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HIMALAYAN OROGEN AND GLOBAL TECTONICS

Edited by

, ANSHU K. SINHA

Wadia Institute of Himalayan Geology
Dehra Dun, India

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CHAPTER 4

Nappe and Thrust Tectonics in Zanskar Area (NW Himalaya): Review of the So-called 'Autochthony' of the Tethys-Tibetan Zone

AYMON BAUD

Musee Geologique, UNIL-BFSH2, Ch-1015 Lausanne, Switzerland

In a series of recently published papers, the Tethys-Tibetan zone of the Zanskar synclinorium was consistently claimed to be the normal stratigraphic cover, in autochthonous position, with minor faults and very 'local disturbances', structurally inseparable from the underlying High Himalayan crystalline (Fuchs, 1985, 1986, 1987, 1988, for example). Some inconsistencies in this curious interpretation, resulting from solitary, rapid field work and superficial Landsat image analysis, are given below.

1) In the Omlung area of the Markha valley (NE Zanskar), the Indus zone is shown as stratigraphically overlying the late Cretaceous 'shillakong' formation (Fuchs, 1985, p. 432 & pl. 3. fig. 7, 8). The very detailed observations of C. Talon (abs., 1988) indicate at least two major thrusts separating reversed stratigraphic units.

2) To the SE, in the Nyimaling area, Fuchs (1985, p. 434) founded no thrust or nappe boundaries, but only normal stratigraphic contacts. In two recent publications, Stutz and Steck (1986) and Stutz (1988) describe three large-scale structural elements in this allegedly 'autochthonous' region:

(a) a plurikilometric ductile recumbent fold nappe (Langtang), overlying the shallow-water Cambrian sediments of the Nyimaling tectonic unit;

(b) southwestward, the basal nappe thrust evolves at a higher level to flats and

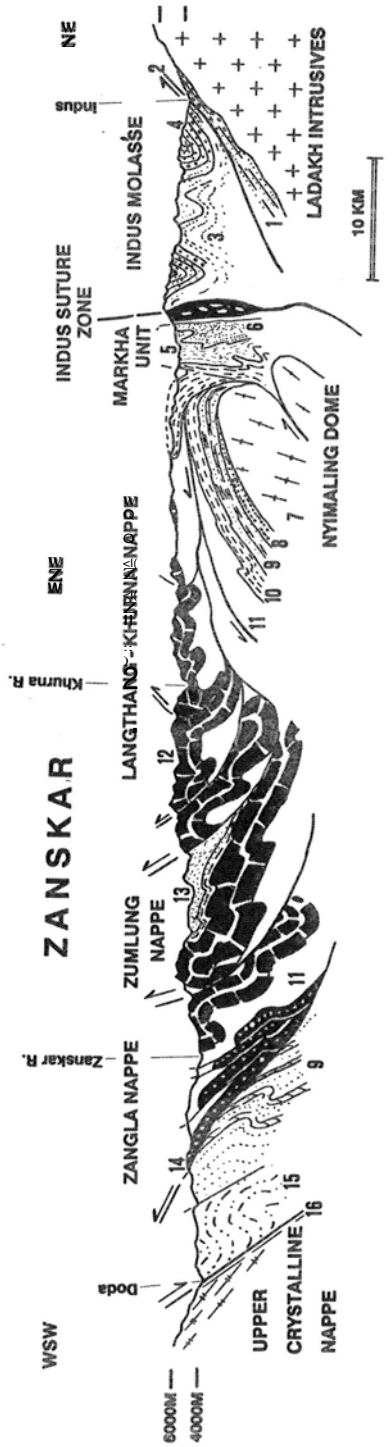

Figure 1 : Geologic cross-section of eastern Zanskar from the lower Doda River to the Indus River near Hemis, modified after Baud and associates (1982) and Stutz (1988).

1 — autochthonous molasse, 2 — Hemis thrust, 3-5: displaced Indus flysch and molasse, 3 — Eocene flysch and marine molasse, 4 — post-Eocene continental molasse, 5-6: Markha basinal deposits (Permian to Late Cretaceous; Stutz, 1988), 7 — Nyimaling crystalline and intrusives (Early Paleozoic), 8-9: Cambrian quartzite and dolomite, 10 — Carboniferous slates and marble, 11 — Permo-Triassic shales, s.s. and limestone, 12 — Kioto limestone, (Jurassic p.p.), 13 — Late Jurassic — Cretaceous shales, s.s. and marls, 14 — Permian Panjal traps, 15 — Infracambrian-Cambrian slates and quartzites, 16 — Zanskar shear zone (Herren, 1987).

ramps (Fig. 1) through the Mesozoic carbonate sedimentary units of the Tethys-Himalaya (Zanskar); and

. c) in the Markha Valley, the nappe root zone is cut by a late dextral strike-slips, shear-zone corridor.

In the same cross section, Searle (1986, p. 933) also observes an impressive nappe development resembling the Helvetic nappes of Switzerland.

3) West of the Zanskar River, the Paleogene Lingshed limestone, given as the autochthonous substratum of the Spongtang ophiolitic klippe, has actually been thrust southward jointly with the Spongtang unit over the formerly partly deformed Zanskar shelf (Baud *et al.,* 1985; Gaetani *et al.,* 1985; Garzanti *et al.,* 1987). The basal thrust of the Lingshed nappe is defined by Senonian to Maastrichtian limestone lenses within Maastrichtian Goma black slate.

