ZHANG Cong, Thomas Bader, ZHANG Lifei, Herman van Roermund and SONG Shuguang, 2013. The Multi-Stage Tectonic Evolution of the Xitieshan Terrane, North Qaidam Orogen, NW China: from Grenville-Age Orogeny to Early-Paleozoic Ultrahigh-Pressure Metamorphism. *Acta Geologica Sinica* (English Edition), 87(supp.): 517-519.

The Multi-Stage Tectonic Evolution of the Xitieshan Terrane, North Qaidam Orogen, NW China: from Grenville-Age Orogeny to Early-Paleozoic Ultrahigh-Pressure Metamorphism

ZHANG Cong[1, 2, *], Thomas Bader[1], ZHANG Lifei[1], Herman van Roermund[3] and SONG Shuguang[1]

1 Key Laboratory of Orogenic Belts and Crustal Evolution, MOE, School of Earth and Space Science, Peking University, Beijing 100871, China
2 Institute of Geology, Chinese Academy of Geological Science, 26 Baiwanzhuang Road, Beijing, 100037, China
3 Department of Earth Sciences, Structural Geology and Tectonics, Utrecht University, 3508 TA, Utrecht, The Netherlands

The geodynamic evolution of the Early Paleozoic ultrahigh-pressure metamorphic belt in North Qaidam, western China, is controversial due to ambiguous interpretations concerning the nature and ages of the eclogitic protoliths (Mattinson et al., 2006; Song et al., 2006; Yang et al., 2006). Within this framework we present new LA-ICP-MS U-Pb zircon ages from eclogites and their country rock gneisses from the Xitieshan terrane, located in the central part of the North Qaidam UHP metamorphic belt (Fig.1). Xitieshan eclogites contain clearly different protoliths characteristics and as such provide a natural laboratory to investigate the geodynamic evolution of the North Qaidam UHP metamorphic terrane (e.g. Zhang C. et al., 2013). LA-ICP-MS U-Pb zircon dating of three phengite-bearing eclogites and two pelitic gneisses from the Xitieshan terrane yielded 424–427 Ma and 917–920 Ma ages. The age of 424–427 Ma, consistent with geochemical and geochronological data from the former literature, is interpreted to date continental lithosphere subduction post-dating oceanic lithosphere subduction at ~ 440–460 Ma (Zhang G. et al., 2008; Zhang C. et al., 2011). The 0.91–0.92 Ga metamorphic ages and associated metamorphic mineral assemblages are interpreted as evidence for the occurrence of a Grenville-age orogeny in the North Qaidam UHPM belt (Zhang J. et al., 2008; Zhang C. et al., 2012; Song et al., 2012). Using internal microstructure, geochemistry and U-Pb ages of zircons, combined with the petrological and geochemical investigations on the eclogites, three types of eclogitic protoliths are identified i.e. 1) Subducted early Paleozoic oceanic crust (440–460 Ma), 2) Neoproterozoic ophiolite fragments emplaced onto micro-continental fragments ahead of the main, early Paleozoic, collision event (440–420 Ma) and 3) Neoproterozoic mafic intrusions intruded in continental fragments (rifted away from the former supercontinent Rodinia, Fig. 2). The results presented demonstrate that the basement rocks of the North Qaidam terrane formed part of the former supercontinent Rodinia, attached to the Yangtze Craton and/or the Qinling microcontinent and recorded a complex tectono-metamorphic evolution that involved Neoproterozoic Grenville- and Early Paleozoic Caledonian orogenies.

Key words: Grenville-age orogeny, U-Pb zircon geochronology, Tectonic evolution, Xitieshan, North Qaidam UHP metamorphic belt

References

Mattinson, C.G., Wooden, J.L., Liou, J.G., Bird, D.K., Wu, C.L., 2006. Age and duration of eclogite-facies metamorphism, north Qaidam HP/UHP terrane, western China. *Geochimica Et Cosmochimica Acta* 70: A401-A401.

Song, S.G., Zhang, L.F., Niu, Y.L., Su, L., Song, B.A., Liu, D. Y., 2006. Evolution from oceanic subduction to continental collision: a case study from the Northern Tibetan Plateau based on geochemical and geochronological data. *Journal of Petrology* 47: 435-455.

Song, S.G., Su, L., Li, X.H., Niu, Y.L., Zhang, L.F., 2012. Grenville-age orogenesis in the Qaidam-Qilian block: The link between South China and Tarim. *Precambrian Research* 220–221: 9-22.

