The Evolutionary History of the Mesozoic Xuefeng Intracontinental Orogenic Belt in South China: Restrictions and Implications from the Deformation System of Chuangdong-Xuefeng Fold-thrust Belt

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Abstract：

The Chuangdong-Xuefeng Fold-thrust Belt exceeds 400 km and across the Yangtze Block, is an important component of the Mesozoic intracontinental deformation system in Xuefeng Orogenic Belt. It is mainly composed of a series of Chevron Anticline-Box Syncline to Chevron Syncline-Box Anticline and related fault system. The most of the faults, which includes slip-slid featured thrust fault and normal faults, are NE-NNE trending and in parallel with the axes of the folds. The minor faults, in the formal of normal faults, are NW trending and oblique or orthogonal to the axes. The deformation mainly occurred during the Mesozoic, could be recognized as two independent stages, shows a great connection to the evolution of the Mesozoic Xuefeng Intracontinental Orogenic Belt (XIOB). The thickening and thinning of the lithosphere, as the dynamic mechanism processes, had formed the folds and fractures system.

Geological Setting:

The Chuandong-Xuefeng Mesozoic intracontinental progressive spreading deformation belt extends in NE-NNE direction and spans the Middle and Upper Yangtze Block. As an important part of the Mesozoic intracontinental deformation tectonic system, it is mainly composed of a series of thrusting-fold assemblages. The evolution and dynamic mechanism of which are controlled by the property of "Jiangnan-Xuefeng ancient land" (Xuefeng Uplift). The defination has experienced extensive controversy in history. Since Li Chunyu and others first introduced the concept of plate tectonics into China in 1973(Li, 1973), the controversy under the modern tectonic viewpoint mainly includes two kinds:

(1) The Alpine type orogenic belt, which was formed between the collision of Paleozoic Cathaysian Block and the Yangtze Block. This viewpoint is based on the Banxi ophiolitic melange, which indicates that the Yangtze plate and the Cathaysian plate have experienced collision orogeny. Late Paleozoic radiolarian silica rocks found in many places within the South China plate laterly supported this view again. However, more and more evidences show that Banxi Group is a continuous Neoproterozoic sedimentation. Isotope dating of ophiolites and related igneous rocks, once considered as Paleozoic, has been concentrated at 0.9Ga-1.0Ga in recent years. At the same time, the results of paleontology, stratigraphy and sedimentary palaeogeography and magmatic activities in the early Paleozoic do not conform to the characteristics of plate collision and assemblage. Later, this view was challenged by paleomagnetic evidence.

(2) The Cathaysian Plate and Yangtze Plate merged in the Proterozoic Sibao Period (~900Ma). The Xuefeng basement uplift belongs to the late-formed intracontinental orogenic belt. The "Xuefeng Uplift", now known as the XIOB, is part of the intracontinental deformation system within the South China plate. Its Phanerozoic main evolution history includes Caledonian and Indosinian-Yanshanian (Zhang et al.,2013; Shu et al., 2012; Li et al., 2012)

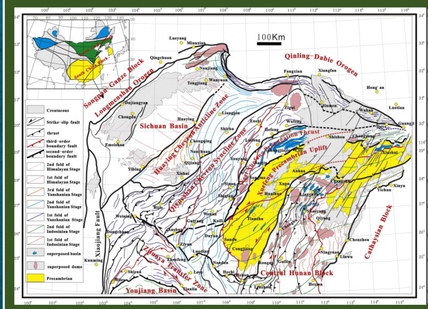

Fig. 1 Fold superposition in the Xuefeng Intracontinental Tectonic System. (Li et al., 2012)

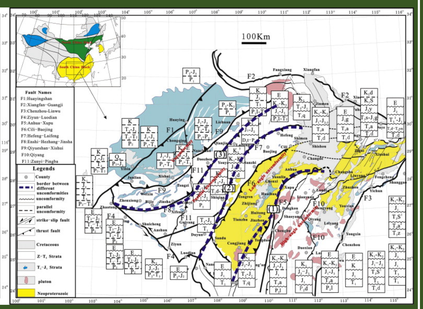

Fig. 2 Distribution of unconformities in the complex Xuefeng Intracontinental Tectonic System in the Indosinian–Yanshanian orogenies (Jin et al., 2009)

