COMPOSITION AND CRYSTALLIZATION CONDITIONS OF OLIVINE-PHYRIC ROCKS FROM KAMCHATSKY MYS PENINSULA

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The Kamchatsky Mys peninsula occupies a unique geodynamic position at the junction of three tectonic plates, acts as a link between the Aleutian and Kamchatka island arcs and considered to be the evidence of the earliest known display of the Hawaiian hotspot activity (Khotin & Shapiro, 2006, Pinegina T. K. et al., 2013, Portnyagin et al., 2009).

Olivine-phyric rocks were found on the Kamchatsky Mys in the ophiolite complex. They are unique in a number of ways. At first the rock contains 40-60% of high-magnesian olivine phenocrysts (up to $Fo_{90.1}$). That allows us to use it for reconstruction of the primary melts composition of these rocks. Moreover, parental melts of these rocks are characterized by early sulfide-silicate immiscibility following the occurrence of primary magmatic sulfide inclusions in early mineral assemblage (Savelyev et al., 2018, Savelyev, 2014). These rocks can be product of different types of magmatism. The purpose of our work was to determine melt composition and formation conditions of olivine-phyric rocks of Kamchatsky Mys peninsula at the first stages of the silicate sulfide immiscibility.

Samples with the least degree of secondary alteration were studied in detail. Besides olivine the phenocrysts assemblage is represented by Cr-spinel (Cr# 0.29–0.44) and plagioclase (An_{90} in the middle to An_{78} in the marginal parts) while groundmass consists of plagioclase (labradorite and bytownite), clinopyroxene (augite, rarely ferro-augite and depleted in calcium augite), small Cr-spinel grains and titanomagnetite.

Olivine and Cr-spinel phenocrysts contain melt inclusions (Fig. 1 c, d), which were experimentally homogenized at one-atmosphere conditions and analyzed using EPMA. Melt inclusions have basaltic (SiO2 = 49.5–52.2 wt%, Na2O + K2O = 2.06 – 3.12 wt%) composition.

