Newmont Ghana is the newest of Newmont’s operating regions, and one that holds great potential for expanded gold production, John Chadwick reports.

Newmont Ghana’s gold production from Ahafo mine was 137,000 oz and 545,000 oz, respectively, during the fourth quarter and full year 2010. Costs applicable to sales were $433 and $450/oz for the fourth quarter and full year 2010, respectively. Fourth quarter production increased from the prior year quarter due to higher mill grade. Costs applicable to sales per ounce decreased from the prior year quarter due to higher production, partially offset by higher labour, power and royalty costs.

The annual gold output increased due to higher grade ore mined at Apensu in 2010 and the start of production at Amoma in October 2010. Costs applicable to sales per ounce increased slightly due to higher labour, power, diesel and royalty costs, partially offset by higher production.

For 2011 gold production for the Ghana operations is expected to be 550,000-590,000 oz due to mining higher ore grade. Costs applicable to sales of approximately $485 to $535/oz are expected.

The Subika Expansion will extend mine life at Ahafo South and there is considerable underground development below the ultimate pit and layback potential. The company is proving up the option of an underground operation below the Subika pit. There is potential for a 4-7 Moz total resource. An exploration decline was collared in January 2010 and now there is simultaneous exploration drilling from underground and surface. This would be Newmont’s first underground mine in Ghana.

There is also Akyem, another development project in Ghana, with its mining lease and EIS approved.

The Ahafo mine is located in the Brong Ahafo region of west-central Ghana, about 30 km south of Sunyani and 290 km northwest of the capital city of Accra. It started production in 2006 and in 2010, produced 545,000 oz of gold at a cost of $450/oz. There are various opportunities for expansion of both output and mining life. At Ahafo North there are reserves of 3.2 Moz—an upside with multiple pit and underground opportunities. Newmont Ghana currently operates four open pits at Ahafo with reserves contained in 13 pits, over a strike length of 40 km.

The operation is currently only operating in the Ahafo south open pits. There is much more gold available in the North section. This year, Newmont will spend between $15 and $20 million on drilling at Ahafo North to better understand the extent of the current Ahafo deposit. Once mining starts in the north, ore will be hauled to the concentrator in the south by either trucks or an overland conveyor system.

The current pits are standard shovel and truck operations that feed a fairly conventional CIL processing plant. Ahafo was the first mine in Africa to have received cyanide in isolatners. It was designed to be in compliance with the International Cyanide Management Code.

Sandvik supplied the drilling fleet of 10 Drltech D45 blasthole drills and one Pantera 1500. The primary hydraulic excavator loading units are four Liebherr 994Bs. These are supported by one Caterpillar 385, a 345 and a 330. There is also one O&K (Bucyrus, and becoming Caterpillar) 1708 hydraulic shovel. The wheel loading fleet is comprised of four Cat 992Gs.

Caterpillar supplied most of the rest of the mobile equipment, including a 32-strong fleet of 785 haul trucks. The haul roads are kept in good condition by eight Cat D10T track dozers and Cat 834 wheel dozer, four Cat 16H graders and one Cat 14H grader. There are also two Cat 777 water trucks.

Metso Process Technology and Innovation (PTI) conducted a Mine-to-Mill Process Integration and Optimisation (PIO) project at Ahafo last year. The result of this was a significant increase in mill throughput without capital investment. This was achieved by reviewing the current operating conditions, identifying inefficiencies and then implementing PTI’s recommended changes in drill & blast, crushing and grinding practices.

A blend of both primary and oxide ore is...
fed to the mill to balance the head grade and recovery in the leach circuit. Ahafo operates a 54 x 75" gyratory crusher for primary ore and an MMD Sizer for oxide ore. This is followed by a SABC circuit comprising a 34 x 16.4', 13 MW SAG mill in closed circuit with two MP800 pebble crushers. SAG milling is followed by a 24 x 39', 13 MW ball mill in closed circuit with a cluster of 26" cyclones. After classification, the milling product is thickened and the overflow is fed to CIL tanks.

There is an opportunity to increase throughput and the ability to process multiple ore blends. Advance scoping and prefeasibility studies are being undertaken this year.

### Open pit mapping

In 2009, Newmont’s Technical Services Economic Geology (TSEG) group surveyed 60 external industry geoscientists to determine current industry practices in geological mapping. This survey assisted Newmont with identifying best practices in mapping data collection and enabled the company to compare the information to mapping practices within its own operations. This provided a benchmark and an opportunity for the TSEG team to host geologists from around the globe at its first Open Pit Mapping Symposium in July 2010 to better define mine mapping standards, exchange knowledge, and create a strong internal network to support the full adoption of the next generation in mine mapping — digital.

