

Bio-inspired mining, models, and simulation

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The future of mining in Europe

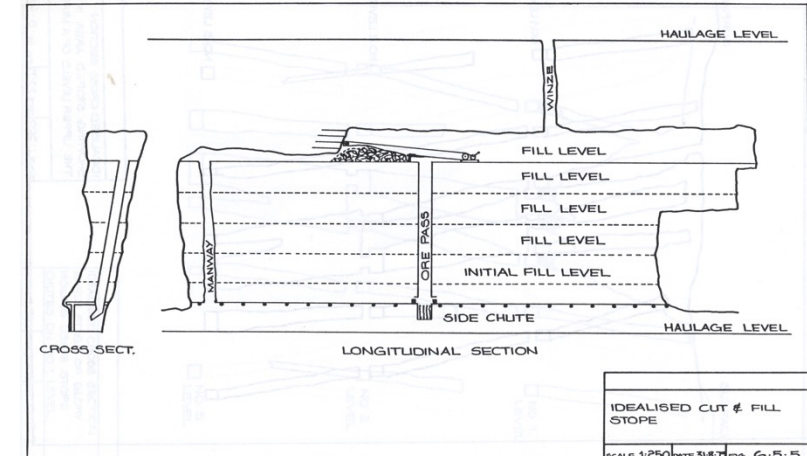
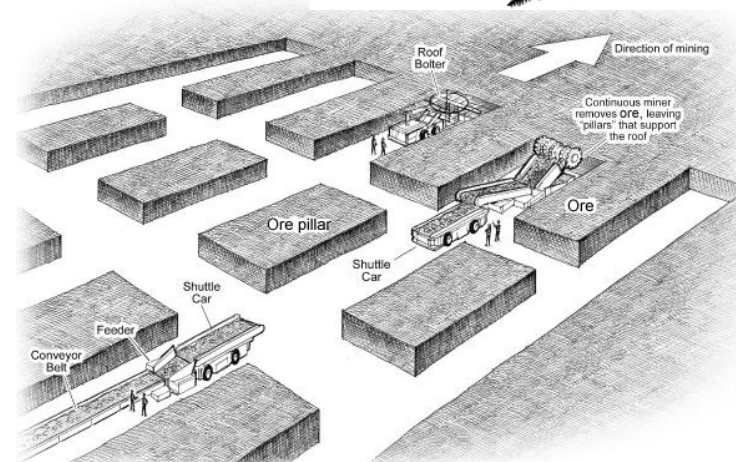
