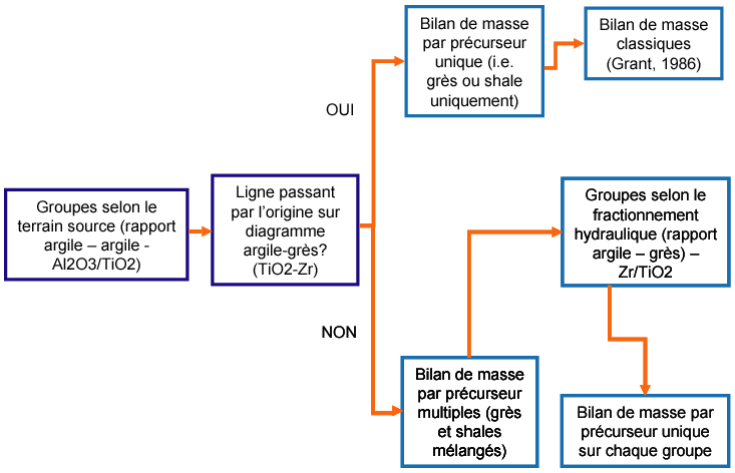
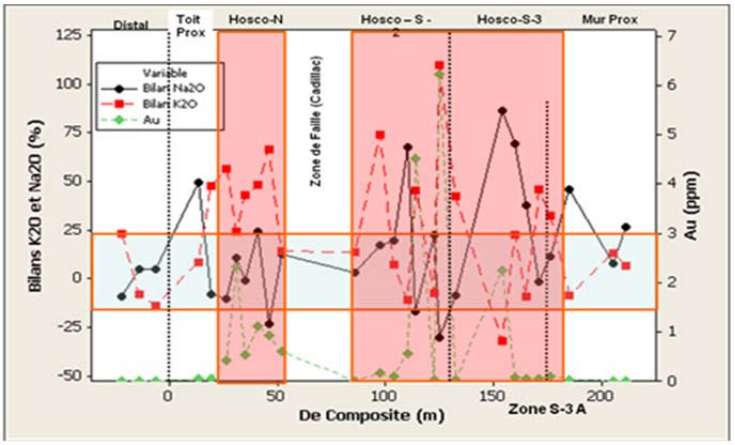
2009-08: Alteration associated with gold in sedimentary rocks

Alteration characterisation help recognise hydrothermal fluid circulation associated with mineralisation. The techniques are well known in a VMS environment and in gold exploration based on modification of the geochemical composition of igneous protoliths (volcanic and plutonic). However, for gold mineralisation, there are a number of localised settings in sedimentary environments where the variability linked to the primary characteristics of the sediment is difficult to distinguish from those caused by alteration processes.



A. Flow chart showing the steps to take to recognise alteration in sedimentary rocks



B. Graph showing local potassium and sodium gains and losses related to mineralisation in the Joanna deposit.

Turbidites have a compositional variability related to weathering and hydraulic sorting of mafic minerals. However, Zr-TiO_2 and Al_2O_3-Zr immobile element diagrams help isolate sample populations with similar origins and similar hydraulic sorting (sandstones vs clays). Samples from each identified population can then be considered as having been derived from a similar pre-hydrothermal alteration protolith. A mass balance calculation method similar to the one used for volcanic rocks can then be proposed for turbidites (**figure A**). Testing the method on the Joanna deposit in Rouyn-Noranda shows that the alterations are visible up to 25 metres beyond the mineralisation (**figure B**).

Project 2009-08 aims to test some approaches for characterising the extent and the nature of the alterations associated with gold mineralisation hosted in sedimentary sequences. The project is limited to two distinct components: gold mineralisation hosted in turbidite sequences and gold mineralisation associated with iron formations.

Iron formations reveal a more complex problem because they consist of three components (chemical, clastic, hydrothermal) that affect the composition. Statistical studies of samples from the Meadowbank deposit in Nunavut show that gold is preferentially associated with the chemical apex. The lithogeochemical approach is thus not sufficient. However, a preliminary mineralogical study indicates that a fertile alteration seems to stand out due to its large grunerite content.

Project 2009-08: Summary	
Objectives	• To identify criteria for evaluating the alteration of sedimentary rocks in the context of gold mineralisation. • To define the extent of alteration. • To assess fertility criteria of iron formations for gold mineralisation.
Innovation	• Development of a flow chart for isolating sedimentary rock families to identify mass gains and losses related to alteration. • Recognition of the mineralogical variability in iron formations containing economic gold grades compared to subeconomic ones.
Results	Joanna (turbidites): • Recognition of areas with mass gains and losses surrounding the mineralised zones. • Alteration extends 25 metres in the stratigraphic roof and wall of the mineralisation. • Mineralised zones show mass balance differences. Meadowbank (iron formation): • Gold is associated with the chemical component of the iron formations. • Economic and subeconomic iron formations show similar co-variations between gold and other metals. • The strong presence of grunerite in the silicate phase is indicative of the iron formation's fertility.