Glassy textures and emplacement characteristics of the Tahtayayla rhyolite-obsidian flow, Hasandag (Aksaray) volcanites, Central Turkey

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The Hasandag (Aksaray) area in Central Anatolia is a volcanic field covered with many cones, craters, tuff and lava flows of various cycles. In the region, the volcanism begun in Middle Miocene with ignimbrites, followed ash, tuff-agglomerate, basaltic andesite, andesite, dacite, rhyodacite and continued with basaltic lavas in Quaternary (e.g. Ercan, 1987). Rhyolite and obsidian observed at around Tahtayayla area in the northeast of the Hasandag volcano were formed during last cycle of the volcanism in Quaternary (Ercan *et al.*, 1989).

The rhyolite and obsidian are characterised by a wide range of surface structure and textures that vary in vesicularity, crystallinity, colour and flow layering,. possibly resulted from local chemical inhomogeneities, particularly with respect to volatile content. Detailed studies of these structures and textures were used to decipher the eruptive history of the rhyolite-obsidian flow and geometry of conduit which fed the flow. Textural information is then used to reconstruct the eruptive sequence of the flow.

The flow is texturally heterogeneous and markedly variable in appearance. The textural heterogeneity of the groundmass and appearance forms the basis for defining rhyolite and obsidian within the flow: less or nonvesicular obsidian; dense, microcrystalline rhyolite. Textural transition between two exist, but are volumetrically minor, many contacts are gradational.

It is not possible to determine the thickness of Tahtayayla rhyolite-obsidian flow because its base is obscured by talus slopes in the flow front. However, the flow starts with basal breccia zone, followed by 3–5 m thick, flow banded rhyolitic level (locally perlitic), then 20–25 m thick obsidian forming an aphyric, flow banded, glassy, layer beneath the white to grey rhyolite crust.

The obsidian level is mainly dark greenish black and reddish brown in colour, and reveal predominantly horizontal flow layering, and contains lens- and spherical-shaped rhyolite fragments in varying size. The rhyolite fragments show similar features of upper main rhyolite, and may include 1 to 10 cm vesicles (Fig. 1). Obsidians are entirely glassy, consisting of some feldspar crystals (up to 5%). They are characteristically fractured giving a brecciated appearance.

The rhyolite level is cream, white to grey coloured, and shows nearly horizontal, thin flow banding, micro folding, and vertical jointing. Thin obsidian layers may be present among rhyolite level. Rhyolite shows well-developed flow foliation consisting of alternating submillimetre scale layers of crystal rich and crystal free lava. The crystal rich bands contain

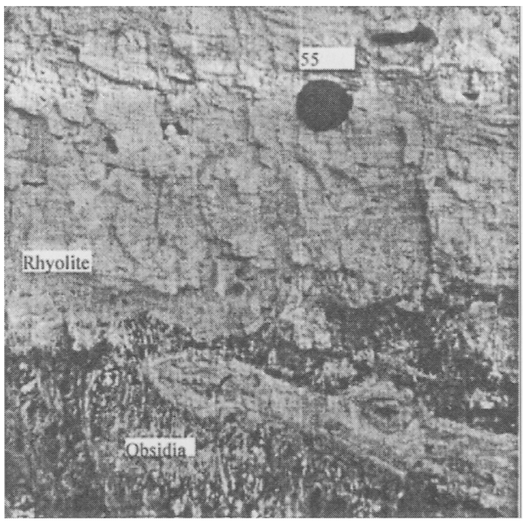

FIG. 1. Obsidian containing lens- and spherical- shaped rhyolite, and flow foliated cream-white rhyolite at the top.

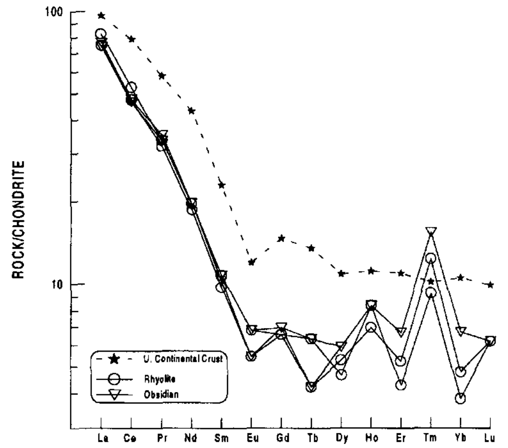

FIG. 2. Chondrite (Boynton, 1984) normalised *REE* patterns of rhyolite and obsidians, compared with upper continental crust (Taylor and McLennan, 1981).

quartz and feldspar crystals as well as numerous vesicles. The groundmass is nearly completely glassy, indicating that most of groundmass crystallisation occurred after the eruption. Most of the vesicles are angular in outline, have jagged bubble walls and show differences in size, and may have formed as a result of rapid inflation of a cooling, viscous material that was quenched shortly after vesiculation.

The structure of the flow studied can lead to inferences concerning the mode of origin of the structures and the extrusive style of the flow (e.g. Fink, 1983). It is suggested that flow foliation form parallel to the walls of the conduit, and that fractures form in vent area due to thermal contraction and the extension caused by magma pushing up from below. However, the Tahtayayla rhyolite-obsidian flow lies on the slope of Hasandag volcano so fracture patterns were probably strongly controlled by the underlying topography.

Glassy textures in the flow may have developed as three steps: (1) crystallisation within the flow releases dissolved magmatic volatiles, (2) advance of the lava forms microcracks through which these gases can move upward, (3) cooling of the upper surface increases the yield strength and creates a nondeforming crust through which the rising gases are unable to migrate (e.g. Manley and Fink, 1987).

The variations in textures do not correlate with major and trace element chemistry of the flow. The rocks are chemically nearly homogeneous. Major and trace element composition is fairly restricted with a narrow range of SiO_2, Al_2O_3, alkalies, Fe_2O_3(total), CaO and TiO_2.

They have K_2O/Na_2O ratio between 0.9 and 1.2. The range of variation for trace elements is narrow as well. They have significantly low La/Y (1.5–2.3) and Nb/Y ratios (0.8–1.1). However, the rocks are enriched in Ba, Sr, Zr and Ce. Major and trace element geochemistry of rhyolite and obsidian suggest that they are calcalkaline and high-silica in composition. They show *LREE* enriched patterns with $(La/Eu)_N$ = 11–14. *REE* contents are comparable with upper continental crust (Fig. 2).

Conclusively, the Tahtayayla rhyolite-obsidian flow are characterised by similar physical features and chemical compositions but varying textural features, all of which suggest they were generated and erupted under similar conditions. They appear to have flowed from their source. They contain many physical features indicative of flowage across the surface as lava, reflected by flow layering, crystallites, breccias and gas cavities. As the flow stopped and cooled, most of their characteristic features formed, including devitrification, foliation, jointing, various size of vesicles.

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