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Development of Detachment Folds in the Mexican Ridges Foldbelt, Western Gulf of Mexico Basin

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Examples of natural folds growing in a homogenous mechanical stratigraphy of alternating competent and incompetent thin layers of fine-and coarse-grained sediments are examined, and the fold growth process is quantified. Our analysis reveals the overall response to loading of siliciclastic sequences corresponds to that of flexural flow and parallel-to-bedding heterogeneous pure shear. Folds start out as low-amplitude sinusoidal disturbances that rapidly become finite-amplitude folds of heterogeneous strain. We also analyzed the kinematics of fold growth, and derive the following scaling relations: i) degree of amplification scales like the height above the detachment and strain; ii) wavelength selectivity broadens with increasing strain; and iii) deposition of syn-sedimentary geometries is function of strain. These relations are a natural consequence of idealized area-preserving laws of fold growth. We are also able to define a progression of fold shape change as a function of the fundamental parameter strain. Initially structures grow by limb rotation and the selective amplification of a single dominant wavelength giving rise to “monochromatic” folds. When strain reaches ca. 8% rocks undergo softening/plastic yielding leading to strain localization around hinges and the development of sharp fold profiles. This induces a secondary mass flow that causes accelerated fold amplification. In this stage of fold development limbs lock ceasing to rotate, and fold amplification is mainly by hinge migration.