# SULPHATE MINERALS FROM WEATHERING OF SHALE NEAR ITHACA, NEW YORK

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Epsomite, gypsum, and alunogen formed by the weathering of shale are fairly common near Ithaca, and the object of this brief note is to describe their occurrence, which is probably duplicated in many other regions of sulphide-bearing shales.

These minerals are by no means confined to one geological formation, since they are found on the Moscow shale, Genesee shale, and the lower part of the Portage; but they are perhaps most abundant on the Genesee shale between Esty's and Portland Point on the east side of Cayuga Lake. There are similar occurrences in some of the gorges near Ithaca. The efflorescence of epsomite on the cliffs along the east side of Cayuga Lake near the south end was mentioned by L. C. Beck.[1]

The epsomite occurs as a loose, white, powdery coating which forms on the cliffs irregular patches often 10 sq. m. (100 sq. ft.) or more in area during dry seasons. It is thickest where a small ledge overhangs a recess, and in these places sometimes forms fluffy masses as much as 2 or 3 cm. (1 in.) thick. Microscopic examination shows the epsomite to consist of very fine curved fibers which themselves are aggregates of extremely small crystals. In the winter, due to slow recrystallization of the material, the epsomite was found in somewhat more compact form and consisted of distinct crystals up to about 0.5 mm. long by 0.1 mm. wide. The mineral was identified by its optical properties, taste, and qualitative chemical reactions.

Gypsum occurs both as a coating on the edges of the beds and between the laminae of the shale. Being less easily soluble than the epsomite and alunogen, more of it remains during the wet seasons of the year. The surfaces of the thin plates into which the weathered shale easily separates are often half covered by gypsum, in distinct crystals up to 1 or 2 mm. long, strongly colored by limonite. Small amounts of gypsum also occur mixed with the epsomite. Secondary gypsum, such as is described here, is easily distinguished from primary gypsum deposited with the shale since the latter would be more intimately mixed with the clayey material and would occur in the fresh as well as in the weathered rock.

Special conditions seem to have been necessary for the formation of the alunogen since it is much less common than the epsomite and gypsum. Perhaps, in places where it was not formed, all of the sulphuric acid united with substances more easily attacked than the hydrous aluminum silicates from which the aluminum must have come, or the acid was not of sufficient concentration to attack these aluminum compounds. The alunogen occurs as white to slightly yellow botryoidal masses of finely fibrous structure. Single crystals are rarely more than 0.005 mm. in width by 0.2 mm. in length so that aggregates are usually seen in examining the crushed mineral under the microscope. The alunogen sometimes cements fragments of shale together. The mineral was identified by qualitative chemical reactions, refractive index of 1.477 (±.005), inclined extinction and low double refraction.

Melanterite, in somewhat altered form, with refractive indices higher than those of the pure unaltered mineral, was found in small amounts at only one locality, where it was associated with the three other sulphate minerals mentioned.

The sulphate in all of these minerals comes from the oxidation of the pyrite and marcasite in the shales; the lime and magnesia of the gypsum and epsomite, respectively, are presumably from carbonates, and the alumina of the alunogen from the clayey material. The salts are brought to the surface in solution in water which evaporates and leaves the minerals as described. Secondary minerals containing the alkali metals were not found in this region.

It may very well be supposed that the formation and crystallization of these sulphates, in itself a stage in the chemical weathering of the shale, may help also in the mechanical disintegration of the rock by opening wider the fine cracks already existing, in much the same manner as freezing water.

[1] Mineralogy of New York, p. 251 (**1842**).