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Shear-related gold mineralization in Northwest Ghana: The Julie deposit

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ABSTRACT

The Julie deposit is currently the largest gold prospect in NW Ghana. It is hosted in sheared granitoids of TTG composition of the Paleoproterozoic Julie greenstone belt. The main mineralization consists of a corridor of gold-bearing quartz veins forming a network of a few tens of metres in thickness, trending E–W and dipping 30–60° N, contained within the main shear zone that affects these rocks. The core of this vein corridor is altered by sericite, quartz, ankerite, calcite, tourmaline and pyrite, and is surrounded by an outer halo consisting of albite, sericite, calcite, chlorite, pyrite and rutile. A second set of veins, conjugate to the first set, occurs in the area. These veins have alteration halos with a similar mineralogy as the main corridor, however, their extent, as well as the size of the mineralization, is less important. In the main corridor, gold forms micron-sized grains that occur in pyrite as inclusions, on its edges, and in fractures crosscutting it. Silver, tellurium, bismuth, copper and lead commonly accompany the gold. Pyrite occurs disseminated in the veins and in the surrounding rocks. Up to several ppm Au occurs in the structure of pyrite from the main mineralization.

1. Introduction and exploration history

In the Birimian terranes of Southern Ghana, commercial gold exploration and exploitation have been active since the early 1900s, notably with the development of world-class deposits in the Ashanti and Sefwi belts, which have received extensive attention in the literature (e.g., Junner, 1932; Milési et al., 1989; Klemd et al., 1996; Allibone et al., 2002; Feybesse et al., 2006; Perrouty et al., 2012, 2015; White et al., 2015; Amponsah et al., in press). Conversely, very little is known of the Birimian mineralization of NW Ghana (Fig. 1), where alluvial and bedrock indications of gold have only been reported since the early 1960s. Nevertheless, it is now recognized that this part of the country hosts an important gold-producing area, known as the Wa-East gold district. Numerous gold camps occur in this district, the most important of which is the Julie deposit. Other examples include Collette, Kjersti, Julie West (Fig. 2), plus Kandia, Baayiri and Danyawu, which lie just outside the area covered by the map in Fig. 2.

The first discoveries of mineralization in this part of Ghana are attributed to the Gold Coast Geological Survey (Griffis et al., 2002). Survey geologists mapped the area and outlined prospects in the Wa-Lawra greenstone belt during the early 1960s, in the adjacent Koudougou-Tumu granitoid domain and in the Julie greenstone belt. A Russian geological team carried out additional prospecting and geological mapping, also in the 1960s. However, it was not until the 1990s that systematic exploration activities started. Kenor Corporation held the first prospecting licence for the Julie deposit, from September 1996 to May 1999, which was then taken over by Crew Gold Corporation who detained it until February 2010. These companies focussed their work mainly on target generational prospecting, which included interpreting Landsat satellite and airborne geophysical data, geological mapping, and geochemical sampling (mainly soil, grab and auger sampling methods). Surface targets generated by these first-pass geological and geochemical surveying methods were tested further to top of bedrock by rotary air-blast (RAB) and air-core (AC) drilling. From December 2004 to May 2005 a total of about 4815 m of reverse circulation (RC) core were drilled, to assess bedrock mineralization. Crew Gold Corporation identified 312,000 oz (8.8 t) of gold (grading at 2.9 g/t) and estimated mineralization to extend to depths of over 30 m along a 3.5 km strike length (Azumah Resources Limited, 2012). Further exploration was carried out by Azumah Resources Limited in 2006 and beyond, who discovered 834,000 oz (23.6 t) of measured and indicated gold (at 1.53 g/t), with a proven reserve of 202,000 oz (5.7 t) (at 2.84 g/t) in the Julie deposit (Table 1). Azumah acquired the prospecting licence in February 2012. Currently, they have drilled some 43,700 m, to establish trend and continuity of the mineralization first detected by Kenor. In 2013, 2.21 Mt of indicated resources was estimated, making Julie the largest gold resource in NW Ghana.

