

根據鏡煤素反射率分析評估台灣西部山麓帶褶皺逆衝帶的 熱成熟度

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摘要

基於鏡煤素反射率的技術，在台灣西部山麓帶褶皺逆衝帶中以熱分析方法估算斷層系統的埋藏深度、累積位移及摩擦熱峰值溫度。整個綜合體的區域熱結構表明，岩石暴露在 100°C 至 180°C 的最高溫度下，對應於 3.7-6.7 公里的埋藏深度。在形成褶皺逆衝帶東部邊界的水里坑斷裂觀察到 90°C 的巨大溫差，該斷層與雪山山脈變質岩接觸。較大的熱差異對應於水里坑斷層上估計在 5.2-6.9 公里範圍內的累積位移。然而，由於垂直偏移較小，雙東斷層和車籠埔斷層之間的熱差異顯然無法確定。在其他斷層上沒有觀察到在水里坑斷層上觀察到的大位移，這些斷層被解釋為背覆式逆衝系統內較年輕的斷層。在穿透車籠埔斷層的岩心樣本中觀察到鄰近斷層帶的局部高溫。在岩心深度為 225 m、330 m 和 405 m 處觀察到三個主要斷層帶，以及兩個較低的破裂帶，其中包括深灰色窄剪切帶。鏡煤素反射率為 1.8%，高於背景值 0.8%，僅限於 330 m 斷裂帶中 1 cm 厚的狹窄剪切帶內。剪切帶內峰值溫度在 550-680°C 範圍內的估計值，遠高於 130°C 的背景溫度，這被解釋為地震斷層期間的摩擦加熱所致。

關鍵字：集集地震、斷層岩石、熱分析、鏡煤素反射率、剪切熱、累積位移。



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Thermal maturity of a fold–thrust belt based on vitrinite reflectance analysis in the Western Foothills complex, western Taiwan

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Abstract

Burial depth, cumulative displacement, and peak temperature of frictional heat of a fault system are estimated by thermal analysis in the fold–thrust belt of the Western Foothills complex, western Taiwan based on the vitrinite reflectance technique. The regional thermal structure across the complex reveals that the rocks were exposed to maximum temperatures ranging from 100 °C to 180 °C, which corresponds to a burial depth of 3.7–6.7 km. A large thermal difference of 90 °C were observed at the Shuilikeng fault which make the eastern boundary of the fold–thrust belt where it is in contact with metamorphic rock of Hsuehshan Range. The large thermal difference corresponds to cumulative displacements on the Shuilikeng fault estimated to be in the range of 5.2–6.9 km. However, thermal differences in across the Shuangtung and Chelungpu faults cannot be determined apparently due to small vertical offsets. The large displacement observed across the Shuilikeng fault is absent at the other faults which are interpreted to be younger faults within the piggyback thrust system. Localized high temperatures adjacent to fault zones were observed in core samples penetrating the Chelungpu fault. Three major fracture zones were observed at core lengths of 225 m, 330 m, and 405 m and the two lower zones which comprise dark gray narrow shear zones. A value of vitrinite reflectance of 1.8%, higher than the background value of 0.8%, is limited at a narrow shear zone of 1 cm thickness at the fracture zone at 330 m. The estimated peak temperature in the range of 550–680 °C in the shear zone is far higher than the background temperature of 130 °C, and it is interpreted as due to frictional heating during seismic faulting.

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Keywords: Chi–Chi earthquake; Fault rock; Thermal analysis; Vitrinite reflectance; Shear heat; Cumulative displacement