Petrogenesis and Emplacement of the TTG and K-Rich Granites at the Buzwagi Gold Mine, Northern Tanzania: Implications for the Timing of Gold Mineralization.

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Abstract

The Buzwagi gold mine, found in the Neoarchaean Nzega greenstone belt of northern Tanzania; is underlain by Neoarchaean mafic volcanic rocks which are intruded by a massive body of ultramafic rocks that are cross-cut by grey coloured TTG and pink microcline K-rich granites. Geochemical alteration studies for the sheared and hydrothermally altered K-granites show that the LFSE and REE were significantly mobilized during the shearing and subsequent injection of hydrothermal fluids events whereas the HFSE remained virtually unchanged. The Buzwagi mine TTG exhibit geochemical characteristics of other worldwide known TTG (Al_2O_3 ~ 15.0 wt %; Na_2O/K_2O ratios of 1.19-5.16, low concentration of heavy REE with Y contents of 3-7 ppm and Yb = 0.3-0.5 ppm leading to high Sr/Y ratios (61-152) and La/Yb = 32-140) which are comparable to those of Phanerozoic adakites. The Buzwagi mine TTG are characterized by strongly fractionated REE patterns (La/YbCN = 23-100) with slightly negative to no Eu anomalies (Eu/Eu* = 0.77-1.05), negative anomalies of Nb, Ta and Ti, and εNd (2713) values of + 1.19 to + 1.77. These geochemical and isotopic characteristics are interpreted as formation of the TTG by partial melting of the hydrous basaltic crust at pressures and depths where garnet and amphibole were stable phases in the late Archaean subduction zone. The Buzwagi mine K-rich granites differ from their TTG counterparts in having elevated concentrations of incompatible elements like K, Zr, Th, Hf, REE. They however share similar Nd-isotopic compositions (εNd (2674 Ma) = + 1.19 to + 1.22), and some geochemical features including fractionated REE patterns (La/YbCN = 13-204) with slightly negative to no Eu anomalies (Eu/Eu* = 0.78-0.89), negative anomalies of Nb, Ta and Ti. These geochemical features and isotopic signatures have been interpreted as formation of the K-granites by anhydrous partial melting of the TTG (and greenstones).

The Buzwagi mine K-granites were emplaced at 2674 ± 18 Ma, some 40 Ma years after the emplacement of TTG at 2713 ± 8 Ma. The timing of the Buzwagi mine granitic magmatism falls within the peak crustal growth period in the northern part of the Archaean Tanzania Craton. Gold mineralization at the Buzwagi mine is hosted in quartz veins that are within strongly sheared and hydrothermally altered K-granites in which silica and sericite alterations and sulphides (mainly pyrite and chalcopyrite although chalcocite is also present) are important. The Buzwagi gold deposit is thus a typical Archaean orogenic deposit whose mineralization is hydrothermally and structurally controlled and the abundance of sulphides, silica and sericite alteration assemblages suggest that the deposition conditions were reducing and acidic in nature. Owing to its epigenetic nature, it can be inferred that the maximum age of deposition of gold at the Buzwagi mine is ~ 2674 Ma; which is more or less the same age

inferred for the Golden Pride mine (~ 2680 Ma) both of which are found in the Nzega greenstone belt.

Keywords

Nzega greenstone belt;

Buzwagi mine;

TTG;

Sheared K-granites;

Gold mineralization;

Silica and sericite alteration