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The geology of the Lega Dembi gold deposit, southern Ethiopia: implications for Pan-African gold exploration

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Abstract The Lega Dembi deposit is the largest gold producer in Ethiopia. It is situated in late-Precambrian metamorphosed sediments of the N-S trending, volcano-sedimentary Megado belt, which forms part of the late-Proterozoic Adola granite-greenstone terrane in southern Ethiopia. The lode-gold mineralization occurs in a N-S trending, steep westerly dipping quartz-vein system that follows the structural contact between underlying feldspathic gneisses and the volcanosedimentary sequence of the Megado belt. This contact also marks the northernmost extension of the regional-scale, sinistral strike-slip Lega Dembi-Aflata shear zone. Mineralization and intense quartz-veining is best developed in graphite-rich sediments within an area not more than 80 m away from this tectonic contact. Hydrothermal wall-rock alteration includes actinolite/tremolite-biotite-calcite-sericite and chlorite-calcite-epidote assemblages. Gold occurs preferentially in the sericite alteration zone, where it is closely associated and intergrown with galena. The variable deformation of the gold-quartz veins suggests a syn-kinematic timing for the gold mineralization during transcurrent shearing in a dilational segment of the shear zone. In addition to the structural control, lithological control on gold deposition is indicated by the almost exclusive occurrence of the gold mineralization in graphite-rich metasediments. This close relationship suggests that gold precipitation was the result of chemical reduction of regional ore-bearing fluids. Temperature conditions of mineralization are constrained by the actinolite-biotite alteration assemblage and by arsenopyrite chemistry, which indicate that

ore deposition occurred at or close to peak metamorphic conditions at upper-greenschist to lower-amphibolite metamorphic grades. Rb-Sr dating of sericite indicates an age of about 545 Ma. for hydrothermal alteration and, thus, for gold mineralization. The style of gold mineralization, structural pattern and lithological assemblages at Lega Dembi are very similar to lode-gold deposits most commonly reported from Archaean granite-greenstone terranes. These similarities may open new perspectives for the exploration of lode-gold deposits, which has previously primarily focused on Archaean greenstone belts rather than Proterozoic or even Phanerozoic meta-volcanosedimentary belts.

Introduction

Shear-zone hosted, mesothermal lode-gold deposits are a major source of world gold production (Woodall 1988). The vast majority of these gold-bearing vein systems is spatially closely associated with the tectono-metamorphic evolution of predominantly late-Archaean greenstone belts, that are an intricate feature of many Archaean cratons (e.g. Anhaeusser 1976; Colvine et al. 1984, 1988; Robert and Brown 1986; Kerrich 1986; Foster 1989; Groves et al. 1989; de Ronde et al. 1992). In addition to their commonly late-Archaean age, these deposits bear numerous similarities worldwide, which led to the term 'Archaean lode-gold deposits', that was coined to describe the styles of gold mineralization, associated alteration patterns and structural controls of gold deposits in late-Archaean granite-greenstone terranes (comprehensive reviews are given by, inter alia, Groves and Foster 1991, Colvine 1989, Groves 1993, and Kerrich and Cassidy 1994)

In recent years, however, an increasing number of workers have questioned the restrictive use of the term 'greenstone belt' for linear to irregularly shaped meta-volcanosedimentary rocks of predominantly Archaean age, since similar lithological associations and tectonic

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