EGU2012-6230: **Sill-like bodies of high-pressure ultramafic cumulates in tectonic blocks of the Pekul'ney complex (central Chukotka): their composition and inner structure**

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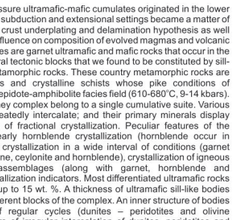
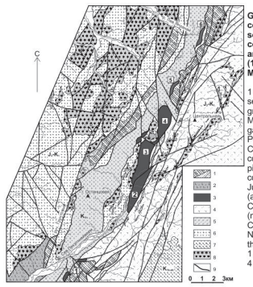
During the last decade petrology of high-pressure ultramafic-mafic cumulates originated in the lower crust of the relatively thick lithosphere in both subduction and extensional settings became a matter of keen interest owing to development of lower crust underplating and delamination hypothesis as well as proposals of high-pressure fractionation influence on composition of evolved magmas and volcanic rocks. Peculiar rocks of the deepest complexes are garnet ultramafic and mafic rocks that occur in the Pekul'ney complex. The latter includes several tectonic blocks that we found to be constituted by sill-like layered bodies and embedded them metamorphic rocks. These country metamorphic rocks are represented by lower crustal amphibolites and crystalline schists whose pike conditions of metamorphism correspond to high-pressure epidote-amphibolite facies field (610-680˚C, 9-14 kbars). All varieties of ultramafic rocks of the Pekul'ney complex belong to a single cumulative suite. Various types of ultramafic rocks regularly and repeatedly intercalate; and their primary minerals display regular correlations consistent with trends of fractional crystallization. Peculiar features of the Pekul'ney complex ultramafic rocks are early hornblende crystallization (hornblende occur in peridotites and olivine pyroxenites), garnet crystallization in a wide interval of conditions (garnet presents in pyribolites along with clinopyroxene, ceylonite and hornblende), crystallization of igneous clinozoisite in the most differentiated assemblages (along with garnet, hornblende and clinopyroxene), and lack of plagioclase crystallization indicators. Most differentiated ultramafic rocks contain clinopyroxenes with Al_2O_3 contents up to 15 wt. %. A thickness of ultramafic sill-like bodies studied varies from 350 to 1100 meters in different blocks of the complex. An inner structure of bodies is determined by regular intercalation of regular cycles (dunites – peridotites and olivine clinopyroxenites – pyribolites) and members of irregular intercalation of dunites, peridotites and olivine pyroxenites. A thickness of individual regular cycles varies from 50 to 410 meters. Cumulative ultramafic rocks of the Pekul'ney complex crystallized from a high-magnesium water-rich mantle-derived primary melt in a wide range of temperatures at a pressure of 11-13 kbar. The complex was originated in a setting of erisialic arc. The Pekul'ney complex can be considered as a reference object for investigations of petrology, geochemistry and compositional evolution of subduction-derived mantle melts caused by high-pressure fractionation.

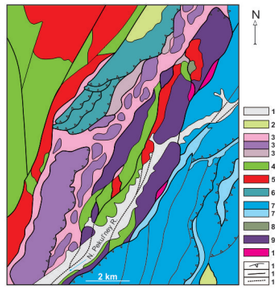


Tectonic setting of the Pekul'ney Range and the structures of central Chukotla (Morozov et al., 2001). 1 – Chukotka microcontinent, 2 – Omolon microcontinent, Eskimos microcontinent, 4 – Uda-Murgal system, 5 – Algan-Velikaya River zone, 6 – Pekul'ney-Zolotogorie system, 7 – Koryak-Kamchatka province, Okhotsk-Chukotka belt, 9 – Anadyr-Bristol volcanic belt, 10 – Cenozoic depressions, 11 – South Anyui and Kolyuchinskaya-Cross Bay sutures. П – Pekul'ney block. For other blocks acronyms are not shown, boundaries of blocks are not shown as well.



Geological position of the Pekul'ney complex blocks in the structures of the southern part of the Pekul'ney Range (the compilation is based on the geological maps and sketches published in Palandzhayn et al. (1982, 1996), Stavsky et al. (1996) and Morozov et al. (2001)).

1 – metamorphosed volcanic-sedimentary sequences, including greenschists (a) and gneisses (b), presumably Late Paleozoic-lower Mesozoic; 2 – Late Paleozoic(?) layered gabbro; 3 – blocks of the Late Paleozoic Pekul'ney complex; 4 - Middle Jurassic-Early Cretaceous volcanic-siliceous (oceanic) complex, 5 – mélange after Hauterivian picritic-basaltic volcano-plutonic complex, containing blocks of this complex; 6 – Late Jurassic – Early Cretaceous volcanic-plutonic (arc) complex (undifferentiated); 7 – Late Cretaceous tuff-terrigenous deposits (neoautochthone), 8 – Late Jurassic – Early Cretaceous granitoids; 9 – fractures. Numbers on the sketch corresponds to blocks of the Pekul'ney complex that were investigated: 1 – Krivorechensky, 2 – Southern, 3 – Central, 4 – Northern, 5 – Watershed, 7 – Yanranay.