Yang, J.S., Wu, C.L., Zhang, J.X., Shi, R.D., Meng, F.C., Wooden, J., Yang, H.Y., 2006. Protolith of eclogites in the north Qaidam and Altun UHP terrane, NW China: Earlier oceanic crust? *Journal of Asian Earth Sciences* 28: 185-204.

Zhang, C., Zhang, L.F., van Roermund, H., Song, S.G., Zhang,

* Corresponding author. E-mail: congzhang@pku.edu.cn

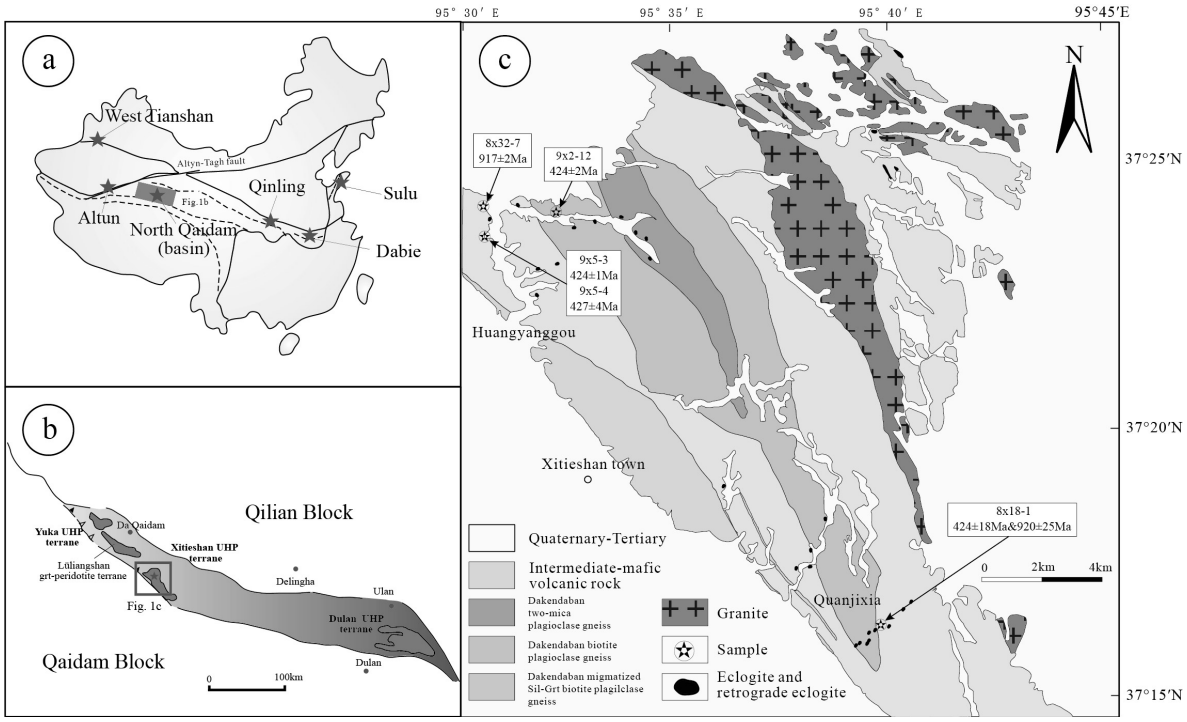

Fig. 1. Simplified geological maps. Modified after Zhang C. et al. (2011).
(a) The location of the North Qaidam UHP metamorphic belt in China. All Chinese UHP belts are marked with asterisks. (b) The distribution of UHP terranes in the north Qaidam UHP metamorphic belt. Geographical names used in text are indicated. The blue region in the figure illustrates the North Qaidam UHPM belt and the red square refers to the location of the Xitieshan area. (c) Geological sketch map of the Xitieshan terrane including sampling locations.

