NEWBERYITE AND OTHER PHOSPHATES FROM ASCENSION ISLAND

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On the small volcanic island of Ascension, situated in the South Atlantic, latitude 7°57′ south, longitude 14°28′ west of Greenwich, Daly[1] found that "thin deposits of phosphate, on the basaltic flows, occur at many places." Professor Daly kindly placed all of the limited amount of his collections of such material, together with his notes on its occurrence, at the disposal of the writer. Acknowledgement is due to Professor Daly for this kindness and to Professor E. S. Larsen for advice and assistance during this study.

A specimen from the roof of a pressure-dome cavern of a young basaltic flow, running north from the vent 1 km. NNW of 1460-foot Sisters Peak, consists of a fragment of dark colored lava, with the outer surface covered by a botryoidal layer of white to light brown material 5–10 mm. in thickness. A thin section, cut across this crust, shows an outer layer of white, crystalline material, in places with a radial structure, which has an index of refraction lower than balsam. Next beneath this is a layer of yellowish or light brown material, which is amorphous and has an index higher than balsam. Between this and the basalt is a lighter colored, crystalline material of nearly the same index as the overlying amorphous layer. All three layers are not everywhere present on the surface of the specimen, the outer white layer being, by far, the more plentiful and continuous. The basalt is made up of dark glass carrying small laths of feldspar. Toward the crust-covered surface it is somewhat altered and lighter colored.

Practically the pure mineral from the outer layer was readily obtained and, on examination by the immersion method, it was found to have the following properties which identify it with newberyite $2MgO \cdot P_2O_5 \cdot 7H_2O$. The crystal form was not well enough developed to determine the optical orientation.

[1] Daly, R. A. The Geology of Ascension Island, *Proc. Am. Acad. Arts & Sciences*, vol. **60**, 10, 1925.

	Newberyite, Ascension	Newberyite[2]
	biaxial, positive	biaxial, positive
α β γ	1.517 ± 0.003 1.520 ± 0.003 1.531 ± 0.003	1.514 1.518 1.533
2V Dispersion	35° (measured) $\rho < \nu$ perceptible	45° $\rho < \nu$
Color	white	white
Specific Gravity	2.30	2.10

The layer of brownish amorphous material is exposed, in places, in the form of small, rounded knobs (3–5 mm.) and is there nearly free from its associates. It corresponds closely to collophanite $3CaO \cdot P_2O_5 \cdot H_2O$.

	Collophanite, Ascension	Collophanite[3]
	Isotropic	Isotropic
n	1.58–1.59	$1.569, 1.61\pm$
	amorphous	amorphous
	conchoidal fracture	
Color	mottled	white, etc.
Specific Gravity	>2.40 <2.75	$2.7\pm$

The inner layer is the most irregular and least abundant. While mainly in fine aggregates, irregular grains, showing no crystal form, but large enough for study under the microscope, are of not infrequent occurrence. These show the following properties:

[2] Larsen, E. S. The Microscopic Determination of the Non-Opaque Minerals; *U. S. Geol. Surv. Bull.* 679, p. 209, 1921.
[3] *Loc. cit.*, pp. 174, 175.

	Biaxial, distinctly positive
α β γ	1.590 ± 0.003 1.602 ± 0.003 1.617 ± 0.003
2V	nearly 90° (estimated from several sections normal to an optic axis).
Color	slightly reddish.
Specific Gravity	2.8±

These properties correspond most nearly to martinite $5CaO \cdot 2P_2O_5 \cdot 1\frac{1}{2}H_2O$.

	Martinite[4]
β B	1.606 0.02
2V	medium large
Color	colorless
Specific Gravity	2.89

Some fragments of this material seem to show outlines of feldspar laths in a parallel position, suggesting that the material has replaced the glass of the basalt. A small amount of the material, shown by the microscope to contain a few per cent. each of basaltic glass and collophanite, was obtained for chemical analysis by removing particles of basalt with the electro-magnet and by floating off the minerals of the two outer crusts by the use of heavy solutions with a gravity of 2.75 or less. The analysis corresponds fairly well to the composition $5CaO \cdot 2P_2O_5 \cdot 3H_2O$ or with the same ratio of CaO to P_2O_5 as those assigned to martinite but with double the amount of H_2O. The optical properties are so near those of martinite as to identify the mineral as martinite.

[4] *Loc. cit.*, pp. 105,216.

	Analysis (1)	Molecular Ratios			$5CaO \cdot 2P_2O_5 \cdot 3H_2O$	Martinite, Curacao (2)
SiO_2	3.76	.0626				
FeO	0.62	.0086				
MnO	0.39	.0055				
MgO	0.21	.0052				
CaO	40.50	.7219	.7728	5×.1546	45.34	47.63
Na_2O	1.34	.0216				
K_2O	0.94	.0100				
H_2O+	7.39	.4106	.4567	3×.1522	8.73	5.46
H_2O-	0.83	.0461				
P_2O_5	44.19	.3110		2×.1555	45.93	47.87
	100.17					

(1) by Mrs. S. Parker, Zurich.
(2) Kloos, quoted from Dana, p. 830.

It is noteworthy that the outer crust is high in magnesia while the inner crust is low in magnesia and high in lime though both are apparently derived from the underlying basalt.

Material collected on the path to Gill's observatory, 500 meters from shore at Mars Bay, SW. corner of the island, consists of stalactitic crusts on lava and finer loose material and dust from hollows on the lava-flow. Some of the stalactites are largely of the white mineral already identified as newberyite but also contain a few small but well formed prisms which show parallel extinction, with n along the prism $=1.510\pm$ and across $n=1.702\pm$. An occasional stalactite carried a few comparatively large white grains with the following properties: uniaxial, negative; $\epsilon=1.485\pm0.003$, $\omega=1.520\pm0.003$. This mineral was readily soluble in water; the solution gave a distinct test for sulphate; tests for the bases were negative, none being made for the alkalies. On allowing the solution to evaporate to dryness, none of this mineral was found but, instead, a few sheaves of colorless, prismatic plates with the plane of the optic axes normal to the length, sections nearly normal to an optic axis being rather frequent. The following properties were determined: biaxial, positive; $\alpha=1.568\pm0.003$, $\beta=1.590\pm0.003$, $\gamma=1.624\pm0.003$; $2V=60°$ (estimated from sections nearly normal to an optic axis or to the acute bisectrix); dispersion $\rho>v$ perceptible.

Of the loose material and dust, grains larger than 40 mesh were nearly all of the amorphous material, already identified as collophanite. The fines through 40 mesh, besides collophanite, also included fine aggregates of newberyite, halite, grains of basalt, and lath-shaped crystals and fragments of a feldspar slightly more sodic than normal labradorite.

The rather plentiful amounts of volcanic glass and of labradorite laths and fragments, in the loose material, may either have fallen as volcanic ash or be a product of disintegration of the lava flow. The comparatively unfractured condition of many of the feldspar laths and their freedom from adhering glass seem to indicate some disintegration either of the lava in place or of small lapilli.