Paper Number: 1362

Orogenic gold in greenstone belts in northeastern Fennoscandia

Kalinin, A.A.[1]
Geological Institute RAS, Apatity, Russia

The northeastern part of the Fennoscandian Shield is well known for Ni deposits in Pechenga, apatite deposits in Khibiny, rare metal deposits in Lovozero and Kovdor, but poorly explored for gold. As a result, there are only a few gold occurrences and no mined deposits in northwest Russia, in contrast to adjacent areas in Finland with one large world-class (Suurikuusikko) and numerous small (Pampalo, Saattopora) gold deposits. All known gold occurences in the Russian part of the Fennoscandian Shield are located in Neoarchean and Paleoproterozoic greenstone belts, similar to the Finnish deposits. This presentation describes investigated gold occurrences, compares them with well-studied mined deposits in Precambrian shields, and shows prospective areas for gold resources in the northeastern part of Fennoscandia.

In the Kolmozero-Voronya belt, the Oleninskoe and Nyalm-1 gold occurrences are located near the fault intersections in deformed and intensely altered amphibolites, close to or within minor intrusions and dikes of gabbro, diorite, granodiorite, and quartz porphyry. The amphibolites are mainly tholeiitic basalt with flows and sills of komatiite, which are metamorphosed to lower amphibolite facies. Mineral associations in the altered amphibolite include Ca-rich diopside, zoisite, Ca-Fe garnet, and quartz in distal zones; potassic alteration, mainly biotite, in middle zones; and quartz, with minor actinolite and tourmaline, in proximal zones. A quartz–sericite–tourmaline association is common in altered granodiorite and quartz porphyry. Altered rocks in the proximal zone contain disseminated arsenopyrite, Ag-Sb sulphosalts, and gold. Three generations of silver- and gold-bearing minerals can be distinguished: early küstelite inclusions in arsenopyrite and löllingite, electrum as intergrowths with Sb-sulphosalts (freibergite, boulangerite, diaphorite, fyzeliite, uchucchacuaite, ramdohrite) and dyscrasite, and late high-grade gold in quartz. Gold deposition occurred during the retrograde stage of a Neoarchean metamorphic event. The age of a pre-mineralization quartz porphyry is 2.83 Ga and the age of a post-mineralization pegmatite is 2.450 Ga.

In the Strel'ninsky greenstone belt, the Sergozerskoe and Vorgovy gold occurrences are located near the fault separating Neoarchean complexes of the Strel'ninsky belt from the Paleoproterozoic Imandra-Varzuga belt. Gold mineralization is controlled by a zone of ductile deformation and alteration at the contact of komatiitic basalts and tholeiiteic basalts. Host rocks are metamorphosed at upper greenschist to lower amphibolites facies. Chlorite, calcite, and quartz form the distal alteration halo, and alteration mineral assemblage in the proximal zone includes biotite, calcite, and quartz. Native high-grade fine gold is associated with disseminated arsenopyrite and gersdorfite. The gold occurrences formed in Early Proterozoic at the retrograde stage of the Svecofennian metamorphic event (1.85-1.70 Ga).

Gold occurrences of the Paleoproterozoic South Pechenga belt are located in basalts, andesite-basalts, and their tuffs, which were metamorphosed to upper greenschist facies. Gold is concentrated in quartz metasomatites, formed at the intersections of NE- and NW-trending faults. Lenses and bodies of gold-bearing quartz metasomatites cut stratigraphic boundaries of volcanic units, and were folded together with the host rocks. Quartz metasomatite formed at the peak of the Svecofennian metamorphic event

(~1.93 Ga), as has been established by Sm-Nd and Rb-Sr isotope studies. Metasomatites contain disseminated arsenopyrite with gold as inclusions.

The tectonic setting, structure, alteration, and character of mineralization in the investigated occurrences are typical pf orogenic gold deposits formed in supracrustal complexes at the amphibolite facies of metamorphism. Two epochs of gold mineralization were distinguished in the region: Neoarchean (2.83-2.60 Ga) and Paleoproterozoic (1.93-1.70 Ga), and in some cases Paleoproterozoic mineralization is present in Neoarchean rocks.