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Palaeotectonic setting of the south-eastern Kédougou-Kéniéba Inlier, West Africa: New insights from igneous trace element geochemistry and U-Pb zircon ages

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ABSTRACT

New U-Pb zircon ages and geochemistry from the eastern Kédougou-Kéniéba Inlier are presented and integrated with published data to generate a revised tectonic framework for the westernmost Birimian terranes. The Falémé Volcanic Belt and Kofi Series are highly prospective, hosting several multi-million ounce gold deposits and a significant iron ore resource, but remain under-researched. It is therefore important to constrain the fundamental geological setting.

The igneous rocks of the eastern Kédougou-Kéniéba Inlier are dominantly of high-K calc-alkaline affinity, with fractionated REE patterns and negative Nb-Ta anomalies. The plutonic rocks in the Falémé Belt are dioritic to granodioritic in composition, with moderately fractionated REE patterns and metaluminous A/CNK signatures. Felsic, peraluminous granite stocks, dykes and plutons with fractionated REE patterns and negative Eu, Ti and P anomalies intruded both the Falémé Belt and Kofi Series. Albitisation masks the affinity of some units, although use of the Th-Co diagram shows that prior to albitisation, all igneous units belonged to the high-K calc-alkaline series. New U-Pb age data for the Boboti and Balangouma plutons indicate crystallisation at 2088.5 ± 8.5 Ma and at 2112 ± 13 Ma, respectively. Inherited zircons in the Boboti pluton indicate magmatic activity in the Falémé Belt at 2218 ± 83 Ma coincided with the oldest dated units in the Mako Belt to the West.

Systematic changes in Dy/Yb, Sm/La, Nb/Zr, Rb concentration, Eu-anomaly and $\varepsilon_{Nd}t$ over ~200 Ma reveal that the tectonic setting in the KKI evolved from a volcanic island arc environment to an active continental margin. Crustal thickening, as a result of a shift to collisional tectonic setting, combined with magmatic differentiation, led to the generation of peraluminous, granitic melts with a significant crustal component. A small suite of more basic intrusive and extrusive rocks on the eastern margin of the Dialé-Daléma basin are highly metaluminous and display limited LILE enrichment, with normalised HREE values close to unity. The Daléma igneous rocks may have formed in an extensional back arc, related to the arc system.

1. Introduction

The Birimian terranes of the West African Craton are considered to be an important record of crustal growth in the Palaeoproterozoic (Boher et al., 1992; Doumbia et al., 1998; Gasquet et al., 2003). The exact tectonic setting and geodynamic processes that gave rise to the Birimian terranes remain a subject of debate. In part this is because of the complex nature of the terranes, but also due to gaps in the geochemical and chronological datasets. The Kédougou-Kéniéba Inlier (KKI; Fig. 1) represents the westernmost outcrop of the Birimian in the Leo-Man shield, and is separated from the majority of the Palaeoproterozoic terranes by the overlying Neoproterozoic sandstones of the Taoudeni Basin. The western part of the KKI is well studied, with most attention given to the Mako Volcanic Belt (MVB; Fig. 1) in Eastern Senegal (e.g. Debat et al., 1984; Abouchami et al., 1990; Ledru et al., 1991; Dia et al., 1997; Diallo, 2001; Gueye et al., 2008; Ngom et al., 2009; Treloar et al., 2014). By comparison, the eastern KKI (the Falémé Volcanic Belt and Kofi Series; Fig. 1) is under-researched, despite hosting several world-class Au deposits, including the Loulo, Gounkoto, Sadiola and Tabakoto gold mines all of which are situated east of the Senegal-Mali Shear Zone (SMSZ; Bassot and Dommanget, 1986; Dommanget

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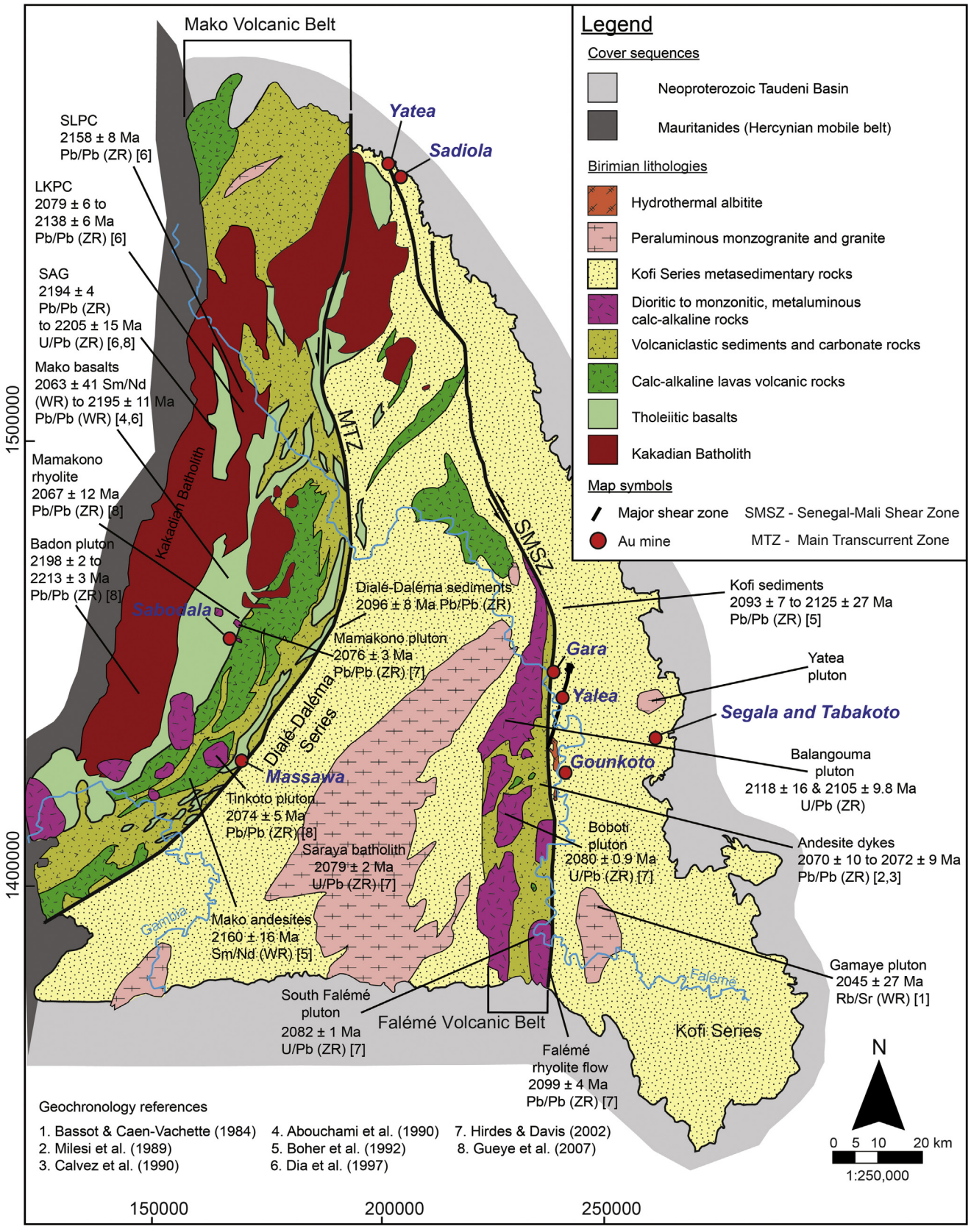

Fig. 1. Geological map of the Kédougou-Kéniéba Inlier, including units of the Mako belt referred to in the text (modified after Lawrence, 2010).