The Kubo Quicksilver Deposit in the Province of Tosa.

By

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The island of Shikoku lies in the southern part of south-west Japan, and consists of thick mountain masses running from east to west. These mountain masses are of geological interest because of their construction. South of the central axis of the mountain range we find series of crystalline schist, paleozoic and mesozoic formations; and on the north granitic rocks. In the lower paleozoic series, there is a very interesting occurrence of quicksilver, called the Kubo Quicksilver Mine.

This deposit is situated in Kubo in Kami-Nirō village, Kami-gōri, in the province of Tosa, at a distance of about twelve kilometers from the city of Ōdochi, which is the chief town in the district. The mountainous country around consists of various phyllitic rocks which have been subjected to a strong dynamical metamorphism. The prominent rocks of this area are graphite phyllite, green and red pyroxenites, and quartzite of the Lower Chichibu Paleozoic series (Mikabu series). The foliation of these rocks strikes in general north-east, the dip being to the south. So far as observed, the intrusion of eruptive rocks is unknown.

The graphite phyllite is a hard fissile argillaceous rock with a distinctly foliated structure intercalated with small lenticular patches or narrow veins of quartz. The carbonaceous material homogeneously distributed throughout the mass gives the rock its black color. Microscopic sections show that the carbonaceous material crystallized in part as graphite, so that the graphite phyllite of this district is with difficultly distinguished from the graphite schist of the Crystalline Schist System (Sambagawan series).

Under the head of the pyroxenite here is included greenish and reddish schistose rocks interstratified with the graphite phyllite. The green pyroxinite is a schistose, or imperfectly schistose, granular crystalline rock with close resemblance to chlorite schist. Under the microscope this rock is seen to contain fresh pyroxene crystals in a groundmass composed of fine epidote needles, chlorite, with a few glaucophane and light green serpentine substances. This pyroxene is colorless and transparent, traversed by characteristic cleavage cracks, the extinction angle of the crystals measuring the same as the diopside; but it is always broken into many pieces cemented by a green, fibrous, serpentine substance which may be its alteration product. From these facts this rock may be considered an original pyroxenite rock; some basic eruptive rock subjected to dynamical metamorphism. The red pyroxenite is a deep-red, fissile rock of the same appearance as graphite phyllite. It is always intercalated with green pyroxenite. Its character, as revealed by the microscope, is quite different, consisting of minute grains of feldspar, together with abundant fine grains of hematite, magnetite and epidote. The hematite grains are of such quantity as to give the rock a dark red color.

The metalliferous vein of quicksilver deposit is a single main vein, together with a few narrow, parallel veins, approximately parallel to the strike of the rock complex, chiefly in the graphite phyllite. The principal vein is characterized by a light brown color, easily distinguished from the country rock. This color probably comes from the iron oxide derived from the thermal water. The thickness of the outcrop is about one meter, and it may be traced about one kilometer. The color of the vein is deepes in the central part than in the periphery. These quicksilver veins are a group of numerous minor veinlets or stringers of calcite and quartz occupying the interstices along the fracture planes of the rocks. The thickness of the veinlets varies from very narrow to over six centimeters. Large lenticular veinlets are frequently observed. These veinlets tend to abound in the centre and to diminish toward the peripherial part of the outcrop. The structure of the veinlets is sometimes that of true fissure filling, short or irregular in form, and sometimes brecciated with fragments of the country rock cemented together with calcite or calcite and quartz. Thus these veins has been crushed many times, and filled with calcite and quartz through many generations. The walls ars usually irregular and the bordering rock is always impregnated to the some distance with calcite or quartz. In general, chambering, splitting and brecciation are features of this vein. The banding and foliation of the rocks pass over into the foliation of the veins, from which we may also judge that the vein affords very strong evidence of dynamical metamorphism with the rock complex after formation.