Sketch demonstrating the geological structure of the Rekul'ney Range in the middle stream of the Northern Pekul'neyveem River.

1 - Quaternary deposits; 2 - tuff-terrigeneous deposits, K2 (neoautochthone); 3 - picritic-basaltic complex, K1hau, including melange (a), volcanic rocks (b) and coarse-grained tuff-terrigeneous deposits; 4 - arc complex, J3-K1; 5 - gratins, J3-K1; 6 - mixtites, K1; 7 - siliceous-volcanic complex, J2-K1 (a) and greenschist-facies metamorphic rocks after it (b); 8 - layered gabbros, PZ(?); 9 - Pekul'ney complex, including high-P ultramafic cumulates and mafic metamorphic rocks; 10 - gneisses; 11 - contacts, including thrusts (a), normal faults observed (b) and inferred (c).

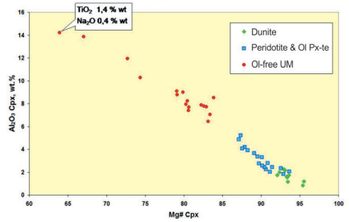
General view of the Northern block of the Pekul'ney complex

Mineral assemblages and parameters of cumulative ultramafics and country mafic metamorphic rocks

	Ultramafics							Metamorphic rocks
	Dunite	Peridotite	Ol-pyroxenite	Ol-free "Websterite"	Ol-free "Clinopyroxenite"	Ol-free "Hornblendite"	Differentiated	
Number of samples	14	6	14	5	10	10	8	25
Primary minerals	Ol±Spl±Cpx	Ol+Cpx+Spl ±Opx±Hbl	Cpx±Spl±Ol ±Opx±Hbl	Cpx+Opx±Opx	Cpx+Cpx+Grt ±Hbl	Hbl+Cpx+Grt ±Cpx	±Hbl±Cpx±Grt ±Cpx±Czo	No
Secondary minerals	Serp, Bruc, Mag, Di, Chl, Am, Tm, Spl, Ca-Grt, Ep, Ilm, Pump, Cal	Chl, Mag, Czo, Ep, Hbl, Am, Ca-Grt, Pump, Prv, Di, Ilm, Tm, Cal						Qtz, Ab (Olig), Rt, Tm, Hbl, Am, Grt, Zoi, Czo, Ep, Prv, Pump, Chl, Phg, Kap, Crn, Cord, Ky, Law Anz, Cal.
Cr# Spl/Cry	0.45-0.75	0.04-0.20	0.05-0.33	0.00	0.00	0.00	0.00	-
Mg# Spl/Cry	34.0-51.5	47.3-63.6	36.1-61.8	66.5-67.7	53.6-57.0	48.2	40.4	-
$Fe^{+3}/(Cr+Al+Fe^{+3})$ Spl	0.087-0.201	0.057-0.088	0.059-0.146	0.041-0.048	0.040-0.049	0.041	0.046	-
Mg# Ol	84.0-92.3	82.5-88.5	76.2-86.7	-	-	-	-	-
Mg# Opx	-	82.9-85.0	83.1-87.0	80.2	-	-	-	-
Mg# Cpx	89.5-95.5	87.3-93.6	86.7-92.9	82.9-85.7	79.1-82.5	72.4-78.7	63.6-65.7	-
Al_2O_3 Cpx, wt.%	0.7-3.4	2.1-5.2	1.8-4.9	3.3-7.9	7.7-8.9	9.6-11.8	13.7-15.2	-
TiO_2 Cpx, wt.%	0.03-0.23	0.08-0.24	0.10-0.35	0.29-0.42	0.31-0.47	0.58-1.01	0.91-1.28	-
NaO Cpx, wt.%	0.09-0.37	0.08-0.44	0.08-0.20	0.06-0.36	0.11-0.49	0.16-0.37	0.22-0.38	-
Mg# Hbl	-	82.0-86.7	82.7-84.4	77.4-81.2	74.7-80.2	69.5-74.3	57.3-67.1	55.7-79.7
Al_2O_3 Hbl, wt.%	-	11.5-14.3	11.9-12.7	14.3-15.7	14.5-17.0	14.4-17.5	15.0-17.7	11.3-17.1
TiO_2 Hbl, wt.%	-	0.45-0.63	0.45-0.50	0.49-0.51	0.49(7)-0.59	0.71-0.91	0.81-1.16	0.0-0.50
Mg# Grt	-	-	-	(59.3-63.7)*	52.8-58.3	45.4-49.4	35.4-44.7	20-48
CaO Grt, wt.%	-	-	-	(7.1-7.6)*	7.6-8.5	7.9-11.7	9.6-15.5	5-12
Mg# Chl								65-85
Mg# Phg								65-89

