# Computational modeling of ductile folding in sedimentary rocks

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**Abstract**

Ductile folding of sedimentary rock layers typically occurs at great depths where both the overburden pressure and temperature are high. Folding results from a number of mechanisms including buckling due to lateral compression and fault movement of the underlying strata. Movements experienced by folded strata are typically very large and may include significant rigid body translation and rotation, in addition to the actual straining of the folded layers. More specific types of straining could include any one or a combination of the following: plate-like bending of the deforming stratum, in-plane extension, in-plane compression, and either in-plane or out-of-plane shearing. Such movement could induce strain localization even as the layer continues to deform plastically. In this paper we present a mathematical model for capturing isothermal ductile folding processes and the accompanying strain localization in sedimentary rocks using nonlinear continuum mechanics and finite element modeling. We use a fully Lagrangian approach along with multiplicative plasticity theory for finite deformations, considering the effects of all three invariants of the stress tensor in the constitutive description. We also simulate the rigid body translation, finite rotation, and subsequent rupturing of preexisting faults using finite deformation kinematics and stick-slip contact mechanics. We apply the technique to simulate the 3D folding of the Sundance Formation(?) located approximately 450 m above the Tensleep sandstone in the Sheep Mountain Anticline, Bighorn Basin, Wyoming.

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