Geophysical Research Abstracts
Vol. 16, EGU2014-13067, 2014
EGU General Assembly 2014

New method for estimating viscosity ratio and shortening from the geometry of the fold trains

Marta Adamuszek (1), Marcin Dabrowski (1), Daniel W. Schmid (2), and Raymond C. Fletcher ()

(1) Polish Geological Institute, Lower Silesia Branch, Wroclaw, Poland (marta.adamuszek@pgi.gov.pl), (2) Physics of Geological Processes, University of Oslo, 0316 Oslo, Norway

Shortening of a mechanically layered medium in the direction parallel to the layering leads to the development of buckle folds. In this study, we focus on the deformation of a single viscous layer embedded in a viscous matrix. The shape of the folds is dependent on 1) the mechanical properties of the medium, in particular, the viscosity ratio between the layer and the matrix and the stress exponent in the flow law, 2) the initial perturbation present on the layer interfaces, and 3) the amount of the background shortening. The fold formation is accompanied by the layer thickening. Folds develop due to amplification of the initial perturbation. In case of the lack of such a perturbation, no folding is observed and the layer only undergoes thickening. The amplification of the perturbation can be best examined in the frequency spectrum, when the perturbation is decomposed into individual sinusoidal waveforms. Then, the folding process is analysed from the perspective of the evolution of individual waveform.

In the buckling process, the amplitude growth is a result of a kinematic and dynamic amplification. The kinematic amplification causes the growth of the amplitude of each component with the same rate. Conversely, the dynamic amplification is selective and influences differently various parts of the spectrum. The dynamic amplification pattern is specific for certain values of viscosity ratio and stress exponent, and amount of shortening. Additionally, it is also a function of amplitude spectrum and changes with progressing deformation. As a result, the dynamic amplification leaves unique traces in the amplification spectrum and, thus, can be a source of information about the mechanical properties of the layer and matrix and the shortening.

The relation between the fold growth, the dynamic and kinematic amplification spectrum and the range of parameters can be best studied using theoretical methods. In this study, we employ the Large Amplitude Folding model [1], a mathematical model that satisfactorily predicts the evolution of fold geometry parameters up to large amplitudes. Based on the analysis of the dynamic amplification, we develop a new method of estimating the viscosity ratio and shortening from the geometry of the fold shape. We test the method using the numerically generated folds and show a good correlation between the input parameters employed in the numerical modelling and results of the fold shape analysis.

[1] Adamuszek M., Schmid D.W., Dabrowski M., 2012, Theoretical analysis of large amplitude folding of a single viscous layer, Journal of Structural Geology, Vol. 48, p. 137–152