Tilting of the Dublin Hills, Death Valley Area, California: Implications for Mechanisms of Crustal Extension

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Despite Death Valley's contributions to understanding crustal stretching, the mechanisms by which extension was accommodated are still unresolved. So-called low angle normal faults (LANFs) dipping at less than 30^o have been mapped throughout the Basin and Range Provence, yet LANFs are not mechanically feasible under typical crustal conditions. Two models circumvent the LANF paradox: the rolling hinge and the discrete normal fault model. In both models, faults are initially steep and tilt to lower dips as extension is accommodated. In the rolling hinge model, extension was related to northwest motion of a hinge in the active fault, with displacement on a series of now-inactive but physically connected fault strands younging in the same direction. The alternative is that each fault is discrete, rooted into the mid-crust, active during the same overall time span, but lacking any systematic timing relations. New $^{40}Ar/^{39}Ar$ ages for rhyolitic volcanic rocks in the Dublin Hills indicate fault-related tilting more or less exclusively after 9.5 Ma. The picture that is now emerging across a series of tilted fault blocks to the east of central Death Valley is one of a few faults becoming active more or less coeval with magmatism between ~13- 9.5 Ma (east of the Resting Spring Range, Greenwater Range, the Sheephead fault at Sheephead Pass, Black Mountains), with more widespread faulting after much of the magmatism had ended (Resting Spring Range, Dublin Hills, Sheephead Mountain, Black Mountains). Volcanism in the Greenwater Range continued until ~3.5 Ma. Faulting persisted longest in the vicinity of the Black Mountains, with exhumation locally in excess of 10-12 km between 11.6 Ma and the present, and particularly from 8-6 Ma. However, Neoproterozoic to Cambrian sedimentary rocks were exhumed widely by erosion prior to the onset of extension in an area that is now bounded by the right-lateral Furnace Creek and Sheephead faults (Resting Spring Range, Dublin Hills, Eagle Mountain, Sheephead Mountain, Furnace Creek Wash, southern Black Mountains). The new data from the Dublin Hills, in conjunction with previously established constraints from other fault blocks, are consistent with the discrete fault model for late mid-Miocene and younger deformation.