Côte d’Ivoire and Ghana Mine Site Visit Report

Sissingué, Yaouré, Edikan, Prestea & Wassa Gold Mines

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Introduction

From May 31st to June 5th, we travelled through Côte d’Ivoire and Ghana to visit four producing gold mines as well as one gold development project of West African gold producers Perseus Mining out of Perth and Golden Star Resources out of Toronto. The map below shows the location of each mine. We first flew to the Sissingué project in the North of Côte d’Ivoire and travelled to the other mine sites by bus and truck. The company’s senior and local management teams attended each mine visit and provided us with comprehensive technical insights on every mine and deposit. We stayed overnight at the campsites of Sissingué, Edikan and Prestea and we enjoyed excellent food and superior local hospitality at all the operations. Security was not a concern, however, we took reasonable precaution while travelling on the road in Côte d’Ivoire.

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This report aims to provide a high-level overview of the recent on-site activities and reflects our impressions on a selective basis. The views expressed and the pictures shown herein are solely ours. The technical and financial information in this report were obtained by the companies and publicly available company sources. We remind readers that no part of this report can be copied or otherwise reproduced without our prior permission.

Sissingué Gold Mine, open pit gold mine, Côte d’Ivoire

Sissingué is located at the border to Mali and has good access by road and by air. The mine lies in the Syama-Boundiali greenstone belt, a well-known district to host favorable structural and geological settings for gold mineralization. The mineralized structure at Sissingué primarily is in disseminated sulfides, hosted within fine-grained pyrite and arsenopyrite in alteration zones located close to granite intrusions. The gold appears to be homogenously distributed in the deposit and has so far made Sissingué a low-cost and predictable mining operation with consistent head grades to the mill. The ore is mined from the Sissingué pit (current strip ratio of 3:7), transported to a JAW crusher, then stockpiled and conveyed to the SAG mill and the gravity circuit. The slurry (grinded ore
and water) is pumped to a smaller pre-leaching thickener to remove excess water and subsequently to seven CIL (carbon-in-leach) tanks. Cyanide (concentration of 260ppm) and activated carbon is added to the slurry to leach and cause the gold to be absorbed by the carbon. In the elution circuit, the gold is pulled from the carbon and the remaining cyanide in the tailings (5ppm) is destroyed. Overall, the Sissingué leaching kinetics are favorable and up to 95% of the gold is recovered within a 20h (oxide) to 38h (sulfides) cycle.

Sissingué has a relatively short life of mine (LOM) of 4.6 years based on current reserves and resources. Over LOM, the project is expected to produce 78k ozpa Au at all-in sustaining costs (AISC) of $756 per ounce. The mine has a current workforce of 663 (including contractors) and 92% of the employees originate from Côte d’Ivoire. In our view there is limited potential for additional ore feed after the Sissingué LOM. The regional exploration program focuses on the discovery of smaller satellite intrusives (hosing ~50k oz. Au), but at this time it seems rather unlikely to us that another volume deposit will be discovered. Given its small-scale (2.8mtpa), the Sissingué plant could be mobilized fairly easy to another site for longer-term use after LOM, which provides some optionality to Perseus.

Yaouré Development Project, gold development project, Côte d’Ivoire

Yaouré is a ~1h drive by truck from Yamoussoukro, the capital of Côte d’Ivoire. The project is fully permitted and funded, but in terms of size, it is ~3x the capacity of Sissingué and will be built by the Sissingué construction team. There is good site accessibility by road and the Koussou hydro-electric power station, which will provide power for the project, is in close proximity to site (~6km). As per the DFS (definitive feasibility study) Yaouré has an after-tax IRR of 27% (at $1,250 gold) and an initial Capex of $263M with an 8.5-year mine life. At the peak of construction, the mine will employ a ~800 workforce (thereof ~80% locals) and until today, Perseus has received more than 7’000 job applications from the five surrounding villages.
Yaouré is located in the eastern half of the Bouflé greenstone belt, immediately south of a major break, and consists of two mineralized pits, “Yaouré” and “CMA”, which both are dominated by basalts with several large, sub-vertical granodiorite intrusions and multiple porphyry dykes. The gold mineralization is structurally controlled in stacked shear zones and remains open in multiple directions. Limited district exploration has been conducted to date, thus ~50% of Perseus’ exploration budget next year will be allocated to Yaouré.

As per the DFS, the two pits will deliver a 1.7-2.4 gpt Au head grade to the mill and gold production will peak at 230k ozpa Au. The processing of the ore is by conventional crush-grind-CIL similar to Sissingué and the plant does not require a sulfide flotation cycle. The CMA pit will provide ~85% of the mill feed, however, the existing CMA underground reserve of 595k oz. @ 6.2 gpt Au is currently not in the mine plan, but in our view this will be incorporated in an updated LOM plan rather sooner than later.

In our view Yaouré has exploration upside particularly by testing the CMA underground mineralized extension down dip (~30°) along the ~1km thrust fault. However, this extension in a mining scenario has some challenges to deal with, mainly due to rock dilation (non-uniform vein widths) and cracking at depth. The understanding of the geology and the definition of the appropriate mining method will be key in our view to unlock the CMA underground potential. The trade-off is between a low-CAPEX underground mine (e.g. room and pillar mining) which will on the other hand limit the extraction of the ore to ~60-70% or, alternatively, to operate a selective, but costlier mining method to get the maximum vertical meter performance (oz./vm) along the CMA strike.
Edikan Gold Mine, open pit gold mine, Ghana

It took us a one-day trip including a ~11h bus ride to get from Yamoussoukro to the Edikan gold mine in Ghana. The road conditions got increasingly worse after we passed the Tarkwa, the local capital of the Wassa district in Ghana. After arriving at the camp on Sunday night, we had a full day site tour on Monday. The mine is located nearby the village of Ayanfuri and has a workforce of currently 2,651 (including contractors). In essence, Edikan consists of five open pit mines with either harder, fresh intrusion-related gold mineralization with granodiorites as the primary host rocks (e.g. Esuajah North pit) or shear zone related mineralization where the gold is primarily hosted in softer oxidized sedimentary rock types (e.g. Bokitsi pit).

