blende, resembling actinolite, results, commencing from the periphery and along cleavages. As the alteration proceeds still further, chlorite, (var. penine,) results, which may color the surrounding minerals green for a considerable distance.

Besides the secondary green hornblende mentioned, a brown variety is quite abundant. In some cases it is undoubtedly primary, but may in part be derived from the diallage. The advanced decomposition of the dark silicates, often makes it difficult to decide which is primary and which is not. This hornblende is usually of a dark color, with a violet shade, when fresh, and the pleochroism is strong. A greenish color or bleaching, usually results as the first stage of chemical alteration, and it gradually passes to fibrous aggregates of green secondary hornblende, and finally to chlorite.

The small amount of quartz is apparently primary. It is mostly clear and fresh, but also contains small needle-like inclusions, and infiltrated hornblende. The amounts of apatite and brown mica are very subordinate, and the latter is evidently secondary. Magnetite as a primary accessory constituent, is in quite large amount, and in some cases the sulphides are important.

Relation of Sulphides.

In contrast to the primary magnetite, the relation of the sulphides to the rock minerals is striking. Besides the primary magnetite, however, is a small amount, in fine-dust like particles, which results from the alteration of pyroxene and hornblende. The *primary* magnetite is always in the form of more or less rounded grains, enclosed in the dark silicates and sulphides, with unaltered contours.

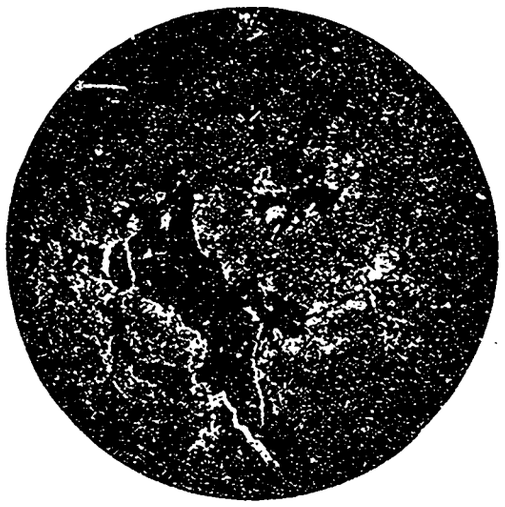

Fig. 4.—Ore-rock, showing part of a veinlet of chalcopyrite chalcopyrite and pyrrhotite, which extends across the section along a line of shearing. The epidote and pyroxene are granulated and strained by pressure, showing undulatory extinction and a curved cleavage. The sulphides replace the pyroxene and epidote in a typical manner, etching the borders of the grains and extending along the cleavage planes.—Magnified about 70 diameters.

The ore which is almost exclusively pyrrhotite, is largely confined to the neighborhood of the dark silicates. It is possible that it has in part, been formed in place, by sulphur-bearing waters reacting on the iron, resulting from the alteration of the silicates. But whether the sulphides originated in this way, or were introduced from external sources, they are certainly secondary.

Where the hornblende and peroxene are still fresh and compact, the sulphides form a border around them, sharply defined by the edge of the mineral. But as the rock minerals become more altered and fibrous, the change proceeds further. At first, fine threads of sulphides insinuate themselves, between the fibres and along the cleavages, and may finally replace the whole silicate fragment. This often results in a more or less complete pseudomorph, but the change has gone on so delicately, that the sulphides

Fig. 5.—Ore-rock, showing decomposed feldspar, with secondary hornblende and chlorite. About the centre can be seen an area of secondary, greenish, fibrous hornblende, which is largely replaced by ore, but in such a manner that the sulphides retain the orignial fibrous structure of the hornblende.—Magnified about 50 diameters.

preserve the *fibrous structure* of the replaced mineral. This change of course, is very often incomplete, but the principle is always the same, and the *greatest development of sulphides is always found, where the alteration of the rock minerals* is most prominent.

(2) Rock strongly impregnated with ore, taken from the shaft, at a depth of 30 feet.

The rock itself is a diabase gabbro, with a hypidiomorphic-granular structure; in places rather coarse grained, and with prominent feldspar crystals.

A somewhat gneissoid structure, and slickensided surfaces have been developed by dynamic stresses.

The principal constituents are: feldspar, epidote, pyroxene, hornblende, and chlorite, with apatite, magnetite, calcite, etc., as accessories.

The feldspar is a basic plagioclase, approaching labradorite, or bytownite, and when not too much altered, shows a typical albite twinning. As a rule the feldspar is in an advanced stage of decomposition, and the twinning structure may be entirely obliterated. It builds irregular grains and aggregates, but often presents good crystal outlines, in a ground-mass of pyroxene or hornblende, giving the section somewhat the appearance of a diabase. Most of the feldspar has passed to indistinct aggregates of highly polarizing secondary products, consisting of calcite, sericite, or saussurite, and colored greenish by migrated hornblende and chlorite. Fig. 1 shows such an altered feldspar individual. Around the edge of the altered grains can be seen a rim of clear "*regenerated*" feldspar, in optical continuation with the old.

One of the most prominent minerals is a clear variety of epidote, characterized by the fact that the plane of the optic axes is at right angles to the cleavage. It is always in the form of irregular grains, sometimes