The Kongur Shan Normal Fault: An Example of Mountain Building Assisted by Extension (Karakorum Fault, Eastern Pamir)

TALK

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The northernmost segment of the Karakorum fault is an active normal dextal wrench fault that bounds the Muji Tashgorgan Plio-Quaternary basin. The KongurShan (7719m) and Mustaghata (7545m) form great antiformal domes, 25 Km wide, elongated along a direction N 110.They are growing "en échelon" on the Eastern side of the Karakorum fault (1).

The Kongur antiform folds a large regional overthrust between a volcanic arc complex and a thick (probably Permo-Carboniferous) sedimentary sequence underneath. The sediments (red-violet to greenish-grey sandstones, shales, slates and calcschists) are affected by cascades of recumbent, north-facing isoclinal folds, some of them reaching kilometric sizes.

The allochtonous amphibolite volcanic arc complex, is described in the Oytag Akezi area, 200 km south of Kashgar, on the north flank of the KongurShan antiform. The 3 or 4 thousand meters thick allochtonous sequence, possibly Upper-Middle Paleozoïc, consists mainly of metabasalts, garbenschiefer amphibolites, granodiorites, gabbros and greywackes, all thrusted above the folded and schistosed green and red sandstones formation probably of Upper Paleozoic age. Shear senses in mylonitic gabbros (greenschist facies) at the base of the amphibolites are consistent with emplacement of the arc complex as a NNE vergent thrust-sheet. Biotites in the sole contact of the nappe yields Ar/Ar Jurassic ages of 146±0.7 Ma but limited Quaternary displacement is also suggested. Preliminary U/Pb ages imply also Lower Jurassic metamorphism in the Mustaghata core. The core of the Kongur antiform is made of augengneisses and leucogranites, garnet micaschists, and chloritoid schists. Overall, the allochtonous metabasites and the foliation in the gneisses wrap the antiformal dome but there are local complexities. Biotite schists form a tight, NW-SE trending syncline and near-horizontal lineation show clear evidence of right-lateral shear. The Kongur antiformal structure is interpreted as a growing ramp anticline thrusted northwards by the Main frontal Pamir thrust (MPT) system, over the 10 000 m thick Tarim Plio-Quaternary sediments. The Kongur massif, on the restored cross section, therefore appears like a gigantic crustal structure 20 to 30 Km high; the total horizontal shortening is estimated to exceed a hundred kilometres.

To the West and Southwest, the Kongur anticline is bounded by active slip normal faults, which contribute to shape the topography of its western face. West dipping, mylonitic gneisses at least 1000m thick with downdip lineation characterize a normal fault zone within which plastic deformation of quartz agregates and development of shear bands and C-S structures indicate a down to the west, shear sense along the western flank of the Kongur antiform. This normal faulting occurs under greenschist metamorphic facies conditions allowing crystallization of quartz-chlorite-muscovite.Those gneisses are cut by the steeper, active normal fault, a situation reminiscent of the Miocene North-Himalayan normal fault.at Everest.To the South, the Mustaghata (7545m) anticline is the twin structure of the Kongur, and gneisses there have given Jurassic ages with U/Pb method on zircons, probably dating the protolith of the gneisses.

Ar/Ar ages obtained on micas, use of K feldspar Ar/Ar modelling with the multi-domain theory and fission tracks ages performed on apatites lead to the proposal of a major contrast in the cooling history of the Kongur-Shan gneiss antiform at 2 Ma (2) The dated minerals crystallized or have been reequilibrated during the greenschist facies metamorphism that

