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World-Class Gold Deposits and Emerging Exploration Opportunities in the Loulo District, West Africa

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The Paleoproterozoic wider Loulo district in western Mali contains +30 Moz of gold, with three deposits, Yalea, Gara, and Goukoto, contributing +20 Moz of this endowment.

The Loulo district can be subdivided into two domains based on differences in geology and mineralisation styles. The eastern Kofi domain, hosting Yalea, Gara and Goukoto, is dominated by metasedimentary rocks and mineralisation is more typically orogenic. Gold is commonly focussed along shear-reactivated D₁ structures, with pre-mineralisation albite or tourmaline alteration enhancing competency contrasts. In contrast, the western Falémé domain, which currently only hosts <1 Moz deposits, contains voluminous, broadly syn-mineralisation, high-K, calc-alkaline intrusive rocks (i.e., the Falémé intrusives), and mineralisation appears similar to oxidised intrusive-related systems. Syn-mineralisation strain is distinctly lower, and mineralisation is spatially associated with large hydrothermal ± magmatic breccia complexes, hypabyssal intrusives, and primary carbonates.

These domains were previously interpreted to be separated by the Senegal-Mali Shear Zone. However, mapping indicates that this shear zone does not exist, with intrusive relationships observed locally between the Falémé intrusives and Kofi domain metasediments.

Mineralisation-related carbonate veins with low $d^{18}\text{O}_{\text{SMOW}}$ (13.3–14.8‰) and sulphides with low $\delta^{34}\text{S}_{\text{CDT}}$ (–4.6 to 3.9‰) support the involvement of magmatic fluids within and adjacent to the Falémé domain, as typified by the Kabe-West deposit. Atypical H₂O-CO₂-NaCl-FeCl₂ fluid inclusions also indicate a component of magmatic fluids at Gara. However, evidence for magmatic fluids generally decreases to the east.

The lack of a major structural break between the Kofi and Falémé domains, and evidence for mineralisation-related magmatic fluids in both domains, suggests that the Falémé intrusives were both an important heat source for the district-scale hydrothermal system and, to varying extents, a direct contributor of fluids. This reassessment of the importance of the Falémé intrusives has highlighted the prospectivity of the Falémé domain, which is underexplored compared to the Kofi domain.