



## SMART SURVEYORS FOR LAND AND WATER MANAGEMENT

...  
TECHNIFICATION OF OPEN PIT EXPLOTATION  
THROUGH TOPOGRAPHY AND  
IMPLEMENTATION OF MINING PLANS IN MINAS  
BELENCITO - MONJAS - SAN ANTONIO

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# TECHNIFICATION OF OPEN PIT EXPLOTATION THROUGH TOPOGRAPHY AND IMPLEMENTATION OF MINING PLANS IN MINAS BELENCITO - MONJAS - SAN ANTONIO

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**Key words: Plan implementation, Geology and Mining, Photogrammetry, Women  
in mining topography (Gender diversity)**



# SMART SURVEYORS FOR LAND AND WATER MANAGEMENT

## HOW DO YOU GET TO THIS RESULT?



SAN ANTONIO MINE STERILE DISPOSAL AREA IN RESTORATION



BELENCITO MINE STERILE DISPOSAL AREA IN RESTORATION





## SPACE LOCATION OF THE PROJECT

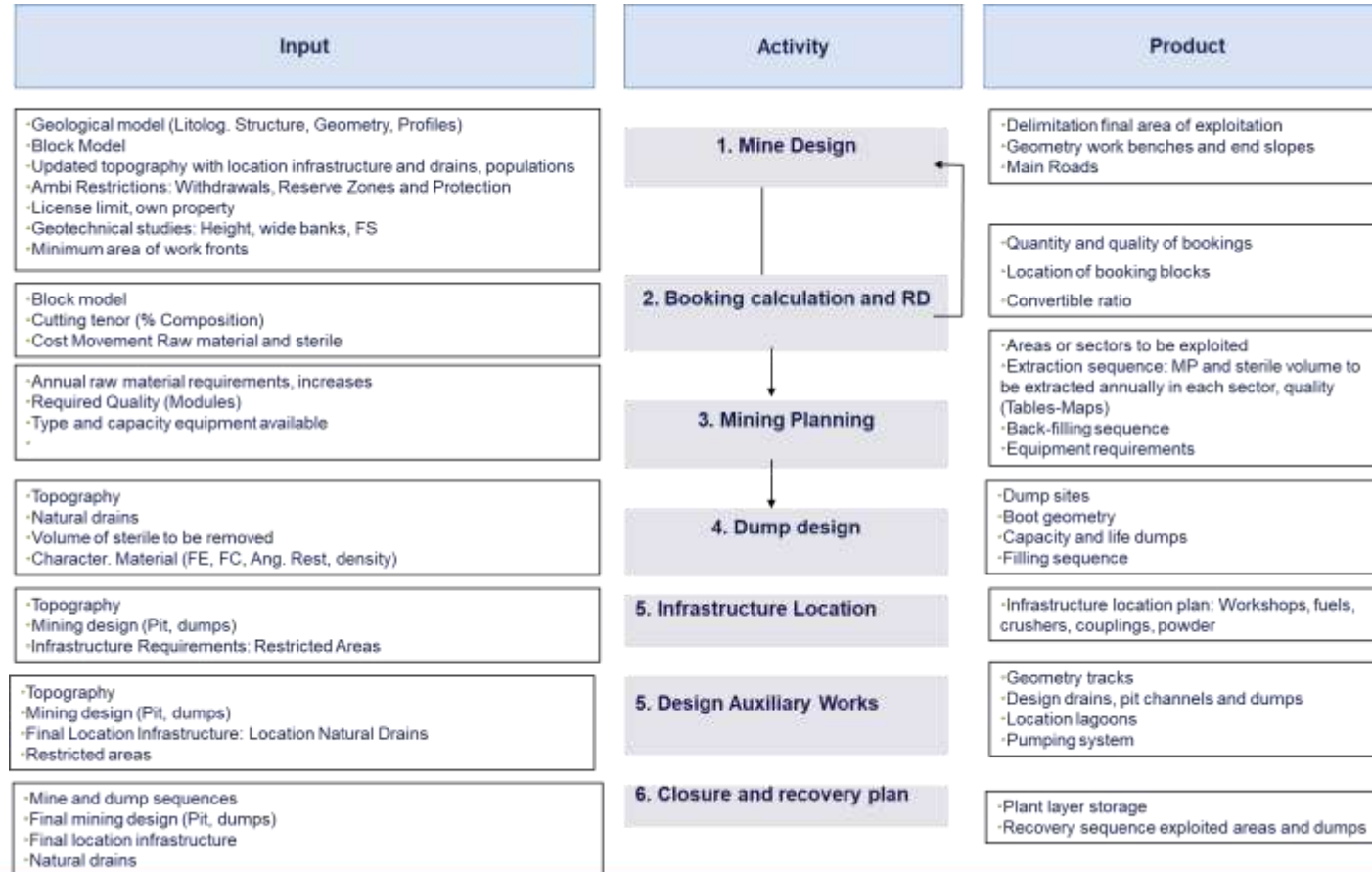


The mining exploitation under study is located in the Republic of Colombia; Boyacá department. There are three mining titles:

- San Antonio Title 14665 Mine with an area of 659 Hectares
- Belencito Title 11387 Mine with an area of 692 Hectares
- Monjas Title 911-15 Mine with an area of 117 Hectares

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## MINING PLANNING PROCESS



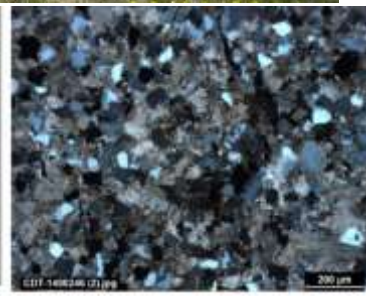
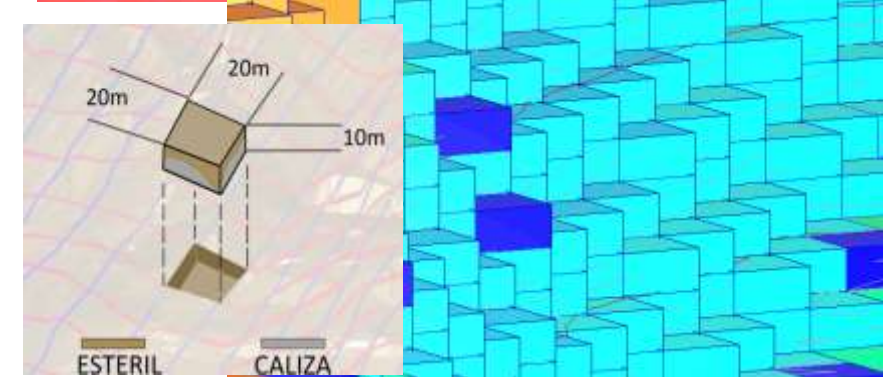
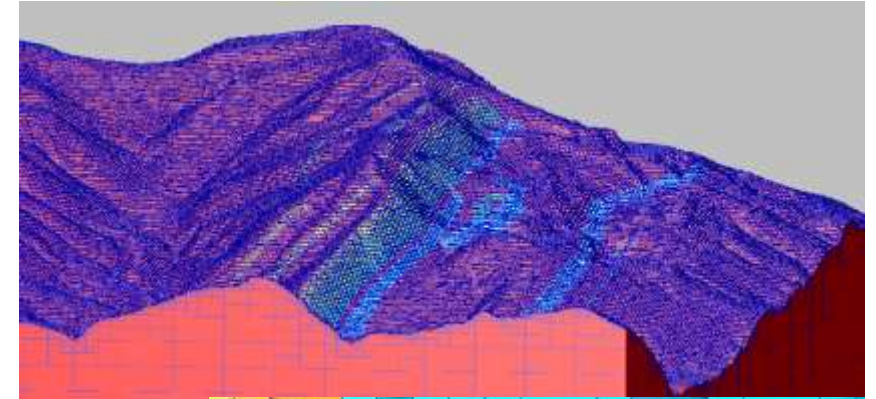




