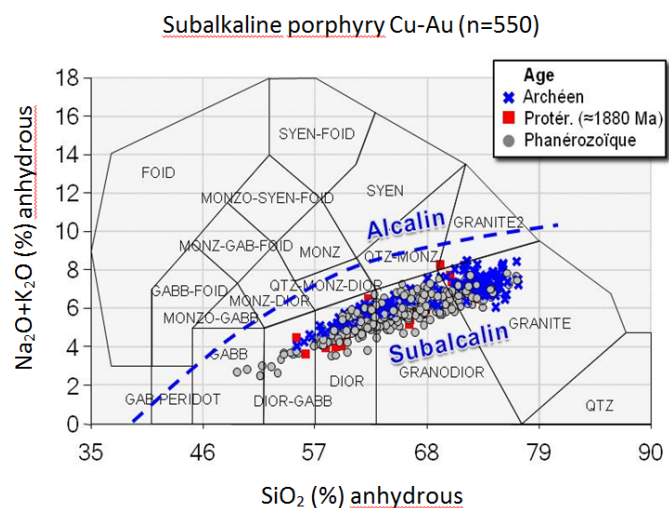


Project 2011-07: Subalkaline porphyry Cu-Au: geochemical characteristics and exploration targets in the Archean and Paleoproterozoic high-grade metamorphic terrains of Quebec

This project focuses on the geochemical characteristics of subalkaline porphyry intrusions containing Cu-Au mineralisation whose ages vary between 2734 and 1 Ma. Emphasis is placed on methodology, firstly, to recognise the true nature of the protoliths by subtracting the effect of hydrothermal alteration and by comparing the geochemistry of recent intrusions and Archean or Proterozoic intrusions and secondly, to identify the discriminant geochemical elements that distinguish between mineralised and non-mineralised intrusions. The proposed approach has led to the development of several regional exploration targets in the Superior (excluding the Abitibi Subprovince) and the Grenville Provinces.

A litho-geochemical database of porphyry Cu-Au was created from the literature. It contains 639 samples from 60 deposits, including the main large deposits in the world and especially the few known Paleoproterozoic deposit from Scandinavia. A third of the samples in the database are geochemically altered and most of the samples (560) have been classified subalkaline and calc-alkaline. The effect of the alteration was neutralised by calculating the oxides predicted in Lithomodeleur (Project 2011-04) using the mass balance calculation method on modelled precursors. This has allowed us to notice for the first time that the representatives of this class of porphyries are remarkably grouped along a differentiation curve, with one series going from gabbroic diorites to granites, and especially that there is no difference in the major element concentrations and in the classification between Archean, Proterozoic and recent Cu-Au porphyries (attached Figure).

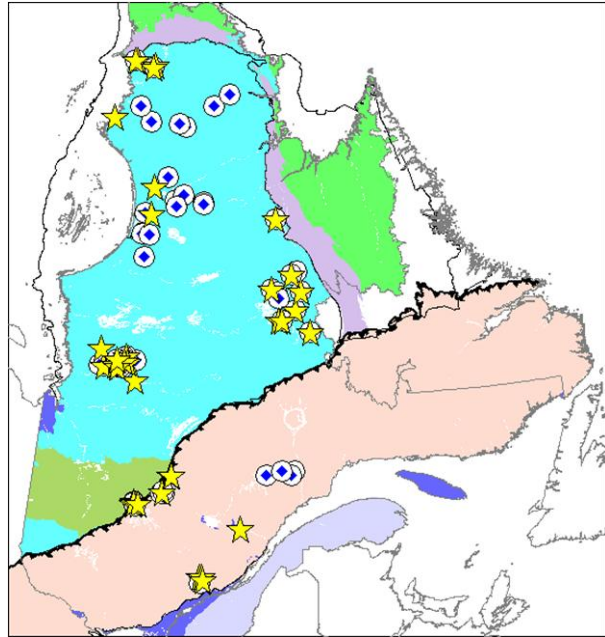
The challenge then became to recognise in the Superior and Grenville rocks, and among the 6 393 litho-geochemical samples from SIGÉOM's intrusions, the « geochemical recipe » as close as possible of Cu-Au mineralised porphyry. Using filters, the two litho-geochemical data banks were compared in order to evaluate the performance of the most discriminating elements and the ratio of elements that characterise this type of mineralisation. The purpose of the comparison was to retain the greatest quantity of litho-geochemical data in the porphyry Cu-Au database and to subtract the most data possible from the SIGÉOM database, which *a priori* contains very few mineralised porphyries. Effectiveness of the various criteria used was evaluated using an ROC (Receiver Operating Characteristic) curve. The most effective discriminating criteria for reducing the number of samples in the SIGÉOM database are the ones that use rare-earth elements and composite indices that take into account a series of filters operating on minor and trace elements. These new discrimination criteria make it possible to recognise possible subalkaline porphyries favourable for Cu-Au mineralisation in a litho-geochemical database. To facilitate the transfer to the user, new software was created in Lithomodeleur. This fertility tool is based on a neural network model that



Organised distribution of subalkaline porphyry Cu-Au samples in a TAS diagram (Middlemost, 1985) for predicted oxide values by using mass-balance calculations on modelled precursors.

was trained using the two databases (SIGÉOM and Cu-Au Porphyries). Two models were created. They differ in the number of trace elements required for the calculations.

In total, 38 out of 611 (6.2%) samples from the SIGÉOM intrusions were found to be favourable (yellow stars, attached Figure) using the discriminating filter approach; 57 out of 1396 (4.1%) samples were found favourable using one of the two neural network methods in Lithomodeleur (circle with blue diamond, attached figure). 40 % of the samples overlap between the methods. Two sectors have been identified in the Grenville: the Grenville Front along the extension of the Abitibi and in the La Bostonnais Arc, Portneuf region. In the southern Superior Province, the Lac Ell intrusion close to the X Eleanor Mine, as well as several other magnetic intrusions at the contact between the Laguiche metasedimentary rocks and the Eastmain volcanic belt has been identified as potentially fertile. The Lac Pau gold-bearing porphyry intrusions as well as other adakitic arc intrusions in the Ashuanipi Subprovince are considered as targets.



Identification of Malartic-Lamaque-type porphyry intrusions on a Pearce diagram (1996).

Project 2011-07 : Summary	
Objectives	<ul style="list-style-type: none"> To better identify and characterise the geochemical nature of porphyry Cu-Au protoliths by removing the effects of hydrothermal alteration. To compare the geochemistry of Cenozoic subalkaline Cu-Au porphyries with the geochemistry of known Archean and Proterozoic mineralised porphyries. To recognise intrusions favourable for this type of mineralisation in the high-grade metamorphic terrains of the Superior and Grenville Provinces.
Results	<ul style="list-style-type: none"> Discriminating geochemical approach based on trace elements. Automated fertility tool in Lithomodeleur to identify porphyry Cu-Au. Several exploration targets confirmed in the field using porphyry-type mineralisation.
Innovations	<ul style="list-style-type: none"> New discriminating technique for porphyry Cu-Au. New discrimination tools in Lithomodeleur.