Based on the new 2018 mine plan, Edikan is expected to produce ~200k ozpa Au at AISC at sub-$1,000 over the remaining mine life of ~6 years. The plant is currently processing 6.5mtpa Au and numerous technical improvements have been made over the last few quarters to improve the mine’s efficiency. This includes the installation of a “mill slicer” to optimize the mill feed, the improvement of the liner profile of the primary crusher and the appointment of only one mining contractor. The processing circuit is crush, grind, gravity with a sulfide flotation and sulfide regrind circuit that produces a 2% mass pull which is sent to the CIL processing unit, i.e. 98% of the mass will go directly to the tailings without cyanide leaching, which is a major cost benefit. In terms of metal distribution, this means that >90% of the gold is within <3% of the ore, which we think makes Edikan a more “sensitive” mining operation in terms of grade and tons.

Our overall impression was that the 2018 updated LOM plan has shown steady operational improvements and that the operating team on site is actively pursuing additional efficiencies. Mining is now less selective than before, but we also think that after the current LOM Edikan will have run its course and there is limited near-mine exploration upside at this time. The question therefore becomes how Perseus will replace this ~200k ozpa Au operation in the future. To fill this production gap, we think Perseus could become a natural acquirer in West Africa gold mining M&A based on its record of accomplishment to successfully develop and build projects in the region.
Prestea Gold Mine, underground gold mine, Ghana

From Edikan it took us a ~1.5 hour drive to get to the Prestea Mine of Golden Star Resources where we stayed on the camp overnight and visited the mining operation the following day. Prestea is a high grade underground mine (grades >10 gpt Au) and is located along the prolific Ashanti Trend. The gold is typically found in a system of laminated quartz veins hosted in graphitic faults. The Central Shaft brought us down to the 24 underground level from where we took the train to the production level with currently twelve open stopes (S1-S12). Being underground, we got a good idea on the complexities and challenges of the Prestea mining operation, which have persisted over the last few quarters. To mine the deeply dipping mineralized zones between the hanging wall and the footwall, Golden Star uses Alimak mining over significant highs of up to 160m. One issue of mining this ore body with this selective mining method has been significant unplanned dilution of up to 30%, causing a severe cost overrun in 2018 (cash costs of $1,291/oz. Au). The dilution results primarily from pinch zones at the individual production stopes which was well recognizable underground. Re-mapping of each stope intends to validate the necessary production drilling practices to improve the dilution control. Another technical challenge is the single pass system for ore and waste, causing a bottleneck of the underground operation. However, during our tour Golden Star has been very transparent how these issues will be addressed, which is essential to re-build investor confidence in the asset. Although the mine is currently under a strategic review process, our impression clearly is that Golden Star intends to fix Prestea rather than putting it on care and maintenance. This site tour has validated our thesis that Prestea is a potential turnaround mine, which in our view accounts for no more than 10% of Golden Star’s market capitalization.

Furthermore, Golden Star actively promotes and develops livelihoods for post-mining land use, such as the plantation on old tailings. 98% of the employees of the Prestea mine are local Ghanaians and more than 85% of the value in goods and services for the mine are retained by the host communities.
Wassa Gold Mine, underground gold mine, Ghana

Our tour concluded with the visit of Golden Star’s Wassa underground mine and processing plant, which was around a ~2h drive from Prestea, mostly on paved roads. The Wassa deposit is hosted in highly deformed and altered sedimentary and volcanic rocks (see drill core picture below) and the folding and deformation of the deposit makes Wassa a geologically challenging mine, however, the deposit has very solid ground conditions which compensates for the complexity. Wassa is currently ramping up from ~3,600 tpd to 5,000 tpd. The ore is mined using sub-level open stoping with cemented back-fill.

We used the main decline and drove down to the 645 Level within the B-Shoot where diamond drilling is ongoing. We were impressed by the engineering work of the underground infrastructure, which is accessible by larger mining equipment including 60t trucks. The current Wassa underground mine has a strike length of 1,2km and extends vertically over 475m. The ramp up to the current 3,600tpd was ahead of plan, which is the result of a better than anticipated ton per vertical meter performance, i.e. Wassa produces more gold compared to the mine plan despite slightly lower grades but due to more tons of ore. However, the ramp up to 5,000 tpd requires aggressive drilling to test >2mt of mineralization before this material is mined and milled and we think this might get somewhat challenging also due to the dip and structure of the orebody as outlined in the 2024 life of mine plan. Overall, we think Wassa has the potential to become a real company builder for Golden Star, but the mine has its complexities and in our view will remain a CAPEX intensive project for the near future driven by more tons being mined.

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Disclosure Certain travel and accommodation expenses for the author in connection with the above-mentioned site visits were paid by Perseus Mining and Golden Star Resources. No fees or commissions were paid, nor were any other benefits granted by the above-mentioned companies to SSI Asset Management AG or the author. As per July 2nd 2019, the Precious Capital Global Mining and Metals Fund, which is managed by SSI Asset Management AG, held 1,100,000 shares of Golden Star Resources and 8,700,000 shares of Perseus Mining. Opinions in this report are solely those of the author. The information provided in this report is from various sources; however, SSI Asset Management AG or the author do not guarantee its accuracy or completeness. This report is prepared for general circulation and for general information only. This report does not constitute any investment advice to buy or sell any securities and is for information purposes only.