

Early Alteration Matters: A Lesson From the Ormaque Orogenic Gold Deposit, Val-d'Or, Québec, Canada

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In Archean orogenic gold deposits, the reactivation of structures controlling fluid circulation is a common phenomenon leading to the superimposition of hydrothermal episodes. This complicates the interpretation of distal alteration halos and their use in exploration. The Ormaque deposit, located in Val-d'Or (Abitibi, Canada) illustrates this complexity. It consists of a network of subhorizontal quartz-tourmaline-carbonate (QTC) veins of up to 650m in length and 2m in thickness, mainly hosted in a syn-volcanic porphyritic diorite, as well as in andesitic tuffs, and centred on weakly mineralized E-W subvertical shear zones. Our work demonstrates the existence of two other hydrothermal events predating the QTC veins and the main deformation episode. The first episode, mainly observed in the less altered southern part of the deposit, is characterized by centimetric veins of magnesian tourmaline (Mg# $\pm$ 70), associated with white mica alteration. A second, more extensive episode, exceeding 200m in width and centered around some of the E-W subvertical shear, mainly consists of an alteration envelope of Fe-rich chlorite (Mg#30-45) where pyrite-chalcocopyrite veins and carbonate-magnetite±pyrite chalcocopyrite sphalerite veins are common. Locally, the tuff is intensely altered by a garnet-chloritoid-magnetite and Fe-rich chlorite (Mg# $\pm$ 20) assemblage, with disseminated auriferous pyrite, reminiscent of metamorphosed alteration zones associated with some Abitibi VMS deposits.

These two early hydrothermal events are followed by the emplacement of the QTC veins. A proximal tourmaline-carbonate-pyrite alteration reaches 2m in width, with a distal zone extending up to 5m overprinting both earlier alteration facies. Within the Fe-rich chlorite envelope, this alteration is more intense and differs from the southern part of the deposit with more Fe-rich tourmaline (Mg#45-55 vs 65-75) and chlorite (Mg#45-50 vs 60-65). Some alteration assemblages associated to the QTC veins therefore likely result from the modification of altered rocks from earlier hydrothermal episodes, likely of volcanogenic origin.