NEWMONT GHANA GOLD LTD.
AHAFO SOUTH PROJECT

WASTE ROCK AND TAILING GEOCHEMISTRY

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INTRODUCTION

Geologic formations or materials hosting gold deposits exhibit broad variability in structural setting, porosity, permeability, and mineralogical composition. Disturbing or processing geologic materials during mine-related operations can potentially change local rock-water interactions from existing conditions; thereby initiating geochemical reactions that may require additional mitigation measures.

Newmont Ghana Gold Limited (NGGL) is committed to understanding site-specific geochemical processes that result from exposure of geologic materials to weathering during and after mine operations at the Ahafo South Project. Primary concerns are the release of pollutants to the environment, including surface runoff, toe seepage, and infiltration to groundwater from waste rock storage facilities and tailing storage facility; and water that would collect in the mine pits. Periodic monitoring, including collection and analysis of water samples, will provide data necessary to evaluate the current geochemical characterization program and develop appropriate mitigation measures that would minimize or abate potential adverse effects of the geochemical processes.

Separate composite samples of oxide and sulfide rock intervals were collected from recovered drill cores whose locations were determined to be representative of subsurface geologic material present within the volume of rock to be removed from the proposed Ahafo South mine pits. These samples were analyzed using static test procedures (acid-base accounting) as an initial assessment for potentially acid generating rock at the Ahafo South Project. Analytical results of these samples were displayed in NGGL's Environmental and Social Impact Assessment (ESIA) (August 2005).

GEOCHEMICAL CHARACTERIZATION PROCEDURES

NGGL maintains discipline-specific standards for environmental management, including waste rock and tailing management. NGGL's Environmental Standard for waste rock management addresses characterization of waste rock, design and construction of waste rock disposal facilities, potential acid generation, storm water controls, monitoring, and closure/reclamation. The following are selected standards from NGGL's Environmental Standard for waste rock management:

- Waste rock shall be physically and geochemically characterized prior to design, and during operation, and closure and reclamation phases.
- Acid rock drainage (ARD) potential shall be determined using reliable acid-base accounting methodology.
- Potentially acid-generating waste and ore that is stockpiled must be managed to prevent the release of pollutants to the environment, including surface runoff, toe seepage, and infiltration to groundwater.
- During the design phase, a balance of potentially acid-generating and non-potentially acid-generating material must be developed in order to evaluate and design controls to isolate potentially acid-generating material from the environment in the near- and long-term through mine planning.
- Waste rock disposal facility design and construction must incorporate measures to minimize the generation of acid.
- Sites must develop and implement a waste rock and ore tracking system. Sites must demonstrate that waste rock has been properly characterized and routed to the appropriate disposal facility.

NGGL's Environmental Standard for waste rock characterization follows guidance established by the U.S. Bureau of Land Management (USBLM) and Nevada Division of Environmental Protection (NDEP) where applicable:

U.S. Bureau of Land Management (USBLM), 1996. State of Nevada Acid Rock Drainage Testing Requirements. Information Bulletin No. NV-96-097. Nevada State Office, Reno, Nevada, USA. March 14, 1996.

Nevada Division of Environmental Protection (NDEP), 1990. Waste Rock and Overburden Evaluation. Bureau of Mining Regulation and Reclamation, Carson City, Nevada, USA. September 14, 1990.

A summary of the waste rock material testing performed and methods used by NGGL at the Ahafo South Mine Site are presented in Table 1, along with requirements of NDEP for comparison purposes. A summary of USBLM guidelines that vary from NDEP requirements is presented following Table 1. A discussion of results of the Ahafo South Phase II testing, as they relate to NDEP and USBLM guidelines, is located at the end of the next section "Current Status of Geochemical Characterization".

