SOME NOTES ON THE CONTACT BETWEEN THE YANGFANG GRANITE AND THE OVERLYING TIAO-CHI-SHAN BEDS.

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WITH ONE PLATE AND TWO TEXT FIGURES

INTRODUCTION

Early in July, 1928, Mr. H. K. Lin, the noted lawyer of Peking, approached Dr. W. H. Wong, director of the Geological Survey of China, for solution of some water supply problems, recently arisen in a tract of hilly land (of which Mr. Lin is the owner) in the eastern foot of the Mont Miao Feng Shan (妙峰山), near the village Pei An Ho (北安河) West of Peking. Accordingly, Dr. Wong instructed us to make a detailed topographic survey of the said region besides taking down geological facts. A full week's labor of ours resulted in the preparation of the accompanying geological map which is to be explained by the present paper.

The geology of this region is quite simple but the petrology is highly intricate, and what interested us most is the nature of the contact between the granite and the overlying pyroclastics of the Tiao-chi-shan Series. It has been Dr. Wong's opinion[1] that this contact is an unconformity, that is to say, the pyroclastics are younger than the granite. Recently Mr. H. S. Wang in a recent paper[2] demonstrated that the pyroclastics are intruded by and therefore older than the granite. In the following pages we attempt to bring forth evidences for the intrusion theory. Since Mr. Wang reasoned only in a general way, the publication of more detailed observations is not altogether superfluous.

THE GRANITE

As already noted by previous authors the Yang-fang granite is a medium-grained, biotite granite of light red color. It extends from the village of Yang Fang (羊坊) to the south of the temple Ta Chiao Ssu (大覺寺). So far as our observation goes, the predominant minerals are quartz and orthoclase,

1. Geology of Hsishan, pp. 36-38.

2. Bull. Geol. Surv. of China, No. 11, 1928, pp. 22-23.

but plagioclase occurs not infrequently. The mafic minerals are biotite, magnetite and hornblende, which latter is only occasionally present. The quantity of the biotite is far from being constant. Some specimens show hardly any trace of biotite while in others it is so abundant that numerous glittering flakes can be seen by the naked eye.

THE PYROCLASTICS.

In the mapped region only the lower part of the Tiaochishan series, about 150 m. thick, is represented. It consists of trachytic agglomerates and tuffs, with the former predominating. The agglomerates are more or less massive but the tuffs are distinctly bedded; the strike is north by east while the dip angle is generally low. Microscopically these rocks are grey or greenish grey in color, fine in texture, and highly indurated on account of unusual metamorphism. Microscopically it is difficult, owing to intense weathering, to distinguish the mineral constituents. Among the felspars predominates orthoclase which often occurs in microlitic crystals but occasionally in phenocrysts of Carlsbad twinning. Quartz seems to be rare. Mafic minerals are often decomposed and disintegrated, and it is only in fresher specimens that hornblende is seen to be far more abundant.

THE RELATION BETWEEN THE TIAOCHISHAN BEDS AND THE GRANITE.

The contact line between the granite and the Tiaochishan beds, as we trace it from Chin-shan (金山) to Ta-chiao-ssu, is essentially parallel to the strike of the latter. This fact could, at first, be easily taken as evidence for an unconformity. Careful observation shows, however, that the granite often sends off apophyses into the neighboring rocks. Two typical examples will be mentioned here. In a gully near a small house south-east of Shan Men (山門), granite dikes, averaging 1 foot in width, extend into the tuffs for a couple of yards (See Fig. 1). The granite of these dikes is finer grained tending to become aplite. Another example can be found north of a valley near the temple of Chin Shan, just behind a Cha-pung' or tea-house by the road side. There a granite apophysis about 3 yards long and 1 foot wide, invades into the Tiaochishan rock.

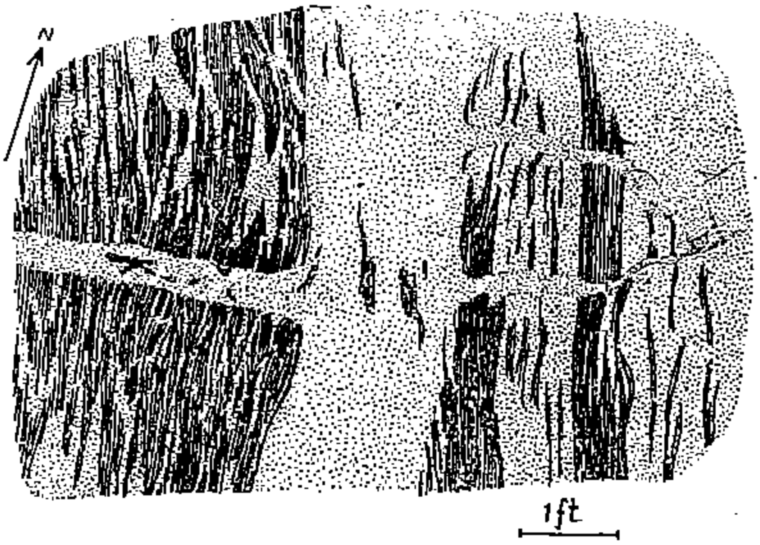

Fig. 1, A block of volcanic tuff invaded by five granite dikes. Reduced 10 times.