4) In the Phugtal-Thongde-Phe area (SW Zanskar), the basal contact of the competent Panjal trap formation (permian) with various folded or imbricated Paleozoic formations is considered essentially stratigraphic by G. Fuchs. Fuchs' map and prof1les (1987, pI. 1,2, fig. 12) clearly indicate that undeformed basic dykes crossing the underlying pile of sediments penetrate the Panjal trap formation without deformation. This fact is far from field reality, as shown by several teams of geologists who found the basal contact of the Panjal trap formation to be tectonic in this area. None of the underlying Paleozoic dykes cross this basal contact. Recently, Kiindig (1988) absolutely independently and after detailed structural analysis confirmed the tectonic, southwestward thrusting contact of the Panjal trap, sole of the Zangla nappe (Fig. 1). Below the thrust, Kiindig recognises a 'Schuppen zone' (our Phugtal unit, Baud *et al.,* 1982; see also Searle's abs., 1988) that is separated from the High Himalaya crystalline by a younger tectonic contact - a large-scale normal fault, the Zanskar shear zone (Herren, 1987). To the East, the decollement level of the Zangla nappe jumps from the basal Panjal trap down to the incompetent Carboniferous evaporite, as observed by Gaetani *et al. (1985).*

5) The High Himalayan crystalline is composed of several tectono-metamorphic units, as shown by Pognante *et al.* (abs., 1988) and by Kiindig (1988), with outliers of thrusted low-grade metasediments on top of the crystalline.

Nappe tectonics are a reality in the Zanskar area (Thakur and Sharma, 1983) as well as in other parts of the Himalaya, with a ductile style and large recumbent folds at the lower level and thrust sheets with a ramp and flat style at the shallow level (Fig. 1).

Thus the important challenges for future investigations are now the detailed study of the geometry of the nappes and of their sequences and times of emplacement. There is no doubt that. the autochthonist hypothesis will be quickly forgotten.

REFERENCES

Baud, A. *et. al.* (1962). Le contact Gondwana-Périgondwana dans Ie Zanskar oriental, Ladakh (Himalaya). *Bull. Soc. Geol. France* (7), 24{2, 341-361, Paris.

Baud, A., Garzanti, E. and Mascle, G. (1985). Latest marine sediments (Early Paleogene), geological events and nappe structure in the central Zanskar area (NW Himalaya). *Himalayan Workshop*. Leicester.

Fuchs, G. (1984). Note on the geology of the Markha-Nyimaling area in Ladakh (India). *lb. Geol. B.-A., 12711,* 5-12, Wien.

Fuchs, G. (1985). The Tibetan (Tethys) zone - is it allochthonous? *Conlr. Himal. Geol.,* 3, 6777, New Delhi.

Fuchs, G. (1986). The geology of the Markha-Khumak region in Ladakh (India). *lb. Geol. B.-A.,* 128/3-4,403-437, Wien.

Fuchs, G. (1987). The geology of southern Zanskar (Ladakh) - evidence for the autochthony of the Tethys zone of the Himalaya. *lb. Geol. E.-A.,* 130/4,465-491, Wien.

Fuchs, G. (1988). Arguments for the autochthony of the Tibetan zone. *Himalayan-Karakoram-Tibet Workshop Meeting* (Abs.) Lausanne, 1988.

Gaetani, M., Garzanti, E. and Jadoul, F. (1985). Main structUral elements ofZanskar (NW Himalaya). *Rend. Soc. Geol. It.,* 8, 3-8, Rome.

Garzanti, E., Baud, A. and Mascle, G. (1987). Sedimentary record of the northward flight of India and its collision with Eurasia (Ladakh Himalaya, India). *Geodinamica Acta, 114-5,297-312,* Paris.

HelTen, E. (1987). Zanskar shear zone: Northeast-southwest extension within the Higher Himalayas (Ladakh, India). *Geology, 15, 409-413.*

Kundig, R. (1988). Thesis, ETH, ZUrich.

Pognant, U., Castelli, D., Genovesa, G. and Benna, P. (1988). The crystalline units of the High Himalayan belt in the Lahul-Zanskar region. *Himalayan-Karakoram-Tibet Workshop Meeting* (Abs.). Lausanne, 1988.

Searle, M.P. (1986). Structural evolution and sequence of thrusting in the High Himalayan, TibetanTethy and Indus suture zones of Zanskar and Ladakh, western Himalaya. *I. Sir. Geol .•* 8, 923936.

Searle, M.P. and Cooper, DJ. V. (1988). Structural evolution of the North Indian shelf sediments in the Zanskar Range, NW India. *Himalayan-Karakoram-Tibet Workshop Meeting* (Abs.) Lausanne. 1986.

Stutz, E. (1988). Evolution paleogeographique et tectonique d'un segment de la marge nord-indienne: g6010gie de la chaine de Nyimaling aux confins du Ladakh et du Rupshu (NW-Himalaya, Inde). *Mem. Geol.,* 3, Lausanne.

Stutz, E. and Steck, A. (1986). La terminaison occidentale du Cristallin du Tso Morari (HautHimalaya, Ladakh meridional, Inde): subdivision et tectonique de nappe. *Ecl. Geol. Helv .• 79/* 2, 253-269, Basel.

Talon, C. (1988). L'unite des melanges d'Omlung. Une activite volcanique en milieu oceanique au Maestrichtien superieur. *Himalayan-Karalwram-Tibet Workshop Meeting* (Abs.), Lausanne, 1988.

Thakur,V.C. and Sharma. K.K. (cds.) (1983). *Geology of the Indus Suture Zone of Ladakh*. Wadia Institute of Geology, Dehra Dun.