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Best practices for geotechnical planning and design in open pit mining operations: A sustainability approach

Chrys Steiakakis
Mineral Resources Engineer, MSc
Civil Engineer, MSc, ASCE
Geosysta Ltd

Zach Agioutantis, PhD
Professor of Rock Mechanics , TUC
Research Professor, Virginia Tech

P. Schilizzi, PhD, E. Papakosta, A. Tsalidis, G. Pagonis
Mining Engineers
Public Power Cooperation of Greece (ΔΕΗ)

Presentation outline:

Geotechnical Importance in Sustainable Mining

Geotechnical Best Practices in Open Pit Mining

Case Study of a lignite open pit mine in Greece

Conclusions

Geotechnical Importance in Sustainable Mining

Sustainable Mining:

Cost effective mining

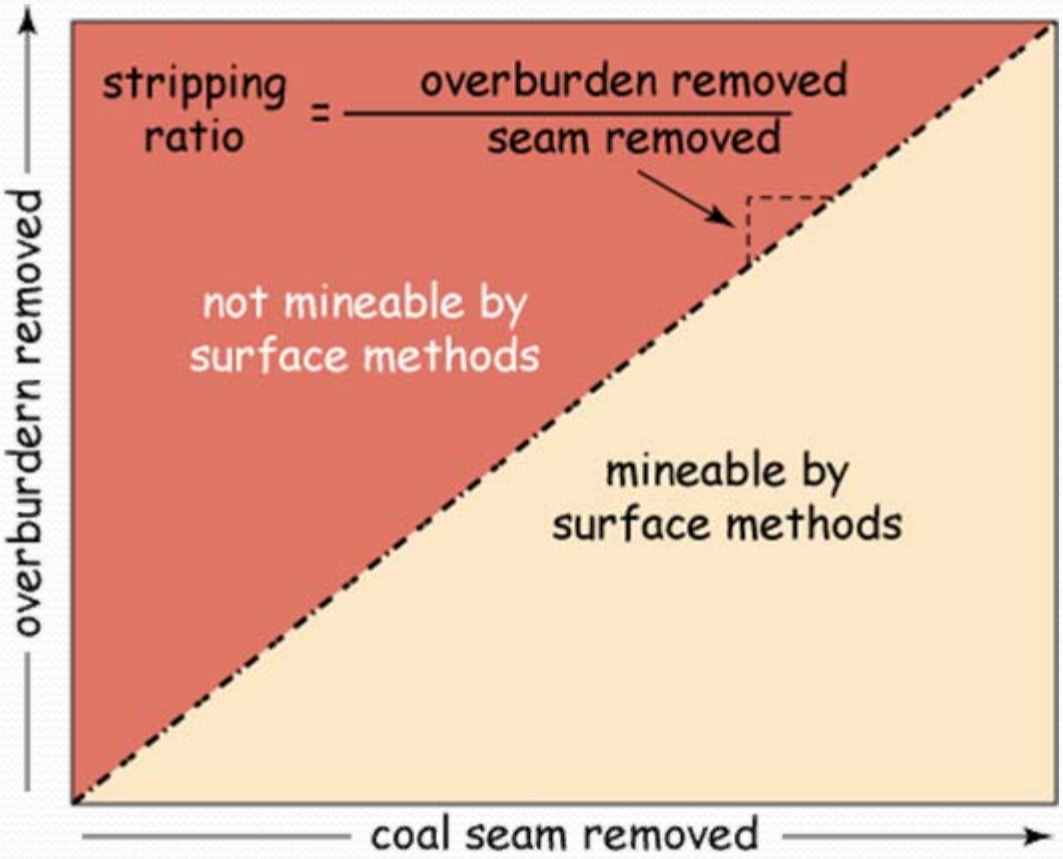
Minimize Environmental Impact

Produce added social and economic value

How Geotechnical involvement affects sustainability?

Geotechnical Importance in Sustainable Mining

Striping Ratio:



Geotechnical Importance in Sustainable Mining

Striping Ratio:

Too **LOW** can produce slope failures

Geotechnical Importance in Sustainable Mining

Striping Ratio:

Slope failures can result in loss of life

Tibet Gold Mine, 2013

Geotechnical Importance in Sustainable Mining

Striping Ratio:

Slope failures can result in operation disruption

Geotechnical Importance in Sustainable Mining

Striping Ratio:

