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Active tectonics of the Rif Mountains (Morocco) from geomorphic and geochronological data

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We present results of a geomorphological and morphotectonic analysis of the Rif Mountains (Morocco). We show that the present day kinematics of the Rif is characterized by active deformation along normal and left-lateral strike-slip faults in the North-East (Trougout, Rouadi, Boujibar and Nekor faults), reverse fault in the South (the South Rif Front) and inherited fold structures in the West. Digital Elevation Models of offset drainage features (streams, fluvial terraces) allow determining horizontal cumulative displacements of ∼25-35m along the Trougout fault and ∼40m along the Nekor fault. 14C dating of tectonic markers yields vertical and horizontal slip rates of ∼2.8 mm/yr and ∼2.3 mm/yr respectively, along the Trougout fault. For the first time, cosmogenic 3He method is used on volcanic rocks to date the successive exposure of the fault plane. Along the Trougout fault, this yields recurrence time between 3,1 and 4,1 ka. The present-day localized transtension seen in the northeastern Rif morphology (Ras Tarf) is coeval with uplifted marine terraces near the Al Hoceima Bay. U/Th dating of shells yields an average uplift rate of ∼0.2 mm/yr during the past 500 Ka. These data show that active transtension in the northeastern Rif is also associated with uplift. Comparison with cosmogenic 10Be/3He dating of perched fluvial surface located above these marine terraces is in progress and may allow us to confirm or not this uplift rate. In the western Rif, geomorphic markers allow us to suggest that active deformation is accommodated along blind thrust and NNW-SSE inherited folds. These new morphotectonic constraints are consistent with the GPS measurements showing southwestward overall motion of most of the Rif belt with respect to stable Africa and suggest a continuum of the deformation from the Pliocene.