Ore Geology Reviews 99 (2018) 217–234

Contents lists available at ScienceDirect

Ore Geology Reviews

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

The South Um Mongul Cu-Mo-Au prospect in the northern Eastern Desert of Egypt: Tonian porphyry-style mineralization with an Ediacaran hydrothermal iron oxide overprint

Yasser Abd El-Rahman[a,b,*], Thomas Seifert[c], Amir Said[a]

[a] Geology Department Faculty of Science, Cairo University, Giza 12613, Egypt
[b] State Key Laboratory of Lithospheric Evolution, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China
[c] Department of Mineralogy, TU Bergakademie Freiberg, 09596 Freiberg, Germany

ARTICLE INFO

Keywords:
Porphyry copper
IOCG
Neoproterozoic
Continental arc dacite
Post-collisional monzogranite
Arabian-Nubian Shield

ABSTRACT

The South Um Mongul prospect is occupied by Tonian porphyritic dacite (773 ± 6.9 Ma) intruded by Ediacaran post-collisional hornblende gabbro (603 ± 3.5 Ma) and monzogranite (558 ± 4.6 Ma). The dacite porphyry was formed in a continental arc and hosts a weakly mineralized porphyry system. The earliest veinlet stockwork contains mainly chalcopyrite and molybdenite, which is associated with biotite-rich potassic alteration. The sulfide-bearing system evolved to intermediate sulfidation veins and hosts chalcopyrite and tetrahedrite with minor sphalerite and cobaltite, while the alteration evolved to sericitic-argillic assemblages.

A younger iron oxide-rich hydrothermal system is associated with the monzogranite overprinting the previous sulfide-bearing one. The iron oxide-rich system evolved from quartz-magnetite veins with potassic selvages to quartz-specularite and barite-specularite veins associated with more pervasive sericite-chlorite alteration. The sulfur isotopic signature of the barite indicates mainly a magmatic-hydrothermal origin with a limited involvement of meteoric water. The sulfur source may have been mafic melts accompanying the monzogranite, while the Ba was most likely leached from the host rocks, especially the varieties that were affected by potassic alteration. The magnetite hosts chalcopyrite inclusions. The monzogranite was probably derived from melting of an amphibolitic lower crust related to the formation of the earlier Tonian porphyry copper-hosted dacite porphyry. The earlier Tonian melting might have caused the low sulfide contents in the hydrous lower crust, which became fertile for Au-rich magmas during later remelting process, which caused the formation of monzogranite. This model is substantiated by the close association between the native gold and the supergene oxidation products of the chalcopyrite inclusions in the magnetite rather than the oxidation assemblages of the sulfides of the earlier Tonian porphyry system in the prospect.

Supergene oxidation occurred under near-neutral to mildly alkaline conditions due to the scarcity of pyrite in the prospect. It is manifested by the formation of atacamite and chrysocolla in association with goethite and widespread incipient argillic alteration, which resulted in plagioclase alteration to clay minerals. Only the sericitic alteration, which is related to the early porphyry copper systems, contains jarosite, alunite and svanbergite, which indicate more acidic conditions during the formation of such argillic alteration. This reflects pyrite oxidation which is related to either supergene processes or hypogene processes accompanying the younger iron oxide-rich hydrothermal system.

1. Introduction

Porphyry systems at convergent plate margins, and less commonly in post-collisional settings, are considered significant repositories of Cu, Mo and/or Au (Sillitoe, 2010; Richards, 2011). Relative to typical porphyry systems associated with the calc-alkaline magmas emplaced in voluminous volcanoplutonic arcs above subduction zones, systems related to post-subduction tectonic environments are sulfur-poor and Au-rich and tend to occur in association with isolated magmatic complexes (Richards, 2009). Despite their diversity, porphyry systems are considered one of the best-modeled deposit types (Seedorff et al., 2008). They are characterized by distinctive zones of hydrothermal alteration related to the mineralization, which provide a useful footprint for exploration (Cooke et al., 2014). On contrary to porphyry

* Corresponding author at: Geology Department Faculty of Science, Cairo University, Giza 12613, Egypt.
E-mail address: yasser@sci.cu.edu.eg (Y. Abd El-Rahman).

https://doi.org/10.1016/j.oregeorev.2018.06.011
Received 7 March 2018; Received in revised form 6 June 2018; Accepted 12 June 2018
0169-1368/