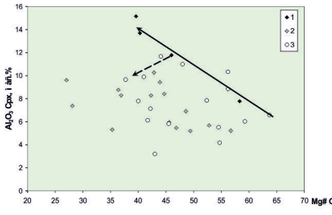
* - data from (Pertsev, 1988a; 1992) for rocks with similar Cpx compositions.

Primary Cpx composition in UM cumulates



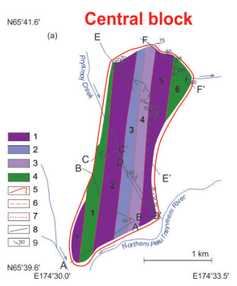
UM cumulates constituting different blocks were probably formed from similar melts at similar conditions

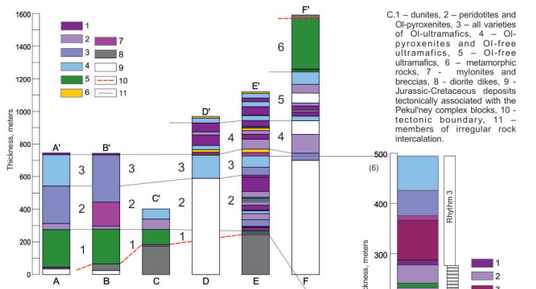
Influence of metamorphism on compositions of clinopyroxene and garnet



1 – primary minerals; 2 – recrystallized minerals; 3 – data from the literature undifferentiated to primary and secondary ones. Solid arrow corresponds to the trend of magmatic differentiation; dash arrow reflects changes in mineral compositions due to recrystallization.

Central block



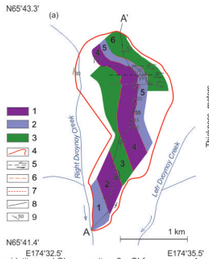


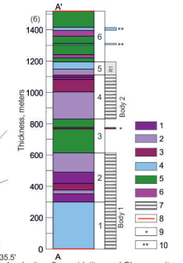
A.1 – dunites and peridotites, 2 – pyroxenite and Ol-free ultramafics, 3 – ultramafics of different varieties, 4 – metamorphic rokcs, 5 – tectonic boundary of the block, 6 – boundaries of the sill-like bodies, 7 – boundaries between the members, 8 – cross-sections, 9 – dip and strike of layering.

B.1 – dunites, 2 – peridotites and Ol-pyroxenites, 3 – Ol pyroxenite and Ol-free ultramafics; 4 - Ol-free ultramafics, 5 – metamorphic rocks, 6 – mylonites and breccias, 7 – dorite dikes, 8 – Jurassic-Cretaceous deposits tectonically associated with the Pekul'ney complex blocks, 9 – covered exposures, 10 – tectonic boundary, 11 – lines of the correlations.

C.1 – dunites, 2 – peridotites and Ol-pyroxenites, 3 – all varieties of Ol-ultramafics, 4 – Ol-pyroxenites and Ol-free ultramafics, 5 – Ol-free ultramafics, 6 – metamorphic rocks, 7 – mylonites and breccias, 8 - dorite dikes, 9 - Jurassic-Cretaceous deposits tectonically associated with the Pekul'ney complex blocks, 10 - tectonic boundary, 11 – members of irregular rock intercalation.

Northern block

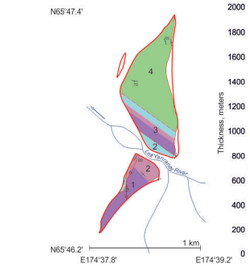


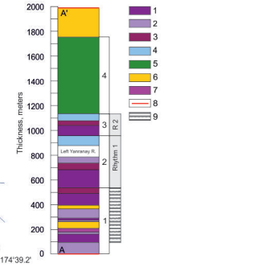


1 – dunites, peridotites and Ol-pyroxenites; 2 – Ol-free ultramafics; 3 – metamorphic rocks; 4 – tectonic boundary of the block; 5 – fractutes inside the block; 6 – boundaries of the sill-like bodies; 7 – boundaries of the members; 8 – cross-section; 9 – dip and strike of layering.

