5. COMPOSITION OF RHYOLITES FROM CONTINENTAL "BASEMENT," ODP SITE 639[1]

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INTRODUCTION

Holes 639E and 639F were drilled along the western slope of a tilted fault block in an attempt to recover complete syn- and pre-rift stratigraphic sections and continental basement. Both holes ended in an apparent talus pile or conglomerate that includes cobbles of altered rhyolitic rock. Three small pieces of rhyolite (comprising about 20 cm of sample) were recovered from the bottoms of Holes 639E and 639F in the core catchers of the deepest cores. This note presents geochemical data from these rhyolitic rocks. Also recovered were quartz sandstones, graywackes, metasandstones, and quartz breccias. This assemblage of continentally derived "basement" material was overlain by mudstones, limestones, and crystalline dolomites (see "Site 639" chapter; Shipboard Scientific Party, 1987).

Petrologic Description

The cobbles recovered from Sections 103-639E-3R, CC, and 103-639F-2R, CC, are fine-grained, pink rocks with feldspar and mica phenocrysts identifiable in hand sample. In thin section, the rocks are seen to be highly altered, porphyritic rhyolites with quartz, feldspar, mica, and altered mafic phenocrysts. The groundmass has a spherulitic texture; individual spherules are composed of quartz and alkali feldspar and are about 1 mm in diameter (Fig. 1). The euhedral and subhedral feldspar phenocrysts are albite and possibly sanidine, although heavy alteration and clouding of the feldspars made optical determinations difficult. All of the primary mafic minerals (biotite and hornblende) are completely replaced by chlorite, although original grain outlines are preserved (Fig. 2). Rutile and zircon are accessory minerals. For further descriptions of these rocks, the reader is referred to the "Site 639" chapter (Shipboard Scientific Party, 1987).

Composition

Compositions of two of the rhyolite cobbles are given in Table 1. Whole-rock compositions were determined by X-ray fluorescence at the Colgate University facility using techniques outlined in Norrish and Hutton (1969) and Schroeder et al. (1980). Rock powders were fused with a lithium metaborate-lanthanum oxide flux and analyses were calibrated with United States Geological Survey rock standards. The rocks have compositions typical of rhyodacite-rhyolite.

Mineral and groundmass analyses are given in Table 2. The mineral analyses were done at Cornell University on a JEOL Superprobe 733. The high degree of alteration made microprobe analyses difficult, even with a small (2-μm) spot size. The radiating rosettes/spherules that make up the groundmass appear to be mixtures of fine-grained quartz, albite, or possibly a Na-zeolite such as natrolite. Muscovite was the only K-bearing phase identifiable by microprobe analysis. Most of the feldspar phenocrysts were too altered for analysis, although the few analyses obtained are almost pure albite ($An_{1.2}Ab_{98}Or_{0.88}$). No sanidine or other potassium feldspars were found.

Alteration

Both petrographic and compositional data indicate that the rhyolites have been heavily altered, probably by hydrothermal solutions. Microprobe investigations indicate that either the entire rock (groundmass and phenocrysts) has been altered to mineral assemblages that are too fine to be analyzed or it has been silicified or albitized. The only K-bearing phase appears to be muscovite, and all mafic minerals have been altered to chlorite and opaques. Mineral separates of possible K-feldspars were attempted. Small amounts of Samples 103-639F-2R, CC (24–26 cm) and 103-639E-1R, CC (10–12 cm) were crushed in a WC piston mortar. The crushed samples were sieved through plastic meshes (508, 286, and 157 μm), and the fractions were ultrasonically cleaned in distilled water. The crushed samples contained abundant mica and chlorite flakes. Although difficult to identify, feldspar grains were handpicked. The feldspar separates were etched with HF fumes and stained with Na cobaltinitrate solution. Only a few grains accepted the stain, although small fractures and alteration surfaces were stained. This suggests that most of the potassium resides in mica and altered surfaces and grain boundaries in the rock.

The spherulitic groundmass may be a primary texture, comprising protocrystals of quartz and albite. However, glass is very susceptible to hydrothermal alteration (Fisher and Schmincke, 1984). Given the high degree of alteration suffered by the rhyolites, together with the difficulties in obtaining reasonable microprobe analyses of the groundmass, the spherules could represent heavily altered and recrystallized glass that is now rosettes of quartz, zeolites, and clays. Both the textural and compositional data are inconclusive.

Discussion

The altered rhyolite cobbles recovered together with coarse quartz sandstones and graywackes at the bottom of Holes 639E and 639F indicate that this rock assemblage is continentally derived. However, the variety of rock types and the small amount of loose material that were recovered lend some ambiguity to the interpretation of these rocks. The cobbles could be from a submarine talus bed resting on top of basement. Alternatively, the rhyolite cobbles could be part of a basal conglomerate unit on top of Hercynian basement. Finally, the rhyolite could be derived from brecciated rhyolite flows and as thus, compose the top of true continental basement.

