



GOLD FIELDS




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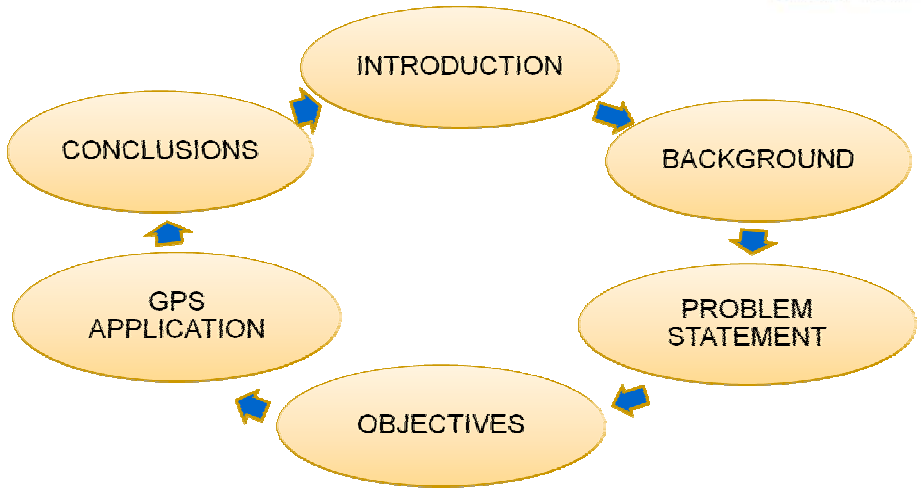
**THE USE OF RTK GPS IN BLAST
OPTIMIZATION “THE CASE OF GOLD
FIELDS GHANA LTD, TARKWA”**

BY
FRANCIS MENSAH
EILAT 2009, FIG WORKING WEEK

PRESENTATION OUTLINE



GOLD FIELDS



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graph TD; INTRODUCTION --> BACKGROUND; BACKGROUND --> PROBLEM STATEMENT; PROBLEM STATEMENT --> OBJECTIVES; OBJECTIVES --> GPS APPLICATION; GPS APPLICATION --> CONCLUSIONS; CONCLUSIONS --> INTRODUCTION;
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BACKGROUND



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- Tarkwa Gold Mine is owned by Gold Fields Ghana, IAMGOLD and the Government of the Republic of Ghana in a 71%, 19% and 10% ratio.
- Tarkwa is a large, low-grade open pit gold mining operation being operated by Gold Fields Ghana Limited (GGL).
- Annual production average is 110 million tonnes.
- Tarkwa Mine is located in Southern Ghana between Latitude 5° 15'N – 5° 30'N and Longitude 1° 50'W – 2° 05'W.
- The concession covers an area of approximately 295 km² extending from the town of Tarkwa in the south for a distance of 25 km to Huni Valley in the northeast limit.

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BACKGROUND



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Location of GGL Concession



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BACKGROUND



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Mine Geology

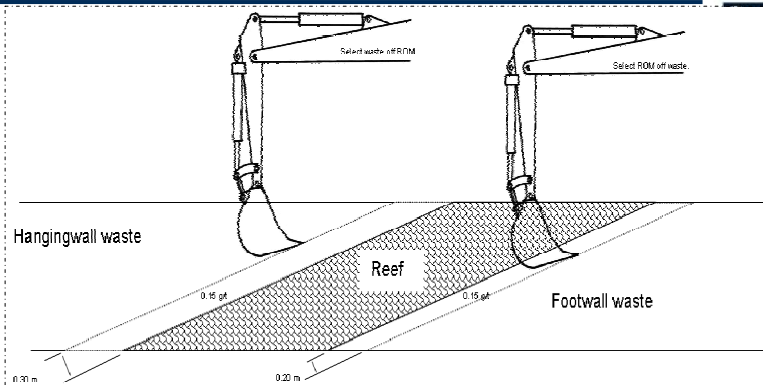
- The producing section of the concession is in two ridges which extend over a strike length of 12km and are perpendicular to each other. The gold bearing reefs of the area are called conglomerate and are focused in the lower part of the Tarkwaian System.
- Due to the alternating nature of the reef/waste layers within the ore body, selective mining is practiced at Tarkwa. This allows the mine to achieve planned grades by separating the ore from waste in a way that minimizes dilution and minimizes ore loss.