That the pyroclastics are intruded by the granite can be proved in another way. As already mentioned the Tiao-chi-shan beds are metamorphosed. In the field it was found that the intensity of metamorphism increased as we approached toward the contact line. The rocks farther away from the contact are fine-grained and even glassy; the rocks close to the contact are coarse-grained and even holocrystalline. We have taken pains to select rock specimens just from the contact line so as to include both granite and Tiaochishan rock in a single thin section. Under the microscope such a section interesting discloses nature's secrets. On the one hand the granite is finer-grained than usual as might be expected, on the other hand the volcanic tuff is coarse-grained. The essential minerals in the latter are felspars, hornblende and quartz. It is worthy of noting here that hornblende far exceeds quartz in quantity, while in the granite part not a single crystal of it can be identified. This probably means that hornblende is recrystallized from pre-existing material in the tuff. Quartz is not, as is the case in any primary igneous rock, homogeneously distributed; but occurs in isolated patches, which fact shows that quartz is added in from the granite magma. The contact line between, as seen under the microscope, is sharp in one place but very indistinct in another. In the latter case the granite magma seemed to have fused and dissolved the volcanic material so as to become mixed together to form what may be termed a hybrid rock.[1]

[1] A. Harker, Natural History of Igneous Rocks, p. 333.

INCLUDED ROCK BODIES IN THE GRANITE

About 2 or 3 hundred meters away from the contact line a zone of included rock bodies appears in the Granite, which may be traced from the mapped region to as far as the east of Chin Shan. To petrographers interested in the problem of magmatic assimilation we will recommend this as a place well worth careful studying. Unfortunately our time was limited and systematic collection could not be done. We will here only mention the observed facts.

At the outset the fact which impressed us most is that these inclusions are arranged in a direction essentially parallel to the strike of the Tiaochishan beds. Furthermore stratification can be clearly observed in less altered parts. These are sufficient to prove that these inclusions are nothing but metamorphosed Tiaochishan beds. But they are not all. The physical characters—the color, structure, texture, hardness, and habit of weathering—of these bodies (of course we speak of the less altered parts) are identical to the true Tiao-chi-shan beds. And when we scrutinize them with the aid of the microscope we can demonstrate that there is every gradation in the intensity of metamorphism. Some are only slightly affected, such as the huge mass just behind the work-men's house by the road side. Others suffered strong metamorphism and therefore underwent recrystallization. Still others appear to have been dissolved and assimilated by the invading magma. In the last case it is hardly possible to tell where the inclusion ends and where the granite begins—the gradation is well-nigh imperceptible. A good natural section of such a case can be seen on the road a couple of yards S.W. of Hsiou Chen Kuan (修眞觀), which is repro-duced here from our field sketch (Fig. 2.)

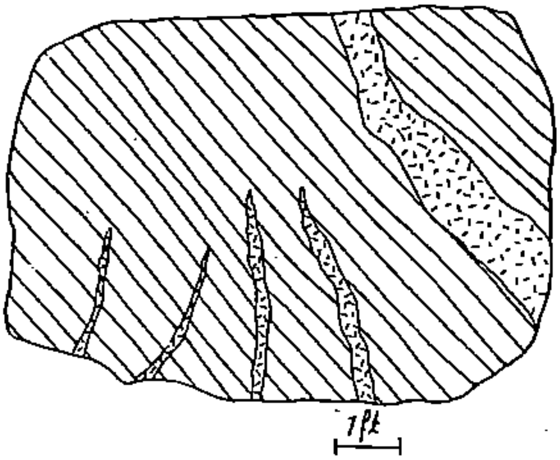

Fig. 2 Sketch showing the details of the commingling of granite and volcanic tuff in the zone of inclusions, reduced about 10 times. Note that the central belt of granite was injected at a slightly later stage, sending out dikes from both sides.

For clearness' sake the contrast between the granite and the inclusions has been made stronger than it really is.

Another feature worth noticing is the gneissic banding frequently met with in the zone of the inclusions. As observed in the field the banding is always more or less parallel to the strike of the Tiaochishan beds. This is probably due to the compressive pressure of the fluid magma, which is normal to the contact, and to the recrystallization of hornblende crystals. The former imparted the necessary differential deformation[1] while the latter gave the gneissic banding.

DIKES

Besides the granite dikes already cited, pegmatite dikes, several inches to one or two feet in width and extending for 100 yards, frequently occur in the granite itself. They either make a high angle with or are at right angles to the lamination of the included bodies. Quartz veins are rare, only one large vein has been found south of Hsiou Chen Kuan, its strike being parallel to the inclusions.

SEQUENCE OF GEOLOGICAL EVENTS

The geological events as revealed from the above considerations may be summarized as follows:

1. Formation of the volcanic rocks of the Tiaochishan Series.
2. Intrusion of the granite and metamorphism of the Tiaochishan beds at the contact with and within the granite.
3. Filling of the vein-fissures by the pegmatitic solution from the residual magma.

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1 A. Harker, loc. cit. p. 341.