NGGL's Environmental Standard for tailing management addresses characterization of tailing, protection of groundwater, prevention of uncontrolled releases to the environment, management of process fluids, monitoring, and closure/reclamation. The following are selected standards from NGGL's Environmental Standard for tailing management:

- Tailing shall be physically and geochemically characterized and results shall be utilized in the design, operation, and closure and reclamation of tailing storage facilities.

- Acid rock drainage (ARD) potential shall be determined using reliable acid-base accounting methodology.

- Ongoing periodic tailing characterization in the form of kinetic tests to confirm ARD predictions based on static test results shall be conducted.

- Sites shall develop a Fluid Management Plan that addresses the management of solution during the operation and closure and reclamation phases.

- Sites shall develop and implement a closure and reclamation plan for tailing storage facilities, including a Solution Management Plan and drain-down predictions incorporating water quality and quantity issues.

TABLE 1. COMPARISON OF WASTE ROCK EVALUATION REQUIREMENTS FOR AHAFO TESTING

Nevada Division of Environmental Protection (NDEP)	NGGL Ahafo Project Testing
Sample Collection	
Sample material must be representative of the range of applicable materials and the sampling program must consider variations in lithology, mineralogy, color, sulfide mineralization, degree of fracturing, degree of oxidation, and the extent of secondary mineralization.	Composite samples were created from rock core within each pit area from multiple boreholes distributed across the oxide, transitional, and sulfide zones of the pit. Each composite sample was analyzed for whole rock mineralogy based on x-ray diffraction data, ICP elemental analysis, and LECO carbon and sulfur values.
Evaluate Potential to Release Pollutants	
Meteoric Water Mobility Procedure (MWMP) Evaluates the potential for dissolution and mobility of constituents from a mine rock sample by meteoric water. Procedure consists of a single-pass column leach or a bottle roll or large barrel with agitation over a 24 hour period using a solid to extraction fluid ratio of 1:1. The extraction fluid is Type II reagent water. The extraction fluid is then filtered and analyzed.	Synthetic Precipitation Leaching Procedure[1] (SPLP) Evaluates the potential for inorganic constituents to leach from mining waste by an extraction fluid whose pH reflects the pH of acidic precipitation in the geographic region of interest. Procedure consists of shaking (end-over-end rotation at 30 rpm) a mining waste solid mixed with extraction fluid (pH representative of the geographic region) at a solid to fluid ration of 1:20 for a period of 18 hours. The leachate is then filtered and analyzed.
Evaluate Potential for Acid Generation using Static Testing (Acid/Base Accounting (ABA) or Equivalent)	
Determine Neutralization Potential (NP) Procedure calls for adding known amount of Hydrochloric acid to a sample, heating the sample, and then titrating the sample to pH 7 with Sodium Hydroxide. The acidity consumed is then converted to tons of $CaCO_3$/1000 tons.	Determine Acid Neutralizing Potential (ANP) Carbonate carbon is calculated from the difference between the Total Carbon[2] and the residual carbon after reaction with hydrochloric acid, which causes the loss of carbonate minerals via gaseous carbon dioxide. ANP reported as %CO_2. The ANP value can be converted to NP units by multiplying by 22.7 kg $CaCO_3$/tonne/%CO_2.
Determine Acidification Potential (AP) By Alternative I or II Alternative I - a.) Determine Total Sulfur by LECO furnace. Assume all sulfur is acid generating and convert to tons of $CaCO_3$/1000 tons. If NP:AP >1.2:1, then evaluation is stopped and material is considered non-acid generating. If < 1.2:1 then complete b.) Alternative I - b.) Determine Total sulfide sulfur content described in Standard Methods of Chemical Analysis, or other equivalent procedure. Convert to tons of $CaCO_3$/1000 tons and if NP:AP >1.2:1 then evaluation is stopped and material is considered non-acid generating. If <1.2:1 then initiate kinetic testing. Alternative II – Determine peroxide oxidizable sulfur and convert to tons of $CaCO_3$/1000 tons. If NP:AP >2:1 then evaluation is stopped and material is considered non-acid generating. If <2:1 then initiate kinetic testing.	Determine Acid Generation Potential (AGP) AGP is determined by estimating the Total Sulfide Sulfur content. It is calculated as the difference between Total Sulfur[2] and Sulfur after pyrolysis of the sample and is reported as a negative number in %CO_2. The AGP value can be converted to AP units by multiplying by -22.7 kg $CaCO_3$/tonne/%CO_2. Determine an Net Carbonate Value (NCV) NCV is determined by adding together the ANP and the AGP and is an indication of the net neutralizing potential of the material in %CO_2. Samples with NCV values less than 1 may require further investigation. NCV Confirmation Analysis NGGL has performed additional testing to evaluate sample mineralogy components that can impact the NCV, including use of various methods to determine Carbon and Sulfur constituents and Acid Neutralization Potential acidity (ANPA) titrations with peroxide corrections to evaluate the effect of iron hydrolysis. In addition, NGGL has performed kinetic tests including peroxide acid generation (PAG) tests and Biological Acid Production Potential (BAPP) tests to confirm NCV classifications and metals.