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BACKGROUND



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If blast fragmentation is poor, conditions will not allow select mining to be optimised (the planned dilution will not be respected) and the grade reconciliation can be poor as a result.

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BACKGROUND



Mining – Haulage & Drilling Fleet

Machine Type	Quantity
Liebherr 984 Excavators	4
Liebherr 994_200 Excavators	4
Liebherr 9250 Excavators	1
Liebherr 994B Excavators	2
Liebherr 994B Face Shovel	1
O&K RH120 Excavator	3
Caterpillar 785C Trucks	44
Tamrock Pantera 1500 Drill Rigs	22

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STATEMENT OF PROBLEM



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- Before the introduction of RTK GPS into the blasting process at Gold Fields Ghana limited (GGL), blast fragmentation was resulting in sub-optimal feed size to crushers on the Mine and an unfriendly floor conditions resulting in excessive sheeting of digging floor to prevent tyre damage.
- Using RTK GPS to improve blast fragmentation through accurate drill depth and design pattern in order to achieve a constant throughput.
- Increase pit loading efficiency.
- Decrease rock breaker hours.
- Reduce equipment damage.
- Reduce in-pit sheeting costs respectively.

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OBJECTIVES



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The primary objectives of the blast optimization are:

- To maximize crusher throughput.
- To minimize loading times.
- To minimize cycle times.

GPS APPLICATION



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RTK GPS Set-up at GGL

- The system is made up of
- 1 R 5700 Trimble unit
- 1 R 5800 mobile base unit
- 10 R 5800 receivers (Rovers)

A calibration survey was performed on 8 known control points to establish the base station with the following results:

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GPS APPLICATION



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Current RTK GPS application include:

- Planimetric control points survey
- Pit excavation volume survey
- Mine plan design survey
- Grade control mark-out survey
- Drill pattern design mark-out

GPS APPLICATION



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Calibration Results

From-To	# of Satellites	RMS (m)	Slope Distance (m)	Horizontal Precision (m)	Vertical Precision (m)	PDOP (m)
Base-PT6	7	0.005	3481.582	0.010	0.016	1.305
Base-PT9	7	0.004	2418.006	0.010	0.017	1.652
Base-PS3	6	0.004	1835.020	0.007	0.017	2.096
Base-TEB1	7	0.003	2927.499	0.006	0.012	1.888
Base-GFID13	10	0.006	5296.384	0.010	0.017	1.524
Base-AKE5	7	0.003	1468.594	0.006	0.011	2.395
Base-AKE3	10	0.005	1957.357	0.007	0.012	1.124
Base-KOT3	10	0.006	4412.562	0.007	0.012	1.135

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GPS APPLICATION



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Accuracy Test on RTK GPS Positions

- Periodic accuracy test is conducted on the system to ascertain its reliability and one of such exercise is tabulated on the next slide
- Six control points were established at different locations and monitored at different times of the day when satellite availability differs significantly
- The overall error margins were less than 10cm in both axes which is an indication of good quality RTK operation

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GPS APPLICATION



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Accuracy Test on RTK GPS Positions

