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DONGSHAN TERRANE

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Dongshan Terrane is identified by many geologists under different names such as Dongshan Terrane (Guo et al., 1984), and Pingtan-Dongshan terrane (Gao et al., 1981).

Many isolate metamorphic complexes on the Fujian coastal region about 330 km long and 30 km wide are juxtaposed with the Mesozoic volcanic rocks on the interior mountains of Fujian. This phenomenon puzzled Chinese geologists for a long time. Using the terrane conception, a picture of terrane/volcanic mountain chain collision is the best way of understanding on the geology of the southeast coast of China.

The metamorphic complex composes what we called the Dongshan terrane. The rocks are granitic gneiss, amphibolite, hornblende schist, biotite schist, biotite hornblende schist, and migmatite. The protolith of the metamorphic rocks are aluminous-rich clay rocks, volcanic clastic rocks, calcalkaline aluminous-rich basalt, intermediate acidity volcanics, and plagioclase graywacke (Geology and Mineral Resources Bureau of Fujian Province, 1985). Therefore they are referred to be a piece of crust of a volcanic island arc (Gao et al., 1991).

Some Cambrian-Ordovician micropaleobotany fossils, Leiosphaeridia sp., Microphystridium sp., Lignum sp., Lophosphaeridium citrinipeltum, Cymatiosphaera? sp, Multiplicisphaeridium? sp. Lophosphaeridum citrinum and Chitinozoa are found in graphitic biotite quartz schist at Dongshan Island (Huang et al., 1988, Yu et al., 1988). That indicates that the volcanic island arc was formed in the Early Paleozoic. Metamorphic rocks in Zhongmen, Putian County, and Jingjiang peninsula have been dated as 463± 15 Ma and 509± 20 Ma respectively by the Sm-Nd isotopic method (Huang et al., 1989), that matches the fossils ages very well.

The structures of the metamorphic rocks exhibit some distinguished features i.e. fish group structure, southeasternward ductile thrusts, multiple stage ductile pure shear, and brittle fractural systems.

Named by Fjuian geologists, the fish group structures occur in the west coast of Meizhou Bay of Putian and Huian Counties. The schistosity of gneiss trends in WNW direction at Yishan, Huian County. There are lots of biotite amphibolite schist remains, which are the so called fish group structures, in the granitic gneiss with their long axes parallel with the gneiss schistosity. In fact every individual amphibolite schist remain is bounded by two C surfaces which are arranged to be parallel with the schistosity of the gneiss, and two S surfaces which get an accute angle with the schistosity of the gneiss, showing a sinistral shearing along the gneiss schistosity. The S-C fabric showing sinistral ductile shearing in NEE direction also has been discovered at coast of Weitou, Sishi City.

A series of isoclinal folds and thrusts crop out at Aojiao and Donggu villages on the southeast coast of Dongshan island. Biotite gneiss and biotite-quartz schists with relic bedding are tightly folded at Aojiao. The attitudes of hinge line surface and hinge line are 56°/NW54° and 320°/50° respectively, showing a dextral slip-thrusting. That means the rocks of the hanging wall are transported roughly eastward. Mylonites with S-fabric occur at Donggu. The S and C surfaces are measured as 15°/NW60° and 25°/NW35° respectively, which suggests a dextral slip-eastward thrusting. The measurement of magnetic fabric respectively shows a similar kinematic feature as shown by the S-C fabric.

There are at least two sets of ductile conjugate pure shearing zones in Weitou, Shishi. The first set comprises 340° trending dextral shear zone and 25° tranding sinistral shear zones, showing a nearly north-south compression. The second one is composed of 0°-30° trending dextral shear zones and 330°-350° trending sinistral shear zones, suggesting a nearly east-west compression.

The above mentioned ductile conjugate shearing systems are cut by feldspar-quartz veins which are dated as 107 Ma (Yu et al., 1987). Therefore the ductile shearing zones should before or during 107 Ma.

Three systems of brittle conjugate shear joints are well identified in the Fujian coast area (Yu et al., 1987). All of them were formed later than the ductile shear zones. The first brittle conjugate shear joint system is composed of 350°-30° trending sinistral shearing joints and 280°-290° trending dextral shearing joints, formed by a NW-SE horizontal compression stress field. The joints of the system are filled by feldspar-quartz-veins, which were dated as 107 Ma. The second system comprises 23°-43°

trending sinistral shearing joints and 310°-350° trending dextral shearing joints indicating a nearly N-S compression stress field. The joints of this system are filled by basic rock veins dated as 74-75 Ma. The third system comprises 320°-346° trending sinistral joints and 257°-294° trending dextral shearing joints. They cut the 21.7 Ma basalt and the joints of the other conjugate joint systems.

