

A topographic map of the Himalayas region, showing the Indian subcontinent, the Himalayan mountain range, and the surrounding areas. The map uses a color scale where green and yellow represent lower elevations, and brown and white represent higher elevations. The Indian Ocean is visible to the south, and the Bay of Bengal and Andaman Sea are to the east. The text "Tectonique des Himalayas" is overlaid in the center of the map.

Tectonique des Himalayas

12/09/2011
Strasbourg

Jean-Pierre Burg

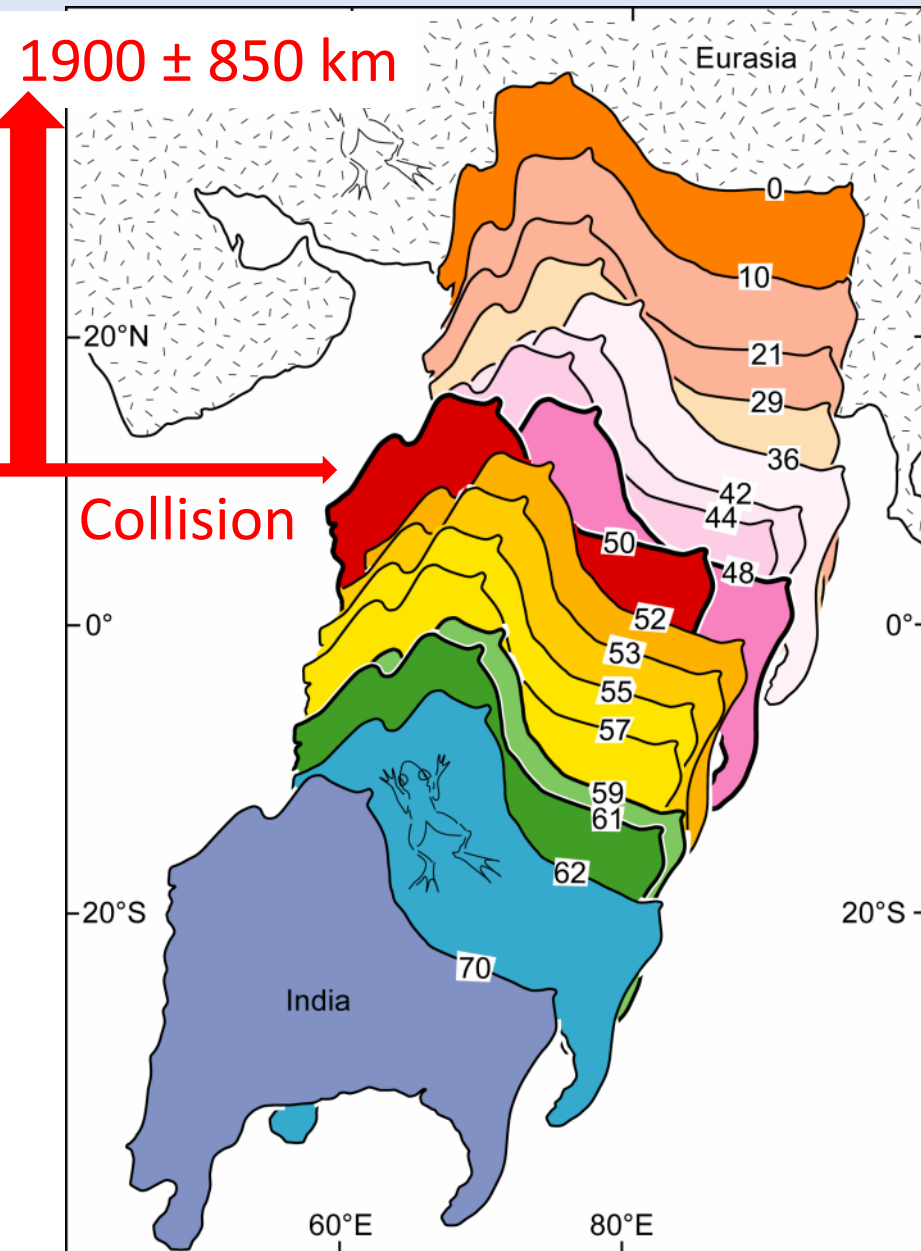
Une histoire de Collision entre l'Inde et l'Asie



Relativ-Bewegungen von Teilplatten Gondwanas in Bezug auf Eurasia

zwischen dem frühen Jura (190 Ma) und Heute (0 Ma) nach Savostin *et al.* (1986) *Tectonophysics* **123**, 1-35

Convergence Inde / Asie



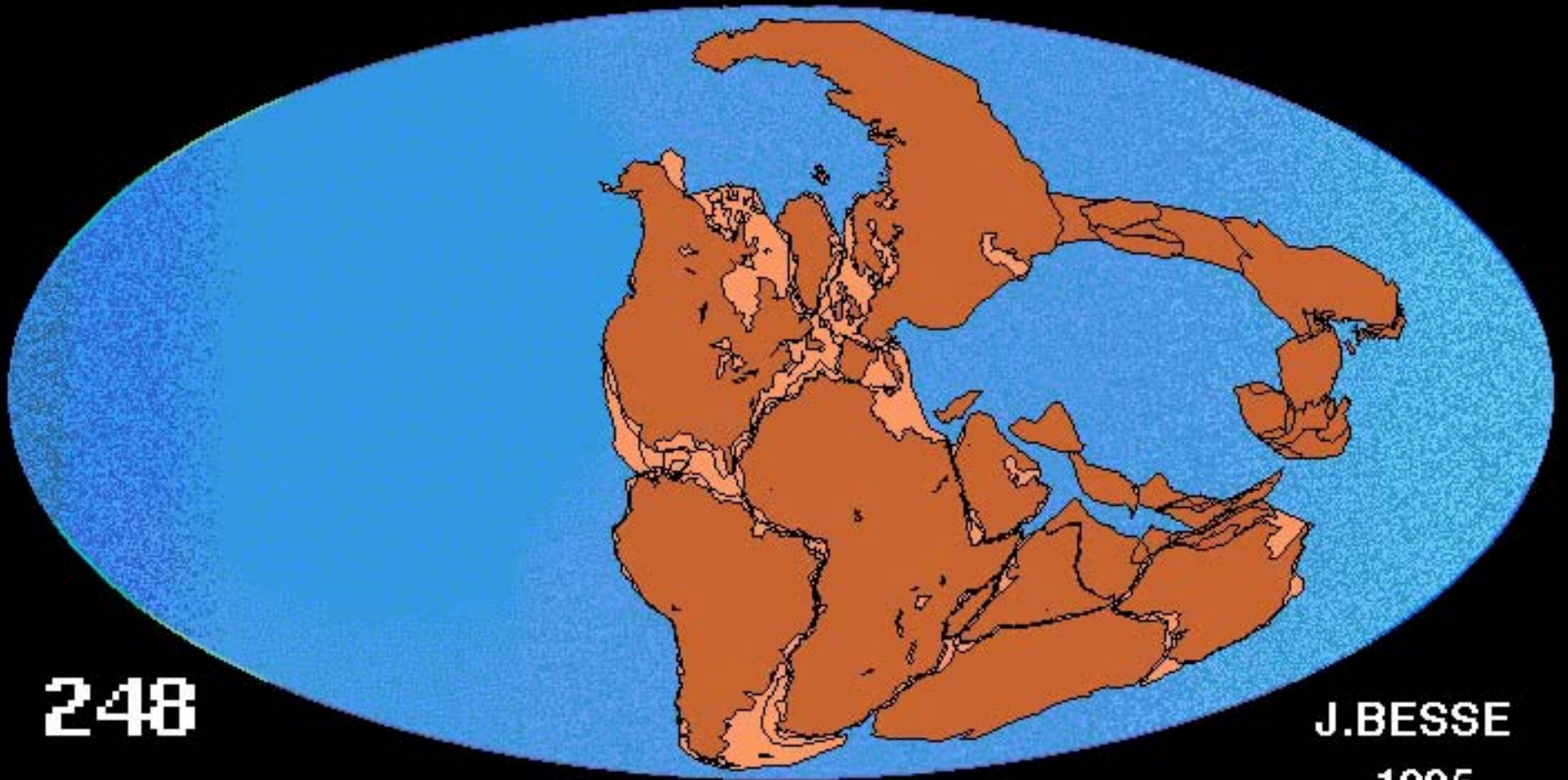
Mouvement relatif

d'après
Patriat & Achache (1984)
Nature, **311**, 615-621

Les chiffres sur la limite nord de l'Inde sont les âges en Ma des positions correspondantes. Les grenouilles indiquent un pont continental à ca. 65 Ma.

Le rapprochement le plus faible entre 61 et 59 Ma représente probablement le commencement de la collision

Convergence Inde / Asie



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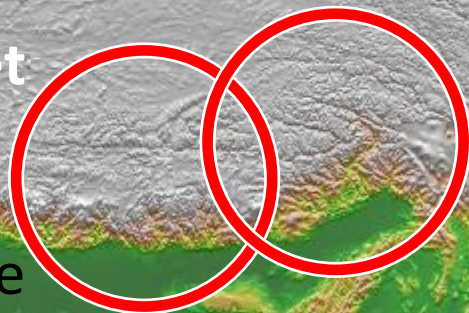
J.BESSE
1995

Himalaya Ouest



1 arc
2 sutures
2 collisions

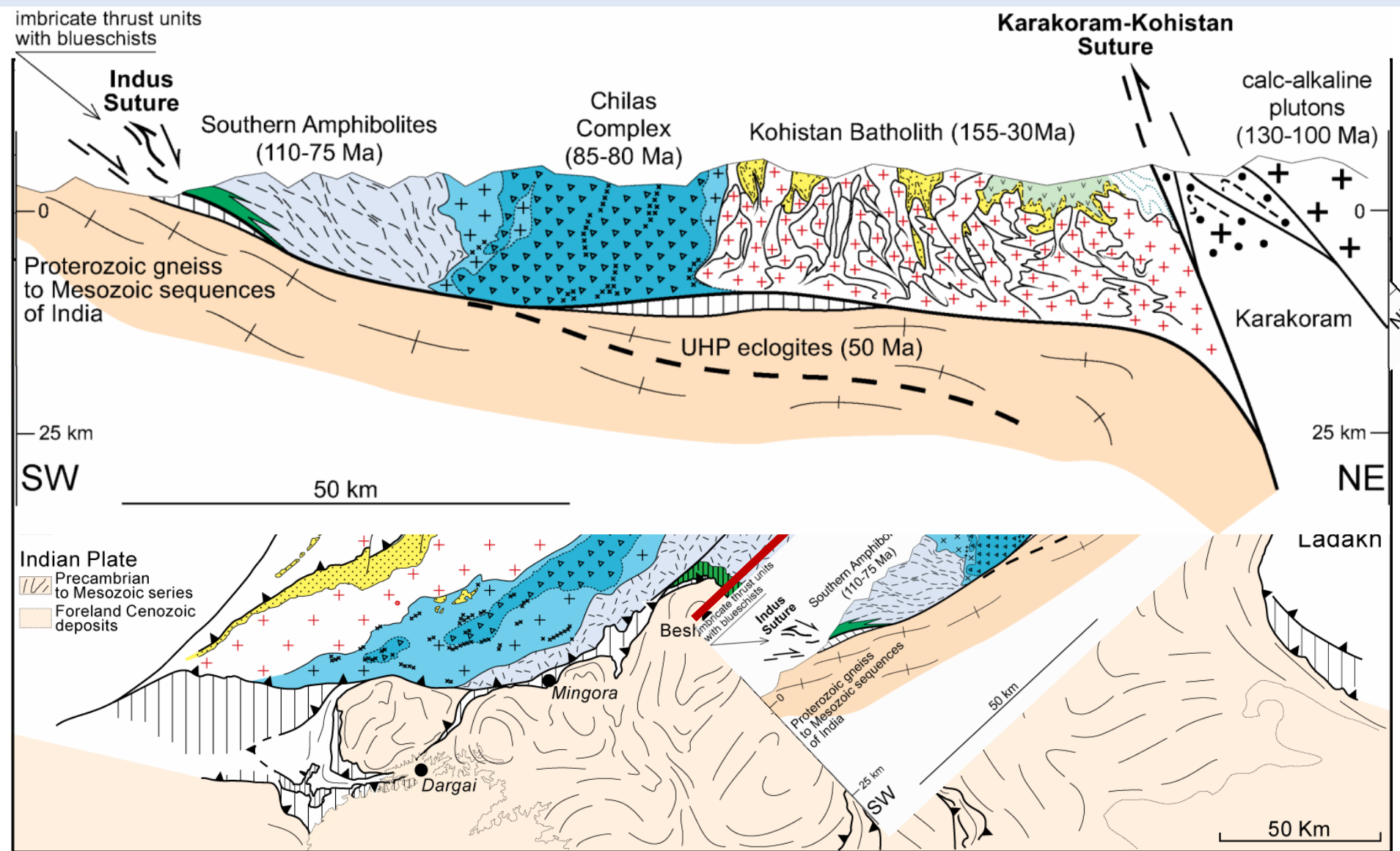
Sud-Tibet



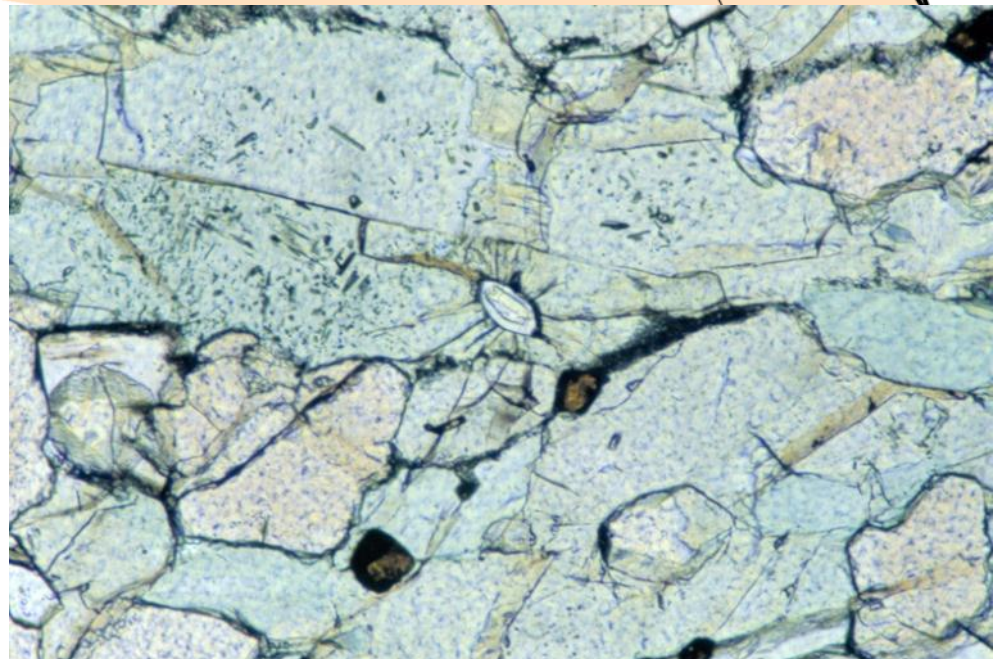
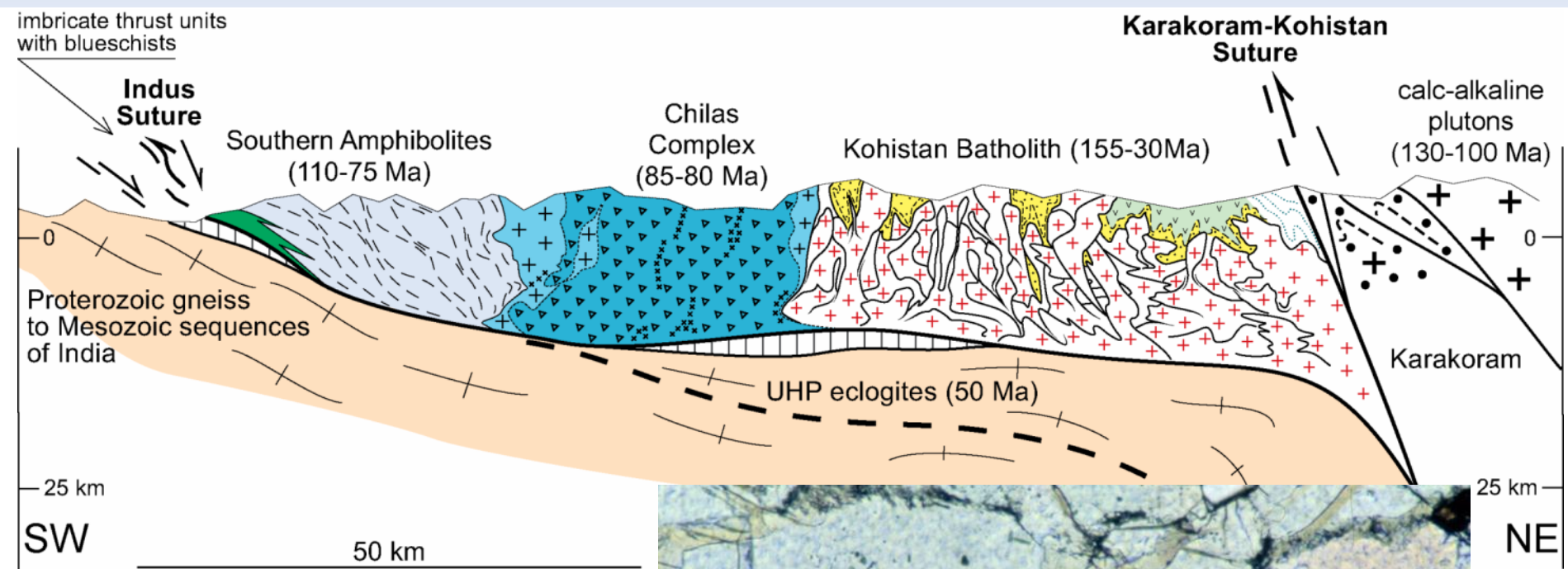
1 suture
1 collision

1 pli crustal
Est Tibet

Coupe géologique du Kohistan



Subduction de la plaque indienne



Subduction de la plaque indienne

TIMING OF HIMALAYAN UHP METAMORPHISM 595

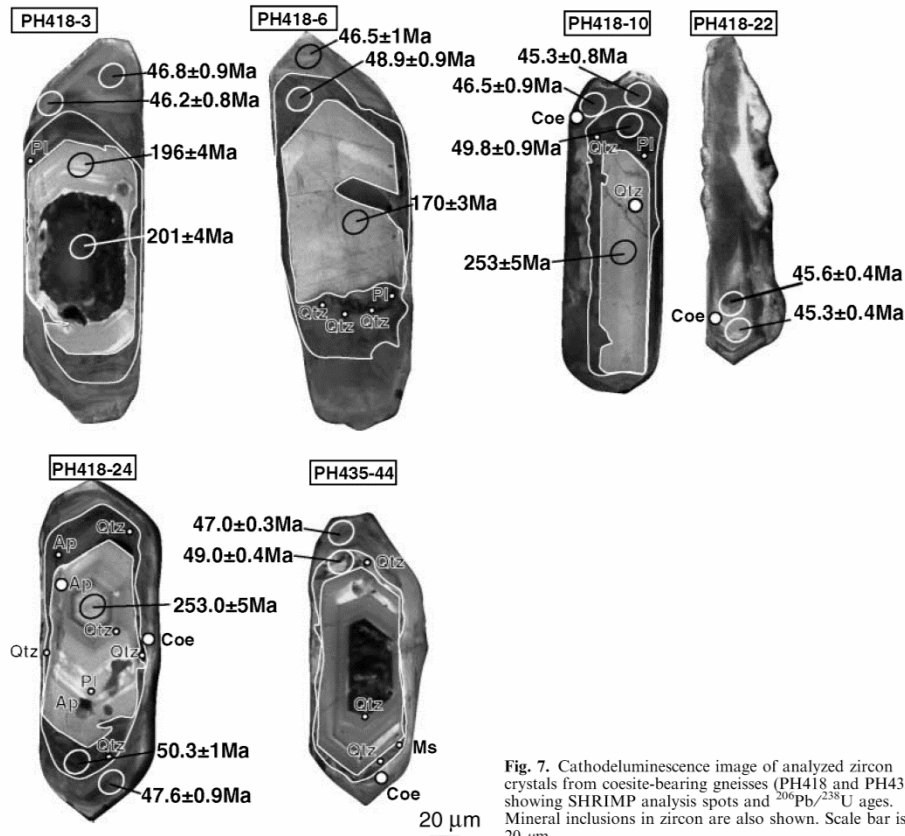
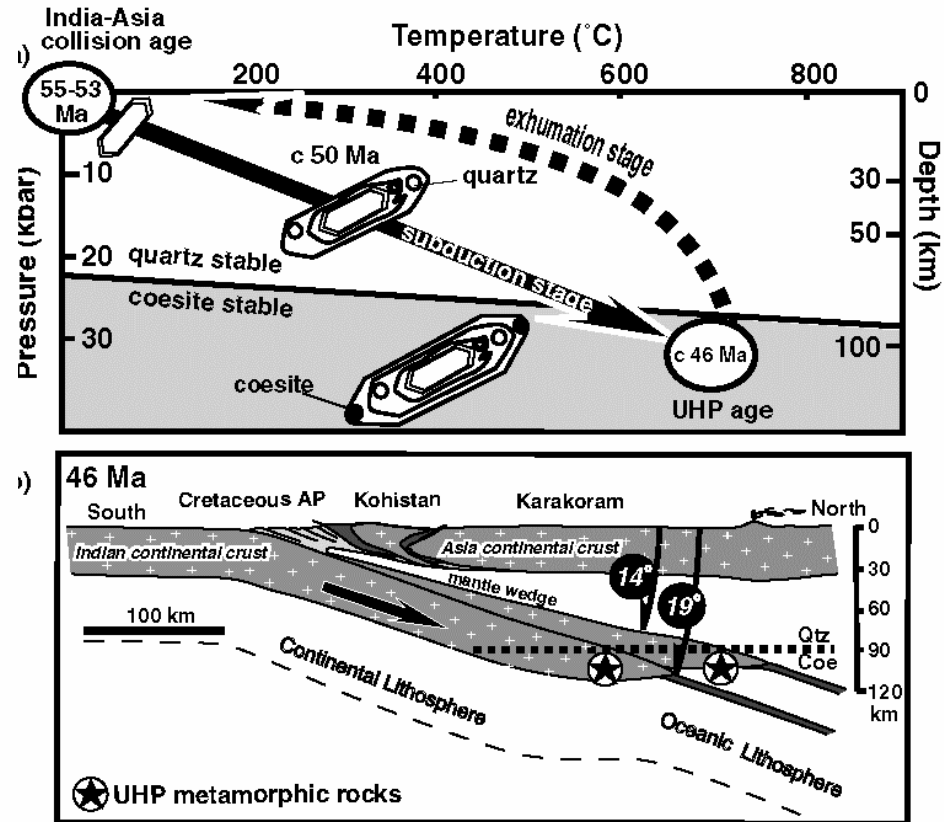
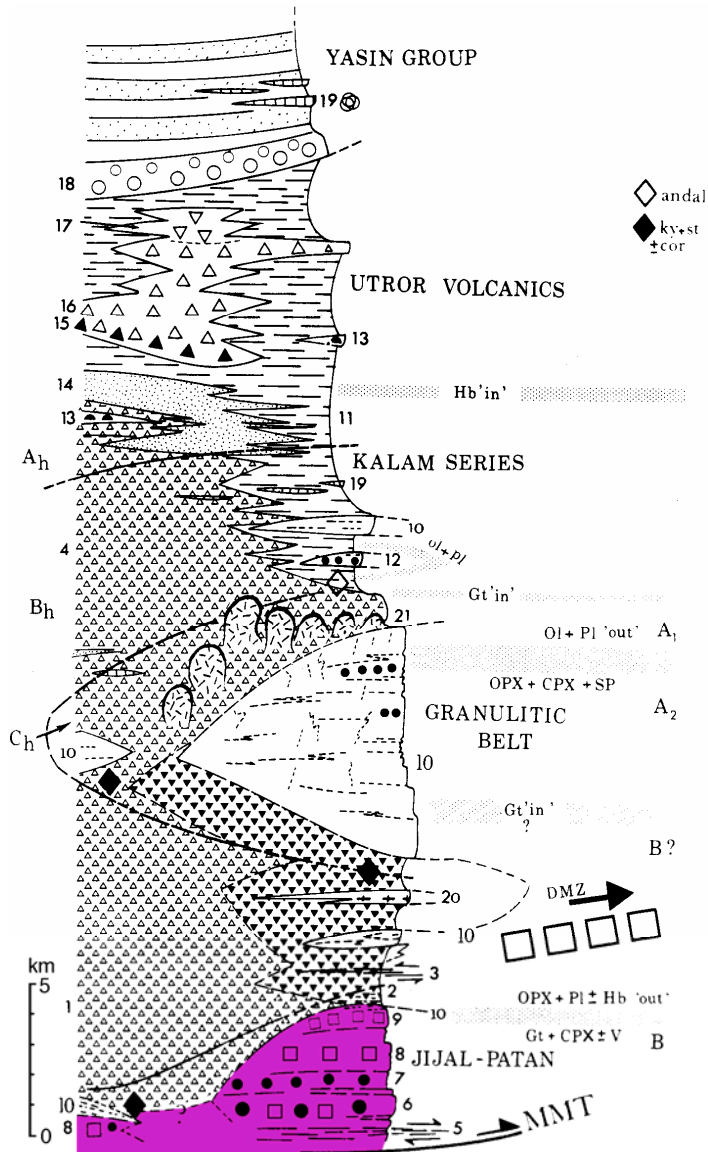


