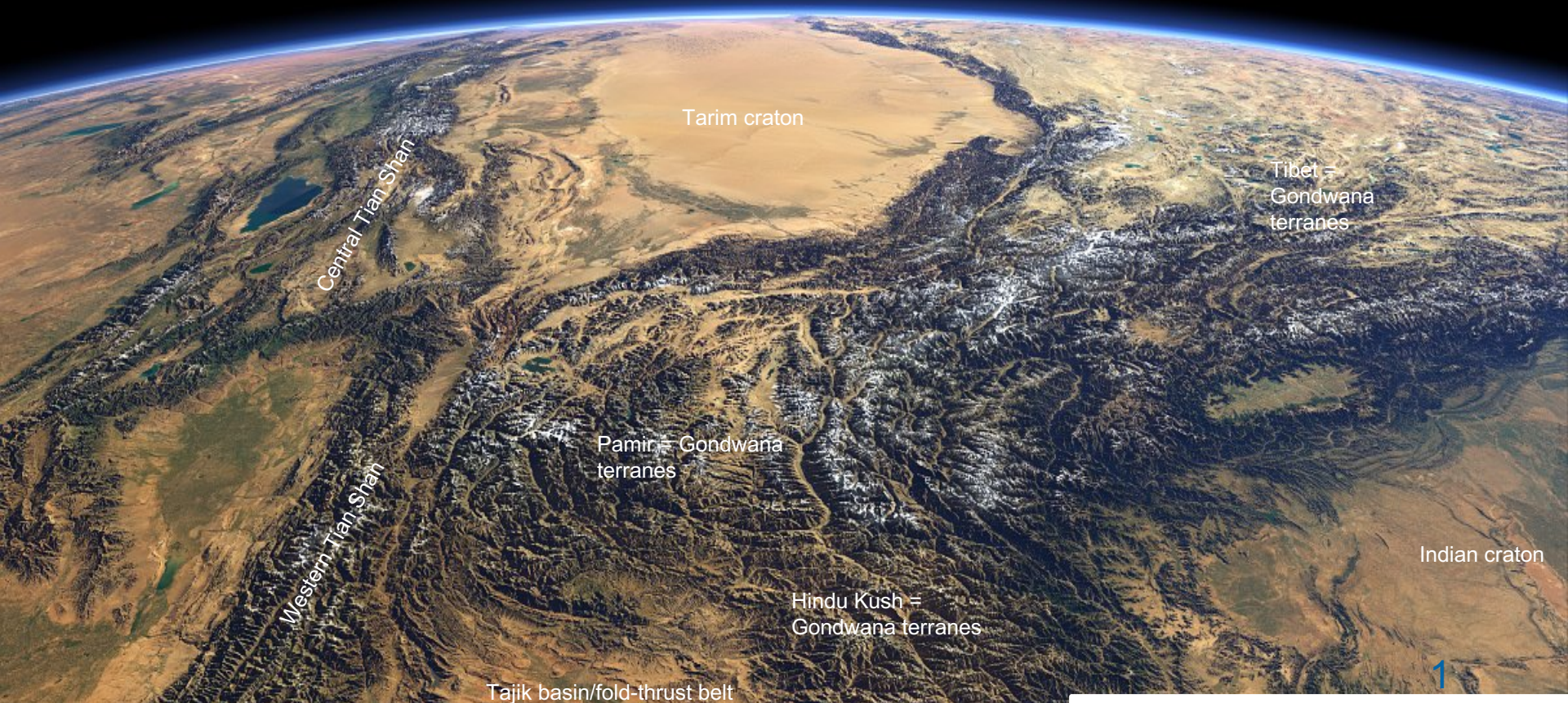


Lothar Ratschbacher  
Bernd Schurr  
Bradley Hacker  
Tajik, Afghan, Kyrgyz, Chinese,  
Uzbek partners

**Post-docs & PhD students**

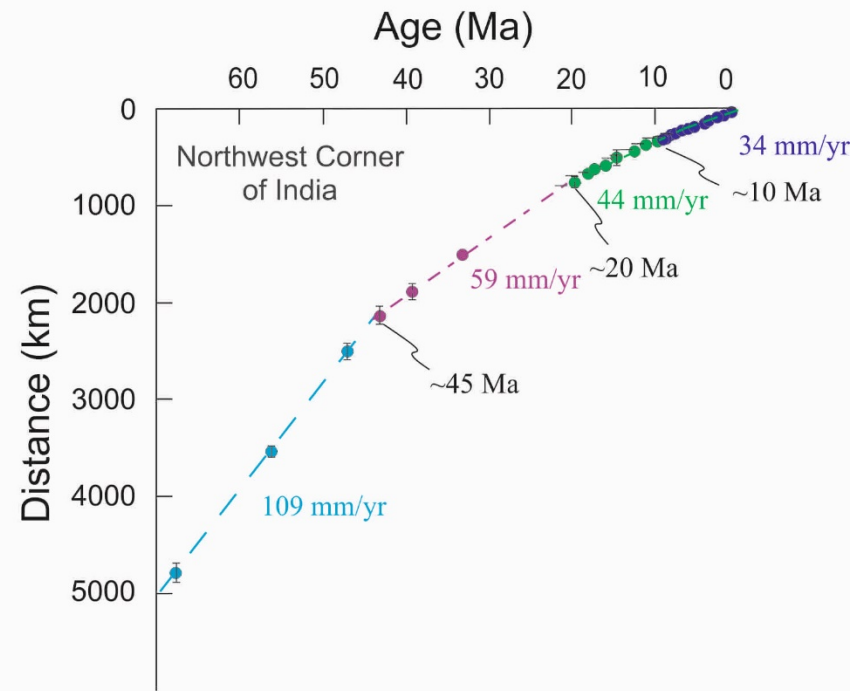
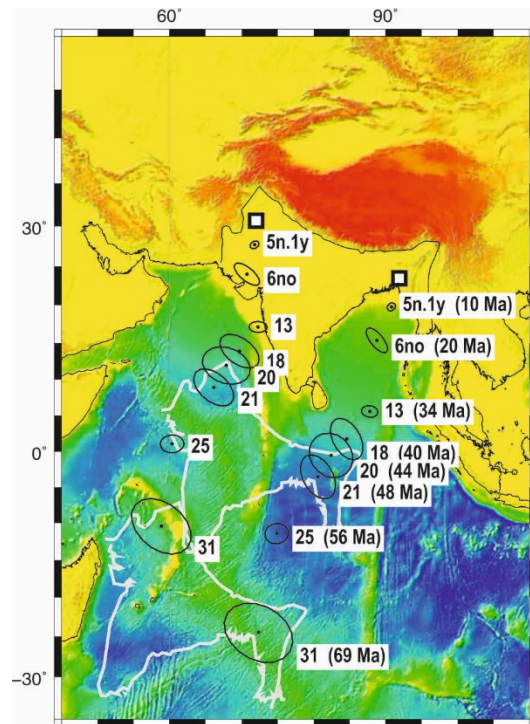
> 50 publications

