Continental accretion by arc-continent collision during the Columbia assembly in South China

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A Paleo-Mesoproterozoic supercontinent, Columbia, has been proposed to exist on the Earth, with its assembly mainly at 2.0-1.8 Ga. However, it is unclear how South China behaved during the Columbia assembly before it became part of supercontinent Rodinia in the Neoproterozoic. A combined study of geochronology and geochemistry of ancient continental fragmentss in question is expected to provide a genetic link to their geotetconic affinity and thus to the relationship between South China and Columbia. In doing so, it is intriguing to know how the middle Paleoproterozoic tectonothermal event in South China is link to the Columbia assembly and if the continental accretion proceeds by arc-contient collision.

A combined study of zirconology and whole-rock geochemistry was carried out for metamorphic rocks in Yangtze Gorge, South China. Zircon U-Pb dating gave concordant ages of 1.97 ± 0.03 Ga with low Th/U ratios of 0.01 to 0.14 for migmatite, metapelites, amphibolite. The similar U-Pb ages were also obtained from zircons from igneous and metamorphic rocks elsewhere in South China, providing the geochronological record of middle Paleoproterozoic metamorphic event in South China. Nevertheless, this period of metamorphic event and subsequent magmatic activity occurred in the north, but only magmatic activity in the south. Both metamorphic and magmatic activities are associated with formation of a unified basement responsible for cratonization of the Yangtze Block due to assembly of supercontinent Columiba.

Zircon ε_{Hf} (t) values of about –6.5 and model Hf ages of about 3.0 Ga were obtained for the metapelites, suggesting that their protolith is ancient Archean crust. $\delta^{18}O$ values of 11‰ and 8‰ were obtained for quartz from the metasediments and garnet from the amphibolite, respectively, indicating that their sources experienced supracrustal recycling. Whole-rock analyses show arc-like distribution of trace elements in the 2.0-1.8 Ga rocks, suggesting their derivation from reworking of arc-sourced rocks. Thus, the continental accretion around the Yangtze continental nucleus was realized by arc-continent collision orogeny during the Columbia assembly. This provides a geodynamic link between the Yangtze cratonization and the global tectonothermal event in the middle Paleoproterozoic.

Ubiquitous and expanding biosphere in deep sediments: Inferred from a microbial profile of Quaternary terrigenous deep deposit, Qaidam Basin, China

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In extreme environments such as hot springs, thermophiles can survive at 121°C, even at 360°C. However, the knowledge on the distribution of the deep biosphere in normal deposits is limited due to objective reasons, such as the difficulty in obtaining deep samples [1].

The present paper investigated a profile (from 200 m to 2400 m) located in the Sanhu region of the Qaidam Basin, Northwestern China, a world famous biogas-producing area in the Quaternary. The results showed that as anticipated, abundant bacterial populations occur from the shallow (100 m) to deep (2400 m, T-101 °C; P-27 Mpa). The number of microorganisms remains between $6.9\times10^3 \sim 4.4\times10^5$ /cm^3 even in the depths of 2396 m ~ 2400 m. The bacterial populations do not decrease with increasing depth, bacterial populations in the depth of 1596 m (71.6 °C, 18.3 Mpa) and the layer below are obviously more than those in the two upper layers (± 600 m and ± 1100m). The nutrient substrate produced by thermal stress could explain this phenomenon [2, 3]. Affected by the lithology of the deposit itself, the number and types of microorganisms vary a lot even over tens of centimeters. All these characteristics demonstrate that the nutrient is the key to the deep biosphere, and that relatives high temperatures of normal deep sedimentary environments does not regulate the survival of microorganisms. The wide distribution of microorganisms during weakly diagenetic stage gives us a novel view of the total number of microorganisms in the deep biosphere. The discovery of commercial biogas accumulations in the Sanhu region of Qaidam Basin, to a certain extent, reflects that the role of microorganisms is much greater than we can imagine.

[1] Parkes *et al*. (2000) *Hydrogeol J* **8**, 11–28. [2] Wellsbury *et al*. (1997) *Nature* **388**, 573–576. [3] Horsfield *et al*. (2006) *Earth & Planetary Science Letters* **246**(1-2), 55–69