The early Cretaceous Xigaze ophiolites formed in the Lhasa forearc: evidence from paleomagnetism, sedimentary provenance, and stratigraphy*

Wentao Huang[1,2], Douwe J.J. van Hinsbergen[2], Marco Maffione[2],Devon A. Orme[3], Guillaume Dupont-Nivet[1,2,4,5], Peter C. Lippert[3],Carl Guilmette[6], Nathaniel Borneman[7], Kip Hodges[7], Lin Ding[8]; Zhaojie Guo[1]; Paul Kapp[3]

[1] Key Laboratory of Orogenic Belts and Crustal Evolution, Ministry of Education, School of Earth and Space Sciences, Peking University, Beijing 100871, China, W.Huang@uu.nl
[2] Department of Earth Sciences, Utrecht University, Budapestlaan 17, 3584 CD, Utrecht, The Netherlands
[3] Department of Geosciences, University of Arizona, Tucson, Arizona 85721, USA
[4] Géosciences Rennes, UMR 6118, Université de Rennes 1, Campus de Beaulieu, 35042 Rennes Cedex, France
[5] Institute of Earth and Environmental Science, University of Potsdam, Karl-Liebknecht-Str. 24-25, 14476 Potsdam-Golm, Germany
[6] Département de Géologie et de Génie Géologique, Université Laval, Québec, Qc., Canada G1K 7P4
[7] School of Earth and Space Exploration, Arizona State University, Tempe, Arizona, USA
[8] Key Laboratory of Continental Collision and Plateau Uplift, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing, China

The Xigaze ophiolite belt, exposed in the Yarlu-Tsangpo suture zone, contains thinned remnants of an oceanic lithosphere formed during the closing of the Tethys Ocean in early Cretaceous. At this time, its latitudinal position between the converging Indian and Asian continents has direct implications on understanding the timing and processes of the subsequent continental collision. Here we report paleomagnetic investigations on the Lower Cretaceous sedimentary rocks unconformably covering mantle lithosphere of the Xigaze ophiolites in Sangsang, and interfingering with radiolarian sequences in Qunrang (Southern Tibet). Detrital zircon U–Pb ages of the Sangsang sedimentary rocks indicate a clear Gondwanan suggestive of a Lhasa terrane provenance. The youngest peak of the age spectrum constrains the deposition age to be ~120 Ma, which is further tested through calcareous nannofossil biostratigraphy of this section. A positive fold test of the isolated characteristic remanent magnetization (ChRM) shows that these sediments from Sangsang likely carry a primary magnetization. At face value, the paleomagnetic results from the Sangsang sedimentary rocks suggest the deposition at rather low latitude, of ~8°N, consistent with previous findings. However, rock magnetic tests and ChRM direction analyses show us that it is very likely that these Sangsang sedimentary rocks were affected by compaction/compression-induced inclination shallowing. We apply two different correction methods to estimate the magnitude of inclination shallowing. Using the elongation/inclination (E/I) correction method, the mean inclination is corrected from 16.9° to 30.2° within 95% confidence limits between 24.8° and 37.3°; Using an anisotropy-based inclination correction method steepens the mean inclination to 31.1 ± 9.6° after a curve fitting-determined particle anisotropy of 1.40 is applied. These corrected inclinations are statistically indistinguishable from each other and yield an estimated paleolatitude of ~17°N. We also investigated the Qunrang sediments deposited ca. 116 Ma as indicated by the zircon U–Pb dating of the interbedded tuff. Isolated ChRM directions from the Qunrang sediments correspond to a paleolatitude of ~12°N. Although we cannot correct the potential inclination shallowing in these sediments due to limited dataset of the ChRM directions and unavailability of anisotropy data, the distribution of the ChRM directions strongly suggest that these were also affected by inclination shallowing. Our new findings imply that spreading and extensional dismemberment of the Xigaze ophiolites occurred around ~17°N, immediately adjacent to the southern margin of the Lhasa terrane from which a contemporaneous ~16°N paleolatitude estimate was published. The Xigaze forearc sediments are Lhasa-derived and unconformably cover the Xigaze ophiolites ocean floor. Previously published interpretations of an equatorial formation latitude, and the existence of a major subduction thrust between the Xigaze ophiolites and the Xigaze forearc sediments are inconsistent with our observations of their contact, our paleomagnetic measurement, and our sediment provenance results.

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