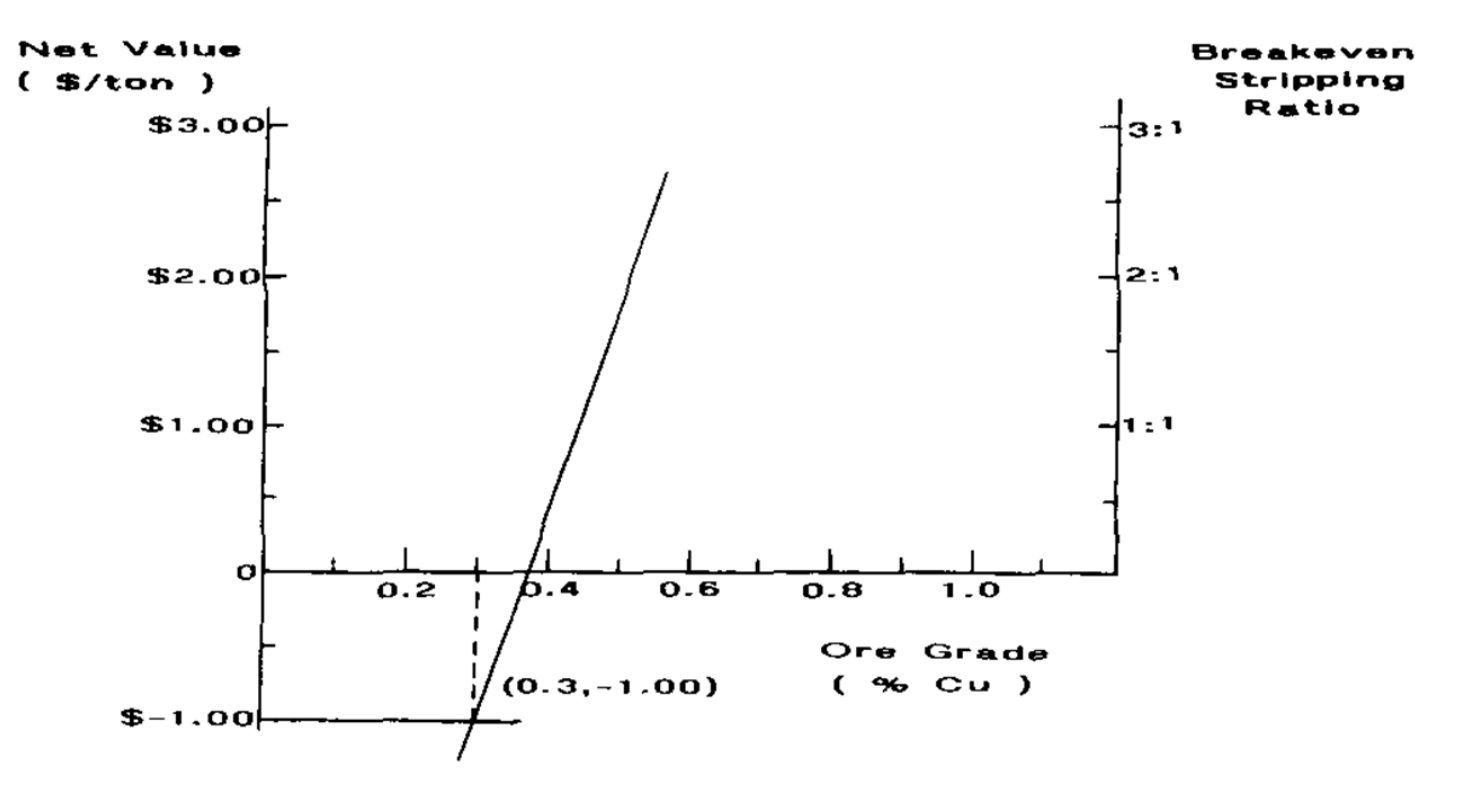
Slope failures can result in Company loss of Credibility

Round Mountain gold mine, Nevada

Geotechnical Importance in Sustainable Mining

Striping Ratio:

Too **HIGH** can produce uneconomical operation



Geotechnical Importance in Sustainable Mining

Environmental and sociological impact

Mine tailings failures

Geotechnical Importance in Sustainable Mining

Why do such events occur?

Due to poor initial design?

Due to poor design implementation?

Due to climatic (weather) conditions?

Due to other events (i.e. seismic, poor blasting)?

Due to combination of factors?

Geotechnical Best Practices in Open Pit Mining

Can such occurrence be prevented?

"Best practice" approach:

Appropriate GEOTECHNICAL involvement in all mine stages

Starting during Reserve Investigation

During Feasibility Study

During Mine Planning

During Mine Production

During Mine Closure

Geotechnical Best Practices in Open Pit Mining

Reserve Investigation:

Involve as early as possible an Engineering Geologist

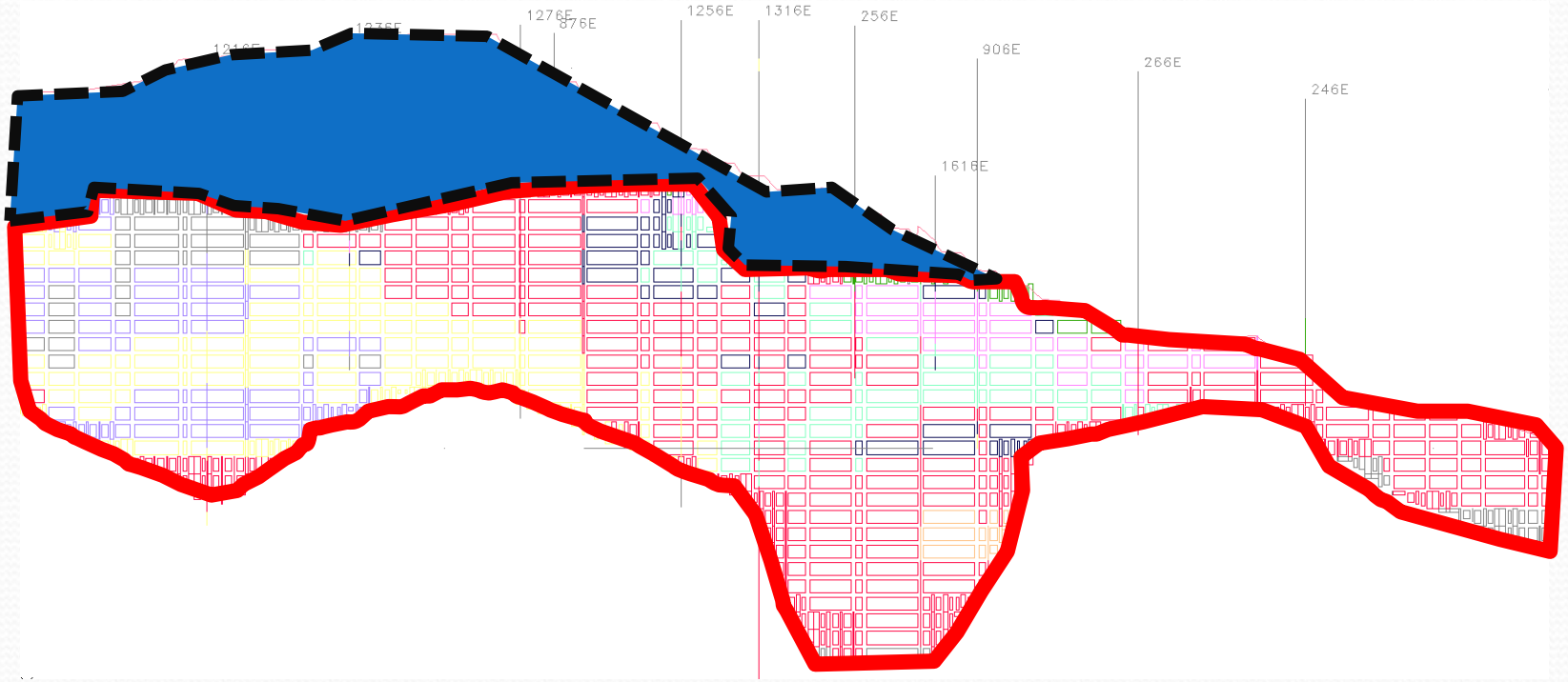
When drilling for reserves….

