Response to the 2nd anonymous reviewer:

This study performed experimental measurements on the electrical conductivities of gabbroic melt with various water contents at high temperature and pressure. The results show the gradual increase of electrical conductivity of gabbroic melt with increasing water content and decreasing pressure. This work has a potential implication for the conductivity anomalies in the Mohns ridge of the Arctic ocean. I would recommend publication after some improvements.

Thanks for your valuable and constructive comments and advisements, which are greatly helping us to improve and enhance our manuscript. In the revised manuscript, all of these above-mentioned issues from the 2nd anonymous reviewers have already been supplemented and modified, accordingly. Each correspondent revised counterpart is detailedly described sentence by sentence, as follows.

1. Can the authors show some micrographs of the products?

Thanks for your precious and valuable comments and suggestions. To observe the macroscopic and microscopic structure of the products after electrical conductivity measurements, we perform the optical microscope observation and the back-scattered electron images acquired with a scanning electron microscope for the recovered anhydrous gabbroic melt and hydrous gabbroic melt with a water content of 2.59 wt%.
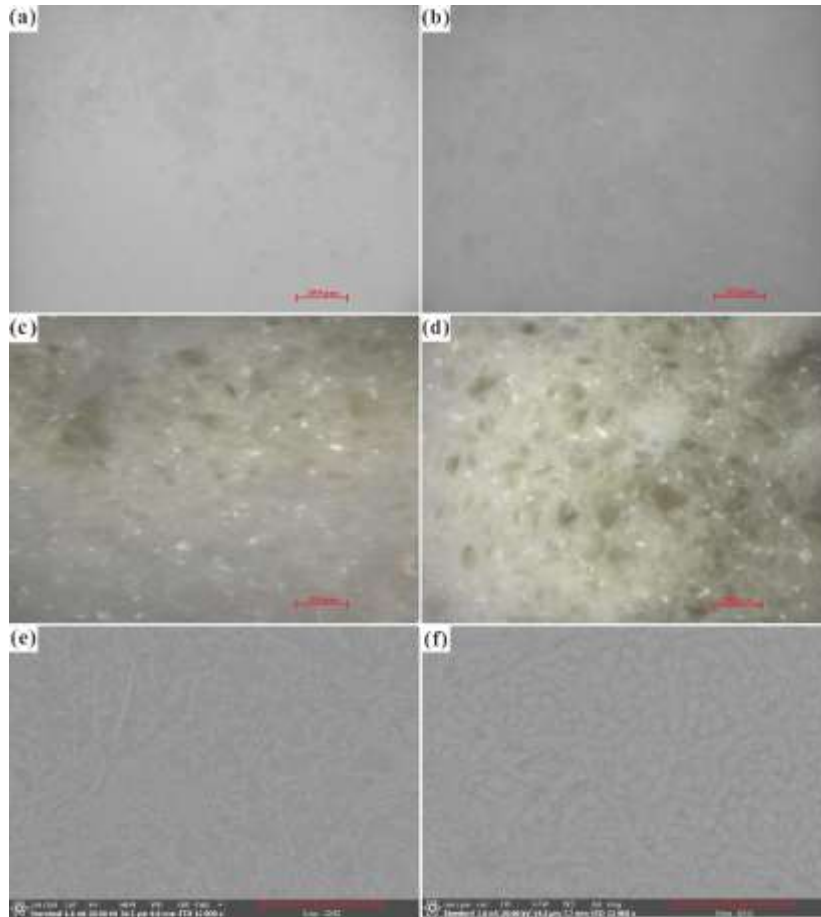
Figure 1. Representative microstructural observations of recovered anhydrous and hydrous gabbroic melts after the electrical conductivity measurements. In here, (a) and (c) are standing for the plane-polarized and cross-polarized reflected microscopy images for the recovered anhydrous sample, respectively; (b) and (d) are standing for the plane-polarized and cross-polarized reflected microscopy images for the recovered hydrous sample with a water content of 2.59 wt%, respectively. The back-scattered electron images were acquired with a scanning electron microscope for the recovered anhydrous (e) and hydrous (f) gabbroic melts with a water content of 2.59 wt%.

