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A step forward in understanding step-overs: the case of the Dead Sea Fault in northern Israel

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The rotational deformation field around step-overs between segments of strike-slip faults is poorly resolved. Vertical-axis paleomagnetic rotations can be used to characterize the deformation field, and together with mechanical modeling, can provide constraints on the characteristics of the adjacent fault segments. The northern Dead Sea Fault, a major segmented sinistral transform fault that straddles the boundary between the Arabian Plate and Sinai Subplate, offers an appropriate tectonic setting for our detailed mechanical and paleomagnetic investigation. We examine the paleomagnetic vertical-axis rotations of Neogene-Pleistocene basalt outcrops surrounding a right step-over between two prominent segments of the fault: the Jordan Gorge section and the Hula East Boundary Fault. Results from 20 new paleomagnetic sites reveal significant (>20˚) counterclockwise rotations within the step-over and small clockwise rotations in the vicinity. Sites located further (>2.5 km) away from the step-over generally experience negligible to minor rotations. Finally, we construct a mechanical model guided by the observed rotational field that allows us to characterize the structural, mechanical and kinematic behavior of the Dead Sea Fault in northern Israel.