MINERALOGICAL NOTES

Fiber-containing and Crystal-lined Basaltic Vesicles: Possible Lunar Analogs

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Abstract

Unusual whisker-like siliceous features occur within the gas-formed vesicles that are conspicuous in many of the basaltic stalactites in lava tubes. The vesicle linings are composed of well-formed crystals in most cases, and crystal-lined vugs branch off from the vesicles. The very small, nodular fibers are about 0.5 μ in diameter and up to about 2 mm long. Another class of crystalline feldspar whiskers of larger diameter also are present. The mechanism of formation is uncertain, but the finer fibers may possibly be fibrils of mesostasis drawn out by the parting of crystals during vesicle expansion. The crystal-lined, whisker-containing vesicles resemble those in lunar basalts, and, at least in some cases, may have been produced by similar processes.

Introduction

The morphological features of the interiors of the gas-formed vesicles that are conspicuous in basaltic stalactites found in lava tubes may involve the same mechanism of formation as similar features noted in the linings of vugs and vesicles of lunar basalts. Jaggar (1931) was probably the first to describe the in situ behavior of stalactites at high temperatures in lava tubes, and to suggest a mechanism of formation from the gas-melted glaze on the roofs of the tubes. Jaggar also noted the characteristic appearances and forms of the stalactites, and the crystallinity of the lining of the vesicles within them. Recently, Peterson and Swanson (1974) vividly described such stalactites from the tube system of the 1970–71 Kilauea eruption on the east rift zone vent at Mauna Ulu. They suggest stalactite formation both by dripping of lava splashed from the flowing stream within the lava tube, and, for the more slender “worm stalactites,” by the slow dripping of the viscous glaze from the lava tube roof.

Procedures

Stalactites were obtained from the collections of the Department of Geology and Geophysics, University of Hawaii, and of the Hawaiian Volcano Observatory, U. S. Geological Survey. Most samples are from lava tubes formed during the extensive 1919 eruptions in Kilauea Caldera.

Results and Discussion

SEM photographs of the vesicle linings (Fig. 1) reveal the distinctive crystallinity characteristic of most vesicle linings. Individual minerals seem to be predominant in certain wall regions; feldspar is especially prominent in some areas, augite in others. Neither the extent nor the reason for this sequestering of minerals in certain areas has been explored yet. Remnants of the mesostasis are held by capillary action between many closely adjacent crystals (Fig. 1A, arrow), and in this instance may be an early stage of fiber formation. In some cases the crystal surfaces follow the interior spherical form of the vesicle, and are often broken or parted to reveal crystal-lined vugs that penetrate beyond the boundary of the vesicle walls.

The smaller fiber-like structures are present in a variety of forms. The individual fibers vary in diameter and may best be described as nodular (Figs.

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Fibers and crystalline lining of vesicles in basaltic stalactites from lava tubes. See text for discussion of details.

IC and ID), and fibers in a given region may represent several generations of growth or formation. A class of larger fibers with crystal-faced surfaces and terminations also are evident (Fig. 1C), and have been identified microscopically as feldspars (An30–70). Some of the finer fibers have droplets of a solidified phase adhering to them, as if after formation they had been exposed to a liquid with a lower melting point (Fig. 1A). Some fibers are sharply terminated; possibly broken in handling (Figs. 1A and 1D). Others terminate in twisted, worm-like growths (Figs. 1C and 1D), similar to the growths observed on some...
fibers could be formed from the mesostasis that is crystal lining has been noted in vesicles formed in this same type of vug formation and well-defined of the crystals within the body of the vesicle. The would be left penetrating into the vesicle, and the gas lava, resulting in the formation of vugs. Usually, vesi-

pressure would form pathways into the body of the and formation of a rigid crystal mixture, crystals spherical bubbles; but with increased crystal growth con

form to the minimum energy condition of the matrix of the thin-walled stalactites. Pressure due to conditions in which the gas pressure need only over-

sive process that might be involved in their forma-

tion. The well-formed crystallinity of the linings and the existence of fibers within the vesicles resemble features noted in the vesicles and vugs of the lunar basalts from the Apollo missions. The importance of the study of those vesicles and some of their unique features was emphasized by Schmitt et al (1970). Others have described and studied the crystallinity of vesicle and vug linings (Jedwab, 1971; Skinner and Winchell, 1972), and the writer has been impressed by this feature in work with the vesicular Apollo 15 basalt, 15556. Fibers have also been described as intrud ing into the vugs and vesicles of lunar basalts (Skinner and Winchell, 1972), and on the surfaces of lunar breccias (Carter, 1973). The general conclusion has been that fibers or “whiskers” in lunar vesicles are the product of growth from a vapor phase, or through a vapor-liquid-solid (VLS) sequence (Carter, 1973). In light of similar features in terrestrial samples, further studies on lunar basaltic vesicles are needed, with perhaps a re-examination of other possible processes that might be involved in their forma-

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References


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