臺灣西南部車瓜林斷層帶中斷層岩的微觀觀察

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摘要

車瓜林斷層為一發育在古亭坑層中呈東北-西南走向的逆斷層，透過干涉合成孔徑雷達、全球定位系統及水準測量皆可觀察到其活動性，並於 2021 年 12 月透過中央地質調查所鑽井取樣定年確認屬於第一類活動斷層，其活動在斷層跡經過的國道三號中寮隧道、高鐵高架橋等重要交通建築造成破壞，因此更進一步了解泥岩在斷層帶中的變形機制與行為是很重要的。基於前人研究在中視尺度對於車瓜林斷層帶的觀察顯示，斷層帶是由黃褐色及深黑色寬帶組成，並透過前人文獻推測寬帶中的黑色條帶為斷層帶中應變集中下的產物，但缺乏微觀證據支持。本研究於高 40 公路南側的斷層露頭採取定向岩樣並製成岩石薄片，利用光學顯微鏡觀察斷層岩在斷層帶中不同位置的微觀構造，初步結果顯示斷層下盤的泥岩由石英、雲母顆粒隨機分布在黏土基質中所組成，石英顆粒大多完整且呈現同步消光，雲母也未受彎曲；斷層帶邊界的斷層岩中可觀察到在黑色條帶中雲母呈優勢排列、石英則產生裂隙及波狀消光，具鱗片狀構造的黑色條帶分布於砂質碎屑邊緣及黏土基質中且有粒徑削減現象；斷層帶中心的斷層岩則具大量微裂隙及以鱗片狀構造黑色條帶為主，礦物顆粒大多呈現優勢排列，變形砂質碎屑指出黑色條帶的剪切方向，粒徑在黑色條帶中明顯削減。綜合上述觀察，礦物顆粒在斷層岩中產生摩擦滑動、破裂彎曲並沿黑色條帶方向成優勢排列，黑色條帶與黏土基質間也觀察到粒徑削減現象，因此推測車瓜林斷層帶中觀察到的黑色條帶為應變集中下透過壓碎作用產生。

Microscopic observations of the fault rocks from Chegualin fault zone, southwest Taiwan

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Abstract

Chegualin fault is a thrust fault within the Gutingkeng formation striking northeast to southwest. Monitor data from InSAR, GPS, and geodetic all show that the Chegualin fault has activity. Chegualin fault has been recognized as first class active fault by Central Geology Survey in 2021 december based on the dating result of the samples from a CGS borehole. The fault passes through the Zhongliao Tunnel on Highway 3 and the high-speed rail, causing damage to these transportation infrastructures. Therefore the further understanding of how mudstone deformed within the fault zone is important. Based on previous studies of the Chegualin fault zone in mesoscopic scale, the fault zone is characterized by yellowish brown and black stripes. The black bands within the stripes were inferred as the products of strain localization when falting but lacking microscopic evidence to justify it. This research collected oriented fault rock samples from the fault zone of Chegualin fault and made into petrographic thin sections for optical microscope observation. Primary results show that the mudstone from the foot wall is composed of quartz grains and muscovite chips randomly distributed in the clay matrix. Quartz grains display synchronous extinction and flat muscovite chips show that the mudstone is not subject to strong deformation. Within the fault rocks close to the boundary of fault zone bended muscovite chips with preferred orientation and cracked quartz grains with undulatory extinction were observed. Black bands with scaly fabric distribute along the boundary of sand clast and clay matrix. Grains size reduction can also be observed between the clay matrix and black bands. Fault rocks from the middle of the fault zone are generally characterized by an abundance of microfractures and black bands with scaly fabric. The mineral grains mainly arrange with preferred orientation. Grains size reduction is obviously in the black bands. In summary, frictional sliding, cracking, rotation between the mineral grains and grain size reduction between clay matrix and black bands were observed. Imply that the black bands within the fault zone were formed by comminution under the strain localization during fault movement.