NOTE ON THE COMPOSITION OF ALLANITE

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The purpose of the present note is to direct attention to two publications, recently issued, on different features of allanite—one on refractive indices,[1] the other on weathering[2]—which have an important bearing on the composition of this mineral.

That a lack of constant chemical composition is exhibited by allanites, even when unaltered, is well known from the numerous recorded analyses of specimens of the mineral from the principal localities in this country and abroad. The recent work carried out independently by Zenzén and Watson on allanites fully accounts for their variable composition. In each case the data obtained by microscopic study show that ordinary black vitreous allanite is not homogeneous, but is composed of a mixture of at least two types of material, the proportions of which vary widely in the allanites studied. The more important facts which bear on the composition of allanites as developed in the two studies are summarized below.

Imperfect knowledge of the "refractive power" of allanite led Zenzén to investigate this property of the mineral, employing the immersion method. Forty specimens, representing "comparatively large fragments or individuals," were selected, 35 of which were from localities in Norway and Sweden. No American localities were represented. Both fresh and altered allanites were studied, the former being of the black variety. Many of the observations were made on specimens previously analyzed, which gives added value to the results.

Specific gravity determinations were made in order to study the relation between this property and refractive index. The results obtained show that the medium refractive index of allanite decreases fairly regularly with decreasing specific gravity. This would be expected, since it is well known that allanites with low specific gravity (about 3.1 and less, according to Zenzén) are strongly altered, a condition which is usually clearly indicated under the microscope.

[1] Zenzén, N., Determinations of the power of refraction of a number of allanites, *Bull. Geol. Inst. Univ. Upsala*, **15**, 61–76, 1916.

[2] Watson, Thomas L., Weathering of allanite. *Bull. Geol. Soc. Am.*, **28**, 463–500, 1917.

Zenzén found that unaltered or but slightly altered allanites were birefracting and pleochroic, and had a high specific gravity and a correspondingly high medium refractive index. He found on the other hand, that allanites, originally birefracting and presumably pleochroic, with specific gravity less than 3.50 and refractive index less than 1.70, were, in most cases, isotropic. No isotropic allanites were observed to have a specific gravity above 3.50 or refractive index above 1.70.

The conclusion to be drawn from these data is that isotropic allanite represents the altered form of the mineral and is derived from crystalline allanite, the original fresh mineral. This is not in accord, however, with recent results obtained by E. S. Larsen[1] on some American allanites, which appeared to indicate that the birefracting (crystalline) allanite substance, at least in the specimens studied, was secondary and was derived from the isotropic form.

The investigation by Watson was primarily concerned with the advanced stage of weathering of allanites, in which the fresh mineral substance and its weathered product were both physically and chemically unlike. However, in the early part of the study, attention was paid to the composition of the supposedly fresh mineral, and the results obtained led to the conclusion that the black vitreous allanites investigated were not homogeneous. They proved to be composed of a mixture of at least two types of material, the proportions of which varied widely in the specimens studied. One was isotropic; the other was birefracting and apparently derived from the first either by alteration or inversion, probably the former.

The two investigations establish microscopically, then, the lack of homogeneous character of black allanites, a conclusion which is in agreement with their variable chemical composition. Whether the isotropic and crystalline forms are chemically similar or dissimilar remains to be established by further investigation. It is generally assumed, chiefly on the basis of water content, that the change of one into the other is an alteration and not an inversion; but additional study is needed to definitely prove which of these processes is responsible.

[1] Quoted by Watson, Thomas L., *work cited*, pages 481–482.