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ION-MICROPROBE ANALYSIS OF FeTi OXIDES: OPTIMIZATION FOR THE DETERMINATION OF INVISIBLE GOLD

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Abstract

Magnetite is a common mineral in a wide variety of hydrothermal Au-bearing ore-deposit types. FeTi oxides also occur as phenocrysts in some Au-bearing silicic volcanic rocks. In oxidized plutons, or reduced plutons that are undersaturated with respect to sulfide, FeTi oxides likely are an important host of Au. To evaluate the volumetric importance of magnetite and ilmenite as hosts for Au in igneous rocks and hydrothermal ore deposits, it is necessary to quantify Au in FeTi oxide minerals. We used secondary-ion mass spectrometry (SIMS) to analyze magnetite and ilmenite standards implanted with ^{197}Au. Samples were sputtered with a Cs^+ primary beam, and negative secondary ions were measured. Because of the small diameter of oxide phenocrysts in volcanic rocks, small raster size and beam-diameter are required. We used a 10-μm diam beam rastered over an area with 50-μm sides. To obtain sufficient background counts and optimum dynamic range, $^{197}Au^-$ counts were measured for up to 5 s per cycle. We obtained measured detection-limits (MDL) of 10 ppb Au in magnetite and 240 ppb Au in ilmenite operating in high-mass-resolution (HMR) mode ($M/\Delta M$ = 4,000 to 5,000). HMR mode was required to eliminate an interference with $^{133}Cs^{48}Ti^{16}O^-$ during analysis of ilmenite. The high MDL for ilmenite was due to the high inherent-Au content of the unimplanted standard. The siting of Au has important implications for both ore genesis and ore extraction. Quantification of Au in FeTi oxides may lead to more accurate mineralogical balances for hydrothermal Au deposits, as well as resolving questions regarding the partitioning of Au in silicic magmas and the behavior of Au in some magmatic-hydrothermal ore-forming systems.