# Tectonics & Geodynamics of Central Asia: An Introduction

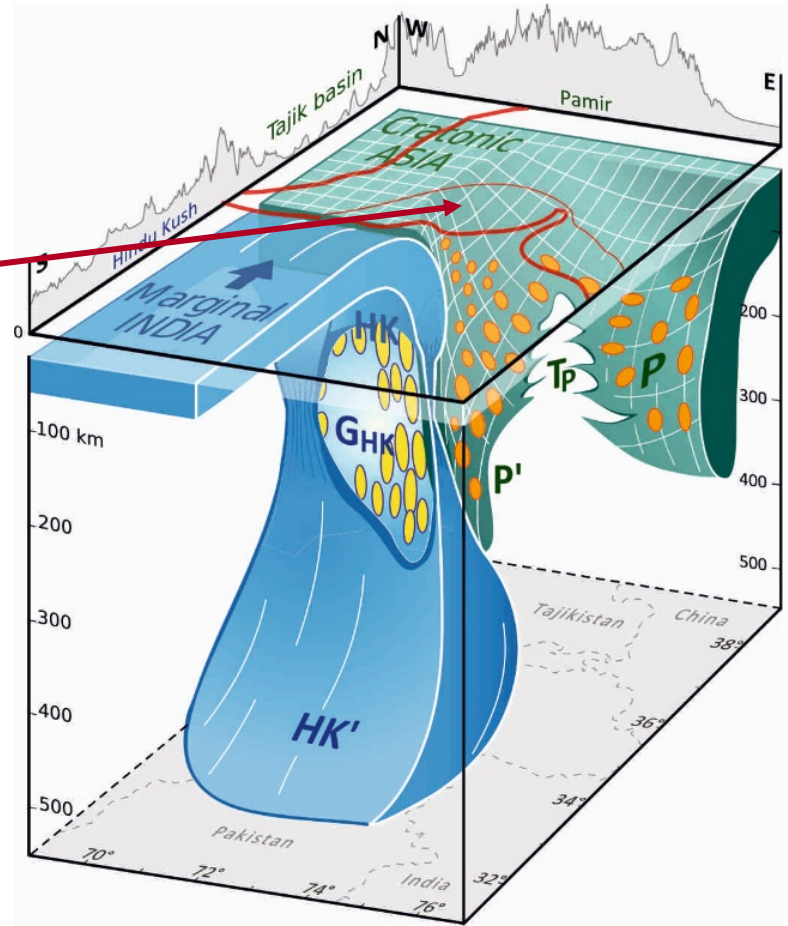
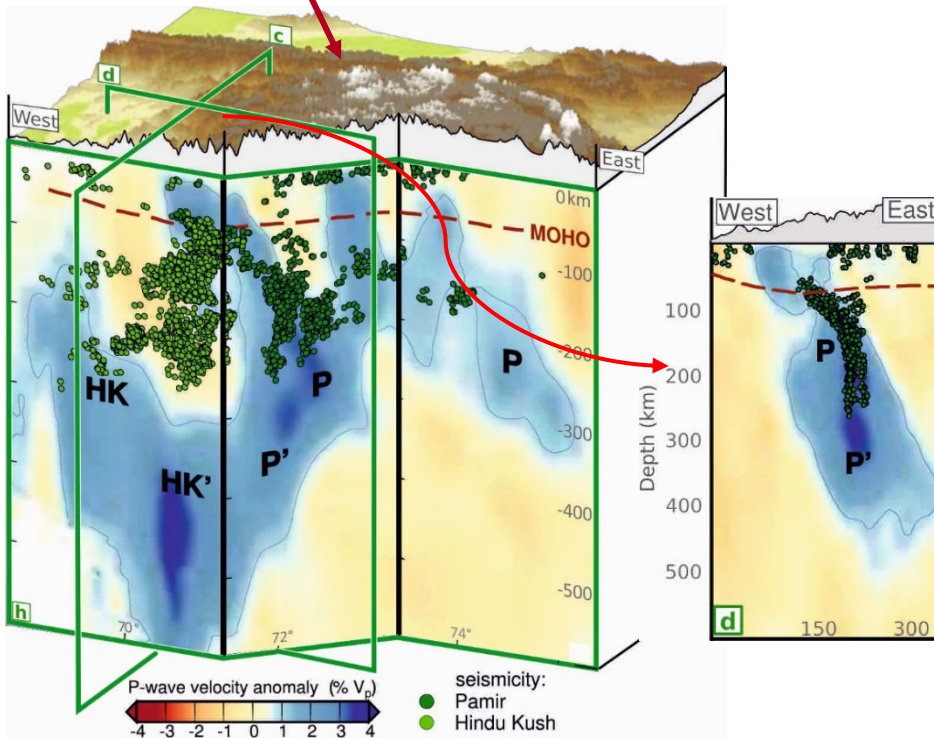
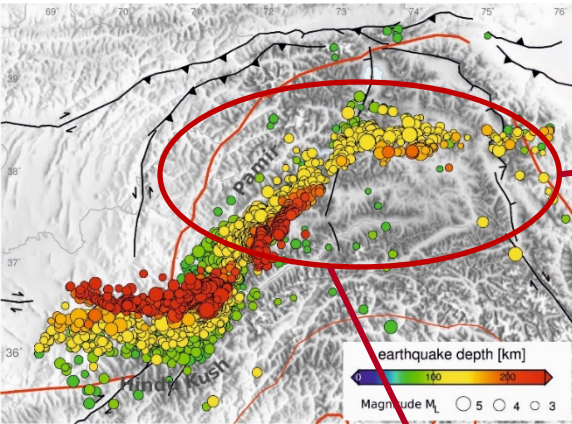




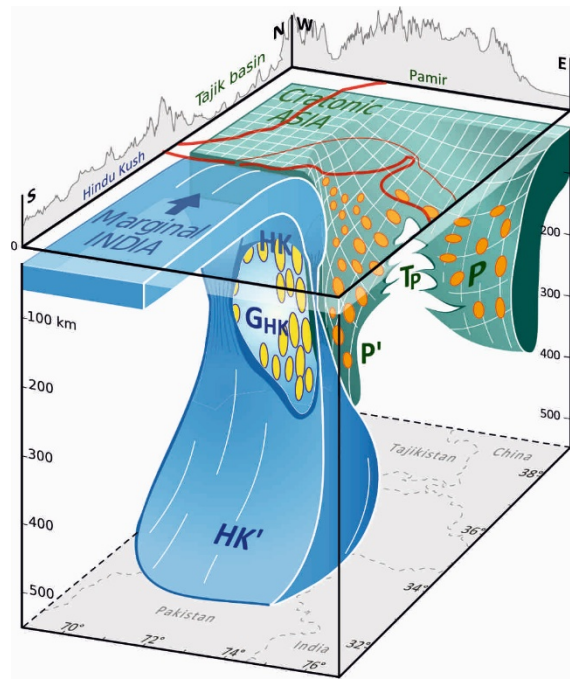
Boundary conditions: Plate motion of the NW corner of India shows changes in rates at ~45, 20, 10 Ma: what happened at ~20 & 10 Ma?



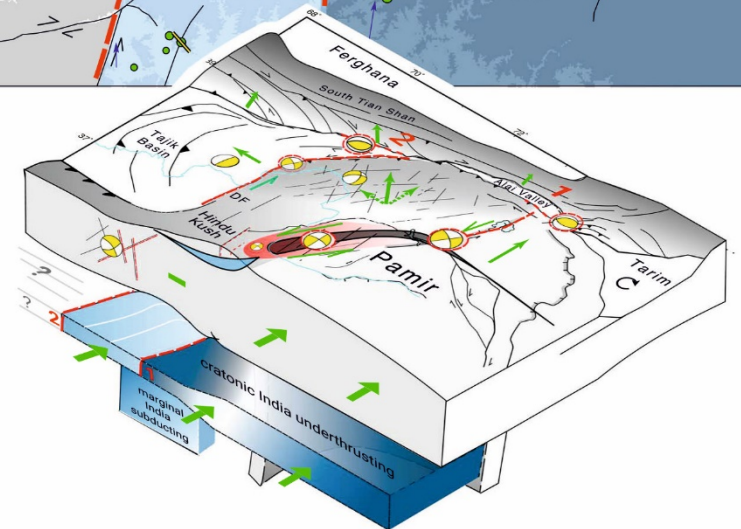
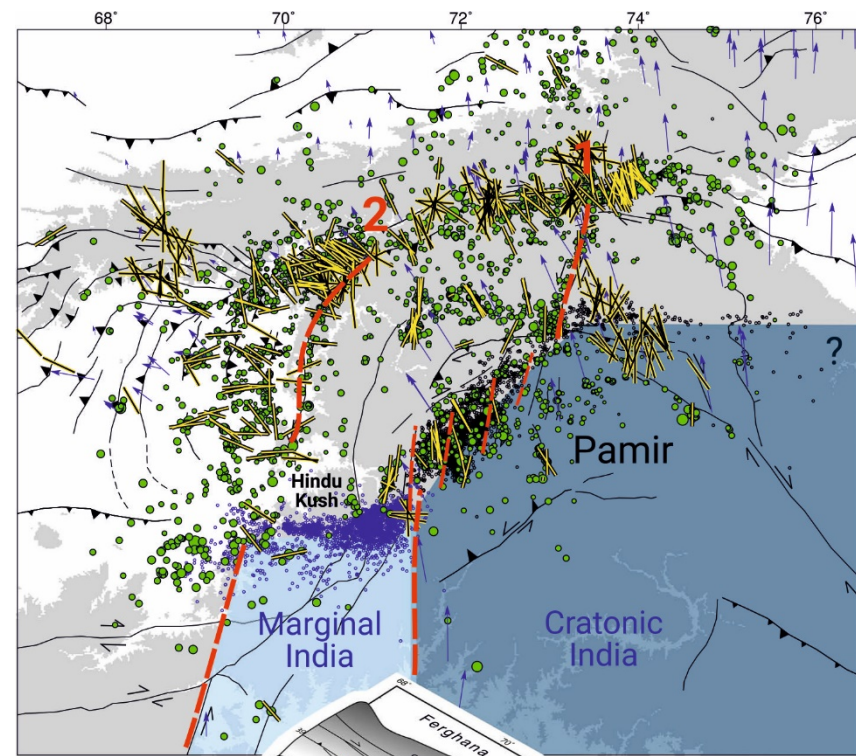
# What is happening TODAY beneath the Hindu-Kush – Pamir?



