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Position of South China in configuration of Neoproterozoic supercontinent

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Configuration and evolution of Neoproterozoic supercontinent and the position of South China within it have been very important targets in earth sciences concerning many forefront topics of general interest. In the common reconstruction of the supercontinent Rodinia, South China was located between Australia and Laurentia, and thus lies in the center of the supercontinent and southeast of Australia[1]. According to the new paleomagnetic and geochronological data for the ~800 Ma Xiaofeng dyke in Yichang as well as existing data, Li et al.[2] suggest that Rodinia would probably spread from the equator to the polar region at about 800 Ma, followed by a rapid ca. 90° rotation around an axis near Greenland that brought the entire supercontinent to a low-latitude position by ca. 750 Ma. As a result, South China is reinterpreted to be placed adjacent to both Australia and India, with a rapid shift of rotation from a position northeast of Australia and southeast of India at about 800 Ma (Fig. 1(a)) to a position northwest of Australia and northeast of India at about 750 Ma (Fig. 1(b)). By combining existing paleomagnetic data[3] with their new paleomagnetic data for the Cambrian sediments in the Sichuan Basin, Yang et al.[4] also place South China against northwestern Australia but remote southeast of India at about 755 Ma.

In the Paleopangaea reconstruction[5], South China was placed in northeast of India. In the discussion of relationship between the Rodinia configuration and the snowball Earth event[6], South China was tentatively placed in northwest of India. In dynamic models of reconstructing the Rodinia assemblage and breakup on the basis of global paleomagnetic data, Powell et al.[7] placed South China in northeast of Australia and thus remote east of India; Meert and Torsvik[8,9] placed South China in northeast of Australia and northwest of Laurentia, interjacent between two transform faults in its southeast and southwest. Geochemical studies of Zhou et al.[10,11] suggest that Neoproterozoic magmatic rocks in the western and northwestern margins of the South China block resemble metaigneous complexes occurring along Seychelles to Madagascar in Indian Ocean and Malani in India[12], having the origin of island arc for some of them. For this reason, Yan et al.[13] suggested that South China was adjacent to India during the Neoproterozoic, but Li et al.[14] argued that it is problematic to interpret as the arc magmatism the Neoproterozoic magmatic rocks in the western and northwestern margins of the South China Block. Apparently, the position of South China and other continents in the Neoproterozoic supercontinent configurations has been an important problem demanding prompt solution.

An extensive study of oxygen isotope analysis and U-Pb dating was accomplished for zircons from eclogites and granitic gneisses along the Dabie-Sulu orogenic belt[19—21]. The results show that the zircons are composed of magmatic cores with mid-Neoproterozoic ages (700 to 800 Ma) and metamorphic overgrowth rims of Triassic ages (245 to 210 Ma). The zircons are characterized by a large variation in oxygen isotope ratios (−10.9‰ to +8.5‰), most of which are lower than δ^{18}O values of the mantle zircon (5.3±0.3‰). Because the oxygen isotope composition of zircon would not be affected by subsolidus hydrothermal alteration and granulite-facies metamorphism, protoliths of low-δ^{18}O eclogites and granitic gneisses are considered mafic and felsic igneous rocks with low δ^{18}O values, respectively. They correspond to bimodal magmatism along the northern margin of the South China Block related to Neoproterozoic rifting tectonics. The mid-Neoproterozoic low-δ^{18}O magmatic activity is contemporaneous with Rodinia supercontinent breakup and global glaciation (snowball earth event), indicating meteoric-hydrothermal alteration at supersolidus temperatures that was caused by rift magmatic activity.

