

## Orogenic gold deposits of the Verkhoyansk-Kolyma fold belt, northeastern Russia

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Taking into account the tectonic setting, mineral composition of the ores, timing of ore formation, and relationship to orogenic granitoids, three main types of orogenic gold deposits can be identified in the Verkhoyansk-Kolyma fold belt:

- 1) early orogenic disseminated gold-sulfide and gold-bearing quartz veins in shear zones
- 2) late orogenic gold-bearing quartz veins in fault zones
- 3) late orogenic intrusion (granitoid)-related gold-bismuth ores

The *early orogenic disseminated and vein deposits in shear zones* were formed during the early stages of the Oxfordian-Kimmeridgian collisional and accretionary events prior to the emplacement of large orogenic granitoid plutons. Well developed linear folds and faults formed in the ore districts. The orebodies are conformable to bedding. They form multi-level veins with accompanying cross-cutting apophyses, and are folded with their host rocks. Gold is free, coarse-grained, and thus easy to extract. Gold reserves are a few tens of tons and the deposits are mostly concentrated in the foreland zone of the Verkhoyansk fold-and-thrust belt. This type of mineralization is characteristic of the South Verkhoyansk synclinorium where dislocation and metamorphic processes were related to subduction processes at the Uda-Murgal arc. Gold mineralization occurs in the western part of the synclinorium in a zone up to 50 km wide and more than 300 km long (Yur-Brindakit and Onocholakh ore districts). Structurally, the location of extensive stratified veins is controlled by shear zones. Rocks are metamorphosed under greenschist facies conditions. The veins are dominated by quartz (95%) with lesser albite and carbonates. The amount of sulfides and gold does not exceed 1 vol%. Sulfides are represented by arsenopyrite with lesser pyrite, galena, sphalerite, and chalcopyrite. Fahlore is often present. Formation of the early generations of quartz is associated with juvenile-metamorphic fluids, and that of the late generations with magma rising to shallow crustal levels.

The largest deposits of northeastern Russia (Nezhdaninskoe, Natalka, Drazhnoe, Bazovskoe, Malo-Tarynskoe) belong to the *late orogenic vein deposits in fault zones*. They form extensive metallogenic belts (Yana-Kolyma, Allakh-Yun), and are hosted by upper Paleozoic – early Mesozoic terrigenous strata. They are associated with the Tithonian-Valanginian S- and I-type granitoids of ilmenite series. The deposits were formed after the intrusion of granitoids, and are typically located several kilometers away from plutons. Their location is controlled by high-amplitude extensive thrusts and less often by strike-slip faults separating blocks with different geologic structure and tectonic history. Frontal and oblique and frontal and lateral intersections between ramps are interpreted as a key structural-tectonic factor controlling the spatial distribution of gold mineralization. Structural-morphological types of the ore zones (vein, vein-veinlet, veinlet-disseminated, mineralized tectonites) occur in various combinations and

proportions. Characteristic features of the orebodies are their constant mineral content of 85-95% quartz, 5-15% ankerite, and ~1% ore minerals..

The *late orogenic intrusion (granitoid)-related gold-bismuth* gold deposits are hosted in dikes of various composition (granite-porphyry, porphyrite, diabase), in small granitoid stocks, and in hornfels aureoles to the stocks.