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Executive Editor
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Dear Editors:

I sincerely thank you for your suggestions. My answers to your questions are listed below.

1. 10nV/sqrt (Hz) is stated. This is a potential not a field strength, while the discussion is about electric fields. Please explain why this is chosen, or correct.

Response: The dipole length between the two electrodes was 50 cm, so the electric field noise floor was approximately 20 $nV \cdot m^{-1}/\sqrt{Hz}$ at 1 kHz. As suggested, the text has been revised as follows: "The receiver achieved a magnetic field noise of less than 6 pT/√Hz at 1 kHz, and the electric field noise floor was approximately 20 nV·m-1/√Hz at 1 kHz."

2. The expression "fluxgate" is a short form derived from "fluxgate magnetometer". Please use the full form at least the first time this is used. (in the abstract and in the main text)

Response: As suggested, the expression "fluxgate" has been defined in the first instance of its occurrence in the revised manuscript.

3. "Results of our experiments support the claim that high-quality CSEM signals can be obtained using this new borehole electromagnetic receiver, and that the electric field component exhibits sufficient advantages for measuring the vertical component of the electric field." – This is not discussed, please describe what is sufficient and for what purpose. What is "high-quality CSEM signals"? What is "sufficient advantage"?

Response: "High-quality CSEM signals" represents a signal with a high signal-to-noise ratio. "Sufficient advantage" indicates that the vertical component can measure both electric and magnetic fields.

4. Last sentence in paragraph 1 states "The receiver realizes high-precision acquisition of the three-axis magnetic field components and the vertical electric field component in the borehole, with broad bandwidth and large dynamic ranges, and stores and transmits status data that contains the root mean squares (RMS) of the magnetic and electric field signals, attitude, orientation, depth, and temperature." What is the difference between attitude and orientation?

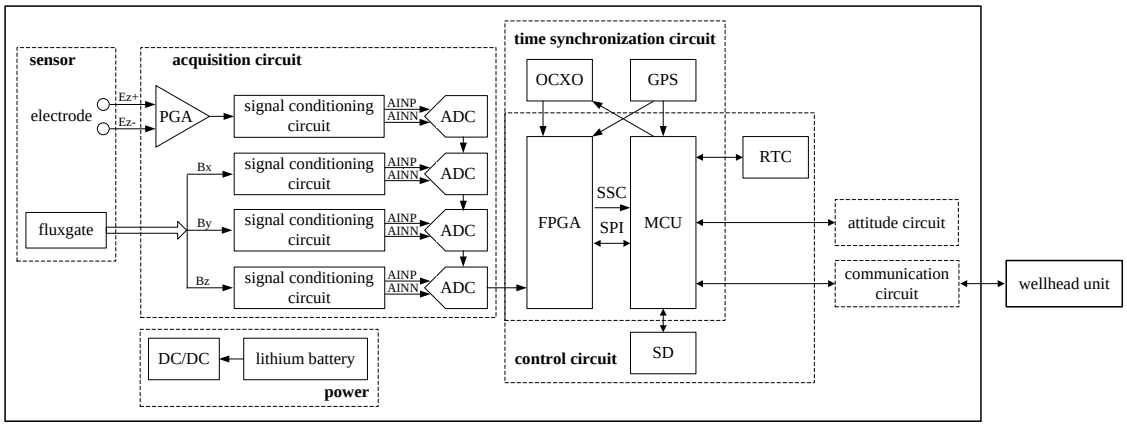
Response: The attitude information includes pitch, roll, and yaw angles, and the orientation generally means yaw angles. As suggested, the text has been revised as follows: “The receiver ensures high-precision acquisition of the three-axis magnetic field components and the vertical electric field component in the borehole, with broad bandwidth and large dynamic ranges. It also stores and transmits status data that contains the root mean squares (RMS) of the magnetic and electric field signals, attitude, depth, and temperature.”

5. Paragraph2: It is stated “…. uses a global positioning system (GPS) and…” Please explain how (if) the GPS unit will work underground (in the borehole).

Response: The GPS unit synchronizes time between the borehole EMRs and the transmitter on the ground and then places it in the borehole.

6. Paragraph 2.2 “… four analog-to-digital converters (ADCs) are daisy-chained”. In Fig. 3 it appears that the ADCs are individually connected to the FPGA (in parallel) and not daisy-chained. Please correct either text or drawing.

Response: As advised, we have revised Figure 3 to read as follows:



7. Paragraph 2.4 “The current high-precision temperature-compensated crystal oscillator… “. This oscillator is not shown in the diagram. Before this only an OCXO has been discussed. Is this a second oscillator? Please explain. If there are two clocks, why is not the OCXO used as a master oscillator but only as a synchronisation device?

