Reply to the reviewer 2#

We are very grateful to comments of reviewer 2#, and we have carefully read and considered the comments, and these comments are important for improving the quality of this manuscript. Based on these comments, we have made carefully modification and proofreading on the manuscript, the detail modifications are mainly focus on the description of measurement principle using FBG strain sensor, explanations of correction factors K_i, and the factors affect the stress inversion results.

Please see the detailed revision, and the modified parts are marked in red in the revised manuscript. Thank you very much for your suggestion and consideration, and we look forward to hearing from you.

Best regards,

Yimin Liu, Zhengyang Hou and Pu wang.

Detailed revision for comments of reviewer 1#

Q1: According to second paragraph and third paragraph on page 106 in Ref. [A], the six resistance strain gauges are connected to through the spring leads to the 6-channel plug. Meanwhile, the six resistance strain gauges install and stretch along the axis of the hollow inclusion shell. In this manuscript, it may be not accurate that calculating the stress tensor by any six FBGs with different installation directions.

Reply: Thanks for your suggestion, I have carefully read Ref. [A]. Leeman uses the same theory as this paper, but the measurement method and the inversion formula is little different. In figure 1, he measured the stress in the borehole bottom by the stress gauge in angle of 45° at the bottom of the hole in three directions, which is indeed convenient for calculation. In fact, the stress tensor inversion at least needs three direction measurement and have some errors, this article adopts the borehole wall measurements, there are the three directions 45°(like Leeman) to each other and the three directions 60° to each other(shown in Figure 5 and Table 6 in my manuscript), so that we can through multiple groups of measuring results inversion average as much as possible to reduce the error of the results. We maybe try to implement more directions to make the inversion results more accurate in the future research. We also add the C.S.I.R. strain cell(Leeman, 1964) in literature review in line 37 and 38.

Ref [A]. Leeman E. R. 1964. The measurement of stress in rock: Part II: Borehole rock stress measuring instruments [J]. Journal of the Southern African Institute of Mining and Metallurgy, 65(2): 254-284.

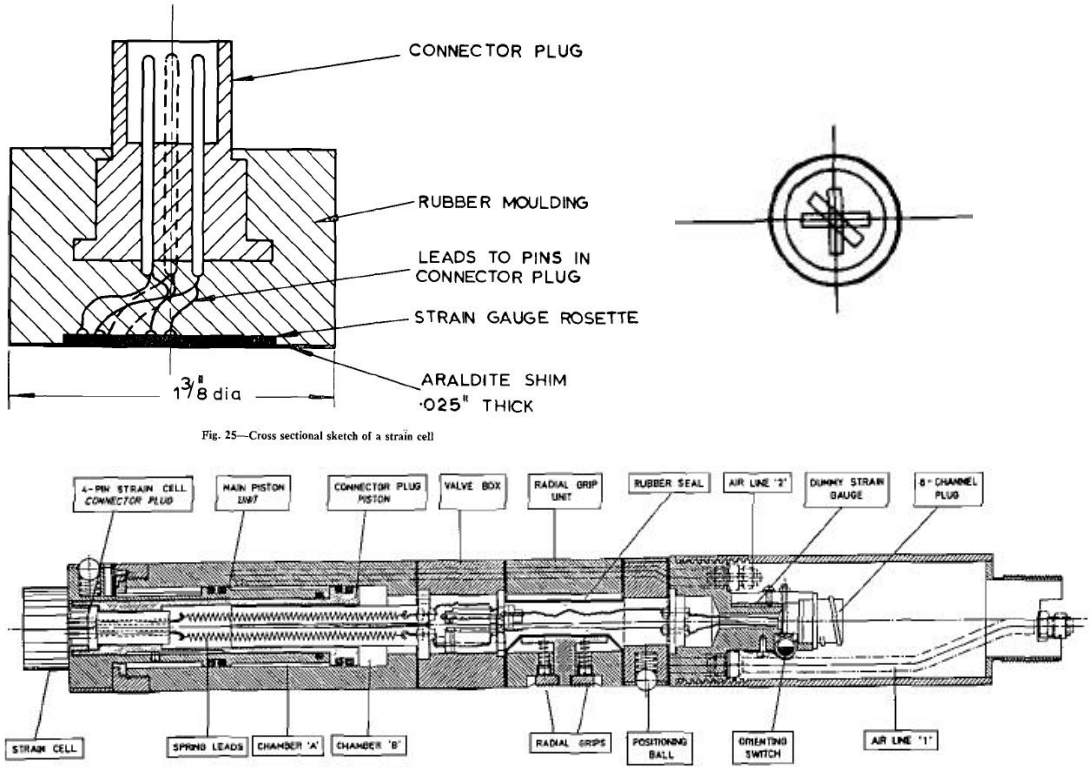

Fig 1 Cross sectional sketch of a strain cell

Q2: The Ki in Equation(9) includes many expression formulas as well as affects the stress inversion results, the authors should indicate the main factor, such as the elastic properties of solid epoxy.(comment 2)

Reply: As the reviewer said the K_1, K_2, K_3 and K_4 in Equation(9) affect the stress inversion results. The correction factors K_1, K_2, K_3 and K_4, are mainly affected by the elastic modulus and Poisson's ratio of the surrounding rock and the epoxy resin(material of the hollow inclusion), shape of the hollow inclusion and borehole size.Therefore, the K factors are variable, and which need to be recalculated according to different working conditions before each overcoring test. Because there are many calculation formulas of the K factors, so they are not listed in the manuscript, and which can be found in the reference(Cai, 2000). The modified parts are marked in red from line 182 to line 185 in Section 3.2.

Q3: As the solid epoxy FBG probes have different elastic properties to the rock，it may be not accurate that calculating the internal strain through the surface strain measured by the external FBG sensors. (comment 3)

Reply: This comment is about the measurement principle of the hollow inclusion cell, and the comment can be associated with comment 2. As a measuring element, FBG sensor is essentially the same as the traditional resistance strain gauge, therefore, to improve the measurement accuracy of hollow inclusion cell, the four K factors are calculated to reduce the influence of elastic modulus, Poisson's ratio of different media, and shape of the inclusion and borehole on the calculation results. Therefore,

the influence of strain transfer effect can be greatly reduced, which is caused by he elastic properties of different media, such as the surrounding rock and epoxy resin.The modified parts are marked in red from line 185 to line 187 in Section 3.2.