

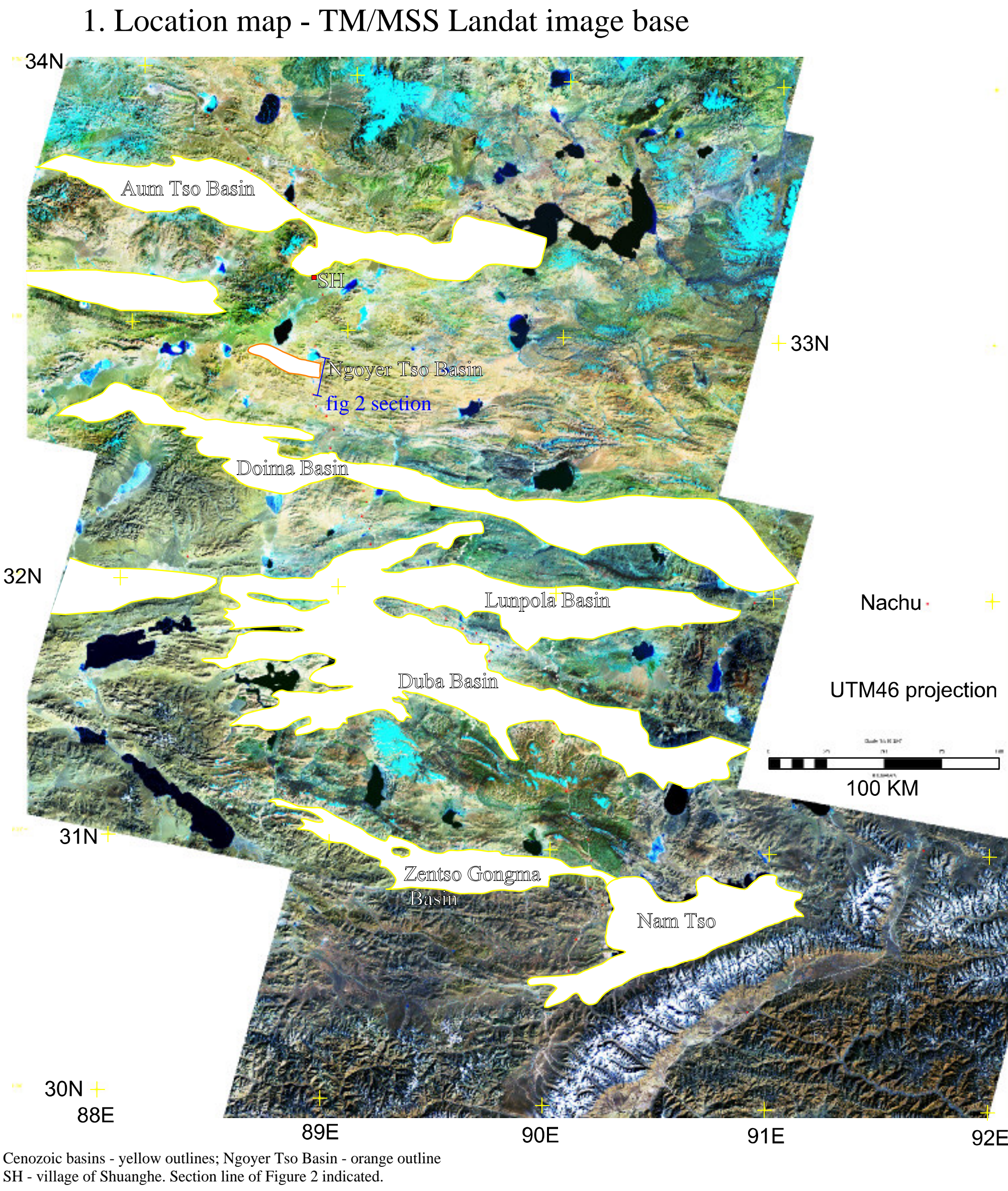
Timing and amount of crustal shortening, Shuanghe area, Central Tibet

W.S.F. KIDD¹, M.A. EDWARDS², Y. LI¹, K.D. NELSON³, L. RATSCHBACHER², Z. WU⁴

¹Earth & Atmospheric Sciences, University at Albany, Albany, NY 12222 USA.
²Institut für Geologie, Technische Universität Bergakademie Freiberg, Freiberg, D-09596 Germany.
³Department of Geology, Syracuse University, Syracuse, New York, 13244 USA.
⁴Chinese Academy of Geological Sciences, Baiwanzhuang Road 26, 100037 Beijing, PRCina.