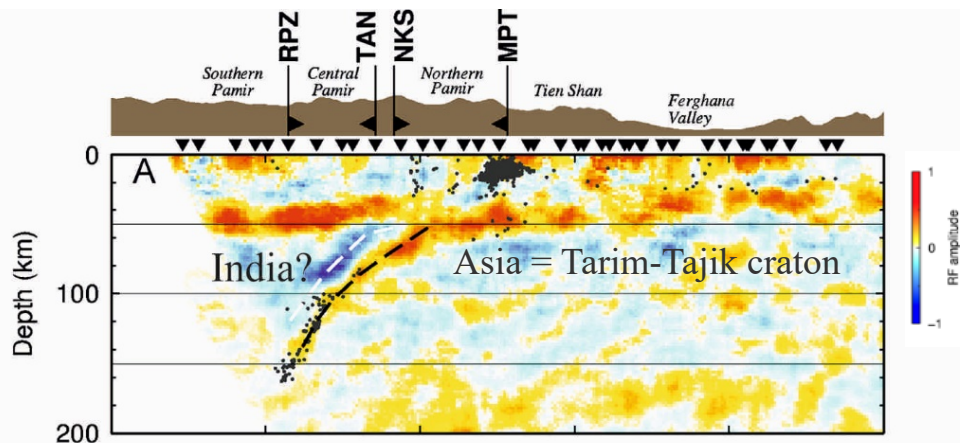




What players are involved?

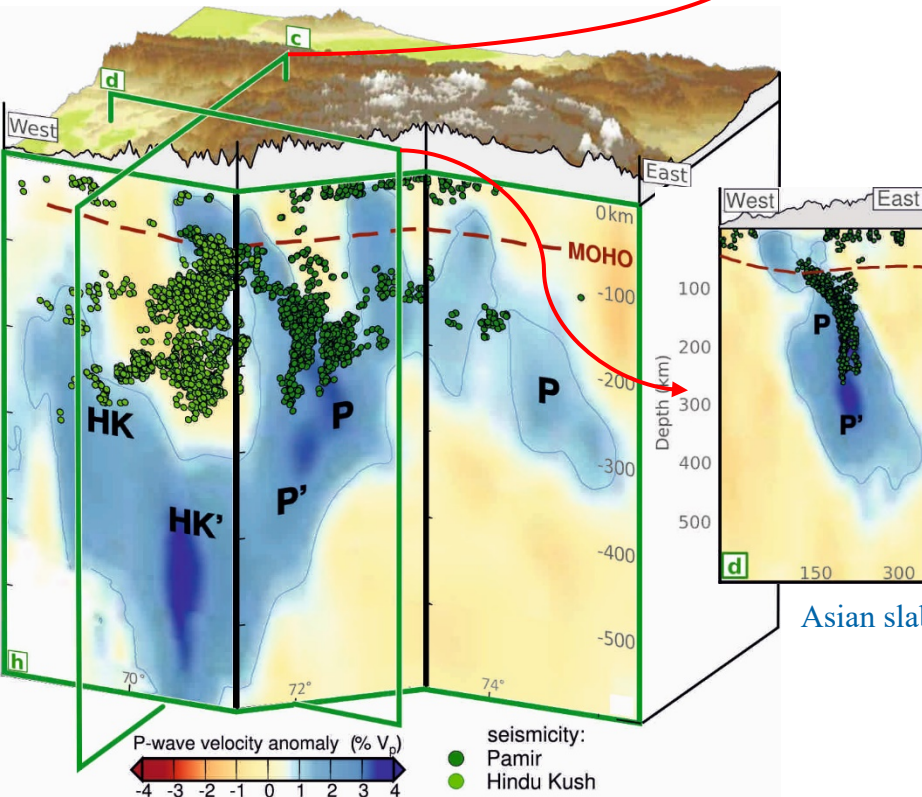


Sipl, Schurr et al. 2013a,b  
 Kufner, Schurr et al. 2016, 2017, 2018  
 Schneider, Yuan et al. 2013

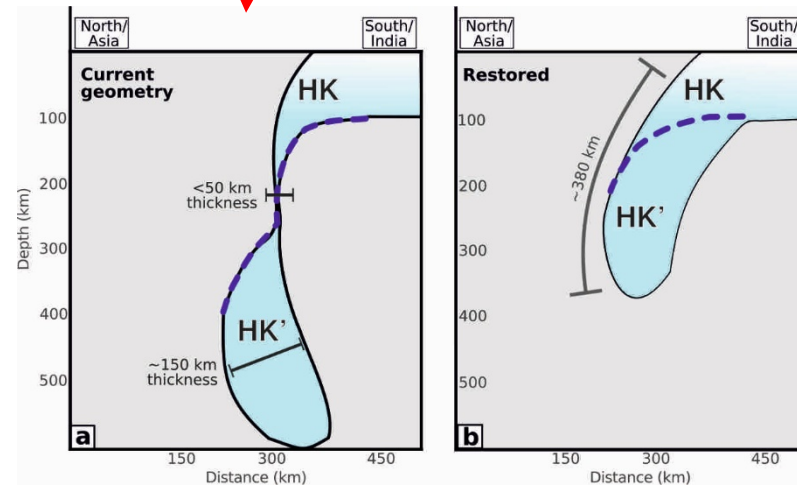
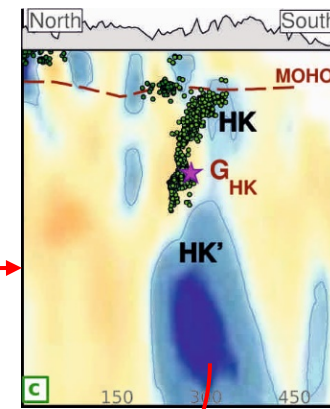




Since when is deep lithospheric indentation going on?



