Silver Isotopes as a Source and Transport Tracer for Gold?

M.A. FEHR, W. ARGAPADMI, E.R. TOTH, M. SCHÖNBÄCHLER AND C.A. HEINRICH

Institute of Geochemistry and Petrology, ETH Zürich, Switzerland (manuela.fehr@erdw.ethz.ch)

The source of gold (Au) is a recurrent subject in ore genesis. Silver (Ag) is often a major component of gold with identical crystal structure. In hydrothermal solutions, Au and Ag have generally similar geochemical behavior, because they are both transported as monovalent Au^+ and Ag^+ complexes with Cl^- or HS^- ligands [1,2]. Silver isotopes are thus a potential tracer for understanding the geochemical enrichment of gold. In this study, the Ag isotope composition of gold samples from the Sheba and New Consort mines in the Barberton greenstone belt (South Africa) was measured. Additionally, Ag isotope data were obtained for gold samples from orogenic and carbon leader type deposits (Witwatersrand), and also for hydrothermal silver ores for comparison.

Gold grains were dissolved with aqua regia and Ag was isolated using an anion-exchange separation procedure [3]. Silver isotopes were measured by MC-ICPMS using a Neptune Plus and mass bias was corrected using external normalization to Pd [3].

The investigated gold samples display an Ag content of 1-12 % and variations of 0.8 ‰ in $^{109}Ag/^{107}Ag$. Gold from Barberton displays similar Ag isotope variations as hyrothermal silver ores [4, this study] and displays overall slightly larger Ag isotope fractionation compared to the studied orogenic and Witwatersrand gold samples [5]. Silver has likely a common source for the two investigated related Barberton gold deposits. Therefore, the observed Ag isotope variations are interpreted to primarily reflect the transport and reaction history of Ag. Reduction of dissolved Ag^+ complexes in the ore fluid to native Ag^0 in the gold alloy is expected to produce the observed Ag isotope variations. Assuming that the oxidized $Ag^+(aq)$ is enriched in isotopically heavy Ag compared to the reduced metallic form [e.g. 4], the Ag isotope variations at Sheba and New Consort can be explained by fractional precipitation of precious metals from a fluid that enters the greenstone belt from an external source [5].

[1] Seward (1976) *GCA* 40, 1329-1341. [2] Stefánsson and Seward (2003) *GCA* 67, 1395-1413. [3] Schönbächler et al. (2007*) J. Mass. Spec.* 261, 183-191. [4] Mathur et al. (2018*) GCA* 224, 313-326. [5] Argapadmi et al. (2018*) Econ. Geol.* 113, 1553-1570.