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The Markoye Shear Zone in NE Burkina Faso

Asinne Tshibubudze [a], Kim A.A. Hein [a,*], Pascal Marquis [b]

[a] School of Geosciences, University of the Witwatersrand, Private Bag 3, P.O. WITS, Johannesburg 2050, South Africa
[b] Orezone Resources Inc., 290 Picton Ave, Suite 201, Ottawa, ON, Canada K1Z 8P8

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ABSTRACT

Birimian supracrustal sequences in NE Burkina Faso are dominated by meta-volcaniclastic greywacke, intercalated meta-conglomerate, siltstone and shale. The sequences where subjected to two phases of deformation and contact metamorphosed to hornblende–hornfels facies during emplacement of pyroxenite–gabbro–norite (Yacouba Mafic complex), granodiorite–tonalite (Tin Taradat granodiorite–tonalite) and dolerite dykes.

Structural studies indicated that the NE-trending, first-order crustal-scale Markoye Shear Zone (MSZ; Markoye Fault of [Jeambrun, M., Delfour, J., Gravost, M., 1970. Carte géologique de L'Oudalan. Bureau De Recherches Geologiques et Miniéres, Burkina Faso.]) has undergone at least two phases of reactivation concomitant to two phases of regional deformation. The first phase of deformation, D1, resulted in the formation of NNW-NW trending folds and thrusts during dextral-reverse displacement on the MSZ. The deformation is termed the Tangaean Event and predates the Eburnean Orogeny. D2 phase involved a period of SE–NW crustal shortening and sinistral-reverse displacement on the MSZ, and is correlated to the Eburnean Orogeny ~2.1 Ga. Deformation in D2 is characterised by NE-trending regional folds (F2) and a pervasive NE-trending foliation (S2-C to S2). Within the MSZ, deformation is characterised by NNE-trending zones of mylonite that are bordered in the hangingwall and footwall by pseudotachylite veins. Buck quartz-carbonate veins and quartz cataclasite veins crosscut the mylonite zones and are, in turn, crosscut by quartz–chlorite–(muscovite) shears that formed during reactivation of the MSZ late in D2. Several generations of veins are recognised at the Essakane main deposit (EMZ): Arsenopyrite–pyrite–gold mineralization in quartz veins formed in D1 during metasomatic alteration of the host rocks; Vein-stockwork gold mineralization is interpreted to have formed late in D2.

1. Introduction

The NE-trending Markoye Shear Zone (MSZ) is a first-order crustal-scale structure that transects the Palaeoproterozoic Birimian Domain of the West African Craton in the east of Burkina Faso (Fig. 1). Between the towns of Dori and Tambão, which are situated west of the international border of Burkina Faso with Niger and south of the border with Mali, the position of the MSZ has been clearly established from combined regional magnetic data (RTP and RTP first vertical derivative) and Landsat imagery. The shear zone marks the western boundary of the Oudalan-Gorouol greenstone belt which extends into Niger. The greenstone belt hosts gold mineralization at Essakane goldfield, and numerous gold artisan sites throughout the study area.

According to Milési et al. (1989, 1992), Castaing et al. (2003) the MSZ is the boundary that separates Eburnean granitoids to the west from the Tarkwa Group meta-sedimentary units to the east. In Milési et al. (1989, 1991, 1992) and Hottin and Ouedraogo (1992), the MSZ is classified as a westerly-dipping thrust. However, unpublished structural studies completed for Ranger Minerals concluded that the MSZ is an east-verging thrust (Rogers and Dong, 2000) and part of a regional dextral strike-slip system.

In early 2007, the MSZ became the focus of structural studies by Orezone Resources Inc. to investigate the spatial and temporal relationships between gold deposits at the Essakane goldfield and to clarify the tectonic activity on the MSZ. During those studies, the lithologies and structure of a region between the Essakane goldfield and Tambão manganese deposit were documented. Numerous traverses where conducted across the MSZ and a GPS-referenced litho-structural database was established for the region. The results of those investigations indicate that stratigraphic and tectonic maps for the Oudalan-Gorouol greenstone belt, and regional geological maps for NE Burkina Faso need revision.

2. Geological setting

The overall lithostratigraphy of the eastern part of Burkina Faso is defined by NE-trending Birimian meta-sedimentary and

* Corresponding author. Tel.: +27 11 717 6623; fax: +27 11 717 6579.
E-mail addresses: Asinne.Tshibubudze@students.wits.ac.za (A. Tshibubudze), kim.hein@wits.ac.za (K.A.A. Hein), pmarquis@orezone.com (P. Marquis).

