Did the Lhasa Terrane Rift from the Indian Subcontinent?

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In a generally believed tectonic model for the evolution of the Tibetan terranes, the Qiangtang, Lhasa, and Himalaya terranes were rifted and drifted from the northern ancient Indian subcontinent and sequentially added to Eurasia (Allègre and others, 1984; Metcalfe, 2002). Audley-Charles (1983, 1984), on the other hand, argued that the Lhasa Terrane has close affinity to the ancient Australian continent, instead of the Indian subcontinent, based on the sudden change of coexisting warm and cold water biota on the Lhasa terrane due to the mixing of the warmer Paleotethyan Ocean water rather than a quick change of paleoclimate. However, this interesting proposal has not been generally accepted scientifically due to the lack of evidence and remains the "Charles Puzzle" in Tibetan geology. Here, we present new paleomagnetic and geologic data from the Lhasa terrane. Coupled with other recently available data, our results support Audley-Charles's argument and suggest that Lhasa Terrane was rifted from the ancient north Australian, not the north Indian subcontinent. Our paleomagnetic data show that the Lhasa terrane occupied paleolatitudes of 25-35°S in the Late Carboniferous (Pennsylvanian), at 45-50°S in the Early-Middle Permian, and at 30-45°S in the Late Permian. After the Permian, the Lhasa terrane moved northward and did not return south again. The paleolatitude changes indicate a complicated displacement history of the Lhasa terrane, which does not fit with the swift northward-drifting model. Recent published lithochemical evidence suggests that volcanic islands were present in the southern edge of the Lhasa terrane in the Middle Permian (Zhu and others, 2010), but the coeval rocks were of rift-type volcanic rocks in the northern Indian margin (Zhu and others, 2010). Provenance analyses also indicate that the peak age of zircon U-Pb isotope is 1160 Ma (Zhu and others, 2009), which is similar to those from Northern Australia. Thus our new data reinvigorates the debate about the "Charles Puzzle".

References

Allègre, C.J., and others, 1984, Structure and evolution of the Himalayan-Tibet orogenic belt, Nature, 307, 17-22.
Audley-Charles, M.G., 1983, Reconstruction of eastern Gondwanaland, Nature, 306, 48-50.
Audley-Charles, M.G., 1984, Cold Gondwana, warm Tethys and the Tibetan Lhasa block, Nature, 310, 165.
Metcalfe, I., 2002, Permian tectonic framework and palaeogeography of SE Asia, Journal of Asian Earth Sciences, 20, 551-566.
Zhu, D.C., and others, 2009, Zircon U-Pb dating and in-situ Hf isotopic analysis of Permian peraluminous granite in the Lhasa terrane, southern Tibet: Implications for Permian collisional orogeny and paleogeography, Tectonophysics, 469, 48-60.
Zhu, D.C., and others, 2010, Presence of Permian extension- and arc-type magmatism in southern Tibet: Paleogeographic implications, GSA Bulletin, 122, 979-993.

Cite as: Wang, C., Ran, B. and Zhao, X., 2010, Did the Lhasa Terrane Rift from the Indian Subcontinent?, *in* Leech, M.L., and others, eds., Proceedings for the 25th Himalaya-Karakoram-Tibet Workshop: U.S. Geological Survey, Open-File Report 2010-1099, 1 p. [http://pubs.usgs.gov/of/2010/1099/wangc/].