Geological Characteristics and Mineralogy of the Makorungo and Nalia Gold Prospects, Northeastern Mozambique

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The northeastern Mozambique is composed of medium-high grade metamorphic complexes of the Mozambique Belt, intruded by Neoproterozoic-Paleozoic granitoids (Norconsult, 2007). Mozambique Belt (MB) is a part of the East African Orogeny and has been associated with a large variety of mineralization, including base metals, gemstones, and gold (Lächelt, 2004). The lack of studies on gold deposits associated with metamorphic terrains in Mozambique weakens the discovery and further exploration of gold. This study focuses on the Makorungo and Nalia gold prospects, northeastern Mozambique, where artisanal and small-scale mining of placer and primary gold is conducted mainly by local people. These prospects belong to Xixano complex, interpreted as a Pan-African nappe, which is composed of supercrustal rocks, enveloping mafic and ganulitic rocks (Viola et al, 2008). This study aims to reveal the geological and mineralogical characteristics of the gold prospects to better understand the ore-forming process. Field observation and laboratory analysis, including petrography of host rocks and ores, and whole-rock and ore chemistry were applied. Quartz veins parallel and at low angle to amphibolite foliation host the gold mineralization in the Nalia and Makorungo prospects. The amphibolites in the Nalia prospect are strongly foliated and composed mainly of hornblende, plagioclase, quartz and clinopyroxene with minor titanite. Secondary minerals include hornblende replacing clinopyroxenes, and biotite replacing hornblende. Whole-rock geochemistry of the amphibolites indicates high silica and total alkali ($K_2O + Na_2O$) contents, 50 to 64 wt. % and 3.3 to 5.2 wt. %, respectively. On the other hand, the amphibolite rocks in the Makorungo prospect are less foliated and mainly comprises amphiboles, plagioclase, and biotite, with minor quartz. Secondary biotite replaces amphiboles. Based on the extinction angles, the plagioclase in the Makorungo prospect is more Na-rich, while the plagioclase from the Nalia prospect is more Ca-rich. The TiO_2 vs. MnO diagram shows that the amphibolites in both prospects are ortho-amphibolites. Total alkali and silica diagram (TAS diagram) indicates protolith of basaltic composition. The mineralized veins in the Nalia prospect show deformation textures including triple-point texture, undulose extinction and variability in cathodoluminescence brightness within individual quartz grain. Evidence of post-deformation is less common in the Makorungo prospect. The ore mineralogy in the Nalia and Makorungo prospects is very similar, despite the absence of sphalerite in the former. Pyrite, pyrrhotite, galena, magnetite and chalcopyrite commonly occur with minor tellurides and electrum (the Makorungo prospect) or native gold (the Nalia prospect). Bismuth, Te, Pb, and W bearing minerals commonly occur as sulfides and tellurides in both prospects. Sphalerite in the Makorungo prospect is characterized by high Fe and Cd contents, ranging 9.2-11.8 wt. %, and 2.9-3.4 wt. %, respectively. Pressure formation estimated from FeS contents in sphalerite coexisting with pyrite and pyrrhotite (sphalerite geobarometry) is within 1.6 and 2.1 Kb, which corresponds to a depth from 5.9 to7.4 Km. The coeval existence of pyrrhotite and sphalerite in the Makorungo prospect suggests a low sulfidation state, along the pyrite-pyrrhotite equilibrium.