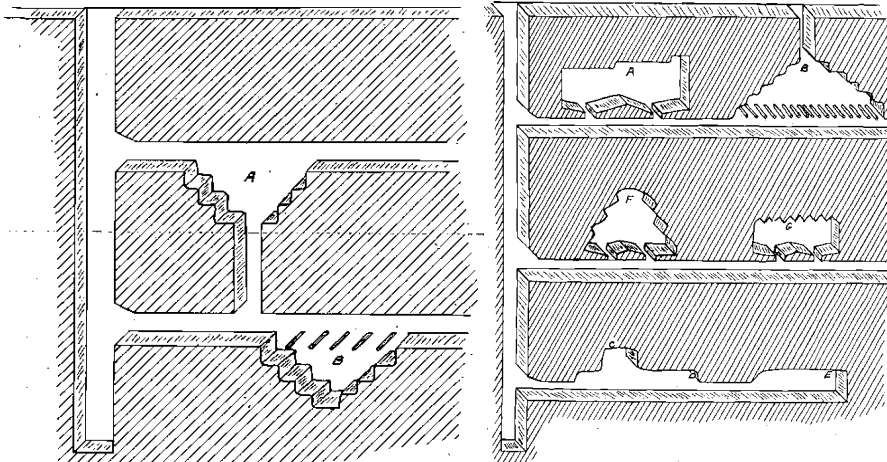
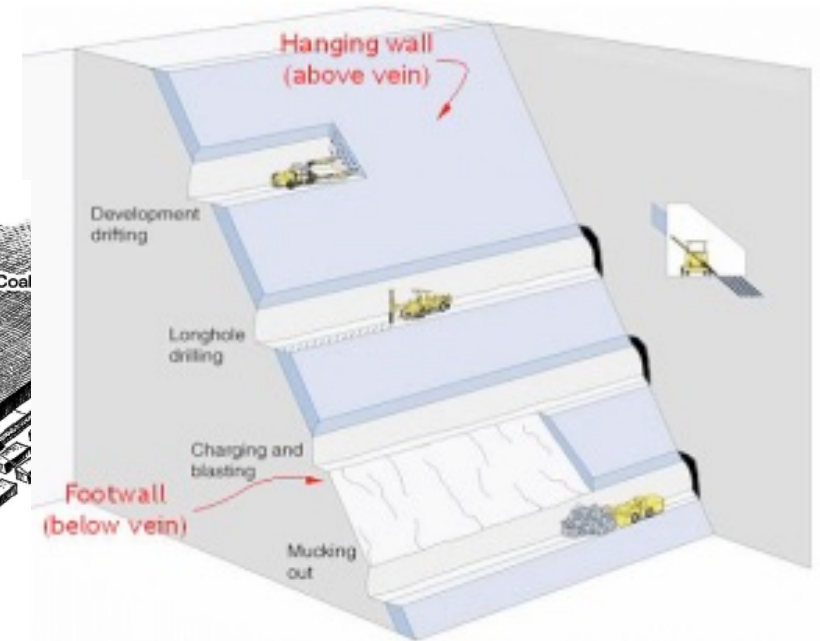
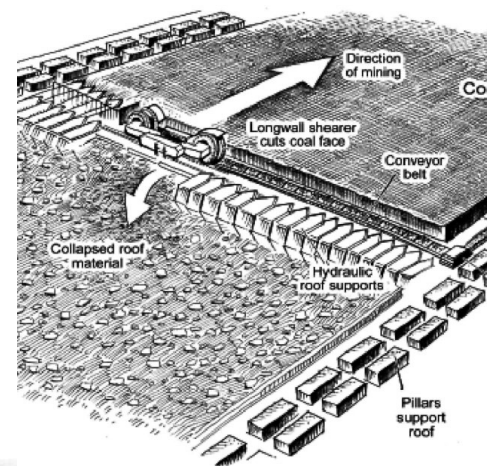
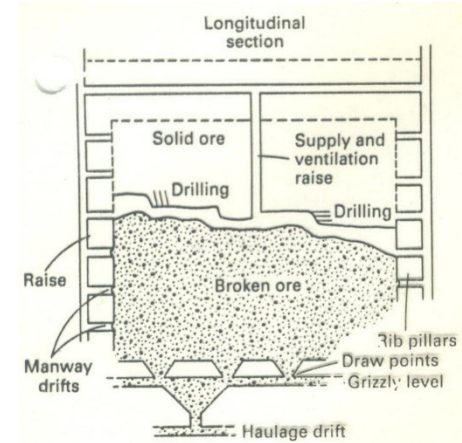
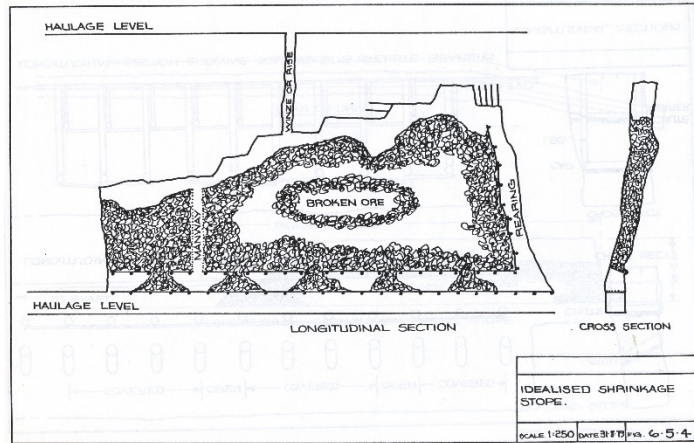
Tuesday, 14 November 2023