Asian slab ~400 km



Indian slab ~380 km

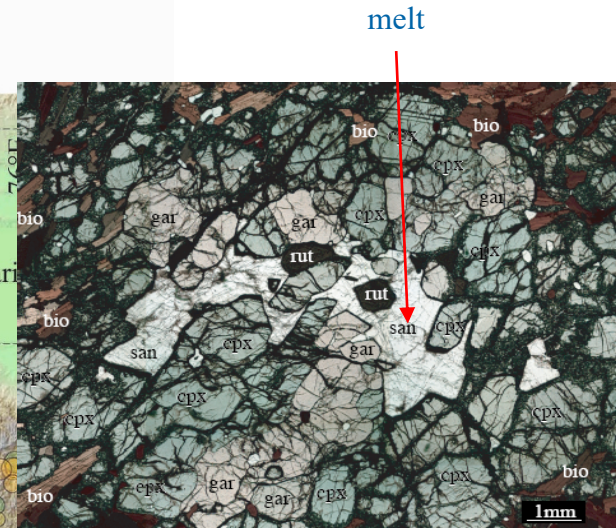
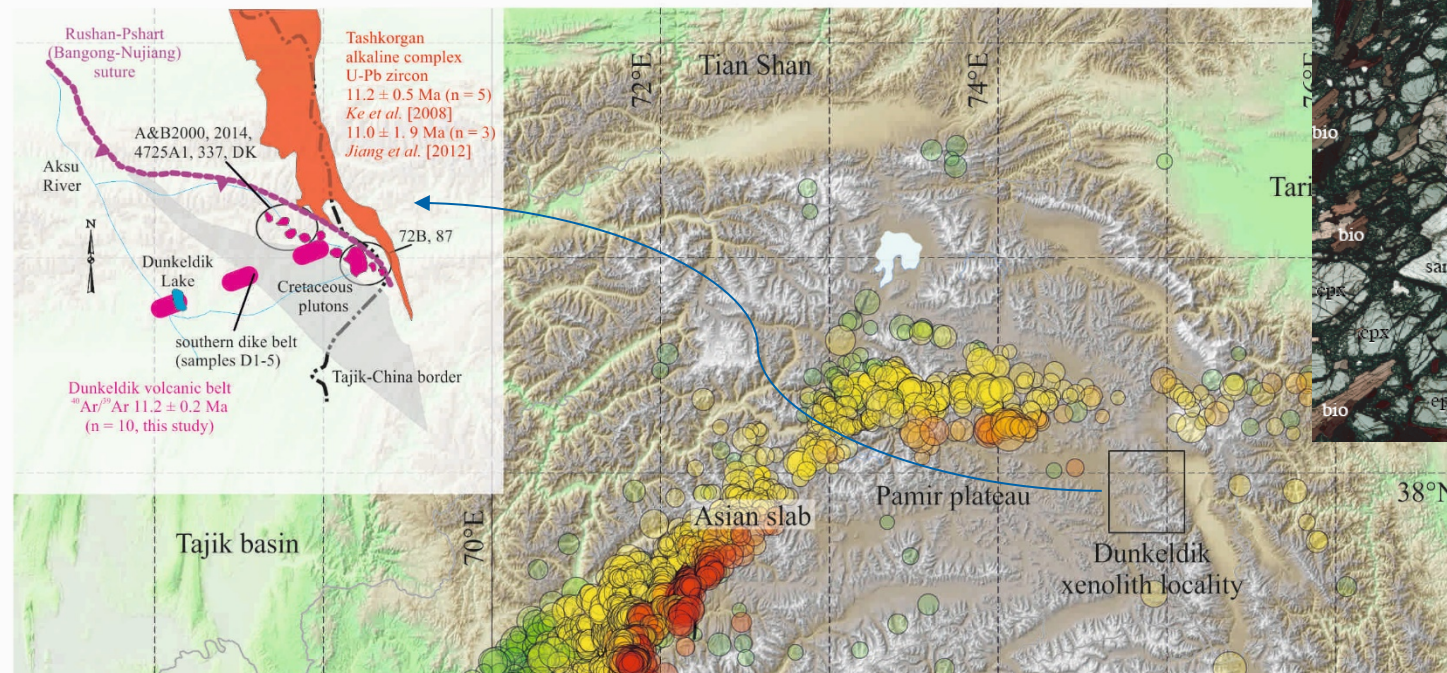
380–400 km slab 'subduction/delamination'  
at 34 mm/yr = 11–12 Ma

What happened at 10-12 Ma underneath the Pamir?  
– Deep Indian cratonic lithosphere started to collide  
with deep Asian lithosphere

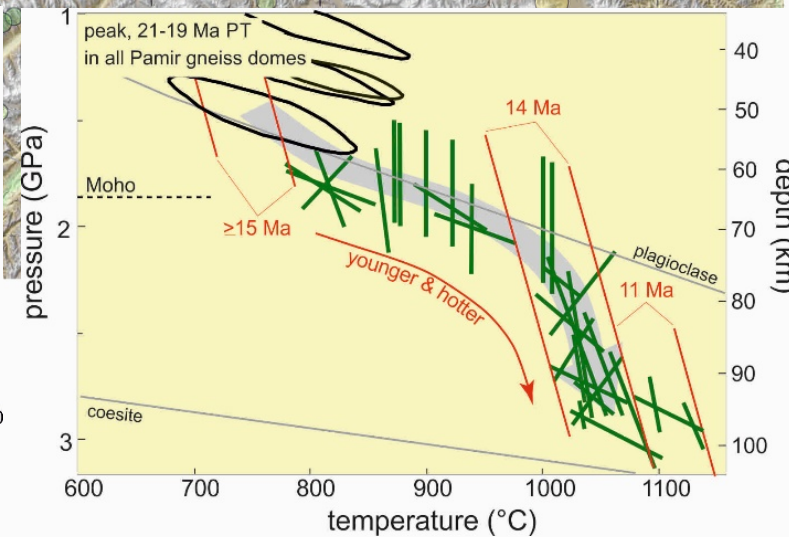
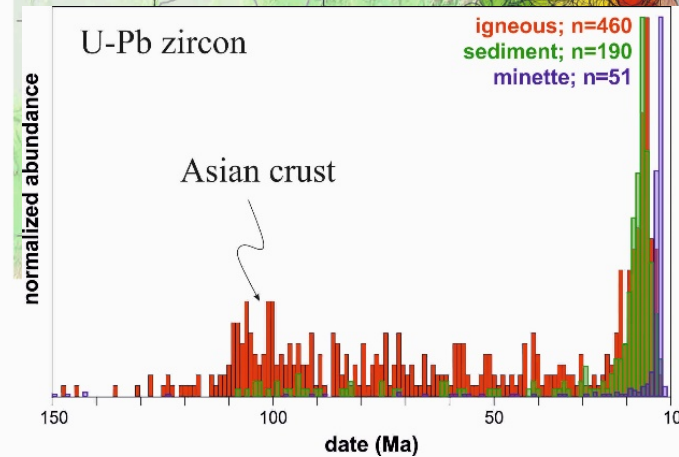


# What are the effects of the deep India–deep Asia collision?

## Effects on the deep crust



- only crustal xenoliths
- in-situ melting
- metasomatism by ultrapotassic + carbonatitic melt

