Zircon U-Pb dating, Hf isotopes and trace elements characteristics of the migmatites in Tianjingping area, northwestern Fujian Province

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The Tianjingping area in northwest Fujian Province is located in the northeast Cathaysia Block. Metamorphic basement rock series of the Cathaysia Block, frequently migmatites, are explosed fragmentarily in southern China. Migmatites in this area have previously been assigned to Precambrian metamorphic basement. In this study, we carried out a combined study of zircon U-Pb dating, Hf isotopes and trace elements on the homogeneous granodioritic neosomes of migmatites in the Tianjingping area and obtained not only Paleoproterozic ages but also precise Caledonian ages. Zircons were characterized by zoning, high Th/U ratios (mostly ≥ 0.1), enriched HREE, positive Ce and negative Eu anomalies, and show features similar to magmatic or anatectic zircons. Apparent $^{206}Pb/^{238}U$ ages for the zircons were 447±2Ma (95% conf., MSWD=0.88), corresponding to a Caledonian event. εHf(t) values ranged from -13.3 to -9.7, indicating a crustal source. Two-stage Hf model ages were from 1.7 to 1.9 Ga, suggesting that protolith of the migmates was formed in the Paleoproterozoic. The granodioritic neosomes had the characteristics of peraluminous calc-alkaline granite, and their REE patterns and trace element spidergrams show features of middle to upper crustal rocks. Together with previous studies, we conclude that the protolith of the Cathaysia basement in the Tianjingping area was formed in the middle-late Paleoproterozoic and expericenced partial melting during the Caledonian period. The rcongnition of Caledonian reworking of the Paleoproterozoic basement in the Cathaysia Block provides new information on the tectonic evolution of the Cathaysia Block in the Caledonian period and the interactions between the Cathaysia Block and the Yangtze Block.

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An experimental study of pressure solution in angular quartz sands under simulated burial conditions

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The size and shape of sand grains are the important geometrical variables controlling pressure solution in sandstones. But experimental studies of pressure solution in very poorly-rounded quartz sands or sandstones have not been documented. In this study, we conducted two simulation experiments for pressure solution in medium-grained (0.25-0.5 mm) very poorly-rounded quartz sands. The first one was conducted to simulate pressure solution under the conditions of burial depths from 0 to 1700 m and the second, from 0 to 2900 m. Based on the geological characteristics of the Dongying Sag in East China where very poorly-rounded sandstones were deposited, the geothernmal gradient, average density of the rocks and the fluid pressure were set to compute the temperature, lithostatic pressure, fluid pressure and effective pressure at different simulated burial depths. The porosities and permeabilities significantly decreased with the increase of burial depths initially and then dropped slowly with time after the simulated burial depths reached to 1700 m or 2900m. The water in the second experiment was highly supersaturated with silica. The silica content reached a sharp peak when the simulated burial depth increased to 2900 m, but then it decreased quickly in the next 100 hours and afterwards gradually with time. This indicates that pressure solution occurs when burial depth reaches to 2900m. The silica content in the pore water in the first experiment was lower than that in the second experiment but the water was still highly supersaturated with silica. The silica content reached a peak when the simulated burial depth increased to 1700m. It then decreased quickly in the next 50 hours and subsequently slowly with time. Therefore, pressure solution in very poorly-rounded quartz sands can also occur at the shallow burial depth of 1700m. The two simulation experiments also indicate that discontinuous subsidence could result in multi-phased pressure solution and provide SiO_2 for multi-phased quartz cementation.