While digital mapping has been adopted extensively in exploration, academic and government mapping programs, only 28% of geoscientists who participated in the industry survey reported using digital mapping methods to collect data, suggesting that paper remains the dominant data collection technique.

In 2006, Newmont Nevada embarked on a program to introduce digital tablets at its mining operations to provide a leading-edge advantage in the interpretation and assimilation of important mapping data. This technique recently was adopted by Ahafo during 2009.

Identifying specific needs of focus, symposium participants identified skills and knowledge gaps occurring across the sites, and evaluated the potential impacts those gaps could have on ore control, geotechnical and resource model improvements. “The timing of this workshop couldn’t have been better,” said Harry Samani, Grade Control Geologist, Ahafo. “I think many of us were at a point of letting go or getting frustrated with mapping and its related issues. The open pit mapping seminar has exposed me to a lot of information that I think will make a significant difference when implemented. This event enabled me to see different ways of conducting and implementing mine mapping best practices. It was a great experience.”

“There is only one thing worse than not mapping, and that is not sharing and using information from mapping,” said Terry Briggs, Chief Development Geologist. “By bringing together the people who collect and interpret the data, it encouraged empowerment within the mine geology departments to improve the mapping process and positively impact the enhancement of safety and efficiency at Newmont’s mining operations.”

Collecting and interpreting geological information within a mining environment is critical to ensuring safe and efficient operations. Geological mapping is important in identifying and preventing risks of rock wall failures, ensuring economic portions of a mine are suitably delineated and processed, and guaranteeing the proper environmental classification of waste material.

Historical methods of mapping on paper are being replaced by digital collection of geological data with digital tablets and 3-D

### Current Ahafo pit statistics

<table>
<thead>
<tr>
<th>Mining started</th>
<th>Apensu 2006</th>
<th>Awonsu March 2008</th>
<th>Amoma July 2010</th>
<th>Subika Early 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pit depth:</td>
<td>180 m</td>
<td>80 m</td>
<td>28 m</td>
<td>192 m</td>
</tr>
<tr>
<td>Total tonnes mined:</td>
<td>121 Mt</td>
<td>40 Mt</td>
<td>3 Mt</td>
<td>86 Mt</td>
</tr>
<tr>
<td>Ore tonnes mined:</td>
<td>20.6 Mt</td>
<td>9.8 Mt</td>
<td>1 Mt</td>
<td>15.3 Mt</td>
</tr>
<tr>
<td>Grade:</td>
<td>2.10 g/t Au</td>
<td>1.54 g/t Au</td>
<td>1.28 g/t Au</td>
<td>2.05 g/t Au</td>
</tr>
<tr>
<td>Gold mined:</td>
<td>1.64 Moz</td>
<td>490,000 oz</td>
<td>42,000 oz</td>
<td>1 Moz</td>
</tr>
<tr>
<td>Final pit depth planned:</td>
<td>244 m</td>
<td>208 m</td>
<td>120 m</td>
<td>372 m</td>
</tr>
<tr>
<td>Total tonnes remaining:</td>
<td>6.3 Mt</td>
<td>94 Mt</td>
<td>32 Mt</td>
<td>340 Mt</td>
</tr>
<tr>
<td>Ore tonnes remaining:</td>
<td>4.7 Mt</td>
<td>35 Mt</td>
<td>12 Mt</td>
<td>61 Mt</td>
</tr>
<tr>
<td>Grade of remaining ore:</td>
<td>3.0 g/t Au</td>
<td>1.38 g/t Au</td>
<td>1.45 g/t Au</td>
<td>2.2 g/t Au</td>
</tr>
<tr>
<td>Gold Remaining:</td>
<td>455,000 oz</td>
<td>1.5 Moz</td>
<td>560,000 oz</td>
<td>4.3 Moz</td>
</tr>
<tr>
<td>Mining complete:</td>
<td>mid 2012</td>
<td>2014*</td>
<td>2011**</td>
<td>~2021</td>
</tr>
</tbody>
</table>

*Current phase; ultimate completion is scheduled for 2021
**Current phase; ultimate completion is scheduled for 2015

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**Note:**

1. Current Ahafo pit statistics
2. Historical methods of mapping on paper are being replaced by digital collection of geological data with digital tablets and 3-D.
photogrammetry. In addition to providing geologists with a better understanding of the orebodies and extension potential, these tools are helping them become more proactive by providing a complete view of the data required to make decisions to mitigate risk and improve development plans in real-time. This sort of thing is especially useful at a site like Ahafo with multiple active and planned pits.