Fig. 7. Cathodoluminescence image of analyzed zircon crystals from coesite-bearing gneisses (PH418 and PH435), showing SHRIMP analysis spots and $^{206}\text{Pb}/^{238}\text{U}$ ages. Mineral inclusions in zircon are also shown. Scale bar is 20 μm .



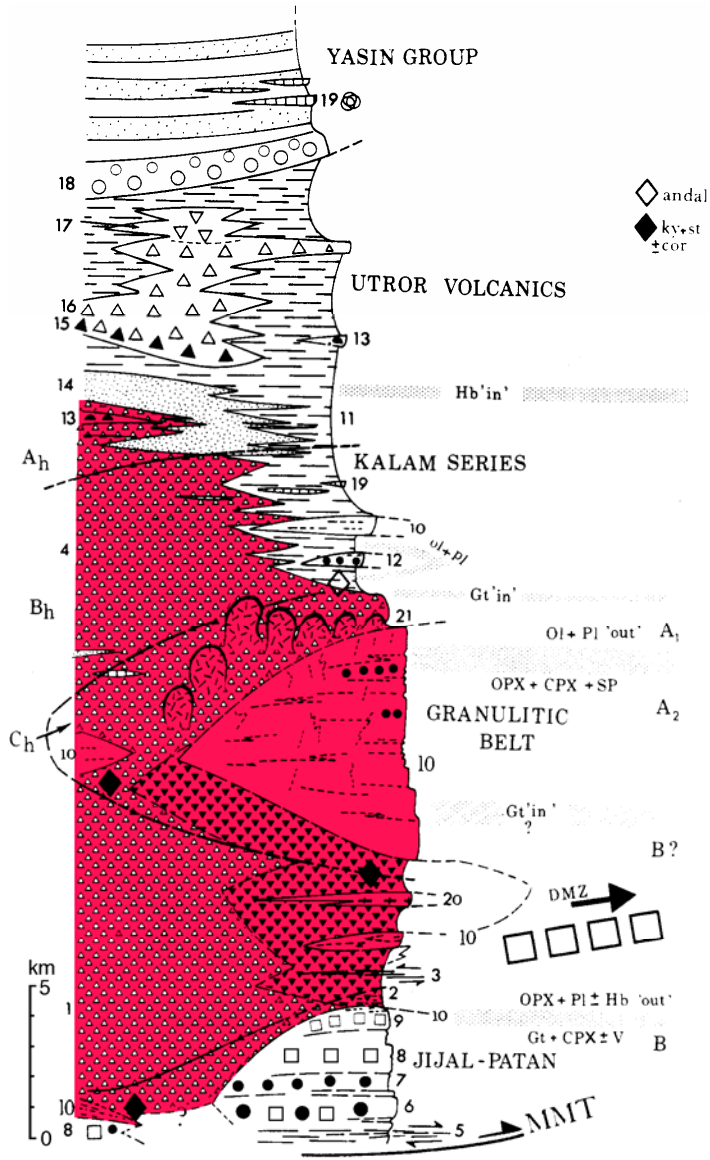
Coupe géologique du Kohistan



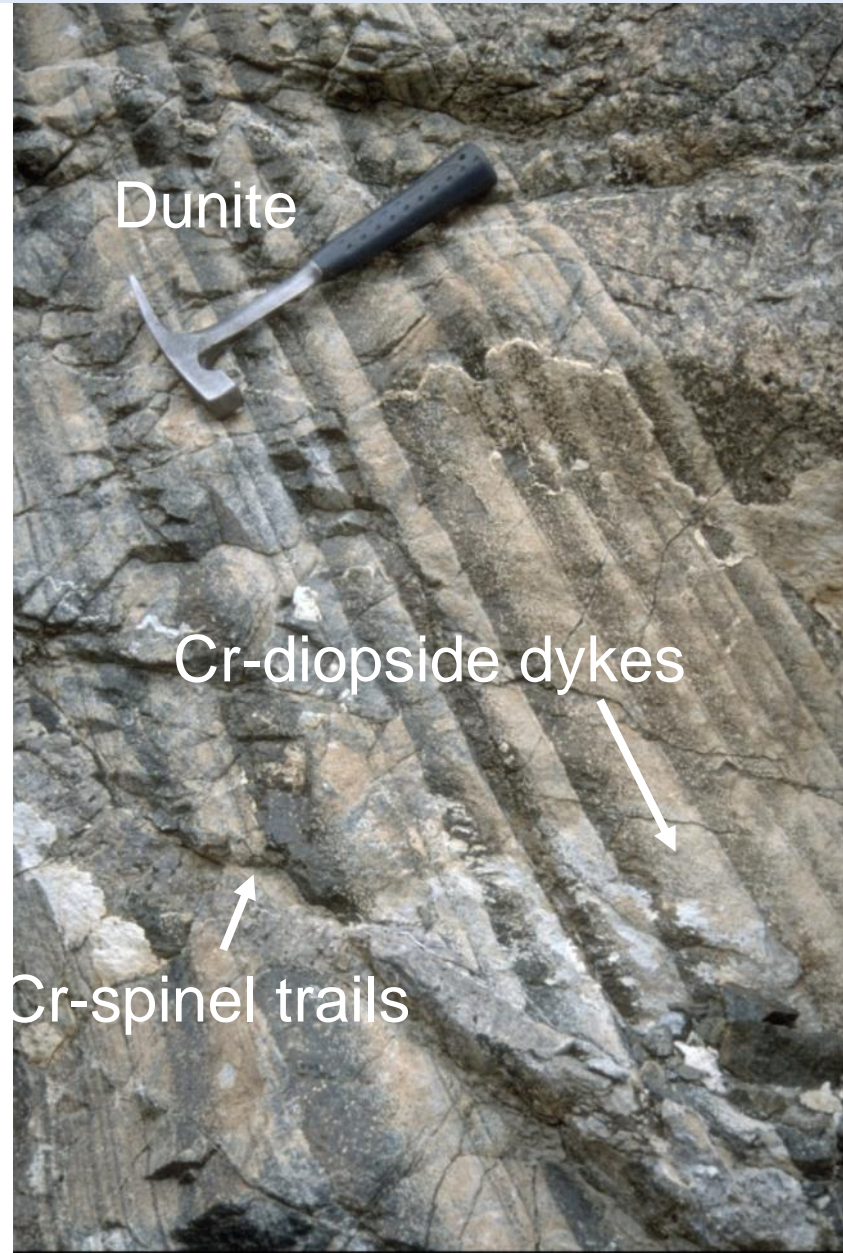
nach Bard (1983) Geol. Bull. Univ. Peshawar 16 105-184



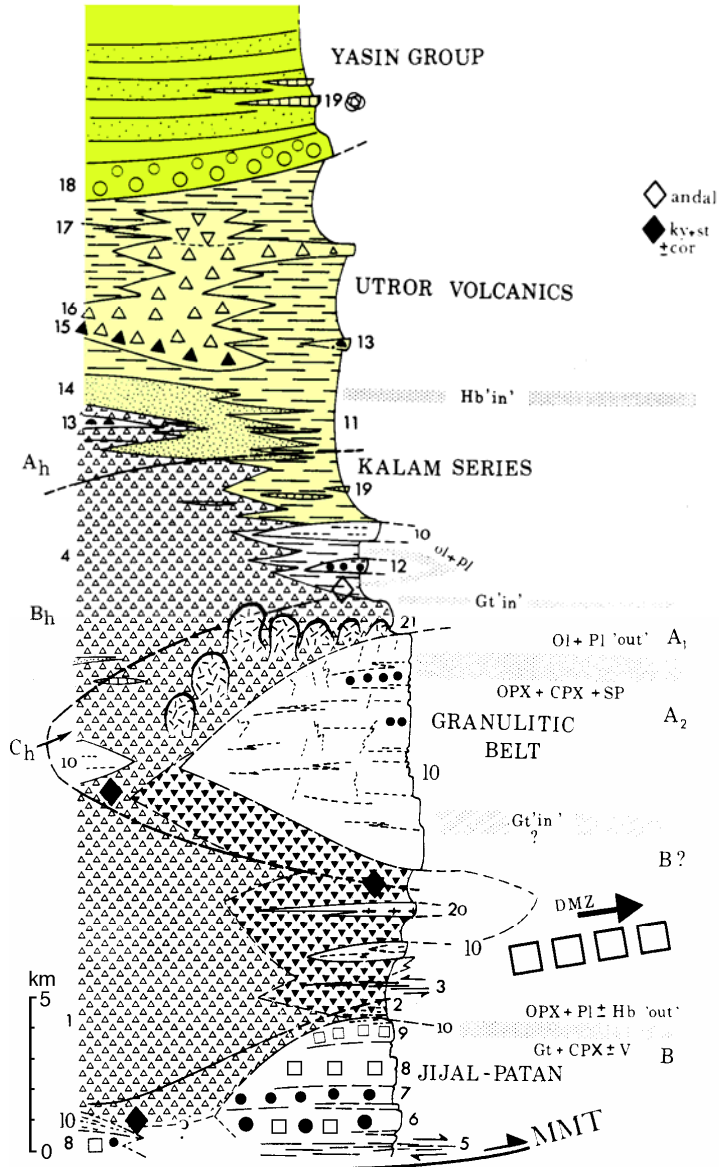
Coupe géologique du Kohistan



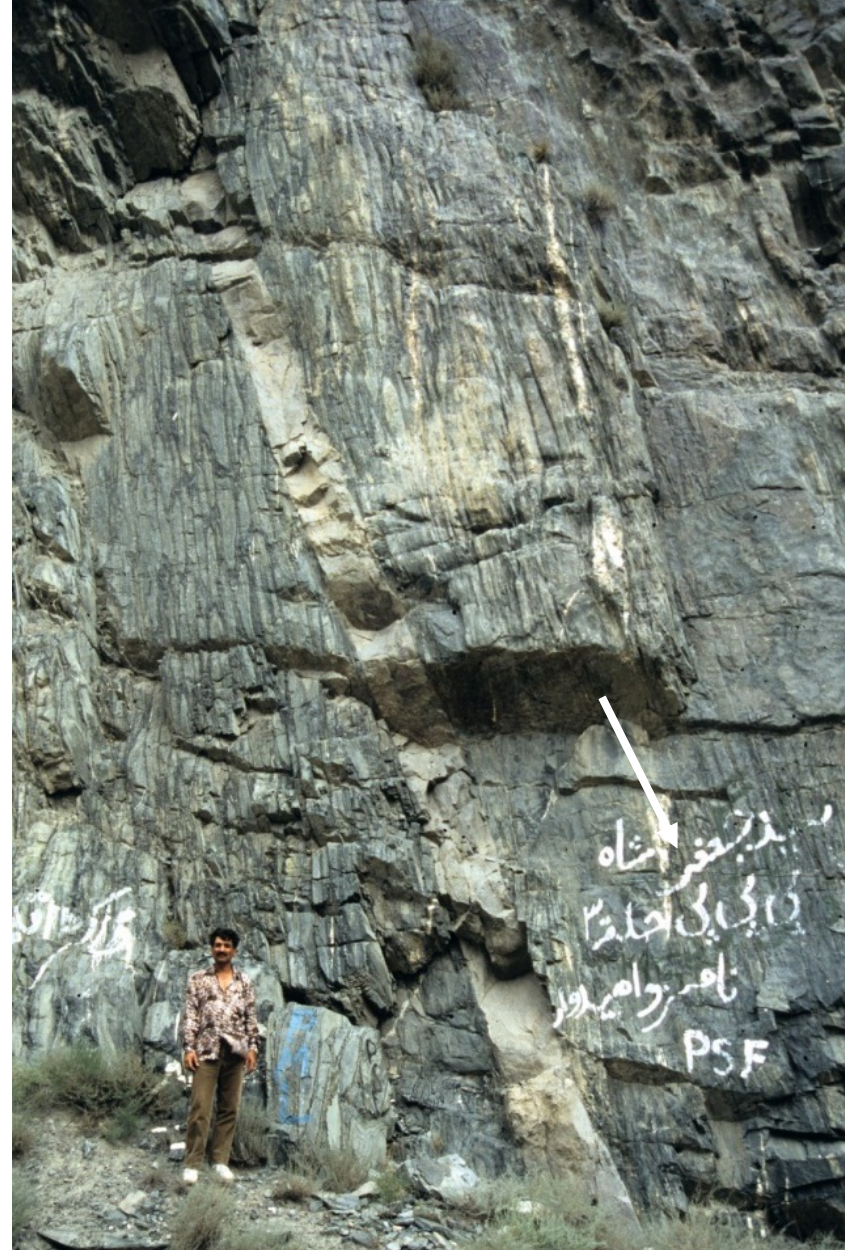
nach Bard (1983) Geol. Bull. Univ. Peshawar 16 105-184



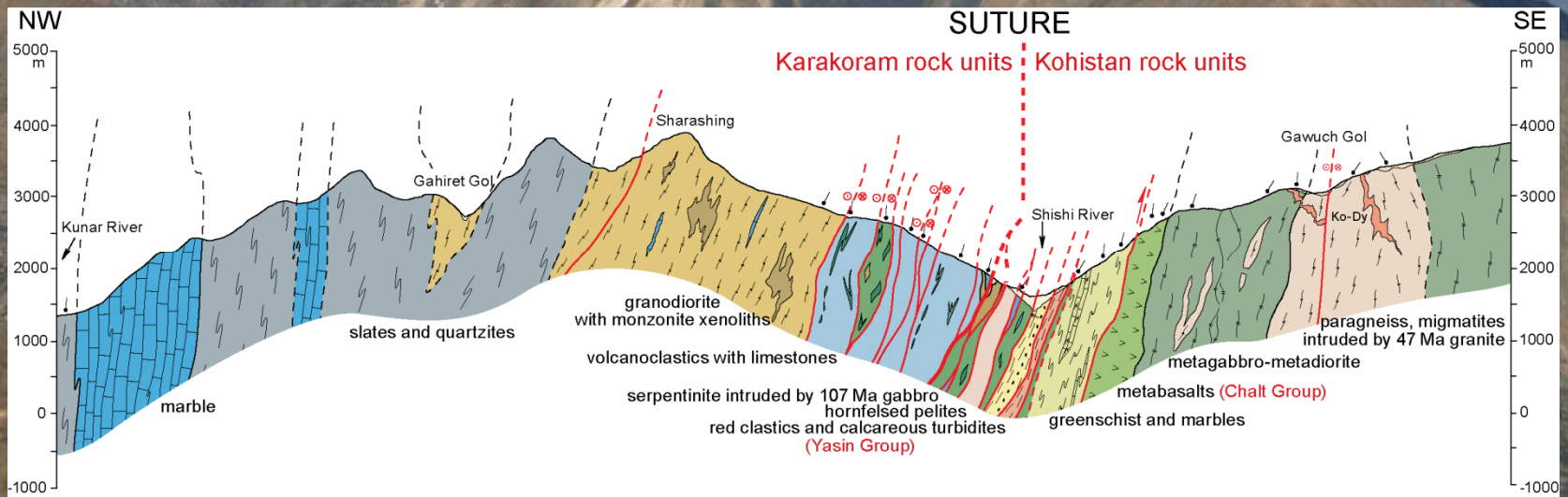
Coupe géologique du Kohistan



nach Bard (1983) Geol. Bull. Univ. Peshawar 16 105-184

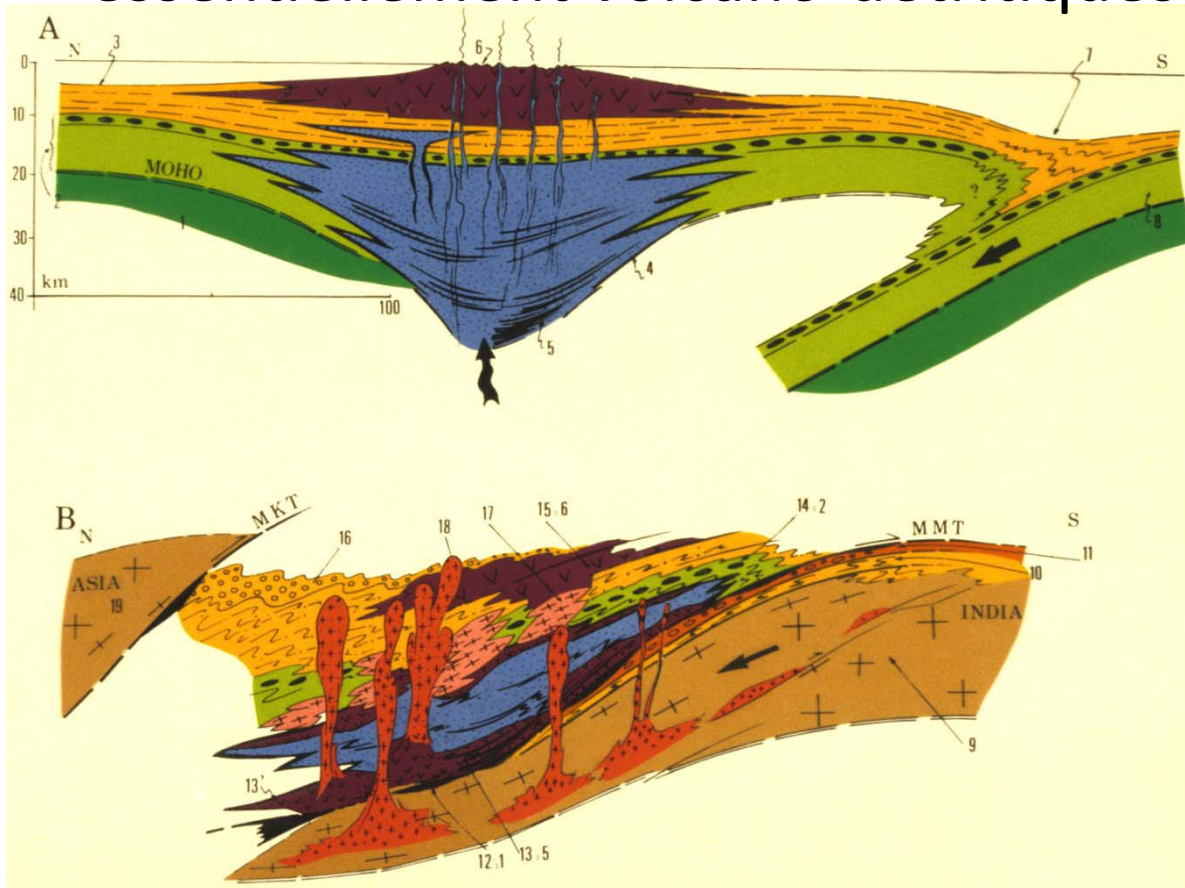


Suture Nord - Karakoram



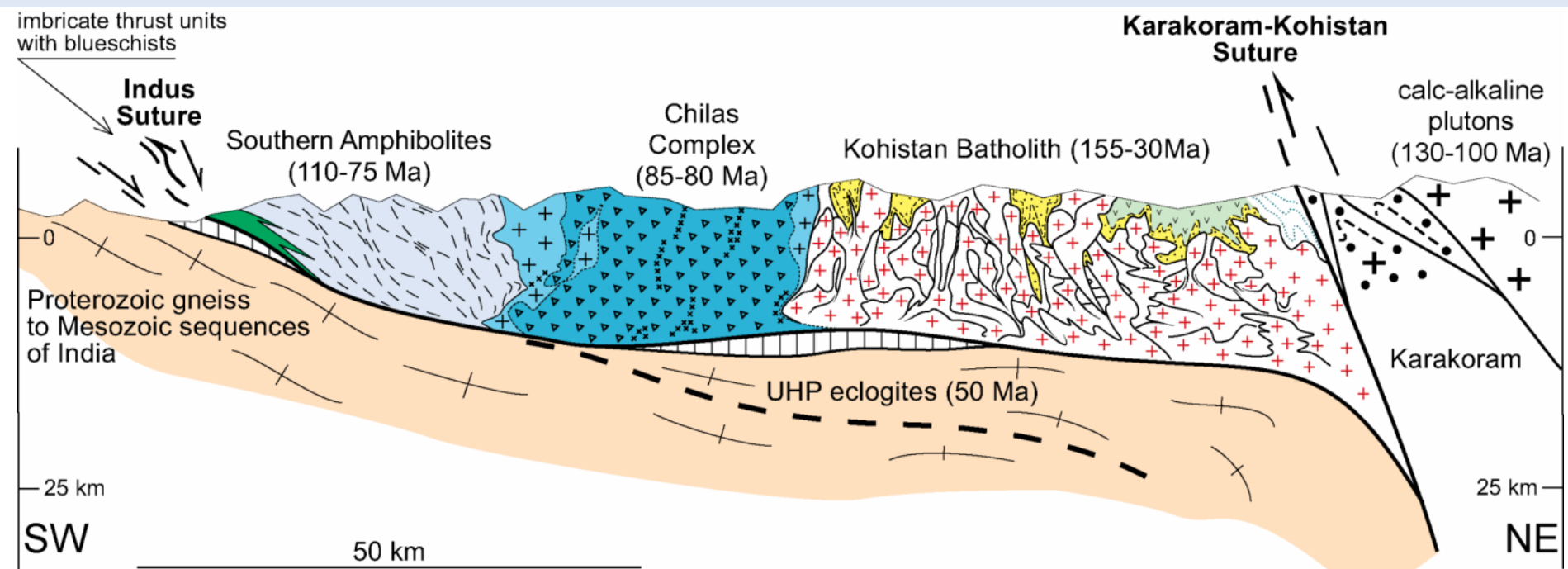
Lithostratigraphie du Kohistan

- une série magmatique calco-alcaline, intrusive dans une croûte océanique portant des sédiments marins, essentiellement volcano-détritiques.