Formation of Fault System and Evolution of Mesozoic XIOB

The transition between Triassic and Jurassic is an important period of tectonic change in the Mesozoic XIOB, which is the time limit for the transformation of the Mesozoic XIOB from lithospheric thickening stage to lithospheric extension and thinning stage The ESR dating of the Anhua-Xupu fault shows that the shallow part of the XIOB (crust) began to fitting the deformatin at 202 Ma (Yang et al., 2006). The intrusion of Jiangyong lamprophyre (172.16 +2.73 Ma, biotite, K-Ar) (Liang et al., 2003; Wang et al., 2004), and Antang OIB basalt (168.0 +0.3 Ma, whole rock, K-Ar) (Wang et al., 2004), in central Jiangxi Province, further indicate the extension and thinning of the continental crust. With the movement and expansion in the direction of SE, an intracontinental deformation active region with a width of 1,300 km was formed in South China(Li et al., 2007). The inheritance relationship between the Mesozoic/Paleozoic XIOB and the reasons for the extension and collapse which are still unclear. However, the latter problems are probably caused by the decrease of the relative convergence rate of the two blocks under the action of the periphery limit. At present, most researchers interpret the evolution of this stage as related to the subduction of the Paleo-Pacific Plate(Li et al., 2012; Li et al., 2007), but there is no doubt that there are some problems in this interpretation (such as the unreasonableness to explain the SE-trending nappe of the Hunan-Jiangxi-Guangxi composite tectonic belt and the rapid uplift of the Xuefeng core belt).

The knee of the burial history curve indicate the uplift of the strata, hints the initial folding formation.

Sample	Formation	Mineral	Tc±1σ (Ma)	Estimated Uplift Time (Ma)	Cation
WD-44	J_3	Apatite	47.8±7.1	96	Mei et al., 2010
WE-8	J_3	Apatite	67.1±4.2	115	Mei et al., 2010
SJ-2	J_3	Apatite	78.2±6	120	Mei et al., 2010
JL-1	J_2	Apatite	76.7±8.8	136	Mei et al., 2010
X5	J_2	Apatite	61±5.1	130	Mei et al., 2010
Esh-21	P_2	Apatite	154.1±10.2	154	Mei et al., 2010
RX-29	S_1x	Apatite	70±5	225	Li et al., 2008
RX-29	S_1x	Zircon	235±20	—	Li et al., 2008
HC-38	S	Apatite	92±7	200	Li et al., 2008
HC-53	S_1l	Apatite	65.9±4	—	Li et al., 2008
HC-60	S_2s	Apatite	74±5	200	Li et al., 2008
HC-60	S_2s	Zircon	139±23	—	Li et al., 2008

Table. 1 The low-temperature thermochronology Samples in the Chuandong-Xuefeng Tectonic Belt.

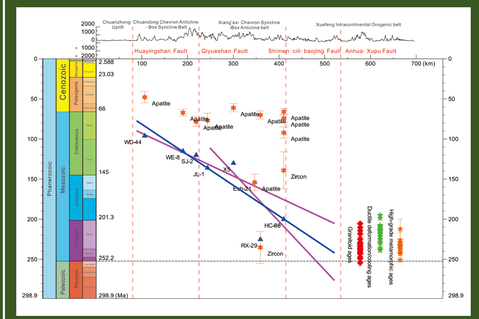

Fig.3 The formation age of folds in Chuandong-Xuefeng tectonic belt.