ACCURACY TEST ON RTK CONTROLS

BASE DATA								
STATION	EASTING	NORTHING	ELEVATION	DATE				
MK1	9983.53	11241.00	212.65	31/12/2008				
MK2	9866.60	11513.59	211.97					
MK3	9813.33	11826.45	208.25					
CW1	9235.97	9783.92	187.59					
CW2	9130.80	9748.52	186.01					
CW3	9006.13	9678.89	188.41					
ROVING DATA								
STATION	EASTING	NORTHING	ELEVATION	DATE	dE	dN	dZ	MISCLOSE VECTOR
MK1	9983.65	11240.97	212.65	3/1/2009	-0.01	0.03	0.00	0.03
MK2	9866.49	11513.49	211.98		0.01	0.09	-0.01	0.09
MK3	9813.25	11826.55	208.24		0.08	0.00	0.01	0.08
CW1	9236.02	9783.82	187.62		-0.05	-0.01	-0.03	0.05
CW2	9130.75	9748.39	186.03		0.05	0.03	-0.02	0.06
CW3	9006.22	9678.84	188.41		0.00	0.05	0.00	0.05
MK1	9983.53	11241.01	212.64	4/1/2009	0.01	-0.01	0.01	0.01
MK2	9866.54	11513.47	211.98		0.05	0.02	-0.01	0.06
MK3	9813.31	11826.45	208.24		0.02	0.00	0.01	0.02
CW1	9236.00	9783.97	187.60		-0.03	-0.05	0.00	0.06
CW2	9130.71	9748.52	186.02		0.09	0.00	-0.01	0.09
CW3	9006.15	9678.90	188.40		-0.02	-0.01	0.00	0.02
MK1	9983.51	11241.03	212.65	5/1/2009	0.02	-0.03	0.00	0.04
MK2	9866.55	11513.46	211.98		0.04	0.02	-0.01	0.05
MK3	9813.21	11826.43	208.25		0.02	0.02	0.00	0.03
CW1	9236.01	9783.96	187.59		-0.03	-0.04	0.00	0.05
CW2	9130.81	9748.49	186.04		-0.01	0.03	-0.03	0.03
CW3	9006.13	9678.90	188.42		-0.01	0.00	-0.01	0.01
MK1	9983.57	11241.09	212.63	6/1/2009	-0.03	-0.01	0.02	0.04
MK2	9866.56	11513.44	212.00		0.04	0.04	-0.03	0.06
MK3	9813.24	11826.39	208.24		-0.01	0.06	0.01	0.06
CW1	9236.00	9783.96	187.60		-0.02	-0.04	-0.01	0.04
CW2	9130.81	9748.48	186.02		-0.01	0.04	-0.02	0.04
CW3	9006.16	9678.89	188.39		-0.03	0.00	0.01	0.03

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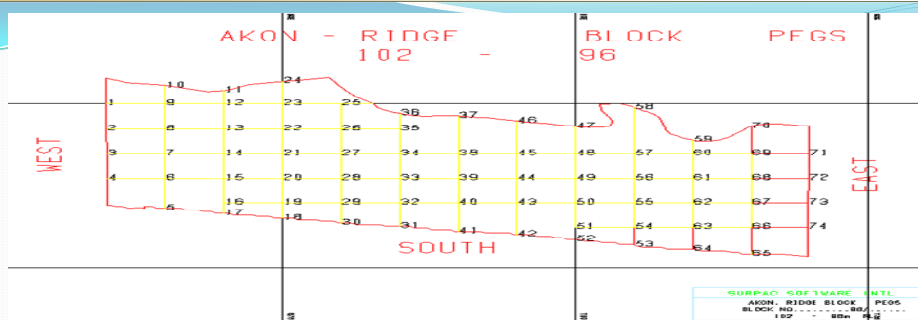
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Data Acquisition, Processing & Transfer

- Data required for the survey work is normally produced by the drill & blast engineer
- The blast pattern is based on the orientation of the ore body, road network & other geological factors



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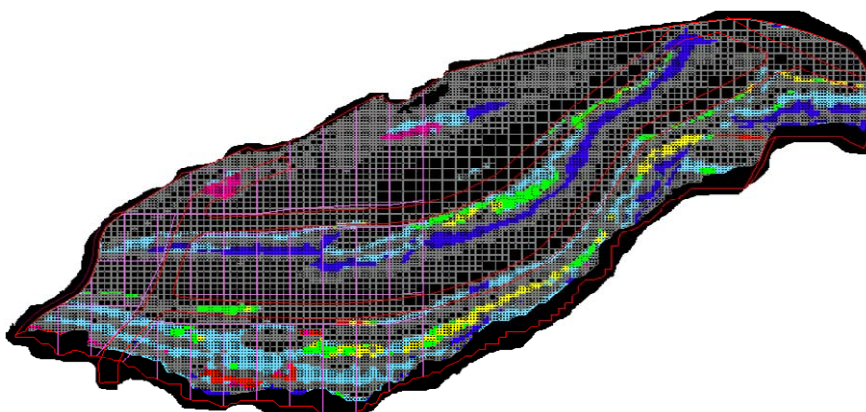
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GPS APPLICATION