The alteration, which is pervasive yet preserves original volcanic textures, is probably hydrothermal in origin.The occurrence of sandstone cobbles with clean feldspars within the same "conglomerate" unit indicates that the hydrothermal alteration was restricted to the rhyolite and probably occurred soon after the formation of the rhyolite.

REFERENCES

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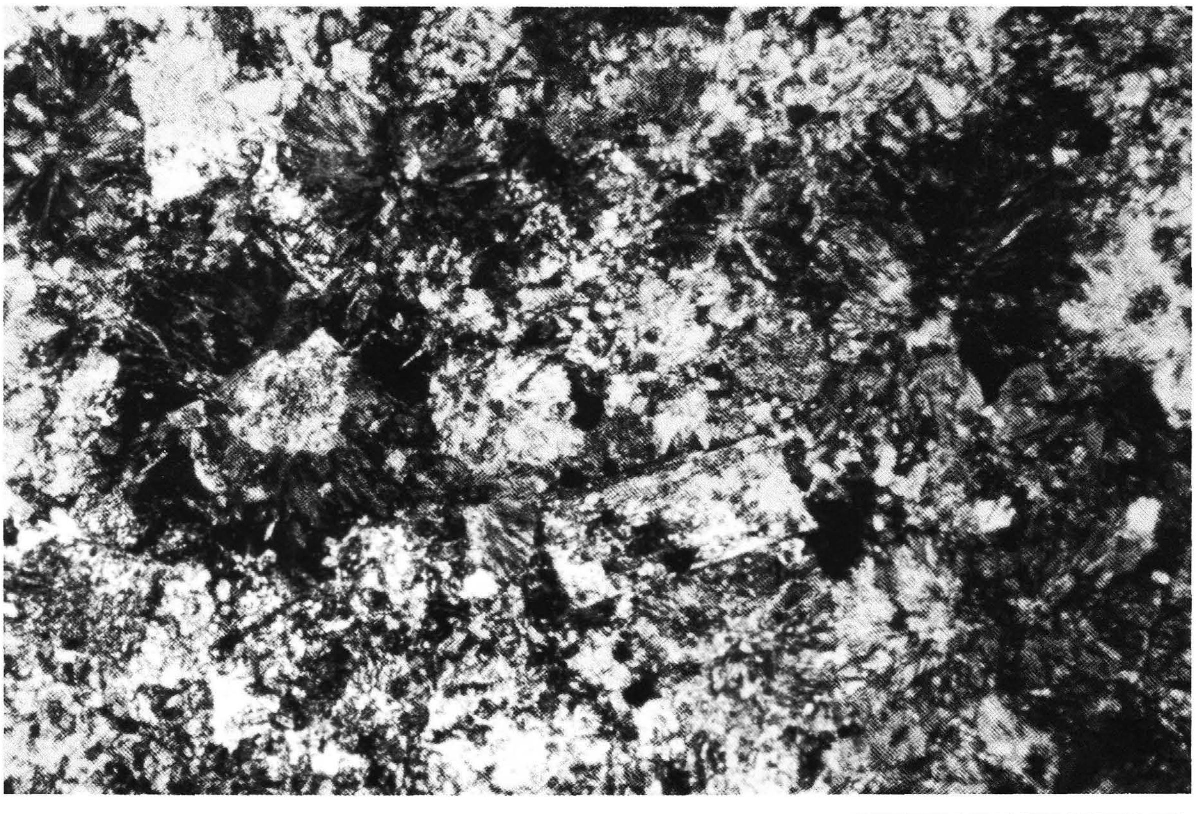

Figure 1. Photomicrograph of rhyolite, Sample 103-639F-2R, CC (18–20 cm). Scale bar is 1 mm. Euhedral albite phenocryst is in the center, surrounded by both fine-grained and spherulitic groundmass.

Table 1. Whole-rock analyses of Site 639 rhyolites.

	Section 103-639F-2R, CC	Section 103-639E-1R, CC
SiO_2	74.19	71.87
TiO_2	0.34	0.36
Al_2O_3	14.96	14.78
[a]FeO	1.93	2.04
MgO	n.d.	n.d.
CaO	0.001	0.02
Na_2O	3.18	3.68
K_2O	4.26	2.59
P_2O_5	0.15	0.14
[b]LOI	1.84	1.65
Sum	100.84	97.13

Note: n.d. indicates none detected.
[a] All iron is reported as ferrous iron.
[b] Loss on ignition.

Table 2. Selected microprobe analyses from Sample 103-639E-3R, CC (2–5 cm).

