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The Tasiast deposit, Mauritania

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ABSTRACT

The Tasiast gold deposits are hosted within Mesoarchean rocks of the Aouéouat greenstone belt, Mauritania. The Tasiast Mine consists of two deposits hosted within distinctly different rock types, both situated within the hanging wall of the west-vergent Tasiast thrust. The Piment deposits are hosted within metasedimentary rocks including metaturbidites and banded iron formation where the main mineral association consists of magnetite-quartz-pyrrhotite ± actinolite ± garnet ± biotite. Gold is associated with silica flooding and sulphide replacement of magnetite in the turbidites and in the banded iron formation units. The West Branch deposit is hosted within meta-igneous rocks, mainly diorites and quartz diorites that lie stratigraphically below host rocks of the Piment deposits. Most of the gold mineralisation at West Branch is hosted by quartz–carbonate veins within the sheared and hydrothermally altered meta-diorites that constitute the Greenschist Zone. At Tasiast, gold mineralisation has been defined over a strike length > 10 km and to vertical depths of 740 m. All of the significant mineralised bodies defined to date dip moderately to steeply (45° to 70°) to the east and have a south–southeasterly plunge. Gold deposits on the Tasiast trend are associated with second order shear zones that are splays cutting the hanging wall block of the Tasiast thrust. An age of 2839 ± 36 Ma obtained from the hydrothermal overgrowth on zircons from a quartz vein is interpreted to represent the age of mineralisation.

1. Introduction

There are five principal geological domains within the borders of Mauritania (Fig. 1a). The Reguibat Shield to the north of the country, hosts Archean and Palaeoproterozoic metamorphic sequences and granites that form the northwestern limit of the West African Craton (Ennih and Liegeois, 2008; Key et al., 2008). Further south the craton margin coincides with the Mauritanides, a Hercynian tectonic belt that consists of Neoproterozoic and Palaeozoic metamorphosed sediments and volcanoclastic formations and that also includes parts of the basement (Villeneuve, 2008). To the east of the Mauritanide belt lies the vast Mesoproterozoic (Teal and Kah, 2005; Rooney et al., 2010) to Palaeozoic Taoudeni basin. Finally to the West of the Mauritanides lies the northern limit of the Mauritania–Senegal–Gambia–Bissau–Conarky Basin, which is a Mesozoic–Cenozoic continental margin basin overlying a Palaeozoic (and probably Archean) basement.

Mauritania is a significant source of copper, gold, and iron ore and was the second ranked exporter and producer of iron ore in Africa, after South Africa, in 2012. In addition to iron ore, Mauritania produces cement, copper, crude oil, gold, gypsum, quartz, salt, and steel (Taib, 2012). The Tasiast gold deposit (location coordinates: 15.5124° W, 20.5786° N) is a >10 million ounce deposit located within the southwestern part of the Reguibat Shield, in the administrative region (Wilaya) of Inchiri, 250 km northeast of the capital Nouakchott.

Before discovery of the Tasiast deposit, the area had been subject to three regional exploration programmes during the 1960s and 1970s with various non-gold targets as summarized in Table 1 (Stuart, 2010). The area was identified as being anomalous in gold during the first regional-scale geological mapping and geochemical sampling programme of the European Development Fund project undertaken between 1993 and 1996 by the Bureau de Recherches Géologiques et Minières (BRGM) and the Office Mauritanien de Recherche Géologique (OMRG). The primary mission of the project was to locate new mineral indices of potential economic importance in the Tasiast area. More detailed soil sampling followed, resulting in the identification of a series of geochemical anomalies which were later tested by manual trenching. One of the soil geochemical anomalies, then called the C6–9 anomaly, eventually became the main Tasiast prospect (Stuart, 2010).

Exploration programmes were conducted by a series of companies, beginning with Normandy La Source Development in 1996 who defined two principal areas of gold mineralisation within the Tasiast prospect (Mining Journal, 2006). Commercial production began in January 2008

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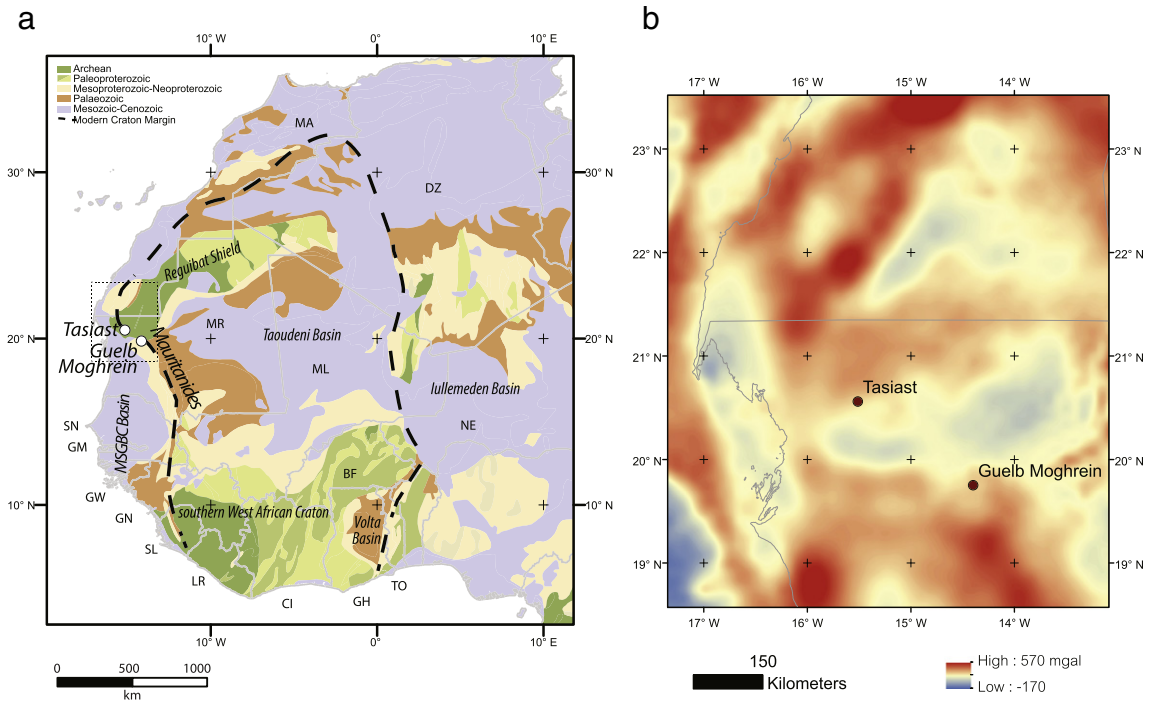

