FINITE AMPLITUDE FOLDING: TRANSITION FROM EXPONENTIAL TO LAYER LENGTH CONTROLLED GROWTH.

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An improved linear folding theory has been developed which considers the non-linear strain weakening of membrane stresses caused by stretching of the competent layer during folding. The resulting theory is simple and accurate for finite amplitude folding and is not restricted to infinitesimal amplitudes as is the linear theory.Two folding modes relevant to most natural settings are considered which are viscous and viscoelastic single layer folding.For these two modes, the new theory provides a non-linear, ordinary differential equation for fold amplitude evolution and an estimate for crossover amplitude and strain where the linear theory breaks down. A new analytical amplitude versus strain relationship is derived for strains much larger than the crossover strain. The new relationship agrees well with complete 2-D numerical solutions for up to 80% strain, whereas the exponential solution predicted by the linear theory gives predictions, which are orders of magnitude off for strains larger than the crossover strain.Analysis of the crossover strain as a function of the controlling parameters shows that the scope of application of the linear theory is restricted to a small range of amplitudes and strains. To resolve this problem, we use the new finite amplitude theory to calculate the evolution of the growth rate spectra during progressive folding. The growth rate spectra exhibits splitting of a single maximum predicted by the linear theory into two maxima at large strains. This bifurcation occurs for both deformation modes.