…use the opportunity for geotechnical data collection, and sampling

Geotechnical Best Practices in Open Pit Mining

Feasibility Study:

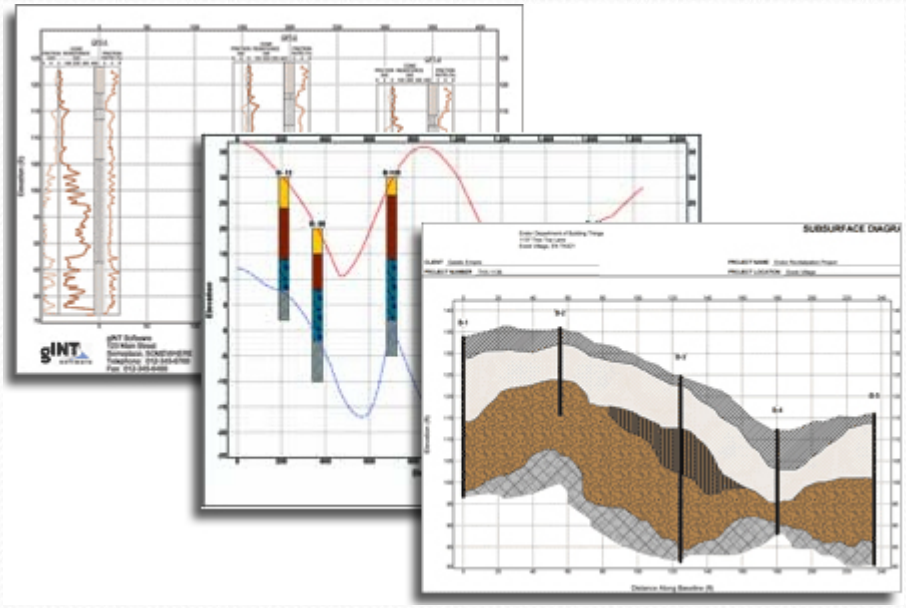
Execute preliminary geotechnical testing of all materials

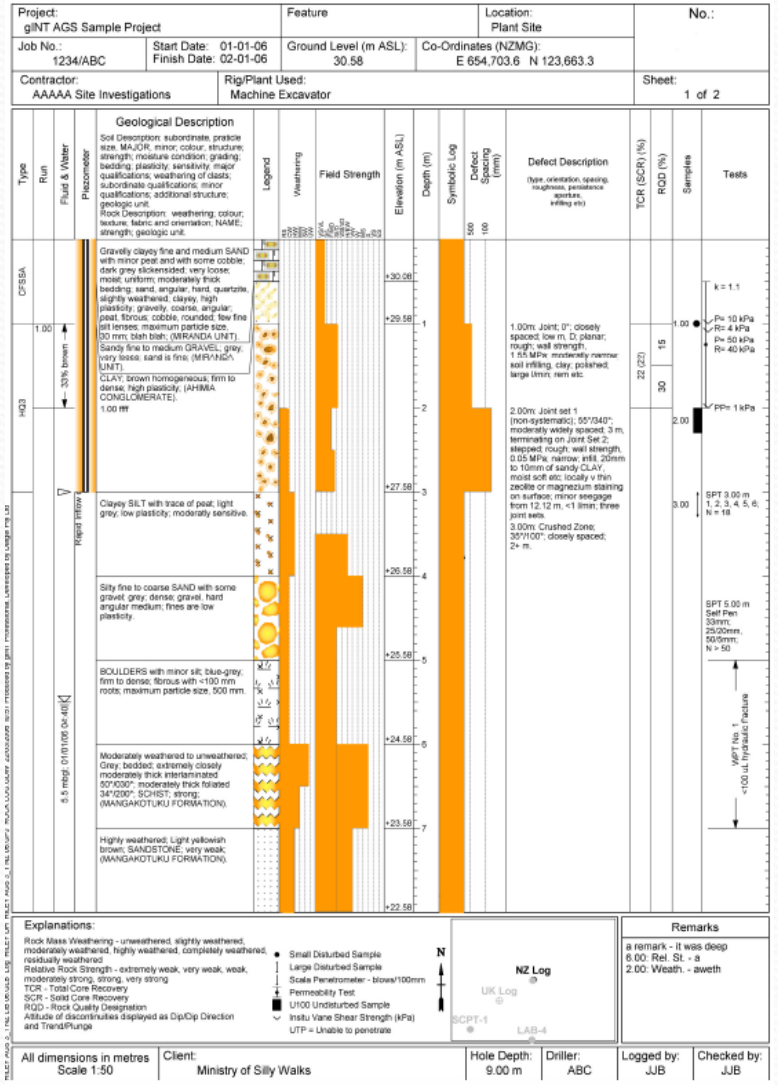


Geotechnical Best Practices in Open Pit Mining

Feasibility Study:

