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Relationships between incremental and cumulative fold growth with neotectonic examples from the southern Tianshan, China

Some mechanisms of upper crustal fault-related folding display profiles of incremental fold growth that are collocated with the distribution of finite fold uplift, whereas others do not. For example instantaneous uplift in fault-bend folding is not coincident with cumulative uplift because fault bends are velocity discontinuities through which rock moves progressively. This causes uplifted rock to move away from the instantaneous locus of uplift. In contrast, some models of detachment folding assume that instantaneous uplift rate is coincident with and proportional to cumulative uplift. We show how these concepts play out quantitatively in two well imaged actively forming anticlines in the southern Tianshan. The Yakeng detachment fold shows collocated growth in which incremental uplift is linearly proportional to cumulative uplift with a high statistical significance. This has the practical result of allowing one to measure fractional uplift quite accurately. In contrast Quilitak anticline is a complex fault bend fold that shows non-collocated fold growth at several scales, which we illustrate with [1] a detailed analysis of progressive motion of young strata through a fold hinge and [2] large-scale folding of the land surface producing giant fold scarps as high as 800 m.