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Block Pattern Layout on Geological data



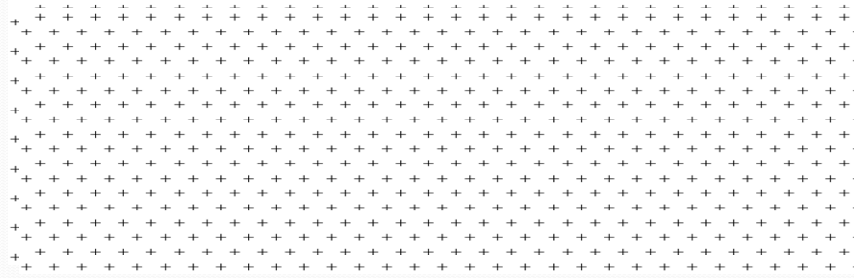
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Pattern Points



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Mark-out hole with GPS



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Drilling in Operation



Hole Checkers at Work



implementation of the flags based system in Akontansi Ridge, week 37

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Benefits of RTK GPS Implementation

- Improved blast to design boundaries
- Good fragmentation
- Low rock breaker hours

% Blast to Design



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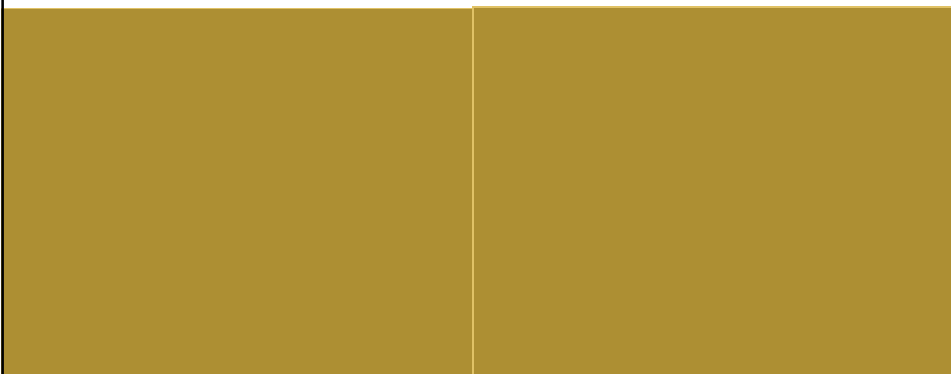
RESULTS



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Blast to Design Before
Implementation

Blast to Design After
Implementation



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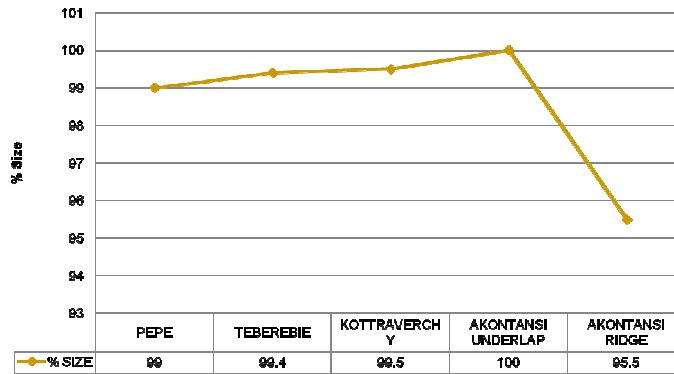
RESULTS