In the vein the quartz usually appears as white translucent masses or white sinter-like masses, sometimes presenting chalcedonic characteristics. The former is quite difficult to distinguish from the original quartz of the lenticular shape which is imbedded in tha foliation of the original rock. Some of this is seen to be of secondary formation from solution, because it contains quicksilver ore in the fissures of the mass. The latter is evidently of secondary precipitation, and always carries the ore in mixture with calcite.

The calcite occurs in different forms, the massive yellowish variety always cements of the rocks and the white crystallized variety filling up the interstices of the yellowish calcite or quartz which is evidently of a later generation. This calcite must have been formed at the time of the vein filling, but at a different time and may be a latter generation than the quartz.

The ore is essentially native quicksilver associated with a very small amount of cinnabar. The native quicksilver is distributed through the vein and occurs in varying quantity, some parts are abnormally rich while others contain a much smaller proportion of this mineral. It is mainly disseminated through the minute fissures or cracks, or even in small cavities in the calcite or quartz veinlets. Sometimes it is contained in the fragments of rock enclosed in the vein, or is impregnated in the country rocks, or distributed abundantly in small fault fissures. The ore more plentifully accumulates in the central part of the vein than in the periphery. The cavities which contain native quicksilver are always orbicular in shape, and mainly are lined with many small rhombohedral crystals of cinnabar. The dimention of the quicksilver globules ranges from the size of a pea to very minute drops. In most cases the drops of quicksilver are so small that they can be correctly described only with a lens. The composition of the native quicksilver is absolutely pure, the analysis conducted by Fujimura, of the Chemical Institute of the Science Collage, showing no trace of impurity and the specific gravity 13.53095 ± 0.00042 at 25°C. In the fissures of the calcite veins we have a minute scaly white mineral with silky lustre which, under the microscope, appears as angular fragments colorless and transparent, among which are hexagonal plates which may be considered kaolinite by their double refraction and by chemical reaction. It is probably a product of secondary changes by metamorphism. This kaolinite always follows the native quicksilver, and sometimes intergrows with very minute globules of quicksilver.

The sulphides and oxides which characteristically associate in quicksilver deposits can not be found here, and only a few crystallized iron pyrites are found in the country rock.

Concerning the genesis of this deposit also there can in this case be no doubt that the ores were formed in the hydrothermal way. Ore-bearing waters, working through or along the zone of weakness produced by dynamical power, deposited their burden in the fissures and cracks. There has been no particular replacement of the country rock by the ore, but merely a filling of the existing pores, cracks and fissures by calcite and quartz associated with native quicksilver and a little cinnabar. The mineral first deposited was cinnabar, and then native quicksilver was deposited. This native quicksilver is not of sufficient quantity to give proof whether it is an oxidation ore of cinnabar or the product of a disturbance affecting such ores. We may, however, judge that the ore was deposited from oxidation, because when the native quicksilver appears it chiefly occurs in connection with cinnabar, but the presence of cinnabar gradually increases with depth while at the native quicksilver proportionately decreases.

In summary, the veins of Kubo Quicksilver Deposit occur in the phyllite series in the Lower Paleozoic Formation ; the principal ores are native quicksilver and a little cinnabar deposited in the fissures of calcite and quartz veins. The structure of the veins indicates that the veins were formed near the surface. Though there are found no younger eruptive rocks which have connection with the deposition of quicksilver ores in other cases, it may be believed to be related to the techtonic distuabance to the rock complex. The deposit owes its origin to the precipitation by hydrothermal springs, firstly as cinnabar then as native quicksilver by oxidation in the surface zone.

Explanation of plates.

PL. I. This plate illustrates the structure of the quicksilver vein.

