Discussion on the dynamic system of China continent in Mesozoic-Cenozoic

Qiu Ruizhao†*, Zhou Su‡, Deng Jinfu‡, Xiao Qinghui†§, Cai Zhiyong¶ and Liu Cui‡

† *Institute of Geology, Chinese Academy of Geological Sciences, Beijing 100037, CHINA*
‡ *China University of Geosciences, Beijing, 100083, CHINA*
§ *Information Center of Ministry of Land and Resources, Beijing, 100812, CHINA*
¶ *Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, CHINA*

* *To whom correspondence should be addressed. E-mail: qiuruizhao@21cn.com*

The lithosphere thinning and "Mesozoic metallogenic explosion" in east China was one of the most noticeable scientific issues in recent decade. Regarding to its dynamic background, various view points have been proposed by the geologists both at home and abroad, and have become a hot spot to be widely concerned (Deng et al. 1996, Zhou et al. 2004). As a matter of fact, the granitic belt in Mesozoic and volcanic belt in Cenozoic running through different tectonic units in east China indicate that the process of compressive orogenic mechanism in Mesozoic and extensional rifting mechanism in Cenozoic actually are the common mechanisms that east China has faced. But what does it control or which geodynamic system does it belong to? The recent geological study on the Qinghai-Tibetan Plateau provides the important evidences to discuss it. Based on the comparison of the tectono-magmatic events and properties in Qinghai-Tibet Plateau and east China, the dynamic system of China continent in Mesozoic-Cenozoic has been discussed in this paper.

The same continental block is controlled by the same geodynamic-system. In the history of the formation of China continent, after Triassic the China continental blocks had been pieced together to form an entity; it should be controlled by the unified geodynamic system.

On the view of geological event sequences, the most important Mesozoic geological event of China continent was the development of Tethyan Ocean developed in the west and orogenic belt in east. Based on the study of ophiolite and granite in Qinghai-Tibetan Plateau, the geological event sequences and set up are shown in **Table 1**. It illustrates the process of Qinghai-Tibetan Tethyan Oceans in west China, represented by Bangong-Nujiang and Yarlung Zangpo, were opened simultaneously at

TABLE 1. tectonic evolution stages of Tethyan in Western Qinghai-Tibet Plateau

Stage	Epoch	Geological events	Bangonghu-Nujiang ophiolite belt	Yarlung Zangpo ophiolite belt
Ocean opened and developed	About J_1	Super plume activity	Oceanic basin opening gabbro magmatism(191+/-22Ma)	Oceanic basin opening gabbro magmatism(>180Ma) T_{DM} age of Nd isotopic is 180—220Ma
Oceanic-crust subduction	J_2-J_3(?)	Oceanic crust subduction	Metamorphic amphibolite is 179Ma in Dongqiao IAT volcanism is 140—167Ma boninite exposed in Dingqing and Shiquanhe	MORB, IAT volcanic boninite exposed in Rikeze IAT volcanism is less than 170Ma SSZ ophiolite
	K_1	Abundance Oceanic-crust subduction	Arc-igneous assemblages in North Gangdaze which relative with subduction and collision is 75-139Ma SSZ ophiolite O-type adakite	Arc-igneous assemblages in South Gangdaze which relative with subduction and collision is 65—110Ma
Collision	the end of K_1 to K_2	Collision & subduction	Arc-continent collision between Qiangtang and arc-island of North Gangdeze igneous assemblages which relative with collision distributing in North Gangdeze	Continuous subduction O-type adakite SSZ ophiolite with the on the active edge-arc of continent
	By the end of K_2	Collision between Gangdeze block and India continent	Intrusive rock and lava of post-collision	The bottom age of volcanic lava in Linzhou basin is about 65Ma Peak ages of granite distributing in South Gandeze is 40—65Ma
Post-collision	E-N	Subduction of intra-continent		Intrusive rock and lava of post-collision

early Jurassic under the reaction of super-plume on the platform setting in late Paleozoic Era. After that Tethyan Ocean had surpassed the stages of oceanic development, oceanic-crust subduction (Bangong-Nujiang $J_2 \rightarrow K_1$ and Yarlung Zangpo J_2(?) $\rightarrow K_2$) and collision (the collision of arc-continent in Bangong-Nujiang by the end of K_1; the collision of India-Asia plates in Yarlung Zangpo in K_2/E ($\approx$ 65 Ma, Zhou et al. 2004)).

