2013-07: Classification of alteration associated with gold mineralisation in the Abitibi region

Alteration is widely recognised in gold deposits. However, although there are some tools for characterising it, most face many limitations, including the lithological sequence, that influence the results. In light of the limitations of the existing tools, it seemed necessary to develop a new, more versatile tool that is independent of lithology and more objective – a new tool to effectively characterise the alteration in a gold-bearing context and to identify the hydrothermal signatures of deposits. In addition, as a follow up to CONSOREM projects on the classification of gold mineralisations along the Cadillac Fault (2011-01 and 2012-01), it seemed worthwhile to define the hydrothermal fields associated with gold mineralisation in the Abitibi using a quantitative approach, and to compare them with the metallogenic camps identified by the descriptive method. This project consists of two components: 1) to develop a tool for characterising alterations in a gold-bearing context, and 2) create a profile of the hydrothermal activity associated with gold mineralisation in the Abitibi.

The present project builds on a methodology based on a quantitative approach to lithogeochemical data. Initially, a large quantity of data from non-volcanogenic gold mines and deposits of the Abitibi was processed using the LithoModeleur software (version 3.5.4) to retain relevant and exploitable analyses, namely altered igneous samples with a gold content higher than 1 g/t which were representative of the deposit. In the end, 405 analyses met the criteria from 56 gold mines or deposits and were selected for this study. Following the compilation of information about the deposits and the integration of lithogeochemical data, mass balance calculation by modelled precursor and by single precursor were used to identify metasomatism.

The tools proposed in this project were developed based on a premise and an observation from many extensive studies. The premise specifies that for a constant fluid composition, the type (e.g. sodic alteration), the intensity (e.g. strong alteration) and the distribution style (e.g. replacement alteration) of the alterations are greatly influenced by the lithology of the country rocks, metamorphic grade and host rock permeability. Among these three parameters which modify the alteration, only the influence of lithology can be neutralised by some of the existing tools; the remaining parameters cannot be controlled by geochemical tools. Mass balance calculations and the carbonate saturation index (CO_2/CaO+FeO+MgO) are the only tools independent of lithology; furthermore, they treat hydrothermalism quantitatively, showing hydrothermal intensity. An observation based on several reviews about gold shows that major proximal alterations associated with non-volcanogenic gold mineralisation are carbonatation, potassic alteration and sodic alteration. Among existing tools, carbonate saturation index reveals carbonatation; gains in potassium and sodium mass balance represent potassic alteration and sodic alteration, respectively.

The two new tools proposed in this project (SatCarbKNa and DiscrCarbKNa, included in LithoModeleur 3.6.0) are a combination of several pertinent tools. They take the shape of binary diagrams illustrating the intensity of potassic and sodic alterations, and the intensity and the type of carbonate alteration. By inserting data from the mineralised samples into the software tools, it was possible to identify hydrothermal signatures specific to several gold deposits in the Abitibi. While respecting the sectoral aspect and the geological context, it is now easy to

compare the signature of various lithogeochemical data with data from known deposit in the Abitibi.

Spatial integration of the hydrothermal signatures of non-volcanogenic gold deposits in the Abitibi demonstrates hydrothermal complexity especially along the Cadillac Fault. Nevertheless, there is some similarity between the hydrothermal fields identified using the quantitative approach (this project) and the metallogenic camps identified using the descriptive approach (projects 2011-01 and 2012-01).

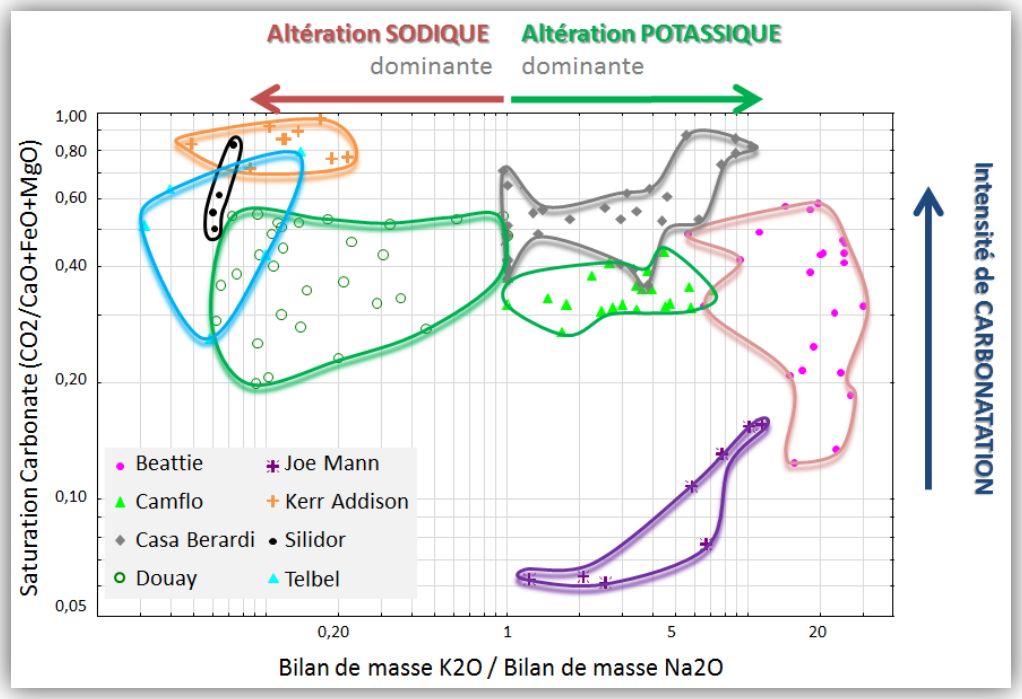

Figure 1. SatCarbKNa characterisation tool to describe potassic, sodic and carbonate alterations: showing fields of hydrothermal signatures for some of the gold deposits in the Abitibi.

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Project 2013-07 : Summary	
Objectives	• To develop a geochemical tool to guide gold exploration better by rapidly identifying alterations in lithogeochemical analyses, and by associating the results with the hydrothermal signatures of known gold deposits. • To identify and quantify hydrothermalism in the Abitibi by deposit and by camp.
Results and Innovations	• Preparing an inventory of alteration characterisation tools and their application (literature). • Compilation of the main features of studied non-volcanogenic gold deposits (literature). • Using mass balance calculations in gold-bearing environments (previously used almost exclusively in VMS contexts). • Statistical processing of the geochemistry of gold deposits. • Development of binary diagrams for the characterisation of alteration by looking at the saturation parameters, carbonate discrimination, and the K_2O and Na_2O mass balance. • Identification of metasomatism for many gold deposits in the Abitibi based on carbonatation parameters, and the potassic and sodic mass balance. As well, identification of discriminant hydrothermal signatures for gold mineralisation. • Identification of hydrothermal fields in the Abitibi, using the geochemical signature of gold mineralisation. • Comparison with the metallogenic camps identified using descriptive methods (projects CONSOREM 2011-01 and 2012-01). • Creation of geochemical tools independent of lithology, showing the main alterations in a gold-bearing context. • New overview of hydrothermal activity associated with gold mineralisation for non-volcanogenic gold deposits in the Abitibi.