Geophysical Research Abstracts, Vol. 8, 01433, 2006
SRef-ID: 1607-7962/gra/EGU06-A-01433

Constraints on Indian plate motion since 20 Ma from dense Russian magnetic data: Implications for Indian plate dynamics

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We use more than 230,000 km of Russian marine magnetic and bathymetric data from the Carlsberg and northern Central Indian ridges, comprising one of the most geographically extensive, dense shipboard surveys anywhere in the ocean basins, to describe in detail seafloor spreading since 20 Ma along the trailing edge of the Indian plate. India-Somalia plate rotations for ˜1 Myr intervals over the past 20 Myr are derived from inversions of more than 6600 crossings of 20 magnetic reversals and ˜1400 crossings of fracture zones that offset these two ridges. Statistical analysis of the numerous data indicates that outward displacement of reversal boundaries due to finite seafloor emplacement widths and correlated noise for anomaly crossings from individual spreading segments constitute two distinct sources of systematic bias in the locations of magnetic anomaly crossings, contrary to the often-made assumption that random, Gaussian-distributed noise dominates the error budget. Seafloor spreading rates slowed gradually by 30% from 20 Ma to 10+/-1 Ma about a relatively stationary pole of rotation. From 11 Ma to 9 Ma, the rotation axis migrated several angular degrees toward the plate boundary, modestly increasing the spreading gradient along the plate boundary. India-Somalia kinematic data for times since ˜9 Ma are consistent with remarkably steady motion, with no evidence for a change in either the rotation pole or rate of angular opening within the few percent precision of our data. The timing and nature of changes in India-Somalia motion since 20 Ma closely resemble those for the Capricorn-Somalia plate pair, indicating that India and Capricorn plate motions are strongly coupled. We speculate that the slowdown in seafloor spreading at the trailing edges of the Indo-Capricorn composite plate from 20 Ma to 10+/-1 Ma resulted from the increasing amount of work that was needed to build topography in

the Himalayan collisional zone. The transition to stable India-Somalia and Capricorn-Somalia seafloor spreading at 10-9 Ma corresponds well with the onset at 8 Ma of folding and faulting across an equatorial plate boundary separating the Indian and Capricorn plates, suggesting that the latter may have played a fundamental role in restoring equilibrium between the torques that were driving and resisting the northward motions of the Indian and Capricorn plates.