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Duplex thrusting in the South Dabashan arcuate belt, central China

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A B S T R A C T

Due to later tectonic superpositioning and reworking, the South Dabashan arcuate belt extending NW to SE has experienced several episodes of deformation. The earlier deformational style and formation mechanism of this belt remain controversial. Seismic interpretations and fieldwork show that the curved orogen can be divided into three sub-belts perpendicular to the strike of the orogen, the imbricate thrust fault belt, the detachment fold belt and the frontal belt from NE to SW. The imbricate thrust fault belt is characterized by a series of SW-directed thrust faults and nappes. Two regional detachment layers at different depths have been recognized in the detachment fold and frontal belts, and these detachment layers divide the sub-belts into three structural layers: the lower, middle, and upper structural layers. The middle structural layer is characterized by a passive roof duplex structure, which is composed of a roof thrust at the top of the Sinian units, a floor thrust in the upper Lower Triassic units, and horses in between. Apatite fission track dating results and regional structural analyses indicate that the imbricate thrust fault belt may have formed during the latest Early Cretaceous to earliest Paleogene and that the detachment fold belt may have formed during the latest Late Cretaceous to earliest Neogene. Our findings provide important reference values for researching intra-continental orogenic and deformation mechanisms in foreland fold-thrust belts.

1. Introduction

In central China, the Qinling-Dabie orogen, which formed during the collision between the North China Block (NC) and the South China Block (SC) along two north-dipping suture zones, has experienced a multistage orogenic evolution. A model comprising three blocks (NC, Qinling-Dabie micro-block, and SC) with two suture zones (Shangdan and Mianlue suture zones) has been proposed to represent the regional tectonic framework of the Qinling-Dabie orogen (Fig. 1b; Zhang et al., 1996, 2001; Meng and Zhang, 1999; Liu and Zhang, 2008, Liu et al., 2010). The SC is composed of the Yangtze Block in the north and the Cathaysia Block in the south (Zhang et al., 2013). Following the closure of the Mianlue ocean, the SC collided with the Qinling-Dabie micro-block along the Mianlue suture zone during the Middle-Late Triassic. Subsequently, the continued continent-continent convergence spurred the large-scale S-vergent thrusting of the South Qinling fold-thrust belt (Dong et al., 2013).

The South Dabashan arcuate belt is located along both the northern margin of the Yangtze Block and the southern margin of the South Qinling foreland fold-thrust belt (Fig. 1). The Chengkou–Fangxian fault zone (F7 in Fig. 1a) separates the South Dabashan arcuate belt from the North Dabashan thrust belt to the north. The structural trends of an arcuate belt on a plane reflect its tectonic background and formation mechanism. In a collisional orogenic model, an arcuate boundary fault should be associated with internal tectonic structures that are also bent (Macedo and Marshak, 1999). However, the thrust faults (F2, F4, F5, and F6 in Fig. 1a) in the North Dabashan thrust belt generally strike NW-SE and terminate at the arcuate Chengkou–Fangxian fault zone, whereas the thrust faults (F8, F9, F10, F11, and F12 in Fig. 1a) in the South Dabashan arcuate belt are parallel to the Chengkou–Fangxian fault zone and form an arc (Fig. 1a). Previous studies on the multistage deformations have primarily mainly depended on the analysis of the superimposed folds. These studies have generally concluded

