



## Strategy to manage falls of ground – a review

The fall of ground management programme remains a priority and is an integral aspect of AngloGold Ashanti's overall safety strategy at its South African deep-level mines. This strategy is in line with policy striving for zero fatalities and to reduce the risk of injuries and loss to levels consistent with international benchmarks. The Mine Health and Safety Council has set a goal to reduce fatal accidents by 20% per year until 2013. Uncontrolled falls of ground and rockbursts are the primary cause of work-related fatalities and injuries among employees at work, and a major source of disruption of mining operations.

The fall of ground management programme comprises five primary areas of focus:

- Mine design – preventing excessive rock damage ahead of the work face
- Mine support – protecting people from falls of ground
- Mindset and attitude – promoting safe behaviour and work practices
- Monitoring – monitoring practices and ground behaviour, including seismicity, to provide warning
- Research and development – developing new knowledge and technologies to solve problems related to falls of ground

The focus during 2007 was to consider what AngloGold Ashanti could do better in this regard. There are three aspects that were specifically addressed in 2007, namely the role of geological features, mine seismicity and rockbursts, and compliance.

### **Role of geological features**

In most cases, geological features such as faults, dykes and other discontinuities, play a part in the incidence of falls of ground and seismicity. These features frequently cause changes in the ground conditions which have to be negotiated by the mining operation. Increased efforts have been made to note, identify, plan for and react to these geological features. While geologists indicate the location of the reef, they do not necessarily specify the detailed location of geological structures and features. To do so requires a detailed and complex geological picture of the ground being mined, and calls for three-dimensional representations of the ground, as frequently the geology is very complex over a short distance. This geological knowledge and information is necessary to enable mine designers and planners to modify the approach to mining and to determine the support required.

An improved advanced knowledge of geology is necessary and is being explored by means of various geophysical techniques, including core drilling, diamond drilling, rock radar, electric pulses and acoustic televiewer probe. The information obtained will be used in better 3D representations to confirm what is already known and to 'see' changes in the rock ahead of the stope face and the location of any 'future' geological structures to be encountered. In order to do this, AngloGold Ashanti has commissioned the Geosciences Resources Group, the Council for Scientific and Industrial Research (CSIR) and Reeves Wireline Services to assist.

### **Mine seismicity and rockbursts**

There are several parts to the approach to increase understanding of seismicity and falls of ground:

- *Back-analysis for leading seismicity indicators.* To obtain more information to assist with pro-active long-term prevention of rock falls, back-analysis is being conducted on all significant fall-of-ground and rockburst events. This analysis determines the reasons for and the extent of the falls and rockbursts, as well as damage sustained in combination with information obtained from the mine's seismic monitoring network.
- *Improved short- and medium-term seismic hazard identification.* AngloGold Ashanti conducts its own seismic research and international seismologists from the United States and Japan frequently visit its South African gold mines to further their own seismic research since the gold mines are in a sense 'seismic laboratories', the like of which are not found anywhere else in the world. Seismology is not an exact science and it is very difficult to know what the earth's crust is going to do and how it will react to increased pressure and changes in force fields and energy. It is believed that this information, coupled with the information supplied by the extensive seismic networks which are installed in all the South African mines and which have supplied copious volumes of data



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over the years, can be used more efficiently and sensibly to assist with the assessment of hazards in the short to medium term. Integrated Seismic Systems International Limited (ISSI), in conjunction with group rock engineers, have been charged with setting up an internal research project to oversee the application of this information.

- *Integrated Damage Reology Modelling (IDRM)* is the integration of a simulated mining layout with the actual behaviour of the rock mass and seismic activity, using information obtained from the seismic networks and is aimed at balancing the predicted changes in the rock mass (as a result of simulated mining) against actual changes manifested as seismicity.
- *Auditing and upgrading mine seismic networks.* Work is also being done on rehabilitating the seismic networks on the mines. An audit is to be done on the current status and shortcomings of the individual networks on the mines and the appropriate steps taken to ensure best practice in terms of rock engineering and the data requirements.

### Compliance

Investigations are being conducted into compliance on mines to address the question of why, if the industry has what can be termed 'best' knowledge, this knowledge is not used and applied – from the design of a mine to the behaviour of people working on the mine in terms of compliance with rules. Compliance is a major component of the Chamber of Mines study which has as an objective the determination of the role of non-compliance in contributing to fatalities and accidents. (See case study *Gold mining industry commissions study into seismicity and rockbursts* at [www.aga-reports.com/07/seismic-study.htm](http://www.aga-reports.com/07/seismic-study.htm))