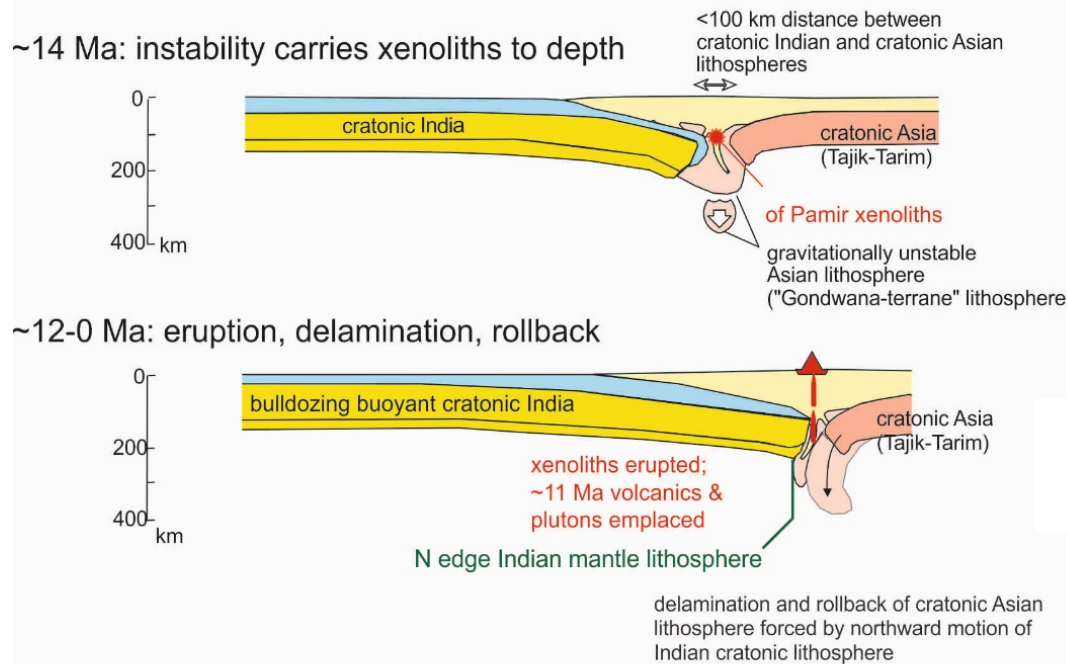


1. Xenoliths have Asian (Gondwana) provenance
2. Were buried and heated — very rapidly 3–4 Myr before ejection
3. Xenoliths ejected at ~11.2 Ma



## Effects on the deep crust

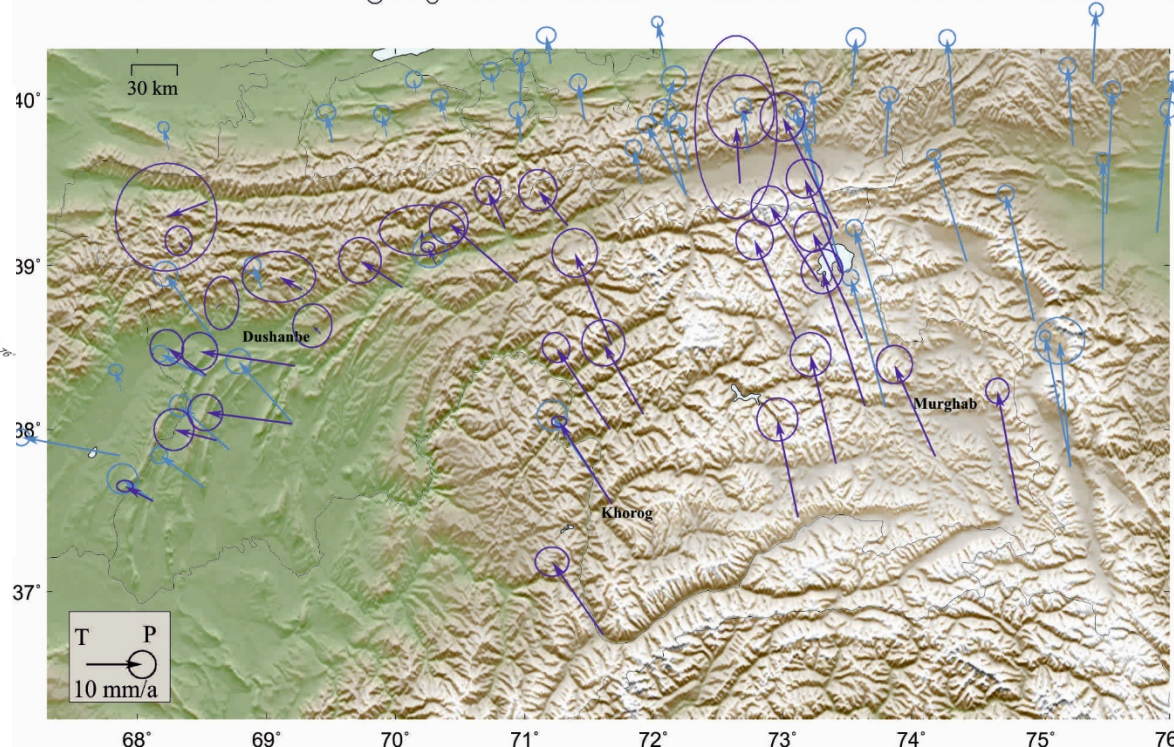
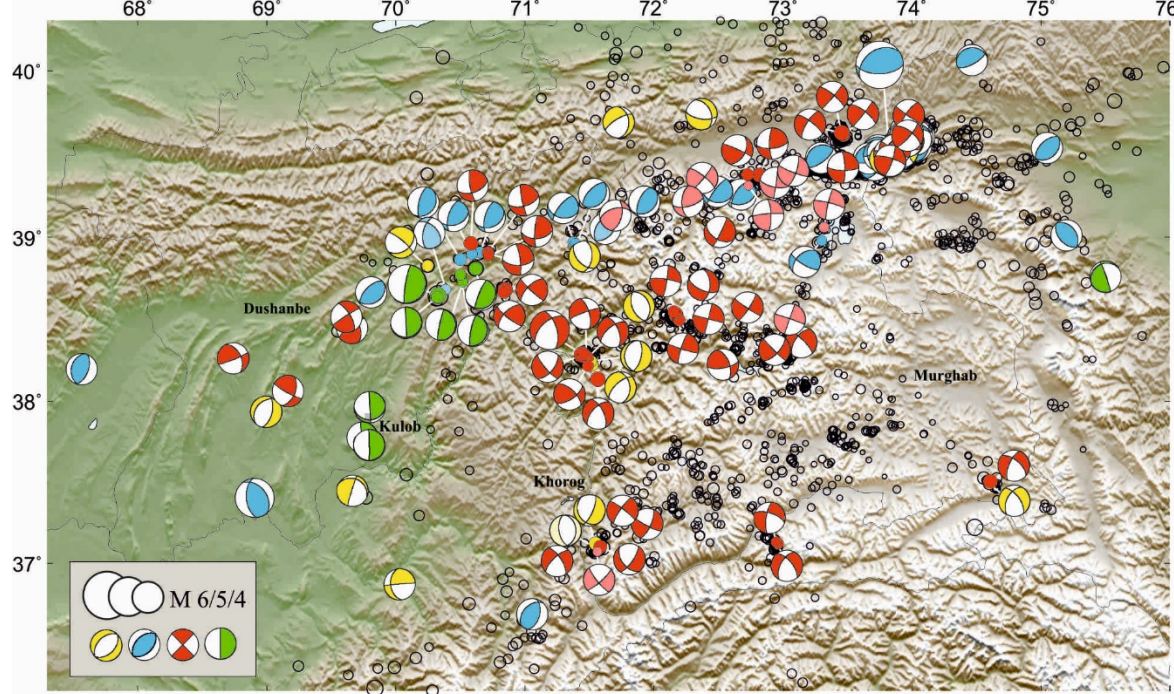
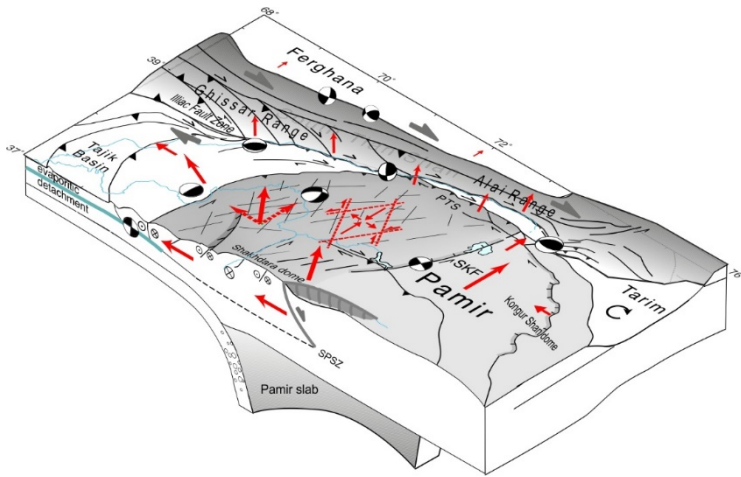
- foundering of gravitational unstable Asian lithosphere
- model for the generation of the classic Neogene shoshonitic magmatism of Tibet/Pamir



## Effects on the orogenic foreland

What is happening TODAY in the orogen and its foreland?

