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Megaclasts from the Carboniferous-Permian Rocks in the Langkawi Islands, Malaysia, and Their Implications

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The Ninth Regional Congress on Geology, Mineral and Energy Resources of Southeast Asia was held in Kuala Lumpur of Malaysia in August of 1998. After the Congress, the author participated in the geological field excursion and investigation in the Langkawi Islands, and noted that the Carboniferous-Permian rocks contain megaclasts of metamorphic and pegmatitic rocks, which indicate the existence of pre-Carboniferous metamorphism and magmatism. The observation results are as follows:

1 Geological Setting

The Langkawi Islands are located in the northwest part of Malaysia. The strata in the area consist of Palaeozoic sedimentary rocks of the Machinchang Formation, Setul Formation, Singa Formation and Chuping Formation in ascending order (Jones, 1966, 1981). These rocks are mainly shallow-marine sediments.

The Machinchang Formation contains small amounts of fragments of trilobites and brachiopods of Late Cambrian age and probably Early Ordivician age. Fission track studies of zircon give an age of 555±37 Ma (Khoo, 1986). Trace fossils (e.g. *Dictyodora*), various cross-beddings and *Kinneyia* ripples are found on the top of the formation.

The Setul Formation is composed mainly of dark limestone with a minor amount of bands of black clastic rocks and mudstones. The rocks are rich in fossils of conodonts, ostracods and tentaculitids of ages from the late Llandovery to early Wenlockian. The Formation is Early Ordovician to Early Devonian in age (Jones, 1981).

The Singa Formation mainly consists of clastic rocks with poorly sorted dark grey mudstone bands and characterized by megaclasts of various compositions. The clasts are composed mainly of sandstone with subordinate limestone, vein quartz and granitic, volcanic and metamorphic rocks. Stauffer and Mantajit (1981), and Stauffer and Lee (1986) have interpreted them as glacial dropstones, Ahmad Jantan (1973) has taken them as slumped deposits, and Altermann (1986) has considered them as ordinary continental-margin deposits. The Singa Formation underlies the Chuping Formation limestones in the Pulau Singa area. The rocks contain scandy fossils. As the Formation is sandwiched between the Devonian Rebanggun beds and Permian Chuping Formation, its age is deduced to be probably Carboniferous to early Permian.

The Chuping Formation conformably overlies the Singa Formation. The rocks are thick bedded to massive limestones, the basal part of which yields abundant fossils of fusulinids and brachiopods of late Early Permian or early Middle Permian age.

Only Triassic and Cretaceous granites are reported from the area up to date. The Triassic granites, represented by the Raya Granite, are biotite-tourmaline-bearing granites with some large phenocrysts of feldspar. The Cretaceous granites are represented by the Tuba Granite, which is more or less high in quartz, low in tourmaline and heterogeneous in texture and structure.

2 Composition of the Megaclasts from the Singa Formation and Their Implications

Detailed observation in the field (the Tanjung Mali area, 6°17′11.5″N, 99°43′42″E) shows that the size, shape and composition of the megaclasts from the Singa Formation are all highly varied. They range from

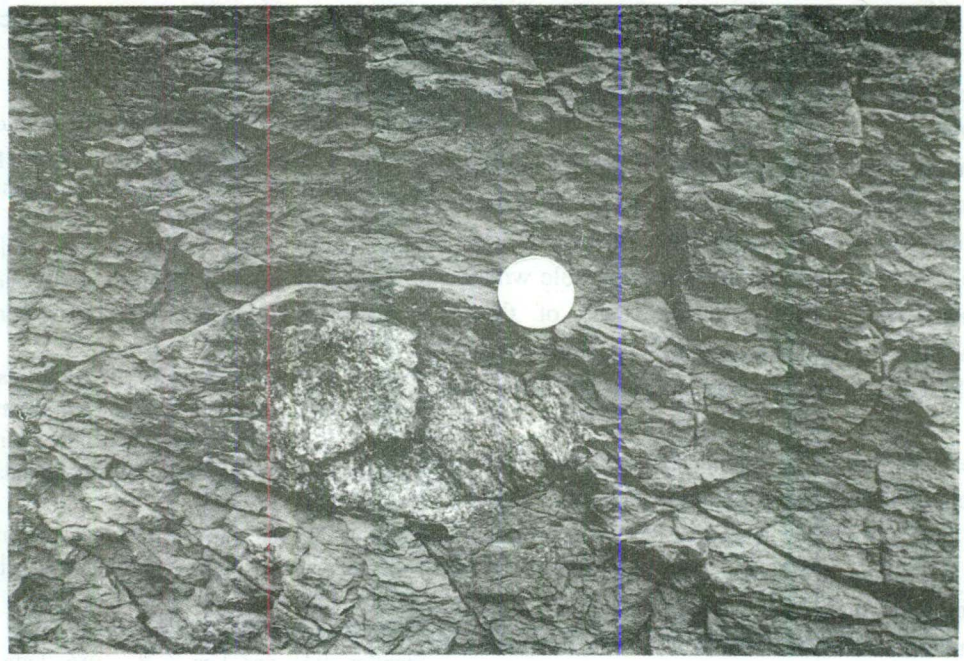

Photo 1 Megaclast of biotite gneiss in the Carboniferous-Permian Singa Formation (the Tanjung Mali area).

