

## SOME PROBLEMS IN THE GEOLOGY OF KWANGTUNG AND KWANGSI\*

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Science is made of a series of problems. There is no exception in geology especially that of South China where geological investigations are just in the beginning. For the basis of discussions toward their possible solutions, some of the most important problems in the geology of Kwangtung and Kwangsi are briefly as follows:—

### *I. What is Tolo Channel Formation?*

Tolo channel formation was named after its type-locality, the Tolo Channel of Kaulung Peninsula, where ammonites of Lower Cretaceous<sup>1</sup> or Upper Jurassic age were discovered several years ago by Dr. M. C. Heanley of Hongkong.

What the typical Tolo Channel formation looks like, I have no idea at all, but, the partly metamorphosed shales and sandstones near Shun Chun (深圳) station of Canton-Kaulung railway were considered by Dr. Heanley as its equivalent<sup>2</sup>. If that is the case, the question arises.

That kind of rock exposed in the vicinity of Shun Chun station seems to be widely distributed in the southern half of Canton-Kaulung railway. The formations lying south of it are mostly igneous, while in the north, the supposed Tolo Channel formation extends for many miles and is then covered by red sandstones and conglomerates in the valley of Tung Kiang or the East River near Shiklung (石龍).

The absence of Ammonite or any other organic remains renders it impossible to correlate the supposed Tolo Channel formation to the True Tolo Channel formation or any other formation except by lithological, topographical and structural similarities. If these are the only criteria available, the so called Tolo Channel formation at Shun Chun Station seems to resemble the Lungshan series, the supposed oldest formation of Kwangtung and Kwangsi, much more than anything else; because both of them are made of partly

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metamorphosed shales and sandstones, complexly folded, faulted, and intruded by igneous rocks, and represented in topography by the rolling hills with here and there small exposures of granite.

The question naturally arising are: (1) Is this the true Tolo Channel formation? (2) If it is, how can we distinguish the Tolo Channel formation from Lungshan series in the absence of paleontological evidence?

If, on the other hand, the rocks exposed near Shun Chun station are not Tolo Channel formation, on account of the absence of Ammonite, the distribution of Tolo Channel formation must be very limited because considerable reconnaissance work carried on last year in the valley of Tung Kiang and other places of Kwangtung and Kwangsi failed to discover similar fossils characterizing the Tolo Channel formation.

## II. *The Age and Nature of the Red Beds.*

Two of the fundamental questions concerning the widely distributed and easily recognized red shales, sandstones and conglomerates of Kwangtung and Kwangsi are: (1) What is their geological age and (2) What is their nature of deposition?

Lying unconformably and nearly horizontally on the eroded granite and Palaeozoic formations, the red beds are, no doubt, much younger and were referred to Tertiary by von Richthofen<sup>2</sup> on account of the plant fossil *Rhus olavia* Schenk found in the red shales near San Swee (三水) city about 30 km. west of Canton. The conglomerate of this series was, many years later, suggested to be Mesozoic<sup>4</sup> by the geologists of the Geographical Society of Tokyo, Japan. Prof. Otto Jaekel of Germany held the same view that, a part at least, of the red beds should be considered Mesozoic in age. The apparently non-fossiliferous character of this series, however, renders the question difficult to be settled at present.

The heterogeneity of material and lateral variation in both material and texture within a limited area<sup>5</sup> suggest rather strongly that the red beds are basin deposits. If this interpretation is right, the widely scattered red conglomerates, shales and sandstones may not be connected at all but represent similar deposits formed under similar climatic conditions at nearly the same time. This is one of the difficulties of the superimposed stream theory<sup>6</sup> which supposes that some of the larger streams of Kwangtung and Kwangsi were developed on a covering formation, the red beds.

III. *The Age of Chin Chu Ao Sandstone* (7), (8) (金竹坳砂岩)

Being the most conspicuous mountain making formation of Kwangtung and Kwangsi, it consists of a series of sandstones of various colors up to 1000 meters or more in total thickness. It overlies unconformably the complexly folded and faulted shales and sandstones of the Lungshan series and is overlain either conformably or disconformably by the shale and limestones, some of which are of middle and upper Devonian age.

There seems to be no doubt about the stratigraphical position Chin Chu Ao quartzitic sandstone, but in regard of its age, we have quite different opinions. It is certainly unfortunate that no recognizable organic remains have been found in the formation itself. Fossils collected by the field parties of the Geological Survey of Kwangtung and Kwangsi from the shales and thin bedded limestones overlying the massive sandstone series have been identified by Prof. A. W. Grabau and Dr. Y. C. Sun (孫雲鑄) as the lowest part of Middle Devonian and by Dr. Chang Hsi-chih (張席禔) as some Silurian<sup>a</sup> and some Lower Devonian<sup>b</sup>.

