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

Tobelko D.P.[1*], Portnyagin M.V.[1,2], Krasheninnikov S.P.[1]

1 - Vernadsky Institute of Geochemistry and Analytical Chemistry RAS, Russia. *dariatobelko@gmail.com

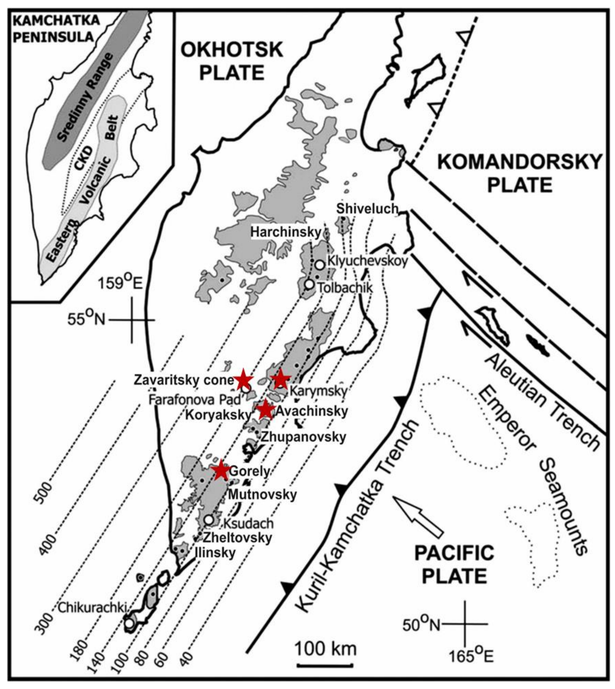
2 - GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany.

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 (Fo_{78-91}), 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 Zavaritsky cone).

Geological setting

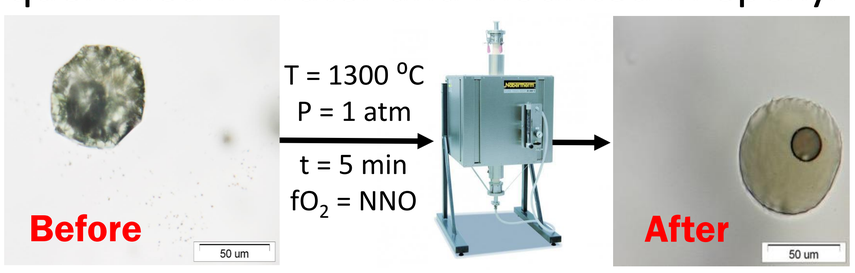
Kamchatka is an active volcanic region related to the subduction of the Pacific plate beneath the Eurasian continental margin (Gorbatov et al., 1997).



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 CO_2–H_2 gas mixture and Ni–NiO oxygen buffer, rapidly quenched in water and mounted in epoxy.



Analytical methods

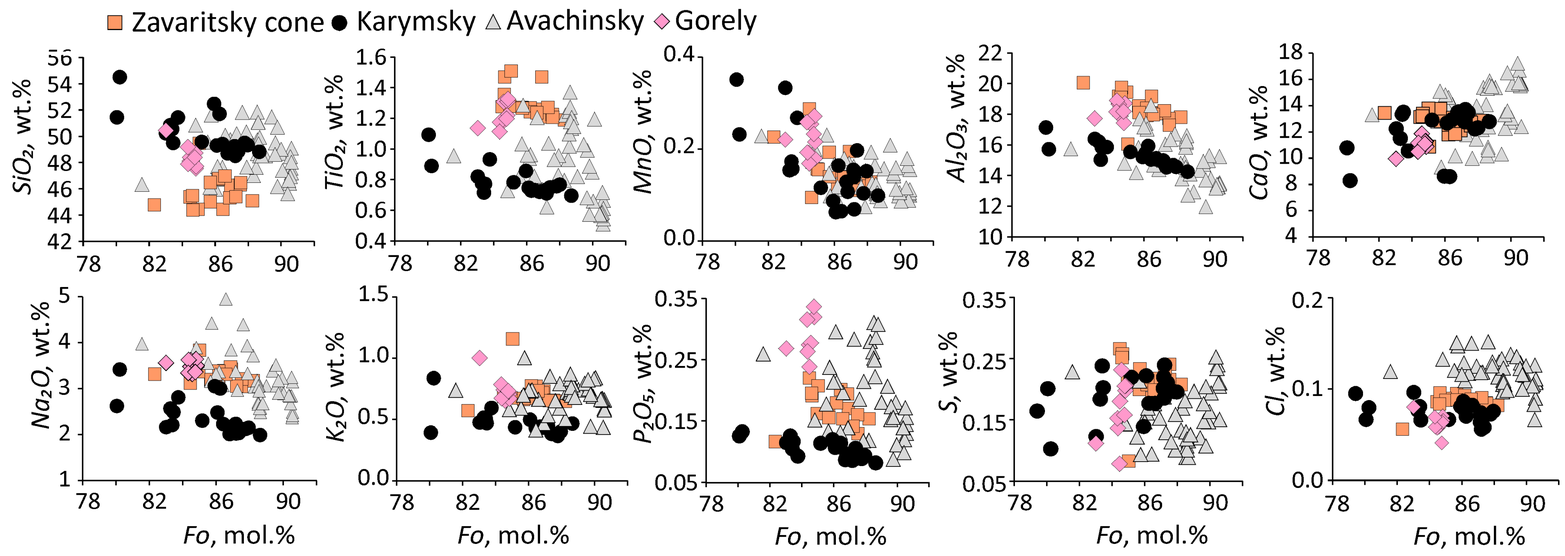
EPMA - major and trace elements in the Melt inclusions, Olivine and Spinel (Geomar, Kiel, Germany)

