

Geochemical characterization of gold mineralization at the Archean Hislop and Grey Fox deposits in Matheson, Ontario

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The Archean Hislop and Grey Fox gold deposits, owned by Kirkland Lake Gold Ltd. and Primero Mining Corporation, respectively, are located in the Hislop Township adjacent to the Porcupine Deseor deformation zone (PDDF), about 85 km east of the gold-rich Timmins district. The deposits are classified as greenstone-hosted quartz-carbonate vein gold deposits, in which the mineralization is in veins and locally associated with pyrite in the wall-rock. In both deposits, the gold-associated veining is concentrated in intermediate to felsic volcanic rocks characterized by an abundance of flow-top features (e.g., hyaloclastite, pillows, amygdules, variolitic/spherulitic textures). These features confer a higher intrinsic permeability, in addition to the increased competency, than is present in the surrounding mafic volcanic rocks; collectively, these attributes make the felsic to intermediate rocks prone to brittle failure during deformation, and hence generate greater permeability. This setting is ideal for fluid migration, and the rocks consequently record a prolonged history of fluid infiltration that has resulted in a series of alterations that pre-date, are synchronous with, and post-date the deposition of gold. It is therefore important to deconstruct these overlapping events to isolate and characterize the alteration and geochemical signatures associated with gold mineralization. This is being approached through integration of petrography, litho-geochemistry, SEM-EDS imaging and analysis, isotopic analysis, and fluid inclusion studies. At the Hislop and Grey Fox deposits, gold mineralization is associated with abundant pyrite and ankerite with minor REE-phosphate phases (monazite, xenotime). A more widespread alteration halo present outside of the gold-mineralized zone is characterized by dolomite and conversion of titanite to rutile. This veining and alteration overprints pre-existing alteration, which includes chloritization, albitization, and sericitization; in addition, late disseminated hematite is common. The increased abundance and degree of alteration present in the intermediate to felsic volcanic rocks in the deposit areas suggest that fluid migration was preferentially localized to these rocks. Thus, recognition of the primary nature of volcanic rocks can provide an important screening method in exploration, and when used in conjunction with geochemical signatures associated with gold, it may prove to be valuable in the search for new deposits here and elsewhere.