MANTLE MELTING CONDITIONS UNDER THE EASTERN VOLCANIC FRONT
OF KAMCHATKA ESTIMATED FROM MELT INCLUSIONS IN OLIVINE

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Introduction
Melt inclusions in high-Mg olivine provide unique constraints on the composition and origin of initially volatile-rich parental subduction-related magmas. Here we present new data on the composition of olivine phenocrysts (Fo78-91), melt inclusions and inclusions of chromium spinel in olivine from high Mg# basalts of the Eastern Volcanic Front in Kamchatka (Gorely, Avachinsky, Karymsky volcanoes and Zavartisky cone).

Geological setting
Kamchatka is an active volcanic region related to the subduction of the Pacific plate beneath the Eurasian continental margin (Gorbatov et al., 1997). The rocks studied were mostly lavas and volcanic bombs, which cooled slowly after eruption, and inclusions in olivine were significantly dehydrated.

Sample preparation
Samples were crushed and olivine grains were handpicked under microscope. In order to melt daughter phases in partly crystallized inclusions, olivine grains were heated up to 1300°C in a CO₂–H₂ gas mixture and Ni–NiO oxygen buffer, rapidly quenched in water and mounted in epoxy.

Analytical methods
EPMA - major and trace elements in the Melt inclusions, Olivine and Spinel (Geomar, Kiel, Germany)
LA-ICP-MS - trace elements in Melt inclusions and Olivine (IG CAU, Kiel, Germany)
SIMS - contents of trace elements and H₂O in glasses of melt inclusions (Yaroslav, Russia)
Raman Spectroscopy - H₂O contents in glasses of melt inclusions (MSU, Moscow, Russia)

Conditions of Primary Magma Formation
• The data obtained by us and in other recent studies (Mironov et al., 2015; Kamenetsky et al., 2017) suggest that the typical temperatures of magma formation in Kamchatka and other island-arc settings are up to 50 – 100°C below the dry peridotite solidus, which is significantly lower than was previously supposed on the basis of partly dehydrated melt inclusions (Portnyagin et al., 2007; Ruscitto et al., 2012; Plank et al., 2013).

Melt inclusions

Magma Crystallization Temperatures

H₂O contents

The temperatures calculated by the new geothermometer are 30–80°C lower than those calculated by Coogan with high-Mg# olivine (Fo> 84) and up to 140°C lower at Fo45.

• T = 1040-1150 °C for Fo>84, and T = 980-1180 °C for the entire range of compositions (using thermometer Sobolev et al., 2019, in prep.)

• T = 1090-1180 °C (Fo>84), and T=1060-1180 °C for the entire range of compositions (by Coogan et al., 2014)

• The calculated initial H₂O content (wt.%) for primitive melts of the Eastern Volcanic Front:

<table>
<thead>
<tr>
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<th>T by Coogan et al., 2014</th>
<th>T by Sobolev</th>
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</thead>
<tbody>
<tr>
<td>Gorely</td>
<td>1.7 ± 0.7 (2σ)</td>
<td>4.9 ± 0.9</td>
</tr>
<tr>
<td>Karymsky</td>
<td>4.4 ± 1.2 (2σ)</td>
<td>7.2 ± 2.1</td>
</tr>
<tr>
<td>Avachinsky</td>
<td>3.5 ± 1.5 (2σ)</td>
<td>5.4 ± 1.5</td>
</tr>
<tr>
<td>Zavartisky</td>
<td>4.1 ± 1.7 (2σ)</td>
<td>5.6 ± 2.4</td>
</tr>
<tr>
<td>Zavartisky(scoria)</td>
<td>2.9 ± 1.6 (2σ)</td>
<td>5.5 ± 1.5</td>
</tr>
</tbody>
</table>

Method of estimating the initial H₂O content in the melt inclusions is based on the significant effect of H₂O in melt on the olivine liquidus temperature (e.g., Almeev et al., 2007). The methods allows estimating H₂O content by comparing independently determined “wet” and “dry” olivine crystallization temperatures (Sobolev et al., 2016, Nazarova et al., 2017).

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