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Multiple metamorphic reworking of basement rocks in northeastern Cathaysia block, South China

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The Cathaysia block records a complex tectonic history, the understanding of which is central to the debate on the evolution of the South China Block and its position in various supercontinental assemblies. Here we investigate two key formations from this block, the Mayuan Group in the northern Fujian Province, northeastern Cathaysia block and its equivalent the Badu Group in southwestern Zhejiang Province. Previous studies traced the Paleoproterozoic records from the Badu Group whereas a Neoproterozoic age was proposed to the Mayuan Group. The metasedimentary rocks sampled in this study from both groups show similar mineral assemblages of garnet+ sillimanite+ biotite+ plagioclase+ quartz± K-feldspar± muscovite± graphite as well as high contents of SiO_2 and Al_2O_3, typical of amphibolite- to granulite-facies metapelitic rocks. Zircon U-Pb data yield two discordia intercept ages of ~1990 Ma and ~2450 Ma from one sample and discordia intercept ages of ~3.5 Ga, 2.5 Ga, 1.86 Ga and 233 Ma from another in the Badu Group. Zircons in two samples from the Mayuan group yield intercept ages of 1859 Ma and 249 Ma in one sample and ~2.6 Ga, 1.87 Ga, 257 Ma and a weighted mean $^{206}Pb/^{238}U$ age of 248 Ma in the other. The ca. 1.86-1.87 Ga and 230-250 Ma ages are interpreted to represent time of metamorphic reworking because zircon grains of these ages tend to have low Th/U ratios, flat HREE patterns and unzoned internal texture as revealed by cathodoluminescene (CL) images. These results confirm that the Badu Group is a Paleoproterozoic lithostratigraphic unit and also suggest that at least part, if not all, of the Mayuan Group is Paleoproterozoic.

Evidence for Paleozoic metamorphic reworking that is considered to have affected the whole of Cathaysia block is not revealed in this study; in contrast our data clearly show obvious Mesozoic metamorphic reworking at ca. 230-250 Ma. Zircon $\varepsilon_{Hf}(t)$ values range from -19 to +11 with a peak at -5.5 and show $T_{DM}^{C}(Hf)$ ranging from 1.9-4.1 Ga with a peak at ca. 2.7-3.0 Ga suggesting that a major crustal growth took place during this time. This interpretation is consistent with the previously suggested crustal growth peaks of ~2.7 Ga and ~2.9Ga. A synthesis of the reliable geochronological data gathered so far on Phanerozoic metamorphic reworking of the northeastern Cathaysia block reveals that the imprints of these tectonothermal events is differently distributed in the different zones. Rocks metamorphosed during the Paleozoic tectonothermal event dominantly occur in the western zone whereas those reworked by high-grade metamorphism during the Mesozoic tectonothermal event mainly outcrop in the eastern zone. For example, Yu et al. (2014) and Zhao et al. (2015) have reported Paleozoic granulite facies metamorphism along the western margin of the Cathaysia Block. Besides the Mesozoic metamorphism recorded by these pelitic rocks, Mesozoic high pressure and high temperature granulites have also been discovered in the Cathaysia Block (to the east of the Paleozoic high grade metamorphic belt).

Our study alerts the previous notion of a uniform distribution of the reworked rocks by high-grade metamorphism all across the northeastern Cathaysia block and provides new insights on the evolution of the South China Block.

References:

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