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Fragmentation

Rock size Passing 750mm



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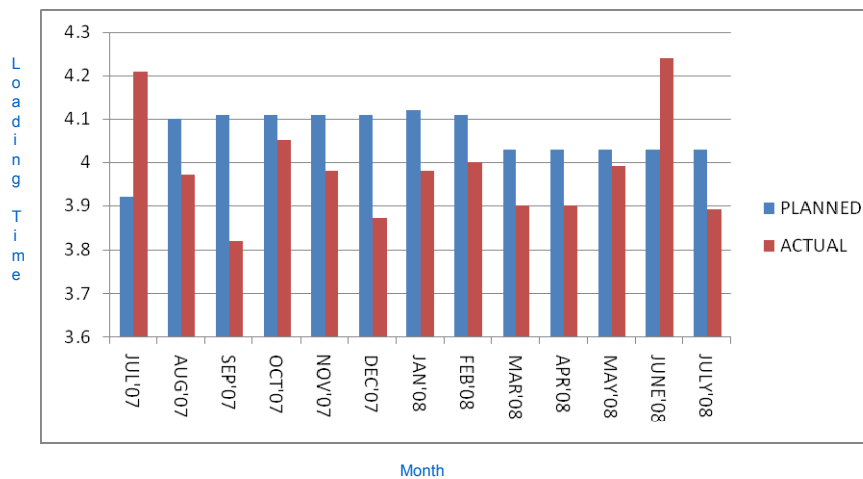
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RESULTS



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Loading Times



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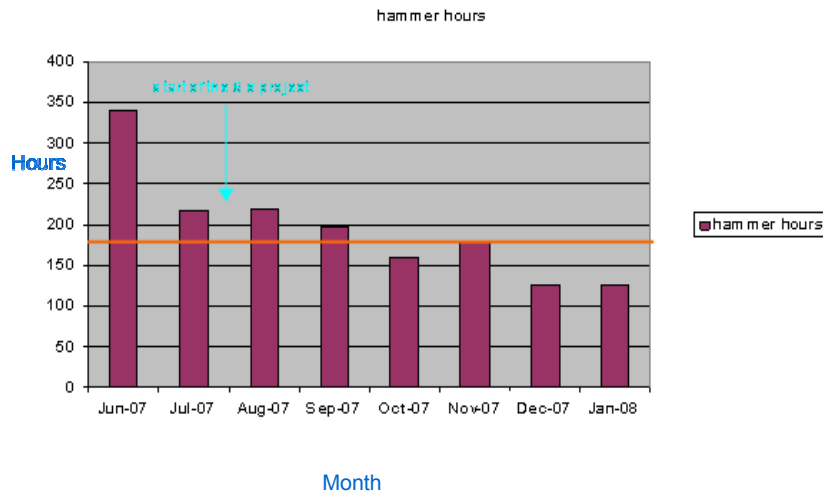
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RESULTS



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Rock breaker Hours



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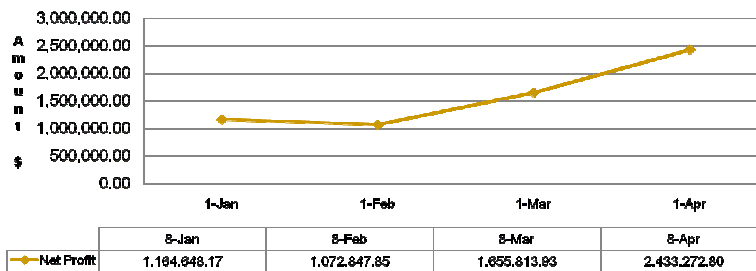
COST BENEFITS



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Benefits	Jan-08	Feb-08	Mar-08	Apr-08
Additional gold revenue	1,106,947.91	1,012,933.72	1,610,617.34	2,363,474.46
Reduced equip damages	50,000.00	50,000.00	50,000.00	50,000.00
Reduced R/Breaker hrs	8,450.26	9,756.04	-10,164.41	-10,222.39
Explosives savings	0.00	4,623.09	31,111.00	76,898.23
Cost				
Drilling flags	750.00	750.00	750.00	750.00
Tulip	0.00	3,715.00	25,000.00	46,127.50
Net Profit	1,164,648.17	1,072,847.85	1,655,813.93	2,433,272.80

Net Profit



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CONCLUSION



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- RTK GPS is less labor intensive and saves cost
- Reduced significantly pit floor sheeting as a result of good floor
- Increased tonnage throughput
- Reduced rock breaker hours
- Improved digger loading times
- Improved truck cycle times

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QUESTION TIME



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THANK YOU

QUESTIONS

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