

Perrouty S, Linnen RL, Lesher CM, Olivo GR, Piercey SJ, Gaillard N, Clark JR, Enkin RJ, 2018, Expanding the size of multi-parameter metasomatic footprints in gold exploration: utilization of mafic dykes in the Canadian Malartic district, Quebec, Canada, Mineralium Deposita, in press

Ore-forming hydrothermal fluids react differently with different country rocks, but few studies have applied this knowledge with the specific goal of expanding the size of hydrothermal footprints in mineral exploration. To develop this concept, 122 metamorphosed mafic dykes from the world-class Canadian Malartic gold district (18.6 Moz Au) were sampled and analyzed for mineralogy, physical properties, and litho-geochemistry (partial and total digestion). The mafic dykes intrude mainly metasedimentary rocks, post-date D₁ deformation, and cross-cut early-D₂ quartz monzodiorite intrusions, but they were deformed and altered during D₂ deformation, mineralization, and metamorphism. They can be subdivided into three groups: Group 1 dykes are least-altered, characterized by amphibole-rich regional metamorphic assemblages and distributed throughout the Pontiac Subprovince. Group 2 and 3 dykes underwent ore-related hydrothermal biotite–calcite–pyrite alteration and are associated with density- and volume-adjusted concentration gains of over 100% in Au–W–Te–C–S–Ag–Cs–Mo–Cu–K–Rb–Se–U–Pb–Ba–F–Bi–Sn. They define a metasomatic footprint up to 6 km away from the deposit toward the SE and up to 2 km away from the deposit toward the SW. Fifty-eight variables that define halos around the Canadian Malartic deposit have been identified and integrated using principal component analysis. PC1 explains 30% of the variance, separates least-mobile elements from ore-related elements, and is interpreted to reflect the ore-forming alteration process. PC2 and PC3 represent igneous processes. PC4 highlights the calcite–pyrite and biotite alteration. Spatial variations of the modal abundances of amphibole, biotite, calcite, and pyrite are the simplest expression of the metasomatic footprint, and they can easily be documented during exploration at the camp scale.

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