Overview of some key characteristics and genesis of the LaRonde Penna world-class Au-rich VMS deposit, Abitibi greenstone belt, Québec: implications for exploration

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The LaRonde Penna Au-rich VMS deposit is the second largest known deposit of its class (58.8 Mt at 4.31 g/t, containing 8.1 Moz of Au). It is located in the Blake River Group of the Abitibi greenstone belt and it is part of the Bousquet district. The ore consists of massive to semi massive sulfide lenses (Au-Zn-Ag-Cu-Pb), stacked in the upper part of a steeply dipping, southward facing homoclinal submarine volcanic sequence composed of extensive tholeiitic basaltic flows (Hébécourt Formation) overlain by tholeiitic to transitional, mafic to intermediate effusive and volcaniclastic units (lower member of the Bousquet Formation) at the base and transitional to calc-alkaline (FII ± FI-type) intermediate to felsic effusive (domes and flow breccia) and intrusive rocks (cryptodomes and dikes) on top (upper member of the Bousquet Formation). This volcanic architecture is thought to be responsible for internal variations in ore and alteration styles: in the upper part of the mine, the

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20 North lens comprises a transposed pyrite-chalcopyrite (Au-Cu) stockwork (20N Au zone) associated with a large footwall discordant to semiconformable quartz - biotite ± garnet assemblage (distal) which transitions laterally into a proximal quartz-garnet-biotite-muscovite zone (gains in MnO, $Fe_2O_3^T$, and MgO and losses of Na_2O and K_2O). The 20N Au zone is overlain by a pyrite-sphalerite-galena-chalcopyrite-pyrrhotite (Zn-Ag-Pb) massive sulphide lens (20N Zn zone). The 20N Zn zone tapers with depth in the mine (1900 m) and gives way to the 20N Au zone where it consists of transposed stringers and local semimassive sulphides (Au-rich pyrite and chalcopyrite) enclosed within a large aluminous alteration halo composed of a quartz-pyrite-kyanite-andalusite assemblage that is interpreted to be the metamorphic equivalent of an advanced argillic alteration that has many similarities to that of metamorphosed high-sulphidation systems where all oxides except SiO_2 and Al_2O_3 have been leached.

The variations in ore and alteration styles along the 20 North lens show that the hydrothermal system evolved in time and space from near-neutral seawater-dominated hydrothermal fluids, responsible for Au-Cu-Zn-Ag-Pb mineralization, to highly acidic fluids with possible direct magmatic contributions, responsible for Au ± Cu-rich ore and aluminous alteration in response to the evolving local volcanic setting that controlled the nature of the ore-forming fluids. The host sequence is interpreted to have been generated in an intermediate setting between back-arc basin and volcanic arc environments. This setting could be responsible, at least in part, for the Au enrichment of the VMS deposits of the Bousquet district and represent an exploration target in other volcanic belts.