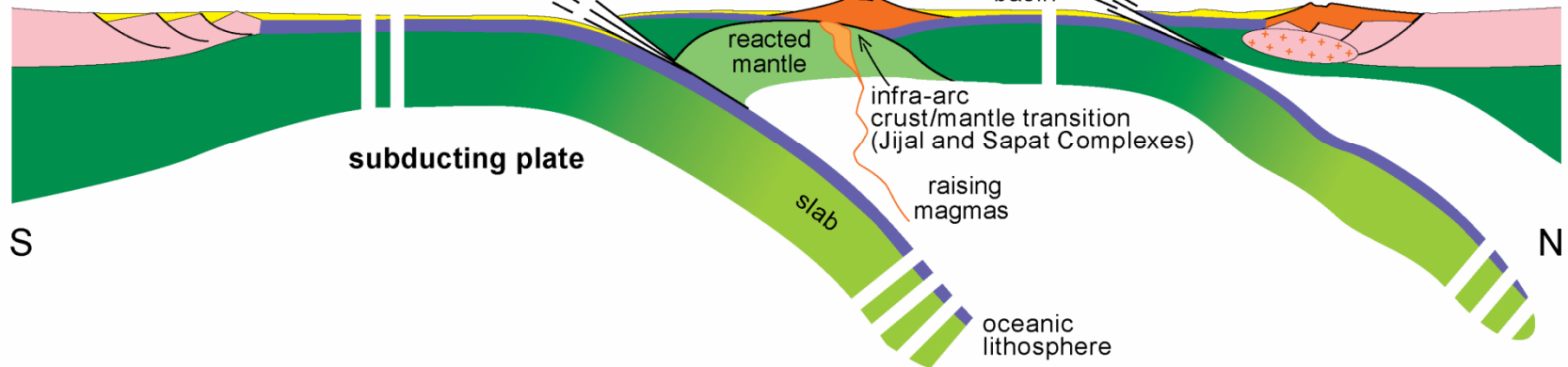
- Interprétée comme arc insulaire intra-océanique établi au Crétacé dans la Téthys.

Interprétation tectonique



130-95 Ma

passive continental margin of India



Interprétation tectonique

ca 50 Ma

Indian continent

Kohistan arc

remnant back-arc basin

Eurasian (Karakoram) margin

45-25 Ma

Indian continent

extruded coesite-rocks

late volcanism

backthrusting

Eurasia

melting crust

MKT

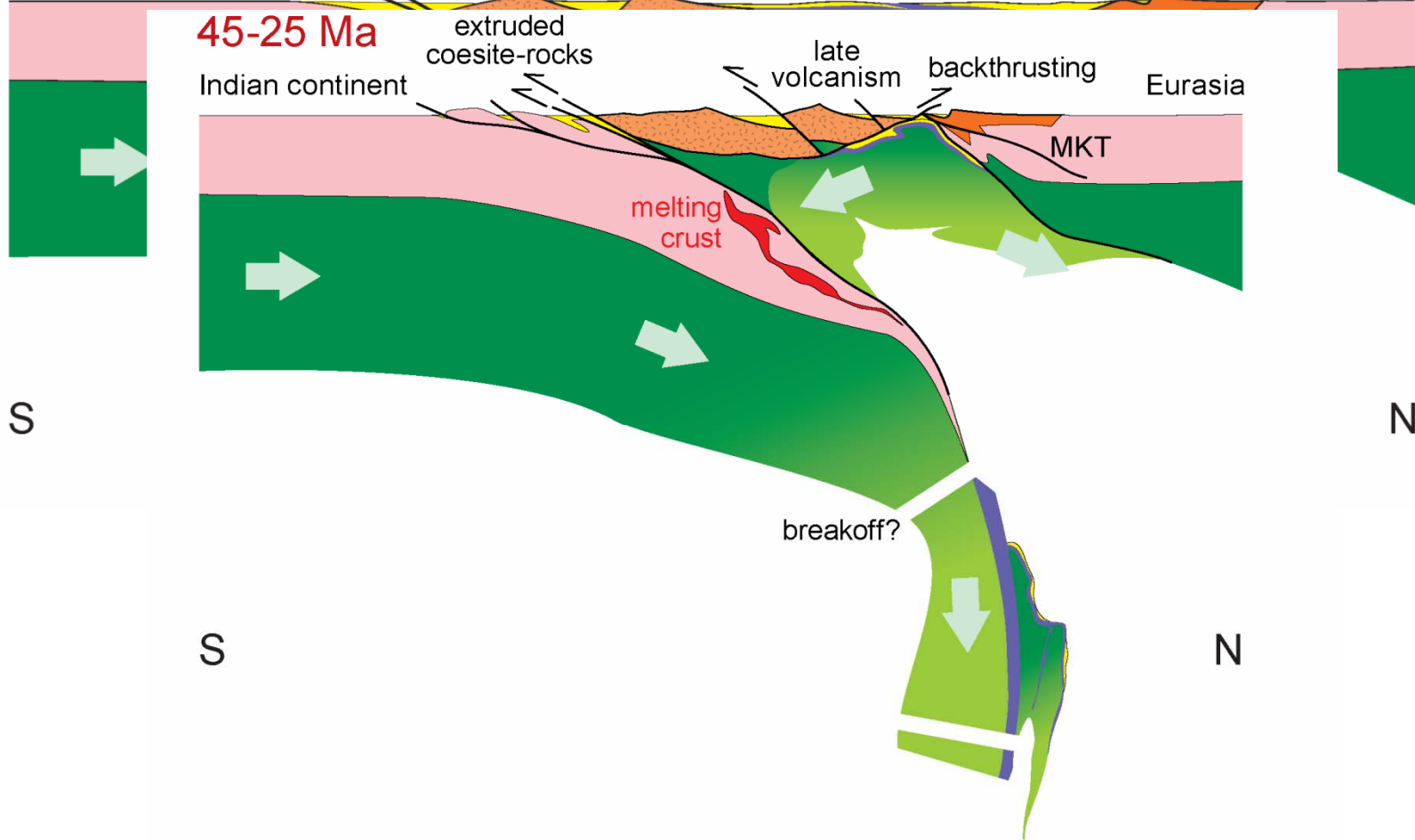
breakoff?

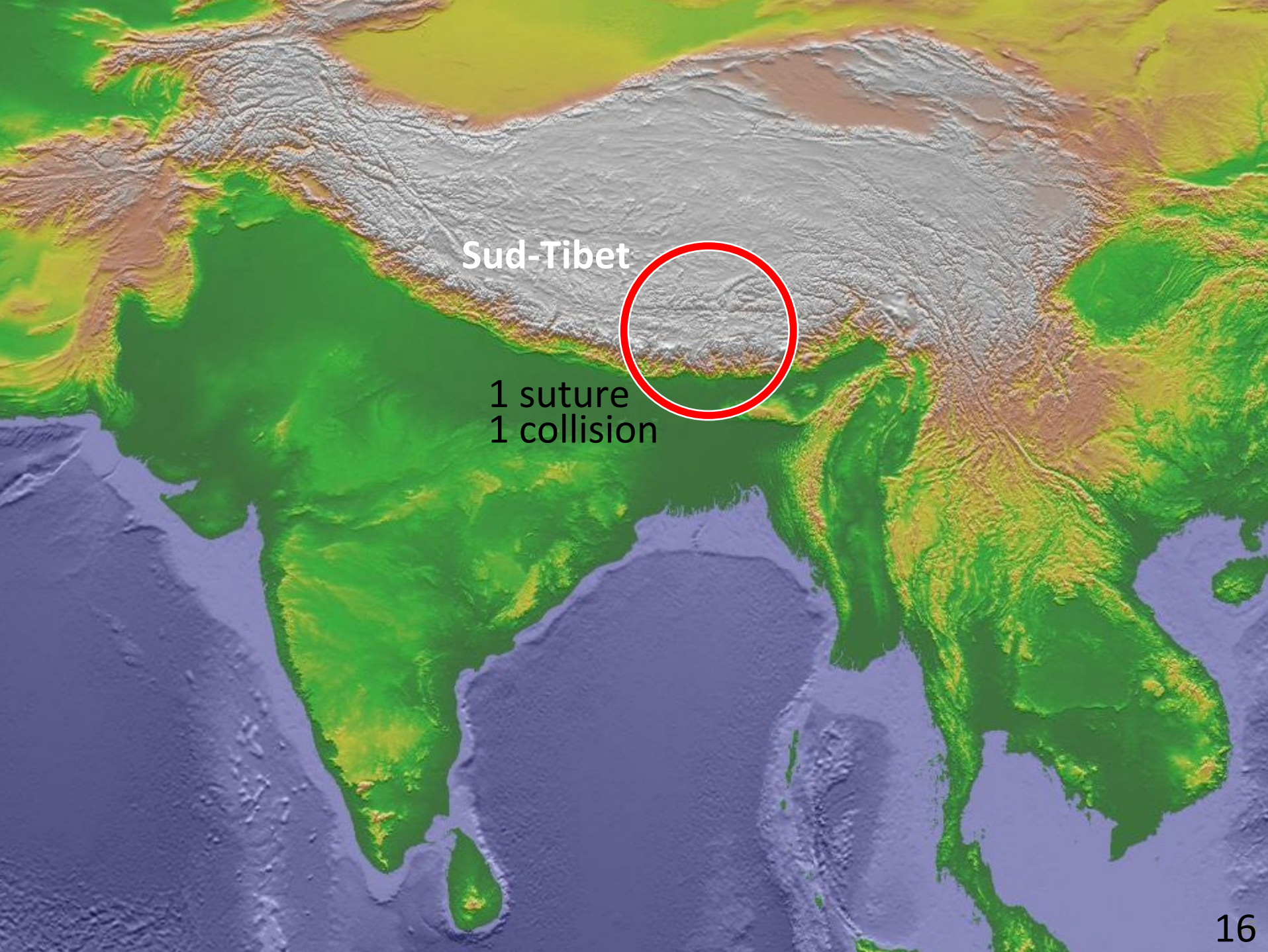
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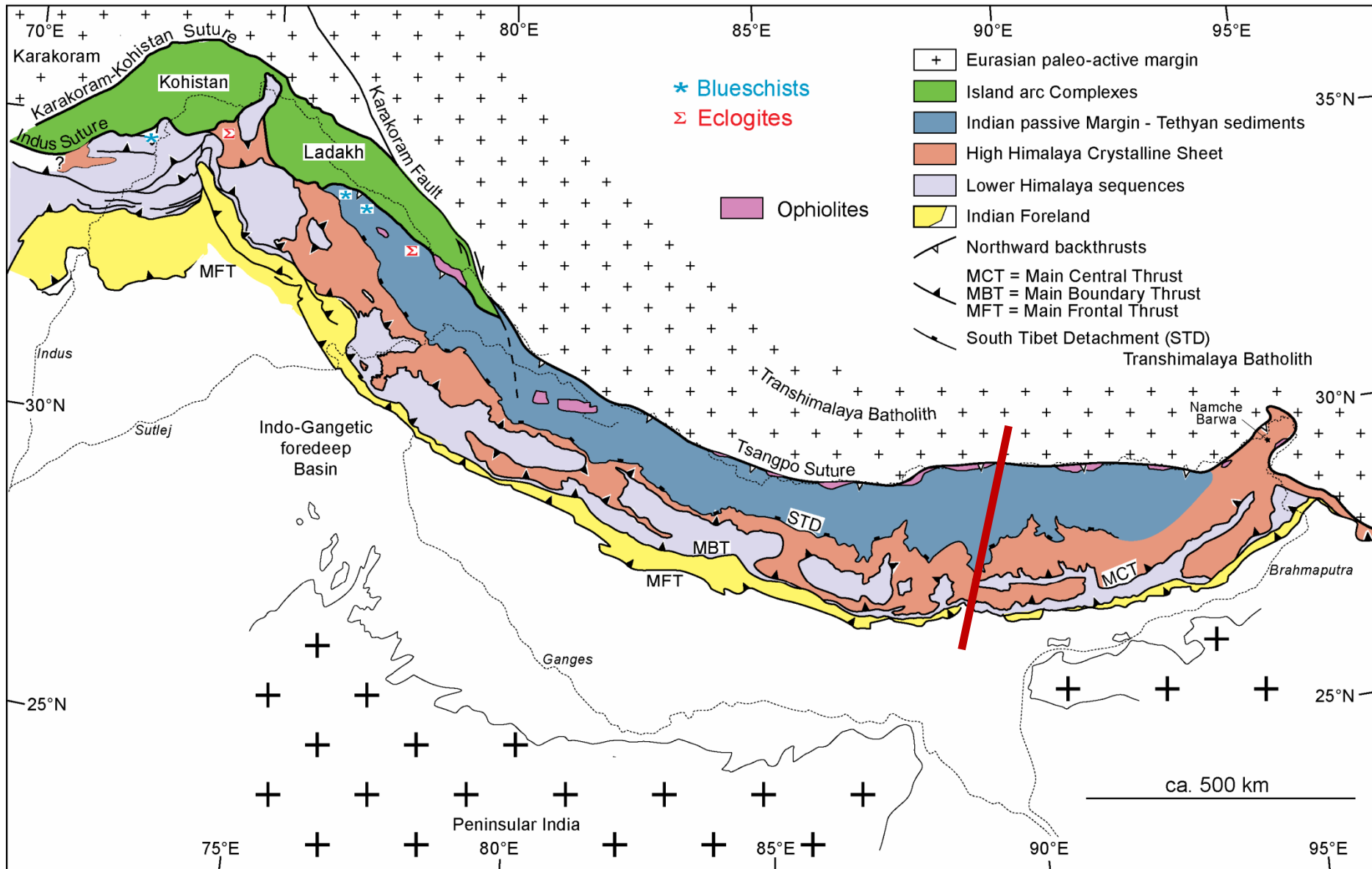




Sud-Tibet

1 suture
1 collision

Carte géologique de l'Himalaya

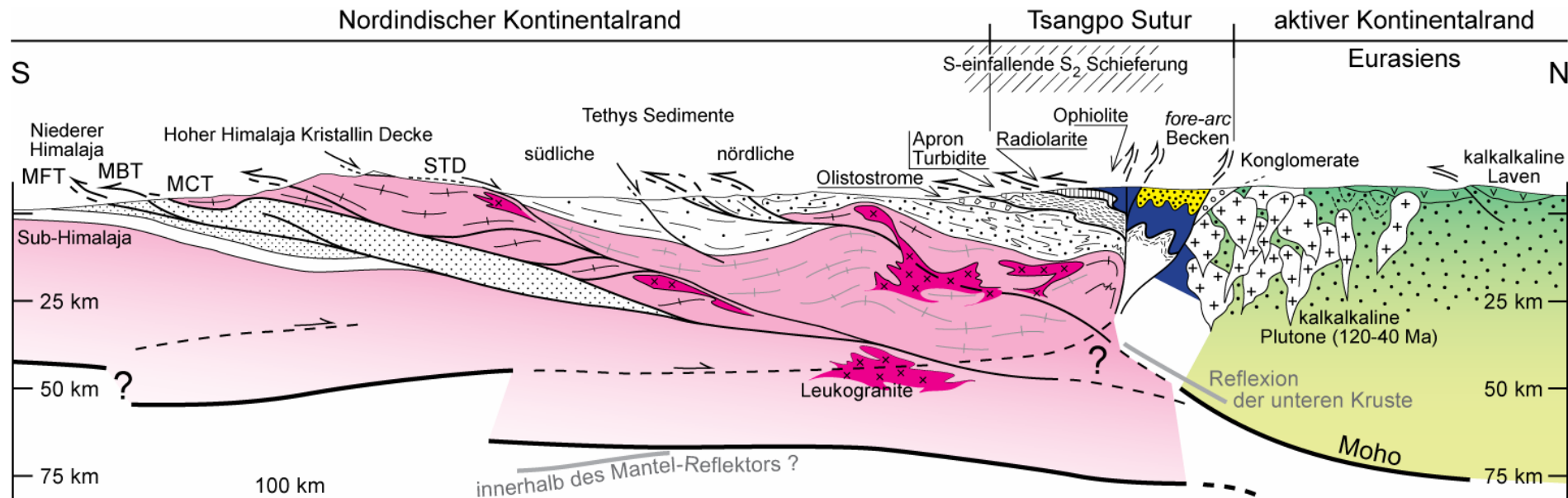


Coupe du Sud-Tibet

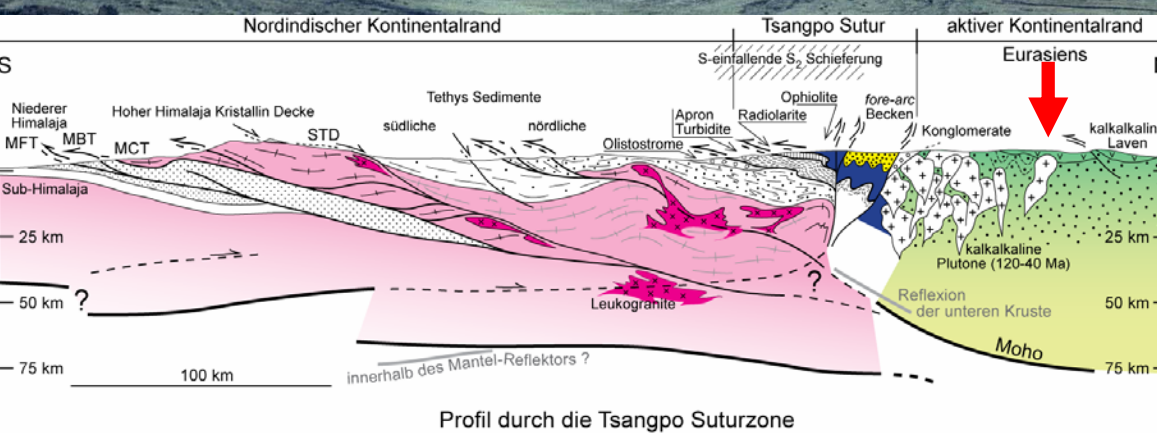
Une marge active continentale.

Une zone de suture.

La chaîne du Haut-Himalaya.

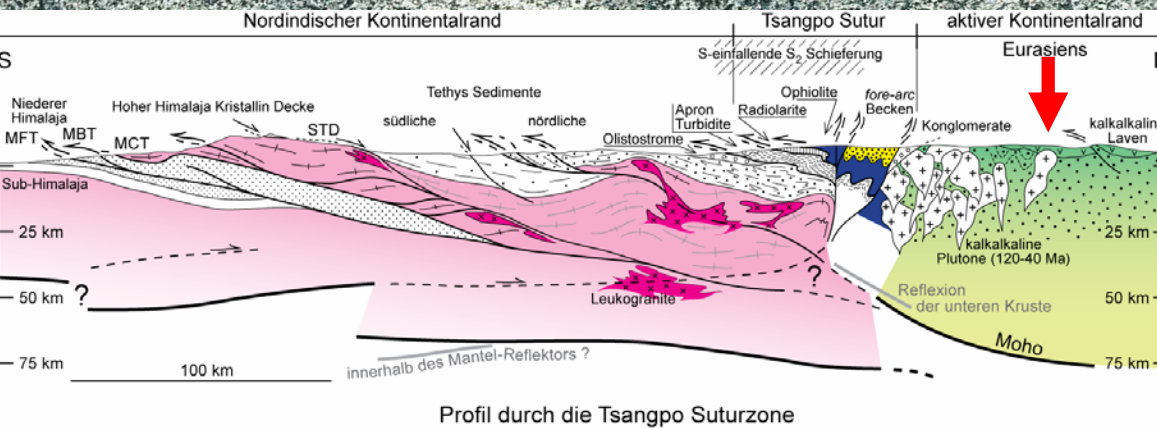


Marge continentale active



des plis érodés affectant le
 stal d'environ 50% avait eu
 ne?

