Solid Earth Discuss.,
doi:10.5194/se-2016-80-RC1, 2016

Solid Earth
Discussions
Open Access
EGU

Interactive comment on "Folding and necking across the scales: a review of theoretical and experimental results and their applications" *by* Stefan Markus Schmalholz and Neil Mancktelow

P. Hudleston (Referee)

hudle001@umn.edu

Received and published: 6 July 2016

This is an outstanding, well-written review of the large body of work carried out on folding and necking/pinch-and-swell, focusing on theoretical and experimental perspectives. The period covered extends back beyond the time when geology first became a discipline in its own right, with references to early work on the strength of beams and columns in the 17th and 18th centuries. Links to relevant engineering and mechanics literature are made throughout. The abstract and introduction by themselves make an excellent mini review of the topic.

The basic physics and mathematics involved in folding and necking are clearly explained, in the text and in the appendices, and the development of ideas nicely traced.

The similarities and differences between the response of layered materials to shortening and extension - by folding and necking respectively – are clearly documented.

The paper is long and there are a few instances of repetitions that could be reduced or eliminated. For instance, Neurath and Smith (1982) is cited in several places in the text and their work is introduced twice, first on p. 815 and then on p. 968. There could be some modest reduction in text by changing the second of these to reflect the earlier introduction.

The appropriateness of the choice of necking rather than pinch-and-swell to use as the general term to describe the phenomenon in extension might be debated, since necking generally implies (to me at least) a single point of thinning, whereas folding encompasses a range of behaviors from a single structure to a fold train. Pinch-and-swell of course implies repetition along the layer. The range of behaviors from single necking to "periodic" pinch-and-swell is covered in this paper.

It might be useful, since this is a review, to define "competent" when the term is first used (line 34), as some readers may be unfamiliar with this usage. And while considering use of terms, it might be worth pointing out somewhere in the text, as was done by Smith, that the non-linear rheology that leads to necking and pinch-and-swell need not be power law.

There are a few issues with the misspelling of proper nouns - Rockhall (line 1067), Dieteric (line 1700), and the MS should be checked for these. Also, it should be checked that all citation's in the text appear in the reference list and vice versa. Examples that (perhaps not surprisingly) I noticed are Hudleston (1973) that is cited in the text but not in the reference list and Hudleston and Stephansson (1972) that is in the reference list but not cited in the text (and in any case should be 1973).

It would be helpful to the reader if references to monographs give page numbers where the citations appear in the text.

The illustrations are excellent, but it would be nice to add one at least that illustrates in some way the dependence of dominant wavelength on spacing of the competent layers .

Specific Comments

line 402. It might be worth pointing out here that the amount of bulk shortening that is undergone before the analytical solution significantly overestimates amplification depends on both the viscosity ratio and the initial amplitude of the perturbation. This of course is discussed elsewhere in the text.

lines 412. I believe Johnson and Fletcher (1994) first used the expression “preferred wavelength. ”Sherwin and Chapple do not use the term, but rather consider the dominant wavenumber a function of shortening. Fletcher and Sherwin also do not use the term preferred wavelength, but refer throughout their paper to the “wavelength that has received maximum amplification.”

line 569. Reference here to Paterson and Weiss (1966) for development of chevron folds from kinks as described in first part of (iv)?

line 627. Perhaps a reference here to authors who considered folding of the crust or lithosphere to be impossible (Ramberg is one, but I don’t recall the reference)..

lines 810-815. This phenomenon is also nicely illustrated in Ramsay and Huber (1987), as reflected by cleavage development in the competent layer.

line 1000. Although there is no layer-parallel shear in the competent layer during necking, there must be in the adjacent matrix.

line 1004. The decrease in amplification rate with increasing extension for necking must be for a different reason than the decrease in this rate for folding – for necking the rate presumably decreases because the wavelength is increasing and progressively further away from the dominant wavelength. For folding the reason is as explained by Schmalholz and Podladchikov (2000).

line 1273. A good natural example of this phenomenon is described (so far only) in a GSA abstract by myself and others (Hudleston, P., McEvoy, M.E., Watkins, W.D., Porter, M., 2015. Rheological information inferred from small-scale folds, Northern Snake Range, Nevada. Geol. Soc. Abstr. with Prog., 47 (7), p. 720.

Fig. 2. The lithology of the matrix in which the quartz veins in parts A and B are embedded should be given.

Peter Hudleston

Interactive comment on Solid Earth Discuss., doi:10.5194/se-2016-80, 2016.