MINE GEOMETRY AND MINING METHODS

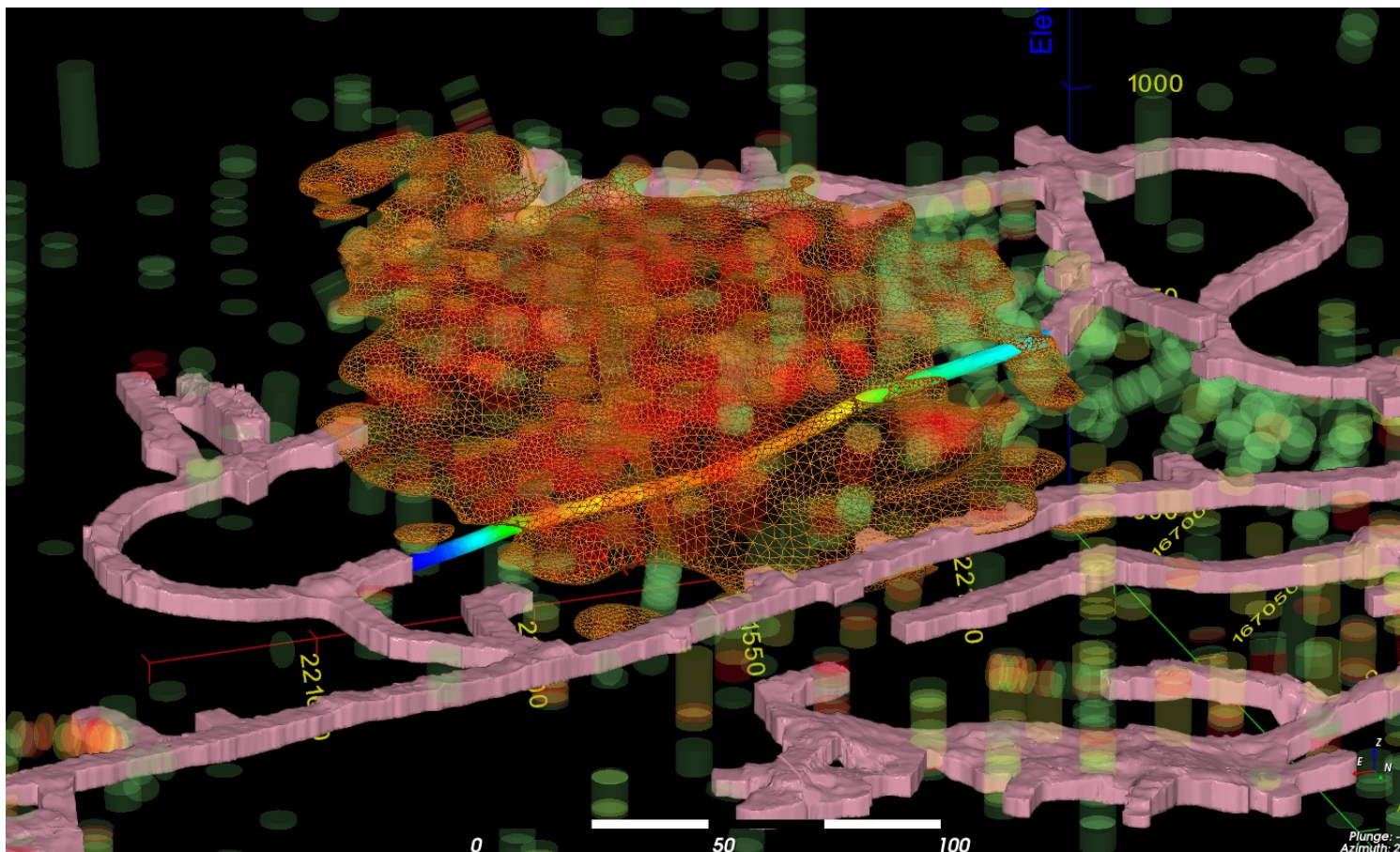
- Conventional mine layouts as used in many mines in Europe