Record geological - geotechnical information in consistent way

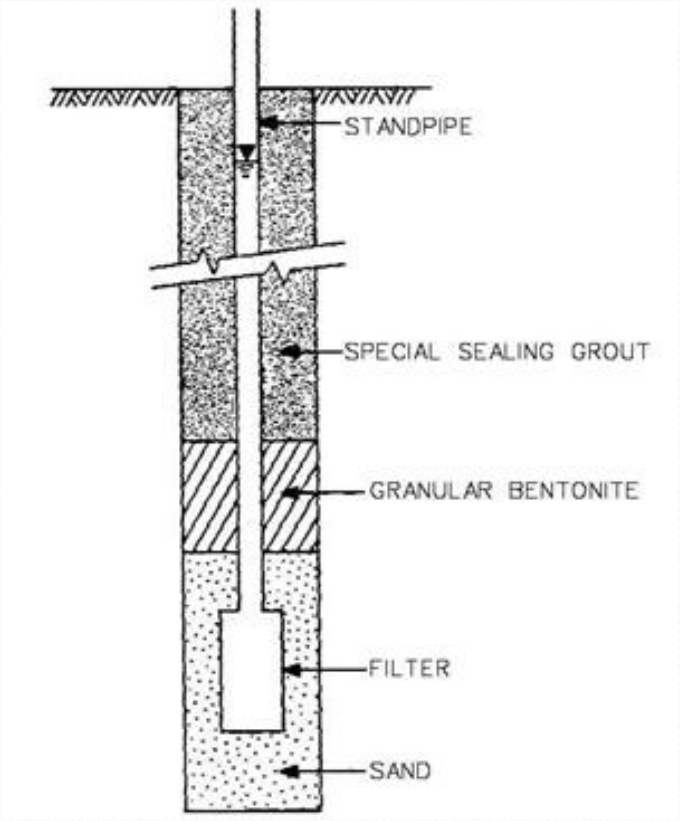


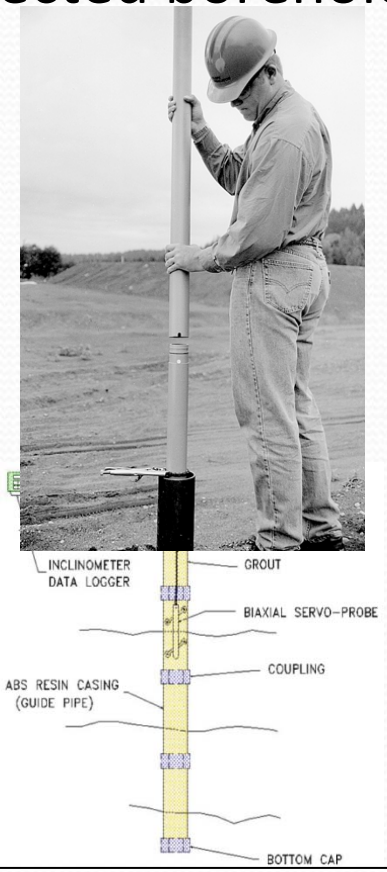


Geotechnical Best Practices in Open Pit Mining

Feasibility Study:

Install monitoring instruments in selected boreholes

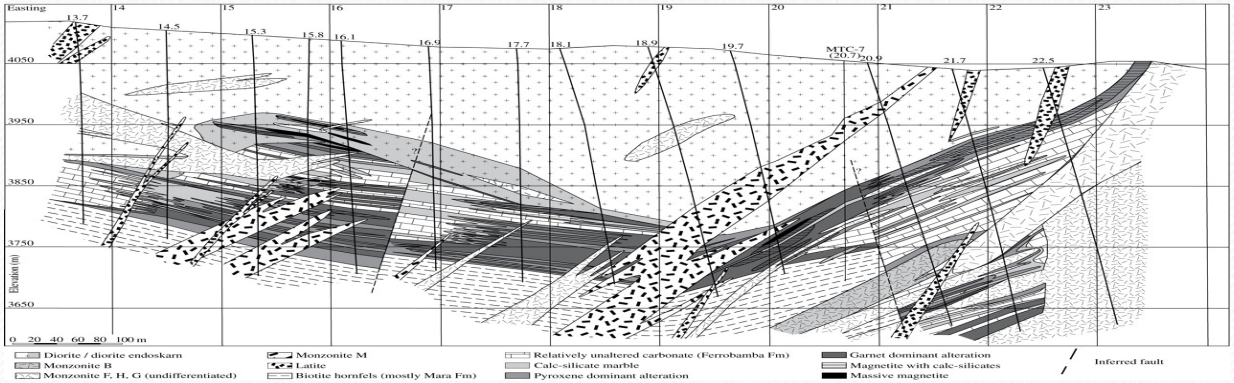


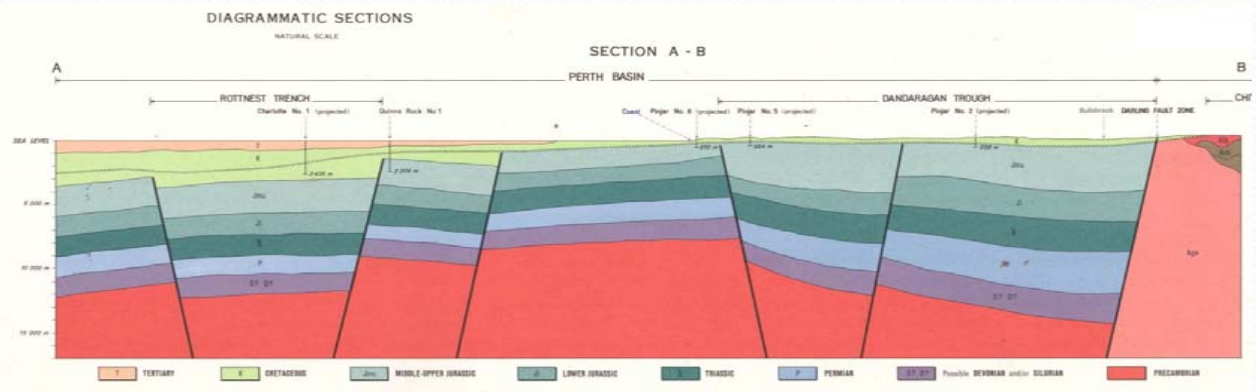


Geotechnical Best Practices in Open Pit Mining

Mine Planning:

Detail evaluation of geological – geotechnical model

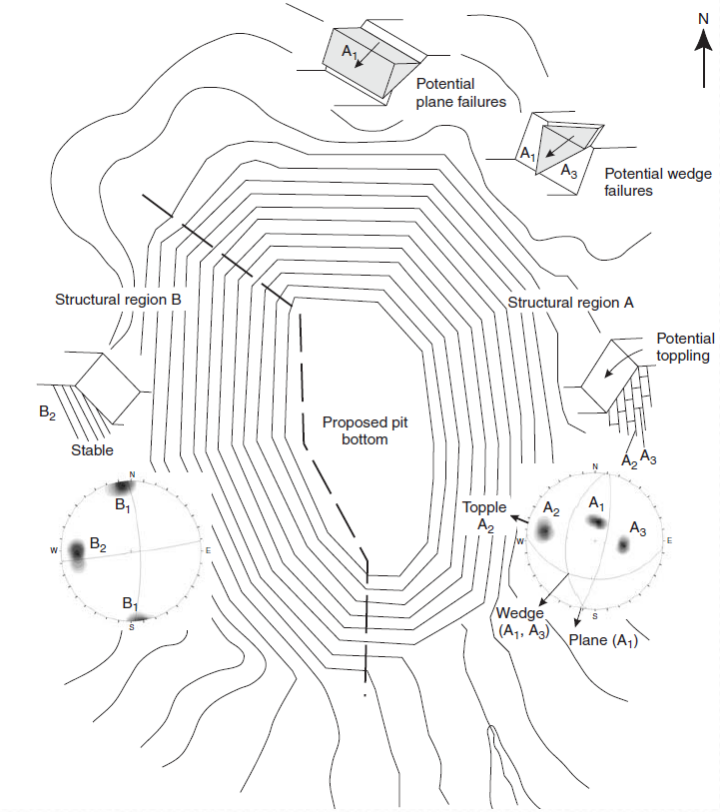


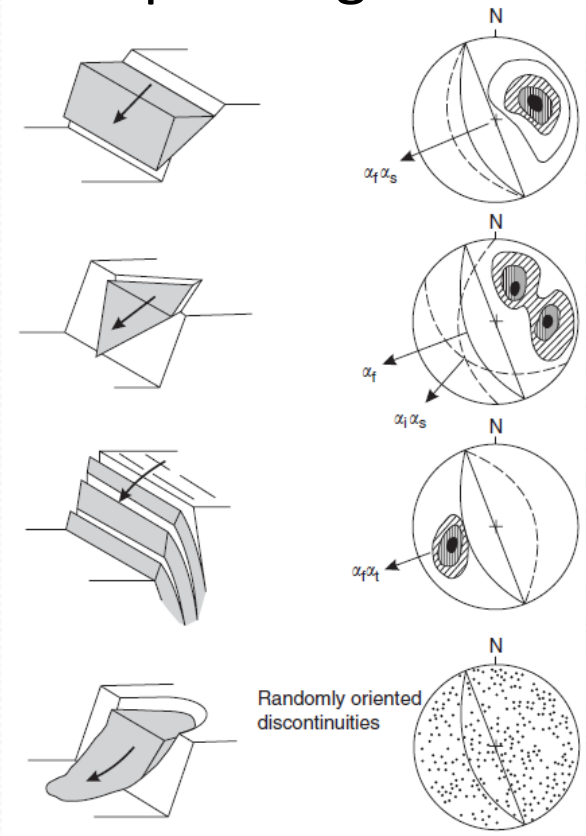


Geotechnical Best Practices in Open Pit Mining

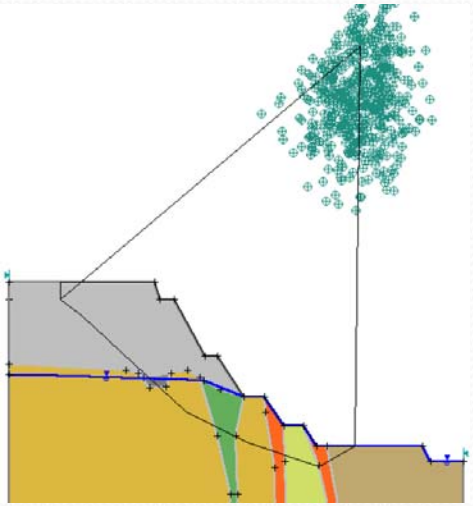
Mine Planning:

Detail slope stability analysis and slope design





Geotechnical Best Practices in Open Pit



Mine Planning:

Deterministic slope stability calculations (FS)

Limit equilibrium analysis

Best estimate of parameters

Probabilistic slope stability calculations (FS)

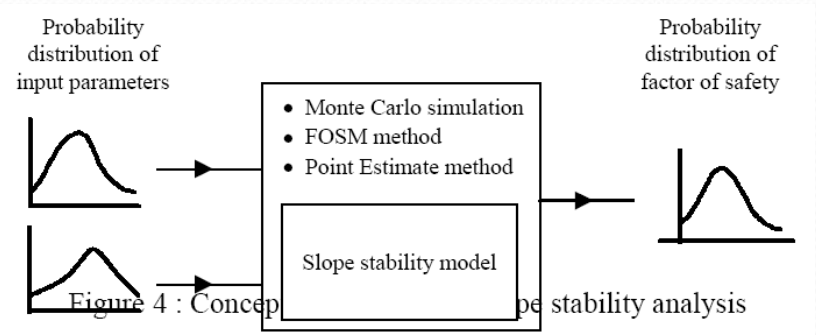
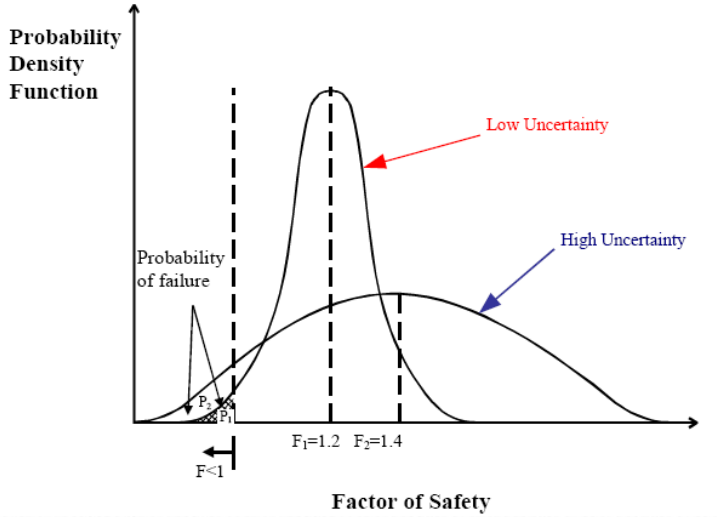


