Geological background and geodynamic mechanism of Mt. Changbai volcanoes on the China–Korea border

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The intense Cenozoic volcanism of Mt. Changbai provides a natural laboratory for investigating the characteristics of volcanism and the dynamical evolution of the Northeast Asian continental margin. Mt. Changbai volcanoes predominantly consist of Wangtian'e volcano in China, Tianchi volcano spanning China and DPR Korea, and Namphothe volcano in DPR Korea. Geochronology data and historical records of volcanism indicate that the three eruption centers were formed in the following sequence: Wangtian'e volcano to Namphothe and Tianchi volcano, advancing temporally and spatially from southwest to northeast. The three eruption centers of Mt. Changbai volcano are located close together, have similar magma evolution trends, bimodal volcanic rock distribution, and an enriched mantle source, etc. Although the Cenozoic volcanism in Mt. Changbai is thought to be somewhat related to the subduction of the Western Pacific Plate, the regularity of volcanic activity and petrography characteristics have continental rift affinity. We therefore conclude that the occurrence of synchronous and similar volcanic activity on both sides of the Japan Sea (i.e., the Japan Arc and Northeast China) likely respond to the rift expansion and the back-arc spreading of Japan Sea. From many perspectives, Mt. Changbai volcano is a giant active volcano with hidden potentially eruptive risks.



Fig. 1a Simplified geological map of northeast Asian continental margin; Fig.2b. The full view of Mt. Changbai volcanoes, the landscape map of Wangtian'e, Tianchi and Namphothe volcanoes (WV, TV, NV), and the detailed sampling points. 2c. Different lithologies include basaltic flow, trachyte and pantellerite, and each kind of lithology represents different phases of volcanic eruption, such as early basaltic flow as lava plateau, followed by trachyte composing of volcanic cones, and finally pyroclastic deposits covering the tops of the mountains. Fig.3 Schematic diagram illustrating the relationship between the development of East Asia continental rift system and the subduction of western Pacific plate, and the formation and expansion of Japan sea (Modified from Liu et al., 1999).



Fig.4a. The age distribution of volcanism of Wangtian'e, Tianchi and Namphothe volcano. Purple dots represent new age data, red dots are from previous researches. 4b. Volcanic age histogram for Wangtian'e, Tianchi and Namphothe volcano. Fig.5. A comprehensive temporal and spatial distribution of Cenozoic volcanism from Northeast China, Japan Sea and Japan Arc (modified from Liu et al., 2001). The volcanic ages are from Fan et al. (2007); Liu (1999, 2001); Wei et al. (2007); Pouclet and Bellon (1992) and Yamamoto and Hoang (2009) and this study.

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