Nevada Division of Environmental Protection (NDEP)	NGGL Ahafo Project Testing
Evaluate Potential for Acid Generation using Kinetic Testing, if required by Static Testing Results	
Conduct in accordance with one of the procedures identified below: 1.) B.C. Research Confirmation Test – Sample is mixed with a nutrient media, culture of *Thiobacillus ferrooxidans* at pH 2.2-2.5 using a gyratory shaker at 35 ˚C in CO_2 enriched atmosphere. The pH is monitored and additional sample is added. If pH rises substantially, then the sample is a non-acid producer. If pH stays low then it is a potential acid producer. 2.) Shake Flasks – Sample is mixed with 600 ml of water or nutrient in a series of samples tested at various starting pH, inoculation, and temperatures. Samples are incubated for up to 3 months and leachates analyzed weekly and bi-weekly for range of parameters. 3.) Soxhlet reactor – Water is placed into a reservoir, vaporized and passed into a condenser. The condensed liquid drips into a thimble holding the sample and then back into the reservoir. Leachates are analyzed after 64-92 hours. 4.) Humidity Cell – Sample in a Plexiglas container is connected to humidified air. A weekly cycle of 3 days dry air passed over the sample followed by three days of humidified air is used and on the 7th day 200 ml of water is added. The leachate is removed and analyzed. The procedure is repeated for 8-10 weeks. 5.) Columns/Lysimeters – Sample is placed into a column and periodically leached by distilled water. Leachate samples are analyzed periodically (usually 8-10 weeks minimum) 6.) Test plots/pits/piles – Run of mine or modified sample is placed on an impervious surface and precipitation leachate is collected and analyzed. Test usually runs for a year.	Even though the Phase 2 ABA test results reported below would not require kinetic testing under the NDEP requirements, NGGL has subjected the Phase 2 samples to kinetic peroxide acid generation (PAG) tests which measures reactive sulfides by oxidizing the sulfide minerals with hydrogen peroxide. Materials that produce PAG leachates with pH values below 4.5 indicate potential acid generating material. In addition, two samples were testing using a biological acid production potential test during the NCV confirmation analysis described above. This procedure consists of mixing a sample with a nutrient solution, inoculated with *Thiobacillus ferrooxidans,* in a gyratory shaker at 35 ˚C at a pH of 2.5. The solution pH is monitored every other day until microbiological activity ceases. The test is equivalent to the NDEP kinetic test 1.) B.C. Research Confirmation Test.
Evaluation of Site-Specific Conditions and Characteristics	
If Kinetic Testing confirms acid generation potential then site-specific conditions and characteristics shall be evaluated and containment/neutralization methods proposed for approval.	Not Applicable

