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# Mesozoic intracontinental underthrust in the SE margin of the North China Block: Insights from the Xu-Huai thrust-and-fold belt

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ABSTRACT

The Xu-Huai thrust-and-fold belt, located in the southeastern margin of the North China Block, consists mainly of thrust and folded pre-Mesozoic strata. Its geodynamic evolution and tectonic setting are topics of long debate. This paper provides new evidence from geological mapping, structural analysis, and making balance cross-sections, with restoration of cross-sections. Results suggest that this belt was subjected to two-phase deformation, including an early-phase regional-scale NW-ward thrust and fold, and a late-phase extension followed by the emplacement of dioritic, monzodioritic porphyrites dated at 131–135 Ma and locally strike-slip shearing. According to the mapping, field observations and drill-hole data, three structural units were distinguished, namely, (1) the pre-Neoproterozoic crystalline basement in the eastern segment, (2) the nappe unit or the thrust-and-fold zone in the central segment, which is composed of Neoproterozoic to Ordovician carbonate rocks and Carboniferous-Permian coal-bearing rocks, about 2600 m thick, and (3) the western frontal zone. A major decollement fault has also been identified in the base of the nappe unit, on which dozen-meter to km-scale thrust-and-fold bodies were commonly developed. All pre-Mesozoic depositional sequences were involved into a widespread thrust and fold event. Six uncompetent-rock layers with biostratigraphic ages (Nanjing University, 1996) have been recognized, and each uncompetent-rock layer occurred mainly in the top of the footwall, playing an important role in the development of the Xu-Huai thrust-and-fold belt. Geometry of the major decollement fault suggests that the nappe unit of this belt was rooted in its eastern side, near the Tan-Lu Fault Zone. Two geological cross-sections were chosen for structural balancing and restoration. From the balanced cross-sections, ramp-flat and imbricated faults as well as fault-related folds were identified. A shortening of 20.6–29.6 km was obtained from restoration of balanced sections, corresponding to a shortening rate of 43.6–46.4%. This shortening deformation was likely related to the SE-ward intracontinental underthrust of the North China Block beneath the South China Block during the Mesozoic.



## 1. Introduction

The Qinling-Dabie Orogen, also referred to as the Central China Orogen, is an important tectonic unit, separating the North China Block to the north from the South China Block to the south (Wang and Mo, 1995). To its western segment, an early Paleozoic Ocean subducted northwards beneath the North China Block, followed by the collision of North China and South China blocks in Silurian, building the Qinling Orogen (Zhang et al., 1989). To its eastern segment (Dabie area), no rock record related to the early Paleozoic subduction and collision was preserved because of likely late erosion (Faure et al., 1999), as an early Mesozoic continental subduction of the South China Block beneath the North China Blocks took place, which is proven by the development of coeval UHP coesite-bearing eclogite and HP blue-schist (Faure et al., 1998, 2003), building the Dabie and the Su-Lu orogens (Gilder et al., 1999; Schmid et al., 1999; Faure et al., 2003). At the same time, widespread intracontinental deformation took place within the South China Block (Song et al., 2015; Shu et al., 2008, 2015). Despite that the SE-ward continental crust underthrust of the North China Block beneath the Su-Lu Orogen has rarely been studied, numerous syn-orogenic and post-orogenic rocks and structural records related to early Mesozoic tectonic events are widely exposed in the SE margin of the North China Block near the Su-Lu Orogen, including the thrust and fold structures and strike-slip ductile shear zones (Faure et al., 1998; Lin et al., 2005; Zhu et al., 2010), UHP metamorphic rocks (Li et al., 2009) and two-stage extrusion of UHP-HP metamorphic rocks (Li et al., 2009, 2010), foreland basin (Zhu et al., 1998) and post-orogenic

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extension followed by emplacement of dioritic-granitic magma (Lin et al., 2005; Xu et al., 2006, 2009). Tectonic evolution was related to regional-scale thrust, fault-related fold, and strike-slip shearing. The arcuate Xuzhou-Huainan thrust-and-fold belt (the Xu-Huai belt in short) was formed under this geodynamic setting (Xu et al., 1987; Shu et al., 1994).

The Xu-Huai belt is located in the SE margin of the North China Block and to the western side of the Su-Lu Orogen, near the Tan-Lu Fault Zone (Fig. 1). Structurally, it appears as a NW-ward convex thrust-and-fold belt, which was intruded by early Cretaceous granitoids. Several large-scale coal mines are distributed in the late Paleozoic strata and were covered by thrust slices near the western boundary of this belt. Thus this arcuated belt is a suitable place to investigate the geological setting and tectonic evolution of the SE margin of the North China Block.

Despite its importance, the geodynamic mechanism and tectonic evolution of the Xu-Huai belt are poorly studied and were debated in the last decades. Several models have been proposed, such as the syn-tectonic thrust (Xu et al., 1987; Shu et al., 1994, 1996; Wang et al., 1998), a result from the clockwise-rotated South China Block suturing with the North China Block (Zhao and Coe, 1987; Zhang, 1997; Gilder et al., 1999), an effect from syn-tectonic transformation (Zhu et al., 2005, 2009; Zhao et al., 2016), and the post-orogeny gravity collapse (Ma, 1991). All previous studies mainly focus on the Dabie Orogen, however, rarely on the Su-Lu Orogen and the Xu-Huai belt, little attention has been paid to the structural analysis and geodynamic mechanism forming the Xu-Huai belt.