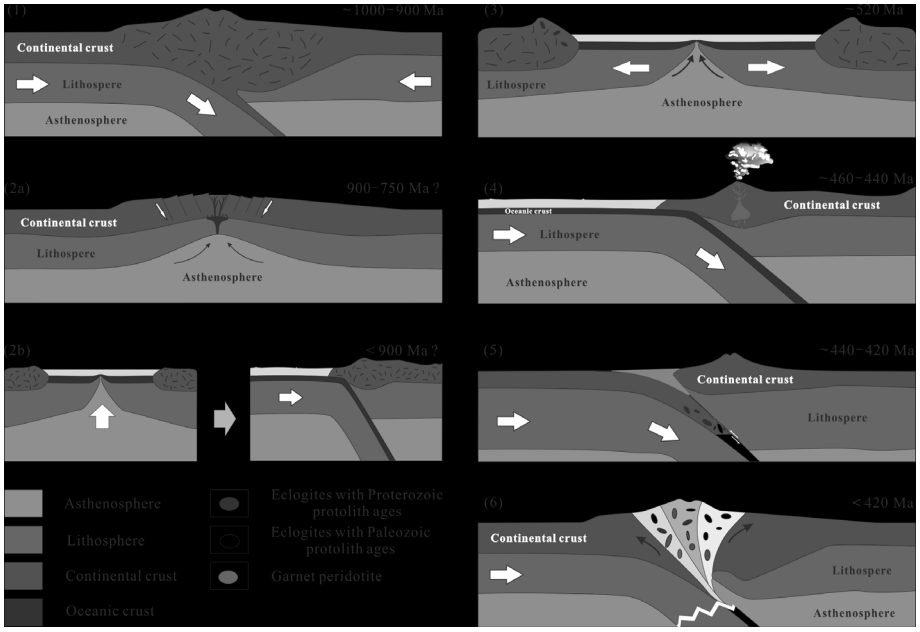

Fig.2 Model illustrating the proposed tectonic evolution of the North Qaidam orogenic belt from the Neoproterozoic to the early Paleozoic.
1) The Neoproterozoic Grenville-age orogeny assembled the supercontinent Rodinia at ca. 1000–900 Ma. 2) As the eclogites exposed in the North Qaidam UHPM belt have clearly distinct Neoproterozoic origins, two stages, here called 2a and 2b, are proposed here to illustrate the orogenic evolution in the time span between ~900 Ma and ~750 Ma. 2a) The initial breakup of the supercontinent, which may have been triggered by mantle plume activities or some other unknown process, causing the intrusion of mafic rocks into the continental crust. 2b) Rifting was followed by spreading and ocean floor formation separating continental segments of the former supercontinent Rodinia. During subsequent subduction fragments of Neoproterozoic oceanic crust became emplaced onto the continental crust. 3) A Paleozoic ocean, here called the Qilian ocean, was formed around ca. 520 Ma. 4) The oceanic crust was subducted at 460 – 440 Ma. Outside the North Qaidam UHPM belt this event is also recorded by the North Qilian suture zone; within the North Qaidam UHPM belt it is recorded in the Shaliuhe section of the Dulan terrane. 5) Following oceanic subduction, a continental crustal fragment that formerly was attached to the NE side of the South China Craton and that already incorporated enbedded Neoproterozoic oceanic fragments probably collided (at 440 – 420 Ma) with North China Craton. Parts of the already exhumed Paleozoic oceanic material might have been trapped by the subducting continental crust. As a result it experienced multi-stage metamorphism in the early Paleozoic. 6) The oceanic slab broke off from the subducting continental lithosphere and the (U)HP unit consisting of eclogites having multiple precursors, garnet peridotite from the mantle wedge and associated country gneisses were exhumed after ca. 420 Ma. Exhumation from mantle depths is enhanced by the buoyancy force of the dominant subducted country rock gneiss.

G.B., 2011. Petrology and SHRIMP U-Pb dating of Xitieshan eclogite, North Qaidam UHP metamorphic belt, NW China. *Journal of Asian Earth Sciences* 42: 752-767.

Zhang, C., van Roermund, H., Zhang, L.F., Spiers, C., 2012. A polyphase metamorphic evolution for the Xitieshan paragneiss of the north Qaidam UHP metamorphic belt, western China: In-situ EMP monazite- and U–Pb zircon SHRIMP dating. *Lithos* 136–139: 27-45.

Zhang, C., Zhang, L.F., Bader, T., Song, S.G., Lou, Y.X., 2013. Geochemistry and trace element behaviors of eclogite during its exhumation in the Xitieshan terrane, North Qaidam UHP belt, NW China. *Journal of Asian Earth Sciences* 63: 81-97.

Zhang, G.B., Song, S.G., Zhang, L.F., Niu, Y.L., 2008. The subducted oceanic crust within continental-type UHP metamorphic belt in the North Qaidam, NW China: Evidence from petrology, geochemistry and geochronology. *Lithos* 104: 99-118.

Zhang, J.X., Mattinson, C.G., Meng, F.C., Wan, Y.S., Tung, K., 2008. Polyphase tectonothermal history recorded in granulitized gneisses from the north Qaidam HP/UHP metamorphic terrane, western China: Evidence from zircon U-Pb geochronology. *Geological Society of America Bulletin* 120: 732-749.