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Field evidences for a Mesozoic palaeo-relief through the northern Tianshan

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The modern Tianshan mountain belt, located in Central Asia, offers a natural laboratory to study orogenic processes linked with convergent geodynamical settings. Most of the previous studies either focused on the Paleozoic evolution of the range – subductions, arc accretions and continental collision – or on its Cenozoic intra-continental evolution linked with the India-Asia collision. At first order, the finite structure of this range obviously displays a remarkable uprising of Paleozoic "basement" rocks – as a crustal-scale 'pop-up' – surrounded by two Cenozoic foreland basins. The present-day topography of the Tianshan is traditionally related to the latest intra-continental reactivation of the range. In contrast, the present field study of the northern Tianshan brings new and clear evidences for the existence of a significant relief, in this area, during Mesozoic times.

The investigation zone is about 250 km long, from Wusu to Urumqi, along the northern flank of the Tianshan where the rivers deeply incised the topography. In such valleys, lithologies and structural relationships between Paleozoic basement rocks, Mesozoic and Cenozoic sedimentary series are particularly well exposed along several sections. Jurassic series are mostly characterized by coal-bearing, coarse-grained continental deposits. Within intra-mountain basins, sedimentary breccias, with clasts of Carboniferous basement rocks, have been locally found at the base of the series. This argues for the presence of a rather proximal palaeo-relief of basement rocks along the range front and the occurrence of proximal intra-mountain basins, during the Jurassic. Moreover, while a major thrust is mostly evoked between Jurassic deposits and the Paleozoic units, some of the studied sections show that the Triassic to Jurassic sedimentary series can be followed from the basin to the range. In these cases, the unconformity of the Mesozoic series on top of the Carboniferous basement has been locally clearly identified quite high in the mountain range or even, surprisingly, directly along the northern Tianshan "front" itself. Combining available information from geological maps, field investigations and numerous drilling wells, regional-scale cross-sections have been built. Some of them show "onlap" type deposit of the Triassic to Jurassic clastic sediments on top of the Paleozoic basement that was thus significantly sloping down to the North at that time. Our study clearly evidences, at different scales, the existence of a major palaeo-relief along the northern Tianshan range during Mesozoic, and particularly during Jurassic times. Such results are compatible with previous fission tracks and sedimentology studies. From this, the Tianshan's uplift and the movements associated with along its northern front structures, which are traditionally assigned to its Cenozoic reactivation, must be reduced. These new results question on the mode and timing of reactivation of structures and on the link between topography and intra-continental collisional settings.