LA-ICP-MS - trace elements in Melt inclusions and Olivine (IG CAU, Keil, Germany)

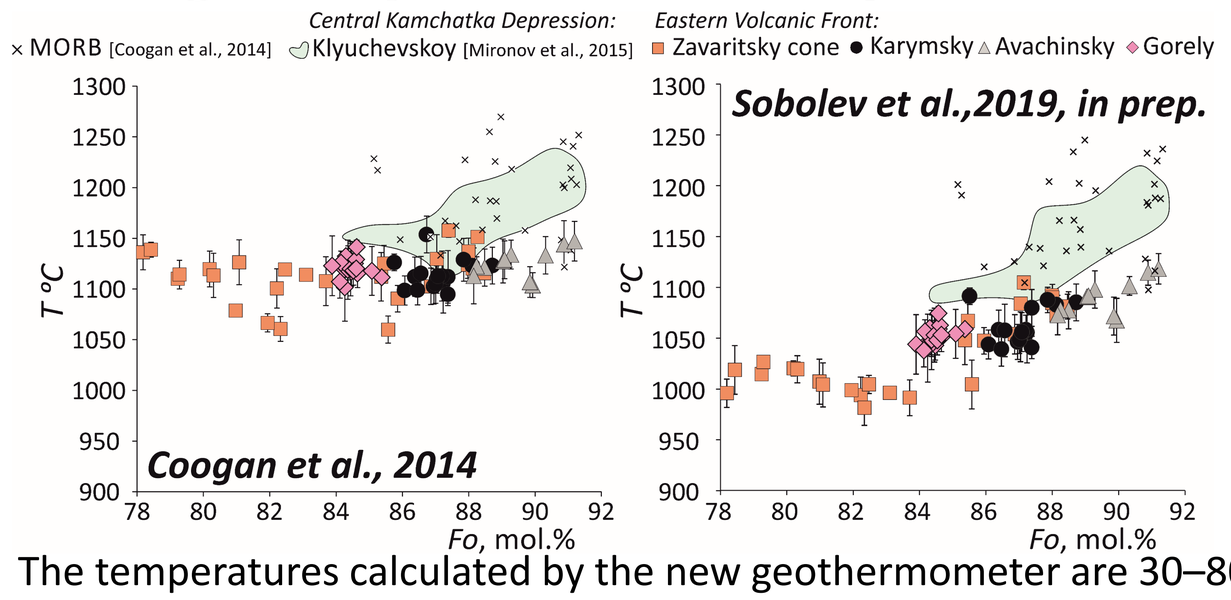
SIMS - contents of trace elements and H_2O in glasses of melt inclusions (Yaroslavl, Russia)

Raman Spectroscopy - H_2O contents in glasses of melt inclusions (MSU, Moscow, Russia)

