26. "BASEMENT" ROCKS OF GORRINGE BANK

PREFACE

Igneous rocks have been recovered from the Gorringe Bank in the eastern North Atlantic, through deep drilling (see Chapter 2), dredging and piston coring. The results are presented here. Two interesting and contrasting suites of rock have been discovered. One is an "ophiolite" suite thought to represent the original oceanic crustal layer generated by accretion at the axis of a Mid-Oceanic Ridge. The other, a silica deficient alkaline suite, more closely resembles igneous bodies located behind subducting zones and may be associated with younger intrusions accompanying the development of a compressive plate boundary along the Azores-Gibraltar seismic belt (Le Pichon *et al.*, 1970; and McKenzie, 1970). This chapter gives petrographic descriptions and a single chemical analysis of selected samples and offers brief discussions of their geological significance.

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26.1. PETROGRAPHY OF THE GORRINGE BANK "BASEMENT"

Jose Honnorez, Rosenstiel Institute of Marine and Atmospheric Sciences, University of Miami, Miami, Florida
and
Paul J. Fox, Department of Geological Sciences, State University of New York at Albany, Albany, New York

INTRODUCTION

Igneous rocks were obtained at Site 120 on the northern flank of Gorringe Bank (water depth 1711 meters, see Chapter 2). Core 8 recovered approximately 0.9 meter of basement rocks below Lower Cretaceous, partly silicified pelagic sediment. The basement was encountered at 246 meters below the sea floor and was penetrated to 253.4 meters before the hole was abandoned.

RESULTS

Most of the recovered igneous material is a holocrystalline metagabbro composed of large crystals (ranging from 0.5-1 cm in length) of gray feldspar and tan pyroxene with interstitial patches of dark minerals. The texture is panallotriomorphic granular (Figure 1). The Ca-plagioclases are generally twinned according to albite and/or pericline, and/or Carlsbad laws. They are typically slightly zoned with a core An content of about 55-60 per cent. Largest crystals of Ca-plagioclase are often broken resulting in twisted and offset twin planes. The partial alteration of the pyroxene has produced a dense network of dark parallel lines which have clouded the pyroxenes and thereby obscured the interference colors. As a result, the pyroxene species could not be identified with certainty. The outer portion of the pyroxenes grades into an amphibole, generally actinolite, which surrounds the pyroxene by a felty growth of fibers. In some instances, however, the actinolite is in optical continuity with pyroxene. Upon occasion the mantling amphibole is a zoned pleochroic hornblende with pleochroism ranging from either bright orange to dark red brown, or from light green to dark blue green. The hornblende often contains small euhedral prisms of apatite. The finer grained material filling the interstices between the pyroxene and plagioclase crystals is made up of fine fibrous green chlorite, an unidentified mineral (similar to chlorite), and longer blades of a colorless amphibole (tremolite?). Rare patches of quartz are associated with the chlorite. The accessory opaques are small round bodies which have been partly replaced by a submicroscopic colorless material. The results of a major element chemical analysis and normative mineral computation for a metagabbro sample (120-8-7) are given in Table 1 (analysis by J. Honnorez).

DISCUSSION

The basement sample recovered at Site 120 is a gabbro originally composed of Ca-plagioclase, pyroxene, and opaque minerals which have subsequently reequilibrated to changing physiochemical conditions. Occurrence of the secondary amphiboles (actinolite and hornblende), chlorite, and quartz suggest that the gabbro recrystallized under amphibolite greenschist metamorphic conditions.

A few small chips of light green gray, glomeroporphyritic metabasalt were found accompanying the core of