2. In figure 8, there are two small errors. For example, 0.3 in the vertical coordinate should be -0.3; the electrical conductivity value of the anhydrous basaltic melt from Ni et al., 2011 (log δ~0.1) in this figure is much higher than the extrapolation from the reference. Please check the value and correct it.

Thanks for your valuable and professional comments and suggestions. According

to your valuable advisement, we have already checked and modified these two errors in the Figure 8 of the revised manuscript. I doubly checked the original electrical conductivity results on the anhydrous basaltic melts to be reported by Ni et al. (2011) very conscientiously. This mistake has already been corrected in the revised edition.

3. In Table 3, the derived value for activation volume is negative, which means that the electrical conductivity increases with increasing pressure. This contrasts to the fact that electrical conductivity of gabbroic melt decreases with increasing pressure (Figure 5). Can the authors explain this?

Thanks for your precious and professional comments. The influence of pressure on the electrical conductivity of gabbroic melt can be depicted as,

$$\sigma = \sigma_0 \exp(-\Delta H/kT) = A_0(1-BP) \exp[-\frac{\Delta U + P\Delta V}{kT}]$$

In here, σ_0 stands for the pre–exponential factor (S m^{-1}), k stands for the Boltzmann constant (eV K^{-1}), T stands for the absolute temperature (K), ΔU stand for the activation energy (eV), ΔV stands for the activation volume (cm^3 mole^{-1}), and P stands for pressure (GPa), respectively. The pre–exponential factor (σ_0) and activation enthalpy (ΔH) of pressure dependence can be illustrated as the relations of $\sigma_0=A_0(1-BP)$ and $\Delta H=\Delta U+P\Delta V$.

For the derived value for activation volume (ΔU) is negative, the corresponding activation enthalpy (ΔH) reduced slightly from 0.85 eV to 0.81 eV with the rise of pressure from 1.0 GPa to 3.0 GPa, as shown in Table 2. And the exp($-\Delta H/kT$) increased slightly with increasing pressure, correspondingly. Meanwhile, the pre–exponential factor (σ_0) had significant reductions with increasing pressure. When the pressure raised from 1.0 GPa to 3.0 GPa, the pre–exponential factor (σ_0) decreased greatly from 3020

S/m to 617 S/m. According to Arrhenius relation, both of the pre–exponential factor (σ_0) and activation volume (ΔV) made changes and affect the electrical conductivity of gabbroic melt as the experimental pressure increased. And the reduction degree of the pre–exponential factor (σ_0) was much more significant than the increase of the $\exp(-\Delta H/kT)$. And thus, the activation volume (ΔV) cannot directly indicate the pressure dependence of the electrical conductivity of gabbroic melt, the variations of activation volume (ΔV) and pre-exponential factor (σ_0) need to be considered comprehensively.

4. In line 354-356, dacitic melt is from Laumonier et al., 2015, and andesitic melt is from Guo et al., 2017. Please correct it.

Thanks for your important and precious comments. According to your valuable advisement, we have already modified "dacitic melt reported by Guo et al. (2017), the 20.41 wt% of andesitic melt reported by Laumonier et al. (2015)" to "dacitic melt reported by Laumonier et al. (2015), the 20.41 wt% of andesitic melt reported by Guo et al. (2017)" in the revised manuscript.

5. Is it appropriate to apply gabbroic melt with ~8 wt% H_2O to the Mohns ridge of the Arctic ocean since the partial melting of mid-ocean ridge is usually water-poor?

Thanks for your precious and valuable comments and suggestions. For the representative Mohns ridge of the Arctic Ocean, previously available petrological and geochemical results have already revealed that the range of water content for the crustal rock and melt in the Mohns ridge is ~0.25–2.64 wt% (Neumann, E. R. and Schilling, J. G. Petrology of basalts from the Mohns–Knipovich Ridge; the Norwegian–Greenland Sea. *Contrib. Mineral. Petrol.* **1984**, *85*, 209–223; Poreda, R., Schilling, J. G., and Craig, H. Helium and hydrogen isotopes in ocean–ridge basalts north and south of Iceland.

Earth Planet. *Sci*. *Lett*. 1986, *78*, 1–17). It is really a little high to apply gabbroic melt with ~8 wt% H_2O to the Mohns ridge of the Arctic ocean. According to your valuable advisement, we have already modified the relative discussions in the revised manuscript.