

Low-grade ultramafic-hosted SMS deposits: Case study of the Pobeda hydrothermal field

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Introduction

Seafloor massive sulphide (SMS) deposits associated with ultramafic rocks are widespread along the Mid-Atlantic Ridge (MAR). Compare to basalt-hosted, these deposits are enriched in Cu, Zn, Au, Co, Ni, and Au, where Cu+Zn contents vary from 20 to 40 % (Fouquet et al., 2010). The Pobeda hydrothermal cluster (17°09'N) is located on the eastern flank of the MAR rift valley and associated with lower crust and mantle rocks (gabbro-peridotites) of an oceanic core complex (Bel'tenev et al., 2015; 2016). The sulfide mineralization shows low grades of Cu, Zn, and Au with high Ni contents. The factors affecting this unusual composition of SMS from Pthe obeda site are considered.

Results

The Pobeda cluster was discovered in 2014-2015 during 37 Cruise of the R/V Professor Logatchev (Polar Marine Geological Exploration Expedition). This cluster consists of two hydrothermal fields. The age of the SMS is estimated at >177 ka (Gablina et al., 2018) and present-day hydrothermal activity is observed (Bel'tenev et al., 2015, 2016). Deposits were sampled by TV-grab (seven stations) and by dredge (two stations). The host-rocks are mainly represented by serpentinized peridotite and gabbroid. The recovered samples are represented by fragments of massive sulfide (no chimneys), mineralized rocks, hydrothermal crusts, and sulfide-bearing sediments. The detailed compositions were determined for 40 samples of massive sulfides.

The mineral composition is represented by pyrrhotite and pyrite; isocubanite, sphalerite, chalcopyrite, anhydrate, and opal are less common. The texture of alteration and replacement were recognized in most of samples.

The mean metal content was compared with SMS of the MAR related to ultramafic and mafic host-rocks. For ultramafic-hosted deposits, the SMS of Pobeda hydrothermal cluster is characterized by low contents of Cu, Zn (Cu+Zn <10%) (Fig. 1) and Au (Fig. 2). The

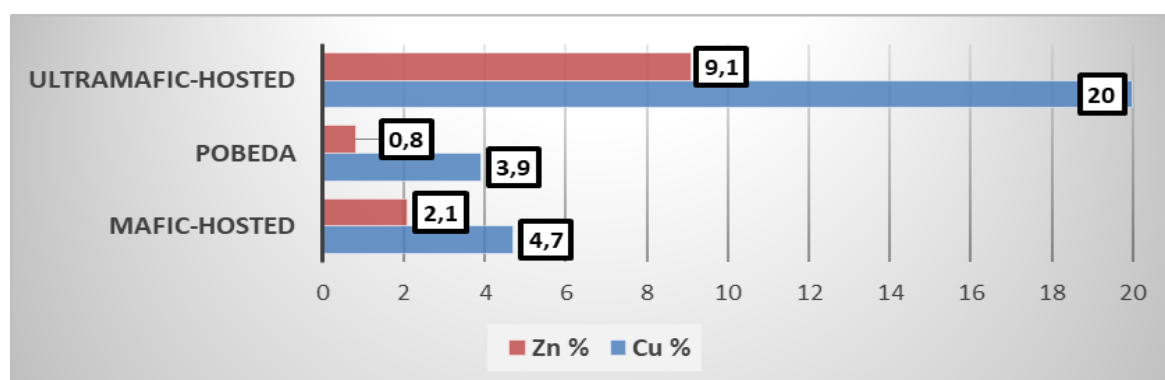


Figure 1. The mean Cu and Zn content in SMS from Pobeda and from the MAR related to ultramafic and mafic host-rocks. (Source: VNIIOkeangeologia database: ultramafic-hosted deposits – 334 samples; mafic-hosted deposits – 726 samples).

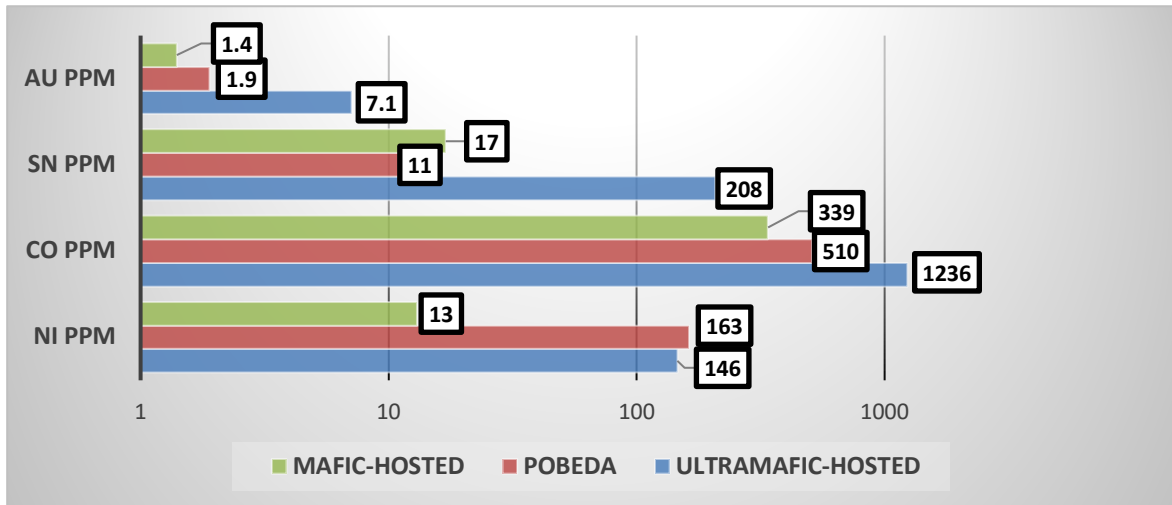


Figure 2. The mean Au, Sn, Co and Ni content of SMS from Pobeda and from the MAR (related to ultramafic and mafic host-rocks).

elevated Sn concentration is usually detected in ultramafic-hosted deposits (Fouquet, 2010) but is not typical for the Pobeda SMS deposits (Fig. 2). Despite the low major metals content, SMS are highly enriched in Ni (max = 613 ppm) (Fig. 2), which is typical for the MAR ultramafic rock-hosted deposits.

The following factors are considered to control the depletion of Cu, Zn, and Au and enrichment of Ni:

Cu, Zn, and Au depletion and Ni enrichment could be related to unrepresentative sampling of the hydrothermal mound. Video observation registered abundant chimneys, which are characterized by higher concentrations of ***Cu, Zn, and Au*** metals but were not recovered. Another reason for low grades of ***Cu, Zn, and Au*** metals in Pobeda SMS might be connected with the age and degree of alteration. Taking into account old age (and long evolution) of the samples (>177 ka) and high degree of secondary processes that resulted in wide spread textures of replacement, it is suggested that Cu and Zn were dissolved from the primary minerals and re-deposited in more enriched (younger) zones (“zone-refining” process). In addition, the presence of abundant pyrrhotite and relicts of anhydrite indicate a very high-

temperature (above 350° C) environment that might not have been favorable for **Cu, Zn, and Au** precipitation. At the same time, these environments promoted high Ni in the SMS.

Acknowledgments

The authors would like to thank Larisa Lazareva for the provided samples. We express thanks to operators Vladimir Shylkovskiyh and Natalia Vlasenko for microprobe investigations.

This work was partly supported by the Russian Foundation for Basic Research, project № 18-05-00861\19.

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