Structural styles of the Shuilikeng fault system in the central Taiwan mountain belt

Estilos estructurales del sistema de fallas Shuilikeng en la parte central de la cordillera de Taiwan

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Abstract: The Shuilikeng fault system in the central Taiwan mountain belt forms the structural boundary between two different tectonostratigraphic zones: the Western Foothills to the W, and the Hsuehshan Range to the E. It comprises a steeply-dipping roughly north-striking transpressive fault zone with splays, folds and bifurcations linked to the main structure. The structural style of the Shuilikeng fault system changes from N to S; while to the N it is defined by diverging splay and non-cylindrical folds branching off the Shuilikeng fault, to the S its structure is dominated by east-striking right-lateral strike-slip faults in the Hsuehshan Range and by a rejoining splay with a composite kinematics in the Western Foothills. At the southernmost tip of the study area, the Shuilikeng fault is defined by a several hundred meters-wide high strain zone and the structural architecture of the Western Foothills is that of a regional anticlinorium branching off the Shuilikeng fault intensely folded and faulted along its limbs.

Key words: Taiwan, fault system, transpression.

Resumen: *El sistema de fallas Shuilikeng en la parte central de la cordillera de Taiwan forma el límite estructural entre dos zonas tectonoestratigráficas diferentes: las Western Foothills hacia el O, y el Hsuehshan Range hacia el E. Se compone de una zona de falla de tipo transpresivo de alto ángulo orientada aproximadamente N-S que comprende fallas, pliegues y bifurcaciones de la estructura principal. El estilo estructural del sistema de fallas Shuilikeng cambia de N a S; mientras que al N está definido por fallas y pliegues no cilíndricos que se ramifican desde la falla Shuilikeng, al S su estructura está dominada por fallas direccionales orientadas E-O con movimiento dextro (Hsuehshan Range) y por una falla con una cinemática compleja que se ramifica y reincorpora a la estructura principal (Western Foothills). En el extremo sur del área de estudio, la falla Shuilikeng está definida por una zona de alta deformación de varios cientos de metros de ancho y la arquitectura estructural de las Western Foothills se define por un anticlinorio regional que se ramifica desde la falla Shuilikeng y que es intensamente plegado y fallado a lo largo de sus flancos.*

Palabras clave: *Taiwan, sistema de fallas, transpresión.*

INTRODUCTION

The structural architecture of the central part of the Taiwan orogen has been classically interpreted as a west-verging fold-and-thrust belt developed above a shallowly east-dipping detachment (Suppe, 1981; Ding et al., 2001; Carena et al., 2002). Nevertheless, earthquake seismicity (Brown et al., in review; Wu et al., 1997), magnetotelluric (Bertrand et al., 2009) and geological (Brown et al., in review) data suggest that a transpressive, thick-skinned style of deformation, that is reactivating pre-existing basement faults (Mouthereau et al., 2002), may better describe the evolving structure of the interior of the central Taiwan mountain belt. In the study area, the change from one structural style to the other takes place across the Shuilikeng fault system. Therefore, determining its structure and kinematics has important implications for understanding how the entire Taiwan mountain belt is growing. Here, we present the results of new structural mapping along the Shuilikeng fault system which is then combined with earthquake focal mechanism data to better resolve its structure and kinematics.

GEOLOGICAL BACKGROUND

In the study area (Fig. 1), the western part of the central Taiwan mountain belt can be divided into two tectonostratigraphic zones separated by the Shuilikeng fault system; the Western Foothills to the west, and the Hsuehshan Range to the east. The Western Foothills comprises unmetamorphosed Eocene to Miocene platform sediments that are thrust over Late Miocene to Recent synorogenic sediments of the foreland basin. The Hsuehshan Range is made up of weakly metamorphosed Eocene and Oligocene clastics that, eastward and southward reach lower greenschist facies and have a penetrative pressure solution cleavage in the hangingwall to the Tili thrust. The juxtaposition of these two zones across the Shuilikeng fault, together with its structural architecture, kinematics, and seismicity suggest that it is a steeply east-dipping transpressive fault system, with linked splays and fault zone bifurcations, that appears to extend into the middle and perhaps even the lower crust (Brown et al., in review, Wang et al., 2002). River channel incision and morphology (Yanites et al., 2010), as well as changes in the stream gradient (Sung et al., 2000) along the main rivers in the interior of the mountain belt, show that the Shuilikeng fault system has been active throughout the Holocene.