G. Graphite phyllite.

C. Calcite veinlets.

H. Holes with the quicksilver globule and cinnabar.

M. Quicksilver globules.

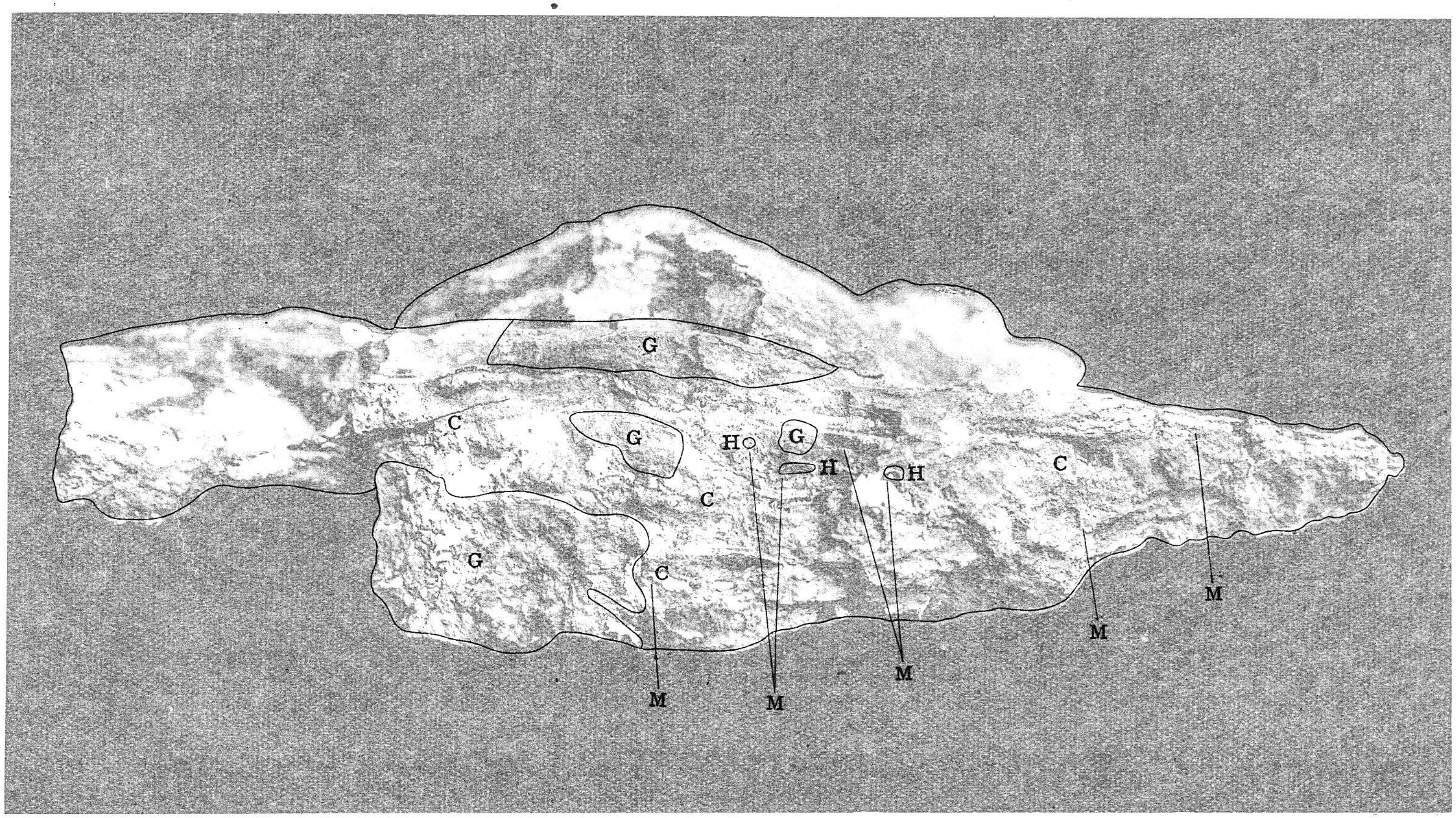
PL. II. This plate illustrates the vein structure showing the quartz-calcite veinlets filling up the fissures of the rock.