Abstract
Geological work during the INDEPTH III project in the region of the settlement of Shuanghe (88.5°E, 33.1°N) reveals new information bearing on the timing and amount of crustal shortening in this region of the central Chang Tang terrane of the Tibetan Plateau. Marine strata of Jurassic and older ages are moderately to strongly folded throughout this region and cut in places by thrusts, with N-S shortening amounts up to about 50%. These are locally overlain unconformably by less strongly folded strata, mainly red clastic rocks ranging from conglomerates to shales, with N-S shortening amounts in the range of about 15% where a detailed section was measured (Norma section). In one locality, southwest of Shuanghe, fossil-dated late early Cretaceous strata (Tibet RG Brigade, 1986), pebbly conglomerates, argillites, and calcareous arenites, are found between the overlying redbeds and the underlying more strongly-deformed rocks, with angularly unconformable contacts both above and below. These shallow marine Cretaceous strata suggest that normal crustal thickness existed in the area at deposition. The younger red beds resemble in facies and in north-directed paleocurrent orientation those of known Eocene age (Smith and Juntao, 1988) in the Fenghuoshan (north and northeast of this region), and Chinese investigators (Tibet RG Brigade, 1986) correlate them with similar fossil-dated early Tertiary redbed strata of the Lunpola Basin (to the south of this region). These well-lithified redbed strata cannot be Triassic, as shown by Kapp et al (2000). In this region these redbeds map at the base of E-W elongated basins that contain overlying Neogene, only partly-consolidated clastic strata. These basins are interpreted by us as being of intermontane, crustal-shortening origin; Burke and Lucas (1989) first pointed out that similar strata of the Lunpola Basin had undergone late Tertiary shortening. While there is most probably not sufficient total N-S shortening in the Cenozoic strata of this region to account everywhere for all or most of the doubling of crustal thickness, they are affected by a significant, non-trivial amount, and the shortening is nowhere near zero except locally in the youngest (Pliocene and/or younger) strata. The melange and ophiolitic rocks that form the oldest exposed rocks in this region have been interpreted by Kapp et al (2000) as originally underthrust from the Jinsha Suture. While Kapp et. al. are clearly right that a major regional low-angle detachment fault occurs at the top of this suite of rocks, we prefer a hypothesis for the origin of the melange and ophiolites, including the blueschists first identified by Hennig (1915), that it marks the suture zone between two parts of the Chang Tang terrane. This would provide a simple explanation (first proposed by Kidd et al, 1988) for the major contrast in origin of the "basement" rocks of the Chang Tang, as shown by their Carboniferous-Permian facies and fossils, being Gondwanan and glaciogenic in the west (Norin, 1946), but Cathaysian and non-glaciogenic in the east (e.g. Yin et. al., 1988). Geophysical data obtained during the INDEPTH III project may allow discrimination between these two hypotheses for the origin of the melange.

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Detailed map and section (Fig 3) shows Cretaceous (probably mid-Cretaceous) strata lying unconformably on and imbricated with early Triassic or older limestone. Red conglomerates and arenites of probable Cenozoic age rest with angular unconformity above; these are moderately tilted and folded. Location of detailed map, sections, given on Fig 4.

