Future of massive cave projects in the dark

The focus of the world’s underground ‘mass’ miners shifts from Chile to New South Wales, Australia, next May as the biggest show on the cave-mining calendar, MassMin, moves to Sydney. With the giant, world-class Cadia East panel cave hitting its straps in the background, the venue is fitting yet many questions are currently being asked about whether or not ‘big’ and ‘bigger’ are actually yesterday’s conference keynotes.
According to one of the chief organisers of MassMin 2016 in Sydney the gathering will weigh up answers to no less a question than this one: “How are we going to deal with the future?”

The new reality for miners with mega-projects in their development pipelines is that deeper, critical de-risking equates to, in many cases, starting with smaller projects than were being envisaged a short time ago. It is a reality with particularly far-reaching implications for the direction of vital cave mining research and
“At some stage people were talking about these super caves where you were producing 100,000 tonnes per day or even more; people were quoting 140,000-150,000, and even 200,000tpd,” said Gideon Chitombo, professor and chair in minerals industry engagement at the WH Bryan Mining & Geology Research Centre in Queensland, Australia.

A key figure in worldwide cave-mining research coordination in the past decade, who won the Australian Academy of Technological Sciences and Engineering award for his work in mass mining ‘super caves’, Chitombo said his discussions with the major proponents of new – brownfield and greenfield – block and panel projects indicated capital and environmental constraints were forcing them to rethink scale, and also the fundamentals of block caving, from the equipment used to methodology and mine design.

“People are now saying, if you have such a big deposit do you have to develop the whole thing? Or do you start small and actually understand the system; build greater deposit knowledge? Then you might be able to get the funding for a bigger project.

“I know there is a lot of debate on this happening at the moment.”

Chitombo said technical risk mitigation remained a substantial issue for the relatively few (but major) proponents of new generation cave mines, linked as it was to the increasing depth and generally declining average grades of mineral deposits being targeted, the formative nature of much work going on to better understand, simulate and design massive caves, their propagation and steady-state operating rates, and surface impacts, and the sheer enormity of costs to be sunk ahead of first production from what were typically multi-billion-dollar developments.

A leading expert in cave design and planning said: “For caving, the specific problem is the greater depth, size and low rock strength of a generation of new mines being planned, or studied, and perhaps also the ability of some recent projects and designs to meet forecast performance.

“The established off-the-shelf designs for caving are showing strong anecdotal signs that they are running out of capacity to manage the problems of depth, strength and size. It means mines won’t be able to template designs from one site to the next at the depths being considered, and design innovation is needed.

“Meeting the challenges of bulk mining at depth will take imagination and good engineering; the ingredients already exist and are being used.”

Simulation-aided engineering principles had been adapted effectively to block cave design for orebodies with smaller footprints, generally in weaker rock.

“Larger footprints are more complex, but [we] have a team testing designs for large deep block caves right now on a project by project basis,” the expert said. “The good thing is...”
that the technology already exists to simulate these designs on mine scale, capturing the right physics for most problems. Improvements in simulation technology will come incrementally as projects need them.

“The clearest thing so far is that the solutions for deep caves are unique, relying on simple principles of stress and cave load management, and they don’t always look like the old cave designs. The problems aren’t intractable, they just need imagination.”

But, warned the same individual, depth, stress, higher extraction ratios and production rates were “up against the limits of current rock mechanics practices from forecasting to observation”.

“The next generation of mass mines won’t work if they are templates of the old ones.”

The industry needed to harness new full-physics thinking about rock mechanics – “moving away from cut-and-paste designs and rules of thumb … is the only way to get to where we need to be”, which was mass mining at greater depths in lower grade ores.

“Innovative design, mines that look different to before, at reduced risk, are needed.”

Chitombo, who gave a keynote talk at the previous MassMin symposium in Santiago, said the collaborative industry research group (involving Newcrest Mining, Codelco and Anglo American) he currently led continued to be preoccupied with the application of “proper” rock mechanics principles in mine design and evaluation, the ability to predict and engineer caving (that is, better understand and somehow control cavability and fragmentation), application of more effective cave performance monitoring systems, and a move away from ‘batch’ materials handling processes to semi-continuous and ultimately continuous systems.

The latter would require new cave mining layouts for more effective utilisation of future semi and fully continuous systems.

“This would mean moving away for the conventional herringbone and El Teniente layouts and total reliance on LHDs which have served the industry well for more than 40 years,” Chitombo said.

A workshop planned for this May in Brisbane would assess the current state of play in rock mass engineering methodology, deep cave mechanics (in high stress environments), and alternative layouts for semi and fully continuous mining systems.

Chitombo hopes to take key conclusions from a one-year program due to wind up in July into a new phase of collaboration between a bigger number of miners, and equipment manufacturers already heading down a path toward new generation mine development machines and material handling systems.
"I'm speaking to a number of companies," he said, "to try to come out with a collaboration where we can share [ideas] and accelerate the development of what we are calling the next generation cave mining.

"My argument, and I'm talking to companies that I'm hoping will support this, is that we need a next generation.

"We can't continue to apply current systems, and we need a radical change in the way we're going to cave in the future. So by the time of next year's [MassMin] conference, we can be in a position to address that key discussion point: how are we going to deal with the future?

"We really need to work together as an industry. Some big players want to do it themselves, but I think we need to collaborate.

"This is not to say that what we are doing with the caving now is wrong. It's just to say, what's next? I don't think we can just say it's going to be business as usual.

"I think we need to use MassMin 2016 as an opportunity to say, as a collective, let's rethink where we are going with caving," Chitombo said.

"There was a time, particularly before the financial crisis, when people were thinking big. Now it's, we'll start smaller and then understand, and potentially have greater control [over caving outcomes], now and in the future.

"It's still going to cost billions of dollars to start these things, so we need to properly understand all of the risks.

"And we certainly need to have available the planning tools, and the new generation of [extraction-level] layout and equipment, to economically mine at greater depths and under different conditions.

"So we still have a lot to talk about, I believe."

*This is an abridged version of an article in the April, 2015, edition of Mining Journal sister title Mining Magazine, www.miningmagazine.com

Tags: Block cave mines, Gideon Chitombo, MassMin 2016, Panel caving

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