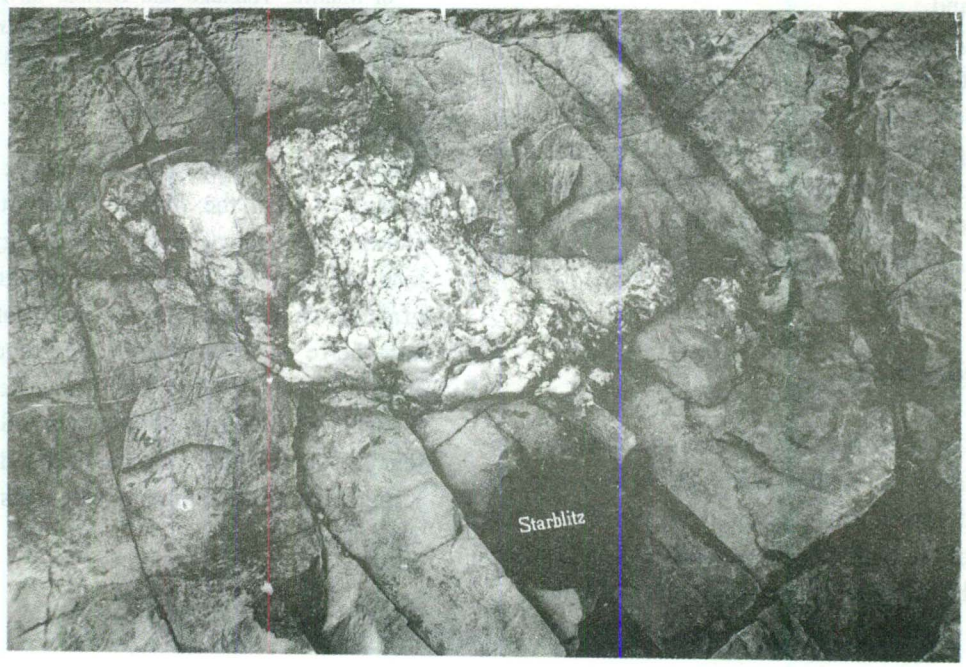

Photo 2 Megaclast of granitic muscovite pegmatite in the Carboniferous-Permian Singa Formation (the Tanjung Mali area).

10–20 to 1–2 cm in size and are rounded and semi-rounded to angular in shape. Besides sedimentary rocks, the most notable are megaclasts of gneiss and granititc pegmatite in the composition. On the basis of an analysis of the megaclasts, the author reaches the following considerations:

(1) The megaclasts show characters of glacial boulders. This is indicated by the characteristics of size, shape and composition of the megaclasts. In view of the stratigraphic age, the rocks should be comparable with Carboniferous-Permian tillites at the base of the Gondwanian Series. Thus, tectonically speaking, the region should be on the northern margin of Gondwanaland.

(2) There exist not only Phanerozoic sedimentary rocks, but also Precambrian metamorphic rocks and basement in the region. The boulders of biotite gneiss occurring in the Singa Formation are composed of biotite, feldspar and quartz, and show fine-grained texture and gneissic structure (Photo 1). As indicated above, the exposed Cambrian to Carboniferous rocks are sedimentary rocks with fossils, and the megaclasts of biotite gneiss can only be derived from the Precambrian metamorphic basement, i.e., the basement of Gondwanaland.

(3) Besides Triassic and Cretaceous granites, there should exist Precambrian granitic pegmatites, which reflect Precambrian granitic magmatism. The megaclasts of pegmatite found in the Singa Formation are composed of megacrystals of muscovite, feldspar and quartz (Photo 2). Therefore, there should have existed Precambrian granitic magmatism in the metamorphic basement of the area.

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Chen Tingyu Born in Chongqing in August 1940, graduated from the Chengdu Institute of Technology (former Chengdu College of Geology) in 1963 and from the Chinese Academy of Geological Sciences as a graduate student in 1966; invited Professor of University Pierre and Marie Curie of France (University of Paris VI) from 1988 to 1989; now Research Fellow of the Chinese Academy of Geological Sciences and Docteur d'Etat des Sciences Naturelles de la France; majoring in granites, mineral resources and geology of Antarctica.