Exhumation of ultrahigh-pressure continental crust in east central China: Late Triassic–Early Jurassic tectonic unroofing

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Abstract. The largest tract of ultrahigh-pressure rocks, the Dabie–Hong’ an area of China, was exhumed from 125 km depth by a combination of normal sense shear from beneath the hanging wall Sino–Korean craton, southeastward thrusting onto the footwall Yangtze craton, and orogen-parallel eastward extrusion. Prior to exhumation the UHP slab extended into the mantle a downdip distance of 125–200 km at its eastern end, whereas it was subducted perhaps only 20–30 km at its far western end ~200 km away. Structural reconstructions imply that the slab was >10 km thick. U/Pb zircon and 40Ar/39Ar geochronology indicate that exhumation up to crustal depths occurred diachronously between 240 and ~225–210 Ma, reflecting a vertical exhumation rate of >2 mm/yr.

The upper boundary of the slab is the Huwan shear zone, a normal-sense detachment that reactivated the plate suture. The lower boundary is represented by the Lower Yangtze fold–thrust belt. NW-trending stretching lineations, NE-vergent, WNW–ESE trending <a> folds, dominant top-NW shear, and conjugate, but overall asymmetric, shear band fabrics, document that exhumation was accomplished by updip and orogen-parallel extrusion accompanied by layer-parallel thinning. The orientation and shape of the folds, and a change from SE to SW flow directions, imply that the slab rotated clockwise about a western pivot during exhumation; this rotation was likely caused by the eastward increasing depth of subduction mentioned above, combined with a possible marginal basin and a weak eastern boundary. Exhumation of the slab produced considerable shortening in the Lower Yangtze fold–thrust belt, perhaps producing the foreland orocline.

1. Significance of the Study

This paper documents the early deformational and pressure-temperature (P-T) history of the exhumation of the world’s largest known tract of ultrahigh-pressure (UHP) rocks, the Dabie–Hong’an area, using new structural, geochronological, and petrological data; the Cretaceous Recent contribution to the exhumation is detailed by Ratschbacher et al. [this issue]. The principal question this paper addresses is as follows: How were these unusual rocks exhumed from depths of 100–150 km? We argue that exhumation was accomplished principally by lithospheric scale normal shear between 240 and 225–210 Ma.

2. Dabie–Hong’an Area

The Dabie and Hong’an areas comprise part of a 2000 km long orogen formed chiefly in the Triassic by attempted north-directed subduction of the Yangtze craton or a microcontinent before or during collision with the Sino–Korean craton (Figure 1). Investigation of UHP tectonics initially focused on the Dabie Shan because of the wide variety of continental crustal rocks metamorphosed under a complete range of low to ultrahigh P, but work later shifted to include the Hong’an area, where exhumation structures are better preserved. From south to north, the main rock units in Dabie (Figure 2) are the Lower Yangtze fold-thrust belt, blueschist, high-pressure (HP) amphibolite, quartz eclogite, coesite ecologitc, Northern Orthogneiss unit, Luzhenguang Group, and Fuziling Group. All are intruded by voluminous Cretaceous plutons, and units on the margins of the mountains are overlain by Cretaceous and younger sedimentary and volcanic rocks. The eclogite- and diamond-bearing clogitges indicate subduction of continental crust to >120 km [Liou et al., 1996]. The apppellations of these units are somewhat misleading, as mafic or ultramafic rocks with the diagnostic HP parageneses constitute only ~5 vol % of an otherwise mainly felsic and chiefly paragneissic sequence.

In the Hong’an area (Figures 1 and 2), blueschist-facies rocks are more widespread, and a distinct eclogite-retrogressed-in-amphibolite unit has been mapped, in addition to quartz eclogite and coesite eclogite. Also, a wider variety of Paleozoic metamorphic rocks crop out in E–W trending fault-bounded units at the northern limit of the range (i.e., the Qinling through Erlangping Groups in the NW corner of Figure 2). Many of these units are best known in the Qinling area (Figure 1) [Xue et al., 1996; Zhai et al., 1998].

3. Ultrahigh-Pressure Petrology

The rock suite in Dabie and Hong’an is chiefly a paragneiss with less granodioritic–tonalitic orthogneiss, the paragneiss

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