Section south of Shuanghe - shortening estimates

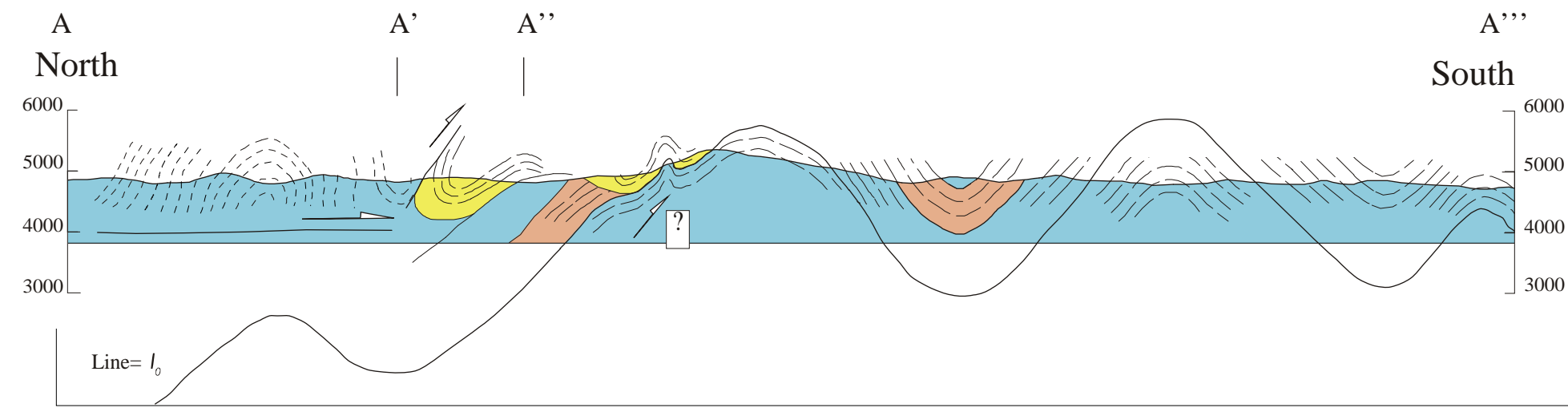


Fig 2. Norma fold/thrust belt south of Shuanghe. Approximately 50% shortening in Jurassic strata; estimated shortening about 15% in Cenozoic, which forms the base of the Ngoyer Tso basin. (2a - section; 2b - map, below)