However, in east China the Yanshanian compressive orogenic belt was developed. The recently determined Tectono-magmatic events (Deng et al. 2004) indicate that North China has surpassed a whole orogenic cycle of preliminary stage in J_1 and early stage in J_2 of orogeny $\rightarrow$ peak orogenic stage in J_3 $\rightarrow$ late orogenic stage in K_1^1 $\rightarrow$ post-orogenic stage in K_1^2; among them, thickening continental crust took place in J_1–J_2, and then the lithosphere was de-rooted at large-acreage after J_3. The most violent period of magmatic activities was in J_3-K_1^1, which was homologous with large-scale metallogeny of 130- 110 Ma and (120±10) Ma peak period (mostly range in 80- 160 Ma) of crust-mantle interaction. The key turning times of tectono-system from extrusion to extension was 140-150 Ma in North China, the time when thickness of lithosphere thinned in East-north China was 145 Ma, and the beginning time of lithosphere extension was 146 Ma indicated east China was really controlled by the same geodynamic system and has gone through the same orogenic process. The geological event sequences of orogenic movement in J-K period in North China are correspondent with Western Tethyan evolution stages. Considering the deep process in J-K period, the development and evolution of Tethyan oceans in west China was a token of hot mantle-flow upwards with the process of extension with lithosphere thinning as a whole; while the compressive orogenic belt developed in east China was a token of cold mantle-flow downwards with the converging process of lithosphere and thickening as a whole.

In Cenozoic period, volcanic activities of 65- 25 Ma and <16 Ma in Qing Hai-Tibetan Plateau are also corresponding to the volcanic gyrations of Paleogene Period and Neogene-Quaternary Period in east China (**Table 2**); While on the deep process, the Qinghai-Tibetan Plateau entered the stage of post-collision and plateau uplifting after the collision of Europe-Asia plates at about 65Ma with the lithosphere converging and thickening, and the recycled crustal rocks had led to the down-going of cold mantle-flow; in east China the continental rifting was developed to form rift basin, marginal sea such as south-China Sea, Japanese sea with the lithosphere thinning by extensional mechanism, which is the token of a hot mantle-flow ascending upwards.

The comparison of the geological events in deep and shallow levels of the west and east China reveals that the time of both was simultaneous and their properties were compensating each other. So the China continent was controlled by a unified geodynamic system since Indosinian, *i.e.* the lithosphere/asthenosphere system (**Figure 1**), which just as what Deng (1996) has pointed out. Tomography geophysics reveals that the

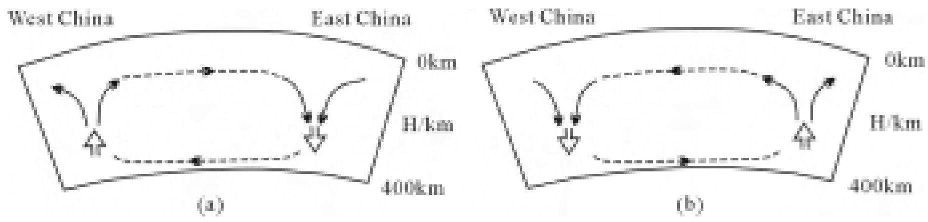

FIGURE 1. Sketch map showing the mantle convective beneath the China continet(after Deng et al. 1996) (a)Mesozoic (b)Cenozoic

TABLE 2. Volcanic events compareing between Qinhai-Tibet Plateau and North China

Volcanism correlative to the continental collision in Qinghai Tibetan Plateau	Volcanism correlative to the continental rifting in east China
（I）volcanic erupting in Paleocene period	
Volcanism in Linzizong area is 63~39Ma Volcanism in Qiangtang area is 39~27Ma Muscovite-biotite-granite in south Gandeze is 35~23Ma	Rift basins and their volvanism in east China is 56~24Ma Japan Sea open in parallel in Paleocene period volcano arc in north-east Japan is 30~23Ma oceanic subduction belt is changed to steep ≥30 degree
（II）late-Qligocene Epoch to early Miocene Epoch: volcanism stop	
Ground uplift, corroded and level planar formed (late Qligocene Epoch to early Miocene Epoch >15Ma)	basin reversed, corraded and level planar formed in North China in 24~16Ma Japan Sea opened at sector in 21~14 Ma
（III）volcanic erupting in late teriary-fourthly	
Volcanism of Gangdeze is 16~10 Ma Volcanism in Kekexili is 15~8 Ma Volcanism in west Kunlun is 4.6~0.2 Ma Volcanism in west Qingling is 15~8 Ma	Rift basins and their volvanism in east China is 16~0.04 Ma Basalt erupting in Datong of Shanxi Province is 0.89~0.23 Ma Siliconic lava erupting is 0.5~0.04 Ma Volvano erupting in South-west Janpan Sea from Miocene Epoch to Pleistocene.

asthenosphere is ubiquitous at the depth of 400 km- 250 km under the China continent(Zhongxian Huang et al. 2003), which might be the link to connect the mantle convection under the China continent and the geological event sequences in west and east China. Since most of the granitic belts and the volcanic belts in east China are with NNE strikes as a whole, no doubt, which imply that the Pacific plate had also played an important role. Therefore, it comes to us that the China continent was controlled by a unified geodynamic system in Mesozoic-Cenozoic, and the granitic belt in Mesozoic, volcanic belt in Cenozoic of East China was the combined result of the systematic changing of lithosphere/ asthenosphere in China continent and the subduction of the Pacific plate.

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