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Trace element geochemistry of greenstone belt gold and gold from the Witwatersrand Basin, southern Africa

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The Witwatersrand Supergroup is believed to have formed over a period of 360 Ma years between 3.07 and 2.71 Ga, and its depositional history has been well documented. The Archaean Barberton greenstone belt has been extensively studied with U-Pb and Pb-Pb dating of ca. 3.0 to 3.5 Ga. The Zimbabwean gold mineralization is thought to have occurred in three phases. The hydrothermal phase associated with the mineralization event occurred at 2.65 ± 0.06 Ga, which was followed by another metamorphic event that occurred between 2.52 and 2.56 Ga; a post cratonic event associated with the intrusion of the Great Dyke of Zimbabwe is dated about 2.41 ± 0.07 Ga, and the mineralization is thought to be similar to the other greenstone belts. The main aim of the research was to test the viability of using gold chemistry to compare the composition of gold ores in South Africa and Zimbabwe. Samples from the Archaean greenstone belts in South Africa and Zimbabwe, as well as samples from ores associated with the Witwatersrand Supergroup. Trace element signatures were determined by LA-ICP-MS and scanning electron microprobe. The following are the most commonly occurring isotopes in gold, namely, 56Fe, 59Co, 60Ni, 63Cu, 66Zn, 75As, 188Os, 105Pd, 195Pt, 202Hg, 107, 109Ag, and 204, 206,207,208Pb and 209Bi. The gold compositional data comparison has been found useful for discriminating between gold samples of hydrothermal origin from the greenstone belts and of modified placer origin of the Witwatersrand Basin. The major differences are elevated concentrations of 56Fe, 60Ni, 63Cu and 66Zn in the greenstone belts, compared to the Witwatersrand Basin, whereas there are higher concentrations of 107Ag and 202Hg in samples from the Witwatersrand Basin when compared to samples from the greenstone belts. These differences have implications for the various models of gold deposition in these environments, pointing to different geochemical histories.