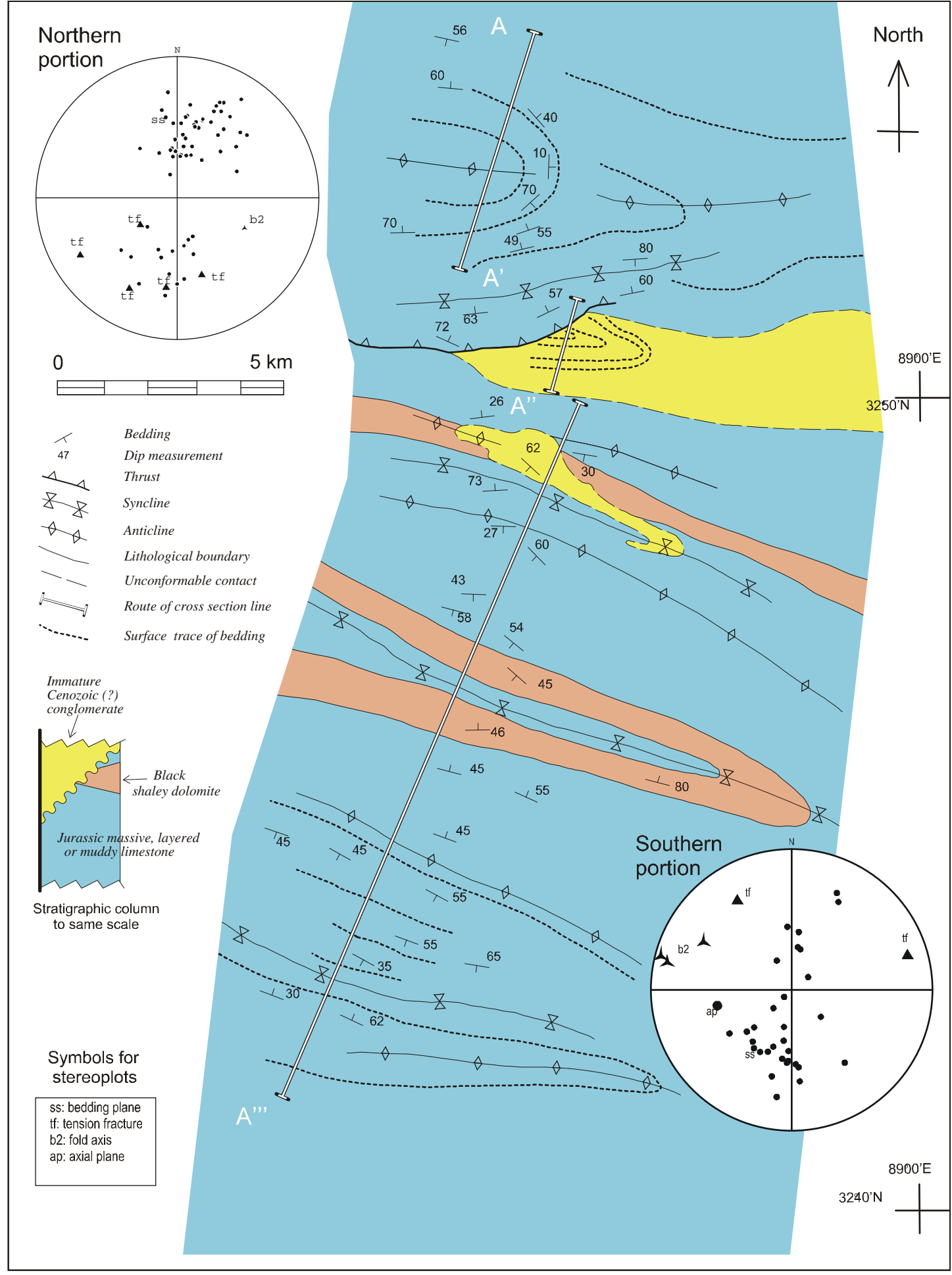


Fig 3. Cretaceous of west