Solid Earth Discuss.,
https://doi.org/10.5194/se-2019-202-RC2, 2020

Interactive comment on "The role of pre-existing jointing on damage zone evolution and faulting style of thin competent layers in mechanically stratified sequences: a case study from the Limestone Coal Formation at Spireslack Surface Coal Mine" *by* Billy J. Andrews et al.

Bailey Lathrop (Referee)

b.lathrop17@imperial.ac.uk

Received and published: 27 February 2020

See attached PDF

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The role of pre-existing jointing on damage zone evolution and faulting style of thin competent layers in mechanically stratified sequences: a case study from the Limestone Coal Formation at Spireslack Surface Coal Mine.
Billy J. Andrews*, Zoe K. Shipton, Richard Lord, Lucy McKay

Dear Editor,

This manuscript describes how mechanical stratigraphy and pre-existing weaknesses affect the style of strike-slip faulting in the Spiresack Surface Coal Mine, Scotland. The authors gave a history of the complex stages of folding and faulting in the Spirestack Coal Mine. They found that faulting in the study area was affected by the presence and orientation of pre-existing structures and whether the fault cuts through multiple lithologies, especially shale. This has implications specifically in the geologic understanding of the area, and generally for fluid flow and strike-slip fault kinematics.

This research has the potential to make a good contribution to Solid Earth, but might benefit from some revisions. I find few issues with science, but the writing and organization of the paper requires some thought. Overall the quality of writing could be improved, and an intense proof-read is likely required in order to make the paper more impactful. In no particular order, my main comments include:

- The writing style lacks clarity and is often difficult to read and understand
- The results section should be reorganised for clarity, and interpretations and results should be separated into different sections
- The paper needs a thorough proofread
- The figures are too busy, and could be simplified
- Relevant figures need to be referred to in the text more often
- The abstract and conclusions should contain more specific results

This paper will make a strong contribution to the field of strike-slip fault growth, and will be of interest to the readers of Solid Earth. I look at some similar research questions in normal faults, so I find the topic particularly interesting. The quality of writing could be improved throughout, and I have made some suggestions throughout the paper on how this could be done.

I am listing my main concerns with the paper below, and have made comments in a PDF of the paper. I would be happy to (and look forward to) reviewing this paper again after these points are addressed.

Kind regards,
Bailey Lathrop
Imperial College London

Fig. 1. Cover Letter

https://doi.org/10.5194/se-2019-202
Preprint. Discussion started: 16 January 2020

Solid Earth Discussions
Open Access

The role of pre-existing jointing on damage zone evolution and faulting style of thin competent layers in mechanically stratified sequences: a case study from the Limestone Coal Formation at Spireslack Surface Coal Mine.

Billy J. Andrews*, Zoe K. Shipton, Richard Lord, Lucy McKay

Department of Civil and Environmental Engineering, University of Strathclyde, Glasgow, G11XJ, Scotland

Correspondence to: Billy J. Andrews (billy.andrews@strath.ac.uk)

Abstract. Fault and fracture networks play an important role in sub-surface fluid flow and can act to enhance, retard or compartmentalise groundwater flow. In multi-layered sequences, the internal structure and growth of faults is not only controlled by fault throw, but also the mechanical properties of lithologies cut by the fault. This paper uses geological fieldwork, combined with fault and fracture mapping, to investigate the internal structure and fault development of the mechanically stratified Limestone Coal Formation and surrounding lithologies exposed at Spireslack Surface Coal Mine. We find that the development of fault rock, and complexity of a fault zone is dependent on: a) whether a fault is self-juxtaposed or cuts multiple lithologies; b) the presence and behaviour of shale, which can lead to significant bed-rotation and the formation of fault-core lenses; and c) whether pre-existing weakness (e.g. joints) are present at the time of faulting. Pre-existing joint networks in the McDonald Limestone, and cleats in the McDonald Coal, influenced both fault growth and fluid flow within these lithologies.

1 Introduction

The mechanical properties, thickness, and interface properties of lithologies in a stratigraphic succession, referred to as mechanical stratigraphy, combine to influence the deformation style of a rock mass (e.g. Ferrill *et al.* (2017)). The effect of mechanical stratigraphy on faulting, in particular normal faulting, has been studied for sand-shale sequences (e.g. van der Zee & Urai (2005); Schmatz *et al.* (2010)), interbedded limestones and marls (e.g. Ferrill & Morris (2003), (2008); Long & Imber (2011); Ferrill *et al.* (2012)), and ignimbrites (Soden and Shipton, 2013). The lithology being cut by the fault influences fault dip: strands in competent layers have steeper dips than those in incompetent layers (Ferrill and Morris, 2008). The ratio of competent to incompetent lithologies thus affects fault style and displacement profiles (Ferrill et al., 2017; Ferrill and Morris, 2008). When incompetent layers dominate the sequence, folding is commonly observed with thin competent beds displaying fault-related folding (Ferrill and Morris, 2008; Lăpădat et al., 2017). The presence of incompetent lithologies also restricts fault growth with strands terminating at incompetent beds. This leads to faults with high aspect ratios orientated

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Fig. 2. PDF With Corrections