Novelly discovered post-mid-Eocene sinistral slip in the eastern Oman Mountains: widely distributed shear with wrench-fault assemblage related to Arabia-India convergence

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The geology of the Oman Mountains was shaped by the SW-directed obduction of allochthonous deep-sea rocks (Hawasina), trench-facies rocks (Haybi) and oceanic lithosphere (Semail Ophiolite) onto Arabian autochthonous shelf carbonates during the Late Cretaceous. Locally, the resulting obduction orogen was overprinted by significant post-obductional extension. NNE-directed extension occurred during at least two episodes which took place from the latest Cretaceous to early Eocene and late Eocene to Oligocene/Miocene, respectively. Moreover, the Oman Mountains, between the eastern Batinah Coastal Plain and the Sur area (Qalhat Fault) display numerous ~N/S-oriented folds and reverse faults. These structures overprinted mid-Eocene to at least Oligocene/Miocene formations (i.e., the Seeb to Barzaman formations).

Detailed structural/field work and satellite image analyses provide ample evidence that these ~N/S-compressional features are cogenetic with ~WNW to NW-striking sinistral faults. All these post-mid-Eocene structures are part of one major left-lateral WNW- to NW-striking shear zone from the Batinah Coastal Plain in the NW to the Batain area in the SE. Sinistral shearing is localized along the southwestern margin of the Saih Hatat Dome, crosses the Fanja area and continues to the northern part of the Jabal Akhdar Dome (Jabal Nakhl Subdome). The straight southwestern margin of the Saih Hatat Dome may correlate with a Permo-Triassic major extensional fault, active during the Pangea rifting. Shearing also affected rocks northeast of this zone, i.e., within the Salma Plateau and the Rusayl Embayment. Thus, shearing affected an area of 250 km by 40 km in width. We term this shear zone hereafter the “Hajar Shear Zone” (HSZ). The amount of sinistral shearing is unknown due to the absence of markers and wide strain distribution, but is likely to be at the order of a few tens of kilometers.

The cause for the WNW-directed sinistral shearing is the overall E/W-directed shortening between the Arabian and Indian plates. During shortening, a pre-existing WNW-striking basement fault zone was reactivated, creating the HSZ. A G-Plates reconstruction between the two plates reveals an ~8° counter-clockwise rotation of India (with respect to fixed Arabia) between 32.5 and 20 Ma,
resulting in ~150 km E/W-shortening between both plates at the easternmost tip of Arabia. The area northeast of the HSZ underwent most E-W-shortening. The 150 km interplate E/W-shortening is the maximum value for sinistral shearing along the HSZ and other faults. Some of the shortening may have been absorbed offshore Oman across the Owen Basin and/or along the continental/oceanic transitions of both plates.