Title: **Gold distribution in Archean continental crust: Evaluating the effects of intracrustal differentiation in the Tanzanian Craton**

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Abstract

We have evaluated the vertical distribution of gold in variably metamorphosed igneous rocks in the Tanzanian Craton: 2.6 Ga upper-crustal greenschist-facies greenstone belt basalts and andesites from the Lake Victoria Gold Field of northern Tanzania, and compositionally similar 2.6 Ga lower-crustal mafic granulite-facies xenoliths that were carried in rift-related basalts that erupted nearby. We implemented the preconcentration method of Pitcairn et al. (2006), which utilizes chromatographic separation of gold from acid-digested rocks using diisobutyl ketone (DIBK), followed by standard addition ICP-MS to determine the distribution of gold in the crust. Repeat analyses of the certified reference material TDB-1, a whole-rock powder diabase dike from Tremblay Lake, Saskatchewan, Canada (certified gold concentration = 6.3 × 1.0 ng/g), yielded an average gold concentration of 6.5 × 1.1 ng/g. Results were reproducible to within 17% for rock powder aliquots between 200-600 mg (n=38), where 400 mg sample aliquots were reproducible to within 6% (n=9), and 600 mg aliquots were reproducible to within 4.5% (n=4). Better reproducibility for the greater sample aliquots likely reflects the 'nugget' effect. Rock samples in the 0.1-0.8 ng/g gold concentration range reproduced to within 27% for 400-600 mg sample aliquots. Although the lavas come from an area containing gold deposits, all were more than 5 km from any gold mine. The Tanzanian greenstone belt basalts have the highest gold concentrations (9 ng/g to 62 μg/g, ave. = 40 (+68/-25) ng/g, 1σ (n=10)), followed by the greenstone belt andesites (0.4 to 120 ng/g, ave. = 1.1 (+0.9/-0.5) ng/g, 1σ (n=14)). The lowest concentrations were observed in the granulite-facies lower-crustal xenoliths (0.1 to 3.3 ng/g, ave. = 0.3 (+0.3/-0.1) ng/g, 1σ (n=21)). Gold is incompatible in silicates and can partition into hydrothermal and/or magmatic fluid or vapour during high-grade metamorphic dehydration reactions or partial melting, particularly if sulfides break down during these processes. Rise of these buoyant mobile phases may explain the observed depletion of gold in the lower crust. Oxidative breakdown of sulfides was observed in some of the lower-crustal xenoliths, whereas some xenoliths did not contain any visible sulfides. Gold concentration in the samples did not, however, correlate with the presence of sulfides, which may indicate that the existing sulfides crystallized after the gold depletion had occurred. References: Pitcairn, I.K., Warwick, P.E., Milton, J.A., and Teagle, D.A.H. Anal. Chem. 2006, 78, p.1290-1295.