The low-grade metamorphic degree fold deformation dating is always difficult, few successful examples are existed. In this case, as a mono-directional fold-thrust belt, a group of Low-temperature Thermochronology were dated (Table. 1)

If it is considered that the stress transfer rate of the East Chuandong-Xuefeng tectonic belt remains unchanged. So the right end of the fitting lin (black line) coincides with the peak age of the tectonic thermal events in the XIOB, and the left end reflects that the folding front of the East Sichuan-xuefeng tectonic belt (Huayingshan area) was formed in the Late Cretaceous, which is unreasonable. If several samples distributed in the partition fold belt of Eastern Sichuan are used to fit, the right end of the red line is at the end of the tectonic thermal event, and the intersection of the right end of the line fitted by the remaining samples with the Anhua-xupu fault is at the beginning of the tectonic thermal event. Considering the small number of samples and inaccurate construction of straight lines, the actual position of the right intersection point of straight lines should move upward, that is, the Lianyuan area in Xuefeng Structural Belt should be compressed from Middle Triassic. (Fig.3)

Conclusion ：

(1) The Mesozoic XIOB partially inherited the characteristics of the early Paleozoic intracontinental deformation. With the converging of Yangtze and Cathaysia blocks in the South China Plate, the SE sourced compressing force formed the NE trend folds and the main fracture system in the Southeastern Chongqing area. During which, the frontal deformation zone of the Chuandong-Xuefeng tectonic belt still within the realm which between the Qiyueshan Fault and the Cili-Baojing Fault. The orogenic belt began to uplift with the lithosphere thicken and the crustal remelting occurred in the middle and lower crust. The foreland area of the orogenic belt began to extend gradually from Cili-Baojing fault to Qiyueshan fault or Pengshui-Jianshi fault, and the overall deformation growth rate was slowly increased by the gravity of the thickened lithosphere. The deformation front is about 150 km away from core of the orogenic belt. The extrusion direction and stress source are mainly SE direction (Phase I in Fig. 4 & upper part of Fig.5).

(2) Afterward, the SEE sourced compressing force formed the NNE trend folds and overprinted the former NE trend folds. The forming of the fold-related fractures dwarfed facing the fractures formed during the former stage. A small part of the SE trend faults which formed during the first stage had turned to be the left-lateral characteristic, and the SE trend small scale normal faults formed during the second stage. The lithosphere may begin to destabilize. Subsequently, the Xuefeng intracontinental orogeny occurred lithospheric weakening, which resulted in the decrease of the relative convergence rates of Cathaysia and Yangtze blocks. Under this dynamic background, the partition fold area was generated and gradually extended from Qiyueshan fault to Huayingshan fault. On the basis of the first stage of deformation, the Chevron Syncline-Box Anticline and the thick-skinned structural area were overprinted by NNE-trending and NE-trending structural lines. It is undeniable that the intracontinental deformation system may also be affected by the subduction the Paleo-Pacific Plate, but the main dynamic mechanism is within the South China Plat (Phase II in Fig. 4 & lower part of Fig.5).

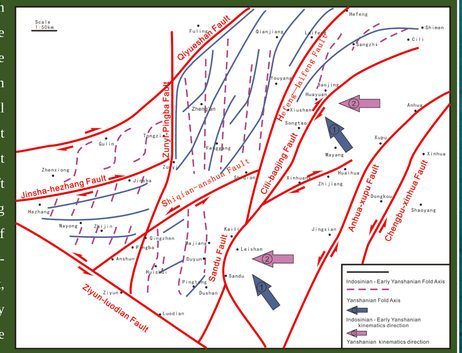

Fig.4 The Schematic map of Folding and deformation evolution, west realm of Xuefeng Mount, (modified after Liu et al., 2010.)

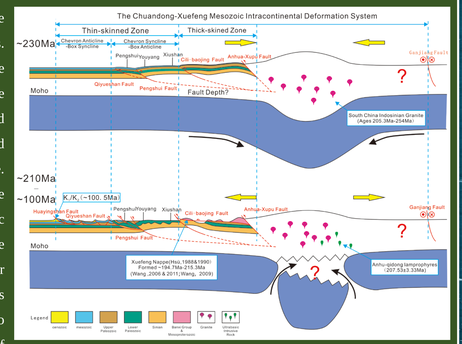

Fig.5 Schematic cartoon showing the tectonic evolutionary history of the Xuefengshan Intracontinental orogeny and Chuandong-Xuefeng tectonic belt(model after Royden, 1993; Houseman, 1981; Nelson 1992.The geological body and the isotopic ages are from Hsü et al.,1988; Hsü et al., 1990; Xu, 2011; Guo et al., 2012; Liang et al., 2003,for explanation see text.