Marge continentale active



forme un batholite linéaire
continentale

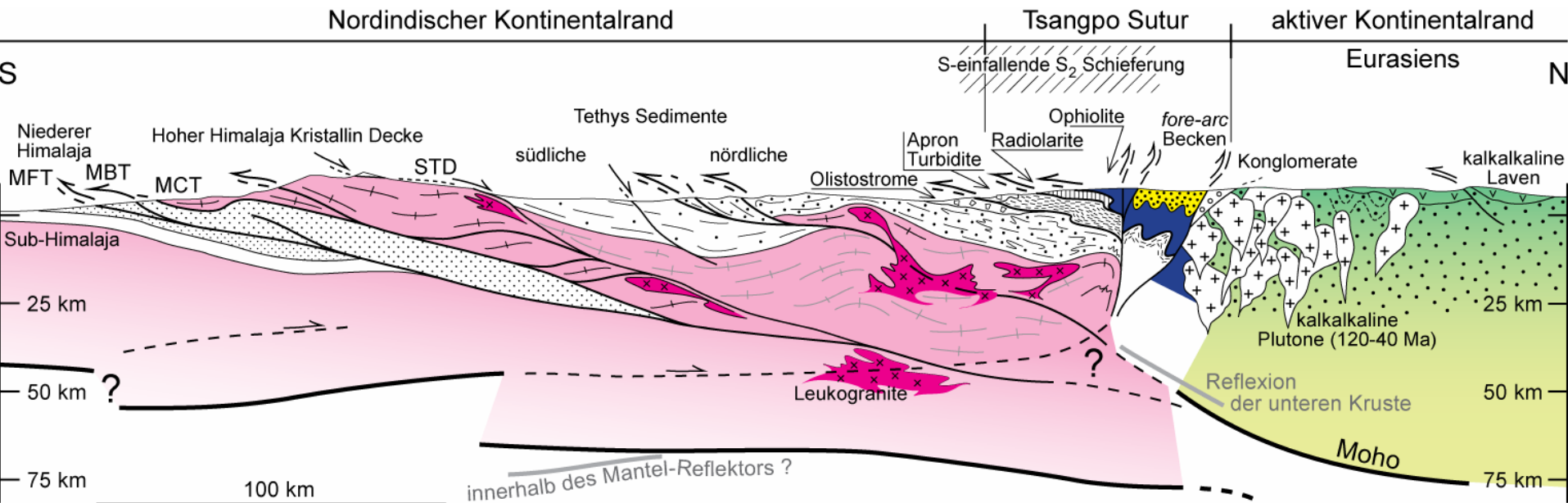
La zone de suture du Yalu Tsangpo

3 Unités

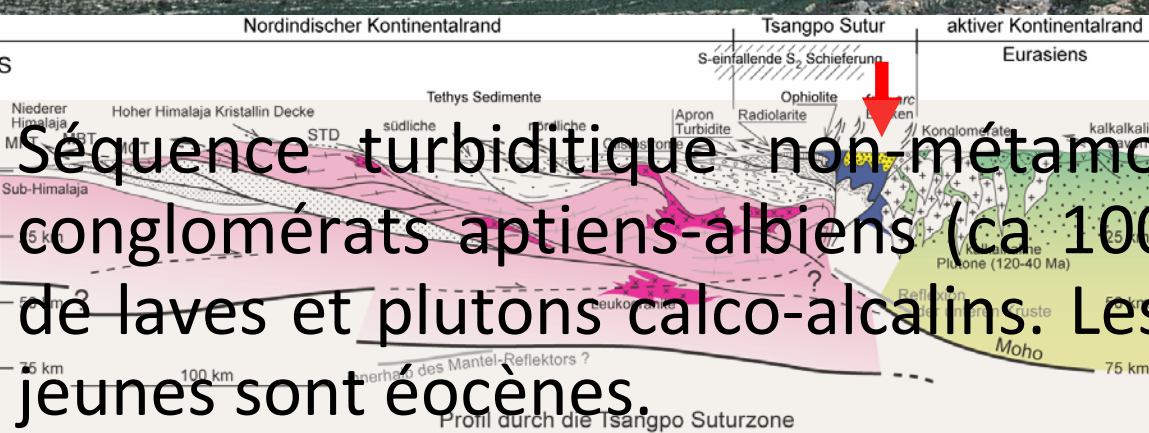
Turbidites d'avant-arc

Ophiolites

Radiolarites



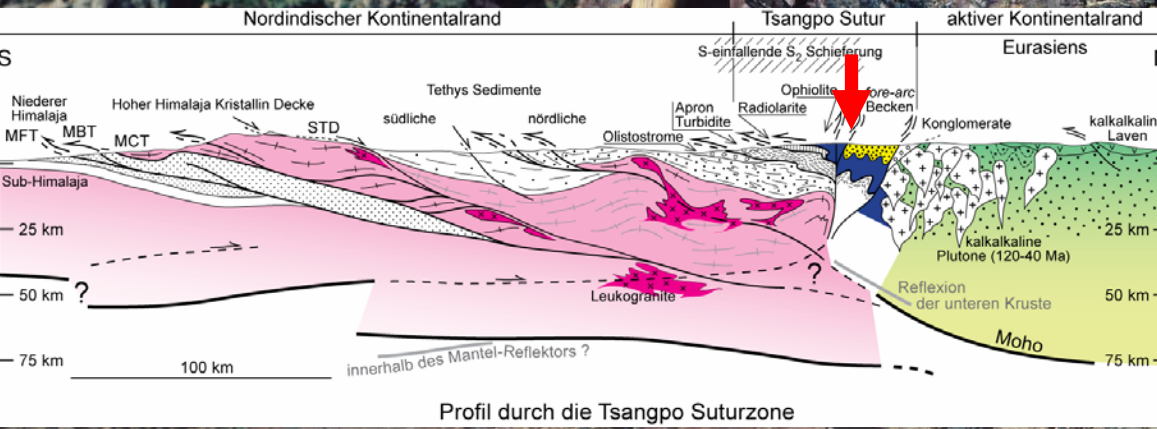
Turbidites d'avant-arc



Séquence turbiditique non-métamorphique à calcaires et conglomérats aptiens-albiens (ca 100 Ma). Galets provenant de laves et plutons calco-alcalins. Les niveaux plissés les plus jeunes sont éocènes.

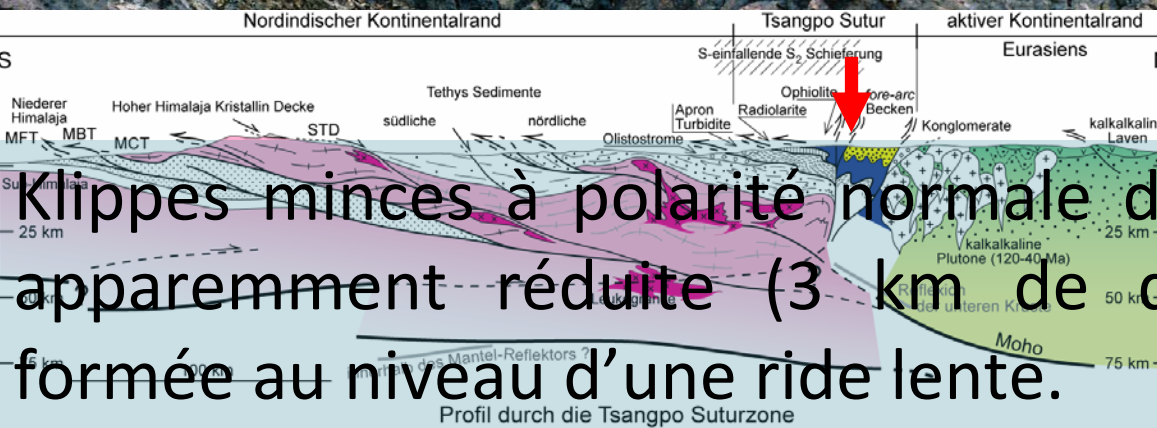
informe E-W entre deux au N.

Turbidites d'avant-arc



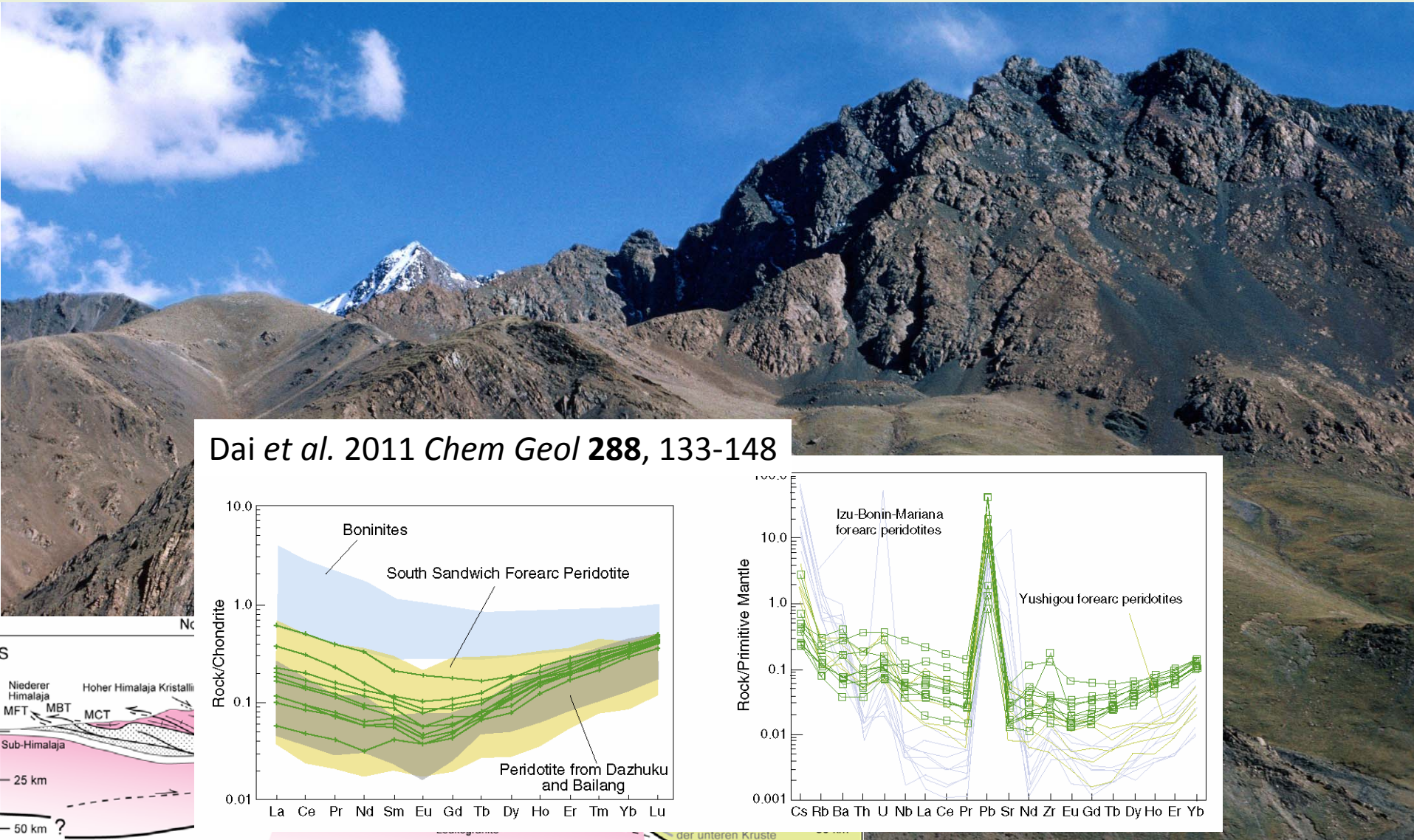
la couverture de laves

Ophiolites

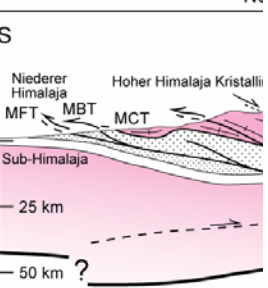
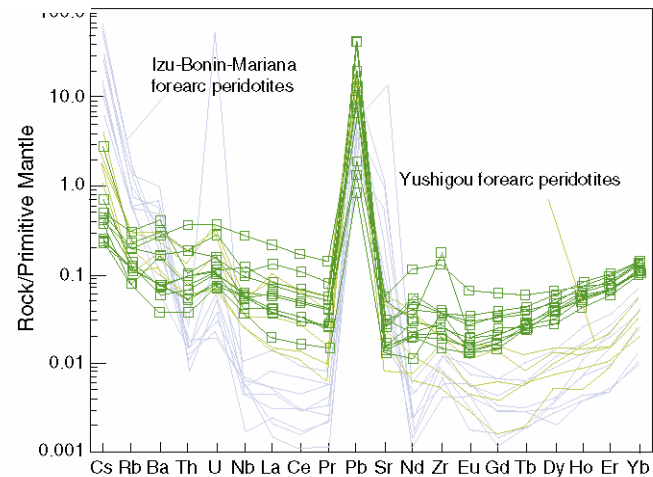
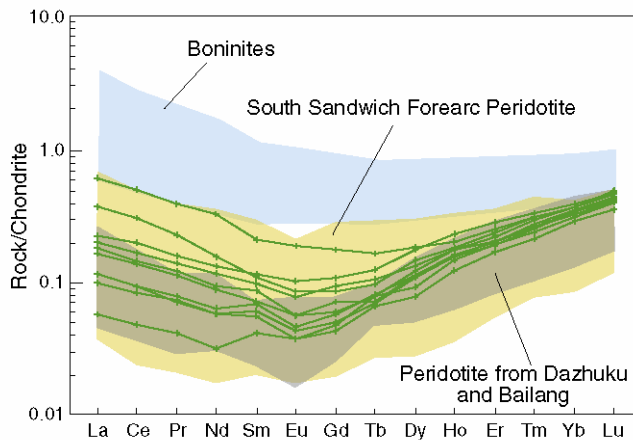


Klippes minces à polarité normale d'une ophiolite à croûte apparemment réduite (3 km de dolérites, rares gabbros) formée au niveau d'une ride lente.

Ophiolites



Dai et al. 2011 *Chem Geol* **288**, 133-148

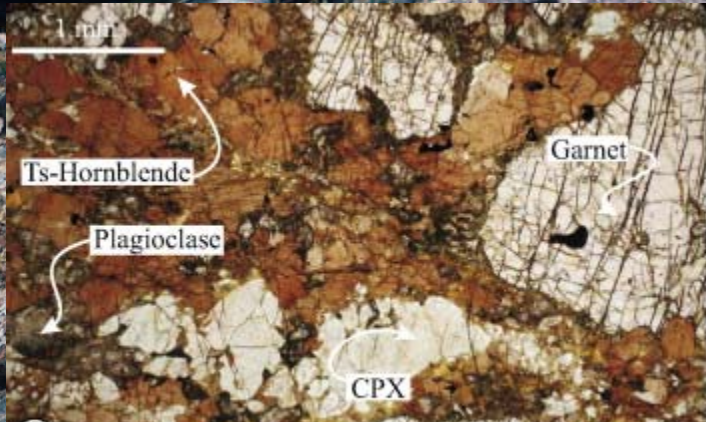


Certaines klippes incluent des restes d'arc insulaire.

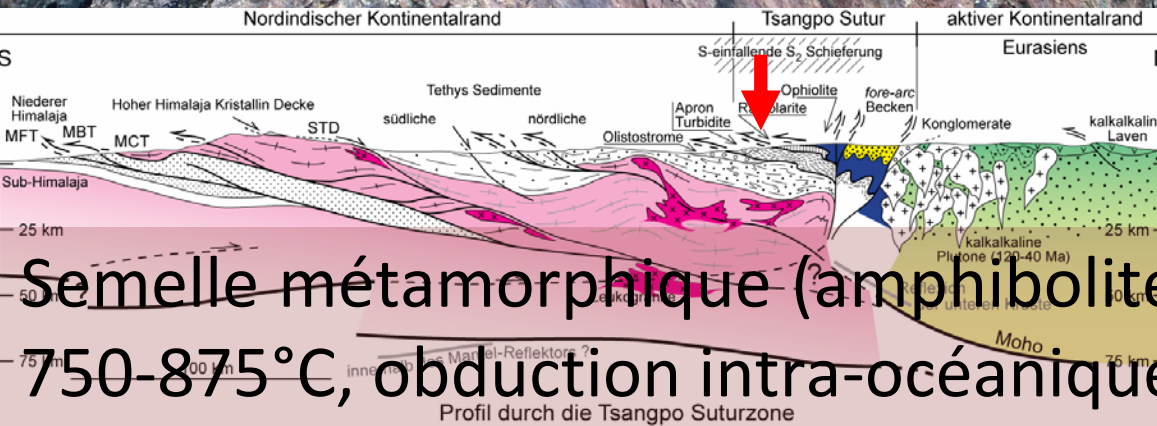
Profil durch die Tsangpo Suturzone

Moho

Allochtones infra-ophiolitiques

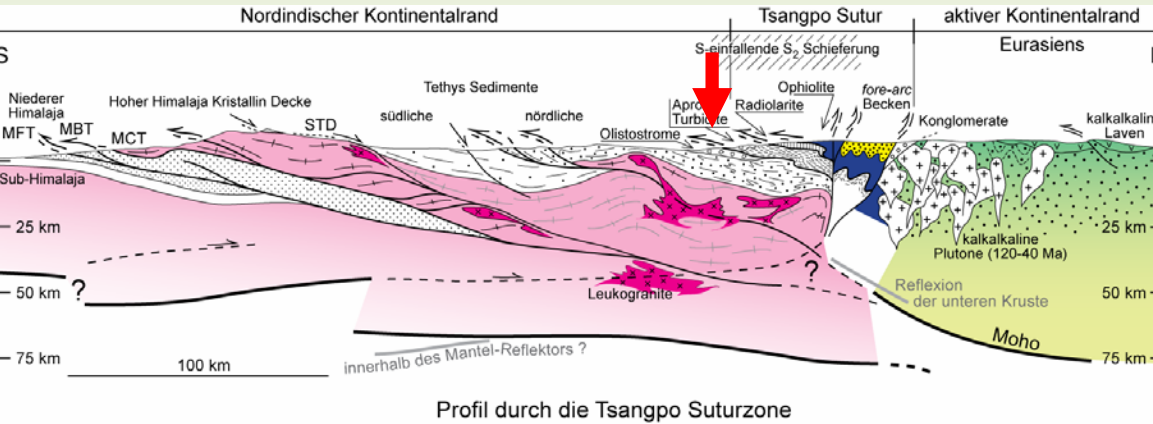


Guilmette *et al.* 2008, *JAES* 32 423-437



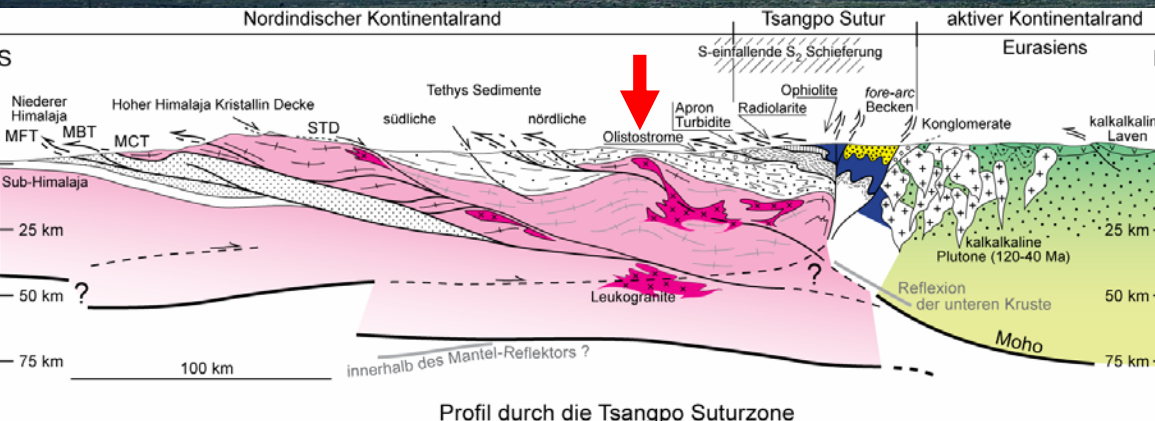
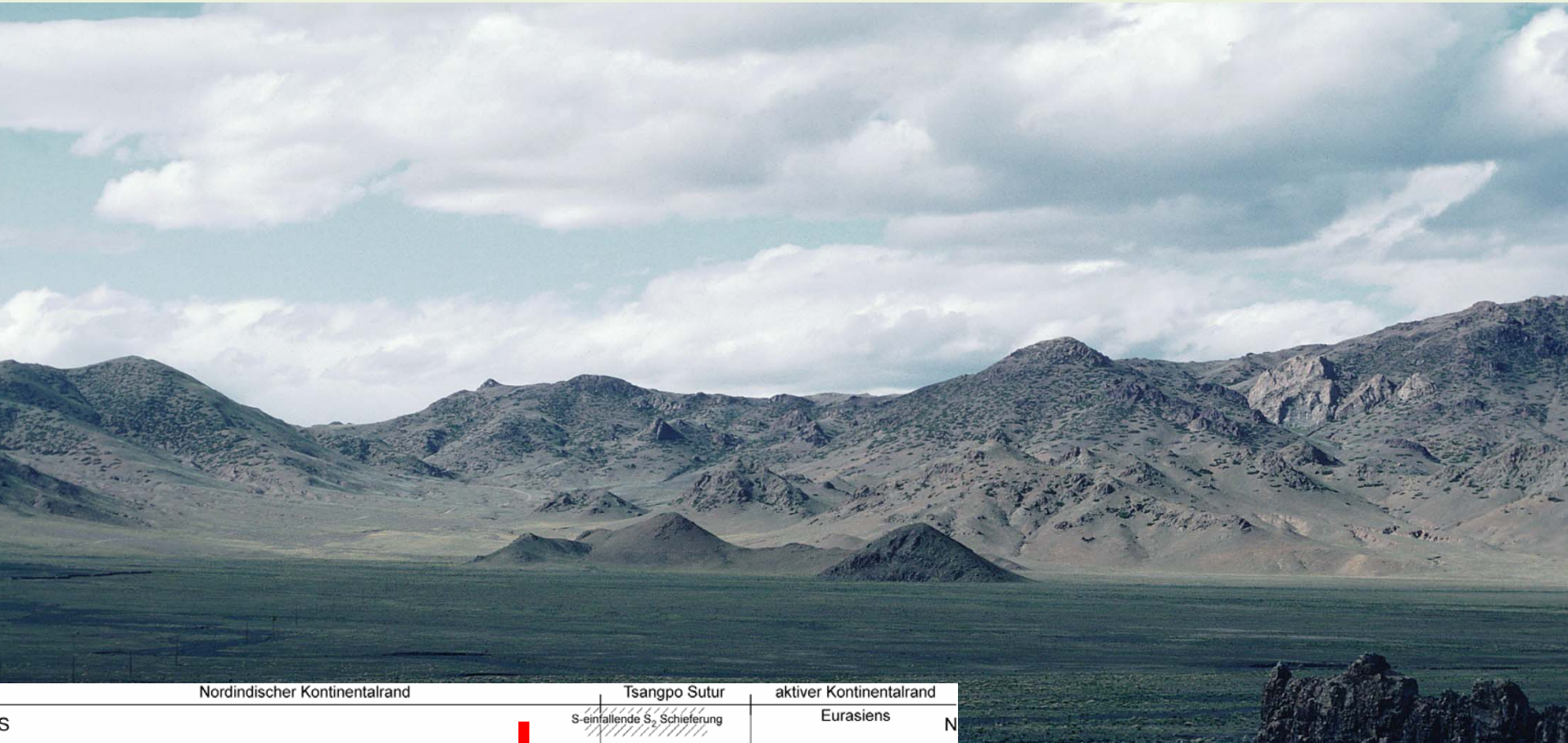
Semelle métamorphique (amphibolites à grenat; 13-15 kbars, 750-875°C, obduction intra-océanique) à 120-130 Ma.

