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What is the fate of STEP faults? The disappearing Nekor fault in the Eastern Rif, Morocco

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Subduction Transfer Edge Propagador (STEP) faults are required for the advance of narrow orogenic arcs, like the Betic-Rif system, as they permit the lateral tearing of the subducting lithospheric mantle. However, not much is known about the superficial manifestation of STEP faults. Here, we present an example from the westernmost termination of the Mediterranean Alpine system, the Betic-Rif arc. Oblique continental subduction in the southern branch of this arc system shows deformation partitioning with the development of southwest vergent thrusts and large NE-SW oriented sinistral strike-slip structures like the Nekor fault. The Nekor fault lies parallel to the thrust front between the External Rif units and the underlying African foreland, cutting through the External Rif units. The fault zone is formed by subvertical strike-slip brittle fault segments that splay into reverse faults and folds towards the south. New structural mapping of the fault zone shows that it terminates brusquely towards the north against exhumed middle-crust rocks of the Temsamane massif. The Temsamane units underwent intermediate pressure low temperature metamorphic conditions during subduction, and were later exhumed by a brittle-ductile extensional detachment with SW tectonic transport, coeval to important volcanism in the region. The Nekor fault terminates in an area were high-angle normal faults cut into the detachment separating upper rocks of the Ketama-Aknoul units to the south from underlying mid-crustal Temsamane units to the north, thus indicating that the Nekor fault must detach at mid-crustal depth. Deformation beneath this detachment was distributed, producing crustal stacking and overturned folding of the subducted External Rif units. This evidence shows that deformation in the crust above STEP faults can be highly partitioned with the development of thrusting and strike-slip faults in upper crustal levels and ductile shortening structures in the middle-lower crust. Once the activity of the STEP fault has propagated forward, post-orogenic type structures, like extensional detachments and volcanism, will erase its surface expression resulting in a region with exhumed metamorphic core-complexes, sedimentary basins and volcanism, without evidence of strike-slip structures.