

# Genesis of the Auriferous C Quartz-Tourmaline Vein of the Siscoe Mine, Val d'Or District, Abitibi Subprovince, Canada: Structural, Mineralogical and Fluid Inclusion Constraints

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## Abstract

The C quartz-tourmaline vein of the Siscoe deposit is a classic example of a high-grade Archean gold lode and averages 45 g/t Au, locally attaining 221 g/t Au. This vein cuts all dikes, the main regional foliation ( $S_2$ ) and several auriferous quartz-carbonate veins and is interpreted to be a shear vein, which formed during the development of a late to post- $D_2$  reverse fault. The vein is composed of alternating tourmaline- and quartz-rich layers with minor amounts of rutile, scheelite, apatite, chlorite, muscovite, carbonate (mainly calcite), pyrite, chalcopyrite, tetradymite, and native gold. Vein filling occurred during the development of a reverse fault through a process involving repeated episodes of opening, mineral deposition, and plastic and brittle deformation. The vein geometry was controlled by local rheologic heterogeneities or by a west-northwest–east-southeast compressive event. The wall-rock alteration is characterized by the occurrence of tourmaline, pyrite, and calcite.

The timing of gold deposition and the gold fineness in the C quartz-tourmaline vein differ from those of the wall rock. In the vein, native gold (4.7–7.3 wt % Ag) was the latest phase to deposit and commonly occurs in fractures that cut across the quartz and tourmaline layers; whereas in the wall rock, gold (7.9–13.2 wt % Ag) started to precipitate just before or synchronously with pyrite. Consequently, the textural and mineral chemical evidence suggests that the fluids in the vein and wall rock were not in equilibrium with each other during gold deposition and that the mechanisms of precious metal precipitation were different in the two environments.

In the wall rock, gold started to precipitate synchronously with sulfides due to reaction of hydrothermal fluids with magmatic ilmenite. This reaction caused the destabilization of gold bisulfide complexes and prompted gold deposition; however, sulfides are very rare in the C quartz-tourmaline vein, and gold deposited after the main episode of vein filling, suggesting that its precipitation was not controlled by pyrite deposition. The occurrence of aqueous-carbonic (AC) fluid inclusions in healed fractures that radiate from gold grains suggests that these fluids were associated with the ore-forming process. Two types of aqueous-carbonic fluid inclusions were identified:  $H_2O$ -NaCl- $CO_2$ -bearing (salinities between 4 and 7 wt % NaCl equiv) and  $H_2O$ -NaCl- $CO_2$ - $CH_4$ -bearing (salinities varying between 7 and 9 wt % NaCl equiv). Both types homogenize at  $T > 190^\circ C$ . Based on structural, textural, and fluid inclusion evidence, we propose that gold deposition in the C quartz-tourmaline vein took place after the main episode of vein filling as a result of continued fracturing and mixing of these two fluids.