Analysis of the Growth of Active Detachment Folds Applying the new Thickness Relief Method, With Examples From the Tien-Shan and Nankai Trough.

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Active folds develop distinctive stratigraphic geometries resulting from the interactions of sedimentation and deformation, which provides a quantitative record of deformation history. Modern seismic with excellent images of growth deposits, allow us to extract this record of deformation in a detailed and quantitative way applying the new thickness-relief method. We apply the thickness relief method to growth strata of two actives detachment folds, one in Yakeng anticline of the southern Tien-Shan China and another at the front of the Nankai Trough Japan (ODP legs 190, 196). The method involves determination of areas of structural relief as a function of height based on thickness variations of all imaged horizons. This yields a high-resolution profile of shortening, as a function of height since shortening is the derivative of the area-height curve. The thickness-relief method has been successfully applied to pre-growth sequences in a number of structures. Here we extend the method to growth strata. The onset of growth is represented in the area-height plot as an upward decrease rate of growth of fold area, which is most easily analyzed through modeling. A wide variety of distinctive behaviors are expected for various ratios of sedimentation to deformation rate, depending also on the depth to detachment. Amplitude obtaining valuable information about the shortening and how this is accommodated into detachment folds. The slope of best-fit line represents shortening or displacement in the area relief graph. So, as deformation and sedimentation starts to interact the geometry of deposits change and area-relief, height, and shortening relationship is affected. Deviation from the linear trend, negative or a decrease in slope, are signatures of the growth in area relief graph, however data are restricted and theoretical models are necessary to understand the behavior of the graph. We use these models to fit real data on growth strata of Nankai and Yakeng detachment folds, which show substantially different behavior. We found that the very young and rapidly growing Nankai fold at a fast-moving plate boundary displays a sedimentation rate that is no more than 25 to 30 % of shortening rate. In contrast the Yakeng anticline in the more slowly deforming Tien-Shan of central Asia shows a sedimentation rate that is 167 % the shortening rate. We make use of available age control to transform these observations into sedimentation and deformation rates.