LETTER

Reply to Aitchison and Ali: Reconciling Himalayan ophiolite and Asian magmatic arc records with a two-stage India-Asia collision model

We recently presented a compilation of paleomagnetic data arguing for Cretaceous extension within Greater India. These data imply that a Tibetan Himalayan (TH) microcontinent rifted away from India, opening an oceanic Greater India Basin (GIB) in its wake. Consequently, we postulated a two-stage India-Asia collision at ∼52 and 25–20 Ma (1).

Aitchison and Ali (2) argue against this scenario because they infer that accretion of a microcontinent should have increased the width of the forearc, which would cause the Gangdese volcanic arc to migrate southward, assuming constant slab dip. Instead, they infer a stationary arc between ∼65 and 35 Ma. They overlook, however, that the Gangdese arc is currently located immediately adjacent to the suture between the TH and the Asian Lhasa terrane: The precollisional forearc, presently only found as relics in the suture (3), must have almost entirely disappeared by compression, probably upon the ∼52-Ma TH-Lhasa collision. Southward migration of the trench due to accretion of the TH microcontinent (which, corrected for postcollisional shortening, was at least 300–400 km wide) was thus largely compensated for by almost complete removal of the forearc. The TH only contains accreted precollisional upper crust, and ongoing subduction must have removed its original underpinnings on collision (e.g., 4). Given the 16- to 18-cm/y convergence rates during initial collision, TH and forearc shortening could have occurred within ∼3–4 Myr (at plate tectonic rates) or 10–15 Myr (at modern Himalayan rates). Both time windows are rapid enough that the geological record of the arc-trench distance may appear constant. Rapid subduction of the TH microcontinental lower crust may have caused the ∼50-Ma Gangdese ignimbrite flare-up, followed by return of the arc to a background state on subsequent GIB subduction.

Additionally, Aitchison and Ali (2) argue that stratigraphic data we cited for a 70-Ma ophiolite obduction age are misdated and should be ∼55 Ma instead. They disregard independent evidence for ∼70- to 60-Ma thrusts, sealed by ∼60- to 50-Ma carbonates in the TH underlying the Spontang ophiolite showing there was ∼70-Ma ophiolite obduction (5) at equatorial latitudes (1). If an additional ∼55-Ma obduction event is demonstrated, paleomagnetic data from the TH would require an obduction latitude close to the southern Lhasa margin, shortly followed by the ∼52-Ma TH-Lhasa collision. Such ophiolites could then be straightforwardly explained as representing the precollisional forearc mentioned above.

We stress that we consider making detailed models for TH ophiolite obduction premature, given the uncertainties in the number of ophiolites, their age(s), and paleomagnetically constrained paleolatitude(s). The brief discussion above, however, illustrates that the two-stage India-Asia collision hypothesis can be rather straightforwardly reconciled with Himalayan ophiolite and Asian arc evolutions, whatever those may turn out to be. We note that a ∼55-Ma ophiolite obduction at equatorial paleolatitudes and a ∼34-Ma TH-Lhasa collision advocated by Aitchison and Ali (2) are entirely inconsistent with the high-quality paleomagnetic data that we presented (1), irrespective of the ophiolite obduction and arc evolution of the India-Asia collision system.

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