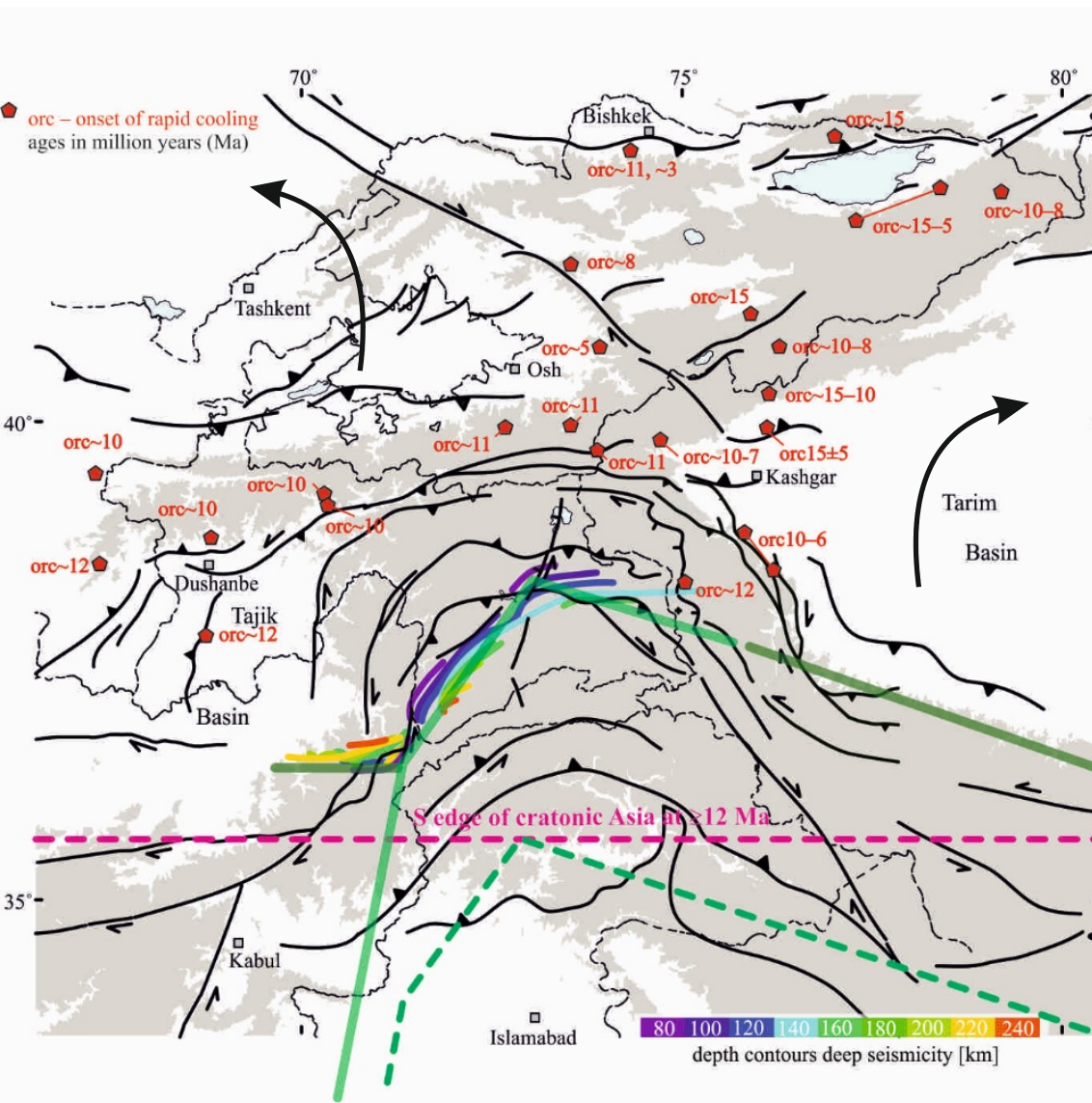
– Interaction of northward motion and westward gravitational collapse of the Pamir-plateau crust into the foreland (Tajik depression)







## When did foreland inversion start? Regional view



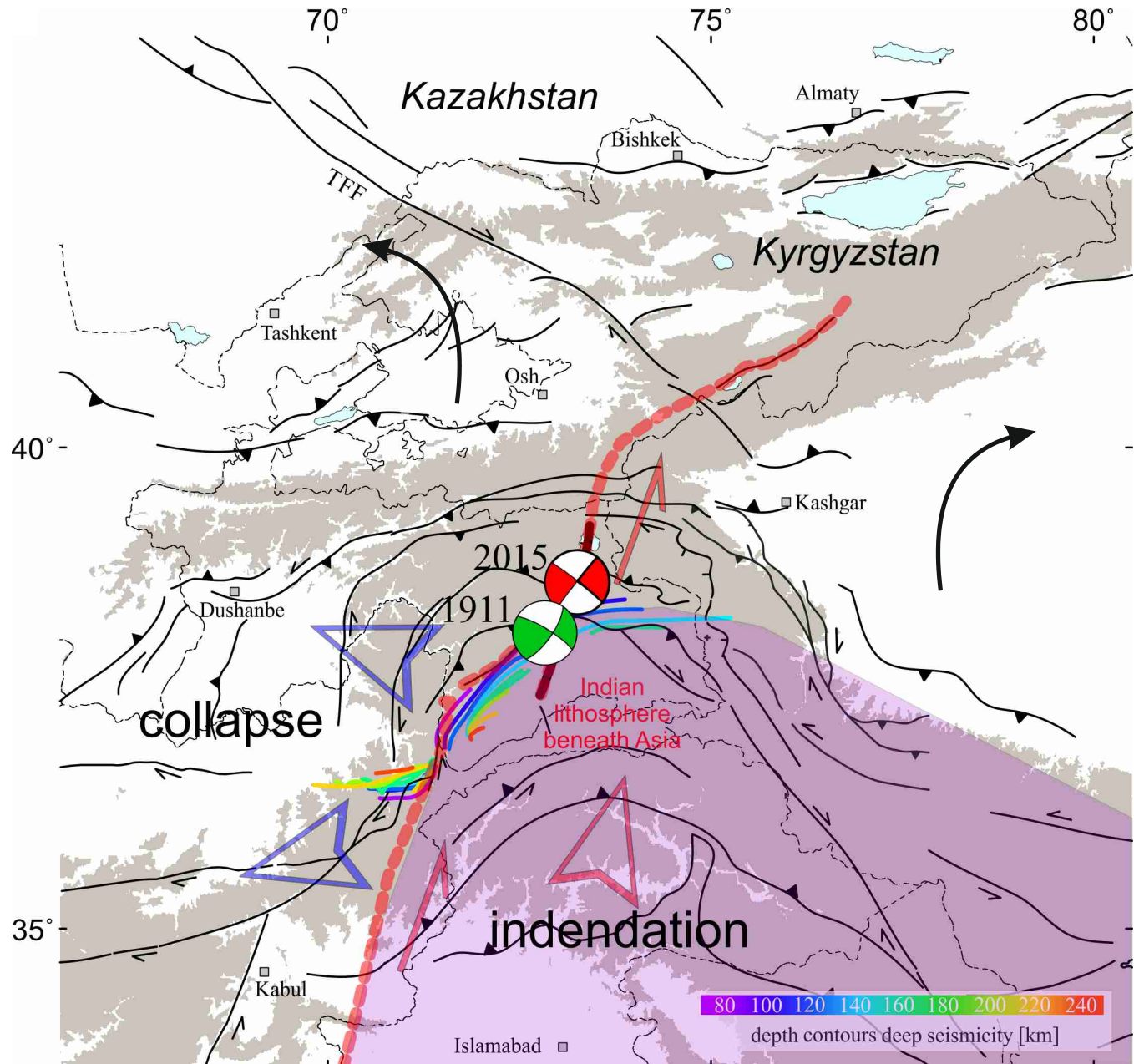
- gravitational spreading of Pamir-plateau lithosphere
- basin inversion
- foreland shortening
- opposing rotation of the Fergana and Tarim basin
- rise of the modern Tian Shan

All started at ~12-10 Ma

= onset of the deep India–deep Asia collision



The future....

