Author's response

Response to the editor of Professor Andrea Di Muro:

Comments to the author:

Dear Dr. Wang, thank you for your answer to the minor comments of the reviewers; please find here below two further comments about the measurement of dissolved water content and its influence on the NBO/T calculation.

Issue 1: *In figure 2, "absorption coefficients" of the 3500 cm-1 band of glasses spanning a wide range of water contents look identical, while significant differences are shown in the bands related to OH and H_2Om species. Moreover, IR spectra are usually shown in terms of absorbance, which is expected to decrease from water-rich to water-poor samples. Please clarify this possible discrepancy and mention explicitly in the text how it is defined the (very high) absorption coefficient shown in the figure and why its unit is the cm-2.*

Thanks for your professional comments and suggestions. For the hydrous gabbroic melts, the signal of the fundamental stretching H_2O vibrational spectroscopy at the peak position of ~3530 cm^{-1} of hydroxyl band revealed to be oversaturated, which was similar to the previously obtained results on hydrous dacitic melts reported by Laumonier et al. (2015). Generally speaking, the absorbance of gabbroic melt in the water-bearing FTIR spectroscopy at the wavenumber of ~3530 cm^{-1} band is possibly related to the charge carrier species of hydrogen-related defects, such as hydroxyl (OH), free proton et al., which was similar to previously reported hydrous electrical

conductivity results on many nominally anhydrous minerals (Huang et al., 2005; Dai and Karato, 2009, 2014a; 2020). For water-rich samples, two obviously characteristic peaks were appeared at the correspondent wavenumbers of ~4500 cm^{-1} and ~5200 cm^{-1}, which were representing the hydroxyl band and molecular water band with an available over-saturated state for gabbroic melts, respectively (Stolper, 1982; Dixon et al., 1995; Guo et al., 2017). Thus, we make the integration at the wavenumber ranges of 3000–4000 cm^{-1} and 4000–5800 cm^{-1} for the anhydrous and hydrous samples to precisely determine the water content of gabbroic melts, respectively. The water content of gabbroic melt (C_{melt}) can be worked out by Beer–Lambert law,

$$C = \omega A/\varepsilon\rho d \tag{1}$$

$$C_{melt} = C_{OH}+C_{H_2O} \tag{2}$$

According to the Equs. 1 and 2, the water contents for three obtained hydrous gabbroic melts were calculated as 2.59 wt%, 5.92 wt% and 8.32 wt% at the wavenumber range from 4000 cm^{-1} to 5800 cm^{-1}, respectively.

Indeed, just as pointed out by the editor of Professor Andrea Di Muro, the absorbance absorption of gabbroic melts in the water-rich FTIR spectroscopy at the wavenumber of ~3530 cm^{-1} band spanning a wide range of water contents look identical. From Figure 2, it is clear that the absorbance absorption of gabbroic melts in the water-rich FTIR spectroscopy at the wavenumber of ~3530 cm^{-1} band spanning a wide range of water contents look identical. Obviously, the intensity of FT–IR spectra will decrease from water-rich (i.e. its correspondent water content is higher than 2.59 wt%) to water-poor (i.e. anhydrous) gabbroic melts. In addition, the unit of vertical

coordinate (y-axis) for a series of FTIR spectra in Figure 2 should be cm^{-1}. As usual, the absorbance of FTIR spectra are one parameter without any consideration of unit, and whereas, the unit of absorption coefficient (cm^{-1}) in our present studies precisely consider the sample thickness. A detailed explanation has already been supplemented in the counterpart of "2.3 Determination of the water content" context in the revised manuscript.

Issue 2: In figure 8, on one side the NBO/T is show identical for the glasses analyses in this study, in spite of their large range in H_2O; however, the dissolution of water changes the NBO/T; is the NBO/T value reported in this figure a 'dry' value? Furthermore, the other data are reported for exactly the same dissolved water contents explored in this study, is that correct? NBO/T values could be added in Table 1 for instance.

Thanks for your constructive and valuable comments and suggestions. Indeed, just as described the editor of Professor Andrea Di Muro, our initial calculating NBO/T results from the EPMA data did not involve the influence of dissolution on the water changes the NBO/T values, because all of previously available reported results on the electrical conductivity of other representative calc–alkaline igneous rock melts in the recent years (Ni et al., 2011; Laumonier et al., 2015; Guo et al., 2017; Chen et al., 2018) did not consider the influence of dissolution on the water changes under different water contents, i.e. the dry calc–alkaline igneous rock melts were selected. According to your constructive and enlightened comments and suggestions, we have already

supplemented the NBO/T values for each anhydrous and hydrous gabbroic melts in the Table 1 of revised manuscript. In order to compare the relationship between the electrical conductivity and NBO/T value on four calc–alkaline igneous rock melts (i.e. dacitic melt, basaltic melt, andesitic melt and gabbroic melt), the dry NBO/T values for four calc–alkaline igneous rock melts were chosen because there is no any related information from all of other previously available reported results on the dissolution on the water changes under different water contents during the electrical conductivity of other representative calc–alkaline igneous rock melts (Ni et al., 2011; Laumonier et al., 2015; Guo et al., 2017; Chen et al., 2018). In order to make an efficient comparison of the electrical conductivity between other representative calc–alkaline igneous rock melts (Ni et al., 2011; Laumonier et al., 2015; Guo et al., 2017; Chen et al., 2018) and ours, we can select the NBO/T value under dry condition rather than consider the effect of dissolution under different water contents, as detailedly illustrated in Figure 8. In case of non-consideration of dissolution effect, the relationship between the logarithmic electrical conductivity of gabbroic melts with four different water contents as a function of reciprocal temperature at conditions of 873–1373 K and 1.0 GPa has already been presented in the Figure 6.

Response to the 2nd anonymous reviewer:

In this revision, the authors provide point-by-point response, which gives reasonable explanations. But there is still one error for citing the electrical conductivity data from Ni et al. (2011) in Fig. 8. The manuscript can be accepted after the correction. In Ni et al. (2011), the experimental data did not cover the temperature range below 1200°C. Therefore, it needs to extrapolate to 1100°C from the equation (3) in the reference. In Ni et al. (2011), the calculated electrical conductivity log (S/ at 2 GPa, 1373 K would be as follows:

H_2O (wt%)	0	2.59	5.92
	−1.63	−0.18	0.57

The values cited in Figure 8 in the revision are different from the extrapolation in Ni et al. (2011), which need to be corrected.

Thanks for your precious and valuable comments and suggestions. Indeed, the experimental data did not cover the temperature range below 1200°C in Ni et al. (2011). And it needs to extrapolate to 1100°C from the equation (3) in the reference. According to the extrapolation in Ni et al. (2011) provided by the 2nd anonymous reviewer, the cited values in Figure 8 have been corrected carefully in the revised manuscript, accordingly.

With Best Regards

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