1 ASTM Method D6234-98. Standard Test Method for Shake Extraction of Mining Waste by the Synthetic Precipitation Leaching Procedure, ASTM, 100 Barr Harbor Drive, West Conshohocken, PA, United States

2 ASTM Method E1915-01. Standard Test Methods for Analysis of Metal Bearing Ores and Related Materials by Combustion Infrared Absorption Spectrometry, ASTM, 100 Barr Harbor Drive, West Conshohocken, PA, United States

USBLM Guidelines contain a summary of testing procedures for determining leaching potential of wastes including the following:

- Toxicity Characteristics Leaching Procedure (TCLP) – U.S. Environmental Protection Agency (USEPA) Method 1311, which is used under the U.S. Resource Conservation and Recovery Act (RCRA) to characterize a waste as hazardous and is designed to simulate leaching a waste that would be disposed of in a sanitary landfill. This test is not applicable to waste rock but may apply to other materials, like tailings, that are to be disposed of outside of initial containment.

- Synthetic Precipitation Leaching Procedure (SPLP) – USEPA Method 1312 which is equivalent to the ASTM Method D6234-98.

- Meteoric Water Mobility Procedure (MWMP) – As previously described, but the guidelines call for comparing the filtered leachate concentrations to drinking water standards or state water quality standards. Further investigation of potential groundwater impacts is required if the leachate concentrations are 10 times the drinking water maximum contaminant level, and the waste rock management plan must address the issue.

USBLM guidelines also contain testing procedures for prediction of acid-generation, including static tests (acid-base accounting (ABA)) and kinetic tests. The guidelines present criteria for determining whether a sample requires further kinetic testing or active material management based on the following ABA results with respect to acid neutralization potential (ANP) and acid generation potential (AGP):

- If ANP:AGP is greater than or equal to 3:1 and/or when the net neutralization potential (NNP) is greater than 20 tons as $CaCO_3$/1000 tons of waste, the material is considered acid neutralizing.

- If ANP:AGP is 1:1 or less, and/or the NNP is less than 20 tons as $CaCO_3$/1000 tons of waste, it is considered acid generating and requires action to reduce the potential for acid generation.

- If ANP:AGP is between 1:1 and 3:1 and with a NNP between -20 and 20 tons as $CaCO_3$/1000 tons of waste, it should undergo kinetic testing to determine if it is possibly acid generating.

Under kinetic testing, USBLM guidelines list procedures for humidity cell tests, net acid-generating potential tests (equivalent to the peroxide acid generation (PAG) test mentioned in the next section), paste pH test, and acid-concentration present tests.

CURRENT STATUS OF GEOCHEMICAL CHARACTERIZATION

Since August 2005, when the ESIA was published for the Ahafo South Project, NGGL has continued its site-specific characterization studies to enhance our understanding of geochemical processes that result from exposure of geologic materials to weathering. NGGL is continuing to conduct sampling, laboratory/field analysis, and modeling to predict potential geochemical changes in the environment as a result of mining-related activities at Ahafo South. Predictive models are based on chemical and mineralogical analysis of exploration core samples (ore and waste rock), local and regional groundwater and surface water quantity/quality data, aquifer test data, and process solution chemistry data, all of which are currently being collected at the Ahafo South Project site.

Waste Rock Geochemistry

Preliminary results of static ABA tests for four mine pit areas (Amama, Subika, Apensu, and Awonsu) at Ahafo South presented in the ESIA, classified the rock materials based on net carbonate value (NCV) as ranging from slightly basic (NCV = 0.1 to 1% CO_2) to highly basic (NCV > 5% CO_2) in sulfide composite samples, with the exception of one sample from the Apensu Mine Pit area that was classified as slightly acidic (NCV = -1 to -0.1% CO_2). The oxide composite samples were classified from neutral or inert (NCV = -0.1 to 0.1% CO_2) to slightly basic.

