Folding of a basement involved, fault-cored anticline:
an example from Sheep Mountain Anticline, Wyoming

N. Bellahsen, P. Fiore, D.D. Pollard
Dept. of Geological and Environmental Sciences, Stanford University, Stanford, CA

We use fracture data and mechanical models to constrain the fold kinematics at Sheep Mountain Anticline, a Laramide fold on the eastern flank of the Bighorn Basin, Wyoming. Four fracture sets are defined with field observations: Set I fractures are oblique to the fold axis and pre-Laramide, Set II joints are fold-perpendicular and interpreted as early-Laramide fractures, Set III joints are fold-parallel and syn-folding in age, Set IV fractures are late to post-folding structures and oblique to the fold axis.

The spatial distribution of the early Laramide (pre-folding) set II joints is discussed in light of 3D elastic models of thrust faulting. We justify using elastic models because small deformation was accommodated during this early-Laramide stage, with inelastic deformation localized near the tipline of the model fault. The distribution of the Set II fracture set allows us to constrain certain aspects of the subsequent fold kinematics, most significantly the position of the forelimb before folding.

The fold kinematics are further constrained by pre- and syn-folding fracture patterns. The distribution and geometry of these sets indicate that the fold grew with a fixed hinge and fixed lateral tips. These results lead us to define a model of fold growth that is significantly different from conventional models proposed for basement involved folding. An important implication of this study is that, for the folding kinematics deduced from fractures within the sedimentary cover, the basement must be internally deformed.