The collision of India and Asia – paleomagnetic investigations on the Lhasa Block and the Tethyan Himalayan sediments

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The timing of initial collision of India and Eurasia is a key issue for models of the formation of the Tibetan Plateau and the Himalayan mountain range. In spite of decades of research it is still highly debated with ages ranging from 34 Ma to about 60 Ma (e.g. Ding et al. 2003; Aitchison et al. 2007; Najman et al. 2010). To determine the collision age it is crucial to know the shape of the colliding continents prior to the collision. Paleomagnetism is the only method to directly determine the paleolatitudinal positions of the pre-collisional southern margin of Eurasia and northern margin of India. Recently several paleomagnetic investigations were carried out on the Lhasa block on the Linzizong volcanic rocks (LVR) (Chen et al. 2010; Dupont-Nivet et al. 2010; Liebke et al. 2010; Sun et al. 2010; Tan et al. 2010). Mean values for the different formations of the LVR yield paleolatitudes ranging from 6.7 to 16.8°N (summary in Najman et al. 2010). Our new paleomagnetic investigation on a dyke swarm (LD B) in the Linzhou basin confirmed this by a paleolatitude of 15.4±7.3°N. Averaging all results of recent paleomagnetic investigations on the Lhasa block yields a paleolatitude for the pre-collisional southern Eurasian margin of 12.7°N (Fig. 1) for a reference point at the suture zone (90°E/29°N).

Paleomagnetic investigations on sediments of the Tethyan Himalayas (Zongpu Fm) of Patzelt et al. (1996) in the Gamba and Duela areas revealed a paleolatitude for the pre-collisional northern margin of India of 4.7°N for about 58.5 Ma at the reference point. New results from the Dibling limestone in the Zanskar area, northern India, are very promising and yield a paleolatitude of 0.4°N for western India (34°N/76.5°E) for the deposition age of the Dibling limestone, i.e.late early Paleocene - late Paleocene (Nicora et al. 1987). These results are only preliminary and further investigations are necessary in order to test for a primary magnetization and to yield sufficient data for statistical analyses on all submembers of the Dibling limestone and thus get a better temporal resolution. In Figure 1 the paleomagnetic results for India and Eurasia are summarized. By intersection of the pre-collisional southern Eurasian and northern Indian margins a collision age of 53 Ma and 55 Ma was calculated for central and western Tibet (provided that the southern Eurasian margin has a similar paleolatitude in western Tibet than in the central part), respectively. The amount of crustal shortening can be determined by comparing the paleolatitudes from the present day shaped continents given by the apparent polar wander paths (APWPs) and the paleolatitiudes of the extended continents. The above results imply crustal shortening along the southern Eurasian margin at 90°E of about 1790 km since the collision and along the northern Indian margin of about 1290 km (Patzelt et al.1996) and 1400 km (results of Dibling limestone) (Fig. 1).

Furthermore, paleomagnetic investigations were carried out on the Tethyan Himalaya in the Tingri area in central Tibet. The results indicate a synfolding remanence with a possible remanence acquisition age between 49 Ma and 58 Ma. Thus folding of the sediments of the Tingri area started within that time span. Assuming that the folding is directly related to the India-Eurasia collision we yield a constraint for the latest possible collision age of about 49 Ma, supporting our prior results.

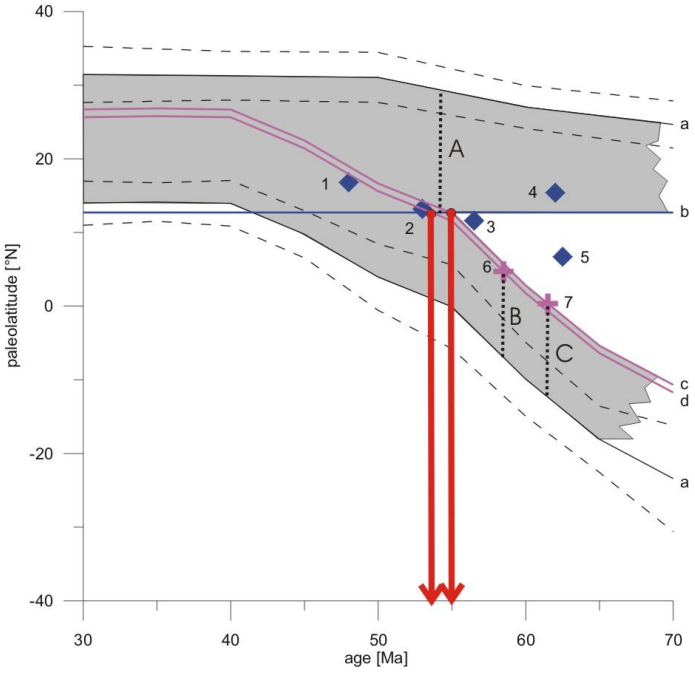

Figure 1. Results of paleomagnetic investigations on the Lhasa block and the Tethyan Himalayan sediments together with the APWPs of India and Eurasia. Diamonds show paleolatitudes for the southern Eurasian margin: 1: mean of Pana Fm, 2: dykes of Liebke et al. 2010, 3: mean Nianbo Fm, 4. LD B, 5: mean Dianzhong Fm. Crosses show paleolatitudes for the northern Indian margin: 6: Patzelt et al. 1996; 7: preliminary results of the Dibling limestone. Solid lines: a: APWPs of India and Euraisa (Besse & Courtillot 2002) with A95 errors indicated by dashed lines, b: paleolatitude of the southern Eurasian margin (mean of all diamonds), c,d: paleolatitude of northern India calculated by c: results of Dibling limestone and d: Patzelt et al. 1996. The red arrows indicate the collision age. Dotted lines illustrate the amount of crustal shortening: A: along the southern Eurasian margin, B, C: along the northern Indian margin based on results of B: Patzelt et al. 1996 and C: Dibling limestone.

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