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The competing roles of Zagros orogeny and Tethys slab-break-off in slowing down Arabia/Eurasia convergence since ∼5 Ma

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Large topographic belts along convergent margins have been recognized to slow down the kinematics of subduction over geologically short time-periods (i.e. few Myr), because their associated gravitational spreading provides significant resistive forces within the framework of plate tectonics. However, it is unclear if short term variations in convergent plate motion may also be induced by changes within the convecting mantle, for example in periods of so-called slab-break-off. The record of past and present-day plate kinematics provides important constraints on the dynamics of the lithosphere, because plate-motion changes must reflect temporal changes in the underlying balance of driving and resisting forces. Here we focus on the convergence between the Arabian and Eurasian plates, across the Zagros mountain belt. Relative motion across this plate boundary is reconstructed since 12 Ma from published paleomagnetic and geodetic data, and features a slowdown of ∼30% which was probably accommodated in the last 5 Myr. We employ global dynamic models of the mantle/lithosphere system in a simple inverse fashion to test whether orogeny in the Zagros is sufficient to induce the observed slowdown. Specifically, we use constraints from the geologic record of shortening to infer a topographic uplift history since 5 Ma that would be compatible in an optimal sense with the observed plate kinematics. A possible Tethys slab-break-off in the recent past – as suggested based on the history of magmatism in the Zagros – and its influence on the dynamics of convergence is also taken into account by introducing a numerical procedure for estimating the associated change in negative buoyancy upon the Arabian plate. Our results indicate that orogenic uplift of the Zagros is the key controlling factor for the convergence decrease since 5 Ma.