GEOLOGICAL DEPOSIT MODELLING

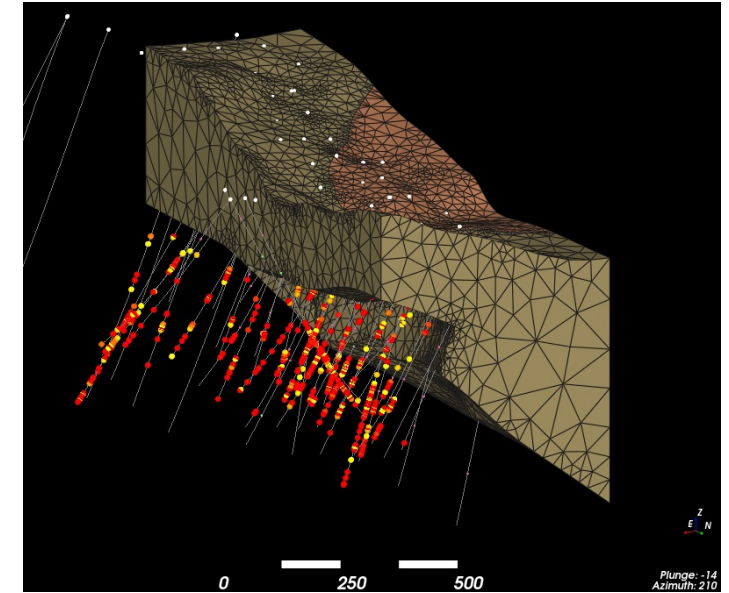
- MVT (Mississippi-Valley Type) Lisheen, Ireland: Main ore-bearing unit modelled in GEOREKA, showing existing workings with simulated 1m diameter tunnel extending the workings





MAJOR IMPROVEMENTS IN GEOLOGICAL MODELLING

- Machine Learning integration into the modelling process
- Tetrahedral optimization enabling simulations (fluid flow, geotechnical, geophysics) on models
- Introduction of function based modelling
 - Domains represented by functions
 - Models created from a ordered list of domain functions
 - Functions can be exported to locally re-create models at any resolution
 - Models with their functions can be exported and loaded onto a robot, without needing a full tetrahedral / triangular model



