GREEN GLASS MADE OF MOUNT SAINT HELENS ASH?

By Kurt Nassau

A specimen of green glass said to be made from ash from the May 1980 eruption of Mount Saint Helen in Washington State was examined and compared with a black glass made by melting a sample of the ash. The glasses are quite different in their properties, and analytical results show that the green glass contains at most 5% to 10% of mount Saint Helens ash, if any.

On May 18, 1980, Mount Saint Helens, in Washington State, erupted violently. The resulting ash cloud rose as high as 10 km (6 mi.) into the upper atmosphere, depositing some three cubic kilometers of material over several states. (About 600,000 tons of ash—basically fine particles of rock—fell on the town of Yakima, Washington, alone.) The author subsequently obtained samples of ash from Yakima, Spokane, and other localities, including a large sample collected in central Washington by C. B. Keenan.

The ash was determined to consist partly of glass and partly of crystalline material, including quartz, feldspar, and other minerals. The particles range from over 1 mm to less than 1 μm in size, and have a bulk density of approximately 1.5 g/cm^3 (Nassau, 1981). Chemical analysis of a variety of ash samples revealed the following composition as typical of this material: 64 wt.% SiO_2, 17 wt.% Al_2O_3, 5 wt.% CaO, 4 wt.% FeO (total Fe), 4 wt.% Na_2O, 2 wt.% K_2O, 2 wt.% MgO, and 1 wt.% TiO_2 (Nassau, 1981). In view of the high silicon, aluminum, and calcium contents, a glass made from this ash would have very high melting and flow temperatures and viscosity (McLellan and Shand, 1984).

In 1983, a green glass appeared on the gem market, mostly in the western United States, with the claim that it had been made by melting Mount Saint Helens ash; purchasers thus could assume that ash is the major ingredient. This seemed to be a claim worth examining in view of the high melting point and viscosity expected of such a product. An examination was undertaken when a sample, shown in figure 1 (left), became available recently from R. J. Cormier. For general discussions of glass, see McLellan and Shand (1984); for discussions of glass in gemology, see Webster (1983) and Nassau (1980).

TESTING

A sample of Mount Saint Helens ash was heated in a 3.75-cm (1.5-in.) alumina crucible in air in an electric furnace. Viscous flow began at about 1300°C, but because of the high viscosity the air bubbles did not disappear until the ash had been heated for several hours at 1500°C. The result is an essentially black glass (figure 1, right), which appears dark gray-green when examined in thin splinters. The color is presumably derived from ligand field and charge transfer processes (Nassau, 1983) involving the high Fe and Ti content, and can be expected to vary somewhat depending on whether the material is heated in an oxidizing or a reducing environment.

The refractive index of the green glass is 1.508, while the black glass showed considerable variation (1.500–1.526), because the high viscosity inhibited mixing of the various components. Specific gravity (measured by the hydrostatic technique) for the green sample was 2.448 and for the black, 2.485. The results for the two samples were sufficiently different to throw doubt on the claimed origin of the green glass, even though some variability in the composition of the ash could be expected.

Semiquantitative (relative) elemental analyses were performed by energy-dispersive X-ray fluorescence using tungsten and chromium radiation excitation. Some elements occur at similar concentrations in both glasses: silicon is 20%, and potassium 30%, higher in the green glass, while traces of chlorine, manganese, and zinc occur at about the same concentration in both glasses.

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Figure 1. Green glass (30 mm long) claimed to be made from Mount Saint Helens ash, and black glass that the author made from a sample of ash.

Some elements are present at significantly higher concentrations in the green glass: approximately twice as much calcium, chromium, and zirconium, and three times as much copper, were present. Other elements have significantly higher concentrations in the black glass: 25 times as much iron, 14 times as much titanium, and twice as much aluminum and strontium. These are all the elements that were detected; with the instrumentation used it is not possible to detect light elements such as boron, sodium, and magnesium.

Here again, a different origin is indicated for the two glasses. The high iron and titanium contents in Mount Saint Helens ash (about 4 and 1 wt.% as oxides, respectively) are adequate to account fully for the color in the black glass. Given the lower amounts of these two elements (1/25 iron and 1/14 titanium) in, and the lighter color of, the green glass, one can deduce that the material contains little if any Mount Saint Helens ash. Allowing for the variability in composition of the ash and for the semiquantitative nature of the analysis, a maximum of 5% to 10% ash in the green glass is indicated.

One final and quite conclusive test was performed by placing small pieces of each glass on platinum foil and heating them in a furnace in air, increasing the temperature by 100°C every 15 minutes. The green glass flowed at 800°C; the black glass did not flow until 1300°C (figure 2). This huge difference is undoubtedly caused by the higher silicon and aluminum concentrations in the black glass and the probable presence of significantly larger amounts of the undetermined oxides of boron and sodium in the green glass. The melting point of the black glass is so high that it would be very difficult and costly to fabricate a uniform glass from it on a commercial scale.

Figure 2. Left, the small, irregular pieces of green and black glass shown in figure 1 after heating to 800°C; right, the black glass heated to 1300°C.

CONCLUSION

Green glass claimed to be made from ash from the 1980 eruption of Mount Saint Helens has significantly different properties and composition from glass actually made entirely from the ash. It contains at most 5% to 10% of this ash, if any.

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