Fig. 1. a) Geological Framework of the West African Craton, showing the location of the Tasiast deposit (gold) in Mauritania, together with the ages of the major terranes, modified from the Geological Survey of Canada 1:35 M map of the world (Chorlton, 2007). The approximate limit of the present day WAC is shown as a heavy dashed line (after Ennih and Liegeois, 2008), and the limit of the gravity data shown in Fig. 1b is shown as a dotted rectangle. Two-letter country codes: BF: Burkina Faso; CI: Côte d'Ivoire; DZ: Algeria; GH: Ghana; GM: The Gambia; GN: Guinea; GW: Guinea Bissau; LR: Liberia; MA: Morocco; ML: Mali; MR: Mauritania; NE: Niger; SL: Sierra Leone; SN: Senegal; and TO: Togo. b) Free Air gravity image of Northern Mauritania showing location of principal deposits.

when the mine was owned and operated by Red Back Mining B.V. (Stuart, 2010). The Tasiast mine is currently 100% owned and operated by the Kinross Gold Corporation. Kinross currently estimates the gold resource to be 12.8 million ounces at an average grade of 1.5 g/t (Table 2). In 2013, 2.5 Mt. ore yielding 144,000 oz. Au at a grade of 1.96 g/t in addition to 104,000 oz. of dump leach gold for a total of 248,000 oz. Au were produced (Table 3) (Sims, 2014).

2. Geological overview

The Tasiast gold deposit is located within one of three principal Precambrian greenstone belts that form part of the Tasiast–Tijirit Terrane located in the western part of the Reguibat Shield (Fig. 1a). The Reguibat Shield consists of a series of west to east accreted, north–south trending Archean and Paleoproterozoic metavolcano-sedimentary belts and domal basement gneiss complexes. The majority of rocks that have been dated in the Tasiast–Tijirit Terrane have been gneiss, TTG and granite samples, and are all between 2.97 Ga and 2.91 Ga in age (Chardon, 1997, Key et al., 2008; Schofield et al., 2012; Gärtner et al., 2013; Montero et al., 2014). There have been two older TTG samples dated in the north of the region between 3.03 Ga and 3.01 Ga (Gärtner et al., 2013; Montero et al., 2014). The single other lithology to be dated in the region is a felsic volcanic obtained from drill core at the Tasiast deposit, which yielded an age of 2.97 Ga (Key et al., 2008), which is currently the best constraint for the age of the host rocks at Tasiast. Although no crystallization events older than 3.03 Ga are preserved in the Tasiast–Tijirit Terrane, whole rock Nd T_{DM} ages ranging from 3.60 Ga–2.95 Ga (Chardon, 1997, Key et al., 2008; Montero et al., 2014) suggest a contribution of older crustal material was involved in its creation.

The Aouéouat greenstone belt lies on the edge of one of a series of ENE oriented long-wavelength gravity and magnetic anomalies (Fig. 1b; Jessell et al., 2015). The Tasiast deposit is hosted within the north–south trending Aouéouat greenstone belt that is continuous for about 75 km strike length and shows as a series of high magnitude parallel anomalies in airborne magnetic data (Fig. 2b). The mine geology is characterized by a mafic to felsic meta-igneous succession, overlain by the remains of a sedimentary basin (Fig. 2a) that formed during rifting in a sinistral transtensional tectonic regime (Kruse, 2013). The preserved sedimentary stratigraphy includes abundant greywackes, siltstones, turbidite sequences and minor amounts of silica facies and

Table 1
Early exploration history of the Tasiast region (after Stuart, 2010).

Period	Operator	Activity	Exploration Scale
1962–1963	BRGM	The pegmatite Mission (for Be and Li)	Regional
1972	BRGM	Nickel Sulphide Mission	Regional
1973–1975	SNIM	Iron Ore Mission	Regional
1993–1996	BRGM + OMRG	European Development Fund project	Regional and infill

BRGM — Bureau de Recherches Géologique et Minières (French Geological Survey).
SNIM — Société Nationale Industrielle et Minière (Majority Mauritanian State-owned mining company).
OMRG — Office Mauritanien de Recherches Géologiques (Mauritanian Geological Survey).

Table 2
Mineral reserve and resource summary as of December 31, 2014.

Gold	Tonnes (×1000)	Grade (g/t)	Ounces (×1000)
Proven and probable reserves	161,822	1.77	9196
Measured and indicated resources[a]	85,573	1.14	3148
Inferred resources	8915	1.71	492
Total[b]	256,310	1.56	12,836

After www.kinross.com/operations/operation-tasiast-mauritania.aspx.
[a] Measured and Indicated Resources exclude Proven and Probable Reserves.
[b] 'Total' Grade is the weighted average of the three cited grades according to tonnes.