Shuanghe Graben

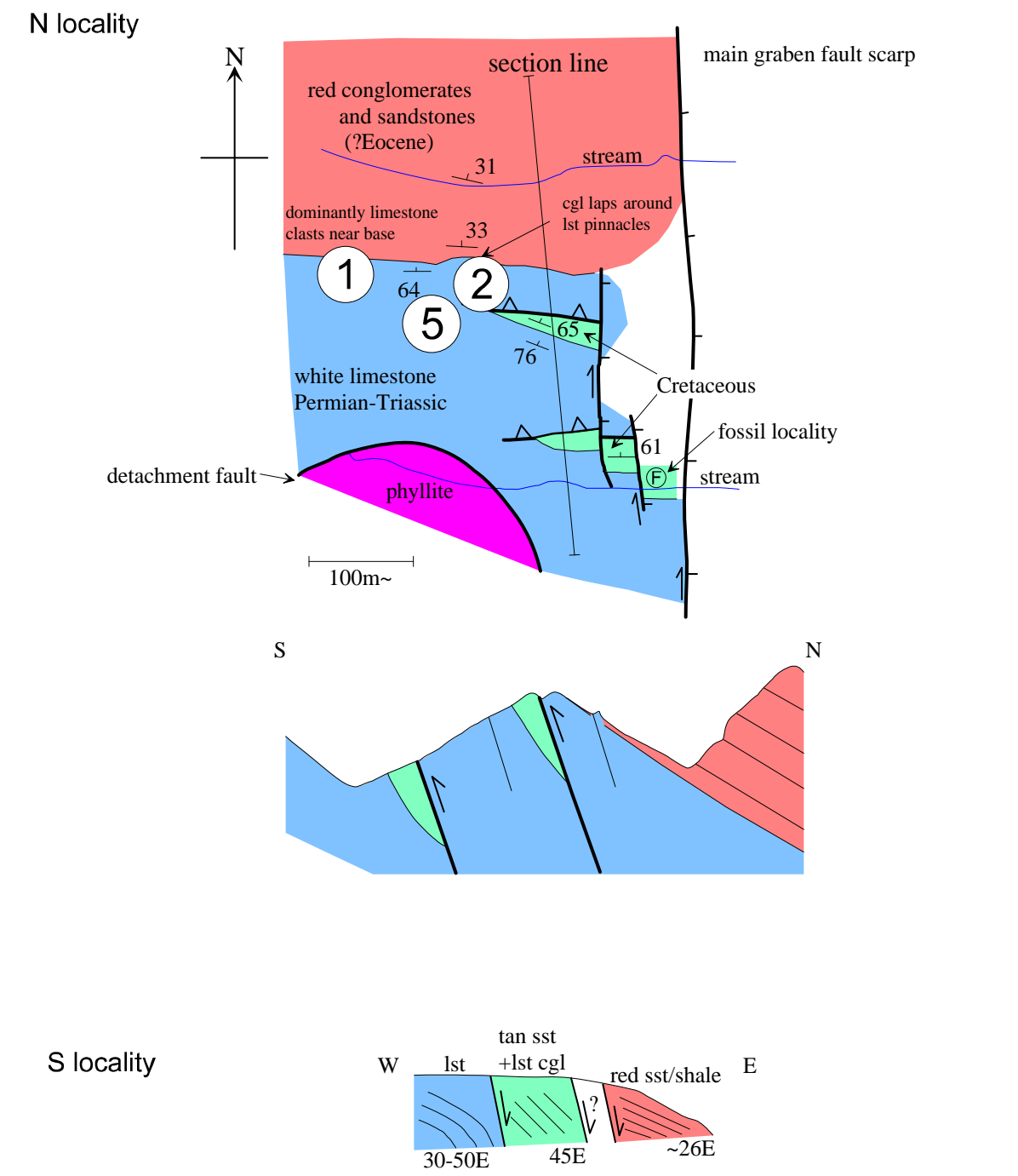
