab to bridge has not been provided.

D. Voltage spikes are present in regulated power supplies to U/W Geophysics lab.

E. Plans for casing hold gym and mezzanine storage deck not yet developed.

F. Black and White processor drain is leaking into the lower tween deck refer.

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Leg 103