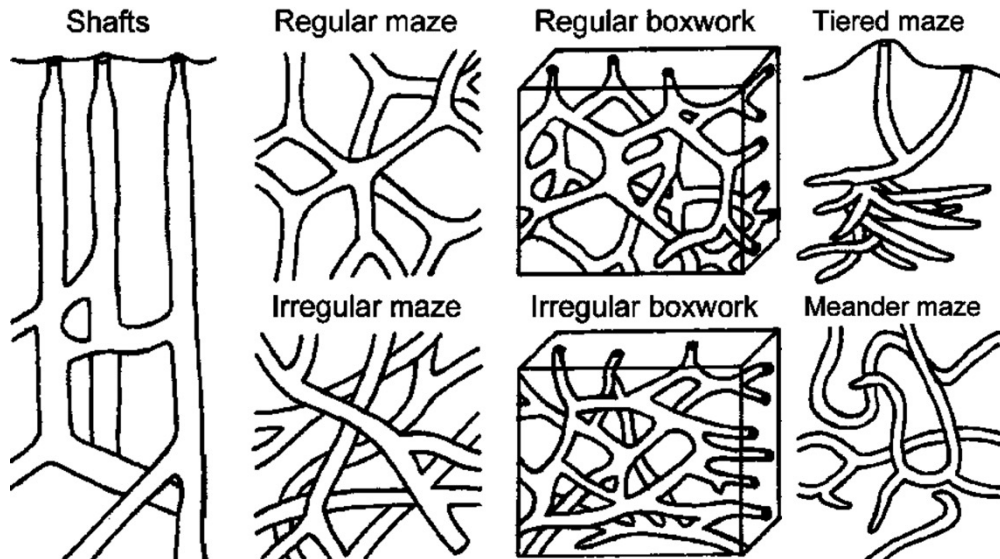
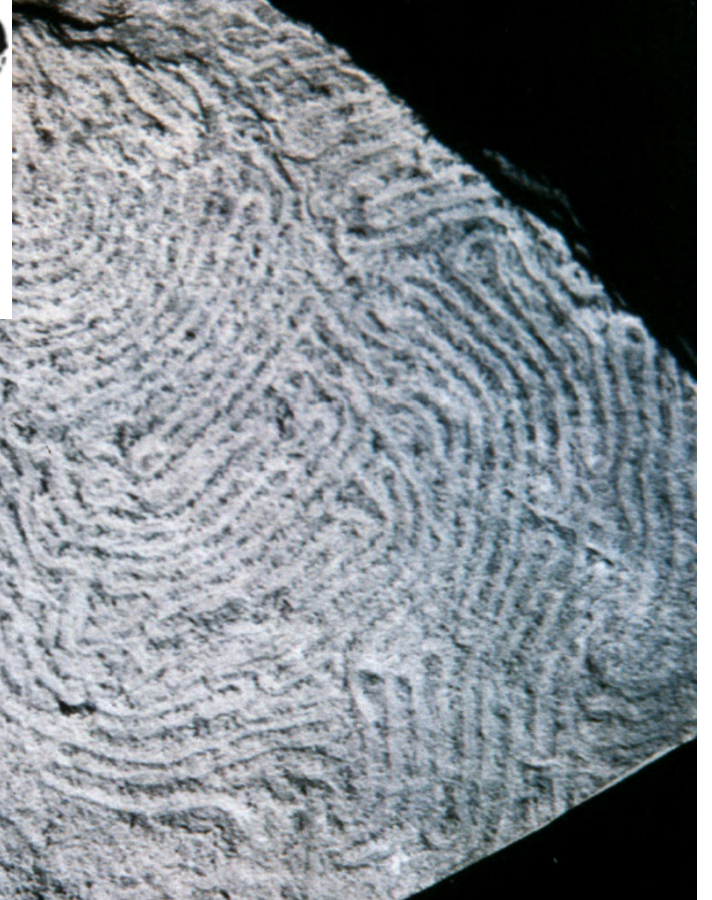
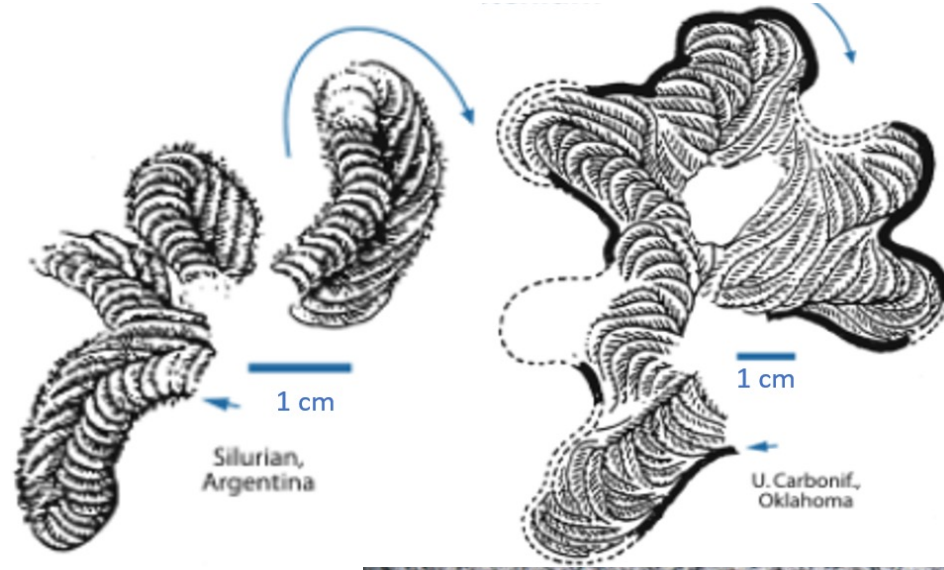
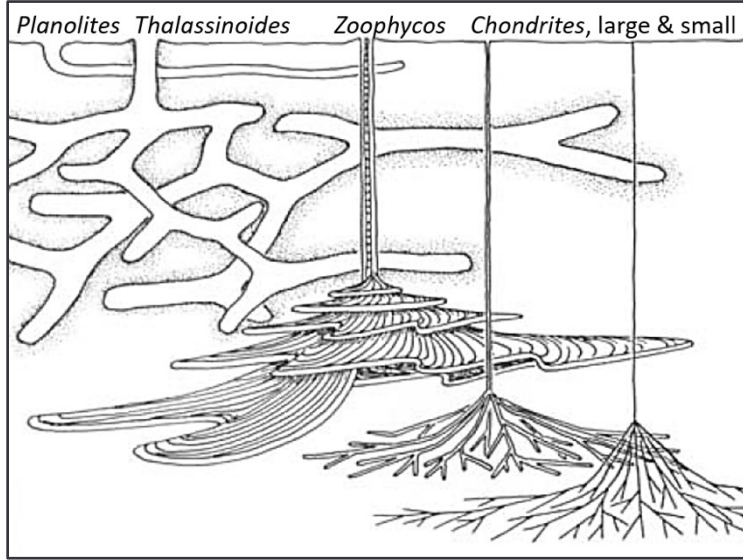
The screenshot shows a software interface with two main panels. The left panel, titled 'Model Descriptors', contains a table with columns 'name' and 'timestamp'. The right panel, titled 'Domain hierarchy', contains a table with columns: 'Domain label', 'Parent Domain', 'Outside Label', 'Resolution', 'Function', 'Polarity', and 'Threshold'.