Mineral sizing

A significant innovation in processing is the use of an MMD Mineral Sizer. “Normal practice in Africa is to process primary ore through a gyratory crusher with a mixture of saprolite,” explains John Mitchell, Senior Metallurgist and Mark K. Jorgensen, Process Manager with Newmont. During the rainy season, Ahafo’s saprolite ore is especially wet and sticky and can contain up to 20% moisture. There are two discrete wet seasons in the region each year.

“In the early phases of design, it was recognised that the mine plan would dictate that up to 50% of the ore would be saprolite for extended periods, sometimes for as much as several years. To ensure production during seasonal, inclement, rainy weather, a dedicated crusher circuit was designed.”

The oxide crusher circuit processes up to 600 t/h of wet sticky saprolite ore. The machine chosen for this duty is a 600-mm x four tooth MMD Sizer. ROM ore is loaded into a crusher feed hopper by a Caterpillar 992 wheel loader and the crushed oxide ore discharges directly to the SAG mill feed conveyor.

Mitchell and Jorgensen note “there is an additional benefit to running two crusher circuits in that ore from the MMD Sizer and gyratory crusher are combined on a single belt to feed to the SAG mill [a Metso Minerals machine 10.4 m in diameter x 5 m effective grinding length]. The first material to be conveyed to SAG mill feed conveyor is MMD Sizer product. This material acts as a ‘cushion’ to the SAG mill feed belt and reduces impact to the belt surface from theprimary crushed ore stockpile fed from the three apron feeders.

The Ahafo license is located in the Yamfo-Sefwi gold belt, a well-defined zone of many gold occurrences that trends 20-30° east of north and stretches northwards from the Ghanaian border with Cote d’Ivoire for a distance of about 200 km. Intruded along this trend are a series of hornblende granodiorites which preferentially exploit a major regional break separating Lower Birimian sediments from Upper Birimian volcanics. Newmont’s property covers three segments of the granodiorite - metasediment contact.

Gold mineralisation is generally associated with a brecciated and hydrothermally altered shear-zone of granodiorite lying in thrust/wrench contact with underlying graphitic phylites of the Birimian Supergroup. The phylilies also contain scattered pods of gold mineralisation, but these appear to be limited to a zone lying no more than 20 m from the granodiorite. The thrust contact always dips east at angles varying from 30° to 65°.

Gold mineralisation is also associated with a shear zone about 1.2 km east of the granodiorite - metasediment contact that was expressed by a low-level soil geochemical target. The granodiorite hosted shear zone is subparallel to the main trend and dipping from 60° east to sub-vertical.

In December 2003, Ghana’s Parliament unanimously ratified an Investment Agreement between Newmont and the Government of Ghana. This established a fixed fiscal and legal regime, including fixed royalty and tax rates, for the life of any Newmont project in Ghana. Under the Agreement, Newmont pays corporate income tax at the Ghana statutory tax rate (presently 25% but not to exceed 32.5%) and fixed gross royalties on gold production of 3.0% (3.6% for any production from forest reserve areas). The Government of Ghana is also entitled to receive 10% of a project’s net cashflow after Newmont has recouped its investment and may acquire up to 20% of a project’s equity at fair market value on or after the 15th anniversary of such project’s commencement of production.

The Investment Agreement also contains commitments with respect to job training for local Ghanaians, community development, purchasing of local goods and services and environmental protection.

Newmont faces a number of challenges in the region. Besides the projects covered in the article, it is assessing other potential gold deposits but it is difficult to “gain timely and cost efficient land access for exploration and project development”, the company says. Nevertheless, Newmont believes there is very significant growth potential in its land holdings in the country.

Power options have been a problem in the past and Newmont is currently working on a long-term plan to be less reliant on the government VRA power grid. The company is currently working on a study for long-term energy options, including alternatives to natural gas and hydraulic energy. Skills shortages are a problem with the “inability to retain, attract and develop talent, at an acceptable cost, [which] leads to inability to sustain and grow our business (low productivity, expatriate requirements exceed project margins, schedules slip, etc...)”.

“Illegal mining negatively impacts our ability to sustain and grow our business in the region,” Newmont also reports.

Newmont remains “committed to growing our relationships and enabling local businesses in Ghana.” It explains that partnerships with host communities and Government are key to building a sustainable business. The majority of the Ahafo mine revenue remains in Ghana, with programs to increase this over time. Mining provides significant benefits to Ghana at the national, regional and local levels.

At the end of 2010, the Ahafo open pits contained probable reserves of 148.3 Mt at 2 g/t Au. Recovery should be 87%. This includes undeveloped reserves at Yamfo South, Yamfo Central, Techire West, Subenso South, Subenso North, Yamfo Northeast, and Susuan totalling 3.2 Moz. The six stockpiles contained Proven reserves of 14.1 Mt at just over 1 g/t Au.

