

A mega shear zone in the Central Range of Taiwan and it's implication for the Late Mesozoic subduction of the paleo-Pacific plate

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ABSTRACT

The metamorphic basement "Tananao Complex" exposed in the eastern flank of the Central Range of Taiwan. The ancient Asian continental margin deposited a thick sequence of sandstone, shale, limestone and volcanic rocks that was the protolith of Tananao Complex (Yen, 1954). In Late Mesozoic Era, the thick sequence of rocks was subjected to several phases of metamorphism and deformation to form the pair metamorphic belts which were the western Tailuko Belt and the eastern Yuli Belt. The Tailuko belt is composed of phyllite, quartzite, quartz-mica schist, metaconglomerate, gneiss, meta-basite, amphibolite, serpentinite, marble and meta-chert, etc. The Yuli belt is composed of a monotonous assemblage of quartz-mica schist, subordinate meta-basite and serpentinite, etc. It is believed that the boundary of the Tailuko belt and the Yuli belt is a large fault (Yen, 1963, 1967), but the field evidence of the fault has never been found. In this study, meso-scale field investigation of the lithologies and rock fabrics indicate that a mega shear zone, called "The Daguan shear zone", separated the Tailuko belt from the Yuli belt. Compared to the existing geological information of Central Mountain Range, we believe that the Daguan shear zone played a role as the boundary of the subduction zone which the paleo-Pacific Plate subducted into the Eurasian Plate in Late Mesozoic Era.

KEYWORDS: Tananao Complex, shear zone, paleo-Pacific Plate

METHODS

Through the review of previous studies, the interpretation of aerial photos and satellite images, field investigations along the river and the logging road, and the observation of microscopic structures, we finish the draft of geological map at scale 1:50,000. The classification of metamorphic rocks and the mapping unit are according to the Subcommission on the Systematics of Metamorphic Rocks, (Fettes and Desmons, 2007) and Lithodemic Unit (NORTH AMERICAN TRATIGRAPHIC CODE, 1983)

STUDY AREA

The study area is located on the eastern flank of the Central Range and it is under the jurisdiction of Hualien County in eastern Taiwan. The main ridge of the Central Range in the study area comprises several precipitous mountains with elevations over 2,000 meters. A northeast-trending range forms the main range in the western part of the area and the topographic elevation decreases eastward from the range. The inaccessibility of the Central Range makes it much more difficult to map than other areas of Taiwan. The current data come from only a few detailed surveys charting the course of several rivers and logging roads.

RESULTS

Tananao Complex in this area is classified into 8 lithodemic units.



The Hutoushan Schist is mainly composed of gray to light gray quartz schist ranging in thickness from several meters to tens of meters and quartzite, intercalated with dark gray mica-quartz schist ranging from tens of centimeters to one meter in thickness. Lenticular chlorite schist several neters thick is only distributed in local areas

The Senrong Schist is mainly composed of dark gray mica schist tens of centimeters thick, intercalated with gray to light yellow mica-quartz schist ranging in thickness from several centimeters to tens of centimeters. The weathered mica-quartz schist shows brown spots. Chlorite schist tens of neters thick is distributed near the boundary between this unit and the lutoushan Schist

The Ruisui Schist is composed of dark gray albite-mica schist with sub-metallic luster. The albite porphyroblast is visible by the naked eye.

The Hongye Schist is mainly composed of gray quartz-mica schist several meters thick intercalated with light gray or light yellow quartz schist ranging in thickness from tens of centimeters to tens of meters.

The Daguan Shear Zone is mainly composed of mylonitic dark gray guartze mica schist and mica schist, intercalated with elongated meta-conbands one to two centimeters thick

The Gaoling Schist is mainly composed of gray quartz-mica schist and black mica schist tens of meters thick, intercalated with gray-to-white quartz schist ranging in thickness from tens of centimeters to tens of meters. In local areas this unit is intercalated with chlorite schist tens of meters thick and lenticula

The Wangxi Marble is mainly composed of white or black/white massive marbles intercalated with layered quartz schist, chlorite schist, metachert or mica schist ranging in thickness tens of centimeters to one meter.

