Journal of African Earth Sciences 117 (2016) 389–400

Contents lists available at ScienceDirect

Journal of African Earth Sciences

journal homepage: www.elsevier.com/locate/jafrearsci

Exploration of gold occurrences in alteration zones at Dungash district, Southeastern Desert of Egypt using ASTER data and geochemical analyses

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ARTICLE INFO

Article history:
Received 17 July 2015
Received in revised form
27 December 2015
Accepted 29 January 2016
Available online 3 February 2016

Keywords:
Dungash district
ASTER data
Alteration
Gold mineralization

ABSTRACT

The present study aims at exploration of new gold occurrences in the alteration zones at Dungash district. Processed ASTER images band ratios $7/6 \times 4/6$ and $(7 + 9/8)$, field geology and mineralogical and geochemical data help characterize three types of alterations in three areas 1 to 3 that may be targeted for Au exploration. Area1 confined to the metavolcanics located in the SE of Dungash gold mine and revealed silicified and sericitized type alterations, composed of quartz, epidote, chlorite, biotite and opaque minerals mainly pyrite and chalcopyrite. Area2 occurs in the gabbro-diorite rocks at Abu Meraiwa area NE of Dungash gold mine, which are rich in kaolinite, illite, sericite, pyrite, arsenopyrite and chalcopyrite that record kaolinitized alteration. Area3 is hosted in carbonaceous listwaenized serpentinite thus indicating the role of listwaenitization type alteration in ore genesis. It is composed of calcite, chromite, pyrite, arsenopyrite, chalcopyrite and Ni-bearing sulphides.

Au contents in area 1 range between 0.12 and 14.91 ppm, and between 6.1 and 16.3 ppm in area 2, while gold values in area 3 vary from <0.01 to 0.03 ppm.

Dungash district is comprised of Pan-African assemblages of ophiolitic ultramafics thrusted over the island arc metavolcanics of dacitic- andesite composition. Gabbro-diorite rocks are intruded in the ultramafics and the acidic metavolcanics as well as diorite-quartz diorite suite intruded in the intermediate metavolcanics. Several acidic dykes, granitic dykes and quartz veins cut through the different rocks types.

1. Introduction

Dungash area is located in the Southeastern part of the South Eastern Desert between lat. 24° 51′ to 25° 00′ N and long. 33° 45′ and 34° 00′ E, covers an area of about 300 km^2 (Fig. 1). It is known by its gold occurrences as one of the most Au-prospective areas in the Eastern Desert.

Primary Au has formed in association with evolution of intra-oceanic arc emplacement and back arc basins (Abdelsalam et al., 2000). Gold deposits originated as epigenetic gold-bearing quartz veins traversing through the basement rocks (i.e., schists, granites, gabbros, and diorites (El Ramly et al., 1970; El Sharkawy and El Bayoumi, 1979). The metallogenetic similarity between ore-genetic processes of the Southeastern Desert in Egypt and circum-Pacic plate tectonic settings was suggested by Garson and Shalaby (1976). Hydrothermal activity derived either by metamorphism or cooling effects of early Cambrian subduction-related calc-alkalic magmatism that generated various mineral occurrences (Pohl, 1988; El Gaby et al., 1988; Johnson et al., 2011). According to Klemm et al. (2001) gold was deposited as a result of the younger (postorogenic) granite intrusions into older basement rocks. Hassaan and El-Mezayen (1995), favor a metamorphic hydrothermal fluid origin of the gold deposits while Harrz (2000), Klemm et al. (2001) and Botros (2004) proposed a combined metamorphic-magmatic origin of these fluids. The gold occurrences and distributions in the Southeastern Desert are tectonically

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http://dx.doi.org/10.1016/j.jafrearsci.2016.01.030
1464-343X/Published by Elsevier Ltd.

