Additional examples with their variations might be quoted, but it would seem that the foregoing are sufficient to bring out the point mentioned in the beginning of this paper.

While the process described was noticed chiefly in specimens from mesothermal deposits, it was also observed, but to a far lesser extent and degree, in deposits formed in shallower zones where the solutions are less concentrated.

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## CRYSTAL CAVITIES IN LAVAS FROM THE HAWAIIAN ISLANDS

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In the *American Mineralogist*, volume **18,** 1933, pages 369–385, there appeared an article by the writer, bearing the above title, and setting forth the results of a mineralogical and paragenetic study of material collected by the late Professor A. S. Eakle. During 1934 this article was the subject of some correspondence from Dr. H. T. Stearns of the United States Geological Survey, who is stationed on Maui, in the Hawaiian Islands. Dr. Stearns has been able to supply valuable information bearing on the field relations of the lavas in which the cavities occur. With his permission, extracts from his letters are quoted below.

Material from three principal localities was studied: Moiliili Quarry, Honolulu, Oahu; Alexander Dam, Kauai; and the Lanikai Hills, whose locality should have been stated as Oahu and not Hawaii. Some of the Lanikai material was erroneously labeled as "near railroad station"; this should have been "near radio station."

Dr. Stearns agrees with the writer's conclusion that the minerals at the first of these localities originated from the nepheline-melilite basalt flow in which they are found, and writes as follows: "The Moiliili Quarry is in the terminal margin of the Sugar Loaf lava flow, probably the youngest on Oahu. This lava was erupted after the dissection of the Koolau dome, and at the quarry rests on emerged reef limestone. The basal water table lies most of the time just below the basalt, which is about 50 feet thick at this point, but in wet weather the water table rises into the lower part of the

basalt. The Sugar Loaf flow displaced Manoa Stream and buried the lower part of the flat floor of Manoa Valley. It is possible that the high volatile content of this particular flow is partly due to the wet ground over which it spread, because without a doubt it shows more primary vein-development than any other flow on the island. However, the nephelite basalts in the Koolau Range, Oahu, were all rich in volatiles as shown by the zeolites in them and the feeble development of pegmatitoid structure in the Maunawili and Kamanaiki basalts."[1]

Dr. Stearns further calls attention to important differences between the Moiliili and Lanikai occurrences: "The flows at Lanikai (basalt of Kailua volcanic series) are typical lava flows of the Kailua dome greatly altered by hydrothermal activity. These flows were apparently poured out as normal aa and pahoehoe flows and based on analogy with the other Oahu flows probably solidified without the development of any secondary minerals." Quoting from page 89 of Bulletin 1: "It is known that the Kailua flows were either directly under or close by the summit caldera of the Koolau Volcano, hence the secondary minerals may have been deposited by ascending vapors during the history of this caldera. If cavities in the breccia can be found containing the same minerals as in the cavities in the lava, then subsequent rather than concurrent hydrothermal action will be established. If it can be proved that the minerals were deposited as each flow cooled then some special condition must have existed during their cooling not common to the other basalts of this type. Possibly the Kailua lavas were erupted under the sea, yet the lack of pillow lava and interbedded marine deposits dictates against such a hypothesis."

Thus the vein and cavity fillings of the Sugar Loaf basalt at Moiliili may be very different in mode of origin from those in the Kailua lavas at Lanikai. I have identified calcite and chlorite in a few thin sections of breccia sent to me for examination by Dr. Stearns indicating that some minerals were deposited in the breccia after it accumulated; but the typical zeolites of the Lanikai flows, epistilbite, laumontite, heulandite, and ptilolite were not found. However, Dr. Stearns reports that the breccia outcrops are very massive and weathered, making it difficult to obtain specimens

[1] See also, Stearns, H. T. and Vaksvik, K. N., Geology and Ground-Water Resources of the Island of Oahu, Hawaii: *Div. of Hydrography*, T. H., Bull. **1**, pp. 189–198, 1935.

which might contain cavities. The origin of the Lanikai minerals can only be determined, therefore, by further study of the breccia and the flows.

Attention was directed to the somewhat altered condition of the Lanikai basalts in the article (page 379). The alteration takes the form of rather feeble chloritization. Providing that it can be convincingly demonstrated that this effect is confined to the vicinity of the latest eruption center, and is not due to superficial alteration, then it will be necessary to agree with Dr. Stearns' hypothesis that it is due to hydrothermal activity. Since it is hardly likely that zeolites and minerals associated with them could survive hydrothermal alteration, it is necessary to grant either that they were produced from the solutions which brought about the alteration, or were introduced later.

Turning in conclusion to the general question of the genesis of zeolites in basaltic lavas, there can be little doubt that at least two modes of origin are possible. They may represent the last residual products of the flow magma, as at Moiliili and Alexander Dam; or they may be produced during the hydrothermal alteration of the lavas by solutions from some source outside the lavas, as in the Michigan copper region, where this process has been convincingly demonstrated. In the one case their substance is derived from the magma which produced the rock in which they are found; in the other, it came for the most part from the rock itself.

## THE OCCURRENCE OF SPHALERITE AT ELLSWORTH, OHIO

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Ellsworth, Ohio, is renowned for the selenite crystals which were formerly found there. Small selenite crystals are still to be had, but unfortunately most of them have the crystal faces corroded to such an extent that they are indistinguishable. While seeking for selenite the writer noticed numerous ironstone concretions lying in the bed and along the banks of the small stream which flows past the clay bank in which the selenite crystals are found. A short journey up-stream disclosed the source of part of the concretions. They were found, in situ, in a bed of shale near the water's edge. This bed is evidently not the only source since they are found in the stream above the point where this particular bed is exposed. Upon breaking a few of the concretions the writer was astonished