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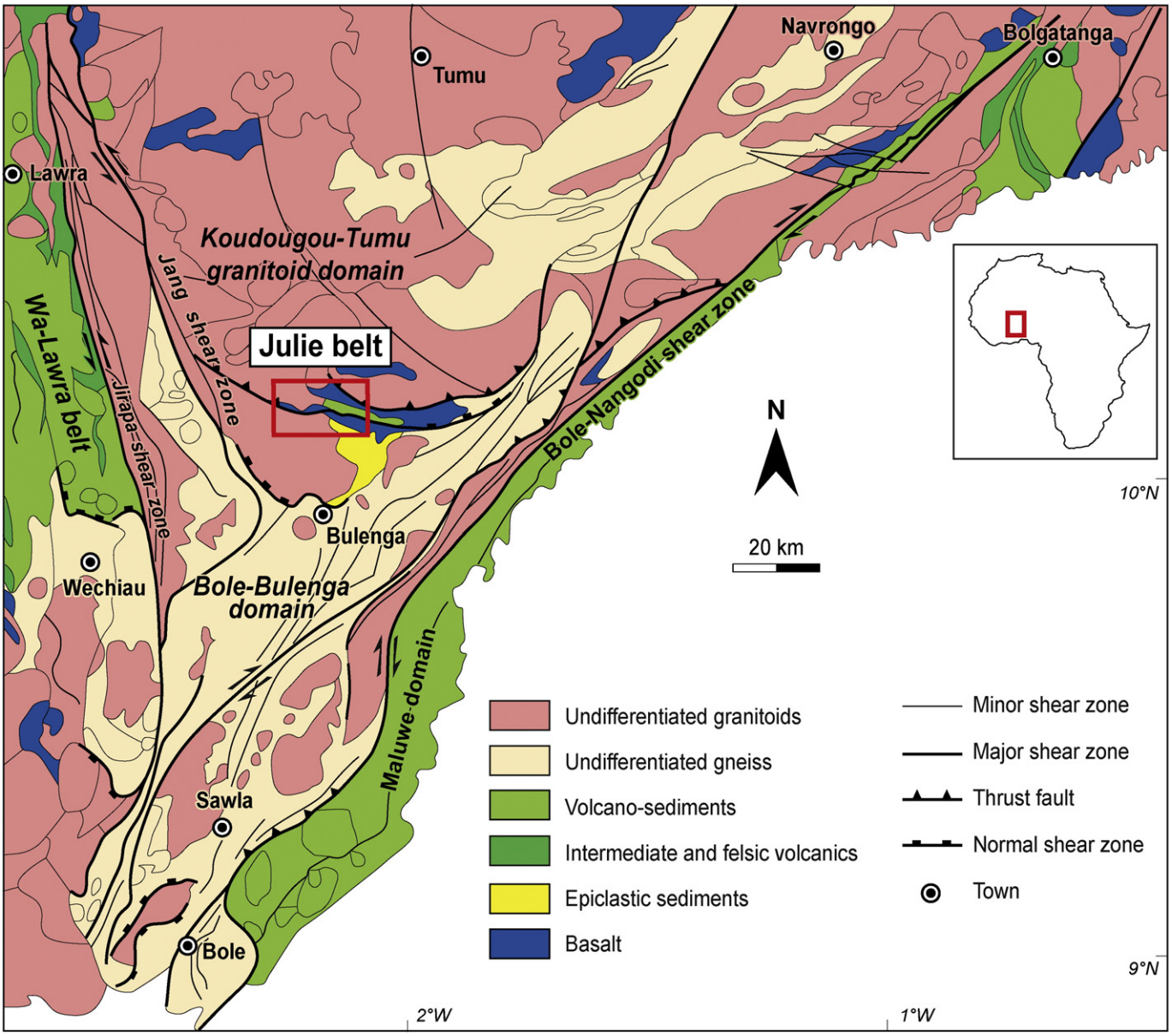

Fig. 1. Regional litho-structural map of Precambrian terranes in NW Ghana (modified after Block et al., 2015), showing the geological context of the Julie belt. The red inset localises the study area.

2. Regional geological overview

Northwest Ghana lies on the eastern edge of the Paleoproterozoic Birimian terrane of the West African Craton (WAC). The Wa-East gold district occurs within the Julie greenstone belt, an E–W trending structure bounded to the east by the Bole-Nangodi greenstone belt, to the south by the Bole–Bulenga domain, to the west by the Wa-Lawra greenstone belt and to the north by the Koudougou-Tumu granitoid domain (Fig. 1). The Koudougou-Tumu granitoid domain is composed of tonalite–trondhjemite–granodiorite (TTG) intrusions formed between 2155 and 2135 Ma (U–Pb zircon ages; Agyei Duodu et al., 2009). Potassic porphyritic granites, dated at 2128 and 2086 Ma (U–Pb zircon ages; Agyei Duodu et al., 2009; Amponsah et al., 2016-in this volume), intrude these rocks. The Wa-Lawra belt is composed of shales, volcano-sediments, basalts and granitoids. Geochronological U–Pb dating on detrital zircons in the volcano-sediments gives ages older than 2139 Ma (Agyei Duodu et al., 2009). The Wa-Lawra and Koudougou-Tumu domain are juxtaposed along the crustal scale sinistral Jirapa fault. The Bole–Bulenga domain is composed of high-grade gneisses, intruded by TTG plutons commonly exhibiting migmatitic textures. The Julie belt is composed of basalts, granitoids, gabbros and volcano-sediments. To date, no geochronological data exist for the rocks from the Julie belt.

Baratoux et al. (2011), de Kock et al. (2011) and Block et al. (2015) highlighted the evidence for multiple deformation phases in the Birimian terranes of NW Ghana. An early, short-lived event (termed Eoeburnean) was identified by de Kock et al. (2011), and interpreted to be driven by pluton emplacement and basin folding, between 2160 and 2150 Ma. Block et al. (2015) proposed that the first Eburnean event (D_1) in NW Ghana occurred around 2137 ± 8 Ma (in-situ U–Pb dating on monazite). This event is characterized by intrusions of voluminous granitoid plutons, locally associated with volcanism and sedimentation, allochthonous thrusting, folding and development of penetrative metamorphic fabrics resulting in crustal thickening driven by N–S shortening. Peak metamorphic conditions of D_1 reach upper amphibolite facies (Block et al., 2015). The second Eburnean phase, D_2, is interpreted to have occurred between 2130 and 2110 Ma (U–Pb dating on rhyolites). This event is characterized by regional scale WNW-trending sinistral and NE-trending dextral transcurrent faulting and