TRACE ELEMENTS MOBILITY IN SILICATE MINERALS OF EOC UNDER THERMAL METAMORPHISM. K.G. Sukhanova, S.G. Skublov, O.L. Galankina and E.L. Kotova, 1 Institute of Precambrian Geology and Geochronology, Russian Academy of Sciences (2, Makarova emb., St.-Petersburg, Russia, 199034), 2Saint Petersburg Mining University (2, 21st Line, St.-Petersburg, Russia, 199106).

Introduction: Mineralogical composition of silicate chondrules usually limited by olivine, low-Ca pyroxene, plagioclase, and rare high-Ca pyroxene [1]. But in equilibrated ordinary chondrites (EOC) initial composition of main components was changed under thermal metamorphism conditions [2] or because of impact events on chondritic parent bodies [3]. These secondary processes lead to the equilibration of the major element composition by diffusion. Petrologic types of EOC from 3 to 6 reflect the intensity of secondary processes where 3 is unequilibrated ordinary chondrite (UOC) and 6 fully equilibrated. Nevertheless, the trace element composition of silicate minerals remains unequilibrated even in type 6 EOC [4].

Elenovka (L5) and Knyahinya (L/LL5) belong to the most common type of meteorites (EOC) and were observed during their felt. Meteorites of 5 petrologic type contain chondrules of all known textures and widespread matrix, that allow analyzing trace element concentrations in olivine, low-Ca pyroxene, plagioclase from porphyritic and nonporphyritic chondrules and meteorite matrix in the equal proportions.

Samples and methods: Olivine, low-Ca pyroxene, plagioclase, and chromite compositions were determined using the Jeol JXA-8230 electron probe microanalyzer (EPMA) equipped with three wavelength dispersive spectrometers at IPGG RAS. Concentrations of trace elements, including the rare earth (REE) elements, were analyzed by secondary-ion mass spectrometry (SIMS) on a Cameca IMS-4f ion probe at the Yaroslavl Branch of the Valiev Institute of Physics and Technology, Russian Academy of Sciences.

Samples of Elenovka and Knyahinya meteorites for this research were provided by Mining museum (Saint Petersburg Mining University). In Elenovka meteorite trace elements were analyzed in olivine, low-Ca pyroxene, and plagioclase from two large porphyritic chondrules (9PO-0, 9POP-2) and one small barred chondrule (9BOP-3). In Knyahinya meteorite trace elements were analyzed in silicate minerals from 1 porphyritic (1PP-1) and 2 nonporphyritic (1RP-2, 1GOP-4) chondrules.

Results: Major and trace elements contents in olivine, low-Ca pyroxene, and plagioclase are constant and equal in studied meteorites (Fig.). Nevertheless, olivine and low-Ca pyroxene of nonporphyritic chondrules enriched in trace elements and REE relative to minerals of porphyritic chondrules.

Trace element composition in olivine and low-Ca pyroxene of chondrules and matrix EOC Elenovka and Knyahinya has only little differences (Fig.) from UOC.
minerals [5]. Olivine of EOC chondrules and matrix highly depleted in Y, Al, and V, but at the same time enriched in Hf and REE relatively olivine of UOC porphyritic chondrules. Chondrule low-Ca pyroxene EOC has high abundances of refractory Zr, Hf, and Ca compared to pyroxene of porphyritic chondrules UOC.

REE concentrations in pyroxene of porphyritic chondrules studied meteorites match to pyroxene of porphyritic chondrules UOC and differ only by negative europium anomaly. These slight differences in olivine and pyroxene trace element composition EOC and UOC confirm experimental data [6, 7] of slow diffusion rates of trace elements under thermal metamorphism conditions on planetesimals. Olivine and low-Ca pyroxene from different EOC shows similar differences compared to UOC that reflect negligible thermal metamorphism impact on trace elements abundances. Thus EOC as the most abundant chondritic group can be used for chondrule-formation studies on the early stages of the Solar system.

Plagioclase under metamorphism conditions riches complete equilibration: Fig.-c shows trace elements mobility during mesostasis crystallization to plagioclase that leads to the formation of Ca-phosphates (apatite and merillite) and high-Ca pyroxene in the meteorite matrix.

Nevertheless, Elenovka and Knyahinya meteorites have the full specter of the main 5 petrologic type attributes: olivine and low-Ca pyroxene composition are homogeneous, glass completely crystallized in plagioclase and high-Ca pyroxene grains occur in meteorite matrix. Chondrites of the 5 petrologic type corresponds to high thermal metamorphism conditions at 700-750°C [8]. But olivine-Cr-spinel geothermometer [9], indicate full olivine equilibration at 690°C and 699°C in Elenovka and Knyahinya meteorites respectively. This metamorphic temperature fit for 3-4 petrologic type ordinary chondrites. This discrepancy can be caused by long heating at relatively low metamorphic temperatures on the chondritic parent body.

**Conclusions:**
Trace elements of silicate minerals (olivine, low-Ca pyroxene, and plagioclase) of equilibrated ordinary chondrites Elenovka and Knyahinya did not change under thermal metamorphism conditions on the chondritic parent body. Olivine and low-Ca pyroxene of porphyritic chondrules EOC consistent in trace element abundances to minerals UOC. Plagioclase EOC depleted in trace elements compared to chondrule mesostasis UOC that confirm it’s crystallization during thermal metamorphism, trace element mobility from chondrule, and crystallization of Ca-phosphates and high-Ca pyroxene.