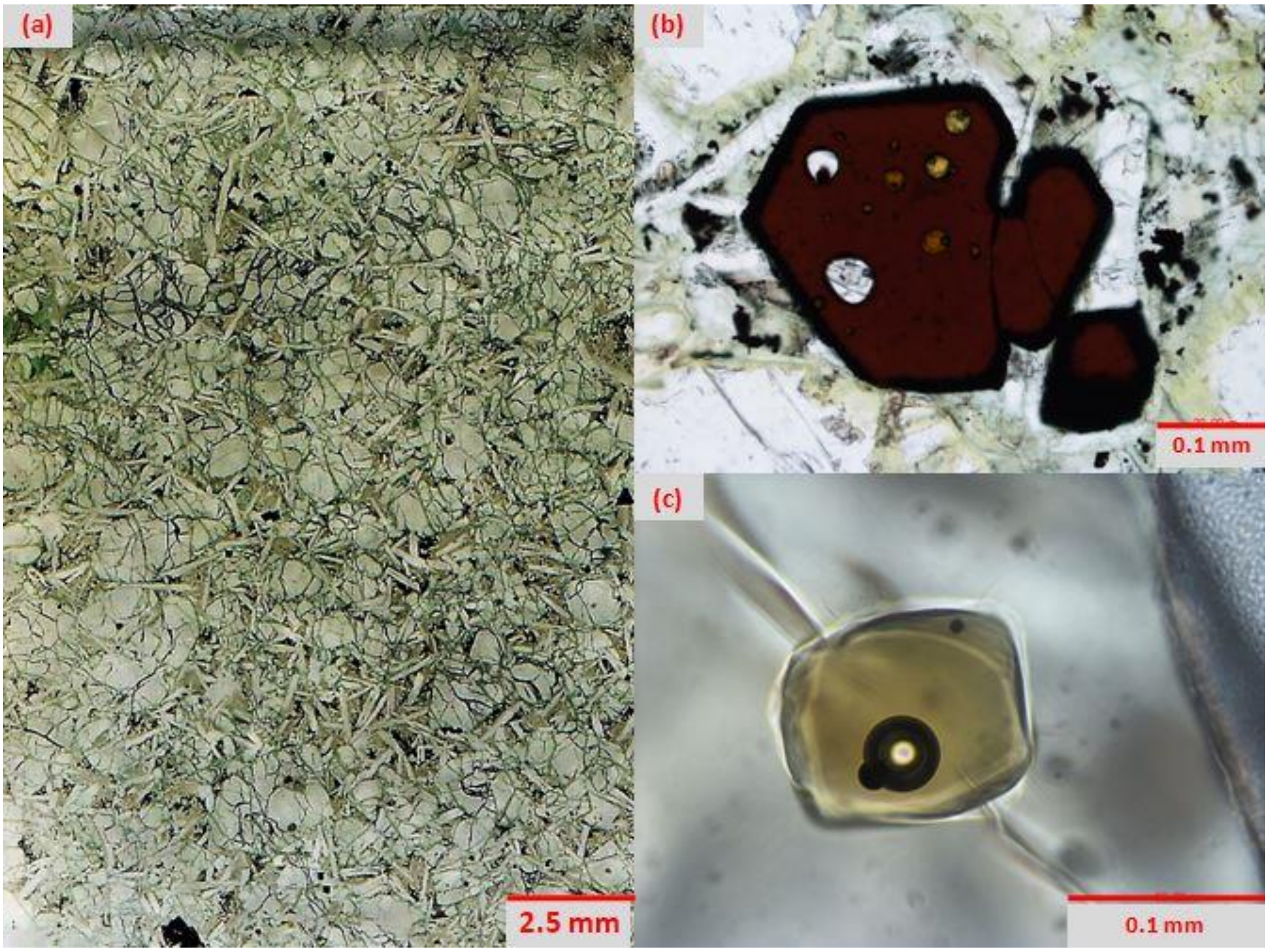

Fig.1 (a) Photomicrograph in thin section (in plane-polarized light). Rock has porphyric texture. (b) Melt inclusions in Cr-spinel; (c) Homogenized melt inclusion in olivine phenocryst.

Redox conditions of the melts crystallization were estimated using the model of olivine Cr-spinel equilibrium of Ballhaus et.al. (1990), average values correspond to ΔQFM — 0.05 ± 0.14 log units.

Temperature was calculated on the base of olivine – Cr-spinel equilibrium following the model of Al distribution (Wan et al., 2008) and correspond to 1243±25 °C, which is typical temperature of MORB primary melts crystallization (e.g.Danyushevsky, 2001, Falloon et al., 2007) in comparison with Hawaiian magmatism (Green et al., 2001). Thus, the rocks studied are similar in their characteristics to the basalts of the mid-oceanic ridges.

This study was funded by Russian Science Foundation project no. 16-17-10145

References

Ballhaus, C., Berry, R. F. & Green, D. H. Oxygen fugacity controls in the Earth's upper mantle. *Nature,* 1990. №348, pp.437-440.

Danyushevsky, L. V. The effect of small amounts of H_2O on crystallisation of mid-ocean ridge and backarc basin magmas. *Journal of Volcanology and Geothermal Research*, 2001. №110, pp.265-280.

Falloon, T. J., Danyushevsky, L. V., Ariskin, A., Green, D. H. & Ford, C. E. The application of olivine geothermometry to infer crystallization temperatures of parental liquids: Implications for the temperature of MORB magmas. *Chemical Geology*, 2007. №241, pp.207-233.

Green, D. H., Falloon, T. J., Eggins, S. M. & Yaxley, G. M. Primary magmas and mantle temperatures. *European Journal of Mineralogy*, 2001. №13, pp.437-451.
Khotin, M. Y. & Shapiro, M. N. (). Ophiolites of the Kamchatsky Mys Peninsula, eastern Kamchatka: Structure, composition, and geodynamic setting. *Geotectonics*, 2006. №40, pp. 297-320.
Pinegina T. K., Bourgeois J. , Kravchunovskaya E. A., Lander A. V., Arcos M. E.M., Pedoja K. & T., M. B. A nexus of plate interaction: Vertical deformation of Holocene wave-built terraces on the Kamchatsky Peninsula (Kamchatka, Russia). *GSA Bulletin,* 2013. №125, pp.1554-1568.
Portnyagin, M., Hoernle, K. & Savelyev, D. Ultra-depleted melts from Kamchatkan ophiolites: Evidence for the interaction of the Hawaiian plume with an oceanic spreading center in the Cretaceous? *Earth and Planetary Science Letters*, 2009. №287, pp.194-204.
Savelyev, D., Kamenetsky, V., Danyushevsky, L., Botcharnikov, R. & Kamenetsky M., P. J. W., Portnyagin M., Olin P., Krasheninnikov S., Hauff F., Zelenski M. Immiscible sulfide melts in primitive oceanic magmas: evidence and implications from picrite lavas (Eastern Kamchatka, Russia). *American Mineralogist*, 2018.
Savelyev, D. P. Plagioclase picrites in the Kamchatsky Mys Peninsula, Eastern Kamchatka. *Journal of Volcanology and Seismology*, 2014. №8, pp.239-249.
Wan, Z. H., Coogan, L. A. & Canil, D. Experimental calibration of aluminum partitioning between olivine and spinel as a geothermometer. *American Mineralogist*, 2008. № 93, pp.1142-1147.