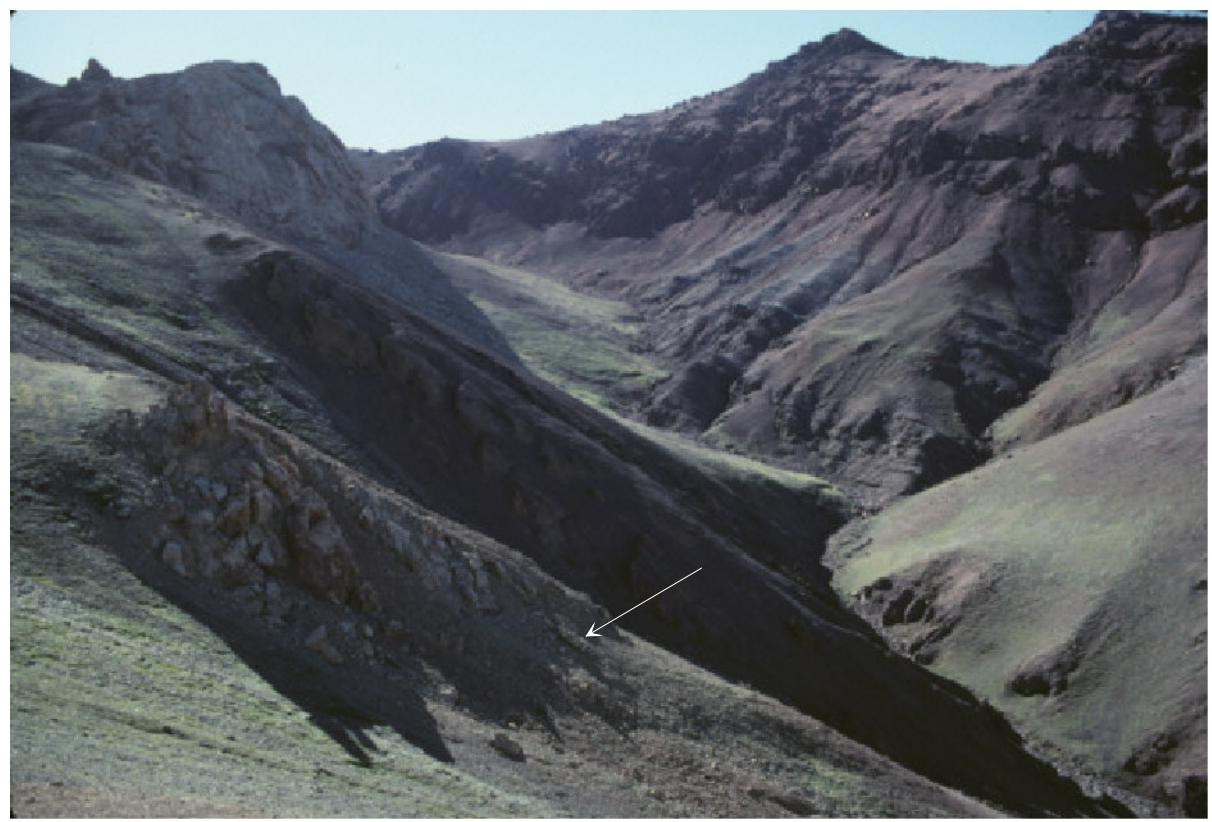
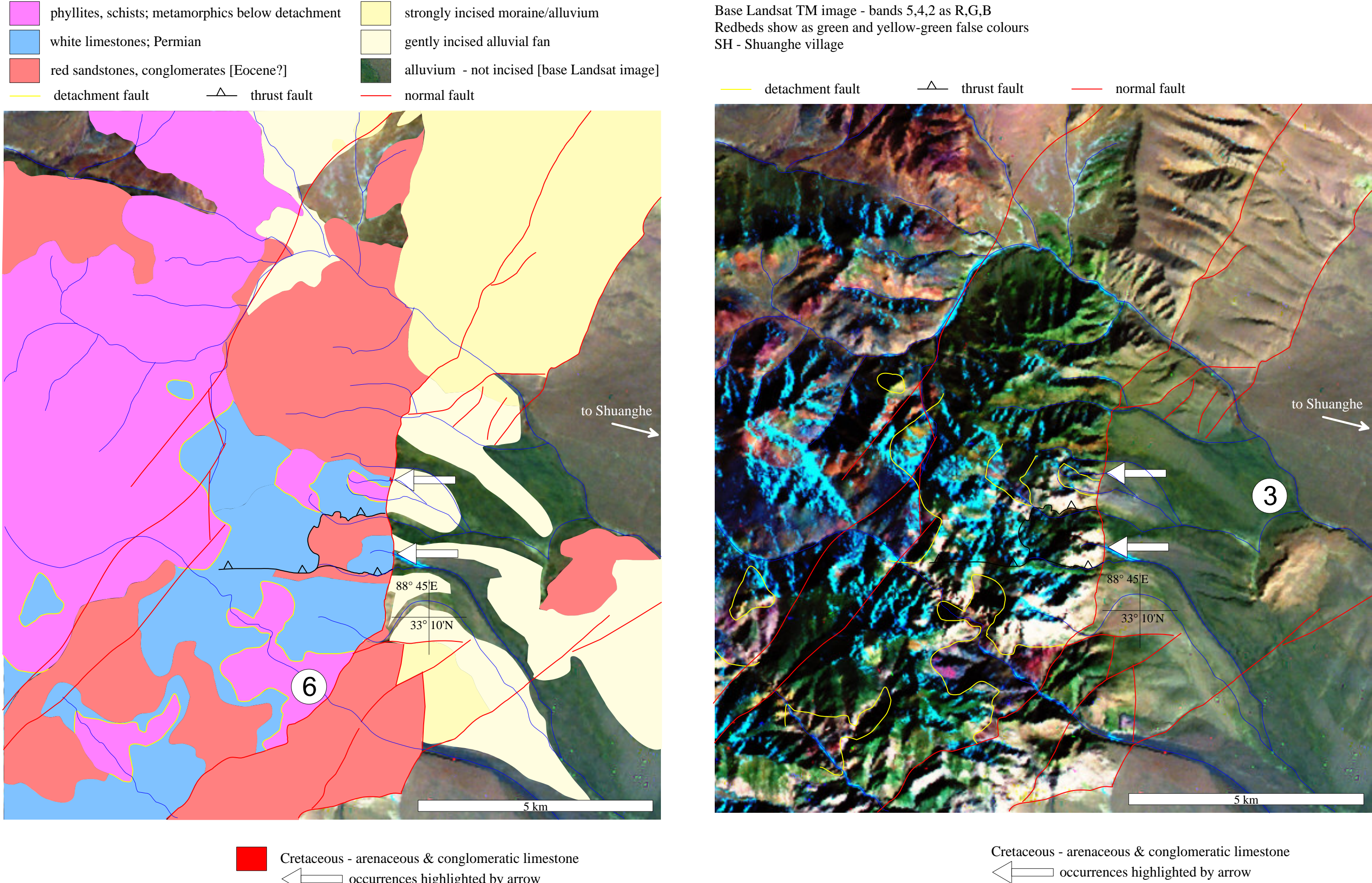


