Blind thrust faults beneath Metropolitan Osaka, southwest Japan, constrained by tectonic geomorphology and seismic reflection data

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We present structural models constrained by tectonic geomorphology, surface geologic mapping and high-resolution seismic reflection profiles to define the kinematic evolution and geometry of active fault-related folds along the Uemachi fault zone (UFZ) and Ikoma fault zone (IFZ) beneath Osaka metropolitan area. The UFZ and IFZ are active intraplate fault systems in southwest Japan, and are defined by 45-km-long arrays of active, west-verging reverse faults. We focus on the northern half of the UFZ and IFZ where we use the kinematic evolution of active fault-related folds to constrain rates of slip on underlying blind thrusts since early Quaternary time. Rocks uplifted in the hangingwall of the IFZ are composed of late Cretaceous granitic rocks that form the stripped cores of basement-involved folds which override a thick sequence of Neogene sediments in the Osaka basin. Numerous secondary, bedding-parallel thrusts also deform the Neogene sediments and late Quaternary fluvial terraces and are interpreted to form by flexural-slip folding that acts to consume slip on the primary blind thrusts across synclinal axial surfaces. The best-fitting trishear model for the forelimb geometry above the IFZ imaged on the seismic section requires a 56-degrees east-dipping thrust fault with a 38-degrees apical angle. This solution provides a 0.7 mm/yr of slip rate on the IFZ based on an age of shallow marine deposits folded across the forelimb identified in the borehole. Very subtle, Holocene fold scarps that deform alluvial fan deposits marked by changes in drainage channel networks coincide with the projected surface trace of the thrust tip. Fluvial terraces folded across the west-dipping forelimb, and east-dipping backlimb of the frontal UFZ suggest that it grows above an active, east-dipping thrust. The seismic sections across the northern UFZ and nearby borehole profiles show that the core of the basement-involved fold also overrides onto the lower portion of the thick Neogene sediments in the Osaka basin. Trishear solution for the northern UFZ suggests that the forelimb geometry has formed above the propagating tip of a 40-degrees east-dipping thrust. A 458 m of slip for the retrodeformed horizon (shallow marine sediments Ma-1) provides a slip rate of 0.38 mm/yr, which corresponds well with a rate of vertical separation estimated on numerous, dated shallow marine horizons across the UFZ.