Subika and underground

The Subika Expansion has a current potential of up to 9 Moz, with 3.7 Moz currently in
reserves and 2.2 Moz in NRM (non-reserve mineralisation). Drilling of 28 km in 41 holes aimed at expanding underground and open pit mineral extensions, added 1.1 Moz of attributable open pit reserves in 2010. The calculation of underground NRM from 91 holes with 25 km of underground core drilling in 2010 will be confirmed through model and stope design updates in mid-2011.

Concurrently, the exploration drift initiated in 2010 advanced 2,635 m, vent raises were completed and initial test stope production is anticipated in early 2011. Completion of an underground pre-feasibility study is anticipated in the second quarter of 2011. Development was progressing in favourable ground and hydrological conditions. The orebody is open at depth and along strike. The operation was stockpiling ore for batch treatment and was working to obtain operating permit. It is in what the company describes as Stage 4 with detailed project engineering and procurement of long lead equipment underway.

The current underground exploration fleet comprises one Boart Longyear LM90 and three LM75 diamond drill rigs. There are three Sandvik underground development/production drills – one Axera D07 240 jumbo, one Axera DD7 420 jumbo and one DL 420 15C Solo. There is a Normet 1610B explosives charging unit. Underground material is loaded by two Caterpillar LHDs, one R2900G and a R1700G. These in turn load two underground trucks, a Volvo A40E and a Cat AD55, with a 12M grader to keep the haul roads in good condition. There are also two Cat IT 62Hs and a Telehandler TH414.

Akyem
Akyem (100% owned) is one of Newmont’s current three main projects for the future, the other two being Conga in Peru (see the May article) and Hope Bay in Canada, which will be covered in June. Located some 125 km northwest of Accra, Newmont has received the Environmental Permit and the Mining Lease for Akyem. Newmont made a development decision late March and estimates first production in late 2013 to early 2014. End of March 2011 detailed engineering is approximately 95% complete.

The Akyem project received full funds approval at the March 2011 Newmont Board meeting. Newmont reported 7.2 Moz of gold reserves at Akyem. It is the company’s second major gold project in Ghana, with potential to double production in the region by 2017:

- Current potential of 8-9 Moz gold, with 7.2 Moz in Reserves and 0.3 Moz in NRM
- Estimated average annual production (first five years): 350,000-450,000 oz
- Estimated average annual CAS (first five years): $450-$550/oz
- Expected initial capital expenditure: $0.85-$1.1 billion (excluding capitalised interest and sunk costs)
- Land access activities in progress
- Major long lead process equipment procured
- Life of mine: ~16 years.

Medical support
Newmont Ghana has been recognised by the Global Business Coalition (GBC) for its workplace program for HIV/AIDS and malaria. It was awarded best in category for its key initiatives in disease prevention and control.

Newmont Ghana was singled out by GBC, not only for the quality of its work but also, notably, because of its reach, which extends beyond the company’s own operations to include contractors, suppliers and local communities. By using a peer education approach to empower individuals both at work and in its wider stakeholder group, the company has been able to widen the net for voluntary counselling and testing on HIV/AIDS. Working in partnership with the Ghana Health Service, the company has also broadened the scope of education and prevention of malaria control through its treated bed net distribution.
program in its local communities and the workplace.

GBC, a worldwide coalition of corporate organizations, including the UN and affiliates such as the World Health Organization (WHO), described the company’s programs as ‘outstanding’. It highlighted success stories such as the company’s malaria program which led to a fall in malaria sufferers from 8% of employees at the start of the program in 2006 to just 1.8% in 2009.

“The impact has been deep,” noted GBC President John Tedstrom. “Newmont doesn’t just reach its workers. It also covers families and contractors – a demonstration of the company’s commitment to being a force for good beyond the factory gates.”

The malaria workplace program involves a proactive effort in disease control through initiatives such as indoor residual spraying and distribution of long lasting bed nets to a work force of over 5,000 as well as communities around the Ahafo mine operations. This is also backed by an educational campaign on prevention and treatment.

The HIV/AIDS program includes voluntary counselling and testing (VCT) services which consist of a wellbeing test for blood pressure and blood sugar. The company annually distributes an average of 72,000 condoms free to employees and contractors. The Peer Educator initiative delivers education on malaria and HIV/AIDS to over 10,000 people each year.

Reference
1. Fragmentation and comminution – Integration and optimisation of blasting, crushing and grinding at the Newmont Ahafo operation, International Mining, September 2010, p57.