Appalachian-style multi-terrane Wilson cycle model for the assembly of South China

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Recently, Lin et al. (2018) stated that eastern South China underwent a polyphase accretion-collision history in the form of an Appalachian-style Wilson cycle. In fact, the available evidence doesn’t support their model.

1. Evidence from Sedimentology

The early Paleozoic: The NE-SW-trending Shaoxing-Jiangshan fault zone divided the South China Block into two depositional regions: Yangtze and Cathaysia. Considering that the entire South China region has been geochemically mapped at the 1:200,000-scale, we herein relate recent investigations, providing the following major geo-sedimentological facts as evidence against Lin et al.’s model:

(1) During the early Paleozoic, the Cathaysia region was marked by 5600–7000-m-thick clastic-facies sandy-muddy depositional sequences. In contrast, the Jiangnan region shows well-developed 3000–5400-m-thick coral-brachiopod-facies carbonate assemblages. The Cambrian-Ordovician depositional sequence in Cathaysia witnessed a period with a neritic-bathyal environment, but not a deep-sea one.

(2) Samples collected from early Paleozoic strata show a passive continental margin setting with negative εNd(t) values from –8.9 to –13.7 and model ages of 2.04–2.36 Ga.

(3) Contemporaneous ophiolite mélangé, volcanic rocks, and turbidites are absent in the Bonma sequence.

The late Paleozoic: After the late Devonian, the entire South China Block entered a stable late Paleozoic depositional period that formed a large carbonate-elastic basin. Abundant fossils (coral, Brachiopoda, Fasculina, and terrestrial plants) are well-developed in various lithostratigraphic columns of eastern South China, indicating depositional settings of land, swampland, littoral areas, and shallow seas. Neither mantle-derived volcanic rock nor deep-sea turbidites have been found.

2. Evidence from Migmatic Rocks

Silurian plutons: More than 200 early Paleozoic S-type plutons have been reported. They occupy an area of 20,900 km² (Wang et al., 2013; Song et al., 2015) and yield 215 groups of zircon U-Pb and mica Ar-Ar ages (460–390 Ma), with a peak age of 440–420 Ma. The (most) garnet-bearing assemblages display peraluminous signatures, negative εNd(t) values from –3.1 to –12.5, and model ages of 1.23–2.43 Ga, suggesting that these plutons were generated from partial melting of ancient crustal rocks, in contrast to the coeval plutons (<2% area or <400 km²) with positive εNd(t) values from –1.4 to –3.2 originating from partial melting of mafic rocks in the lower crust.

Lin et al. cited the MT-HP–type disthene-bearing schist, with a depth of >35 km, in the northern Wuyi terrane as evidence of plate subduction in the early Paleozoic, but this schist in the Neo-Protorezoic Mayuan assemblage (Zhao and Cawood, 1999) has been recently dated with a metamorphic age of 860 Ma (Yao et al., 2017). Lin et al. also presented the gabbro remnants within the Chencai complex as evidence of plate accretion. However, the protolith age of gabbro collected from the same exposure was dated at 879 ± 10 Ma, while the white-colored metamorphic rims of zircons from this gabbro yielded a U-Pb mean age of 438 Ma. This evidence is an example of “the Neo-Protorezoic protolith (arc-type gabbro) which is metamorphosed into amphibolite in the Silurian” (Yao et al., 2017), the same as the garnet amphibolite in the neighboring Longyou area. It is unusual that Lin et al. didn’t take into account these important results in their model.

Triassic plutons: The early Mesozoic S-type plutons are also widely distributed in Cathaysia and Jiangnan. They yielded 179 groups of zircon U-Pb and mica Ar-Ar ages, clustering around 230 Ma (peak age of 240–220 Ma). 97% of the plutons show peraluminous signatures, negative εNd(t) values from –2.2 to –14.3, and model ages of 1.41–2.28 Ga, relative to coeval I-type plutons (<3% of the total area) with positive εNd(t) values from +0.5 to +3.2, derived from partial melting of the lower crust.

In addition to the magmatism that took place within the lithospheric plate, neither Silurian nor Triassic plutons that are distributed throughout an area 1200 km long and 600 km wide show any belt-type geometric features, in contrast to various other accretion/collision belts around the world. The aforementioned two-phase plutons triggered coeval gneiss-facies metamorphism with peak ages of 430–420 and 230–210 Ma, which took place on the margins of plutons and the neighboring wall rocks (Song et al., 2015). Far from the plutons, only regional lower-greenschist-facies slate and phyllite exist, absent of any high-temperature metamorphic rock.

3. Northwest Fujian Fault (NWFF) is not a Boundary Structure

The same early Paleozoic and late Paleozoic strata sequences and rock assemblages occur on both sides of the NWFF. This fault does not trigger a large-scale displacement of pre-Mesozoic strata and plutons. Locally, decameter-scale mylonites are developed around some plutons, but not along this fault. Geological facts do not support Lin et al.’s NWFF being the boundary between West and East Cathaysia.

4. Fuchuan Ophiolite Mélange belongs to the Huiyu Terrane, but not to the Jiuling Terrane

The origins of the Huiyu and Jiuling terranes were proposed by Shu et al. (1995) and were identified in detail. It is unusual that Lin et al. never cited the original documents, and made mistakes in the boundary location of the two terranes. In fact, the Fuchuan ophiolite mélange is located to the southeast side of the Northeast Jiangxi fault and to the northwest margin of the Huiyu terrane, not within the Jiuling terrane as asserted by Lin et al.

Conclusions

(1) The early Paleozoic and early Mesozoic events in South China do not result from plate accretion/collision; intraplate tectonism is a better candidate. Lin et al.’s model is not supported by occurrences of S-type granitoids (>97% of total area) and sedimentological signatures; their conclusions are not supported by the regional geological facts. (2) The Northwest Fujian fault cannot be considered a boundary of two geotectonic units. (3) Lin et al.’s model didn’t take into account recent results.

REFERENCES CITED