# Geochemical Constraint of the Gold Mineralization Sources from the South Mine Complex and the Main/'04 Breaks, Macassa Mine, Kirkland Lake, Ontario

**L Stammers[1], S Horvath[1], N Banerjee[1], S Carmichael[2], R Glover[2], C Evans[2], S Farrell[2], J Johnson[2]**

[1] Department of Earth Sciences, Western University, London, Ontario; [2]Kirkland Lake Gold Inc., Kirkland Lake, Ontario

Kirkland Lake Gold Inc.'s (TSX: KGI) Macassa Mine has two main systems of mineralization: 1) the Main/'04 Breaks, and 2) the South Mine Complex (SMC). The objective of this work is to constrain gold mineralization sources between these systems using characteristic geochemical signatures. The Main and '04 Breaks are part of a post ore, thrust or reverse fault that strikes northeast and dips south 60º to 85º. It is an epigenetic, structurally controlled, greenstone hosted narrow quartz-carbonate vein system with a thin haloing alteration zone. The SMC is a series of structurally controlled zones with a similar set of ore minerals as the Main and '04 Breaks. It is currently interpreted to be a linking Riedel Shear between the '04 Break to the north, and possibly the Amalgamated Break to the south. As such, it dips shallowly to the southeast at 25° to 50°, but steepens up to 60° at depth. The SMC's mineralized zones are more sulphide rich with more prevalent and varied tellurides, and have a wider associated alteration zone than the Main and '04 Breaks. Variability is also seen between the two systems in terms of whole-rock trace- and major-element composition within both the mineralization and alteration. Furthermore, oxygen isotope analyses of quartz and chlorite mineral separate pairs within auriferous samples suggest higher fluid temperatures within the SMC. In addition, oxygen isotope analyses of mineralized whole rock samples and quartz separates from the SMC suggest a greater magmatic component may have been present in the source fluids than its counterpart. We have also conducted in situ synchrotron radiation micro x-ray fluorescence to map trace element distributions within gold-associated sieved textured pyrites, tellurides, and gold grains to determine the elements directly associated with gold mineralization. These associations provide excellent pathfinder elements to gold mineralization, particularly those of nickel and lead. Knowledge of the association of magmatic fluids with the SMC along with the suite of pathfinder elements determined in situ and from bulk analyses can be placed in a structural framework and can be used to generate new targets.