If a part of the overlying shale and limestone series is considered as Silurian, the underlying sandstones should be considered as also Silurian or older. If a part of the overlying series is Lower Devonian, the underlying massive sandstone may be considered as also Lower Devonian or possibly Silurian. If the overlying fossiliferous horizons representing the lowest part of Middle Devonian, the underlying massive sandstone series may be Lower Devonian or older. This seems to suggest that either Silurian or Lower Devonian, both of which were supposed to be wanting, may be present in the N. E. part of Kwangsi. Is that possible?

IV *Age of Granite Intrusions and their relation  
to orogenic movements.*

Granite intrusions are very common in Kwangtung and Kwangsi but their time of intrusion and their relations to orogenic movement are still a problem.

The oldest formation having a sedimentary contact with the granite is the red beds and the youngest one which seems to be effected by the granite intrusion is the Huangkangling series<sup>c</sup> of Upper Permian. It is no doubt that most of the granite intrusions are younger than Permian and older than the

red beds whose age is unfortunately not definitely known. The time of intrusion of granite can not be settled unless the age of the red beds is worked out.

For the sake of simplicity in preliminary mapping, all these intrusions have been considered as a unit. As a matter of fact, metamorphic effects produced by a younger granite intruded into an old one have been observed in many places. The question is not whether they are of the same age or not but is whether their time of intrusion is or is not widely separated.

In regard to this point, the geologists in Hongkong seem to refer all the igneous activities to Late Cretaceous and Early Tertiary<sup>18</sup> on the ground that most of the igneous rocks seem to be younger than the Tolo Channel formation and older than the Rocky Harbour formation which represents a recent lava bed. Some of the members of the Geological Survey of Kwangtung and Kwangsi have the opinion that these may be two series of granite intrusions: one of very old age and the other of Early Tertiary age. There is, however, no positive evidence to support such a belief, as direct contact of granite with Devonian or Permian massive limestones has not been observed in the interior parts of these two provinces.

Granites intruded into a few sedimentary formations only is certainly a fact which demands some explanation. So far as our field observations are concerned, most of the granite intrusions in these two provinces are confined in Lungshan series or in contact with the Chin Chu Ao massive sandstones. No contact with the wide spread limestone formations is known. Why? We don't know, but the following inferences may be suggested as possible explanations:

(1) Being deeply seated plutonic rocks, the granites naturally affect the most deeply buried rocks, the Lungshan series, the most.

(2) The massive quartzitic Chin Chu Ao sandstones overlying the Lungshan series may serve as an impervious cap for the acid magma which can hardly penetrate such a thick siliceous formation by Magmatic stoping and magmatic assimilation.

(3) The granite intrusions are older than the massive limestones. They intruded into the Lungshan series and the massive sandstone series before the deposition of Devonian limestones so that direct igneous contact with the calcareous rocks is naturally impossible.

The last suggestion seems to be improbable if the intrusion of granites is considered contemporaneous to the orogenic movements of Late Cretaceous or Early Tertiary age.

Of the various orogenic movements<sup>11</sup> occurred in Kwangtung and Kwangsi, that one accompanied with the intrusion of granites is probably the most important to produce the present structural and topographical features. This is suggested by the fact that granite intrusions usually lie in the center of domes or along the axis of anticlines with sedimentary rocks dipping away from the igneous masses. Is this conclusive?

Igneous rocks especially the extrusive type is more widely distributed along the coast than in the interior. This seems not only true in Kwangtung but probably true in Fukien and Chekiang as well. What is its significance?

*V. Origin of the Gorges and River Valleys  
of some of the Larger Streams.*

Gorges or hsias (峽) where the rivers cut structural mountain ranges constitute one of the characteristics of some of the larger streams of Kwangtung and Kwangsi. The Mang Tzu Hsia (盲仔峽) and Fclay Hsia (飛來峽) of Pei Kiang (北江), Lin Yang Hsia (羚羊峽) of Si Kiang (西江) and Nu Tan Hsia (努灘峽) of Liu Kiang (柳江) are probably the best known.

These streams are obviously not simply consequent ones because they cut right across structural mountain ranges. They can hardly be simple antecedent streams because great difficulties may be encountered in explain the deposition of red beds in various basins. In part, they may be superimposed streams which were developed on the red beds, but as a whole, they can not be so, because the red beds are supposed to be limited and separated basin deposits. After all possibilities are proved to be insatisfactory, we are forced to infer that these streams must have a very complex history which may be interpreted in the following stages of development:—

- (1) A period of great orogenic movement accompanied with gigantic intrusions of granite (Late Cretaceous or Early Tertiary).
- (2) As a result of (1), basins were formed and deposition of red beds began.

- (3) Peneplain reached after a long period of erosion of the older rocks and the deposition of the red beds.
- (4) Uplift and rejuvenation with the formation of a new system of streams on the peneplain which naturally truncates all former structures. New cycle of erosion began.
- (5) As the results of erosion in the present cycle, deep gorges were formed, structural mountain ranges were etched out according to the relative resistances of different formations. In some places, the streams may be superimposed on the older formations after the removal of the red beds. In other places, they may develop directly on the old formation themselves.

Is this interpretation reasonable?

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