1 – dunites; 2 – peridotites and Ol-pyroxenites; 3 – thin intercalation of Ol-ultramafics,; 4 – Ol-free ultramafics; 5 – metamorphic rocks; 6 – diorite dikes; 7 – members of irregular intercalation of ultramafics; 8 – tectonic boundaries of the block; 9 – the thin vein(?) of dunite-pyroxenite in metamorphic rocks; 10 – the thin vein(?) of Grt-bearing Ol-free ultramafics in metamorphic rocks.

Yanranay block

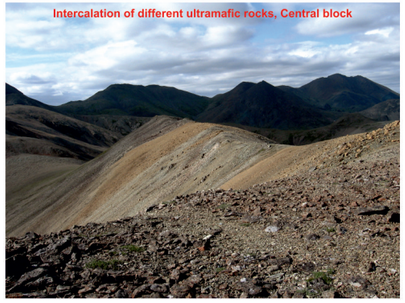




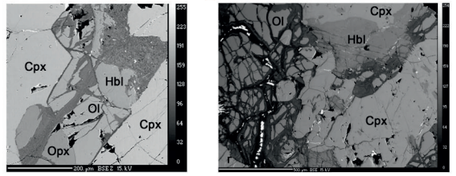
1 – dunites and intercalation of dunites with Ol-pyroxenites; 2 – peridotites and Ol-pyroxenites; 3 – Ol-free ultramafics; 4 – metamorphic rocks; 5 – tectonic boundaries of the block; 6 – boundaries of sill-like bodies; 7 – boundaries of members; 8 – cross-section; 9 – dip and strike of layering.

1 – dunites, 2 – peridotites and Ol-pyroxenites, 3 – intercalation of Ol-ultramafics, 4 – Ol-free ultramafics, 5 – metamorphic rokcs, 6 – tectonized and brecciated serpentinites; 7 – dionte dikes, 8 – tectonic boundaries of the block, 9 – member of irregular intercalation of ultramafics.

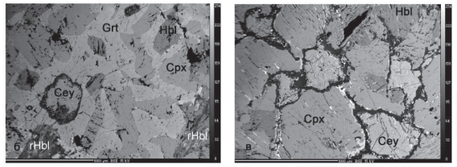
Intercalation of different ultramafic rocks, Central block



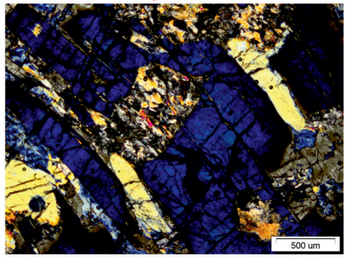
Igneous Hbl in Ol-pyroxenite and peridotite



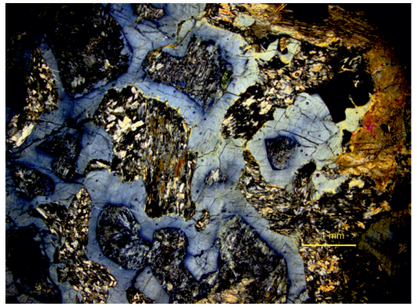
Igneous Hbl and Grt in Ol-free ultramafics



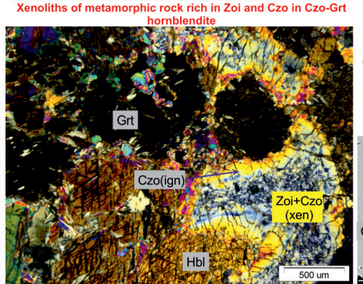
The xenolith of metamorphic schist containing Rt embedded in igneous Czo



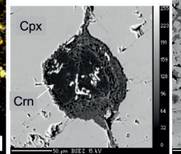
Igneous Grt, Cpx and poikilitic Czo with inclusions of Hbl grains and microxenoliths of metamorphic rocks



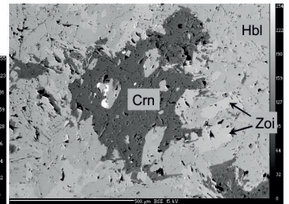
Xenoliths of metamorphic rock rich in Zoi and Czo in Czo-Grt hornblendite



The xenocryst of corundum trapped in Cpx from Grt-bearing Ol-free ultramafic rock



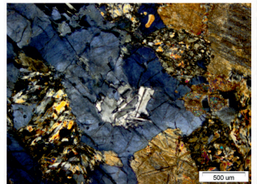
The corundum-bearing metamorphic rock



Intercalation of Ol-pyroxenite and dunite

Bedded mafic metamorphic rocks with abundant large Grt

Microxenolith of Ab-rich rock in igneous Czo



Magmatic contact between a metamorphic rock (at the right) andcoarse-grained Grt hornblendite abundant in microxenoliths rich of Czo and Zoi (at the left)

A xenolith of metamorphic rock in the coarse-grained Grt hornblendite

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