



## When did India and Asia collide? Re-evaluating constraints from the Indus Group of the Indus-Tsangpo Suture zone, Indian Himalaya.

A. Henderson (1), Y. Najman (1), R. Parrish (2), G.L. Foster (3), E. Garzanti (4), and S. Andò (4)

(1) Lancaster University, Dept Environmental Science, Lancaster, United Kingdom (a.henderson@lancs.ac.uk), (2) NERC Isotope Geosciences Laboratory, British Geological Survey, Nottingham, UK, (3) Department of Earth Sciences, Wills Memorial Building, University of Bristol, UK, (4) Dipartimento di Scienze Geologiche e Geotecnologie, Università Milano-Bicocca, Milano, Italy

The Indus Group includes marine and terrestrial Tertiary sedimentary rocks which were deposited in an evolving late-forearc to intermontane basin setting during the closure of Neo-Tethys and onset of India-Asia collision (Brookfield and Andrews-Speed 1984, Van Haver 1984, Searle 1990, Sinclair and Jaffey 2001, Clift et al. 2002). Clift et al. (2002) have constrained the age of collision by determining the lowermost stratigraphic point in the Indus Group that contains detritus from both Indian and Asian plates, and also by identifying where the Asian margin derived Indus Group unconformably overlies Indian margin sediments. The Chogdo Formation, dated by an overlying limestone at older than 54.9 Ma (O. Green, unpublished data cited in Sinclair and Jaffey 2001) is identified by Clift et al. (2001), to be the oldest unit of the Indus Group to contain detritus from both the Indian and Asian plates, and to stratigraphically overly Lamayuru Group Indian slope turbidites and Jurutze forearc basin rocks, thereby pinpointing the timing of continental collision to the Late Paleocene. However, despite its importance, these previous evaluations of the Indus Group have been hampered by poor stratigraphic knowledge and uncertain lateral correlations, largely due to the relatively complex deformation of the rocks and poor biostratigraphic control, and by application of only a limited number of techniques to assess provenance.

We use a combination of geological mapping, biostratigraphy, facies analysis, petrography, bulk rock geochemistry, and isotopic characterisation of single detrital grains to 1) create an accurate and more widely representative stratigraphy for the Indus Group, 2) determine the nature of the contacts which separate the overlying Indus Group from underlying Indian and Asian Plate formations and 3) determine the provenance of the Group, in particular the stratigraphic level within the Indus Group at which both Indian and Asian plate detrital minerals occur together, in order to constrain the time of collision and discover which geological terranes were exhumed and actively eroded during the early stages of the Himalayan orogeny. Our initial analyses indicate that 1) the Chogdo Formation may not be as widely occurring as previous interpretations have led to believe; partly due to obscured tectonic contacts and problems with lateral correlations along strike. Therefore certain stratigraphic intervals which are currently identified as belonging to the Chogdo Formation may well be younger (<48.6 Ma; Wu et al. 2007) Indus Group formations; 2) The Chogdo Formation is overwhelmingly Asian-derived, and there is no unequivocal evidence for input from the Indian plate. Reassessment of constraints to the timing of closure of Neotethys, and consequent India-Asia collision as determined from the Chogdo Formation is therefore required.

Brookfield ME and CP Andrews-Speed. 1984. *Sedimentary Geology* 40: 249–286  
Clift PD, N Shimizu, GD Layne and J Blusztajn. 2001. *Earth & Planetary Sci. Let.* 188: 475–491  
Clift PD, A Carter, M Krol and E Kirby. 2002. In: Clift PD, D Kroon, C Gadicke and J Craig (eds), *Geological Society Special Publication* 195: 97–116  
Searle MP, KT Pickering and DJW Cooper. 1990. *Tectonophysics* 174: 301–314  
Sinclair HD, and N Jaffey. 2001. *J. Geological Society of London* 158: 151–162  
Van Haver T. 1984. *Etude stratigraphique, sedimentologique et structurale d'un bassin d'avant arc: Exemple du bassin de l'Indus, Ladakh, Himalaya* [Ph.D dissertation]. Grenoble, France: Universite de Grenoble. 204 p  
Wu FU, PD Clift and JH Yang. 2007. *Tectonics* 26: TC2014