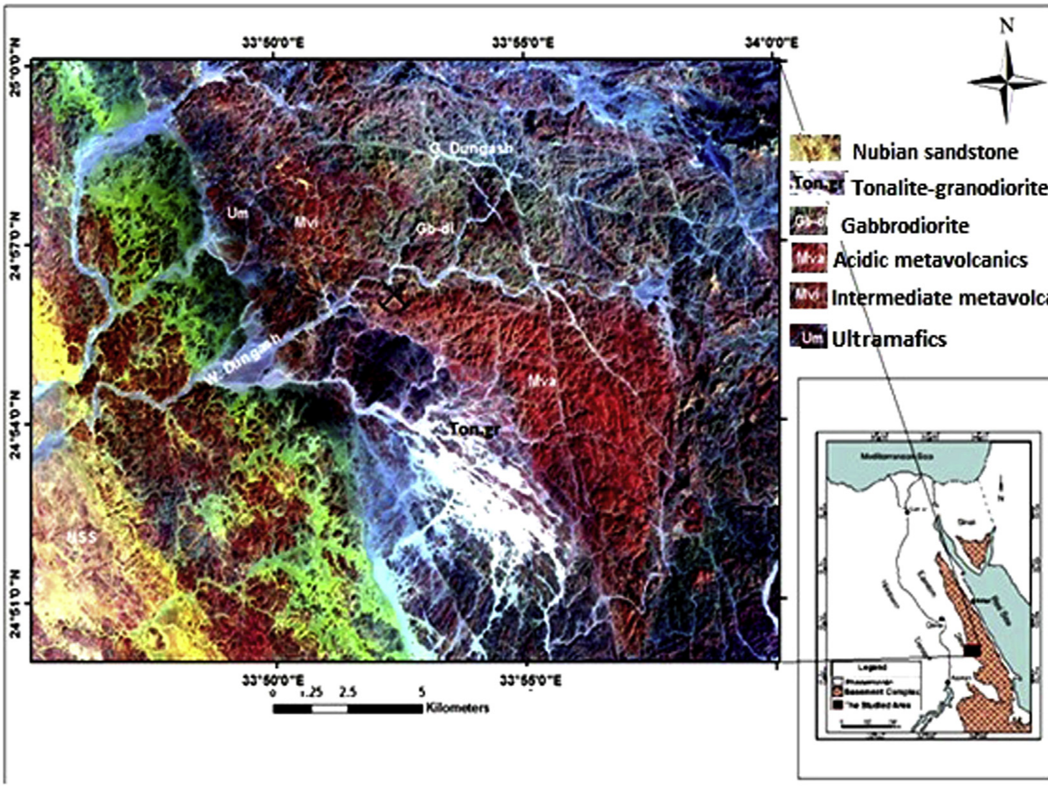

Fig. 1. Location map of Dungash district illustrated on the Aster false color bands 7,5,3.

constrained by reactivating shear zones (Helmy et al., 2004).

Mineralogical and geochemical details of the rock types for geological and mineral mapping of broad regions can be provided from remote sensing techniques (Rowan et al., 1977; Goetz et al., 1983; Boardman et al., 1995; Kruse et al., 2003; Zoheir and Lihman, 2011). Appropriate results for extracting lithologic information and identification of alteration zones with characteristic minerals associated with gold mineralization can be processed through ASTER data (Ninomiya, 2003; Zhang et al., 2007).

Azizi (2010) used SWIR of ASTER data to detect alteration zones from east Zanjan, northern Iran. Salem et al. (2013) used ASTER data constrained by field geology and geochemical data in detecting of new areas of gold bearing silicified iron– carbonated ultramafics (listwaenite alterations) at Barramiya district (~20 km NE of Dungash gold mine).

The aim of present study is to aid the exploration of new gold occurrences in alteration zones at the distinct geological environments of Dungash district. ASTER data combined with field work and mineralogical and geochemical analyses are used to achieve the goal of present study. Processed ASTER images suggested gold potential target areas with various mineral associations deposited in different oregenetic settings.

2. Geological and structure setting

Dungash district is comprised of metasediment, metavolcanic, serpentinite and related talc carbonate rock, metagabbro and older granitoid rock exposures (Khalid et al., 1987). Marten (1986) delineated two areas with strong colorations in hills east of Dungash gold mine, where the quartz veins strike E–W (70°–90°) and dips 80°S. Its trace is marked by a series of inclined prospecting shafts over a strike length of about 1 km, but the vein is not readily accessible. Jakubiak (1988) proposed two vein systems located on hills flanking Wadi Dungash: Dungash West and Dungash East. EGSMA map (1996) described the geology of Dungash area as Neoproterozoic rocks characterized by dismembered ultramafic assemblages comprising serpentinites associated with sheared metasomatized talc-carbonate derivatives, tremolite-actinolite schist and listwaenite ridges intermixed with and thrust over back-arc volcanic and volcaniclastic rocks (Fig. 2). The metavolcanics form a great belt around Wadi Dungash comprising a series of weakly metamorphosed calc-alkaline volcanics of andesite-dacite composition. This mixture of lithofacies and interrelated pyroclastic volcanic tuffs and breccias show east-west–striking bedding planes. Gabbro-diorite plutons as well as the tonalite-granodiorite rocks are intruded the intermediate-acidic metavolcanics. Several acidic dykes, granitic sheets and quartz veins cut through different rocks types. Nubian Sandstone is found unconformably overlie the metavolcanics in the western parts of study area.

Structurally, Dungash belt has experienced multiple phases of deformation that generated structures including folds and uplifts with NW–SE and NE–SW trending axes. These developed in the ultramafics forming NW–SE-trending parallel sheets dipping SW and thrusting over the metavolcanics in a NW–SE trend. This event is followed by NE–SW, E–W, NW–SE and NNW–SSE faults and shear systems developed in the metavolcanics showing regionally continuous planar foliated sequences (S1) with NE–SW 65°W and fracture cleavages (S2) that both constrained the emplacement of Dungash gold deposit (Dourgham et al., 2008). The gabbro-diorite pluton is cut by a NNW directed shear zones intersected by regional faults that apparently moved sinisterly displacement on the NNW and SSE sides of the pluton. These shear zones of shallow steep dipping to the south and west associate many faults and