In the 1980s, the balancing cross-section technique was used firstly for study of thrust deformation and deep-seated structure in foreland and piedmont basins of orogenic belt, such as the North Sea (England) and the Rocky Mountains (North American) (Gibbs, 1983; Mitra and Boyer, 1986; Cooper and Trayner, 1986), and then was quickly accepted by geologists all around the world. The balancing of structural section and the restoration of balanced cross-section were mainly used to interpret brittle deformation (Suppe, 1983, 1986; Ramsay and Huber, 1987; Fossen, 2010). Numerous buried thrust faults and folds (Suppe and Medwedeff,

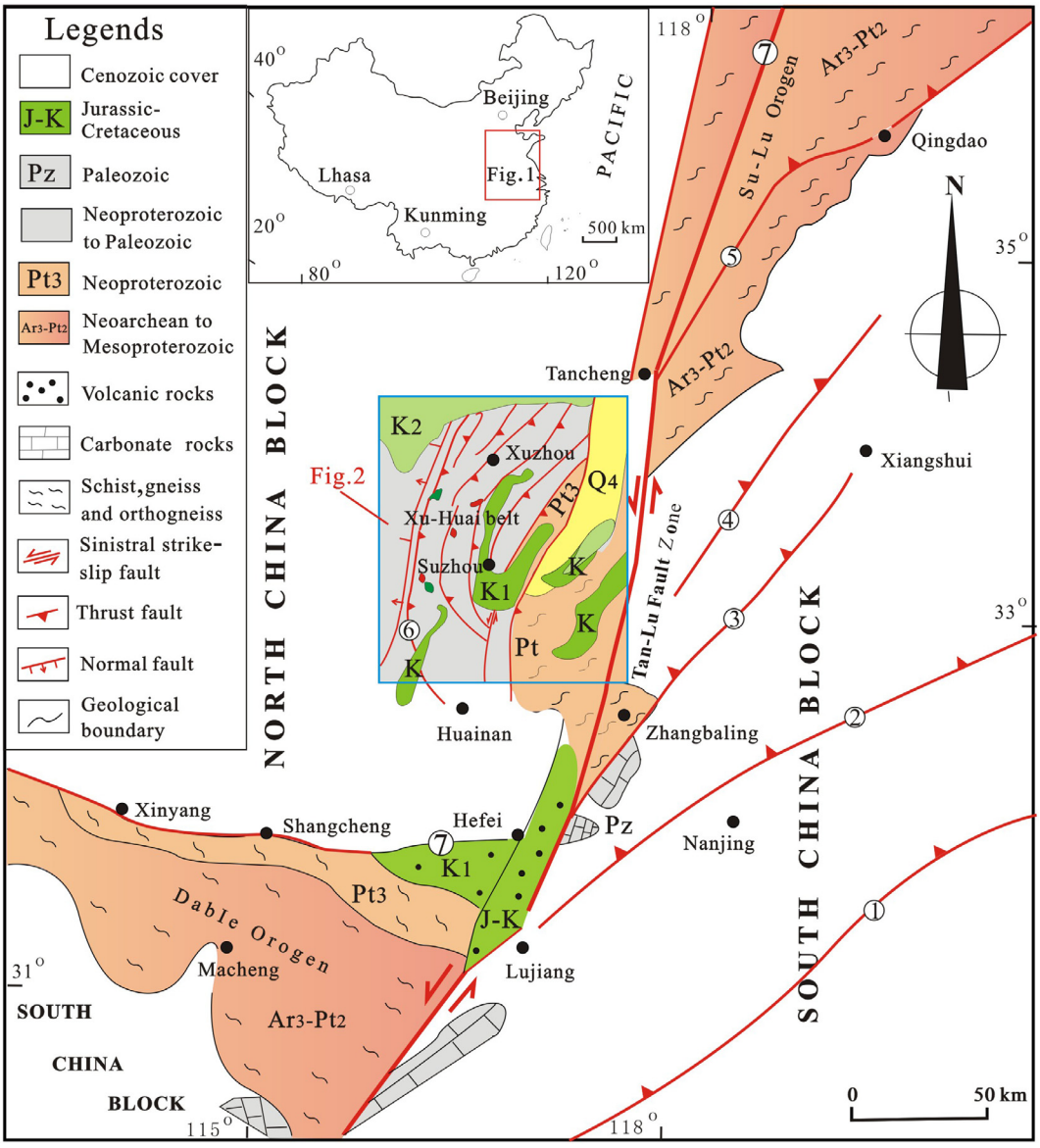


**Fig. 1.** Tectonic location of the Xu-Huai thrust-and-fold belt in the SE margin of North China Block (modified from Xu et al., 1987; Faure et al., 1999; Zhu et al., 2009; Li et al., 2009). Fault names: (1) Liyang-Jiangyin fault; (2) Chaohu-Gaoyou fault; (3) Qingjiang-Xiangshuihe fault; (4) Shuanggou-Liangyungang fault; (5) Tancheng-Qingdao fault; (6) the western boundary fault of Xu-Huai belt; (7) Tan-Lu Fault Zone.