More than ten mafic-ultramafic rock blocks are scattered in the north segment of the Pingtan-Nanao fault zone, northwest boundary fault of the Dongshan terrane. They crop out at Changji, Taohuashan, Daiqianshan, Qinglanshan, Guanshan, Huachu etc. They are pyroxene peridotite; dunite altered into serpentinite, tremolite and talc; olivine anorthosite, gabro, and amphibolite gabbro. Accumulate gabbro is well exposed out at Daiqianshan. They exhibit tectonic emplacement in many localities, while there is nothing of contact metamorphism in the contact zone of the mafic-ultramafic rock blocks with their country rocks. On the contrary, some tectonic shearing features are found in these zones. A mylonite zone occurs between the gneiss and the gabbro at Qinglanshan, Huian County, showing a south-eastward thrusting. The attitudes of the thrust fault planes are 65°/NW58° and 55°/NW45° there. The attitude of $K1\text{-}K_2$ plane of the magnetic capacity ellipsoid, equivalent to the strain ellipsoid, is 32°/NW80°. North-westward low angle thrust sheets of serpentinite are thrust over the late Jurassic rhyolites at Changji, Putian County. The serpentinite sheets always exhibit a few meters thickness of thin talc layers on their top and bottom surfaces, suggesting the sliding surfaces of thrusts.

Plenty of granitoid bodies are distributed along the Pingtan-Nanao fault zone. They are biotite granite, monzonite granite, granite, migmatitic granite and miarolitic granite dated from 90-160 Ma and many of them are dated around 120 Ma (Geology and Mineral Resources Bureau of Fujian, 1986). These intrusive bodies join the Jurassic calcalkaline volcanic rocks on the northwest wall of the fault zone and the metamorphic rocks on the southeast wall which are juxtaposed originally through the fault zone. This implicates that the Dongshan terrane, made of metamorphic rocks collided with the Zhejian -Fujian volcanic mountain chain around Early Cretaceous time.

To make a summary, the evolution of plate tectonics in the studied are a can be divided into three stages: before collision, during collision, and after collision. Before collision, during Late Jurassic-Early Cretaceous, the

Kula oceanic lithosphere plate, which carried a piece of continental crust, the Dongshan terrane, subducts toward the southeast China active continental margin, forming a calcalkaline igneous arc, the Fujian-Zhejiang volcanic mountain chain. Possibly, in that period, the Dongshan terrane was a part of a greater continental block, which can be named Min-Tai terrane, which included the Tailuko belt metamorphic rocks of the Dananao terrane i.e. pelitic schist, chlorite schist, siliceous schist, and marble. The Permian fossils, Schwagerina sp., Parafusulina sp., Neoschwagerina sp., and Waagenophyllum sp. are found in marbles, and the marble is dated as 190 Ma (He, 1986). Therefore it seems that the Dongshan terrane represents the Early Paleozoic basement of the Min-Tai terrane, a piece of volcanic arc, and the Tailuke belt of Dananao terrane represents the Upper Paleozoic and Early Mesozoic of the Min-Tai terrane. During late Early Cretacoeus as the duration of collision, the Min-Tai terrane collided with the Fujian-Zhejian volcanic arc, then the metamorphism and series of ductile deformation occurred consequently. The N-S compression conjugate ductile shear zones occurred resulting from the oblique collision, which implicates that the terrane was transported northward and collided on the northeast trending volcanic arc margin. Some southeastward thrusts and a few northwestward thrusts dismembered the ophiolite suite and emplaced it in its present attitude. After that a dextral strike slip along the collision zone occurred, that caused the formation of the E-W compression conjugate ductile shearzones and the dextral slip-eastward thrusting. Some big thrust must have been formed causing the Lower Paleozoic of the Dognshan terrane to thrust over the Upper Paleozoic Tailuko belt of the Dananao terrane. Finally the NW-SE compression brittle conjugate joints formed by the collision. During the same period the granitoids mentioned above were formed as products of the collision tectonic-thermal event. After collision, the subduction zone jumped southeastward to the east flank of Tailuko belt. The pelitic schists and the ophiolite suite of the Yuli belt (He Chunshen, 1986) represent an accretional prism of the subduction zone. The N-S extension of the south China Sea floor caused the N-S compression brittle conjugate joints in the Dongshan terrane. Finally in the Tertiary the East Taiwan terrane, part of Luzon volcanic arc collided with the southeast China continental margin (Teng, 1990) and the west Taiwan foreland basin thrust belt was formed, giving rise to the NW-SE compression conjugate joints in the Dongshan terrane. Mizutani et al. (1989) suggested that the Mesozoic Nadanhada, Mine, Sikhote-Alin, Ryukyu, Philippines, and Borneo

terrane in the western Pacific region were originally a single superterrane. The Min-Tai terrane is a part of the superterrane, which just complements the blank left over by Mizutani's suggestion.

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