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High–pressure granulite–facies metamorphism and anatexis of deep continental crust: new insights from the Cenozoic Ailaoshan–Red River shear zone, SE Asia

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Studies of crustal anatexis have given valuable insights into the evolution of metamorphism–deformation and the tectonic processes at convergent plate margins during orogeny. The transition of metatexite to diatexite migmatite records crucial information about the tectono–thermal evolution and rheology of the deep crust. Along the Ailao Shan–Red River shear zone, metatexite migmatites, diatexite migmatites and leucogranites are widely distributed within the upper amphibolite and granulite facies zones of the Diancang Shan metamorphic complex. The high–pressure granulite–facies metamorphism with mineral assemblage comprising garnet + kyanite + K–feldspar + plagioclase + biotite + quartz + melt is first recognized from the patch metatexite migmatites in the complex. Detailed petrographic evidence and phase diagram reveal that the migmatite underwent nearly isothermal decompression metamorphism, presenting a clockwise P–T path. The peak metamorphic P–T conditions are constrained by phase diagram at ca. 11 kbar and 810 °C, and the amount of melt generated during heating is up to 18 mol%. The extraction and segregation of melts are evidenced by the presence of leucosomes within migmatites and leucogranite dikes, which record the melt flow network through the crust. Zircons and monazites from migmatites record the ages of the melting episode that began at ca. 36 Ma and lasted to ca. 20 Ma. All these results are in accord with orogenic crust thickening accompanied by pervasive anatexis during the Later Eocene to the early Oligocene in the Ailao Shan–Red River shear zone. Combined with available data related to the other continental–exhumed shear zone, we propose that the crustal anatexis has an important effect on the thermal–state of deep–seated shear zones, is thus controlling the rheological behavior of the lithosphere and plays the essential role in the initial localizing of shearing in the lower crust.