Fig 4a, b. Geological map and image base for central western margin of Shuanghe graben



① Red conglomerates and sandstones (Eocene?) unconformably over Triassic limestones. View to WNW. Unconformity arrowed. Redbeds strike ~E-W.



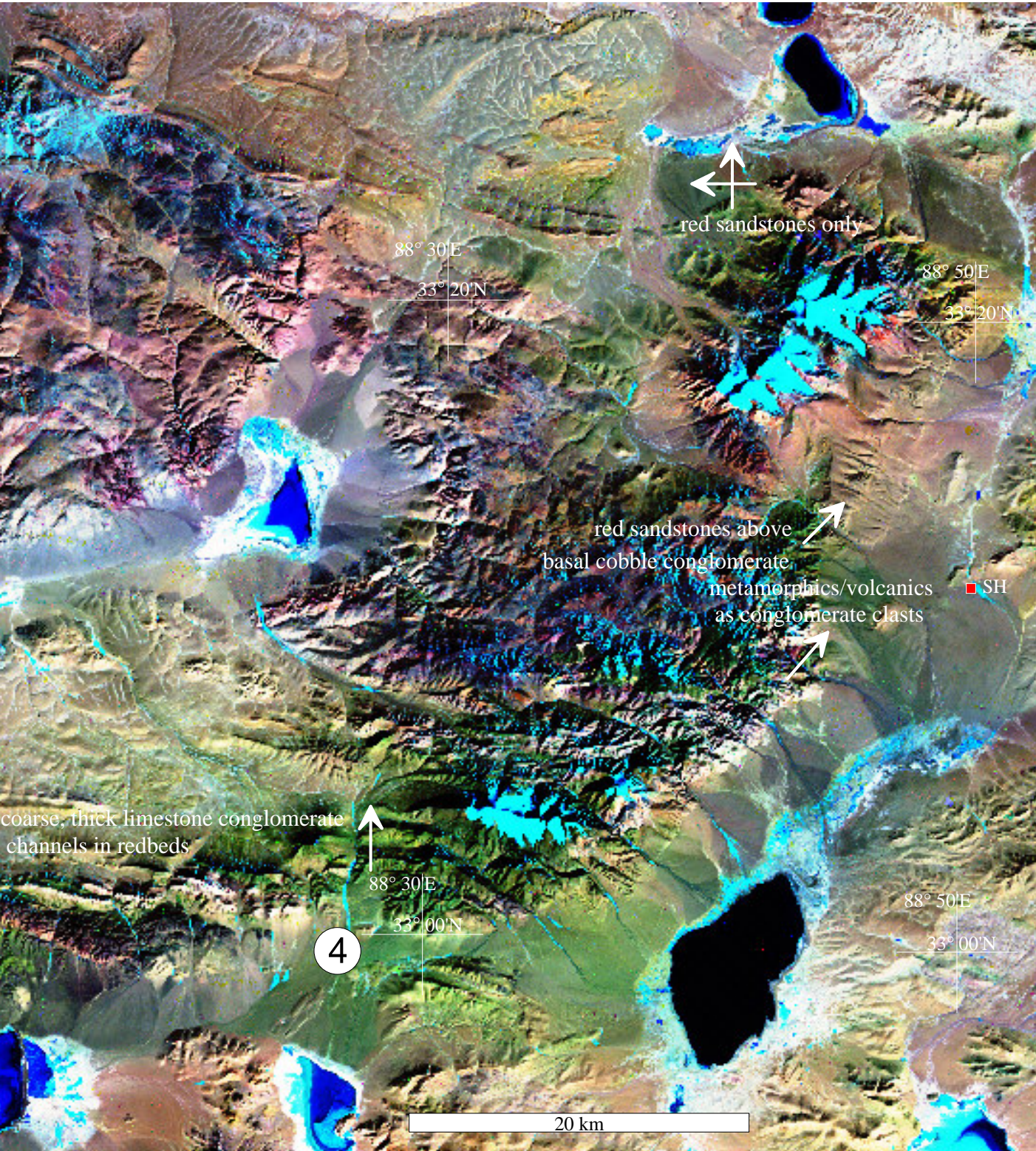
② Base of red conglomerates, with dip slope on right lapping around and unconformably overlying steeply-dipping Triassic limestones



④ Large conglomerate channel-fills in red arenites (Eocene?)

North-directed paleocurrents (Fig 5) and proximal to distal facies change (photos 4) suggest a source towards the Bangong Suture for the ?Eocene redbeds.

Fig 5. Red sandstone and conglomerate facies and paleocurrents - Shuanghe region (on Landsat TM image base)



Base Landsat TM image - bands 5,4,2 as R,G,B. Redbeds show as green and yellow-green false colours. SH - Shuanghe village.