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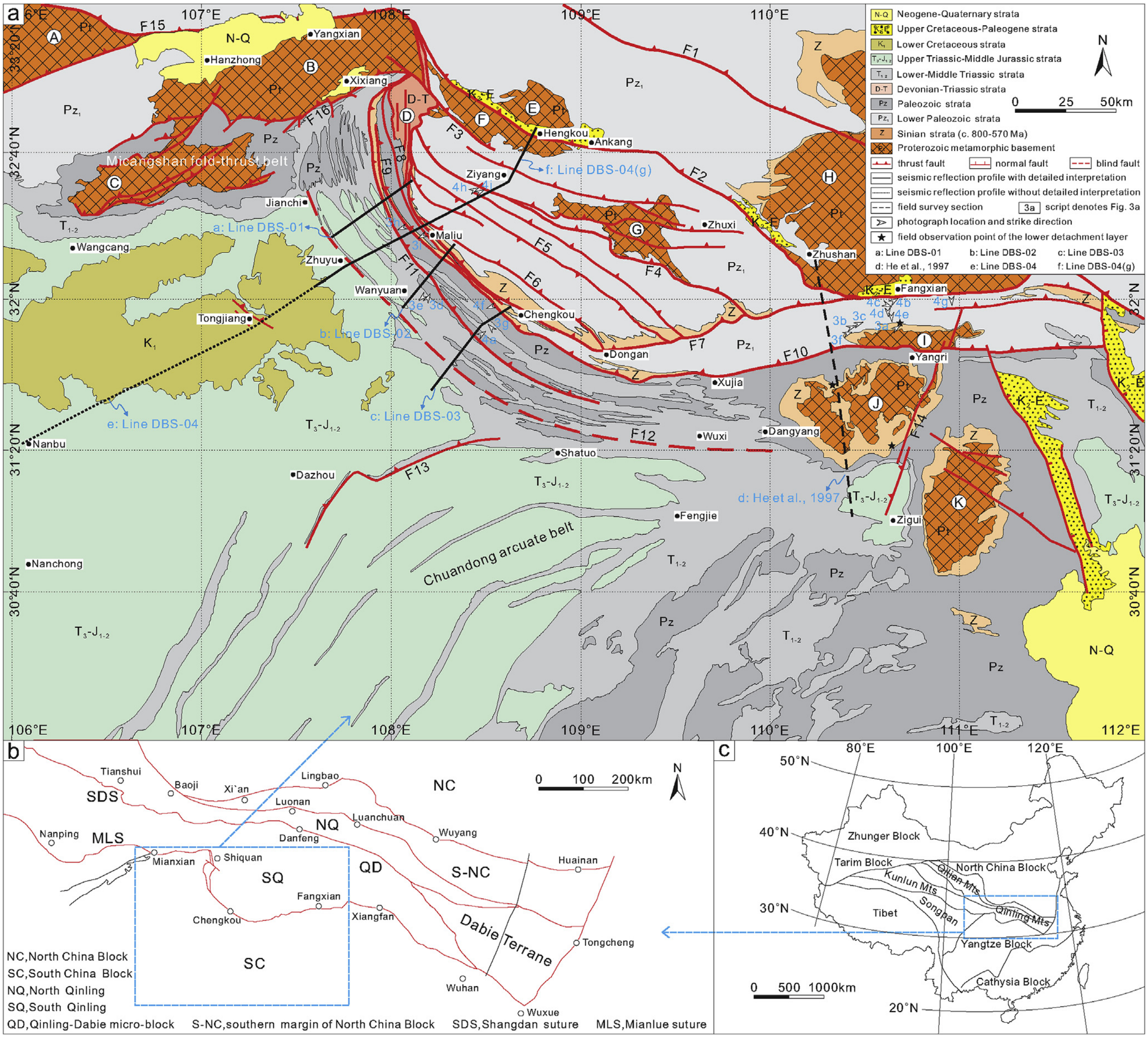

Fig. 1. (a) Structural outline map of Dabashan and its adjacent areas. (b) The main tectonic divisions of the Qinling orogen and the location of Fig. 1a. (c) The locations of the Qinling orogen in China and Fig. 1b. F1-Baihe—Shiyan fault; F2-Ankang fault; F3-Hanwang—Liushuidian fault; F4-Hongchunba fault; F5-Gaoqiao fault; F6-Lujiaping fault; F7-Chengkou—Fangxian fault; F8-Xinglongchang fault; F9-Pingba fault; F10-Xujia—Yangri fault; F11-Zhenba fault; F12-Tiexi—Wuxi blind fault; F13-Wenquan fault; F14-Xinhua—Xingshan fault; F15-Mianlue suture; F16-Xixiang fault; A-Bikou block; B-Hannan massif; C-Micangshan massif; D-Gaochuan terrane; E-Manpoling dome; F-Fenghuangshan dome; G-Pingli dome; H-Wudang nappe; I-North Shennongjia massif; J-South Shennongjia massif; K-Huangling massif.

that two main phases of deformation occurred in the past: foreland folding and thrusting due to collision in the Late Triassic and structural superpositioning during the Late Jurassic to Early Cretaceous (Dong et al., 2006; Hu et al., 2012). A series of thrust faults parallel to the Chengkou—Fangxian fault developed throughout the South Dabashan arcuate belt, and most studies have found that the deformational belt is characterized by the presence of imbricate thrust structures (Zhang et al., 2001, 2010; Li et al., 2006; Dong et al., 2008; Hu et al., 2009, 2012). Dong et al. (2013) proposed that the arcuate belt was dominated by a flower structure. However, the influence of the tectonic superpositioning and reworking during the late stages of the formation of the South Dabashan arcuate belt was intense, and the identifiable deformational styles may be only apparent phenomena. Furthermore, the diversity of the deformational styles in the arcuate belt is puzzling. A basic structural geometric framework and tectonic-sedimentary evolution have been described for the orocline (Liu et al., 2006; Wang et al., 2006; Zhang et al., 2011; Hu et al., 2012; Shi et al., 2012; Li et al., 2013, 2015; Liu et al., 2015a, 2015b; Qian et al., 2015, 2016). Nevertheless, the tectonic uplift differences from E to W in this belt are obvious, and the debate about the perplexing formation mechanism of the arcuate belt continues. For instance, proposed formation mechanisms include the pinning of two culminations (Jiang and Zhu, 1982; Zhang et al., 2001, 2010), dextral transpression (He et al., 1997), sinistral transpression (Wang et al., 2003), and tectonic drag (Li et al., 2002). The classic arc-shaped geometry and poorly understood formation mechanism make this area a natural laboratory to investigate the tectonic evolution of an inter-continental orogen and a foreland fold-thrust belt. An intra-continental orogen can form in a relatively stable craton or