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Interactive comment on "Statistics of the Seismic Sequence and Rupture Directivity of the M5.5 Earthquake in Orkney, South Africa" *by* Carsten Dinske et al.

Anonymous Referee #2

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Dinske et al. investigated the seismicity in deep South African gold mines and the rupture process of the 2014 M5.5 Orkney earthquake. The authors showed that the magnitude statistics of the earthquakes are different for three groups, including aftershocks of the M5.5 event, the fluid-induced earthquakes, and the mining-induced earthquakes. For example, the b-values of earthquakes in the three groups vary from 0.52 to 1.08, and the stress-drop estimates of the earthquakes also seem to differentiate from each other. The study also resolved a rupture model of the M5.5 earthquake using a back-projection method with both underground instruments and surface seismometers. The results show that the earthquake ruptured unilaterally toward the south direction and extended for about 6 km. It is an interesting paper, but I found that the major technical

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details are missing. Without the details, it is challenging to evaluate the significance of the findings. I recommend the authors to clarify the details and explicitly explain the data processing and modeling endeavors.

1, For the 70,000 earthquakes, how are they divided into the three classes? For example, the authors consider events within a period of the M5.5 event as aftershocks? Or they were modeled with ETAS? How do the authors determine the events were caused by fluid migration or mining activities? There are no descriptions or comments on catalog quality. Without an understanding of the catalog, it is difficult to have confidence in the derived statistics.

2, Maybe it's just my ignorance, but it is not obvious to me how the magnitude frequency distributions are modeled (section 2). For example, for the fluid-induced seismicity, what is the considered rock volume? What is the pore pressure? What are the physical assumptions, and how the parameters are derived? What are the magnitudes of stress perturbations? I understand there are reference papers to dig into, but the lack of details confuses me. It is even more confusing when the authors start to talk about stress-drops. I don't think these are the typical waveform derived stress-drop estimates. So how were they calculated? What is the difference between the different types of stress drops listed in Table 1?

3, Similarly, how the back-projection analysis is performed? Did the authors filter the waveforms? Were the waveforms aligned? From the figures, the waveforms were clearly tapered. How was the tapering conducted? How did the author conclude all the used waveforms were just P waves? Are there possibilities of contamination from reflected and refracted phases?

4, The figures need improvements:

Figure 1, why the authors plot Mw 2 and Mw 2.8 and Mw 3.5 earthquakes?

Figures 2 and 3 are difficult to understand. I would recommend the authors to plot 2D

projections instead of pseudo-3D. For example, panels of a map view, North-Depth, and East-Depth would be more informative. Maybe an event density figure would be more informative.

Figures 4 and 5: What do the different symbols mean?! Dots vs + ? No legends!!

Figure 8 right panel, what is the horizontal axis? Distance?

Figure 9: please have a color bar. . .. Also please plot the seismicity in Figure 10 on top of the rupture propagation figure.

Similar comments apply to Figure 11 and Figure 12. . .

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