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Solid Earth
Discussions

Interactive comment on "Mapping undercover: integrated geoscientific interpretation and 3D modelling of a Proterozoic basin" *by* Mark Lindsay et al.

Anonymous Referee #1

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An interesting exercise in modelling the high density response of a Proterozoic basin and some ideas of the origin of the intrusions.

Gravity modelling follows a logical sequence, but after that the paper jumps about and becomes disjointed with the conclusions not really substantiated by the observations. Rewriting this section may make it clearer to read, but the authors should be careful about making claims that their work doesn't substantiate. They show the modelled extent of the high density anomalies with in the Yerrida basin and try to deduce which formations the mafic rocks are associated with.

In general the authors should write to an educated audience, and cut out the text book

explanations of geophysics

individual comments posted on the attached pdf

Introduction Is very verbose and could be tightened up a lot. It needs to be more region specific to entice the reader to continue and focus on the need to use these techniques for this problem. It should also touch on the problems on delineating features under-cover, similar rock types etc

Methods and datasets Mixed up and missing some sections Needs to assume the reader is familiar with basic geophysical processing and eliminate some of the text-book style phrases.

Geochemistry I find it hard to come their conclusions with only 2 drill holes (one in each basin, or so it looks on their map). THD from the Yerrida Basin, appears to be within the spread of ranges of the Narracoota formation (of the Bryah Basin) and DG comes from the Bryah Basin yet could be defined as different from the Narracoota. I think I would stick to the gravity modelling to support their ideas

Basin development This section is confusing, poorly written, maybe if it was organised better, conclusions spelled out and finished off rather than the reader having to piece bits of evidence together to assume this is what the authors intended, it would be more persuasive. I think the authors would be better supporting current theories with their modelling rather than trying to take the theories further without much evidence

Conclusions the only part that is clearly and reasonably concisely written. Although the conclusions on the final model hang together as loosely as the discussion

1. Does the paper address relevant scientific questions within the scope of SE? Yes – is multidisciplinary and looks at the interesting problem of a high density in a basin 2. Does the paper present novel concepts, ideas, tools, or data? Yes - interesting conclusions on a little investigated area 3. Are substantial conclusions reached? Fair – basic conclusions are sound with some interesting hypothesis put forward form the

observations. Missing a couple of points which are brought out in the text but not in the conclusions. 4. Are the scientific methods and assumptions valid and clearly outlined? With some reorganisation, the methods follow on well form each other 5. Are the results sufficient to support the interpretations and conclusions? Fair – the data is sufficient for the main conclusions and the author makes some interesting conjectures on what this might imply 6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes - 7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes 8. Does the title clearly reflect the contents of the paper? Would be better to have the basin name included in the title for searchability, but otherwise the title is fine 9. Does the abstract provide a concise and complete summary? Yes – abstract is the best written part of the paper 10. Is the overall presentation well structured and clear? Needs some reorganisation 11. Is the language fluent and precise? Needs to be tightened up considerably 12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? N/A 13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Fig 1 needs a proper stratigraphic column to assist the rest of the paper. Fig 12 & 14 could be merged with Fig 13 Multiple comments on the other figures 14. Are the number and quality of references appropriate? Yes – just add map references 15. Is the amount and quality of supplementary material appropriate? Appendix 1 is superfluous. Addition of the model is good

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2019-192/se-2019-192-RC1-supplement.pdf

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Solid Earth Discussions

Mapping undercover: integrated geoscientific interpretation and 3D modelling of a Proterozoic basin.

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Abstract. Gravity and three-dimensional modelling combined with geochemical analysis are used to examine the subsurface within, and below the poorly exposed Paleoproterozoic Yerrida Basin in central Western Australia. Understanding the structure of a region is important as key features indicating past geodynamic processes and tectonic activity can be revealed. However, in stable, post-depositional tectonic settings only the younger sedimentary units tend to be widely exposed rendering direct observation of basement and intrusive rocks impossible. Geophysical imaging and modelling can reveal the structure of a region under cover. High amplitude density anomalies around the basin cannot be reconciled with current geological knowledge in the case presented here. The density anomalies infer an abundance of buried and high-density material that is not indicated by the surface geology. A hypothetical causative source for the high-density anomalies is considered to be intrusion and extrusion of volcanic mafic rocks during rifting of the basin. The simplest and plausible stratigraphic attribution of these interpreted mafic rocks is to the Killara Formation within the Mooloogool Group. However, geochemistry reveals that the Killara Formation is not the only host to mafic rocks within the region. Mafic rocks present in the Juderina Formation have largely been ignored in previous descriptions of Yerrida Basin magmatism and results indicate that they may be far more substantial than once thought. Sulphur isotopic data indicates no Archean signature to the mafic rocks, a somewhat surprising result given the basement to the Basin is Archean Yilgarn Craton. It is proposed the mafic rocks were sourced from vents located to the north along the Goodin Fault or under the Bryah sub-basin and Padbury Basins. The conclusion is that the formation of the Yerrida Basin involves a geodynamic history more complex than previously thought. The utility to the approach described here is examined for application to cratonic sag-basin environments. This result highlights the value in geophysics and geochemistry to reveal complexity in the earlier geodynamic evolution of the basin that may be indiscernible from surface geology, but may have high importance for the tectonic development of the region and its mineral resources.

Fig. 1.