STAGES OF DEFORMATION

At least three stages of deformation: D_1 , D_2 and D_3 . and related cleavage: S1, S2 and S3, were identified within this region. The pervasive S_1 cleavage has thoroughly overprinted the S_0 bedding. The S_2 penetrative crenulation cleavage largely replaced S1. S₂ is the secondary foliation locally developed with shear zone. The refolding meta-chert layers indicate that the second fold (F_2) overprint the first fold (F_1) showing the type 3 interference pattern.



 S_1 (blue line) and S_2 (black line) are two sets of cleavage. The latter is crenulation cleavage. (Crossed nicols, the width of photo is 3.6 mm)

DAGUAN SHEAR ZONE

The Daguan shear zone is a NNE trending and west dipping mega ductile shear zone which is mainly composed of mylonitic dark gray quartz-mica schist and mica schist. The shear zone is characterized by abundant varied quartz veins that have been refolded to lenticular or pod shape and nearly parallel to S₂ cleavage. In local areas, the Daguan shear zone is intercalated with elongated meta-conglomerate bands one to two centimeters thick. There are numerous meso-scale ductile shear zones throughout this unit, interlavering with lower sheared rocks. The structures at the western side of the Daguan shear zone are a series of anticlines and synclines, while the structure at the eastern side is homoclinal.





The cleavage on different sides of the Daguan shear zone dips in opposite directions in the northern part but dips in the same .direction in the southern part. It might indicate the movement of the Daguan shear zone or imply that there is a regional structure between the north and the south.



Acknowledgements

This study was supported by a grant (Geological mapping of the Guangfu Quadrangle at Scale 1:50,000, 2009-2011) from Central Geological Survey, MOEA, Taiwan, R.O.C. Mr. Zheng-Han Lin (Miasan Outdoor Center), Mr. Zhi-Yu Chen, Mr. You-Ren Wei, Mr. Wan-Sheng Ou, Mr. Ming-Yi Zhuang, Mr. Yin-Su Xie and many friends are acknowledged for the collaboration in field surveys. This work could not be done without their fervor.

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Abstract EGU2012-11571





S-C fabrics of shear zone were developed in the Hutoushan Schist (Crossed nicols, the width of photo is 3.6mm).



The refolding meta-chert layers shows the type 3 interference pattern.



The recrystalization and granulation of quartz in the mylonite (Crossed nicols, the width of photo is 3.6mm).

FINAL REMARKS

We believe that the Daguan shear zone played a role as the boundary of the subduction zone between paleo-Pacific Plate and the Eurasian Plate. The geologic history is described as:

From the Late Paleozoic Era to the Mesozoic Era, the ancient Asian continental margin deposited a thick sequence of sandstone, shale, limestone and volcanic rocks in this

In the Late Mesozoic Era, the paleo-Pacific Plate subducted into the Eurasian Plate, causing the Nanao Orogeny. The thick sequence of rocks was subjected to several phases of metamorphism and deformation to form the paired metamorphic belts of the Tananao Schist. The high-T/ low P type, also called the Tailuko Belt, includes the Wangxi Marble and the Gaoling Schist, while the high P/ low T type, i.e., the Yuli Belt, includes the Hongye Schist, the Ruisui Schist, the Senrong Schist and the Hutoushan Schist. In addition, the Tamayen Tectonic Block consists of serpentinite, amphibolite, metagabbro, glaucophane schist, etc. that formed during the subduction process. The paired metamorphic belts are bordered by a mylonitic rock unit named the Daguan shear

About 6-5 Ma, the Penglai Orogeny occurred. The Central Range experienced continuous uplifting along the Daguan shear zone. The western part of the Central Range formed many large synclines and anticlines, while the eastern part formed a westerly-dipping homoclinal structure

