Colloidal Gold Adsorption on Phyllosilicates and the Correlation of Gold and δ^7Li: Insights from Kirkland Lake, Hemlo, Hardrock and Red Lake World-Class Gold Deposits, Canada

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Alkali metasomatism is common in most, if not all hydrothermal ore deposits, as the mobile alkali elements Na and K may be either remobilized from precursor rocks or precipitated as new minerals. Lithium is also an alkali element, but its presence in trace concentrations normally bounds it to non-Henrian partitionning behavior. Apart from major Li-hosting minerals (e.g., spodumene, lepidolite), Li is commonly hosted in phyllosilicates (micas and clay minerals) and its concentration in these minerals should in principle reflect that in the related fluids. Furthermore, Li possesses 2 stable isotopes that can be ratioed in rocks and minerals: the Li isotopic ratio (δ^7Li) of hydrothermally-altered ores may hence provide information about mineralizing fluids. Drill core samples from Kirkland Lake Inc.'s Macassa gold mine, one of the world's richest Au deposit, and surface and underground samples from Barrick's Hemlo gold deposit, one of Canada's greatest gold camp, both show good correlations between δ^7Li and Au in the hydrothermal halo surrounding the deposits. Laser ablation ICP-MS maps of hydrothermal alterations from Newmont's Red Lake mine, Canada's 3rd greater gold camp, were constructed to verify which mineral(s) hosted the Li and where was the Au hosted. Gold was found in trace concentrations (0.4-10 ppm) in sericite (an illite-muscovite-type white mica), in concentrations greater than in adjacent sulfides. Finally, a variety of indirect methods were employed on drill cores from Greenstone Gold Mine's Hardrock gold deposit, one of the most promising gold project in Canada, to verify if Au had adsorbed to various phyllosilicates. It was concluded that colloidal Au was transported downstream the hydrologic flow and had subsequently adsorbed to chlorite. These findings demonstrate that as a very mobile and fast-diffusing element, Li may follow gold not only during its hydrothermal emplacement, but also during subsequent weathering and supergene enrichments. Given that fluid-rock reactions are a major control on Li isotope fractionation, δ^7Li appears to be a very efficient tool to study the genesis of-, and explore for gold deposits.