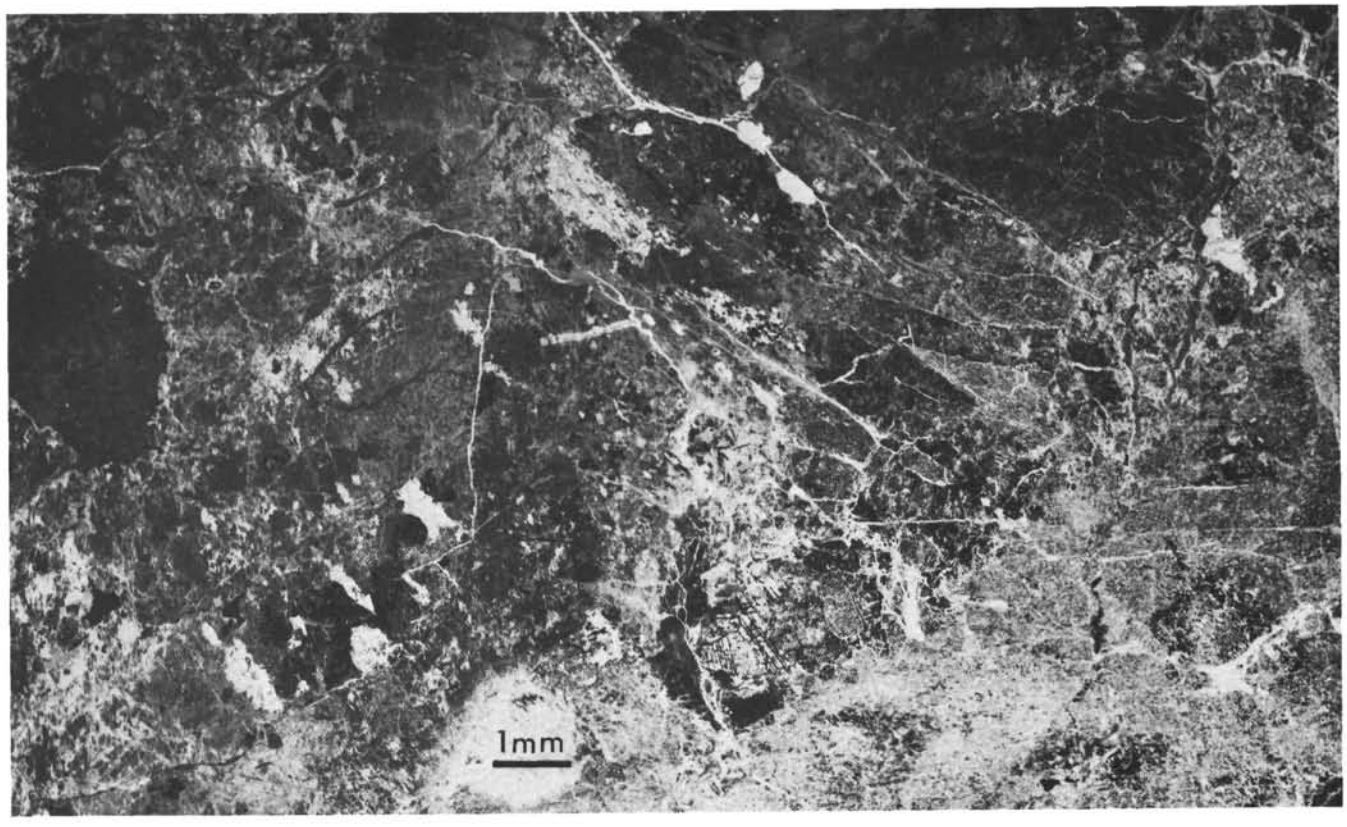

Figure 1. *Reverse print of a thin section enlargement of the holocrystalline meta-gabbro of Core 8, Site 120, Gorringe Bank, illustrating the cataclastic texture developed under amphibolite/greenschist metamorphic conditions.*

TABLE 1
Chemical Analysis and CIPW Normative Minerals: Sample 120-8-7

	Chemical Analysis (Per Cent)		CIPW Normative Minerals (Per Cent)
SiO_2	48.61	OR	1.18
Al_2O_3	17.18	AB	25.80
Fe_2O_3	1.19	AN	32.60
FeO	5.61	DI	8.11
MnO	0.14	HY	12.02
MgO	9.94	OL	12.65
CaO	8.65	MT	1.73
Na_2O	3.05	IL	0.97
K_2O	0.20	AP	0.07
TiO_2	0.51	H_2O^+	3.62
P_2O_5	0.03	H_2O^-	0.97
H_2O^-	0.97	Total	99.70
H_2O^+	3.62		
Total	99.70		

metagabbro at Site 120 (Figure 2). The 0.1-1.0 mm phenocrysts are predominantly twinned plagioclases which have been partially albitized. There are lesser amounts of chlorite-pseudomorphed olivine. The phenocrysts are set in a fine grained matrix of acicular plagioclase, microlites, chlorite, and other alteration products.

The basaltic samples suggest that a basalt originally composed of calcic plagioclase phenocrysts and fine-grained matrix underwent metamorphism which partially albitized the calcic plagioclase and produced the chlorite. The albitization of the plagioclase and the occurrence of chlorite indicate a greenschist facies metamorphism.

