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A polyorogenic model for the Paleoproterozoic Trans-North China Belt: Insights from an integrated structural, metamorphic and geochronological study.

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In the North China Craton, the Paleoproterozoic Trans-North China Belt (TNCB) is a nearly north-south trending zone, of 1200 km long and 300 km wide, that separates two Archean blocks. Previous tectonic models assumed that the TNCB is the result of a ∼1850 Ma collision between the two Archean eastern and western blocks with an intervening ∼2500 Ma magmatic arc. However these models, based mainly on geochronology and geochemistry, lack of structural and metamorphic constraints. Field trips in the best-exposed crustal segment of the TNCB – the Lüliang, Hengshan, Wutai and Fuping Complexes - allow us to recognize several tectono-metamorphic units and to define the bulk geometry and kinematics of the belt. In addition to this field work, new U-Pb and Ar-Ar analyses have been performed in order to constrain the age of the syn-metamophic deformation. The TNCB is composed of two main lithological units. The first one, called the "Upper Wutai-Lüliang Unit" is characterized by volcanoclastic sediments, cherts, tholeiitic basalts, pillow lavas and peridotites metamorphosed under greenschist facies. The lithology and geochemistry suggest that this unit represents an ancient oceanic crust. A suture zone between the Western (or Ordos) Block and an eastern continent (defined herein as the Fuping Block) is identified in the western Lüliang massif. The second unit, called the "Lower Wutai Unit", consists of a thick series of felsic and mafic volcanic rocks with some intercalations of pelitic sedimentary rocks. This series is intruded by granodioritic and dioritic plutons

with a calc-alkaline geochemical signature that complies with a magmatic arc setting. This “Lower Wutai Unit” experienced an amphibolite facies metamorphism. Kyanite-staurolite-garnet assemblages are common in metapelites and attest for a deep burial during which a flat-lying foliation developed. We evaluate the peak of metamorphism at 1883 $\pm$ 11 Ma using the U-Th-Pb chemical EPMA dating technique on monazite. Both the Upper Wutai-Lüliang and the Lower Wutai Units exhibit a flat lying foliation and a conspicuous NW-SE trending mineral and stretching lineation. A mylonitic shear zone with top-to-the-SE shear criteria separates the two units. Therefore, the Upper Wutai-Lüliang Unit is interpreted here as a synmetamorphic nappe overthrusted to the SE upon the Lower Wutai Unit and rooted in the suture zone to the west. The Lower Wutai Unit is extensively migmatized and crustal melting occurred at 1850 $\pm$ 5 Ma as indicated by LA-ICP-MS U/Pb zircon dating of a migmatitic leucosome. The metamorphic rocks are unconformably covered by Paleoproterozoic conglomerates, sandstone and mudstone series called the Hutuo supergroup. The rocks are unmetamorphosed but deformed by SE-vergent folds that argue for a second ductile phase. To the east, the Lower Wutai Unit overlies the gneissic basement of the Fuping massif through a kilometer thick flat lying SE-directed ductile shear zone (the Longquanguang Shear Zone). In the Fuping complex, the ductile normal Pingshan Fault dated at 1824 $\pm$ 10 Ma, using ^{40}Ar/^{39}Ar dating on muscovite, accounts for the post orogenic exhumation of the basement gneiss. Moreover, the Fuping massif shows evidence for a ca. 2100 Ma tectono-metamorphic and magmatic event, which we interpret as resulting from the closure of an oceanic domain (called the Taihang ocean), by westward subduction below the Fuping complex. In conclusion, the TNCB suffered two collisional events. Our model involves three Archean blocks, namely from West to East, the Ordos, Fuping and Eastern blocks separated by the Lüliang and Taihang oceans. Closure of the Taihang ocean is responsible for the 2100 Ma event whereas closure of the Lüliang ocean accounts for the 1880 Ma one. Both events are controlled by westward directed subduction.