Marge continentale indienne



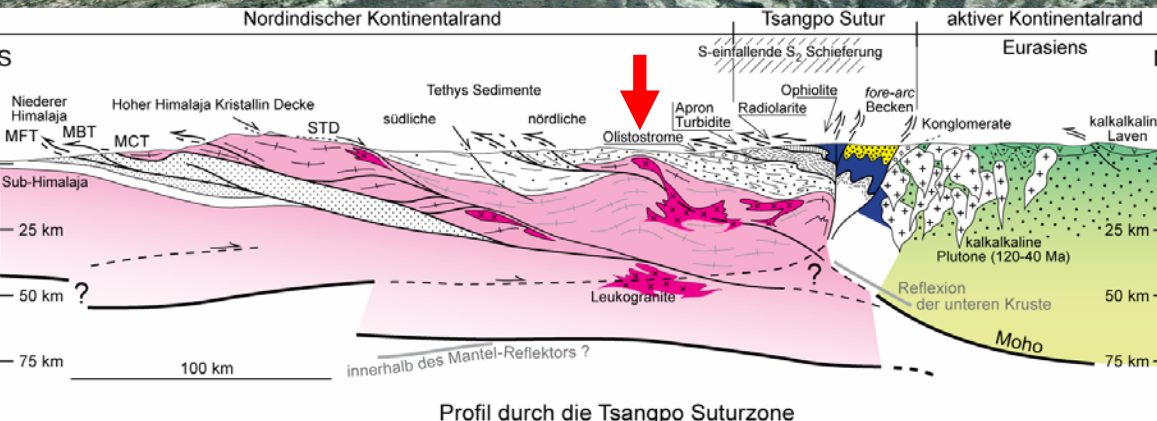
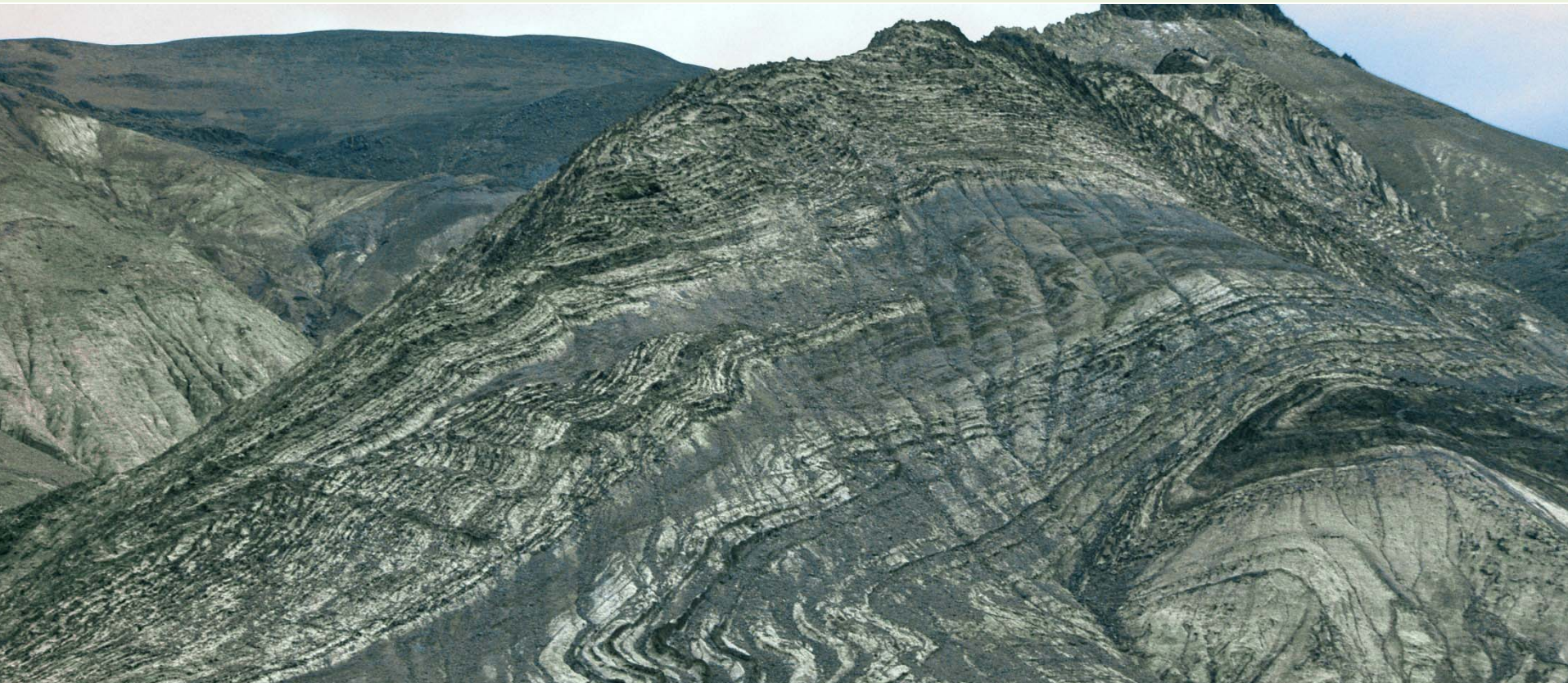
Les ophiolites et les radiolarites sont charriées sur des turbidites allochtones peu métamorphiques, polyphasées.

Marge continentale indienne



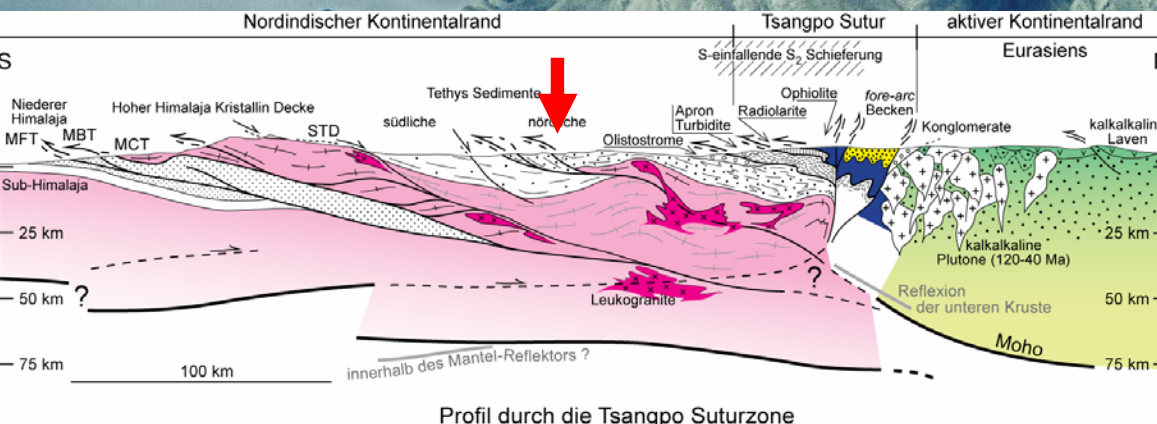
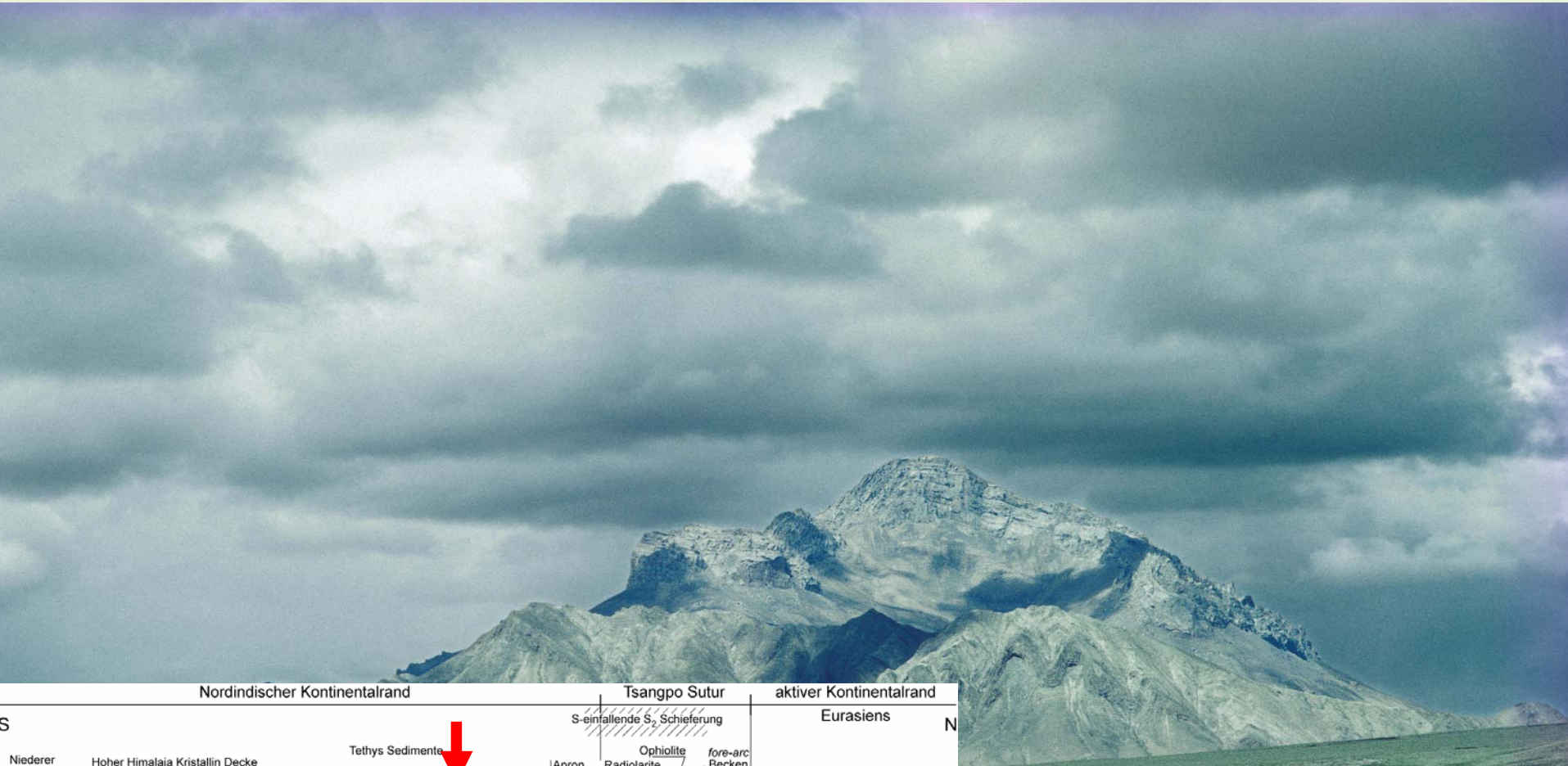
et les plus vieux sont des
es plus jeunes, plissés
cène inférieur.

Himalaya téthysien



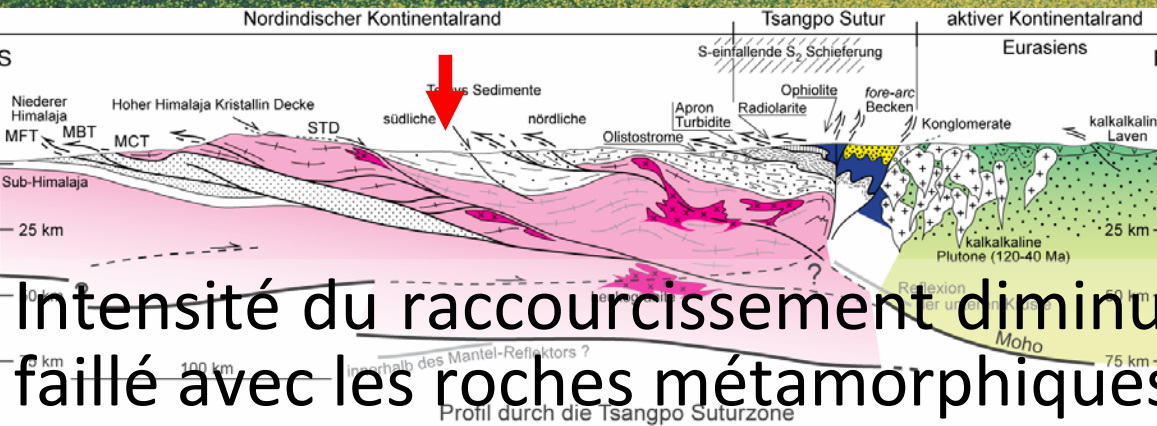
un linéation d'étirement
dance de l'olistostrome

Himalaya téthysien



ne seule phase de plissement pendant l'Eocène inférieur. Le plissement se poursuit vers le Sud. Contact du Haut-Himalaya.

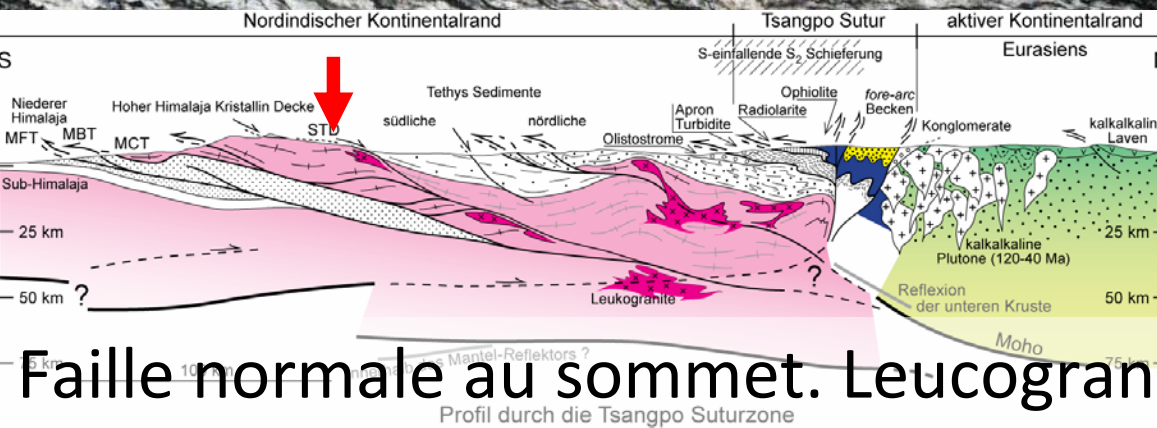
Himalaya téthysien



Intensité du raccourcissement diminuant vers le Sud. Contact faillé avec les roches métamorphiques du Haut-Himalaya.

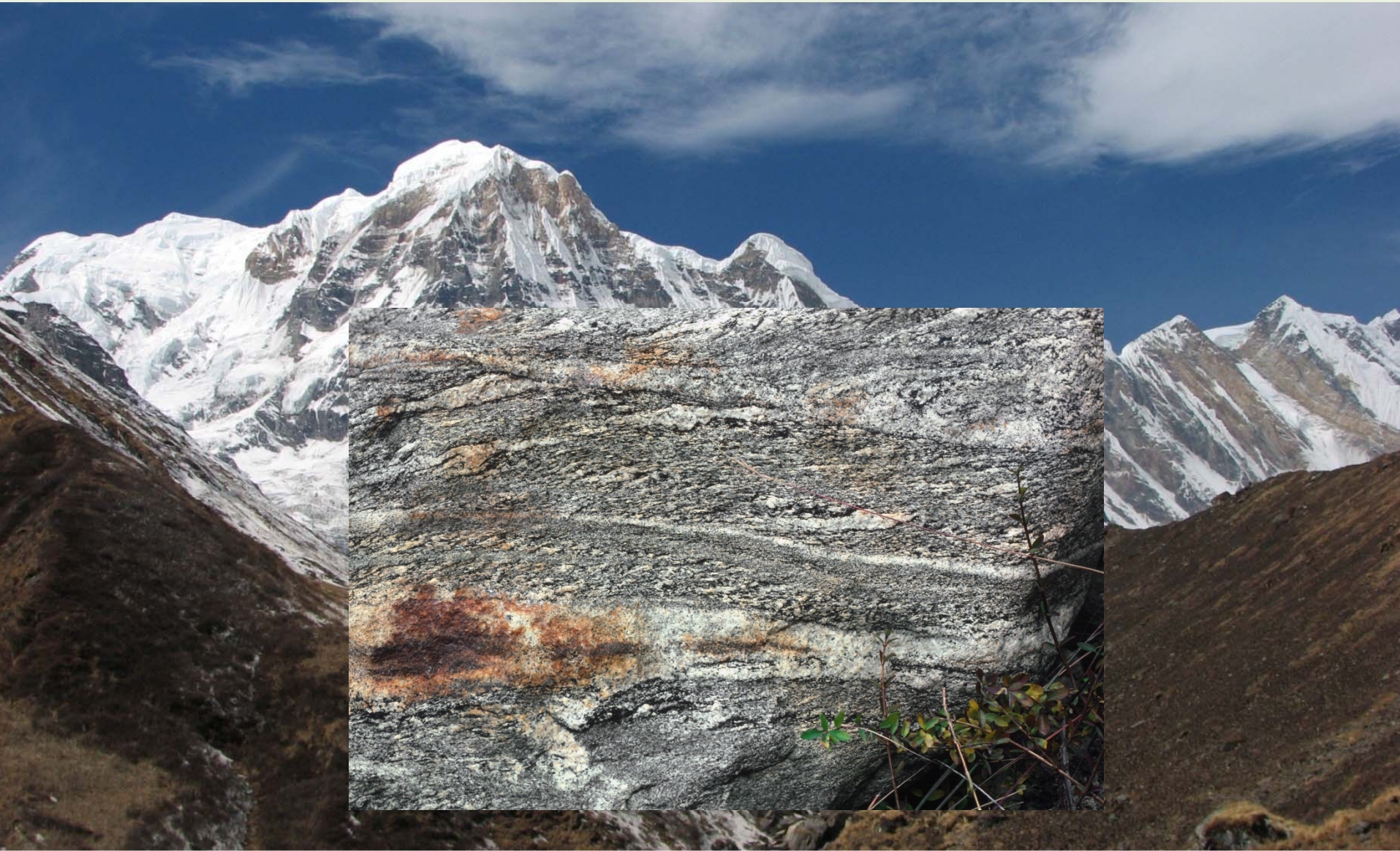


Haut-Himalaya



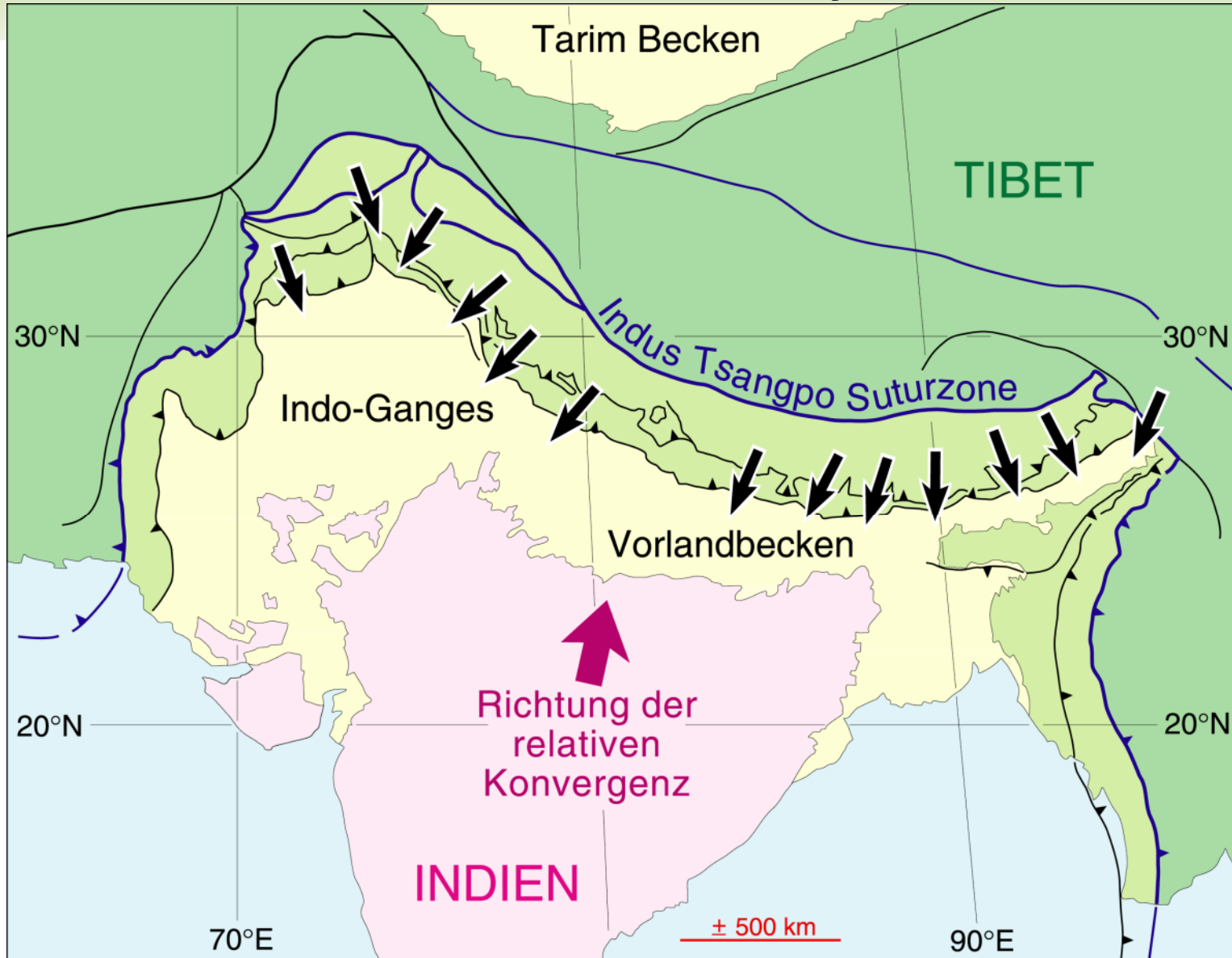
Faille normale au sommet. Leucogranites de 11 à 25 Ma.