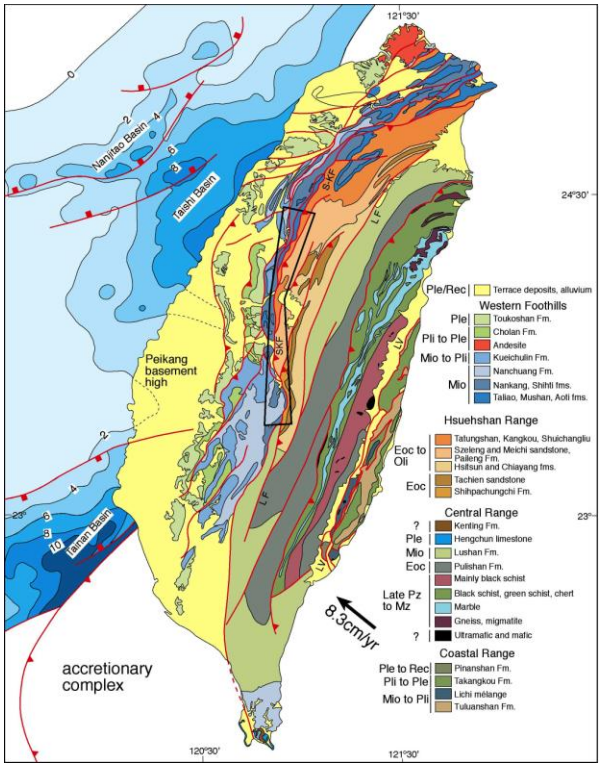

FIGURE 1. *Geological map of the Taiwan mountain belt. The location of the study area is shown. S-KF: Shuilikeng fault; LF: Lishan fault; LV: Longitudinal Valley fault.*

FIELD DATA

Throughout the study area, the Shuilikeng fault system is defined by the structural juxtaposition of the Eocene and Oligocene rocks against the Miocene. The main fault zone has a marked geomorphological signature defined by a series of roughly N-S-sriking valleys. While it crops out poorly, it can be an up to kilometre-wide zone of intense brecciation, or a several kilometre-wide area of complex faulting and folding. The structural style of the Shuilikeng fault system changes from north to south.

To the north (Fig. 2), it is defined by steeply dipping diverging splays and by non-cylindrical folds branching off the Shuilikeng fault. In the Hsuehshan Range these diverging features are north-northeast-striking with the folds being largely asymmetric and west-northwest-verging. In the Western Foothills they are north-striking and roughly parallel to the surface trace of the Shuilikeng fault. For example, the easternmost margin of the Western Foothills is deformed by the steeply dipping nearly north-striking Guaosing fault splaying off the Shuilikeng fault and by the associated north-trending Tachiwei-Guaosing syncline-anticline pair. Minor faults related to the Guaosing fault show a composite kinematics with left-lateral transpressive senses of movement being dominant.

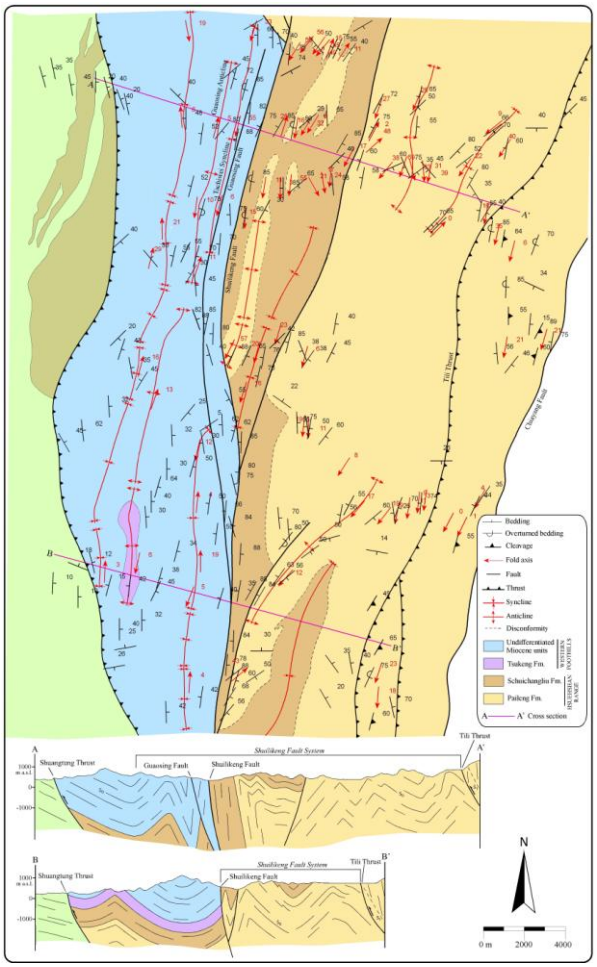

FIGURE 2. *Geological map and cross sections of the northern part of the Shuilikeng fault system in the study area shown in Fig. 1.*

To the south, the structure of the Hsuehshan Range is dominated by right-lateral east-striking strike-slip faults while that of the Western Foothills is defined by a rejoining splay branching off the Shuilikeng fault and isolating a lens-shaped horse of Miocene rocks. For most of its length the rejoining splay is defined by a wide north-striking breccia zone developed into a very thick-bedded sandstone unit. Kinematic indicators such as slickenfibres show a complex kinematic pattern, with a slight dominance of right- and left-lateral strike-slip senses of movement.

In its southernmost part, the Shuilikeng fault is defined by a several hundred meters-wide high strain zone of intense faulting and folding. The resultant geometries are very complex with the thick-bedded sandstone units being largely brecciated and the thin-bedded sandstone and shale units undergoing very disharmonic folding. In that part of the map area, the structure of the Western Foothills is defined by a north-northeast-oriented horsetail fanlike map pattern branching off the Shuilikeng fault comprising a km-wavelength regional anticlinorium highly folded and faulted along its limbs.

ACKNOWLEDGMENTS

G. Camanni acknowledges the grant JAE-Predoc (CSIC). This research was carried out with the aid of the grant MICINN: CGL2009-11843-BTE.

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