G. Graphite phyllite.

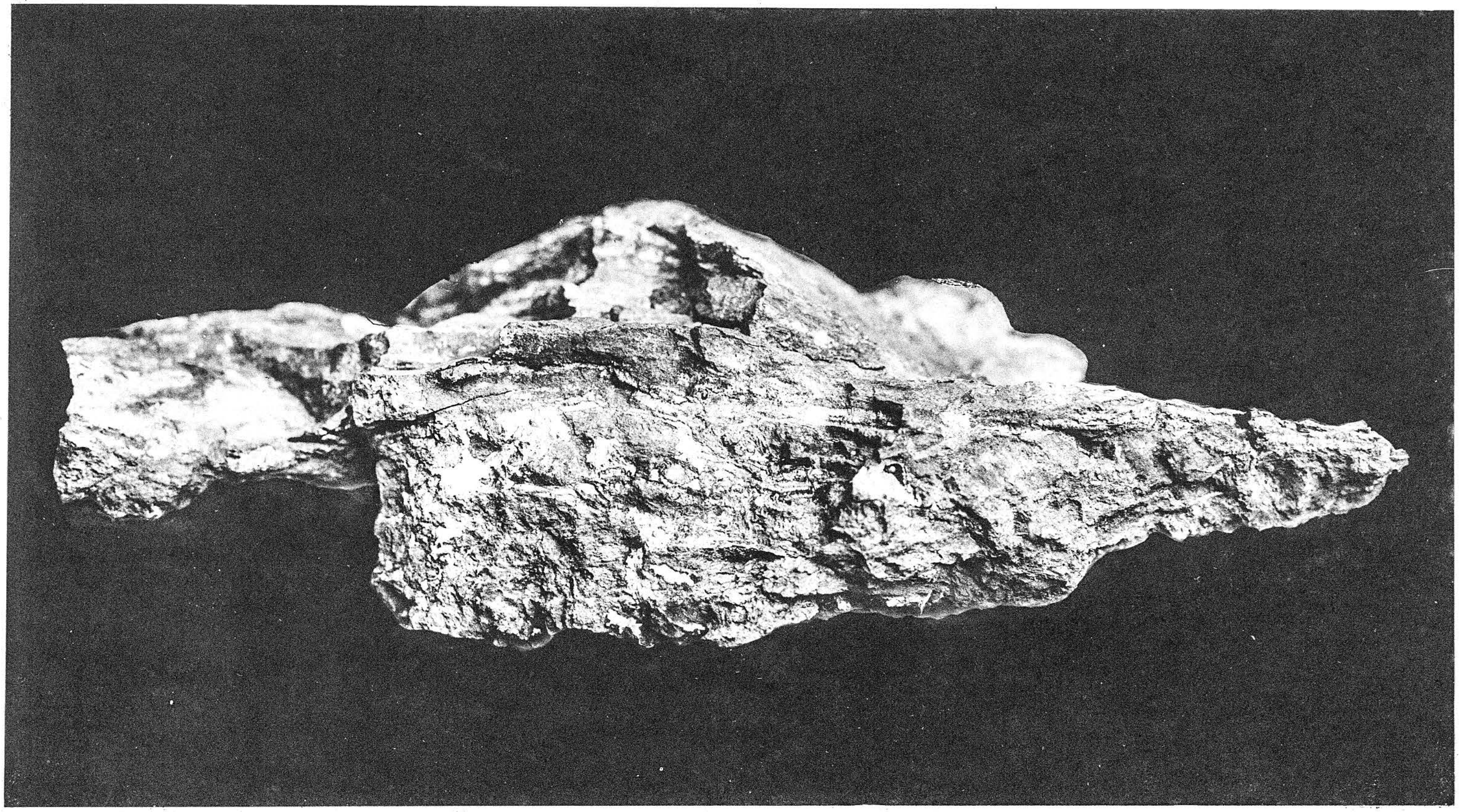
C. Calcite veinlets.