Melt inclusions



Magma Crystallization Temperatures



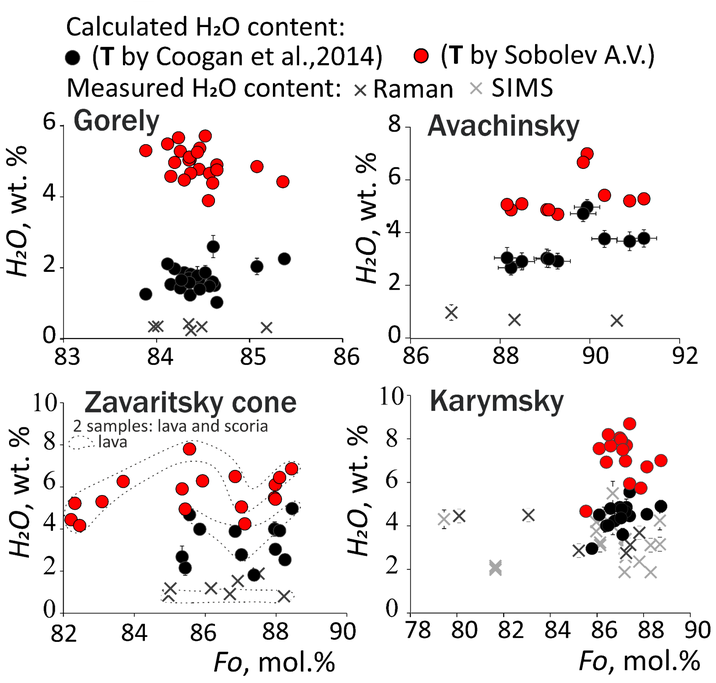
➢ **Al-in-olivine thermometer**

➢ **New unpublished thermometer (Sobolev et al., 2019, in prep.). This method takes into account the effect of titanium and oxidation on the calculated temperatures.**

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 Fo_{78}.

- **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)

H_2O contents

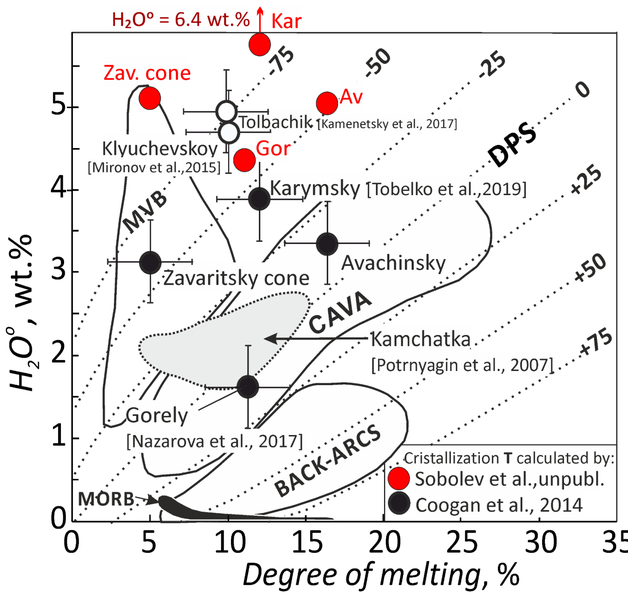


➢ Method of estimating the initial H_2O content in the melt inclusions is based on the significant effect of H_2O in melt on the olivine liquidus temperature (e.g., Almeev et al., 2007). **The methods** allows estimating H_2O content **by comparing independently determined "wet" and "dry" olivine crystallization temperatures** (Sobolev et al., 2016, Nazarova et al., 2017)

- The calculated **initial H_2O content (wt.%)** for primitive melts of the Eastern Volcanic Front :

	T by Coogan	*T by Sobolev*
Gorely	1.7 ± 0.7 (2σ)	4.9 ± 0.9
Karymsky	4.4 ± 1.2 (2σ)	7.2 ± 2.1
Avachinsky	3.5 ± 1.5 (2σ)	5.4 ± 1.5
Zavaritsky (lava)	4.1 ± 1.7 (2σ)	5.6 ± 2.4
Zavaritsky(scoria)	2.9 ± 1.6 (2σ)	5.5 ± 1.5

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).

Dashed lines show the deviation of melting temperatures from the temperature of the dry mantle peridotite solidus at a pressure of 1.5 GPa.

This work has been supported by RFBR project №18-35-00529, №19-05-00934

Authors thank N.L. Mironov for advice on this work and sponsoring participation in the conference.

Authors thank A.V. Sobolev for the opportunity to use unpublished thermometer.