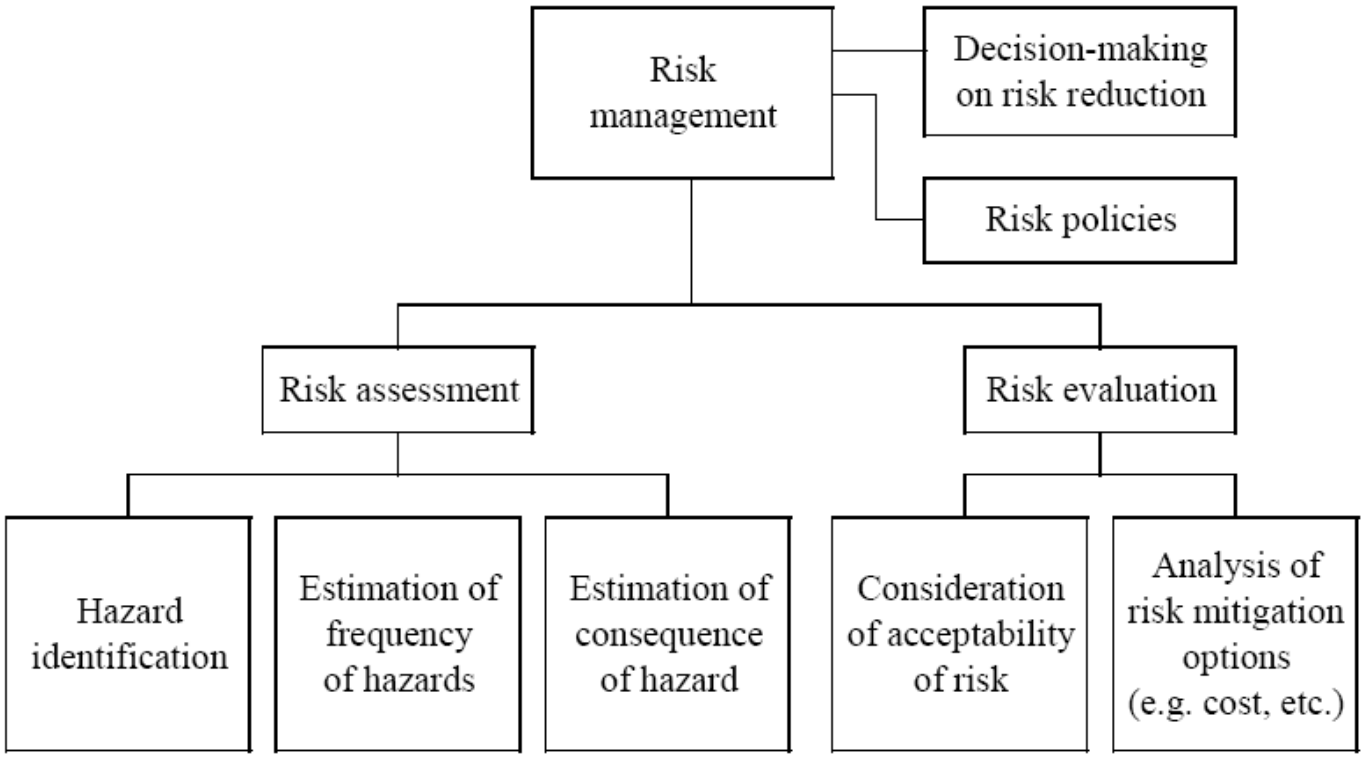
Figure 4 : Concep[illegible]pe stability analysis



Geotechnical Best Practices in Open Pit Mining

Mine Planning:

Execute risk hazard analysis
Implement risk management procedures



Geotechnical Best Practices in Open Pit Mining

Mine Planning:

Design monitoring program

Evaluate and design contingency plans

Geotechnical Best Practices in Open Pit Mining

Mine Operation:

Frequent re-evaluation of geological – geotechnical model

Routine monitoring of slopes

Store and analyze monitoring data (real time database?)

Implement warning and alarm limits

Implement contingency plan

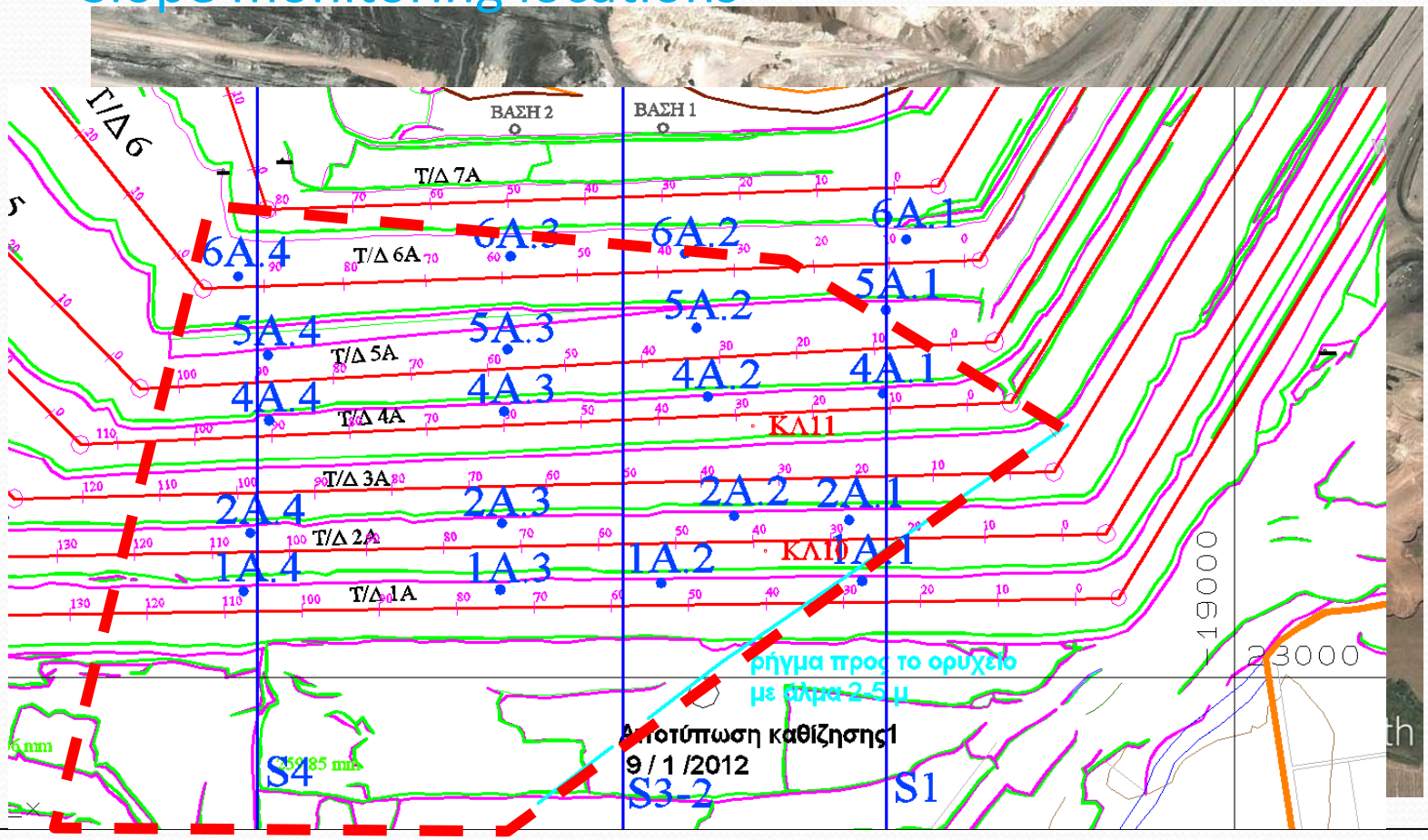
Case Study of a lignite open pit mine in Greece