	Muscovite	Albite	Groundmass
SiO_2	49.45	66.54	86.0
TiO_2	0.21	n.d.	0.01
Al_2O_3	33.86	19.57	9.02
FeO	2.06	n.d.	0.13
MgO	0.99	0.01	n.d.
CaO	0.02	0.24	n.d.
Na_2O	0.13	11.77	5.38
K_2O	8.91	0.11	0.08
Sum	95.71	[a]98.24	100.62

Note: n.d. indicates not detected.
[a] $An_{1.2}Ab_{98}Or_{0.8}$.

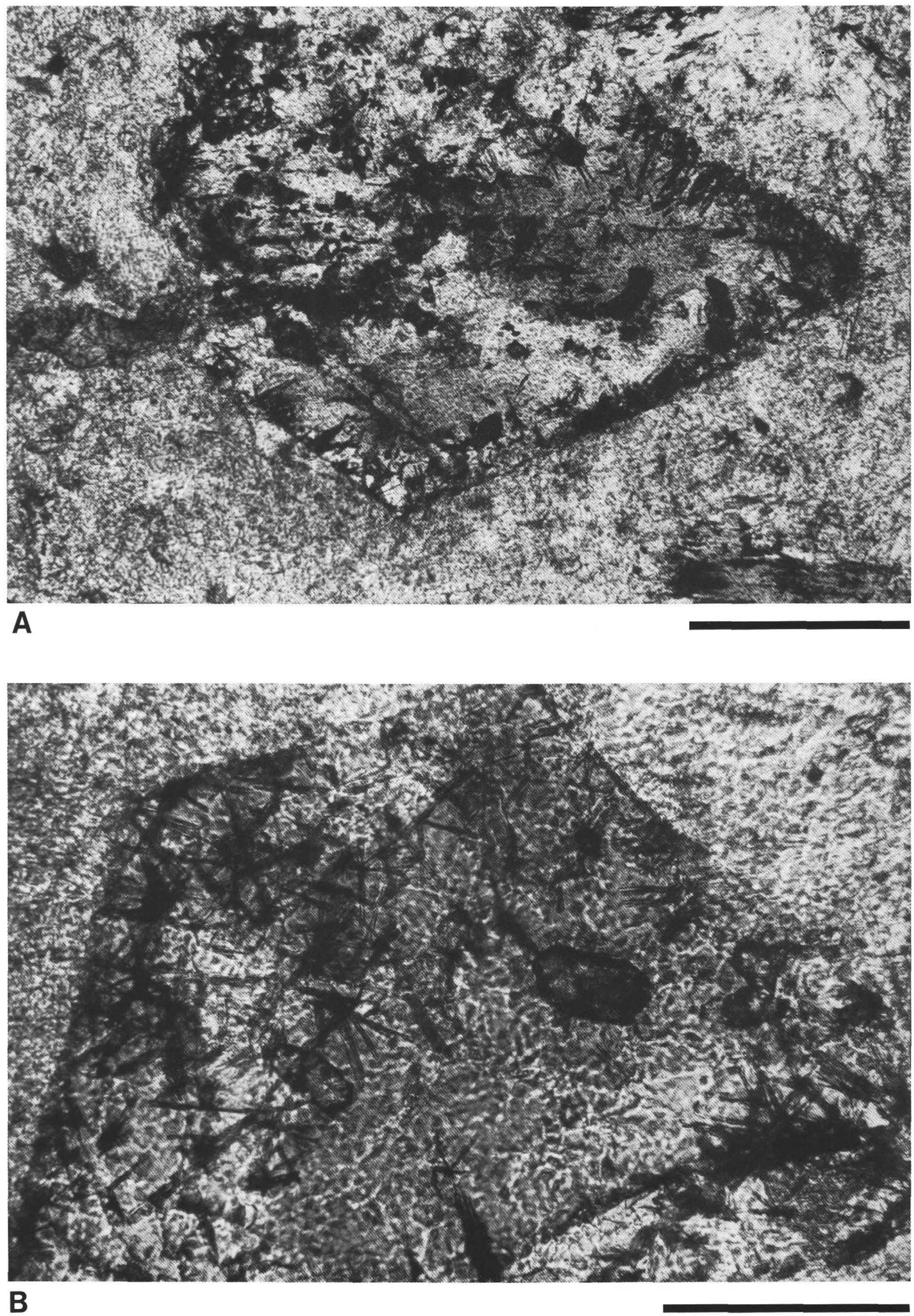

Figure 2. Photomicrographs of chlorite, Sample 103-639F-2R, CC (18–20 cm). **A.** Chlorite pseudomorph after hornblende. The needlelike inclusions are rutile crystals. Scale bar is 0.2 mm. **B.** Chlorite crystal with rutile and zircon inclusions. Zircon is large high-relief inclusion near the center. Scale bar is 0.1 mm.