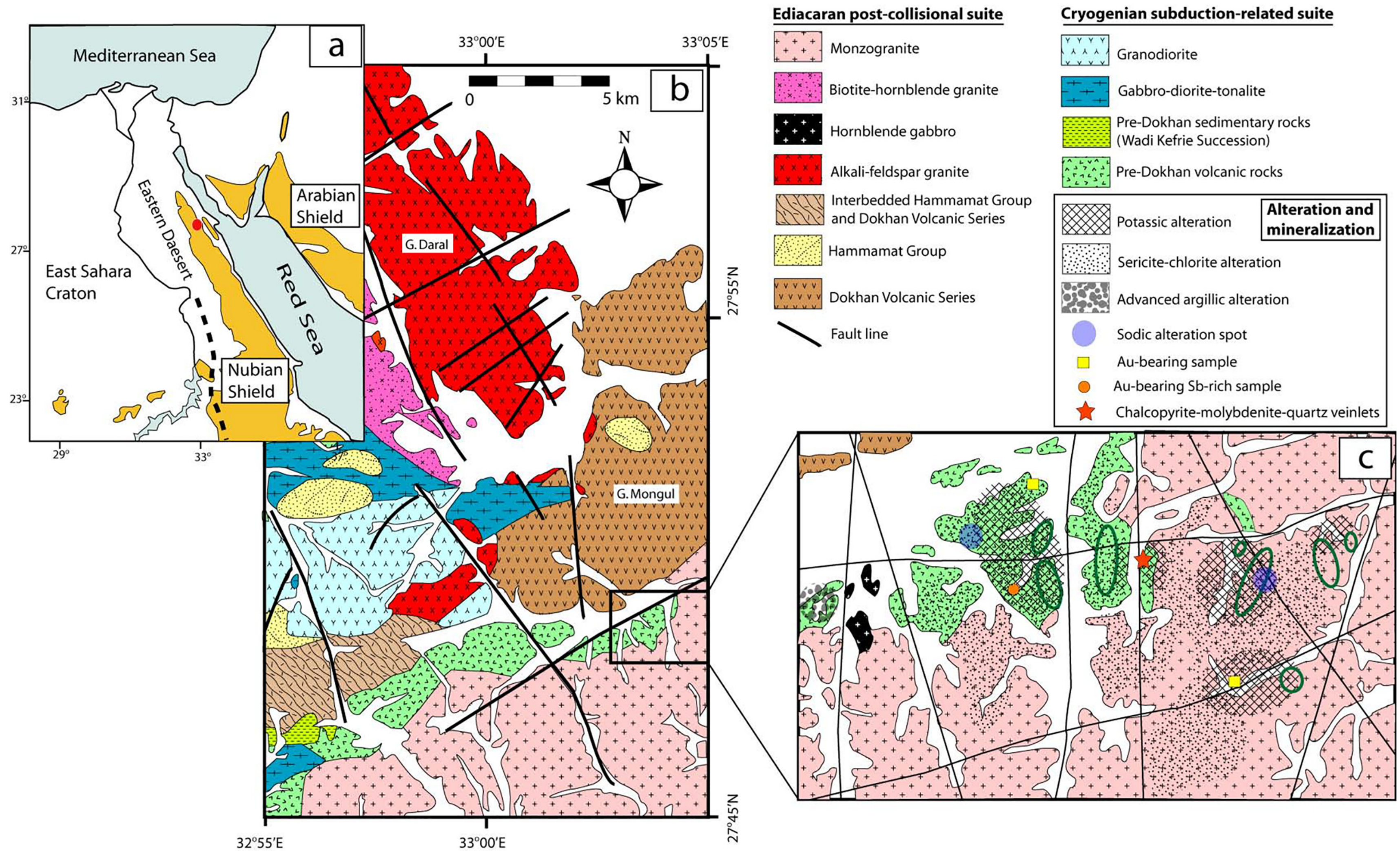

Fig. 1. (a) Precambrian rocks along the Red Sea margins. The approximate boundary between the Arabian-Nubian Shield and the Eastern Saharan craton after Greiling et al. (1994) is represented by the dashed line. The location of the SUM prospect is shown by the red solid circle. (b) The geology of the eastern Ras Gharib belt (modified after Breitkreuz et al., 2010). (c) The geology and the alteration zones along with the mineralization distribution of the SUM prospect. (modified after Wetait and Botros, 1997). The thick green lines represent the anomalous distribution of copper on the surface rocks in the prospect as defined by Botros and Wetait (1997). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)