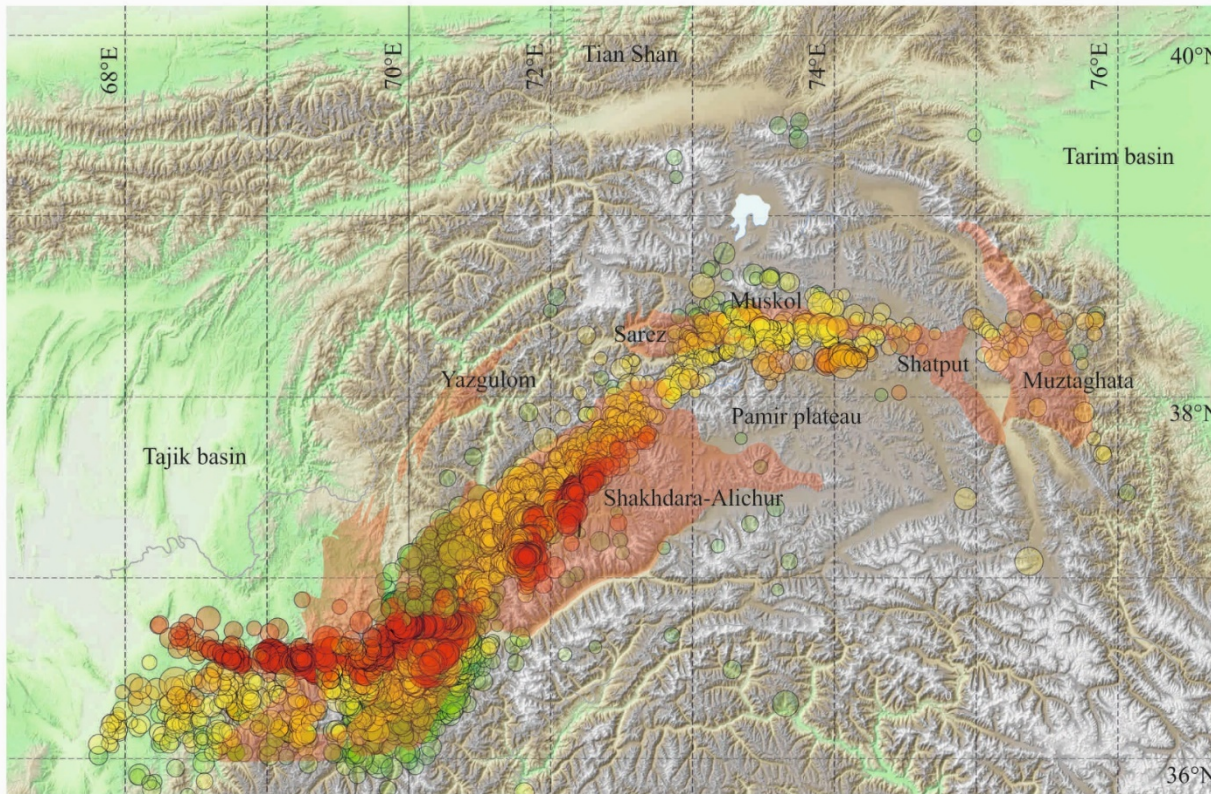


Schurr, Ratschbacher et al. 2014  
 Kulikova, Schurr et al. 2016  
 Metzger, Schurr et al. 2017  
 Kufner, Schurr et al. 2018

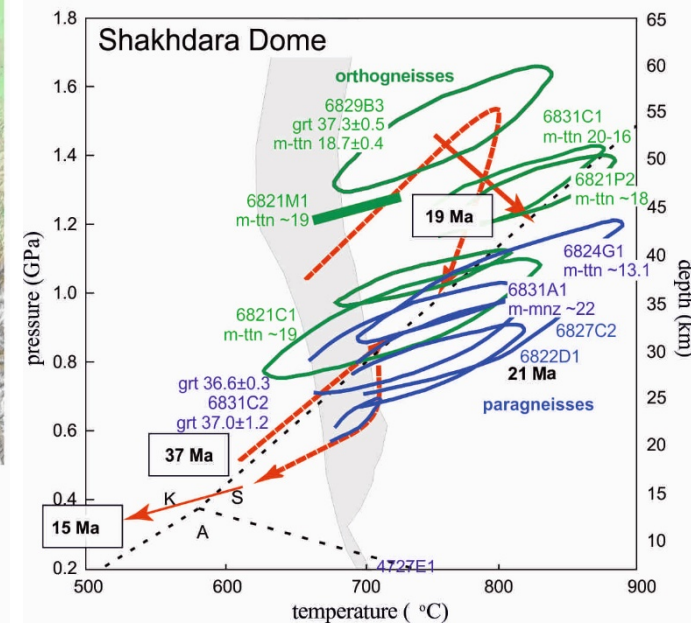
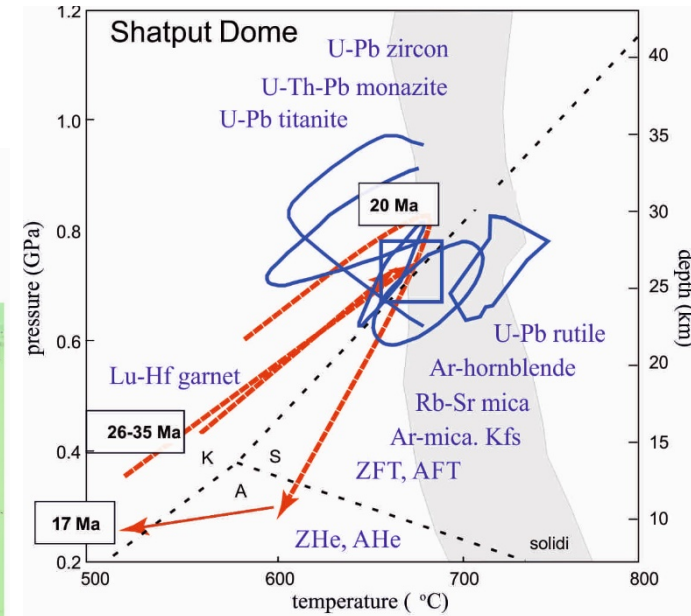
# What happened at ~20 Ma?