Mavropigi Mine Ptolemaida PPC:

Case Study of a lignite open pit mine in Greece

Mavropigi Mine Ptolemaida PPC:

Slope monitoring locations



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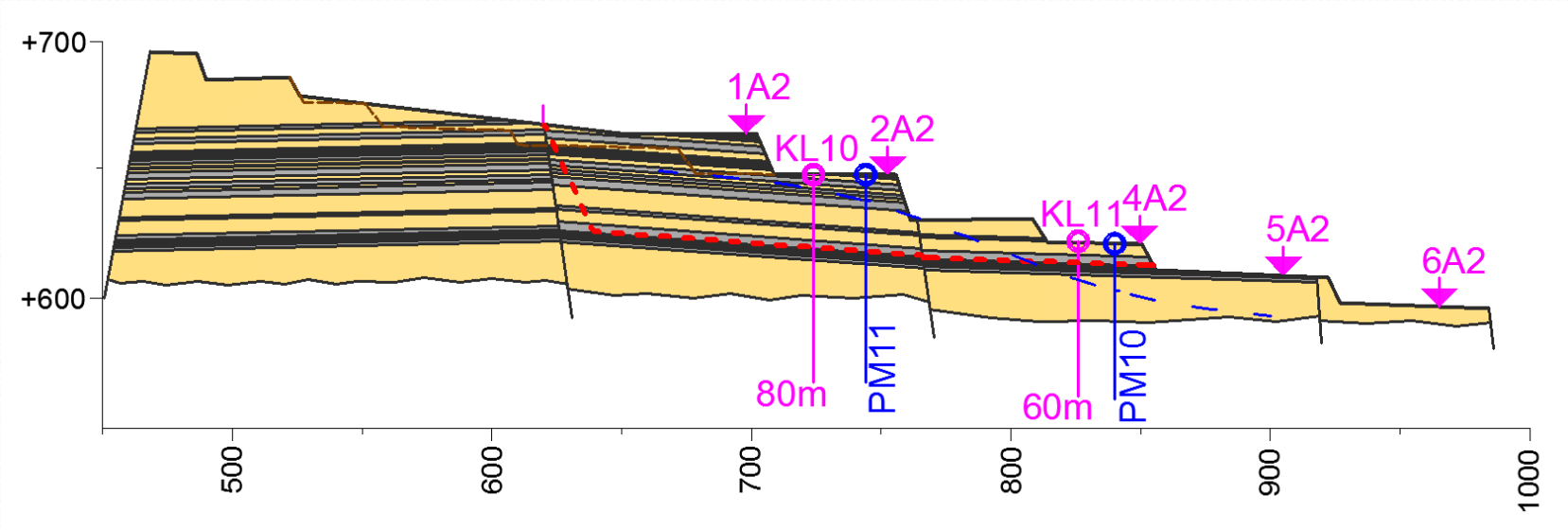

