Melted Xenoliths of Intrusive Rocks in the Pyroclastic Deposits of the Uzon and Semyatchinskaya Ring Structures (Kamchatka)

G. E. BOGOYAVLENSKAYA
Institute of Volcanology, Acad. of Sciences, Petropavlovsk-Kamchatskiy, USSR

Abundant xenoliths of granodioritic and granitic rocks are included in the layered loose pyroclastic deposits and baked tuffs of dacitic composition occurring in the Uzon and Semyatchinskaya ring structures, Kamchatka.

Among holocrystalline rock debris, a great amount of xenoliths of granitic composition showing clear traces of fusion was found. Microscopically, these xenoliths are composed of quartz, potassic feldspar, rare plagioclase and of a few dark-coloured minerals.

Depending on the degree of melting, the holocrystalline granite is transformed into an effusive-like rock containing sometimes up to 70 % of glass in which relics of quartz and orthoclase crystals, and scarce grains of plagioclase and augite are enclosed.

Initial fusion is indicated by a glass rim at the contact between quartz and orthoclase crystals. As fusion proceeds, the glass rim appears along the border of contiguous feldspars, and pyroxenes begin to change. At a more advanced stage of melting, the whole rock is penetrated by veinlets and layers of glass. The highest degree of melting is shown by xenoliths with 75 % of glass. In such cases, the rock is like a true effusive rock, with relics of K-feldspars, of resorbed quartz, and of small pyroxene grains darkened by opaque minerals as phenocrysts.

Feldspars are dissolved first of all. Cribrous, spongy and honeycomb textures as well as fingerprint-like textures are largely present and are typical of melted feldspar crystals. These textures develop first along the borders of the crystals, then cover them completely little by little developing along internal discontinuities such as cleavages and fractures.

Contact between glass and quartz grains is sharp. Irregular, bay-like inlets are usual. Quartz is more fractured than it is in the parental rock. In many cases recrystallization of the marginal parts of the quartz grains to granoblastic aggregates with lower refraction indices is observed.

Glass of the melted rocks is black or brownish. Under the microscope it is clear, transparent, mainly colourless, sometimes slightly coloured around the pyroxene relics, absolutely isotropic with no microlites. It is of liparitic composition (74 % SiO_2), and its refraction index is 1.494-1.497. High porosity and perlitic jointing are typical. The content of glass in the samples examined varies from 15-20 % to 75 % of the rock volume. The chemical composition of this glass is the same as that of the original rock at the initial stage of melting (Table 1).

TABLE 1

	1	*2*	*3*
SiO_2	73.22	74.02	75.04
TiO_2	0.39	0.16	0.10
Al_2O_3	12.16	13.15	12.53
Fe_2O_3	3.00	1.38	1.33
FeO	0.19	0.80	0.69
MnO		0.09	0.08
MgO	0.49	0.19	0.09
CaO	0.80	1.62	1.03
Na_2O	4.25	4.10	4.10
K_2O	3.47	2.85	3.16
H_2O^-	0.28		
H_2O^+	0.73	1.12	1.10
P_2O_5	0.34	0.06	0.07
Total	99.32	99.54	99.32

1. Granite at the initial stage of melting.
2. Glass taken from a granite at the initial stage of melting.
3. Glass taken from a granite at the final stage of melting.

The melting of the granitic xenoliths into a homogeneous glass — which indicates that the melting process ended abruptly, *e.g.* because of an explosion — leads to assuming the existence of a shallow crustal magma able to fuse holocrystalline acid rocks.

In the geological literature, partial or complete fusion of xenoliths of magmatic and non-magmatic rocks by magmas of basic or acid composition is described rather often (AL-RAWI YEHYA and CARMICHAEL, 1967; BULTER, 1963; KNOPF, 1938; LARSEN and SWITZER, 1939; RICHARDS, 1924), and is indicated as the most probable responsible for the formation of effusive-like rocks.

This conclusion is shared also by the present author.

References

AL-RAWI YEHYA and CARMICHAEL, I.S.E., 1967, *A note on the natural fusion of granite.* Am. Miner., *52,* no. 11-12, p. 1806-1814.

BULTER, B. C. M., 1963, *Metamorphism and metasomatism of rocks of the Moine Series by a dolerite plug in Glenmore, Ardnamurchan.* Min. Mag., *32,* p. 866-897.

KNOPF, A., 1938, *Partial fusion of granodiorite by intrusive basalt, Owens Valley, California.* Am. J. of Sci., New Haven, Conn., *36,* no. 215, p. 373-376.

LARSEN, E. S. and SWITZER, G., 1939, *An obsidian-like rocks formed from the melting of a granodiorite.* Am. J. of Sci., New Haven, Conn., *37,* no. 8, p. 562-568.

RICHARDS, S., 1924, *Some inclusions in basalts.* J. Geol., *32,* p. 685-689.

Manuscript received Nov. 1971
Revised manuscript, Sept. 1972