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Minor and Trace Elements in Native Gold: Controls and Metallogenic Implications

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Gold is one of the most critical metals in human history, and still, few investigations have directly studied the composition of native gold as a guide to explain gold systems. Ontario's (Canada) gold deposits serve as a natural example due to their abundance and distribution. The results presented constrain the geochemical signature of native gold using EPMA and LA-ICP-MS in-situ techniques for 299 samples from 70 gold deposits across Ontario. Generally, Ag, Cu, and Hg occur over 100 ppm, with Sb, Pd, Cd, and Bi typically as trace elements between 0.001 and 100 ppm. Gold geochemical signature varies at the craton scale but is consistent at the camp scale: Red Lake, Geraldton-Beardmore, and Confederation Lake samples have similar elemental values and ratios but differ from those in the Abitibi, Temagami, or Wawa greenstone belts. In the Abitibi greenstone belt, differences were identified between samples from the Larder Lake-Cadillac Fault zone versus those from the Porcupine-Destor Fault zone; the latter have higher concentrations of Sb, Cd, and Cu relative to the former. These spatially distinct trace element signatures are independent of local host rocks and deposit types, which have significant implications regarding the controls on the metal content of gold deposits and ore-forming mechanisms, that may reflect district-scale mineral system differences such as source and transport, metamorphism, and remobilization, among others. These data also have important practical applications for industry, for instance, in using elemental vectors that reflect local gold composition and/or in metallurgical processing.