ГЕОЛОГИЯ, ГЕОХИМИЯ И АБСОЛЮТНЫЙ ВОЗРАСТ ИЗБРАННЫХ ПЛАТИНОМЕТАЛЬНО-ХОРИТОВЫХ И ПЛАТНОМЕТАЛЬНО-НИКЕЛЬ-МЕДНЫХ МАФИТ-УЛЬТРАМАФИТОВЫХ КОМПЛЕКСОВ ТЕРРЕЙНОВ ФАЙРВЕЛЛ, ГУДНЬЮС БЭЙ И СРЕДИННОГО, АЛЯСКА И ДАЛЬНИЙ ВОСТОК РОССИИ

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GEOLOGY, GEOCHEMISTRY, AND ISOTOPIC AGES OF SELECTED PGE-Cr AND PGE-Ni-Cu BEARING, MAFIC/ULTRAMAFIC COMPLEXES IN THE FAREWELL, GOODNEWS BAY AND SREDINNY TERRANES, ALASKA AND RUSSIAN FAR EAST

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The Russian Far East and Alaska regions contain important resources of platinum group elements (PGE), nickel and cobalt. Platinum has been successively mined from both areas, mainly in placer deposits eroding Ural-Alaskan zoned mafic-ultramafic complexes. Total combined production from Alaska and Russian Far East PGE placer deposits amount to about 200 tonnes of PGE, almost all in the form of isoferroplatinum. Significant Ni-Cu-Co-PGE lode deposits of Permo-Triassic and Phanerozoic ages also occur in both areas. One deposit, the Shanuch Ni-Co-PGE deposit in Kamchatka, has reached commercial production.

The PGE-Cr and PGE-Ni-Cu-Co geological settings in both diverse regions include the following: 1) mid-Proterozoic and Tertiary, synorogenic, layered mafic intrusions (Lanatrsky Russian Far East; Crillion-La Perouse, Alaska); 2) Permo-Triassic and Tertiary-to-Cretaceous, sill form tholeiitic intrusions (Nikolai and Farewell, Alaska; Kviinum-Shanuch, Russian Far East); 3) Ural-Alaskan zoned mafic-ultramafic complexes of variable ages (Goodnews Bay and southeast Alaska; Konduer and Koryak-Kamchatka Platinum Belt, Russian Far East); and 4) placers mainly derived from 3 above.

The Goodnews Bay district is the site of Alaska's premier PGE district, and is responsible for >95 percent of the historic Alaskan PGE output of about 22 tonnes. Two elongate, Ural-Alaskan intrusions at Red and Susie Mountains are composed of dunite-wehrlite cores and have hornblende clinopyroxenite and clinopyroxenite rims. Host rocks underwent high temperature contact metamorphism. Coarse hornblende

fractions collected during this study from hornblende clinopyroxenite yielded consistent 40Ar/39Ar ages ranging from 188-193 Ma, or of Middle Jurassic age.

Paired Ural-Alaskan intrusions in the Galmeononsky-Seinavsky district are found in the geographic center of the Koryak-Kamchatka Platinum Belt (KKPB), which extends from Koryakia to northern Kamchatka for a distance of approximately 1,000 km. The KKPG contains at least six Ural-Alaskan zoned ultramafic complexes, all of which contain dunite cores and successive rims of clinopyroxenite, peridotite, gabbro and uncommonly diorite. Significant lode chromite-isoferroplatinum mineralization occurs mainly in dunite phases and more than 40 tonnes of platinum has been produced from streams dissecting the Galmeononsky-Seianvsky district. Earlier Russian workers recognized the similarities of the Goodnews Bay district in SW Alaska and the Galmeononsky-Seinavsky district on the Kamchatka Peninsula and believed that they were part of the same metallogenic belt that extended across the Bering Straits. However, samples from the Galmeononsky-Seinavsky intrusions analyzed during this study yielded 40Ar/39Ar hornblende and biotite ages ranging from 71.5 to 73.9 Ma. Basaltic flows thought to be coeval with the Ural-Alaskan intrusions in the KKPG have yielded whole rock 40Ar/39Ar ages ranging from 60.6-64.6 Ma.

In the Farewell and Sredinny terranes of central Alaska, USA and Kamchatka, Russia, tholeiitic, differentiated, peridotite, clinopyroxenite, and gabbro sills, norite-dominant, layered intrusions, and cogenetic, alkali olivine basalt flows intrude and overlie Paleozoic and Mesozoic, continental margin deposits of accretionary origin. Significant PGE, nickel, cobalt and copper sulfide deposits are associated with mafic-ultramafic intrusions in both areas.

In the Farewell area, the mafic and ultramafic sills and pillow basalts intrude and overlie: 1) silty limestone and shale of the Late Cambrian-Lower Ordovician Lyman Hills Formation and 2) calcareous sandstone and shale of the Permian-Pennsylvanian Sheep Creek Formation. Both comprise a part of the Farewell Composite terrane. The Farewell terrane mafic-ultramafic sills do not have orthopyroxene and contain Ti-enriched chromitites. REE and other trace element data from the Farewell suite suggests a magma-mixing model with local crustal contamination. The PGE-Ni-Cu-bearing sills in the Farewell area had been previously regarded by some workers as dikes related to peralkaline intrusive complexes of Early Tertiary age. However, Ar/Ar age dating provides evidence of two older events: 1) Lower Permian (275-to-300 Ma) for sill-form PGE-Ni-Co-Cu-bearing intrusions at the Roberts PGM and Gagaryah deposits, which cut Cambro-Ordovician stratigraphy; and 2) Triassic (225-to-233 Ma) for metalliferous sill-form systems in the Sheep Creek area, which cut Upper Paleozoic strata.

In the Sredinny terrane of southern Kamchatka, more than 40 peridotite, pyroxenite, and noritic intrusions cut metamorphosed sandstone and siltstone of the Kamchatka and Kolpakova Groups. Previous Russian workers believed that the mafic intrusions were Triassic-Jurassic in age. REE and trace element data and the widespread appearance of garnet in the gabbro-norites suggest that chrondritic magmas of the Sredinny terrane have been contaminated by crustal sources. 40Ar/39Ar plateau

ages with simple ‘flat spectras’ from six mafic sills and layered intrusions in the Sredinny terrane range from 49.8 to 53.0 Ma; a seventh sill yielded a 40Ar/39Ar age of 84.3 Ma.

The early Tertiary, mineralized layered and sill-form intrusions in the Sredinny terrane of Kamchatka are similar to the Sanak-Baranof suite of tonalite, peridotite, and gabbro, fore arc plutons in southern and southeast Alaska. The Sanak-Baranof suite of southern Alaska also includes important Ni-Cu-PGE mineralization in Early Tertiary layered and composite gabbros and ultramafic complexes. Examples include the Brady Glacier and on Yakobi Island Ni-Cu-PGE sulfide deposits. New U/Pb and 40Ar/39Ar ages from the Sanak-Baranof igneous belt indicates ages of about 54 Ma for tonalite in the northern part of the belt; 49.0 Ma for tonalite and gabbro in the southern part of the belt; and 20.0 Ma amphibole cooling ages for mafic-ultramafic rocks in the Fairweather Range of southern Alaska. Nd-Sr isotopic data from the Sanak-Baranof suite suggests that magmas were derived from the mixing of melted accretionary wedge sedimentary rocks from a subduction zone.