Chromium- and Vanadium-Bearing Phyllosilicates at the Kerr-Addison Gold Deposit, Virginiatown, ON: Implications for the Sources and Mobilities of Cr and V in Gold Deposits

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An empirical relationship exists between Cr- and V-bearing green micas (e.g., muscovite var. fuchsite/mariposite and roscoelite) and gold deposits worldwide, given that 10% of the 100 largest lode-gold deposits in the world contain green micas. To better understand this relationship, a study was undertaken to evaluate the mobility of Cr and V by determining how these elements are incorporated into phyllosilicates (muscovite and chlorite). Drill core samples from the two principal protoliths at the Kerr-Addison gold deposit (ultramafic and mafic volcanic rocks of the Larder Lake group), collected proximal and distal to ore zones, were observed using optical microscopy to determine the paragenesis of the phyllosilicates. Mineral-chemical analyses were conducted using energy- and wavelength-dispersive spectroscopy (EDS/WDS) in conjunction with laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). Results show that the phyllosilicates are the major secondary mineralogical hosts for Cr and V in the altered rocks, with muscovite replacing chlorite in the ultramafic suite (chlorite islands enveloped by diffuse rims of pitted muscovite, associated with magnesite and rutile, suggesting replacement of chlorite by muscovite). Phyllosilicates in the altered ultramafic rocks contain Cr, whereas those in the mafic sequence contain V. In the ultramafic suite, Cr contents in muscovite are variable but consistent, whereas V contents in muscovite increase away from proximal zones. These results suggest (1) the ultramafic and mafic rocks were the sources of Cr and V, and the fluids were wall-rock buffered, given the protolith control on the phyllosilicate mineral chemistry; (2) Cr is immobile, whereas V may be more mineralogically mobile at Kerr-Addison by preferentially partitioning into hydrothermal rutile, which highlights their contrasting geochemical behaviours; and (3) chlorite is likely to be a stable intermediate host for Cr and V before these elements are incorporated into muscovite.