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Characteristics of a detachment-hosted epithermal gold deposit—example from Banská Hodruša, Slovakia

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The intermediate-sulphidation Au-Ag-Pb-Zn-Cu deposit in Banská Hodruša at the Rozália mine represents an unusual subhorizontal multi-stage vein system, related to processes of underground cauldron subsidence and/or exhumation of a subvolcanic granodiorite pluton, accompanied by development of a low-angle normal shear zone, possibly caused by sector collapse of the hosting stratovolcano. The deposit is located in the central zone of the large Middle Miocene Štiavnica stratovolcano, located on the inner side of the Carpathian arc. The subhorizontal vein system occurs in 400–650 m depth and is ~1.2 km long. It ishosted by andesite, near to the flat roof of the pre-mineralisation subvolcanic granodiorite pluton. The deposit consists of two parts, separated by a thick sill of post-mineralisation quartz-diorite porphyry, which transitions from the footwall of the vein system in the east to its hanging wall in the west. The deposit has been mined since 1992 (~14 g/t Au, 17 g/t Ag, 0.4–0.8% Zn, 0.3–0.6% Pb, 0.1–0.2 % Cu, total production ~9 t Au, 5.5 t Ag).

The oldest mineralisation stage is related to hydraulic fracturing along subhorizontal structures that dip20–30° to SE resulting from vertically-oriented extension and consists of low-grade silicified breccia at the base of the deposit. The major productive stage is related to the early evolution of the low-angle normal fault zone with southward movement of the downthrown block and consists of stockworkE-W oriented steep veins (40–60° to S) with quartz, rhodonite, rhodochrosite, sphalerite, galena, chalcopyrite, pyrite, gold, rare hessite, petzite. Locally, these veinsare accompanied by NE-SW oriented quartz-gold veins resulting from complementary sinistral strike-slip movements. The next stage is related torenewed motion of the downthrown block towards the SE. The corresponding NNE-SSW oriented veinsystemconsists of thin quartz-gold veins with medium dip (~45° to SE) in tension cracks inside the shear zone, and complementary detachment hosted (~30°) quartz-base metals-gold veins located exclusively in the roof of the shear zone.

The ore mineralisation is accompanied by strong adularisation, quartz and illite. Illite dominates along the upper plane of the shear zone. The main migration of palaeofluids occurred along low-angle normal faults of the shear zone from S-SE to N-NW, as indicated by the geological setting of the quartz-diorite porphyries that intruded the shear zone at the end of hydrothermal activity from S-SE. Palaeofluids of low salinity (<3 wt% NaCl eq,) and moderate temperature (~270–330°C) experienced boiling that resultedin precipitation of gold and adularia. The main ore mineralisation is related to focusing of fluids in areas where the both low-angle master planes of the shear zone were relatively close together, i.e., where the hanging-wall argillites were relatively close to foot-wall silicites. Opening of dilatational structuresfluid flowand boiling due to the decreased pressure. The origin of late-stage ore veins in the shear zone was controlled by the extensional tectonic regime with the NW-SE horizontally-oriented main tension stress axes.