Cenozoic gneiss domes

= extensional core complexes



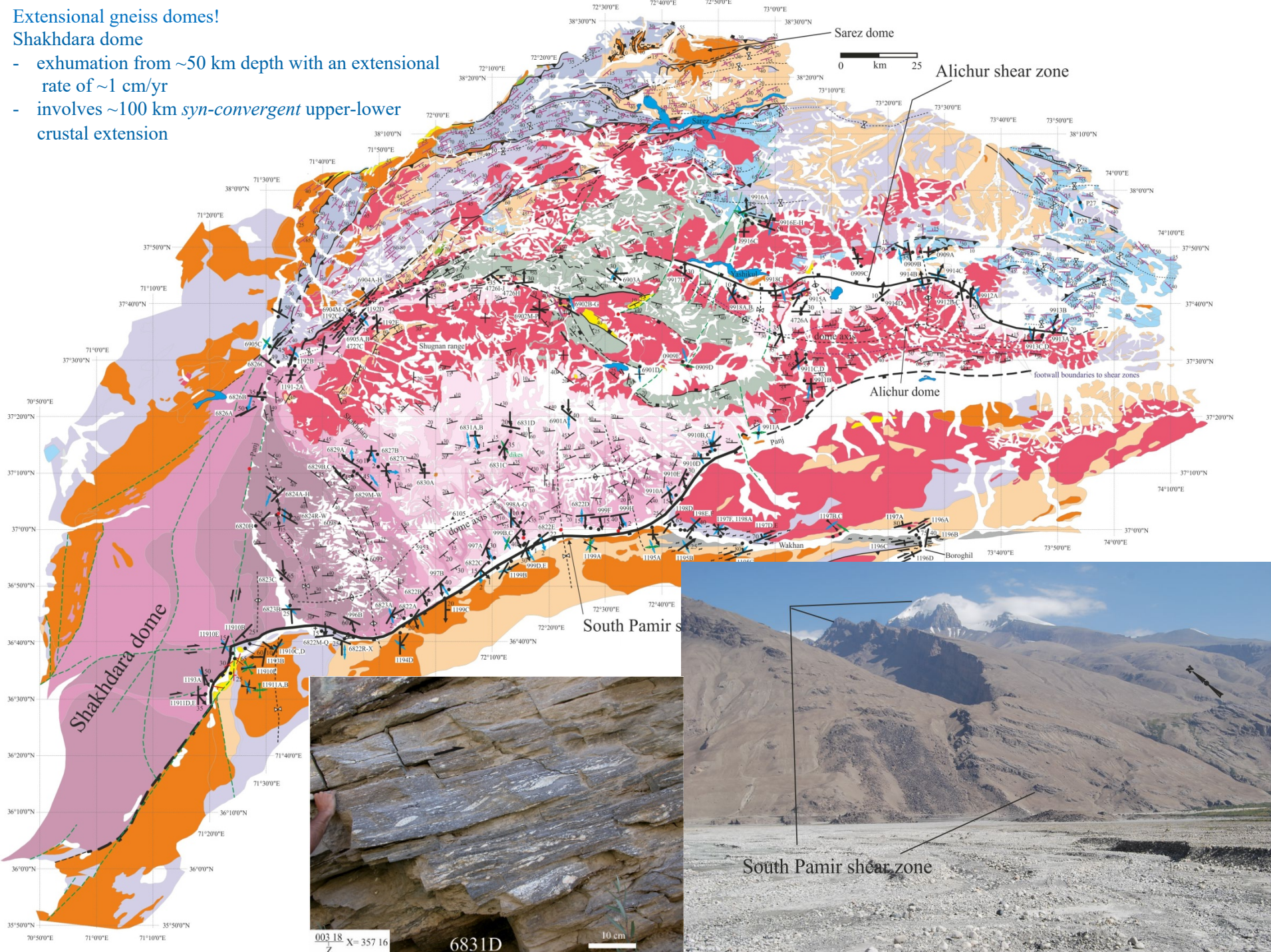
Schmidt, Hacker et al. 2011; Stübner, Ratschbacher et al. 2013a,b; Smit, Ratschbacher et al. 2014; Stearns, Hacker et al. 2013, 2015; Rutte, Ratschbacher et al. 2017a,b; Hacker, Ratschbacher et al. 2017; Worthington, Ratschbacher et al. 2020





Extensional gneiss domes!

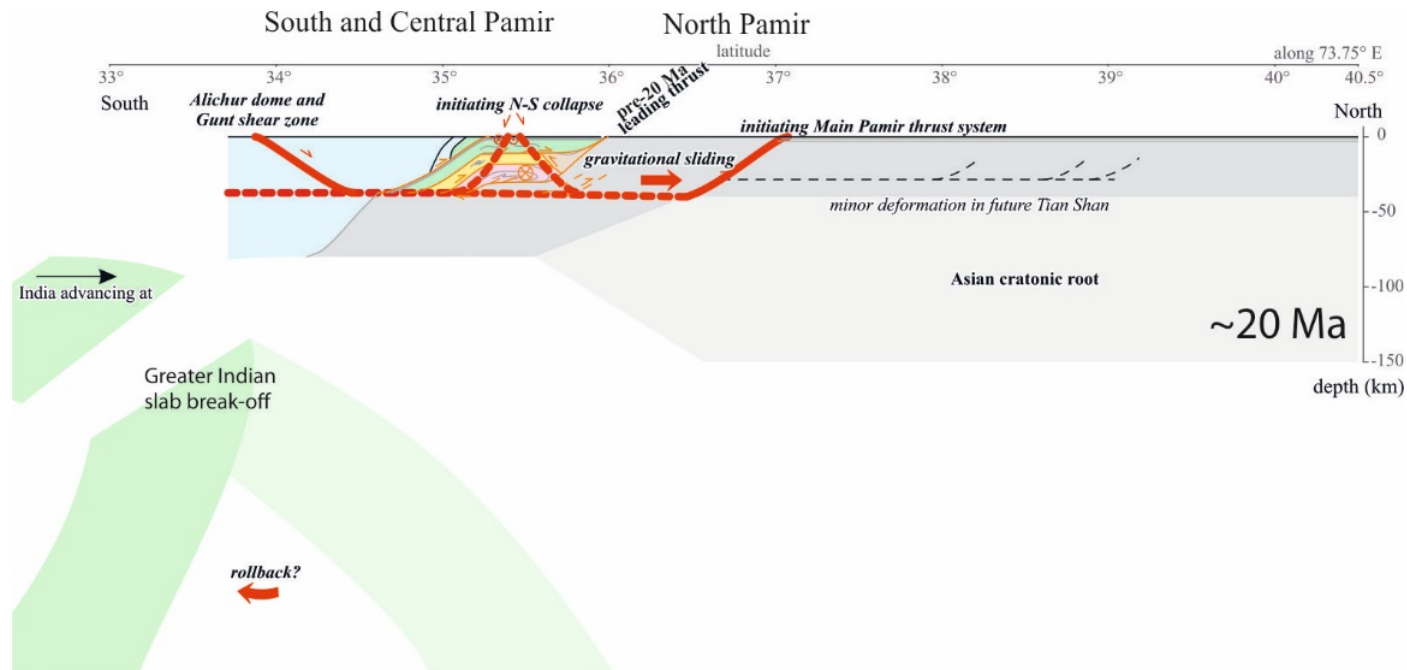
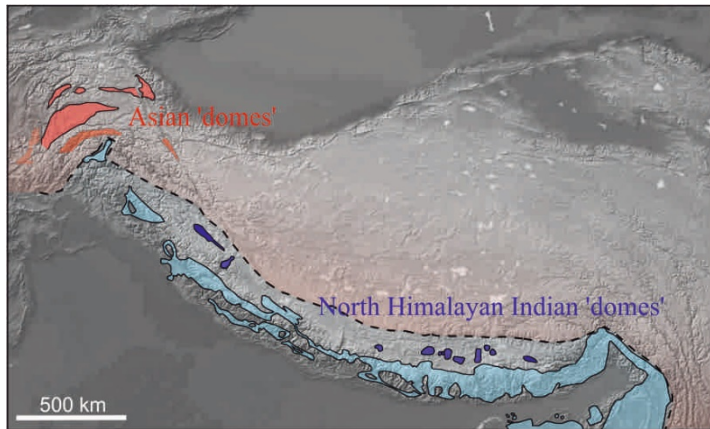
- exhumation from ~50 km depth with an extensional rate of ~1 cm/yr
- involves ~100 km *syn-convergent* upper-lower crustal extension





## What happened at ~20 Ma?

- *syn-convergent* extensional exhumation of the middle-lower Asian crust; synchronous with the extensional exhumation of the Indian crust in the North Himalayan domes
- regional high-grade metamorphism, migmatization, and (anatectic) magmatism
- collapse of the deformation front and loading of the foreland, and first strain transfer into the Tian Shan





**Take home message from the tracks of CATENA**

**Cenozoic Indian plate-motion variations reflect major changes in the India-Asia collision orogeny**

**Mantle processes trigger “catastrophic” changes in the Indian-Asian orogeny**

**View processes in mantle, crust, and surface, and hinterland to foreland together — a single aspect will tell you little**

