Solid Earth Discuss.,
https://doi.org/10.5194/se-2019-151-RC1, 2019

Solid Earth Discussions

Interactive comment on "Characteristics of a fracture network surrounding a hydrothermally altered shear zone from geophysical borehole logs" *by* Eva Caspari et al.

Anonymous Referee #1

Received and published: 8 December 2019

The manuscript entitled " Characteristics of a fracture network surrounding a hydrothermally altered shear zone from geophysical borehole logs" is a good example of analysis of borehole geophysical data and the physical properties of the crystalline rocks. The manuscript clearly explains the method to identify the fractures zones, porosity and in-out flow zones. The manuscript is pleasant to read, although some paragraphs in the "results section" better fit in a "discussion section". However, I found the the discussion part a bit light. This paper has the potential to be very interesting and useful beyond the method of linking fractures to wireline logs. Therefore, I make a few suggestion to increase the interest of the paper.

Printer-friendly version

Discussion paper

Offering to provide data on request to author is insufficient. Please provide the data used for the manuscript in a data repository, or at least as supplementary material. My issues are few and can likely be clarified by the authors in a response and moderate revisions.

Major comments: 1- What are the implications of this fracture network for the system? maybe as far as petrothermal reservoirs and exploitable natural hydrothermal systems, as mentioned in the abstract and in the introduction? In the discussion part the authors do not discuss the implications of their study, in particular the importance of the results on the fluid flow in/out of the borehole. 2- the authors used the electrical resistivity. But it is not clear if they performed this measurement with the dual laterolog (DLL) or another tool? If so please add in the figure both resistivity curves DLL depth and DLL-shallow and their ratio. or explain why they are not used. This measurement can help to distinguish the invade fluid zones. 3- The authors mentioned often in the manuscript the aperture of the fractures to support their interpretation. Unfortunately, no table or plot with this information are present in the manuscript. I suggest the author to add a table to list the number of fractures, their geometry (strike, dip) and the aperture. 4- The authors use the term borehole breakout to describe an zone intensely fractured. In literature borehole breakouts are an important indicator of horizontal stress orientation and are stress-induced enlargements of the wellbore cross-section (Bell and Gough, 1979) and occurs when the stresses around the borehole exceed that required to cause compressive failure of the borehole wall (Zoback et al., 1985; Bell, 1990). Here the term borehole breakouts is misleading, please change this term with enlargements, or similar. 5- All the figures are very small. Sometimes it is very difficult to read the words, the legend and distinguish the symbols.

Minor comments: Lines 97-99: Between 75 m and 95 m, there is a good match between the caliper (increasing), neutron-neutron (decreasing) and energy (deacresing) in the D zone, whereas the BHR shows a deacresing already at 70 m. How to explain this difference among the measurements? Line 197: Please delete one bracket

(2018)). Lines 201-202: Figure 4d on the left-hand shows only an interval related to a single area of cataclasite while in the text three areas of cataclasite are mentioned. Could you add the OTV images and core image boxes of the other two cataclasite zones as additional material? Line 208: Does this mean that this interval is intact or more compact, and no fracture is present? Line 212: Please add Fig4d (middle) Line 214: please indicate in the Fig4d (middle) of OTV the fractures and please specify the aperture (mm) of the fractures. Line 216: I suggest you use enlargements or similar instead of borehole breakouts, see my comment #4 Line 222: please add the figure 4d right-hand. Line 226: Were the resistivity measurements performed with the dual laterolog tool? If so, can you add the deep and shallow resistivity curves, including the ratio of depth to shallow, so as to highlight the invade zone or not? Line 231: please use enlargements, or similar instead of breakout. Line 330: please add reference(s) Line 412: It seems that these two zones, above and below 95 m, are hydraulically distinct. Is there an clay interval that separates the two reservoirs, or at least an aquiclude? Do you have some geological evidences Line 416: please specify the aperture of the fractures (mm) and how many fractures are characterized by large apertures Line 421: Could you see this variation using the DLLdeep and DLLshallow and their ratio (deep/shallow)? Line 432: It means you have two separate water reservoirs. A shallow one, above 95 m where the meteoric water can penetrate into the formation through the fractures and change the salinity. Below 95 m a "deep" water reservoir with a different salinity content is present. What about the chemical composition of the water of both reservoirs? Are there any studies on the subject? Why are these two separated reservoirs, are there geological evidences of an aquiclude of an impermeable layer? what about the deep and shallow resistivity could you help you to identify the two reservoirs? Line 435: A dot is missing after Fig. 12

FIGURES: Fig 1. Please add the lithology and explain the the different colors along the borehole. Add a relative scale (zero on top of the borehole and the altitude at which the borehole is located.

Fig 3. The blue circles around the red dots and squares are not visible. Please change. The figure is very small, I needed a large magnification to see the symbols and writings. Fig. 4a,b,c: Please move the legend, it covers the energy deficit color scale and the data of Figure 4c. Add the meaning of the grey and orange bands. Please add on the legend the scale of the aperture of the fractures. Please add in the fig 4a both calipers (C1-3 and C2-4). This will allow the reader to see immediately if the whole interval is washout (e.g. C1-3 & C2-4»bit size) or breakout (eg. C1-3>C2-4 and vice versa). Insert in the figure caption the value of the bit-size of the borehole and also in the fig. 4a, maybe as black dashed line.

Fig. 4d: The orientation of the OTV images is missing. Please add. I also suggest that you indicate structures such as fractures, bedding planes, etc. in the OTV images including the aperture of the fractures in mm. The OTV image refers to a longer interval than the core boxes. Please modify the figure. I also suggest that you provide a table that includes the fractures (depth, strike and dip) including the opening in mm (when it is possible). It is quite difficult to see these parameters (number of fractures, orientation and aperture) in the figure 4c

Fig. 5: Please change the color of the titles caliper, P-wave velocity, , neutron-neutron, BHR and resistivity in green as the green curves. Please move the legend from the resistivity log.

Fig. 7: Why at around 46-49 mm, the ductile deformation intensity is high but the fractures/m curve indicates high number of fractures? Should not be this interval brittle? Fig. 8: I like very much this figure, but the vectors of ECOP and DOP are very small. Please enlarge the figure

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2019-151/se-2019-151-RC1-supplement.pdf

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2019-151, 2019.