Since August 2005, additional ABA tests (Phase II) have been performed on eight composite samples from the proposed Apensu Mine Pit area using the test methods described in Table 1. The NCV categories reported in Table 2 are based on classification criteria in the ESIA (Table 4-24) and NCV analyses, some of which were previously reported in the ESIA (Table 4-24).

TABLE 2
Composite Sample Results (Phase II) from Apensu Mine Pit Area

Composite No.	Lithology	NCV Category	Hole No.	Interval (meters)
KCW02	Granitoid	Basic	KCP 174	100.5 - 124.8
KCW03	Granitoid	Highly Basic	KCP 174	59.5 - 65.5
KCW04	Granitoid	Slightly Basic	KCP 004	55 - 60
KCW05	Mylonitized Volcanic and Granitoid	Basic	KCP 007	134 - 159
KCW06	Mylonitized Volcanic and Granitoid	Slightly Basic	KCP 177	83.5 - 85.5
KCW07	Phyllonitized Mafic Volcanic	Basic	KCD 008	110.18 - 120.1
KCW08	Saprolite	Inert	KCD 008	10 - 34
KCW09	Saprolite	Slightly Basic	KCP 004	20 - 50

Note: NCV = net carbonate value
Source: Charles Bucknam (Newmont), 2006. Personal communication. April 2006.

Phase II ABA test results shown in Table 3 generally confirm the NCV classifications determined in the original testing. Minor changes in NCV classification were measured in two of the Phase II samples: KCW04 granitoid changed from slightly basic to inert; and KCW08 saprolite changed from inert to slightly basic. However, these classification changes are not significant, supporting the conclusion that there is little tendency for potentially acid generating rock in the vicinity of the Apensu Mine Pit.

TABLE 3
NCV Confirmation Sample Test Results (Phase II)
from Apensu Mine Pit Area

Composite No.	AGP ($\%CO_2$)	ANP ($\%CO_2$)	NCV ($\%CO_2$)	Paste pH	SPLP pH	PAG pH
KCW02 GD B	-0.11	4.10	3.99	9.14	8.42	9.52
KCW03 GD HB	-0.02	7.00	6.98	9.03	7.99	9.38
KCW04 GD SB	0.00	0.04	0.037	NA	8.16	9.19
KCW05 GVM B	-0.14	4.88	4.74	8.80	7.45	9.73
KCW06 GVM SB	-0.09	0.46	0.37	NA	7.40	6.20
KCW07 PHY B	-0.17	2.99	2.82	8.41	7.42	8.08
KCW08 SAP I	0.00	0.47	0.47	4.95	7.82	5.13
KCW09 SAP SB	0.00	0.25	0.25	4.67	7.85	6.36

Note: AGP = acid generating potential; ANP = acid neutralizing potential; NCV = net carbonate value, SPLP = Synthetic Precipitation Leaching Procedure; PAG = peroxide acid generation
Source: Charles Bucknam (Newmont), 2006. Personal communication. April 2006.

Kinetic testing has been performed on the above samples using a peroxide acid generation (PAG) test and the two saprolite composite samples were evaluated using a biological acid production potential (BAPP) method to further investigate neutralization potential. The BAPP test measures potential for acid-generating bacteria to produce sustained acid generation. Because acid is originally added to the incubation chamber, a false positive may result if the pH is maintained at or below 3.5. The peroxide acid generation (PAG) test for the two saprolite samples was used in conjunction with the BAPP test to eliminate false positive results by measuring all reactive sulfides (i.e., peroxide oxidizes pyrite and releases acidity); if the pH is <4.5, the sample has a low neutralizing potential. If the BAPP test shows a pH <3.5, while the PAG pH is >4.5, the sample is showing a false positive for acid generation potential. In this case, the low BAPP pH resulted from the addition of acid and not from the production of acid from reactive sulfides.

