**Supplementary 5: ESM\_5.**

METHODOLOGICAL FEATURES OF THE H2O CONTENT ESTIMATION IN TRAPPED MELTS BY VARIOUS METHODS

Olivine-hosted melt inclusions udergoing various post-entrapment re-equilibration processes. It requires correcting of values measured by instrumental methods for water content and temperature estimation.

Post-entrapment changes of olivine-hosted melt inclusions, that affect to result of their analysis:

1. re-equilibration exchange of Mg and Fe between inclusions and host-olivine

2. Si-loss from melt inclusions

3. H-loss from melt inclusions, leading to the oxidation of Fe

4. crystallization of a material related to the host mineral on the inclusion walls.

To take into consideration all these phenomena and to obtain the most reliable estimates of temperatures and water contents in trapped melts, it is necessary to know the initial FeO content in the melt (to estimate it by an independent method) and to create a model that would take into account the simultaneity (parallelism) of all the above processes. If the first – (estimation of the initial FeO content) can be determined by a very laborious method of construction of diffusion profiles, but in most cases is subject to assumptions and can be debatable, the second is currently implemented in (Portnyagin et al., 2019) and has several estimation assumptions, which cannot always be analytically estimated with sufficient accuracy.

In this reason, our estimates of water content and trapping temperature are based on methodological approaches (Sobolev et al., 2016; Nazarova et al., 2017; Almeev et al., 2007), which we used earlier in (Nizametdinov et al., 2019а).

We use the estimates made using new and alternative approaches (Portnyagin et al., 2019, accounting for diffusive loss of Si and H; Gavrilenko et al., 2016, using the dependence of the Ca distribution factor between olivine and melt on water content) to determine the possible effect of accounting for these factors on the values we present.

Using the approaches outlined in (Sobolev et al., 2016; Nazarova et al., 2017; Almeev et al., 2007), it was determined that the water content of the magmas averaged 5 to 5.5 wt % and could reach 7 wt % with a subsequent decrease with evolution (Fig. 16; Supplementary 1, ESM\_3.xls). These estimates are given without taking into account the diffusive loss of water and silicon inclusions in the melt. However, if these factors are taken into account, using the methodology of (Portnyagin et al., 2019), the equilibrium temperatures in the dry magma according to (Ford et al., 1993) would be 35–50°C higher. This is due to the fact that the correction increases the MgO content in the reconstructed melt composition (Supplementary 1, ESM\_3.xls). At the same time, the average calculated water content of the melts according to the methodology we used increases up to 7.5 wt.% and can reach 10 wt.%. (Fig. 16; Supplementary 1, ESM\_2.xls).

However, the authors of (Portnyagin et al., 2019) propose a different approach to estimate the diffusive loss of water from the trapped melts. Its use allows us to conclude that the water content in the trapped melts of the Korotyshka crater could reach 6 wt % and in the Vostok one inclusions 6.4 wt % (Fig. 16; Supplementary 1, ESM\_3.xls), with average contents of 4.7 and 5.5 wt %, respectively (Tabl. 4).

Another hygrometer for the basic rocks is the dependence of the CaO distribution coefficient between the melt and olivine on the water content (Gavrilenko et al., 2016). Using the data on the CaO content in the reconstructed trapped melts without considering the potential water content (dry melts), the water content reaches 6.3 and 5.5 wt % for the basalts of the Korotyshka and Vostok craters, respectively. If we take into account the diffusive loss of SiO2 and water, as suggested in (Portnyagin et al., 2019), the average H2O contents in the initial melts of Vostok and Korotyshka craters are 3.1–3.2 wt %, and the maximum contents do not exceed 4 wt % (Fig. 16; Supplementary 1, ESM\_3.xls), which is associated with a decrease in CaO during reconstruction of SiO2 and water contents.

The data of independent estimates of water content, in most cases (Fig. 16), agree well with each other and clarify and confirm the previously obtained results about the potential high water content of the source melts feeding the Lesser Brat volcano (Nizametdinov et al., 2019а).

The use of combined techniques (mixing different methods of reconstructing the trapped composition) yields either higher or markedly lower values (Fig. 16).

**Fig. 16. Water content in the trapped melts calculated by different methods.**

1 – Reconstruction of H-Si loss (Portnyagin et al., 2019) followed by reconstruction of the post-entrapment Fe-Mg exchange using Petrolog 3.1 software.

2 – Water content determined from the difference between "dry" and "real" temperatures (Almeev et al., 2007). "Dry" temperature was calculated according to (Ford et al., 1993) after reconstruction of Fe-Mg exchange using the Petrolog 3.1 software.

3 – Water content determined from the difference of "dry" and "real" temperatures (Almeev et al., 2007). "Dry" temperature calculated from (Ford et al., 1993) after reconstruction of H-Si loss (Portnyagin et al., 2019) followed by reconstructions of post-entrapment Fe-Mg exchange using Petrolog 3.1.

4 – Water content determined by the method (Gavrilenko et al., 2016) after reconstructing the Fe-Mg exchange using Petrolog 3.1 software.

5 – Water content determined by the method from (Gavrilenko et al., 2016) after reconstruction of H-Si loss (Portnyagin et al., 2019) with subsequent reconstruction of the post-entrapment Fe-Mg exchange using Petrolog 3.1.