④ (detail) cobble conglomerate from channel in redbeds - mostly limestone clasts

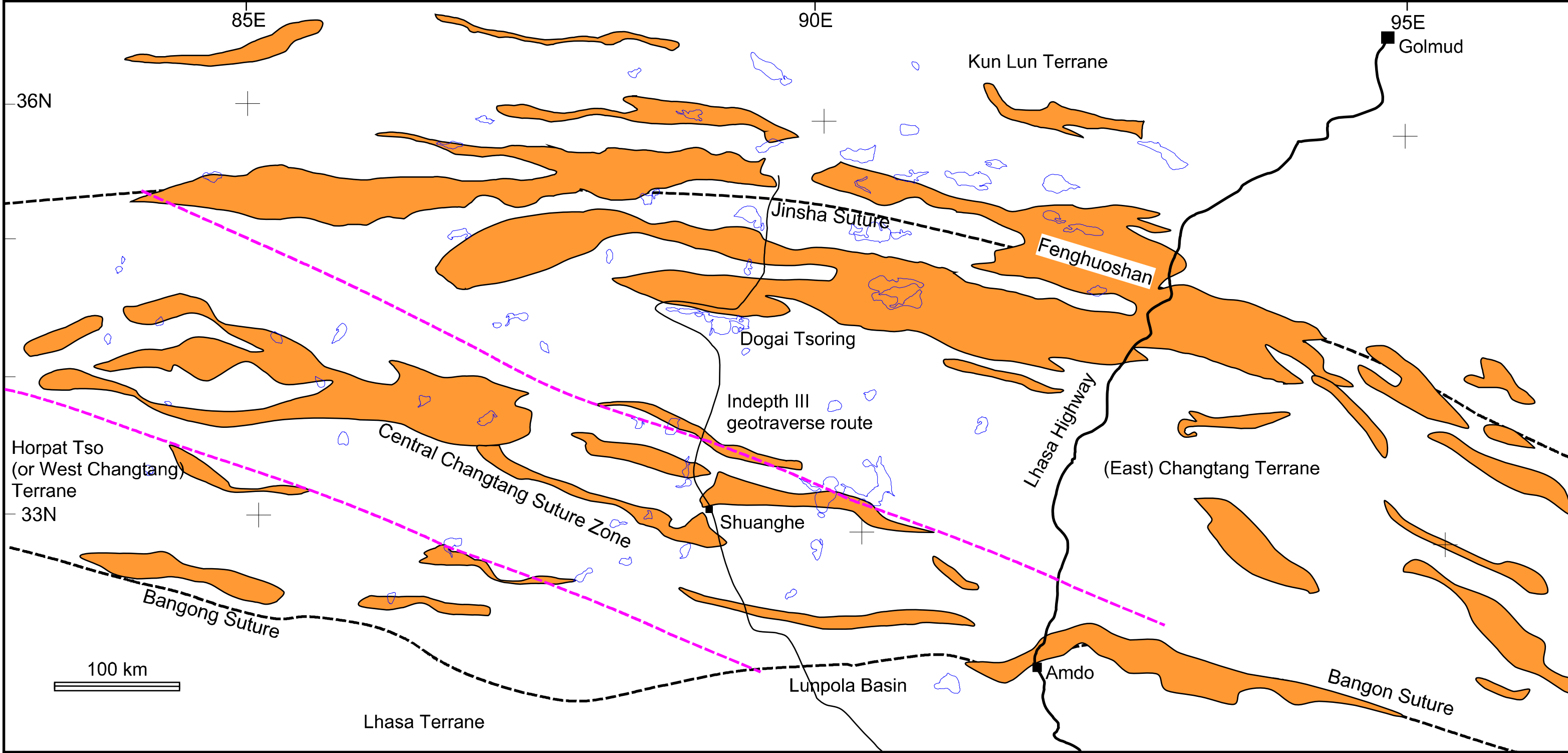


③ View of central and southern Shuanghe range; location of Cretaceous sections arrowed



⑤ Triassic limestone over detachment fault, and view to east over Shuanghe graben

Fig 6 - distribution of Cenozoic and probable Cenozoic redbeds of the central Tibetan Plateau, from published maps and Landsat image interpretation. Location of suggested early Mesozoic Central Changtang suture zone indicated.



⑥ phyllites under, and Triassic limestones over detachment fault; movement top to SW (left)

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