## INPUT INFORMATION



## OUTPUT INFORMATION



## GEOLOGY

## BLOCK MODEL & GEOLOGICAL MODEL

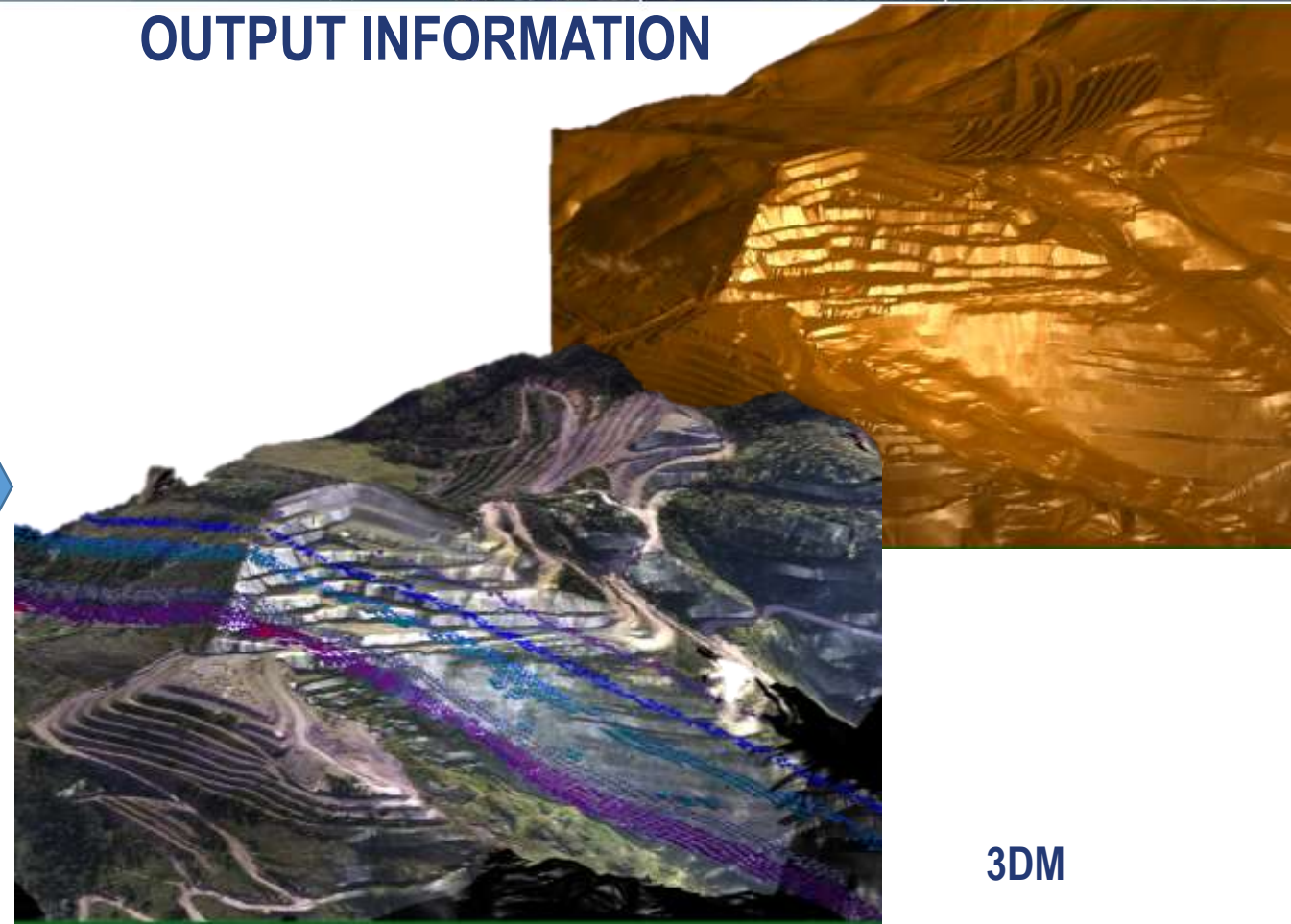


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## INPUT INFORMATION

## OUTPUT INFORMATION



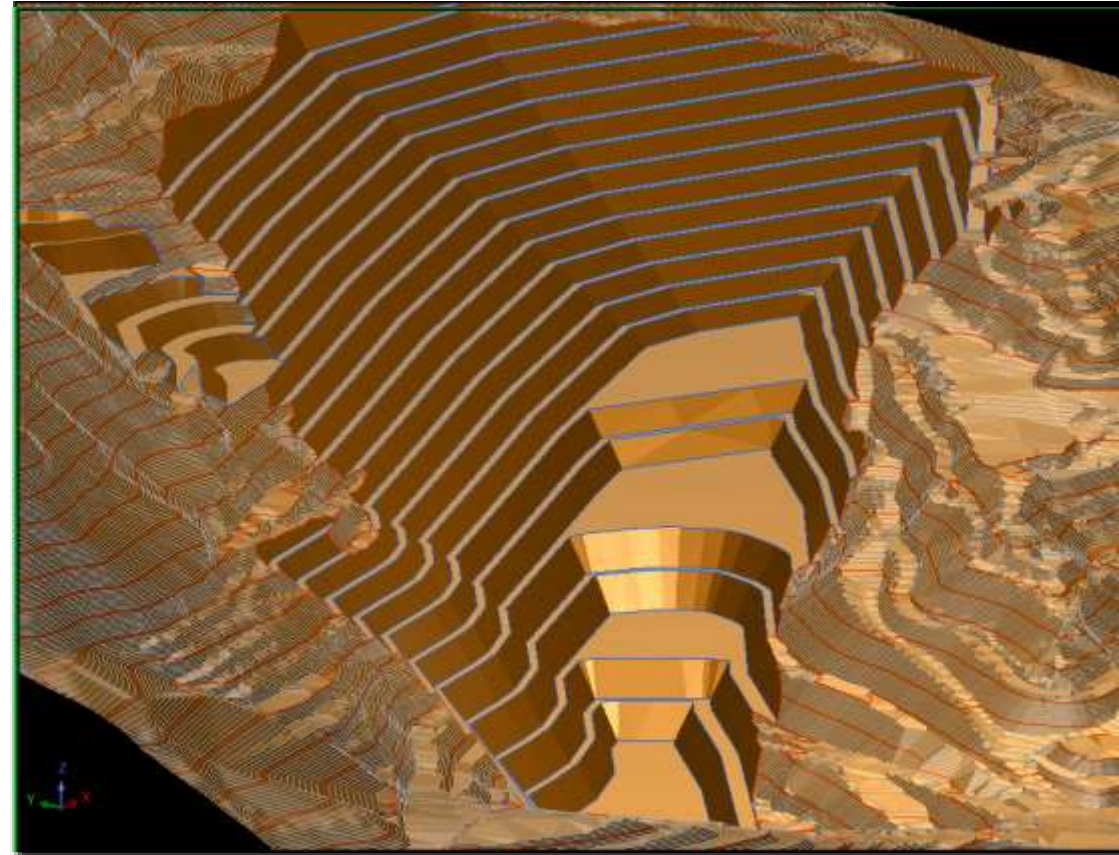
3DM

TOPOGRAPHY





## MINING DESIGN







## TOPOGRAPHICAL REPLANTING IN THE FIELD





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## BEFORE AND AFTER



Geometric cut terraces, slopes with design angles and bench heights according to geotechnics.



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## BEFORE AND AFTER



Geometric conformation of sterile disposal area and subsequent geomorphological restoration.



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## BEFORE AND AFTER



Geometric conformation of area of disposition of steriles preserving heights and angles established in the design.



# SMART SURVEYORS FOR LAND AND WATER MANAGEMENT



## BEFORE AND AFTER



Geometric cut with heights and widths of berms established in the design.



# SMART SURVEYORS FOR LAND AND WATER MANAGEMENT



## BEFORE AND AFTER



Slopes with stable angles,  
floors on one level. Slope  
heights according to design.





## BEFORE AND AFTER



Implementation of access and ramp designs with widths and slopes according to the standard.





## BEFORE AND AFTER



Design of terraces of constant height and berms in a single nibe



## CONCLUSIONS

- It is possible to demonstrate the technology in a mine through topographic control, well-defined berms and slopes and developed ore cloaks.
- Topography has become a very dynamic profession, it must incorporate more knowledge into daily applications in addition to the essence of the surveyor is required to have a broader field of action.
- The technology of mining operations is necessary to be able to guarantee the extraction of minerals, it must be at the forefront of technology.
- Between different Teamworks with people with different capacities allows to achieve success in any project, this with a clear guideline established in a previous planning.
- Topography is an indispensable tool in the implementation of a mining planning, since it allows to make precise cuts and fills, rethink established alignments and comply with the monitoring and production indicators.
- An untracked mine cannot guarantee its long- or medium-term existence.
- Untracked topographical mining becomes a mine with unsafe operations.
- A No Topography mine will generate arbitrary geometries, even though a Mining planning has been established, it will not be able to reach the objectives set with the design data.



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