



## **Paleozoic exhumation history of the North Qinling terrane [U+FF0C] China**

Yunpeng Dong (1,2), Johann Genser (2), Franz Neubauer (2), Xiaoming Liu (1), Zhao Yang (1), Guowei Zhang (1), and Bianca Heberer (2)

(1) State Key Laboratory of Continental Dynamics, Department of Geology, Northwest University, Xi'an 710069, China (dongyp@nwu.edu.cn), (2) Department of Geography and Geology, University of Salzburg, Hellbrunner Str. 34, A-5020 Salzburg, Austria

The Qinling mountain range lies between the North and South China blocks, and is bounded on the north by the Lushan fault and on the south by the Mianlue-Bashan-Xiangguang fault (Dong et al., 2008). The Qinling-Dabie orogen can be subdivided, from north to south, into the Southern North China block with the North Qinling terrane, the Shangdan suture, the South Qinling microcontinent block, the Mianlue suture and the South China block (Zhang et al., 1995; Meng et al., 1999; Li SZ et al., 2007). A number of models for the Qinling tectonic evolution have been proposed. Controversies, however, still exist, in particular on the timing of the joining and the processes of convergence between the North and South China blocks along the Shangdan suture zone. Most authors believe that the collision between the North and the South China blocks occurred after the closure of the Shangdan ocean. However, an increasing body of data is not consistent with simple collision models.

This paper reports new U-Pb age zircon and  $40\text{Ar}/39\text{Ar}$  hornblende and biotite ages from magmatic and metamorphic rocks from the Northern Qinling Terrane. Based on this new dataset, we discuss the exhumation and cooling history of the Northern Qinling Terrane in order to advance the understanding of the tectonic processes that operated during convergence between the North and South China blocks along the Shangdan zone.

The amphibolite-grade North Qinling metamorphic unit forms the centre of the Qinling orogenic belt. Results of LA-ICP-MS U-Pb zircon,  $40\text{Ar}/39\text{Ar}$  amphibole and biotite dating reveal the Palaeozoic tectonic history. U-Pb zircon dating of migmatitic orthogneiss and granite dykes constrains the age of two possible stages of migmatization at  $517 \pm 14$  Ma and  $445.4 \pm 4.6$  Ma. Subsequently, intrusion by granites occurred at  $417.2 \pm 1.6$  Ma.  $40\text{Ar}/39\text{Ar}$  plateau ages of amphibole, ranging from  $397.1 \pm 8.6$  Ma to  $432.3 \pm 3.4$  Ma constrain the cooling of the Qinling complex below ca.  $540^\circ\text{C}$  and biotite  $40\text{Ar}/39\text{Ar}$  ages below ca.  $300^\circ\text{C}$  at about  $367.2 \pm 3.0$  Ma  $\sim 329.5 \pm 0.45$  Ma. The ages are used to construct a cooling path with slow/non-exhumation during  $517\sim 445$  Ma, a time-integrated cooling at a rate  $< 2.5^\circ\text{C}/\text{Ma}$  during the  $445 - 411$ Ma period, an acceleration of cooling and exhumation at a cooling rate of  $6^\circ\text{C}/\text{Ma}$  from  $411$  Ma to  $367$  Ma, and subsequently slow/non-cooling from  $367$  to  $330$  Ma. The data show a significant delay of exhumation after peak metamorphic conditions and a long period of tectonic quiescence between the Silurian and the Devonian/Carboniferous boundary when the suturing of the Shangdan suture occurred. These relationships exclude classical exhumation models of formation and exhumation of metamorphic cores in orogens, which all imply rapid cooling after peak conditions of metamorphism.

### References

- Dong, Y.P., Zhou, M.F., Zhang, G.W., Zhou, D.W., Liu, L., Zhang, Q., 2008. The Grenvillian Songshugou ophiolite in the Qinling Mountains, Central China: Implications for the tectonic evolution of the Qinling orogenic belt. *Journal of Asian Earth Sciences*, 32: 325–335.
- Li, S.Z., Kusky, T. M., Wang, L., 2007. Collision leading to multiple-stage large-scale extrusion in the Qinling orogen: Insights from the Mianlue suture. *Gondwana Research*, 12: 121–143.
- Meng, Q.R., Zhang, G.W., 1999. Timing of collision of the North and South China blocks: Controversy and reconciliation. *Geology*, 27:123–126.
- Zhang, G.W., Zhang, Z.Q., Dong, Y.P., 1995. Nature of Main Tectono-Lithostratigraphic Units of the Qinling Orogen: Implications for the Tectonic Evolution. *Acta Petrologica Sinica*, 11: 101–114. (In Chinese with English

abstract).