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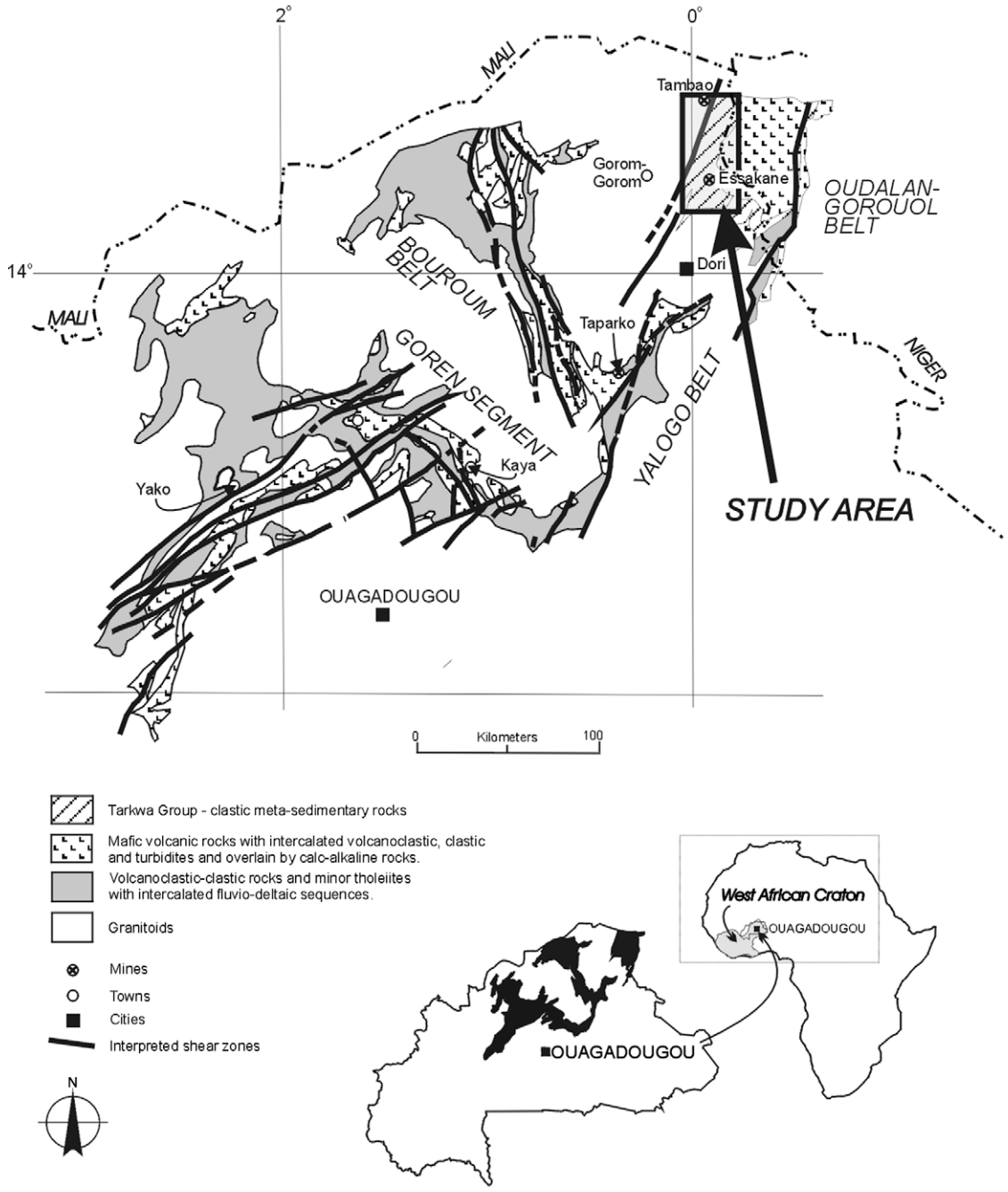

Fig. 1. The Oudalan-Gorouol greenstone belt of Burkina Faso and Niger, together with the Bouroum, Yalogo and Goren greenstone belts. The study area lies on the western margin of the Oudalan-Gorouol greenstone belt, approximately, 310 km NE of Ouagadougou. Modified after Feybesse et al. (1990) and Hein et al. (2004).

meta-volcanic sequences. The meta-volcanic sequences are dated (using Pb–Pb zircon) at between 2238 ± 5 Ma for a rhyolitic tuff from the Goren greenstone belt and 2171 ± 7 Ma for rhyolite from the Boromo greenstone belt (Castaing et al., 2003). The Tarkwa Group (2149–2132 Ma; U–Pb zircon, Davis et al., 1994) unconformably overlies the Birimian sequences. The Birimian sequences and Tarkwa Group are intruded by Eburnean granitoids at 2210–2095 Ma (combined Pb–Pb zircon, U–Th zircon, U–Th–Pb monazite and K–Ar; Castaing et al., 2003). Both sequences were deformed during the Eburnean Orogeny at 2100–2000 Ma (Milési et al., 1991, 1992; Ledru et al., 1991).

Junner (1935; 1940) in Leube et al. (1990) divided the Birimian stratigraphy into two parts. The lower Birimian series (B1) is predominantly sedimentary in origin and includes dacitic/rhyodacitic meta-volcaniclastic sediments, meta-greywacke with intercalated black meta-siltstone and manganiferous chert, argillite, shale and chemical meta-sedimentary rocks (Feybesse et al., 1990; Leube et al., 1990; Hirdes et al., 1996; Milési et al., 1991, 1992). The upper Birimian series (B2) consists of metamorphosed basic (tholeiitic pillow lavas of basaltic composition) and intermediate lavas and pyroclastic rocks (Leube et al., 1990; Milési et al., 1991, 1992; Hirdes et al., 1996). The layout of the Birimian stratigraphy is the subject of controversy: Hirdes et al. (1996) considered B2 to be younger than B1, however, Milési et al. (1991, 1992), Feybesse and Milési (1994) considered B1 to be younger than B2. In contrast, Hein et al. (2004) concluded that meta-volcanic and meta-pyroclastic units are interbedded with meta-sedimentary rocks throughout the type locality in the Goren greenstone belt.