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Understanding early Paleozoic orogeny in South China: structural and geo/thermochronological constraints from the central Jiangnan Orogen and the north Cathaysia

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The early Paleozoic orogenic event in South China involved significant crustal shortening, and was manifested by a regional-scale Middle or Late Devonian unconformity, Silurian high-grade metamorphism, ductile shearing, folding, and plutonism. Despite a lot of geological records, key issues regarding the process and origin of this orogenic event remain controversial. Three competing models have been proposed to explain the origin of this orogenic event: (1) NW-directed overthrusting of the Cathaysia Block atop the Yangtze Block; (2) NW-directed underthrusting of the Cathaysia Block beneath the Yangtze Block; and (3) the combined underthrusting of an assumed East China Sea Block and the Yangtze Block beneath the Cathaysia Block. To address the controversies, we conducted structural coupled with thermochronological and geochronological studies in the central Jiangnan Orogen and north Cathaysia areas.

Our results indicate that the early Paleozoic deformation in the central Jiangnan Orogen area involved intense ductile shearing, which was variably partitioned into dextral and thrust arrays of anastomosing high-strain zones. The dextral arrays strike E-ESE and dip steeply to the south; the thrust arrays strike NE, dip 20∼80° to the SE and bear top-to-the-NW shear criteria. Syn-kinematic recrystallized microstructures and lattice-preferred orientation (LPO) patterns indicate that both dextral and thrust ductile shearing commenced under upper greenschist facies conditions at temperatures of ∼400-500°C. In the north Cathaysia area, the early Paleozoic deformation is featured by sinistral oblique shearing along arrays of NE/NNE-oriented, steep-dipping zones. The grain boundary migration recrystallization and prism <a> slip of quartz indicate that shear deformation occurred under upper amphibolite facies conditions at temperatures of 500-650°C. Combined dating by U-Pb and 40Ar/39Ar shows that the ductile shearing in the two areas commenced at ∼460 Ma, terminated around 420 Ma and was followed by post-orogenic cooling at ∼400-370 Ma.

The newly documented ductile fabrics, coupled with regional considerations of early Paleozoic deformation, metamorphism, and magmatism, allow tracing the spatial distribution of the Early Paleozoic orogen in South China. The traced orogen is bound to the east by the Zhenghe-Dapu Fault and extends through the north Cathaysia domain into the Jiangnan domain, with the southeast Yangtze acting as its foreland fold-and-thrust zone. Notably, the early Paleozoic deformation, metamorphism, and magmatism from southeast Yangtze to north Cathaysia show a broadly northwestward weakening trend, implying that the driving force for the orogeny lay to the southeast of South China. We therefore interpret the orogeny as being externally induced by the amalgamation of South China and Australia during final assembly of eastern Gondwana.

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