Results from the two saprolite composite samples showed BAPP pH values of 3.09 and 3.45, with corresponding PAG pH values of 6.36 and 5.13, confirming that the low BAPP pH values are due to lack of neutralizing capacity and not due to high acid production potential. Results of PAG testing showed pH values above 4.5 for all samples, indicating that there is little potential for acid production for these materials.

The eight composite samples (Table 2) were also tested using SPLP (NMS 2004) to determine trace metals that may be leachable from the rock by meteoric water. SPLP tests are considered screening-level analyses to determine what metals could potentially be released from the rock and whether additional kinetic testing is warranted.

Results of SPLP tests indicate that arsenic and cadmium have the potential to be released in the basic granitoid, basic and slightly basic mylonitized volcanic and granitoid, and basic phyllonitized mafic volcanic composite samples (four of eight samples). In addition, the SPLP solutions showed potential for release of aluminum in six of the eight composites. No potential release of metals were reported in the SPLP extracts for the two saprolite composite samples.

A comparison of the ABA results to the USBLM guidelines for determining whether a rock is acid producing material can be done by dividing the ANP by the AGP in Table 3. If the zero AGP values are set to 0.01% CO_2 then the ANP:AGP ratio ranges from 3.7:1 to 349:1 and the material in Table 3 would all be classified as acid neutralizing.

Tailing Geochemistry

Graeme Campbell & Associates PTY LTD (Graeme Campbell, 1999) was commissioned to carry out geochemical test work on tailing slurry samples from bench-scale metallurgical investigations at the Ahafo site. The tailing slurry samples were prepared from oxide-ore and primary-ore material. This testing focused on acid-base chemistry of tailing solids samples, as well as evaluating multi-element composition of the tailing solids and tailing slurry water. Results of the Graeme Campbell (1999) testing shows the following general conclusions:

- Solids of both oxide-ore-tailing and primary-ore-tailing samples are classified as non-acid forming.
- Solids of both oxide-ore-tailing and primary-ore-tailing samples were enriched in arsenic and antimony.
- Both tailing-slurry-water samples were mildly alkaline and of low salinity. Slurry-water from the primary-ore-tailing sample has an arsenic concentration of approximately 2 milligrams per liter (mg/L).
- Concentrations of total cyanide and weak-acid-dissociable (WAD) cyanide in the slurry-water oxide-ore-tailing sample were approximately 20 mg/L each; whereas the total and WAD cyanide concentrations in the slurry-water primary-ore-tailing sample was about 160 mg/L.

For Ahafo South, 11 composite samples from the Apensu Mine Pit have been analyzed by NGGL for all of the same parameters as waste rock (e.g., ABA, SPLP, and BAPP). Results of this testing are currently being compiled and analyzed.

ACTION PLAN

The results of testing completed to date continue to support the conclusion of non-acid generating conditions present in waste rock materials expected from the Ahafo South Project open mine pit areas. Consistent with NGGL Environmental Management standards, additional and ongoing waste characterization will be conducted on an ongoing basis as mine activities commence.

Additional geochemical studies are being planned to further corroborate the initial findings described above. These studies will include kinetic test studies using on-site waste rock columns and laboratory humidity cell tests for representative composite waste rock samples. Additional geochemical characterization studies for waste rock and tailing will be conducted as indicated in Table 4 and utilized for ongoing mine planning and environmental management. Waste rock and tailing geochemistry will continue to be evaluated and reported.

TABLE 4
Ongoing Geochemical Test Work
Ahafo South Project

Media	Study Objective	Schedule
	Waste Rock Material	
On-Site Waste Rock Columns	Confirm Lab Data	Initiate September 2006
Humidity Cell Tests	Confirm Static Tests	Initiate October 2006
Ongoing Waste Geochemistry	Operational ABA Monitoring	Quarterly
	Tailing Material	
Tailing Geochemistry	Basic Static/Kinetic Testing	In Progress
Humidity Cell Tests	Phase II Kinetic Testing (Confirmation)	Initiate October 2006