Response: Please note, in the revised manuscript, the following modifications have been made to the relevant sections: “The current oven-controlled crystal oscillator has a clock stability of 10-8 s s-1; testing revealed that the time error is less than 10 μs.” There is only one clock, which is an oven-controlled crystal oscillator (OCXO).

8. Paragraph 2.5 “In terrestrial studies…” All studies discussed here are

terrestrial studies. Supposedly you mean surface studies, or similar. Please correct.

Response: The text has been revised as follows: “In surface studies, the fluxgate can be placed in a specific direction on the ground; however, this is difficult to achieve in a borehole.”

9. Paragraph 3.1.3. Please explain why receiver nonlinearity was measured at DC while the real measurements will be made at AC.

Response: The non-linearity test is mainly to evaluate equipment performance. The non-linearity error will also influence the real measurements that will be made at AC.

10. Paragraph 3.2 and Fig 9. It is not clear how x, y, and z are oriented. Is Bz and Ez the vertical direction? If so, then it is clear that the Ez signal from the horizontally oriented transmitter is low. But the Bz should have a significant magnetic flied component. Why is this not the case? Which direction in the receiver is parallel to the transmit dipole A-B (where the current is injected)? That B field measurement should be low, not the vertical B Field. Please explain.

Response: Before placing the borehole EMR in the field test, Bz and Ez were in the vertical direction, but during the movement into the borehole, the borehole EMR attitude changed randomly. Based on your question, we checked the original data. Due to an oversight, the picture channel was incorrectly labeled, and I have made the necessary corrections in the resubmitted manuscript.

11. Fig.9 At what depth were the BH1 and BH2 instruments located?

Response: The BH1 and BH2 instruments were located approximately 5 m below the ground.

12. Fig.10. For all panels: What is time? mm:ss or hh:mm? Y-axis is labelled as Frequency, Hy or Frequency, Ez and similar. Better write Frequency, Hz The component is already given under each panel.

Response: The form of the time is hh:mm. The Y-axis label has been unified with the component given under each panel.

13. It is stated that 41 frequency steps are made. That many cannot be seen. It appears that the duration of the weak high frequency steps are very short, while the duration of the strong low frequency steps are much longer. Why is this? It seems that selecting the opposite would be more logical.

Response: The reason for these durations is because FFT analysis requires multiple waveform cycles to ensure accurate calculations. Thus, the durations of the weak high-

frequency steps are very short, whereas the durations of the strong low-frequency steps are significantly longer.

14. Fig 10. Panels are not well aligned, please organise such that corresponding panels come above each other (or next to each other), f. ex.:
Bx1 By1 Ez1
Bx2 By2 Ez2
or:
Bx1 Bx2
By1 By2
Ez1 Ez2

Response: Thank you for your suggestion. As advised, we have revised Figure 10 in the manuscript.

15. The caption states: "The scale in the figures is provided in dB; however, the data in the figure is calculated with the formula 10logX." Then the scale is not dB as dB always refers to a ratio of power. What is the unit of X? i.e. what is the reference in the 10LogX ? V/m for E and nT for B?

Response: X represents the following formula:

$$X = |FFT[x(n) \cdot \omega(n)]|^2,$$

where $x(n)$ is the time series data, $\omega(n)$ is the window function. The result of the formula (10Log *X*)calculation is the power spectrum.

16. Paragraph 3 (end): It is stated: "We observed that our system has obvious advantages in bandwidth, where the highest frequency can reach 10 kHz". It is not clear why this is an advantage. In Fig 10 one can see that no signals exist above a few hundred Hz. Please explain. The following sentence has the word "sampling" repeated, making the sentence difficult to understand. (typo?)

Response: In the field test, the high-frequency signal attenuates more severely, so no signals exist above a few hundred Hz. Additionally, the text has been revised as follows. "The variable sampling rate that is dependent on the transmission frequency is also a key point."

17. Paragraph 4. It is stated:" According to the measurement requirements of the borehole surface electromagnetic method… "Such requirements have not been discussed or even mentioned in this paper. Thus, no conclusions can be drawn on that. Please add a discussion in the main text or remove this sentence. As in the abstract, here again the Electric field is given as a potential (10 nV/sqrt(Hz)). Please correct.

Response: As advised, we have removed this sentence "According to the measurement

requirements of the borehole surface electromagnetic method…". The test has been defined in the revised manuscript as follows: "Our design employed a low-noise data collector to achieve a magnetic field noise less than 6 pT/ √ Hz at 1 kHz, and the electric field noise floor was approximately 20 nV·m-1/ √ Hz at 1 kHz."

We sincerely hope that all our responses and clarifications are to your satisfaction. Thank you for your consideration. I look forward to hearing from you.

Sincerely,
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