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Interactive comment on "Modeling of the in situ state of stress in elastic layered rock subject to stress and strain-driven tectonic forces" *by* Vincent Roche and Mirko van der Baan

Anonymous Referee #1

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Dear authors and editors,

The paper investigates different strategies to predict depth variation of stress within a sedimentary succession. This is an important issue as an increasing amount of stress models are applied to predict stresses in the upper crust, having only little data. The case study is based on the stratigraphy, log data and in-situ stress measurements from a well located in the Western Canada Sedimentary Basin. The paper is well written and the different strategies are well explained. Results are good portrayed and discussed. Therefore I suggest to accept the paper pending on minor revision.

In the following I will point out the major concerns followed by some smaller comments, which are always marked with the specific line or the figure number.

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General aspects

The introduction chapter is in some parts is patchy and not straightforward. E.g. the paragraph from line 55 to 59 would fit much better before paragraph starting line 48. From my personal point of view, the appendix A (B) would fit well within the introduction or chapter 2. S_V, S_H and S_h are well known. However, the relative position to each other could be mentioned in the introduction. The used strategy (line 209-217) would be a good final paragraph for the introduction.

The general idea is to combine the initial stress model (lithostatic and uniaxial) with certain elastic material properties, a type of boundary conditions (stress- and strain driven) in comparison with a benchmark (in-situ stress data or criticality of potential faults). This is well explained in lines 209 to 213. However, the reader is often mislead that one of the model parts (e.g. uniaxial, strain driven or critical) are separate models. A small sketch showing the relative position of model parts/boundary conditions would help.

The case, that only three in-situ S_h data are available within a short stratigraphic sequence is a drawback. However, the authors should not be judged for lacking available in-situ stress data.

Minor issues with reference to specific lines or figure numbers

line 25: both cited papers from Reiter el. al. and Reiter and Heidbach (2014) are not overview paper on crustal stresses in general, these papers are focused on crustal stresses in Alberta and Canada. May other paper would fit much better as a general introduction.

lines 108-120: introduction ?

lines 187-189: introduction ?

line 198: 'horizontal stress profile' ?

line 220: ‘depth-dependent Poisson’s Ratio’? or lithology dependent Poisson’s Ratio?

line 245: The max. (regional) horizontal stress is ‘negligible’. That could be an assumption, but the maximum horizontal stress as well the correction are introduced and mentioned by several equations in chapter 2. I think that could be mentioned in the introduction.

lines 254-256: discussion ?

lines 269-271: introduction ?

line 636: ‘E’ is introduced, but not explained except line 651.

line 642: ‘A’ and ‘B’ are introduced, but not explained. May avoid A and B by combining Eq. B 8 and B 9?

line 660: Atkinson

some references includes the month (line 805 and 810)

Table 1: I would write b) and c) in the head of the table

Figure 2: Usage of colours instead of several grey tones in the stress profiles would allow much better to distinguish the shown properties/stress profiles

Figure 4: It should be mentioned that Muskwa, Otter Park and Evie member are together the Horn River Formation, which is mentioned only once in line 291. ‘The white stars represents the injection levels.’ Injection level is may be a little bit ambiguous for the location of stress measurements.

Figure 5 and 6. Usage of colours instead of several grey tones in the stress profiles would allow much better to distinguish the shown stress profiles. The stratigraphic column (E and I respective D) should indicate the Keg river and Horn river formation, as they are discussed related to the figures. The stratigraphic column is not the same as shown in Fig 4. Sub-figure 5H is not explained.

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