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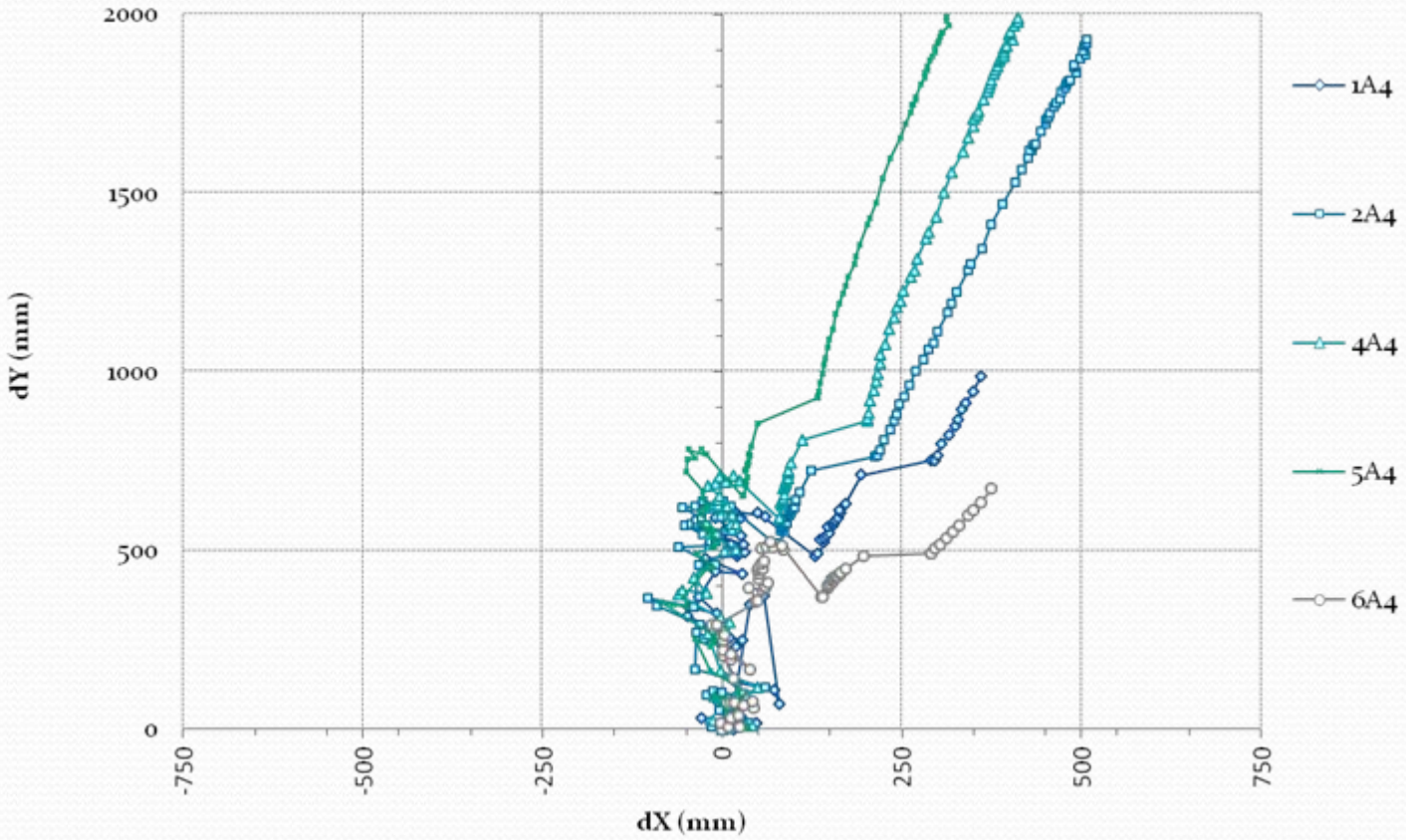

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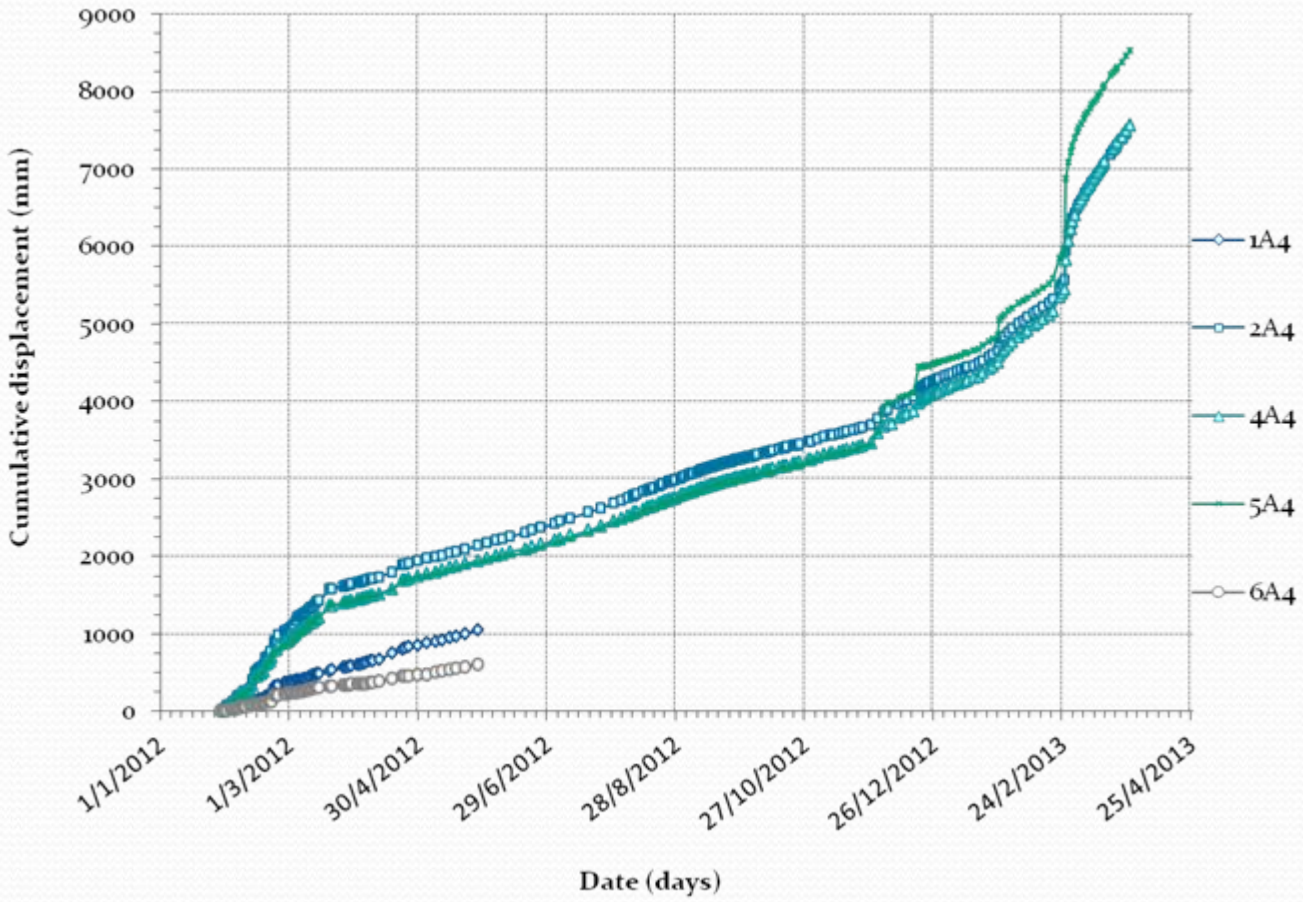

Case Study of a lignite open pit mine in Greece

Mavropigi Mine Ptolemaida PPC:

Conclusions

Geotechnical best practices are tightly linked with the sustainability of mining operations (surface or underground)

An example was presented for best practices with respect to geotechnical planning and design

Yes, there are success stories


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