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The Continental Collision Process Deduced from the Metamorphic Pattern in the Dabie-Hongseong and Himalayan Collision Belt

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Different continental collision belts show contrasting metamorphic trends along their lengths, including the distribution of extreme metamorphism; i.e., ultrahigh-pressure (>100 km depth) and ultrahigh-temperature (900–1150°C) metamorphism. The different metamorphic trends can give important clues for understanding the process of continental collision, which is difficult to study because an important part of the process occurs at great depth and earlier parts of the process may not be preserved. The present study investigates the main factors that control the metamorphic patterns along collision belts, with reference to the Dabie–Hongseong collision belt between the North and South China blocks and the Himalayan collision belt between the Indian and Asian blocks. In the Dabie–Hongseong collision belt, collision began in the east before 245 Ma and propagated westward until ca. 220 Ma. The amount of oceanic slab that subducted before collision was insufficient to pull down the continental crust to the depths of ultrahigh-pressure metamorphism in the eastern part of the belt but enough in the western part of the belt. Slab break-off also migrated from east to west, with a westward increase in the depth of break-off (from ~10 kbar in the east to ~35 kbar in the west). These lateral trends along the belt resulted in a westward change from ultrahigh-temperature (915–1160°C, 9.0–10.6 kbar) to high-pressure (835–860°C, 17.0–20.9 kbar) and finally ultrahigh-pressure metamorphism (680–880°C, 30–40 kbar). In the Himalayan collision belt, collision started from the west at ca. 55 Ma and propagated eastward. The amount of oceanic slab subducted prior to collision was sufficient to pull down the continental crust to the depths of ultrahigh-pressure metamorphism in the west. Slab break-off started in the west at ca. 46–55 Ma and propagated eastward until ca. 22–25Ma, with an eastward decrease in the depth of slab break-off from 30–35 kbar to 17–18 kbar. Consequently, the metamorphic trend along the belt changes eastward from ultrahigh-pressure (750–770°C, 30–39 kbar) to high-pressure and finally high-pressure granulite facies metamorphism (890°C, 17–18 kbar). This study indicates that the different metamorphic pattern along the collision belt indicates different collision process and is strongly related to the amount of subducted oceanic crust between continents before collision and the depth of slab break-off. Therefore metamorphic patterns can be used to interpret both the unpreserved and ongoing tectonic process during continental collision. This study also shows that tectonic interpretations based on petrological study can contribute to better interpretation of geophysical tomography of the area where the collision process is now occurring.