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Weak Anatolian upper mantle inferred from postseismic deformation of the 2023 Türkiye earthquake doublet

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The eastern Mediterranean hosts complex tectonic units with multiple strike-slip and collision plate boundaries. The Anatolian plate is being pushed away from the Eurasian plate and Arabian plate via two left-lateral transform faults with uncoupled crust and upper mantle inferred from anisotropy studies. The rheological structure is thus important to better understand the plate dynamics of the Anatolian and its surrounding plates. The 2023 Mw7.8 and Mw7.6 earthquake doublet in the East Anatolian Fault zone provides a unique opportunity to study viscoelastic relaxation of the upper mantle and time-dependent afterslip over the crustal faults. Here we have derived the first 3-month postseismic displacements from GNSS time series of 94 stations after the events to investigate the early postseismic deformation processes through a three-dimensional viscoelastic finite element model. Afterslip in the model is simulated through a 2-km thick weak shear zone attached to the fault. Viscoelastic relaxation is represented by the bi-viscous Burgers rheology. We find that the observed long-wavelength displacements is dominated by the viscoelastic relaxation even in this early postseismic stage, and the contribution from the afterslip is spatially limited. The viscosity of the Anatolian upper mantle should be lower than 10^{19} Pa s to better fit the observed horizontal and vertical displacements. This inferred weak upper mantle may result from the upwelling mantle due to the tearing African slab.