Haut-Himalaya



5 à 10 km de gneiss cisailés vers le Sud

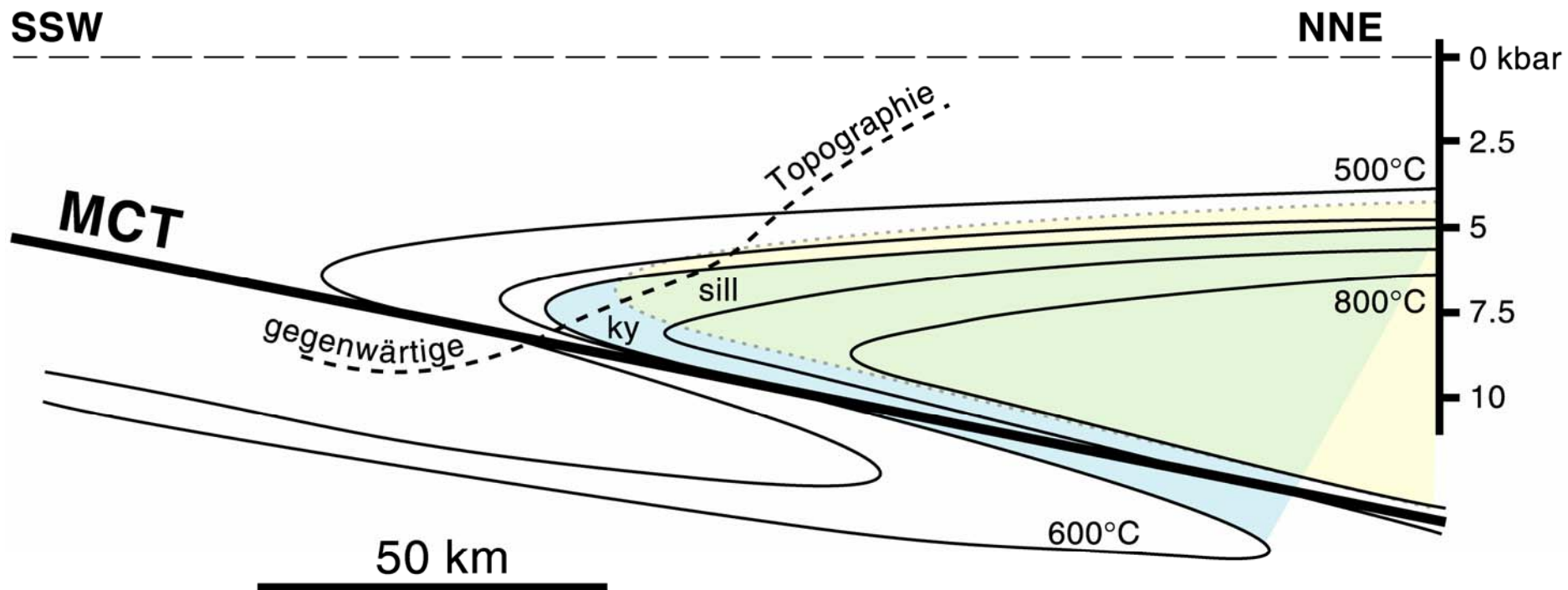
Haut-Himalaya



Linéations radiales, transverses.

Haut-Himalaya

Métamorphisme polyphasé, pression intermédiaire à ca. 35 Ma, à Sillimanite et anatexie vers 20 Ma; **Zonation inverse**.

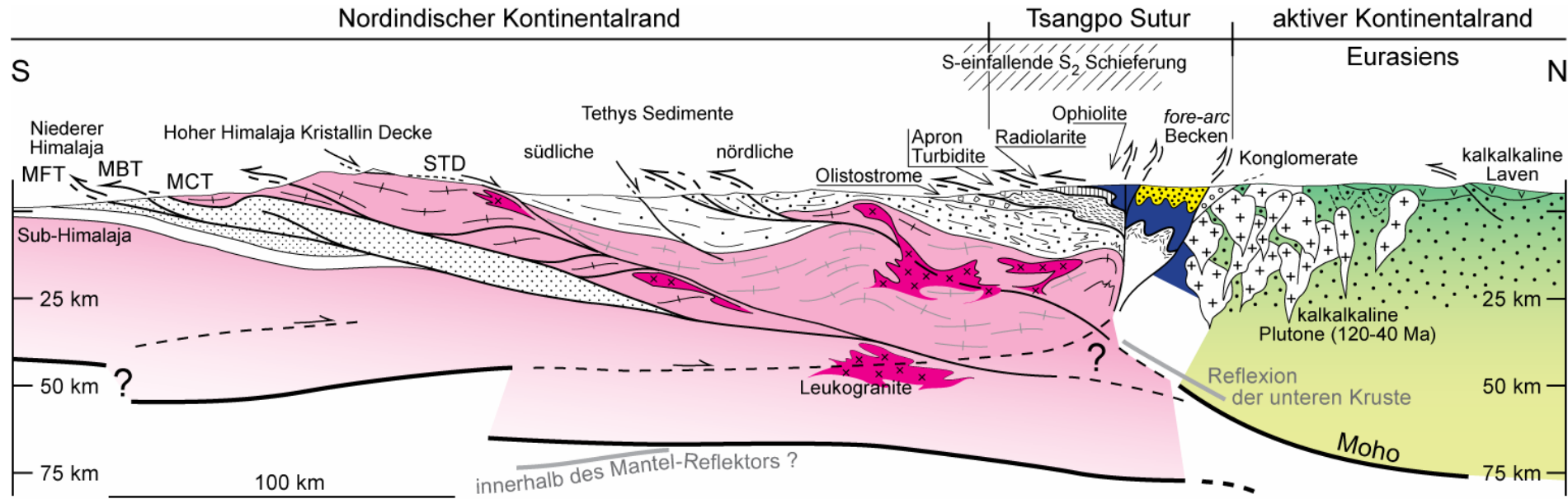


Die Überschiebung eines Körpers heisser Gesteine, mehrere Zehner Kilometer dick, auf kältere Gesteine, erhitzt die letzteren während es die ersteren langsam abkühlt. Die Isothermen in diesem Querschnitt eines Bügeleisen-Modells erhalten eine typische Z-Form für ca. 30 Ma.

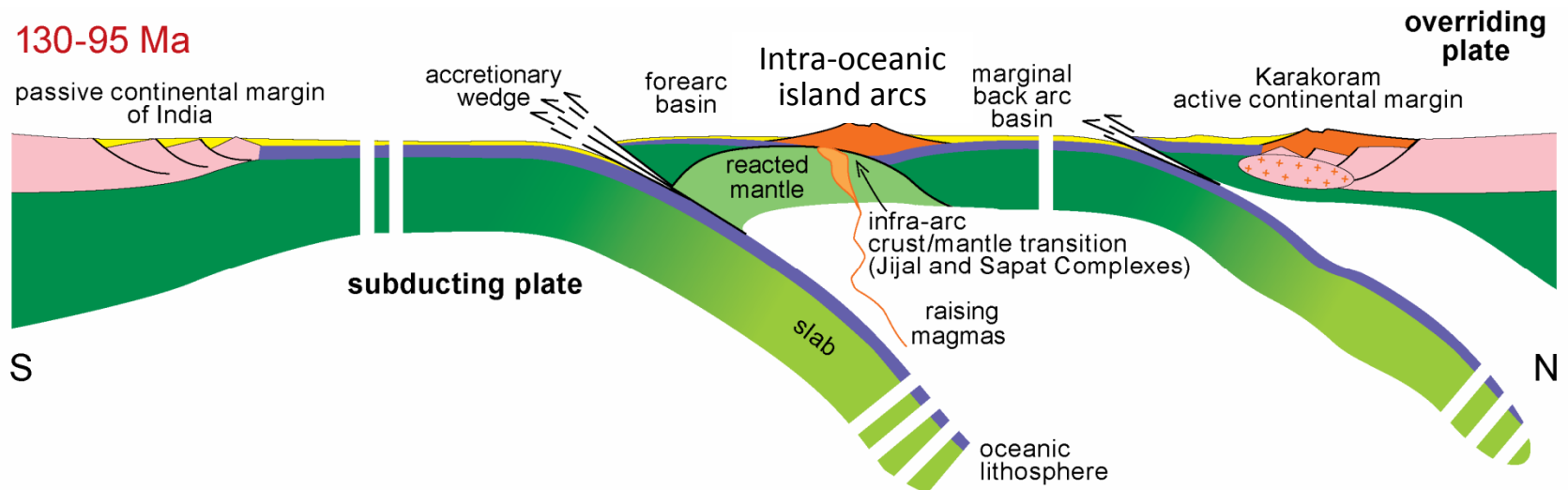
Schraffierte Gebiete entsprechen Gesteinen, die heiss genug sind, um zu schmelzen.

nach Le Fort (1975) *Am. J. Sci.* **275-A**, 1-44.

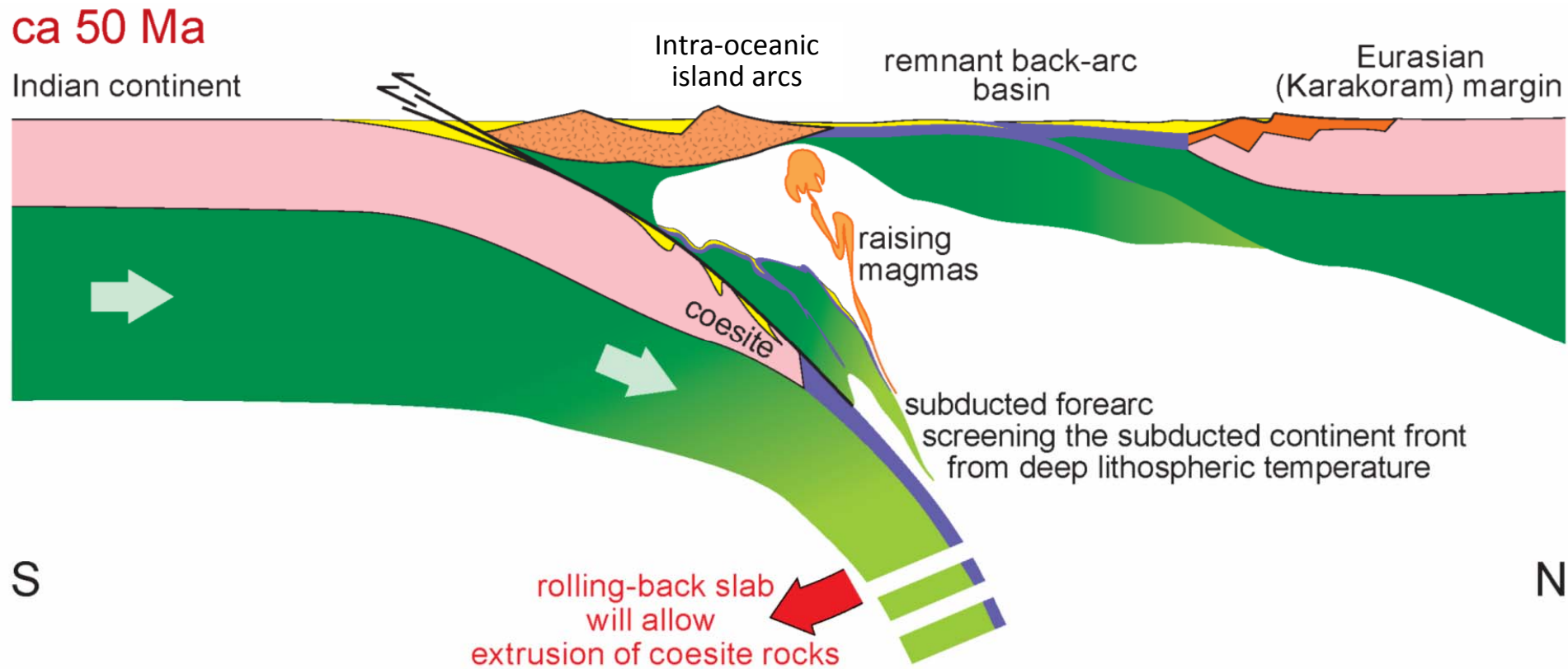
Interprétation tectonique

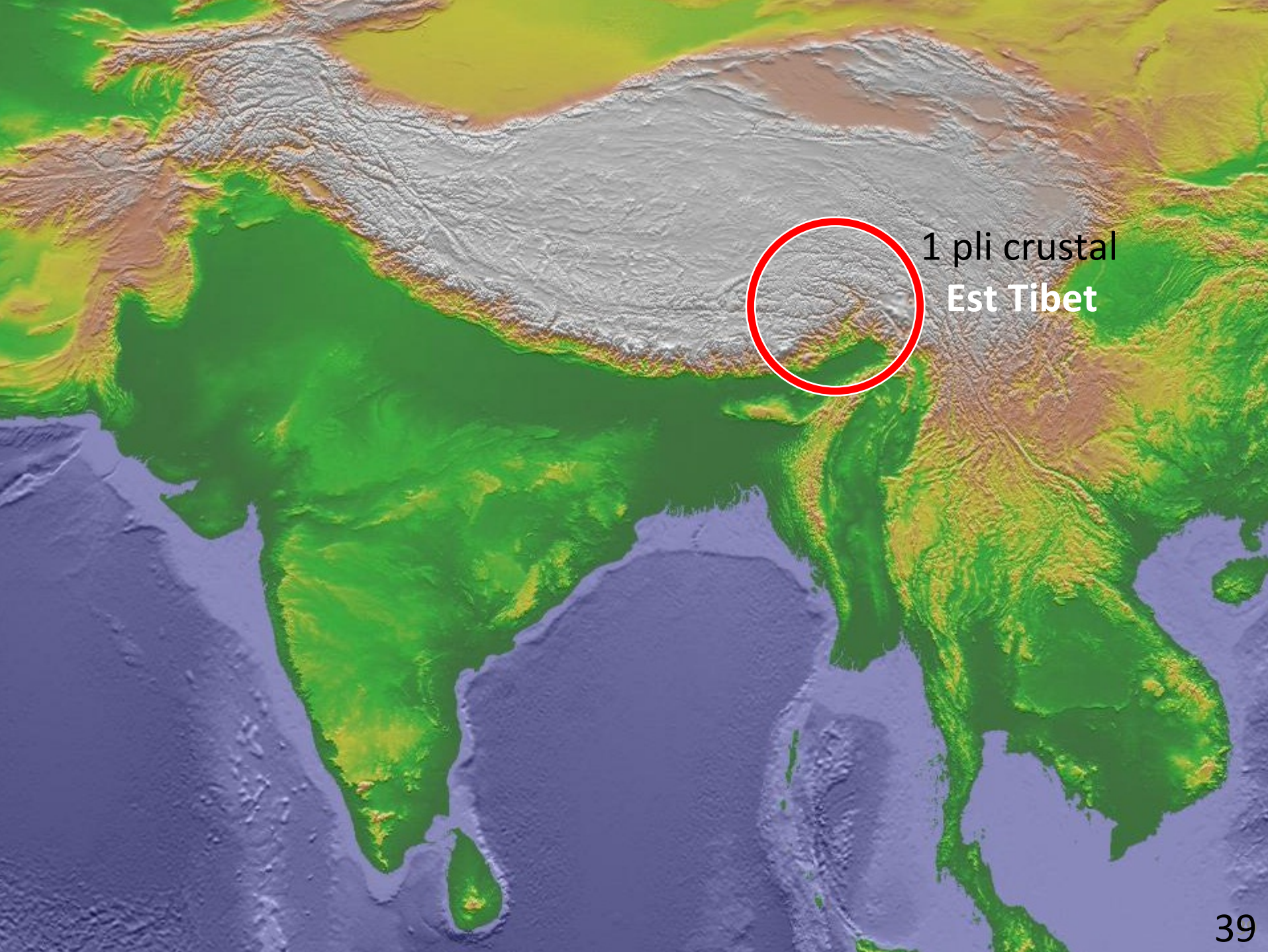


130-95 Ma



Interprétation tectonique





1 pli crustal
Est Tibet

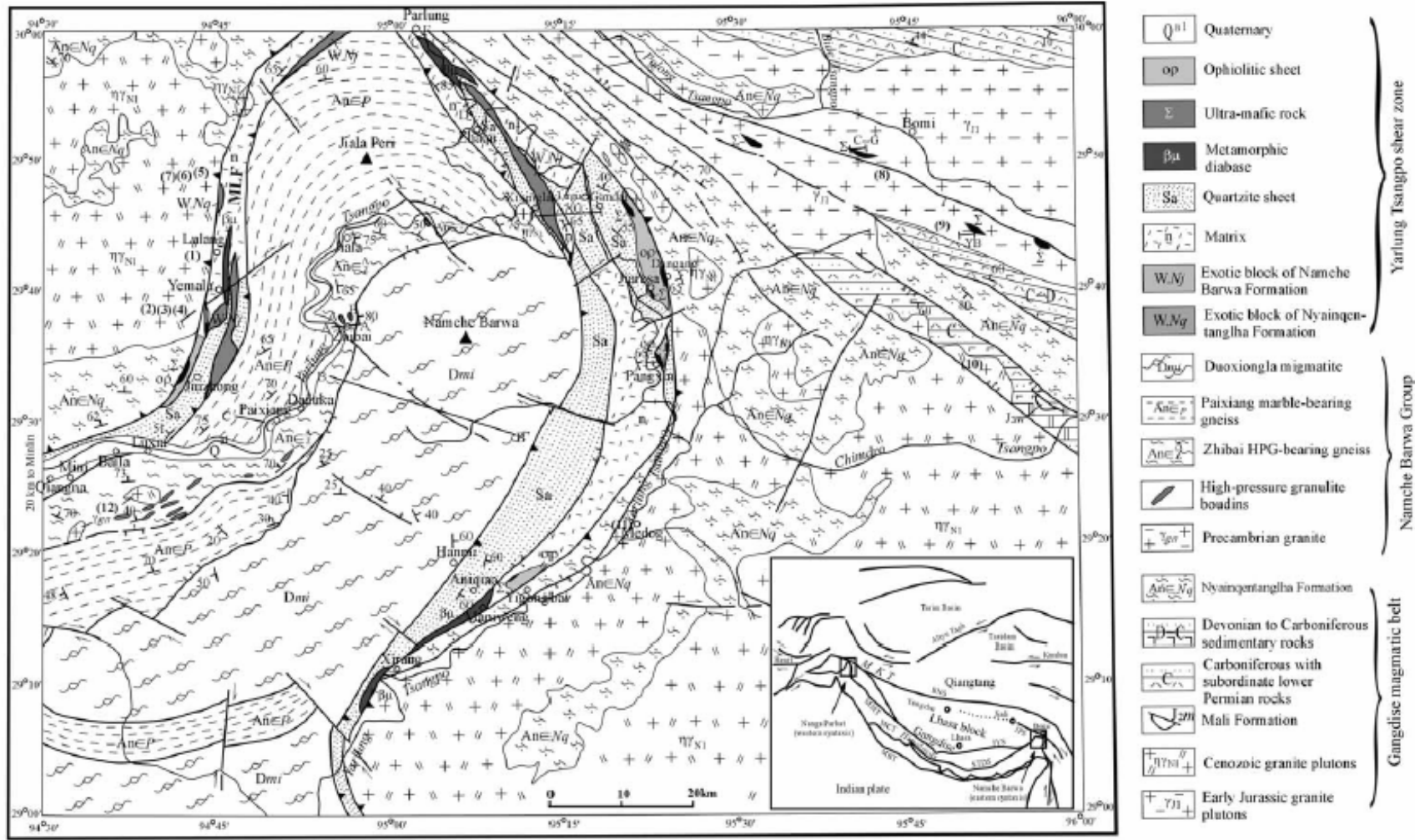
Namche Barwa (7782m)



