Geophysical Research Abstracts
Vol. 12, EGU2010-14013, 2010
EGU General Assembly 2010

A step forward in numerical fold shape analysis

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The geometry of folds is essential for understanding folding mechanism and rock properties during deformation. Thus, it is crucial to be able to characterize fold geometries in an accurate fashion. A variety of the methods describing fold geometry exists in the literature, however they are mainly limited to the analysis of a half or a quarter of the fold's wavelength (e.g. Stabler 1968, Hudlestone1973, Twiss 1988, Bastida et al. 2005, Lisle et al. 2006). Yet, natural folds are rarely isolated structures. Instead they are usually part of fold trains in multilayer sequences. The geometrical description of such assemblies relies on the accurate determination of the hinges and inflection points of individual folds. Precise positioning of these points turns out to be essential as the results of fold shape analysis are very sensitive to these decisions (Lisle et al. 2006).

We have developed a numerical toolbox that is capable of reliably analyze fold shapes. The main advantage of the code is that it can accurately define hinges and inflection points. Even this simple curvature based analysis is difficult to implement as noisy data will deceive the algorithm. We reduce the noise before curvature analysis by applying a Gaussian smoothing algorithm.

We focused on three basic geometrical parameters: amplitude, wavelength, and thickness that can be determined for a wide range of fold geometries. We provide a method that defines the local fold thickness and the average thickness.

We tested the toolbox using natural and synthetic data. The natural folds are taken from the Oslo fold and thrust belt, whereas the synthetic ones are generated for single and multilayer setups using a finite element method code. For the numerical data for a given setup we also compared the analytical solution for the effective viscosity ratio, the amplification ratio and thickening of the layer during deformation with the results obtained by the geometrical toolbox.