Metabasalt in the greenschist facies and metagabbro in the greenschist amphibolite facies are often recovered by dredging from the tectonic escarpments of the Mid-Oceanic Ridge System and fracture zones (for example, see discussion in Melson *et al.*, 1968; Cann, 1969; and Miyashiro *et al.*, 1971). The occurrence and abundance of these rock types have led investigators to conclude that metabasalt in the greenschist facies and metagabbro in the greenschist and amphibolite facies are representative of a portion of oceanic basement (Layer 2) and oceanic crust (Layer 3). The metamorphic gabbros and basalts recovered at Site 120 are similar to some of the metagabbros and metabasalts dredged from the escarpments of the Mid-Oceanic Ridge and fracture zones. (see Miyashiro *et al.*, 1971 for a description of oceanic metamorphic rocks.) The occurrence of metagabbros and lesser amounts of metabasalts at the base of Hole 120 on the north flank of Gorringe Bank supports the suggestion of Le Pichon *et al.* (1970) that Gorringe Bank is a slab of uplifted oceanic crust.

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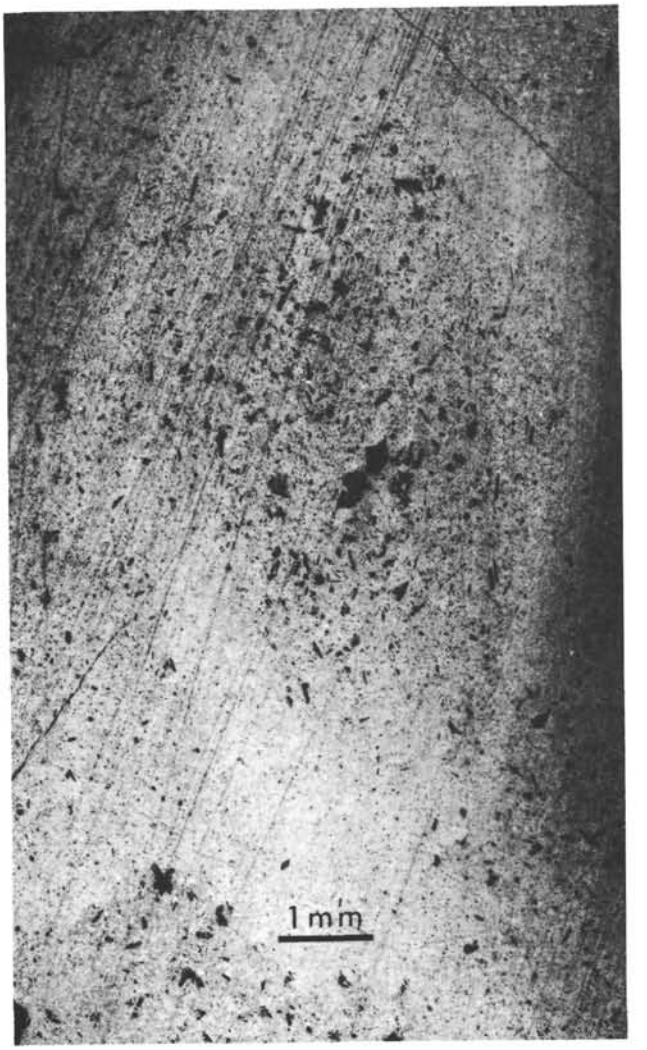

Figure 2. *Reverse print of a metabasalt (spilite) from a drill bit sample. The dark patches are porphyritic and glomeroporphyritic clusters of plagioclase accompanied by chlorite pseudomorphs set in a very fine-grained matrix of acicular feldspar, chlorite, and alteration products. Relic crystal outlines suggest that olivine, now replaced by chlorite, was originally present.*

26.2. PETROGRAPHY OF ROCKS FROM THE CRESTAL AREA OF THE GORRINGE BANK

Anna T. Gavasci, Department of Geology and Geography, Hunter College of the City University of New York, New York
Paul J. Fox, Department of Geological Sciences, State University of New York at Albany, Albany, New York
and
William B. F. Ryan, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York

INTRODUCTION

Samples of igneous rock were recovered from the crestal area of Gorringe Bank in 1965 by coring and dredging from the R/V *Robert D. Conrad* of the Lamont-Doherty Geological Observatory. The sampling objective was to obtain materials which would shed light on the composition and geological history of this uplifted part of the Azores-Gibraltar seismic zone. Numerous boulders and rock fragments were obtained in one dredge, RC 9-7 (36°44.6′N, 11°05.8′W; water depth = 104-130 m), and two piston cores, RC 9-206 (36°40.5′N, 11°04.4′W; water depth = 736 m) and RC 9-208 (36°42′N, 11°07.3′W; water depth = 104 m).

Much of the recovered material was badly weathered, and most of the exposed rock faces were encrusted with carbonate crusts including colonies of byrozoa and coral. Smaller pebbles were often rounded, probably indicating abrasion near an ancient surf-zone on the bank.

Twenty samples were studied in thin section with a petrographic microscope. The analyses are presented in Tables 1 and 2 according to the two igneous rock suites recognized.