Multi-Stage Exhumation Processes of the High-Pressure to Ultra-High-Pressure Metamorphic Rocks: In the View from the Extensional Structures of Tongbai-Dabieshan Orogenic Belt of Eastern China

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Exhumation of deeply buried high-pressure (HP) to Ultra-high-pressure (UHP) terranes remains as a puzzle in lithospheric dynamic processes. A subduction channel and the decoupling of the exhumed slice from the rest of the slab have been considered the most important model for the exhumation of the HP-UHP metamorphic rocks (Ernst, 2005; Guillot et al., 2009). In fact, the exhumation processes on Eastern China are more complex than what we had considered (Faure et al., 1999; Lin et al., 2005, 2009). According to our more than ten years field and laboratory works, at least three stages of the HP-UHP metamorphic rocks exhumation have been separated. These three stages exhumations have different tectonic background and related geodynamics.

During the Early Mesozoic, the North China and South China blocks have convergent motion and generated the Tongbai-Dabieshan HP-UHP orogenic belt (Fig.1; Mattauer et al., 1991; Hacker et al., 1998; Faure et al., 1999; Zheng et al., 2003; Liou et al., 2009). According to our structural analysis, we considered that the HP and UHP metamorphic rocks of the Tongbai-Dabieshan massifs experienced multi-stage exhumation processes. Three independent exhumation stages, from younger to elder, have been identified:

1. The late stage of exhumation (E3)-Cretaceous NE-SW trending metamorphic core complex (MCC) of the central Dabieshan domain and Tongbaishan antiform with the age of deformation around 130 Ma (Fig. 1; Wang et al., 2011); NW-SE trending mineral and stretching lineation with top-to-the-NW kinematics indicated the NW-SE Cretaceous extension. Comparing with the extension tectonics that was expressed by the MCC, syntectonic granite, graben or half graben basins in the entire east China, we proposed that the occurrence of the Tongbaishan antiform and central Dabieshan MCC were shared the same tectonic settings as the destruction of the North China Craton or lithosphere thinning under the Late Mesozoic regional extension in the eastern China (Lin et al., 2013).

2. The middle stage of exhumation (E2)-Late Triassic extensional domal structures with an WNW-ESE long axis: as a destructed dome, it was separated from the Cretaceous MCC of central Dabieshan; NNW-SSE mineral and stretching lineations were indicated by phengite, amphibole and quartz with the top-to-the-NNW sense of shear; in spite of similar geometry and kinematics with E3, this E2 was recognized by geometry and geochronological results; the geodynamic of this extensional structure was considered as the post-collisional collapse around 230-205 Ma(Eide et al., 1994; Hacker and Wang, 1995; Webb et al., 1999; Hacker et al., 2000).

3. The early stage of exhumation (E1) of HP-UHP metamorphic rocks. As the earliest exhumation stage, this deformation was mainly recorded at the limb and the foreland of HP-UHP orogenic belt of Tongbai-Dabieshan (Fig. 1). The geometry of the E1 event constitutes by a series synforms and antiforms with the axial planes have WNW-ESE direction. Even this early stage deformation had largely modified by the later events, the N-S or NNE-SSW trending mineral and stretching lineation is conspicuous. Along the lineation, the deformations are different in different tectonic units. On the southern part of the orogenic belt, top-to-the S or SW sense of shear is preserved at
the northern units of Tongbai-Hong’an massifs, near the Xinyang City. These features of deformation make us interpreted the existence of a syn-collisional subduction channel and the decoupling of the exhumed slice from the rest of the slab (Faure et al., 1999, 2003; Lin et al., 2005, 2009; Ernst, 2005; Guillot et al., 2009). Because of lack of the geochronological work, the age of this early stage exhumation are poorly constrained. The peak metamorphic of the HP eclogite with the age around 250-235 Ma on Tongbai-Hong’an HP massif indicated the period of this event (Cheng et al., 2011 and references therein).

Detail structural analysis and geochronological work could make us well understand the exhumation processes on the HP-UHP orogenic belt. Extensional structures research in HP-UHP metamorphic belt led to new constraints and the improvement our understanding of many tectonics or geodynamic models developed for this deep subduction of continental rocks and their exhumation processes.

**Key words:** Multi-stage exhumation, HP-UHP metamorphic rocks, Tongbai-Dabieshan orogenic belt, Eastern China

**References**


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