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Solid Earth Discussions

Interactive comment on "In situ hydromechanical responses during well drilling recorded by distributed fiber-optic strain sensing" *by* Yi Zhang et al.

Anonymous Referee #1

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This manuscript documents a quite interesting set of observations of localized deformation during shallow drilling, made with an exciting new fiber optic technology for distributed deformation sensing (based on wave scattering). That there are strains generated in the layered rock system during drilling is, I think, to be expected, but it's exciting to see this demonstrated with relatively high fidelity. I was hoping for some discussion on the frequency response at very long timescales, which would help us understand the general limitations of signal detection with DSS, but perhaps this is well beyond the scope of such a short paper.

In terms of how that deformation informs the local permeability structure, I am reluctant

to accept the results from the modeling performed here as a definitive demonstration for two main reasons:

First, the authors glance off the strong possibility of bias from an unmodeled skin effect, even though this is a known source of permeability heterogeneity; thus, they simply haven't tested whether the estimates they've obtained (or the variability between the two sampling locations) are representative of the layered system and not just related to wellbore damage and mud infiltration.

Second, it is perplexing why the authors convert the strain signals to "pressure" in order to use simplistic radial flow models. Unless the timescale of the signal is so short as to cause the system to respond like an undrained medium, strain is not simply proportional to pressure in a fully coupled poroelastic medium (not just the one way coupling they mention). This begs the question: what does this approach offer aside from introducing a whole new set of assumptions that may not hold at such a fine scale? Of course there are very simple yet powerful models of the deformation response in a poroelastic medium that could be used (e.g., Rudnicki, 1986, https://doi.org/10.1016/0167-6636(86)90042-6); using them would permit a way to model strains directly and also remark on the distribution of pore pressure changes. A more sophisticated to replicate the apparent effect of layer contrasts is also warranted.

So, overall the modeling is simply not compelling, which is a disservice to the interesting signals seen in the fiber optic records.

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