# Heterogeneous ultramafic-mafic massifs of the Southern Koryak Highlands (Russian Far East): genesis and geodynamic interpretations

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The data on the mineralogy, geochemistry and age of ultramafic-mafic massifs of the Alaskan-type and spatially associate to them mafic and felsic rocks from the Olyutorsky zone of the Southern Koryak Highlands, which are distinguished as a single mafic-ultramafic complex, are discussed. Our study demonstrated a complex structure of these massifs consisting of rocks of varying age, geochemical characteristics, and genesis. The Alaskan-type massifs from the Olyutorsky zone include both layered and zoned sequences. The associations of layered ultramafic-mafic massif (Seinav) include (a) layered dunite-clinopyroxenite-gabbro series and (b) amphibole and mica (alkaline) gabbroids. The associations of zoned ultramafic-mafic massifs (Epilchik, Matysken, and Galmoenan) include (a) dunites in the cores, (b) clinopyroxenite-gabbro composing the outer portion of the massifs, (c) fine-grained and doleritic gabbro, (d) gabbrodiorite of discordant bodies, and (e) felsic dike rocks.

Dunites and Cpx-bearing dunites from the layered sequences have slightly deformed cumulative textures caused by intercumulus melt migration. The same rocks from the zoned massifs show tabular and protogranular textures resulted from solid-plastic deformations by dislocation creep under high-T and moderate-T conditions. The lattice preferred orientation of olivine from tabular and protogranular dunites are dominated by (010) [100] and {0kl} (100) slip systems, respectively. Wehrlites and olivine clinopyroxenites are composed of deformed olivine clusters merged in a strain-free groundmass of clinopyroxene $\pm$ plagioclase. Gabbros do not show features of solid-plastic deformations. The primary mineralogical features of studied rocks were obscured by subsolidus recrystallization and metamorphism during massif annealing. In particular, most of the diopsides from clinopyroxene-bearing dunites, wehrlites and olivine-bearing clinopyroxenites are commonly very low in aluminum and have much higher magnesium number than co-existing olivines. Cr-spinels and magnetites, which were found in dunites and clinopyroxene-bearing dunites, and Cr-spinels, magnetites and ilmenites, which are present in wehrlites, olivine clinopyroxenites and gabbros, most probably are the breakdown products of some primary Cr-spinels at different temperatures.

The distinguished associations of igneous rocks are derivatives of chemically diverse melts: tholeiitic, calc-alkaline, potassium-rich calc-alkaline, subalkaline, and tonalite-trondhjemite. Changes in the composition of igneous rock associations reflect changes in the geodynamic conditions. The ages of rocks of various associations show a strong correlation with main evolution stages of the Bering Sea region. The associations of layered dunite-clinopyroxenite-gabbro series, which are products of crystal fractionation of a basic melt close to tholeiitic, and the association of tholeiitic gabbro-dolerite and fine-grained gabbro were probably formed in pre-Maestrichtian time and related to the evolution of igneous chambers within an island arc or back-arc spreading center. The calc-alkaline, high-potassium calc-alkaline, and subalkaline rocks (mainly gabbroic in composition) were generated in the

Campanian-Maestrichtian and recorded various stages of the igneous evolution of an island-arc system. The results of fission-track dating of apatite demonstrated that in the Late Maestrichtian-Paleocene-Eocene the rock associations of Cretaceous age were involved into accretion processes. The association of silicic rocks of the tonalite-trondhjemite series was formed almost simultaneously with the collision of an island arc and a continental margin, which occurred in the Eocene-Oligocene.

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