Sequential restoration of folds using growth strata; an example from Sant Llorenc de Morunys, Southeast Pyrenees

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We restore cross sections through the classic Sant Llorenc de Morunys growth structure, southeast Pyrenees, using a method based on the least-squares minimized best fit of blocks. The rigid-body translations and rotations associated with the minimized best fit effectively concentrate displacement on expected slip systems and minimize strain. Mapped layers are divided into polygonal elements, the boundaries of which represent slip systems. Growth strata are stripped layer by layer in order to sequentially restore a cross section. Sequential restoration determines the displacement history of the fold and the migration of fold hinges during its development. During each increment of growth, the youngest layer is stripped and the next youngest layer is restored to a depositional datum. Different boundary conditions on the sides of the model allow different assumptions of pin lines to be tested. These different assumptions produce different amounts, senses and locations of bedding-parallel shear during the restoration. In some restorations, continuity is regained after each increment of the restoration by remeshing initially coincident polygon vertices to a common centroid after attaining a best fit of rigid elements. The change in shape of elements in regaining continuity is a measure of strain at that location, assuming homogeneous strain within each element. In other restorations, the geometry of the initial mesh of polygonal elements forces bedding surfaces to be the dominant slip system. The method is used to restore a set of serial cross sections through the fault-related fold at Sant Llorenc de Morunys, in which the structural geometry is well-constrained by 1:5000 field mapping. Structural and stratigraphic data from the deformed state are translated, rotated and unstrained during the restoration and mapped onto each state of the restoration, providing a check on the viability of the restoration.