Regional geology of Namche Barwa

Geng et al. 2006 *J. Asian Earth Sc.* **27(3)** 265-285

high
plu
me



Yarlung Tsangpo shear zone

Namche Barwa Group

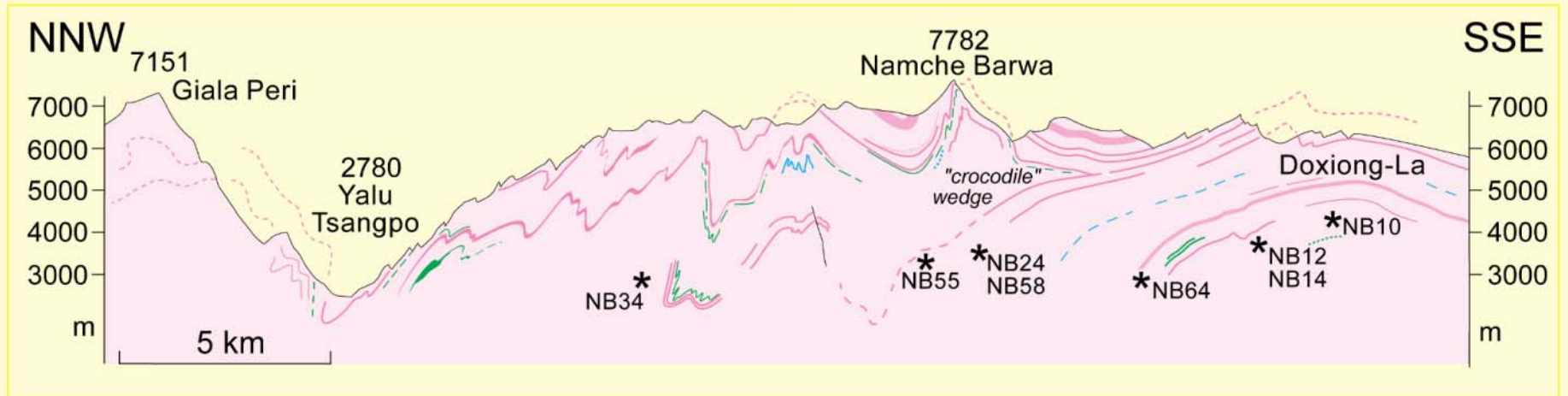
Gangdise magmatic belt

<70

④ Strike and dip of foliation ↖ Suture boundary fault and dip ↗ Thrust fault/normal fault (10) Sample location of granite radiometric dating see table 1 for details
MLF: The Minlin-Lufang fault A-F: Locations of each photo in fig.3 A-A', B-B', C-C': Locations of each section in fig.2 C-G/YH: Position of Fig. 5 A and B

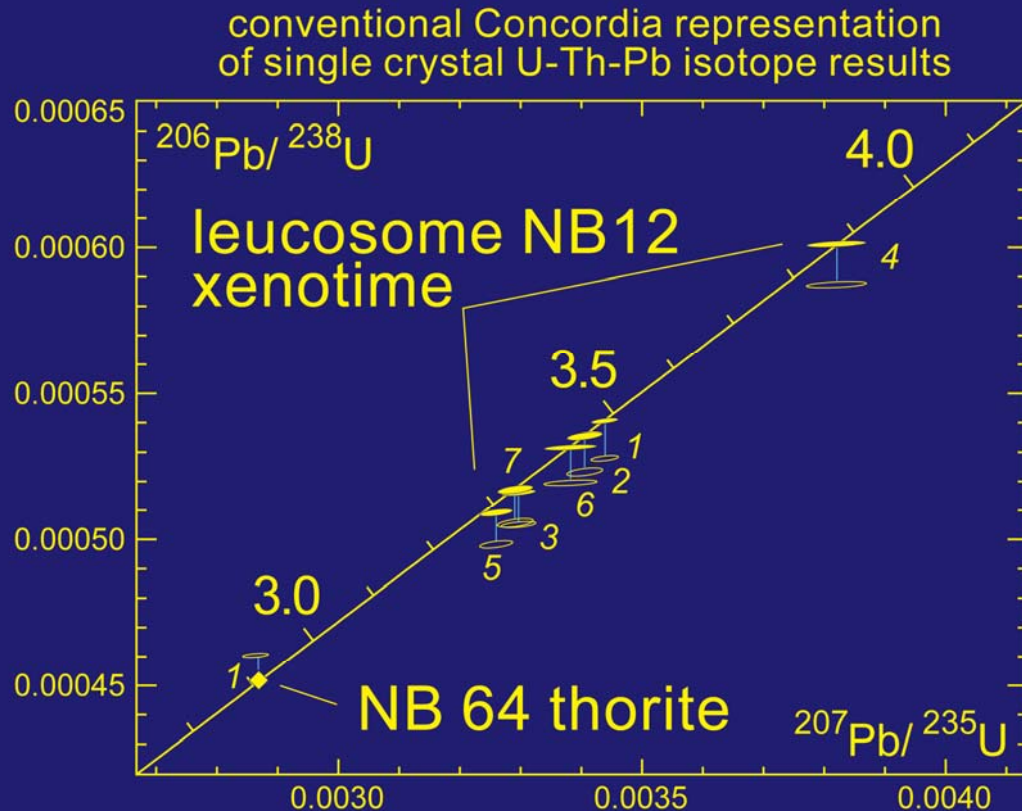
The insert shows the locations of both syntaxis, major suture zones, Indian plate, Himalayas, Lhasa/Gangdise block and Qiangtang blocks.

Namche Barwa cross section



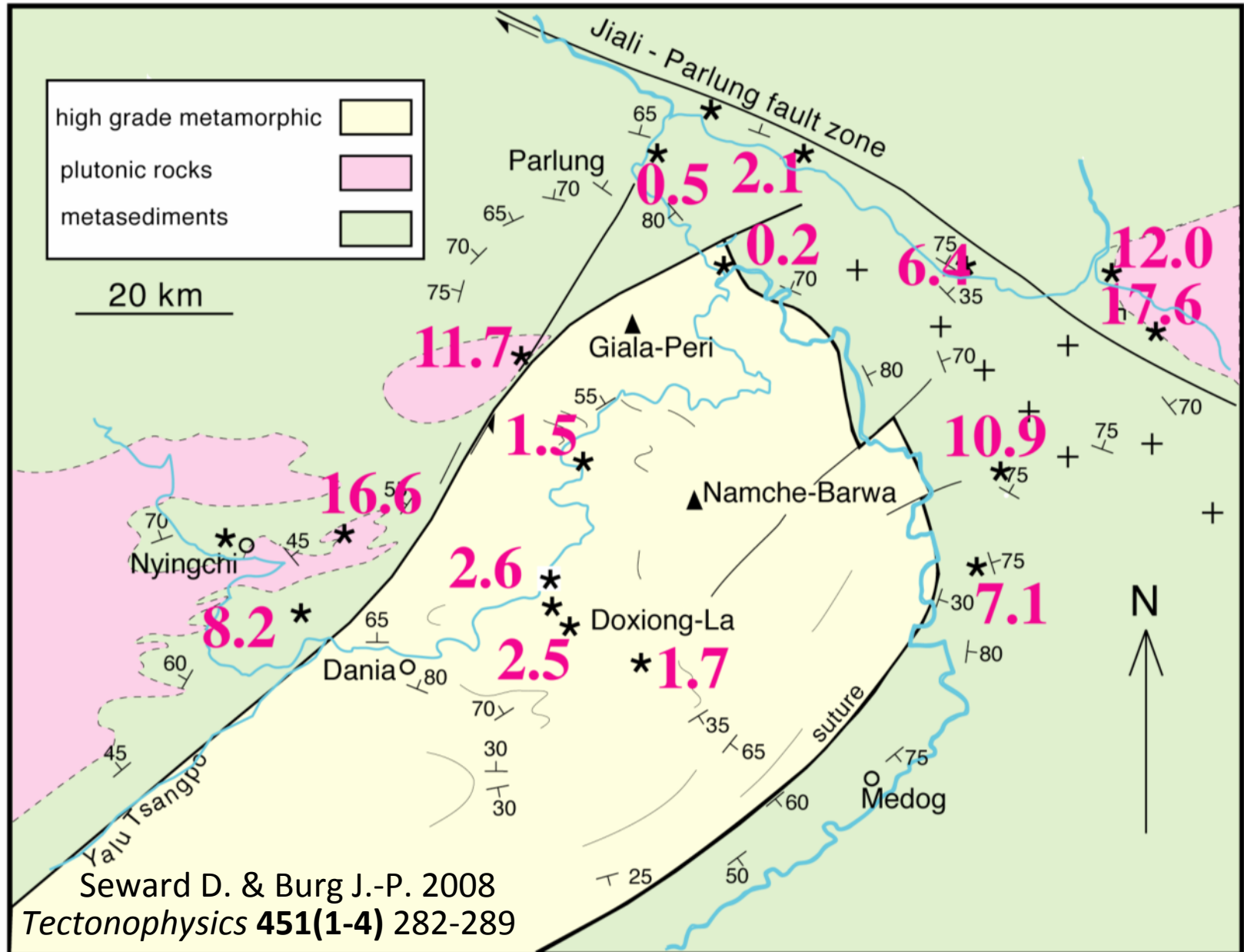
Burg *et al.* (1997) *Terra Nova* 9 (2) pp. 53-56

Namche Barwa migmatites

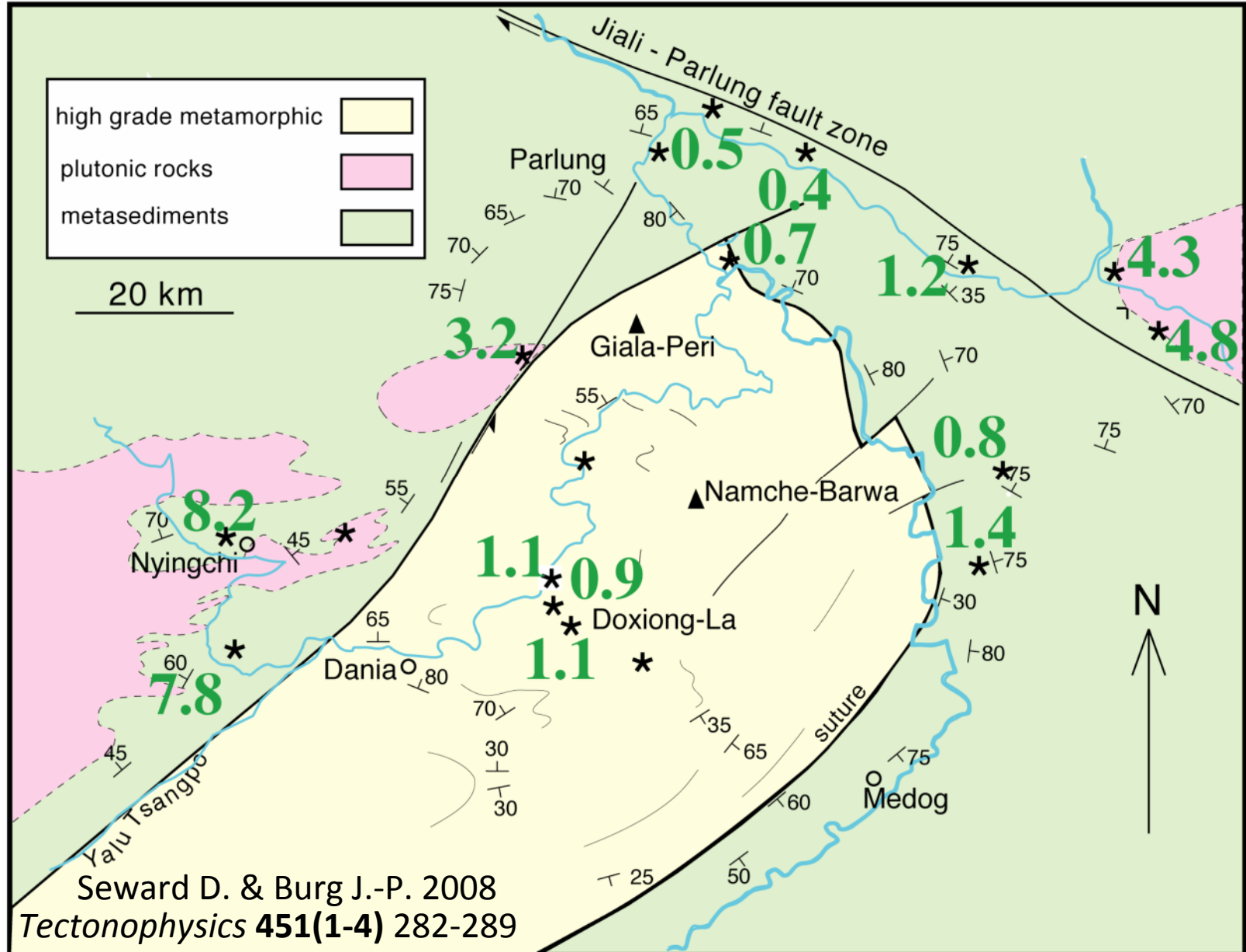


Oberli and Meyer in: Burg *et al.* (1997) *Terra Nova* **9** (2) pp. 53-56

Zircon fission-track ages

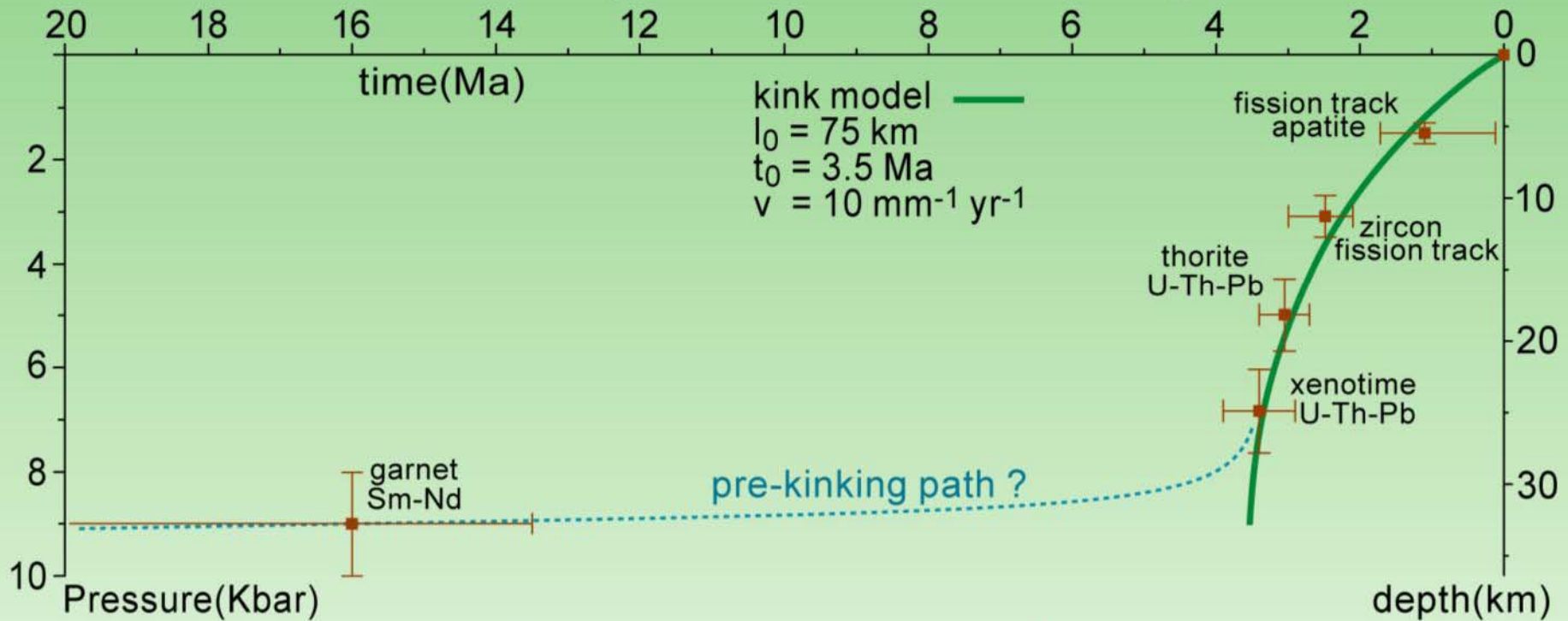


Apatite fission-track ages



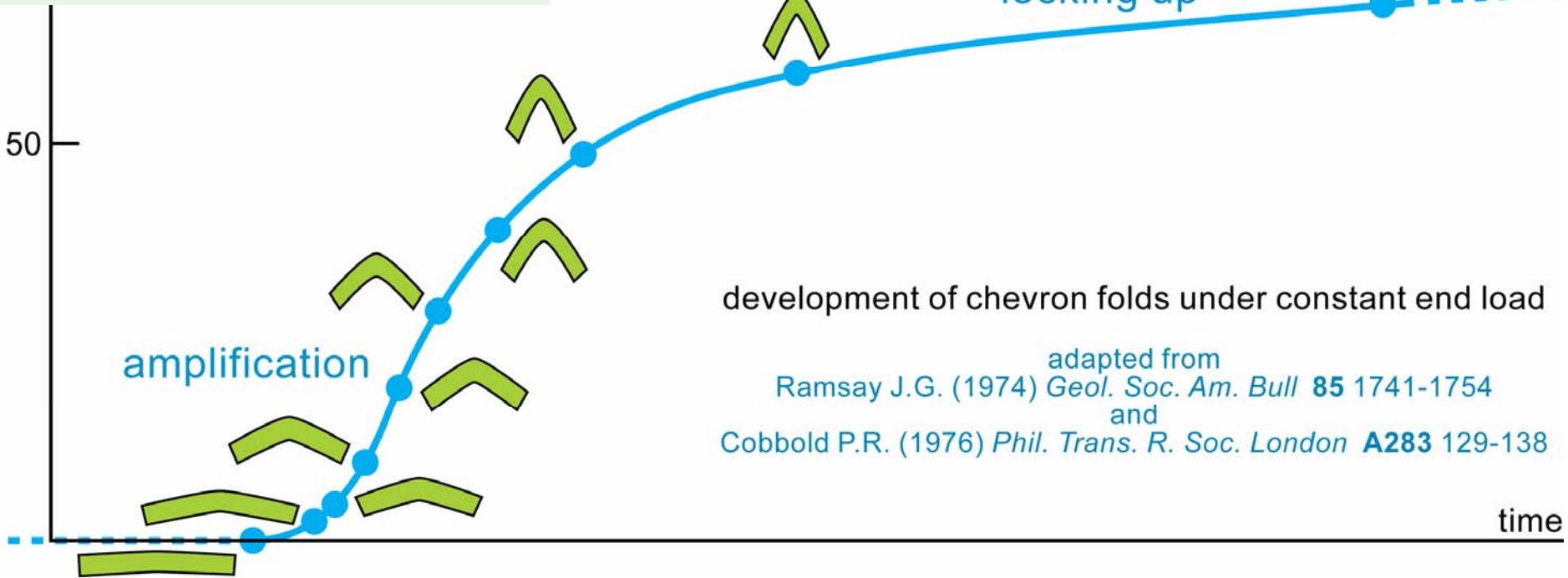
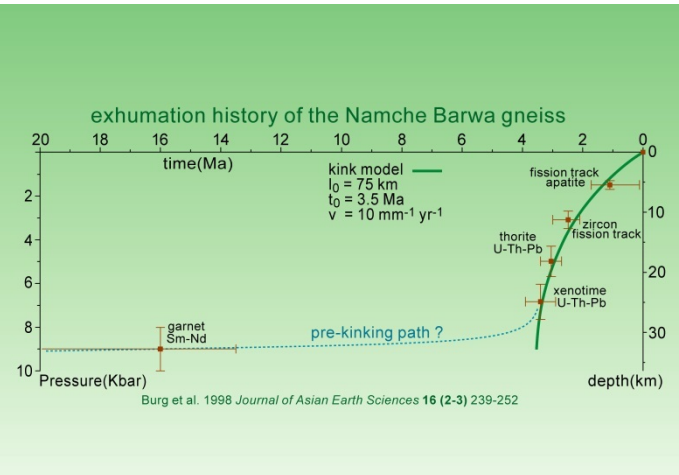
Histoire métamorphique

exhumation history of the Namche Barwa gneiss



Burg et al. 1998 *Journal of Asian Earth Sciences* 16 (2-3) 239-252

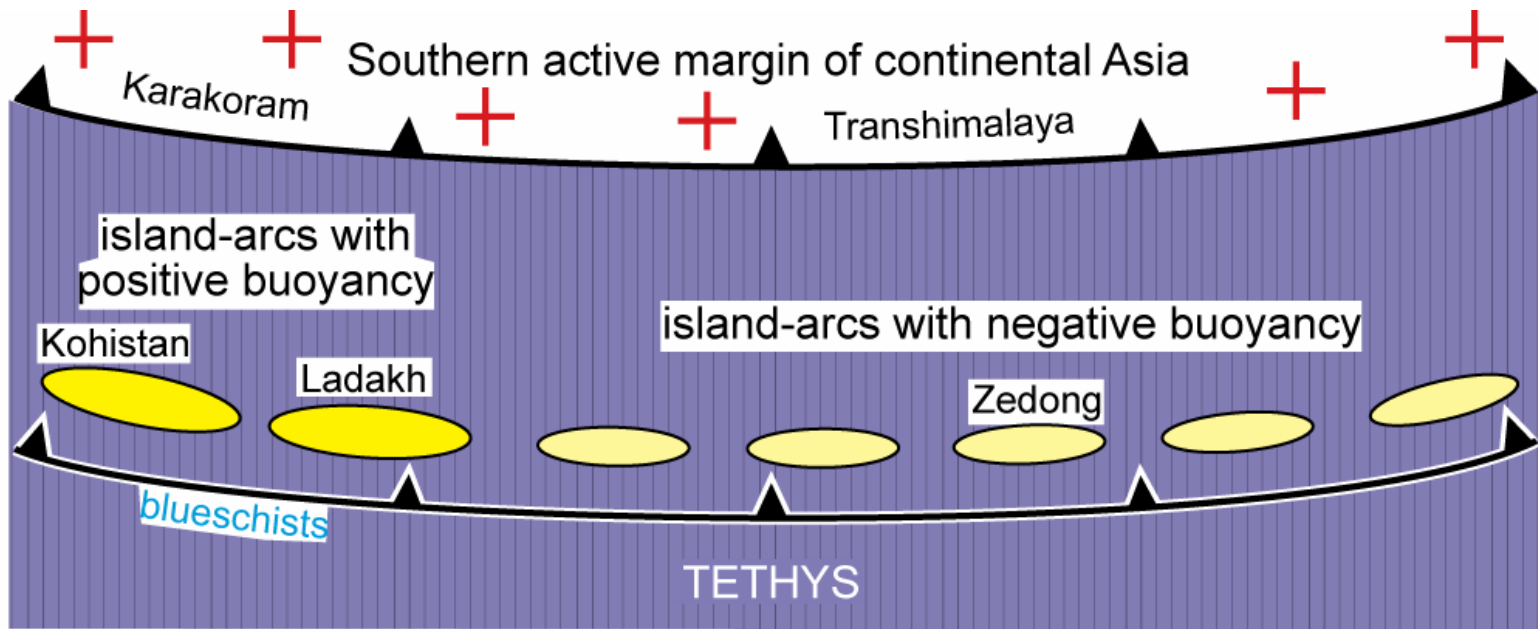
Folding interpretation



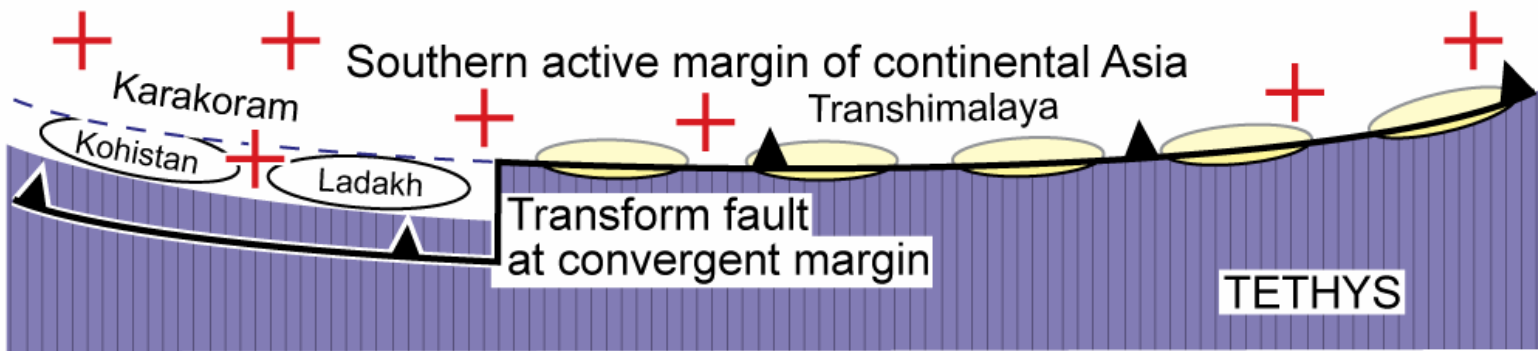
Nanga-Parbat (8125m)