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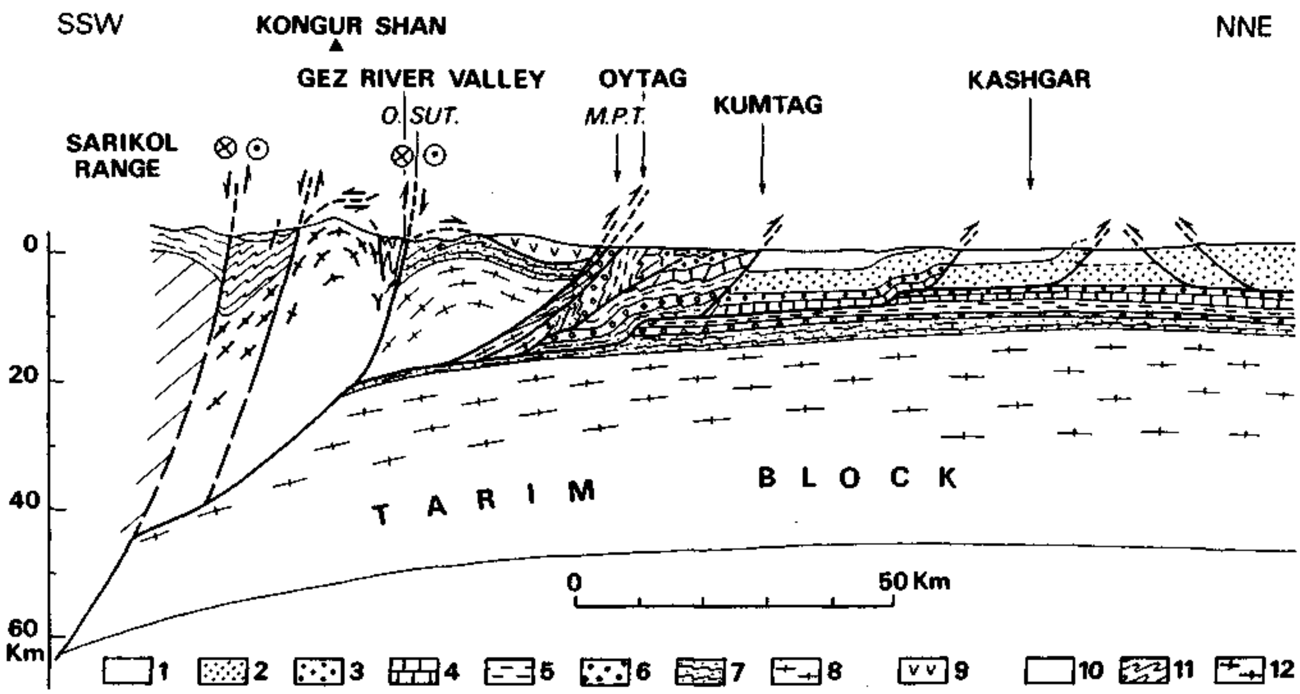
prevailed during normal faulting. The cooling deduced from those therefore records cooling after metamorphism and denudation associated with the normal fault movement. It is clear also, that the sudden increase in cooling rate (from 50°C up to 150-250°C) at 2 Ma. does not match only simple cooling subsequent to metamorphism in the normal fault but is related to a drastic change in denudation related cooling.

For these reasons, it is suggested that the cooling rates record an important increase in normal denudation at 2 Ma. Assumming a minimum geothermal gradient of 30°C/Km these cooling rates after 2Ma. record a maximum value for footwall uplift of the normal fault at rates of 3-5 Km/Ma. Similar rates at other localities suggest that the recovery time of isotherms after uplift is short, and that these rates are also minimum values. Finally, from measurement of the dip-slip component on recent fault scarps,(Liu Qing et al.,1992), concluded to a comparable average value of 1-4 Km/Ma.of relative uplift in the late Quaternary.

Tectonic observations and rates of uplift estimates imply that the Kongur-Mustaghata structures, which represent growing, "en échelon" ramp anticlines, at the scale of the crust, can be explained by Southwestward subduction of the Tarim. As is in the Himalayan example we assist to the coeval development of the frontal Pamir thrust and the rear Muji-Tashgurgan normal fault. In each of these cases, an important delay: almost 20 Ma.is observed between the onset of convergence and associated thrusting and the development of extensional deformation and normal fault. We suggest that an important amount of crustal thickening is necessary before it can induce the development of normal fault.

Kongur-Shan appears as an exceptional example where normal faulting contibutes to create relief and should be regarded as the type example of orogenic extension.



1-Plio-Quaternary; **2**- Miocene-Oligocene; **3**-Eocene; **4**-Cretaceous; **5**-Jurassic; **6**- Triassic; **7**-Devono-Carboniferous and Paleozoïc; **8**-Tarim Precambrian basement.
9-Amphibolitic nappe
10-Plio-Quaternary of the Muji Basin; **11**-KongurShan micaschists; **12**-KongurShan gneiss.

References:

(1): Brunel et al., Tectonics of the Eastern Pamirs, Int. Symposium on the Karakorum and Kunlun mountains june 5-9 1992 Kashi China, p.29.

(2)Arnaud et al., High cooling and denudation rates at KongurShan, Eastern Pamir (Xinkiang, China) revealed by Ar/Ar Alkali feldspar thermochronology, Tectonics ,submitted.

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