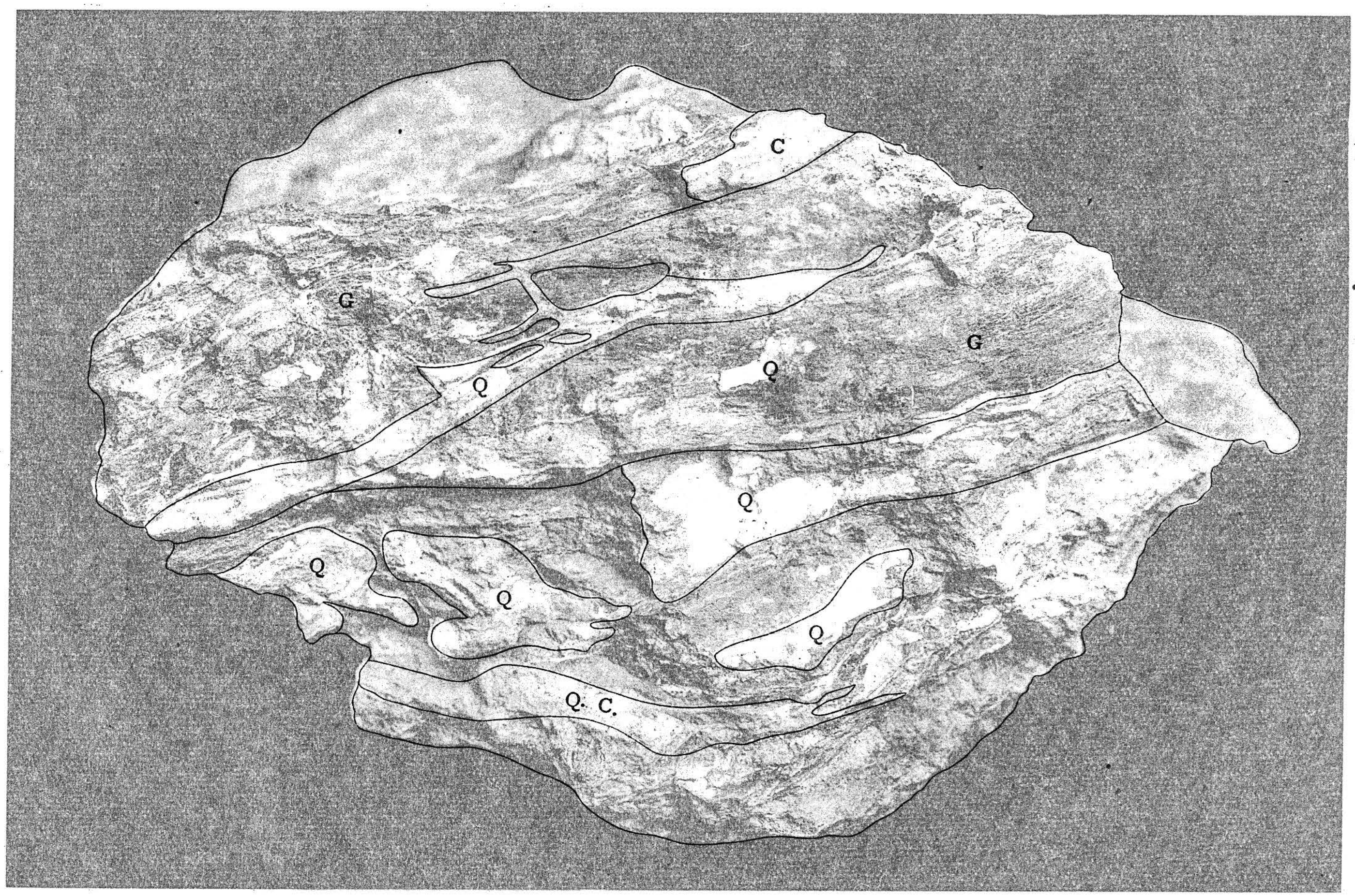
Q. Quartz veinlets.

Pl. I.



Pl. I.




C
G
Q
Q
G
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Q
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Q
Q. C.

Pl. II.