De l'orient à l'occident

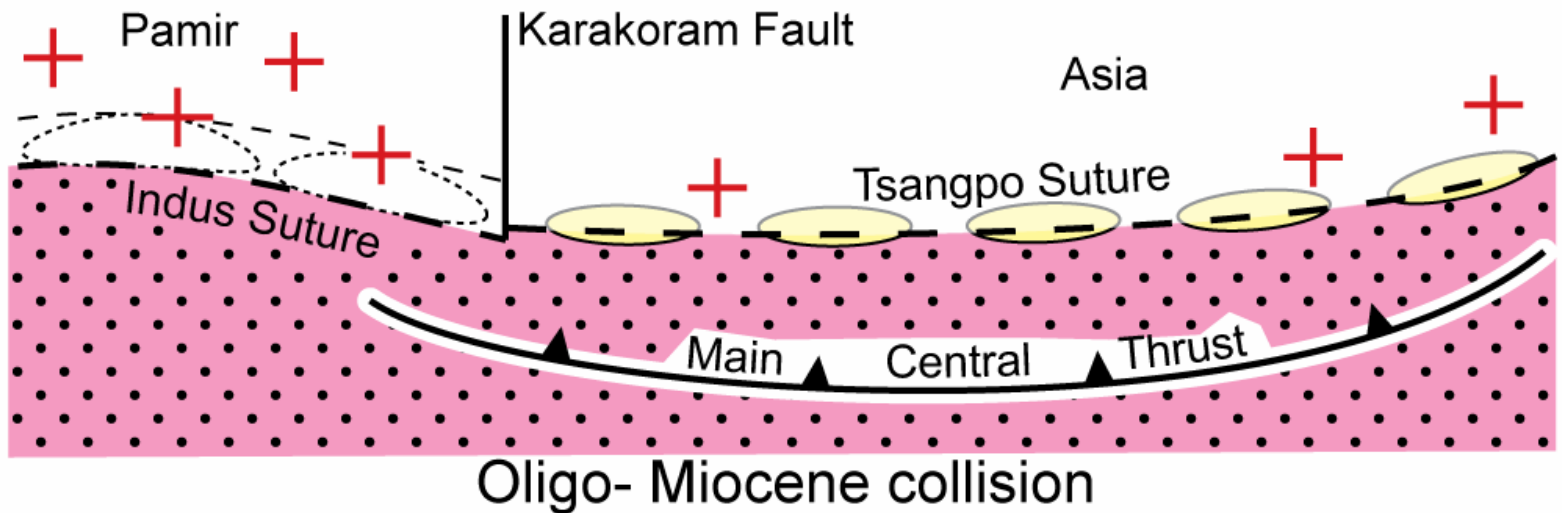
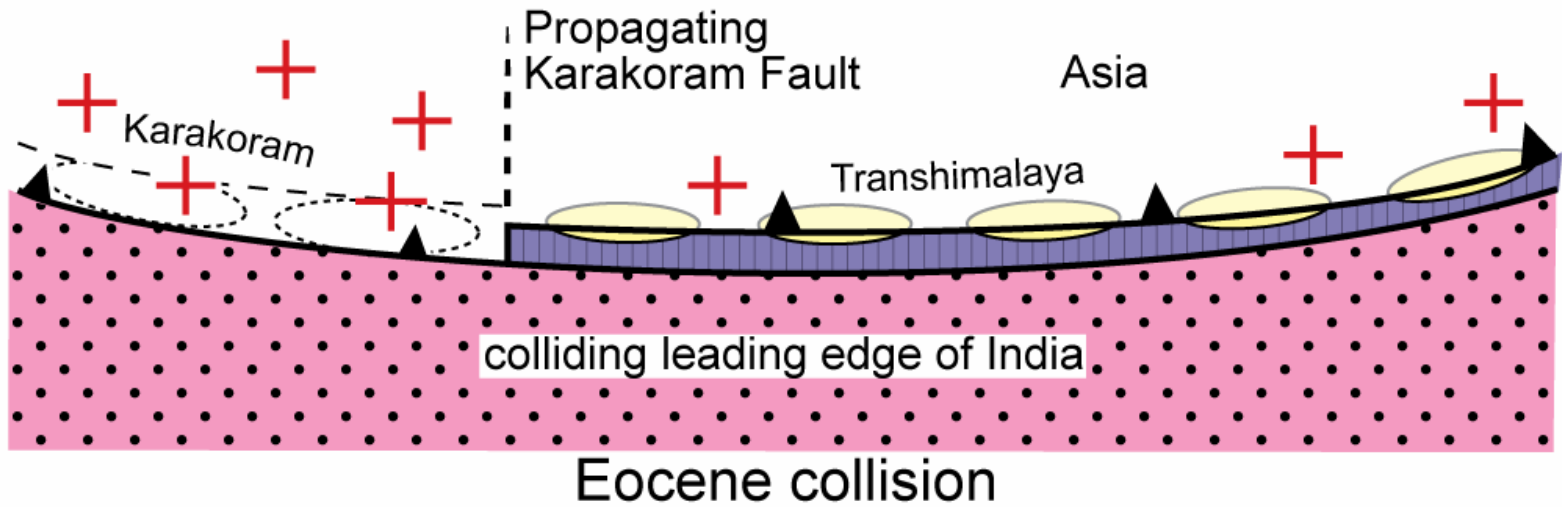


Early- Mid Cretaceous double subduction

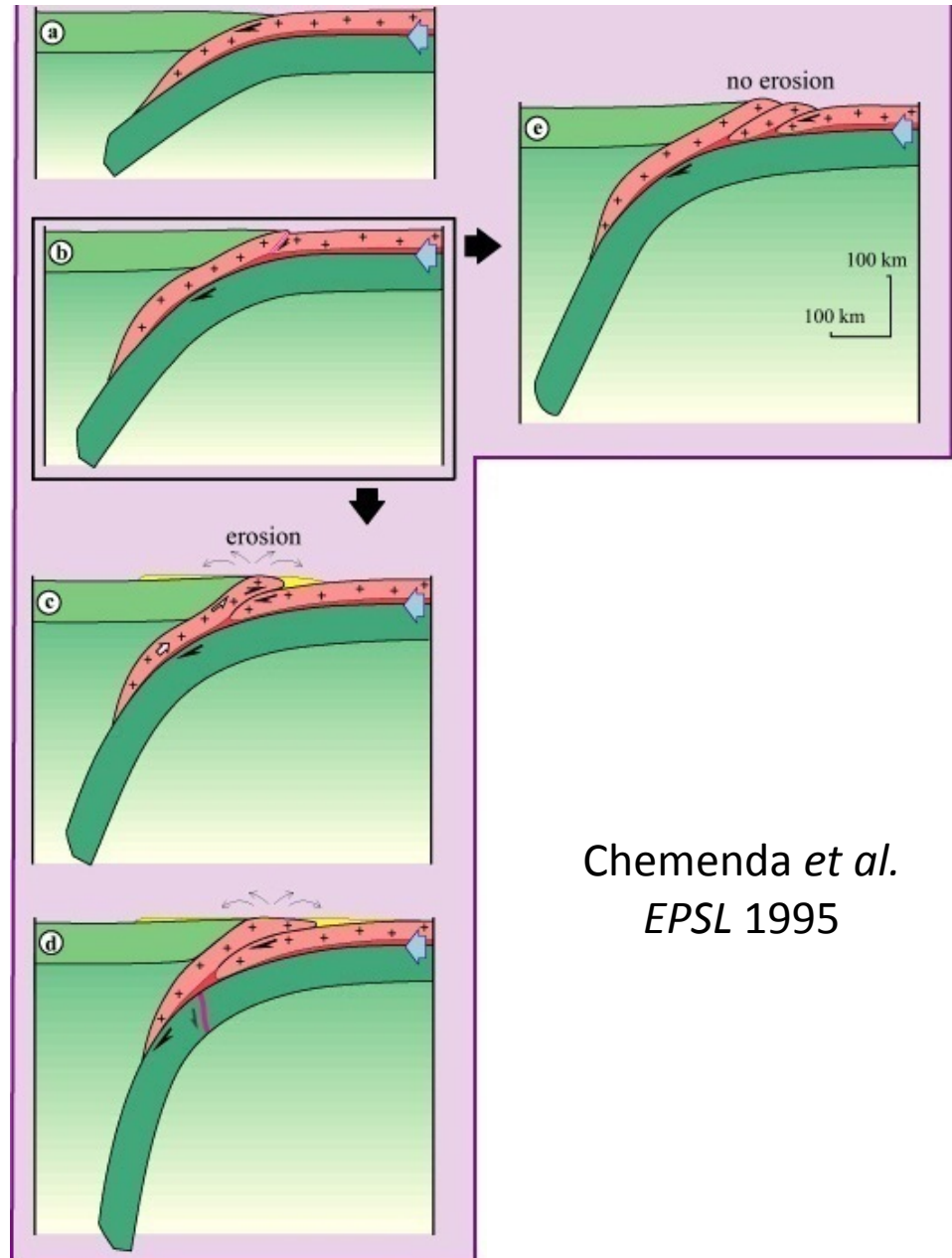
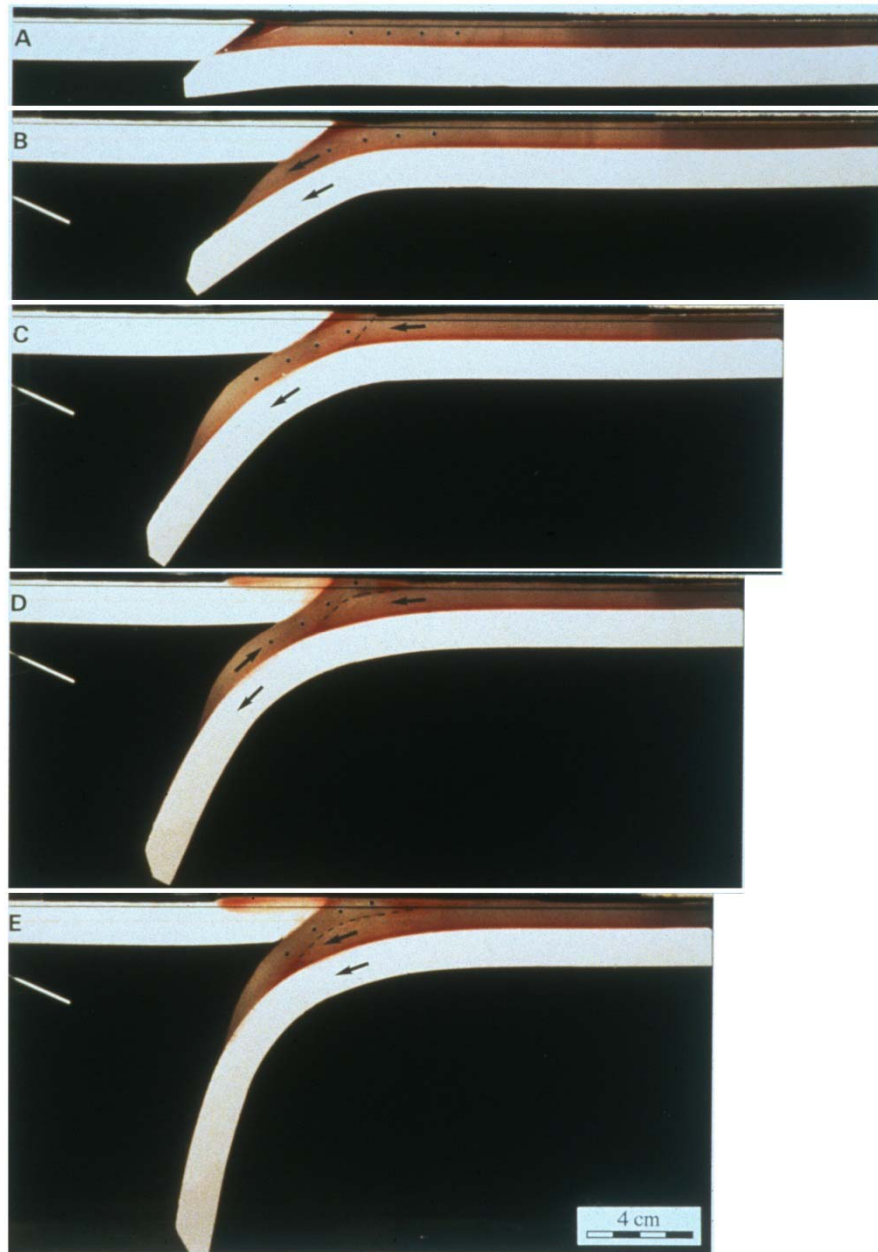


Mid-Cretaceous to Paleocene single subduction

De l'orient à l'occident

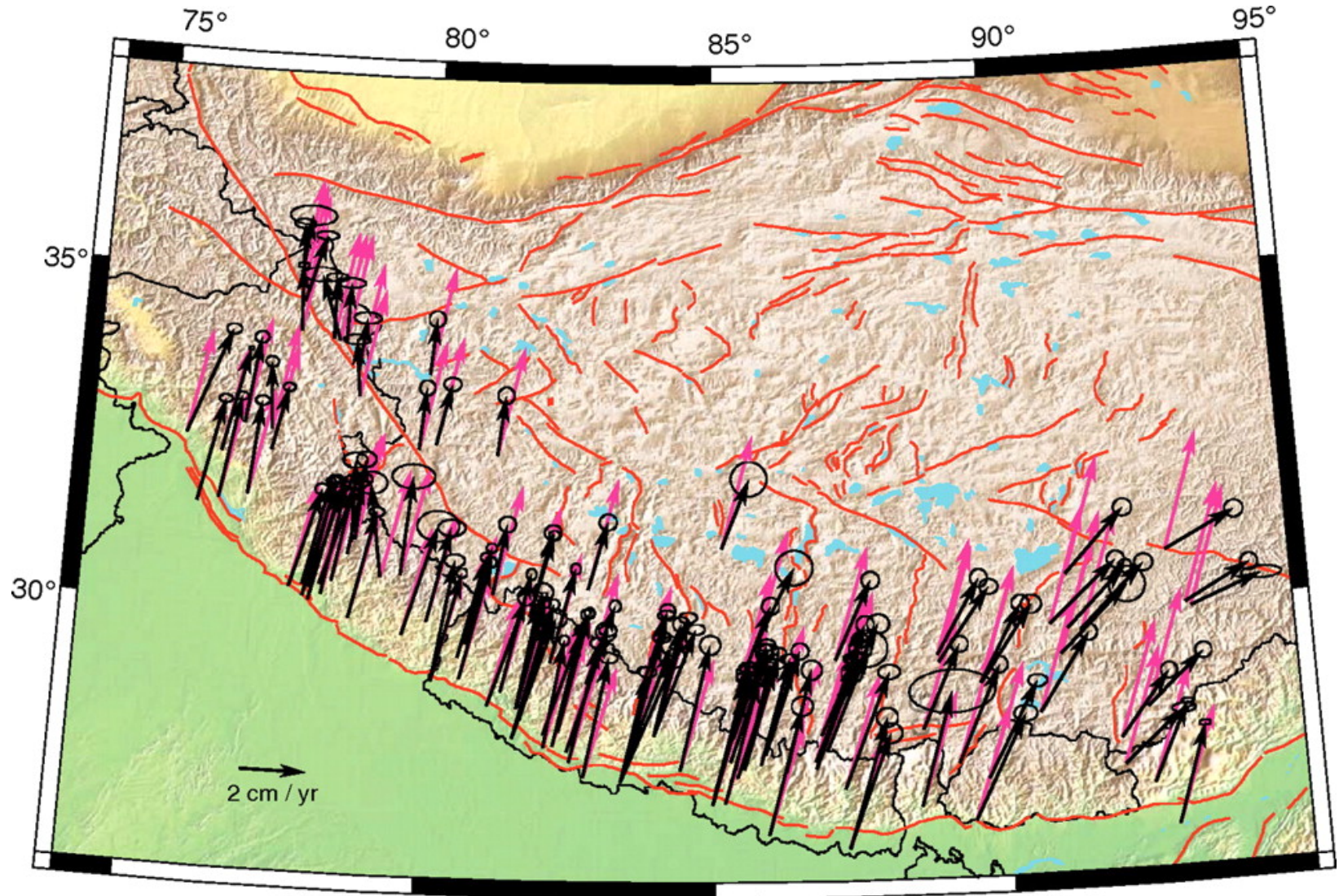


Collision expérimentale

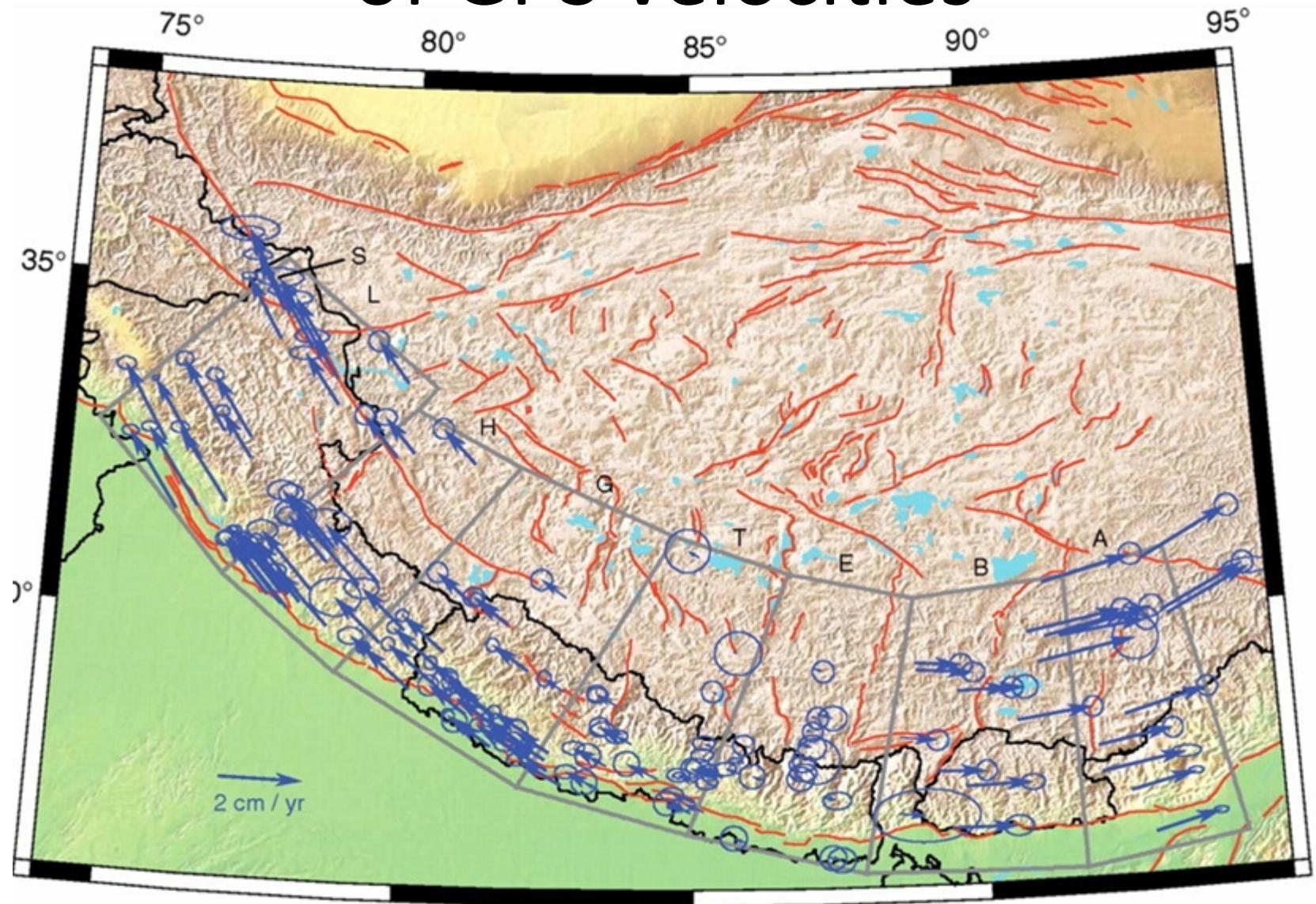


Chemenda *et al.*
EPSL 1995

Global positioning system (GPS) velocities relative to stable Eurasia



Arc-parallel component of GPS velocities



Conclusions

La collision Inde-Asie suit au moins deux zones de subduction: une suture peut en cacher deux

La collision ne construit pas de montagnes

L'Himalaya est une chaîne intra-continentale, le produit tardif de la collision

Les grandes structures actives impliquent le plissement crustal, dynamiquement indépendant de la tectonique des plaques