Granitoids having U-Pb ages of 700 to 800 Ma with a mode of 750 to 755Ma were found in the Seychelles of Indian Ocean[12,22,23], which also show low δ^{18}O values of −1.2 to 7.5‰[24—26] with most of them lower than the normal mantle values 5.7±0.5‰. Bimodal magmatic rocks of middle Neoproterozoic ages occur in Madagascar of Africa[27—30] and India[31,32]. Granitoid having SHRIMP U-Pb age of 823±5Ma is also identified in the Lesser Himalayan granite belt in NW India[33]. It appears that the bimodal magmatic rocks in Seychelles, Madagascar and India can be compared with those in the northern margin of the South China Block with respect to both mid-Neoproterozoic ages and low δ^{18}O values. The comparabilities may point to a given correlation in the geotectonic setting of magmatic activity between the different continents. In other words, they may all be the products of magmatic activity and hydrothermal alteration during the Rodinian breakup. If the correlation is of genetic implication, it is of great value in the reconstruction of the supercontinent Rodinia with respect to the position of South China.

Assuming that the occurrence of Neoproterozoic low-^{18}O magmatic rocks is dictated by the same setting of rift tectonics, Zheng et al.[20] propose to place South China in north of India and thus northwest of Australia. This proposal is now supported by the new paleomagnetic data

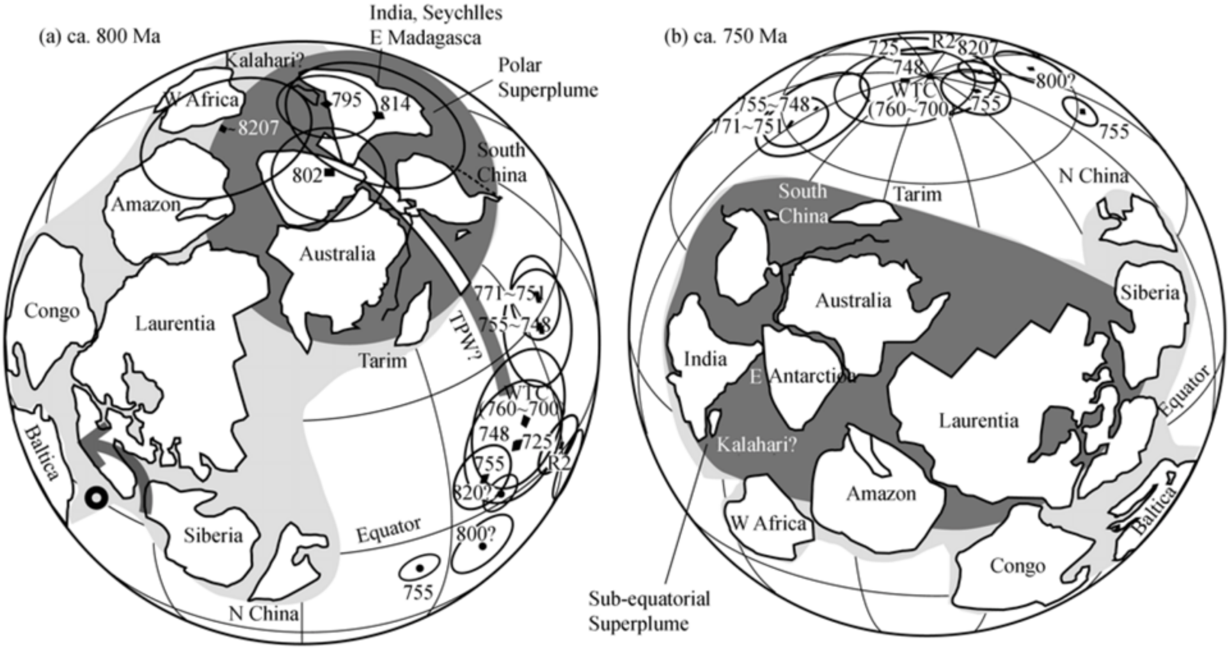

Fig. 1. Position of South China in the paleogeographic reconstruction of Rodinia supercontinent at middle Neoproterozoic (after Li et al.[2]).

of Li et al.[2] and Yang et al.[4]. Therefore, the all available interpretations from the paleomagnetic data[2—4], sequence stratigraphic observation[18], oxygen isotope composition[20] and trace element pattern[13] favor the position of South China in the configuration of supercontinent Rodinia that is adjacent to both Australia and India rather than between Australia and Laurentia, and thus not placed in the center of the supercontinent and southeast of Australia.

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