Ore Mineralization of the Amur Stratiform Zinc Deposit (Southern Urals)

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Presented by Academician D.V. Rundkvist February 22, 2012

Received January 26, 2012

Abstract—This paper deals with the geological structure of the Amur zinc deposit. The host shaly-carbonaceous flysch sediments are evaluated from the point of view of their precious metal, tungsten, and molybdenum potential. It is shown that the rare-metal mineralization is superimposed on a primarily sedimentary precious-metal mineralization and stratiform zinc ores. The discussed data permit us to look at these carbonaceous sediments as highly prospective for rare metal and precious metal mineralization.

DOI: 10.1134/S1028334X12060281

The Amur stratiform zinc deposit is situated in the junction zone between the Magnitogorsk and East Uralian megazones of the Southern Urals, at the latitude of the central part of the Suunduk granite massif’s western contact. Structurally, the discussed territory coincides with the western wing of the meridional brachyanticline fold that gently aims northwards (Fig. 1). There are three strata distinguished in the geological section of the deposit (from bottom to top): molassoid (D₁–2), ore-hosting terrigenous-sedimentary–flyschoid (D₂–3), and volcanogenic (D₃–C₁). The deposits of the molassoid stratum are represented by interwoven quartzites and quartz-feldspar rocks. The flyschoid stratum can be subdivided into two parts: the lower one is composed of feldspar–quartz–biotite and biotite–chlorite shales and marble-altered and dolomite-altered limestones; the upper one contains nearly all the ore bodies and consists mainly of clayey-carbonaceous shales with carbonate rock interbeds. The volcanogenic stratum is composed nearly wholly by tuffs and tuffites of basic composition, pierced with dikes of high-titaniferous gabbros and gabbro-diorites.

The main ore body lies conformably with the general bedding of the rocks, has a bed-like shape, and a gentle (15°–30°) westward dip. The thickness of the ore body is in the range of 1.0–22.5 m (7.8 m, on average). The principal ore minerals are pyrite, sphalerite, and pyrrhotine. The zinc content in ores changes from 0.7 to 26.7% (2.76%, on average); the lead content, 0.01–0.46%; the copper content, up to 0.1%; the gold content, up to 0.1 g/t. In terms of geological conditions and the occurrence and composition of ores, the Amur deposit is similar to the Filizchai deposit in the Caucasus Region.

In 2007–2008, OAO Chelyabinskii Tsinkovyi Zavod (Chelyabinsk Zinc Plant) implemented prospecting and assessment works at the Amur deposit. These works allowed calculation of the zinc reserves, research into ore-hosting deposits for noble and rare metals, and, in addition to this, reconstruction of the paleogeographic settings of their accumulation [2].

The contents of gold, platinum, palladium, and iridium were determined at the Laboratory of Mineral Substance Analysis, Institute of Geology and Mineralogy, Russian Academy of Sciences (head of the laboratory, V.V. Distler), by the atomic absorption method. The lower detection limit for all the mentioned elements was 0.0005 g/t (Table 1). The tungsten, molybdenum, and vanadium contents were determined in the Analytical Test Joint Use Center (ATJUC) of the Fedorovskii All-Russia Research Institute of Mineral Raw Materials (head of the Center V.S. Kordyukov), by the photometric method. The lower detection limits were 0.002% (20 g/t) for W and Mo and 0.0005 (5 g/t) for V.

In the framework of geological allocation, we firstly implemented float sampling (75 samples) and then channel sampling (35 samples of 1 m long) of mainly sulfide- and quartz-altered carbonaceous shales. The average gold content in them was 0.13 g/t, which is 2.6 times higher than in an oregenic anomaly. The highest gold contents in carbonaceous shales were 3.19, 1.79, and 1.65 g/t (Table 1). Notably, nearly all the anomalously high gold contents were spatially associated with local depressions in the limits of the shallow water shelf of the basin [2] where zinc ores accumulated. The highest palladium contents were 0.65 and 0.55 g/t. The average platinum content...
Fig. 1. The section of the western framing of the Suunduk granite massif (with the graph of gold and tungsten distribution from west to east). 1–5 are stratigraphic subdivisions: 1, volcanogenic stratum (D3–C1): basalts and andesibasalts (a), volcanogenic–sedimentary rocks of basic composition (b); 2, flyschoid stratum (D2–3), upper pack: carbonaceous–clayey, carbonaceous–clayey–calciferous shales and rhythmites with marble-altered limestone interbeds; 3, flyschoid stratum (D2–3), lower pack: metamorphic shales and marble-altered limestones; 4, molassoid stratum (D1–2): granite-altered arkose sandstones; 5, polymictic sandstones of the Rymnik Formation (O); 6, intrusive bodies of high-titaniferous gabbroids; 7, ore bodies of the upper ore-bearing horizon; 8, lower ore-bearing horizon (a) and predicted ore bodies (b); 9, disjunctive dislocation (faults and schistosity zones); 10, boreholes and their depths; 11, granites.