name	timestamp
1 Base	Mon Mar 28 ...
2 Scenario2	Mon May 16 ...
3 Scenario3	Mon May 16 ...
4 Nummodel	Tue Oct 25 13:04:...

Domain label	Parent Domain	Outside Label	Resolution	Function	Polarity	Threshold
1 Air	Unknown		15	Topo_func	1	0
2 Post Conglom...	Unknown		10	Post Conglom...	0	0
3 West	Unknown		15	FaultWest_func	1	0
4 Andesite	Unknown		15	EastFault_fun	0	0
5 Andesite	West	Conglomerate	15	And_West_func	0	0
6 Andesite	Unknown	Conglomerate	15	AndCentral_fun	0	0



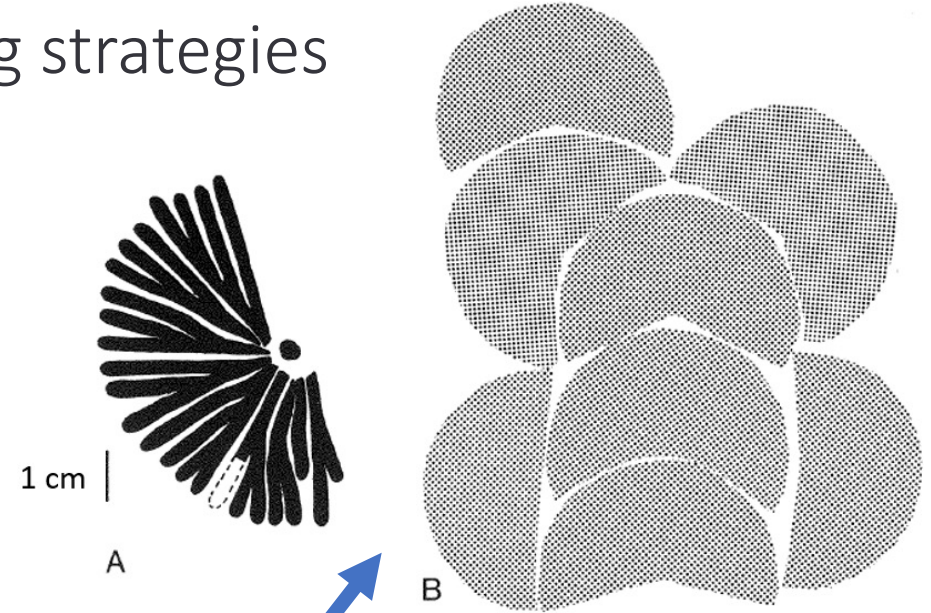
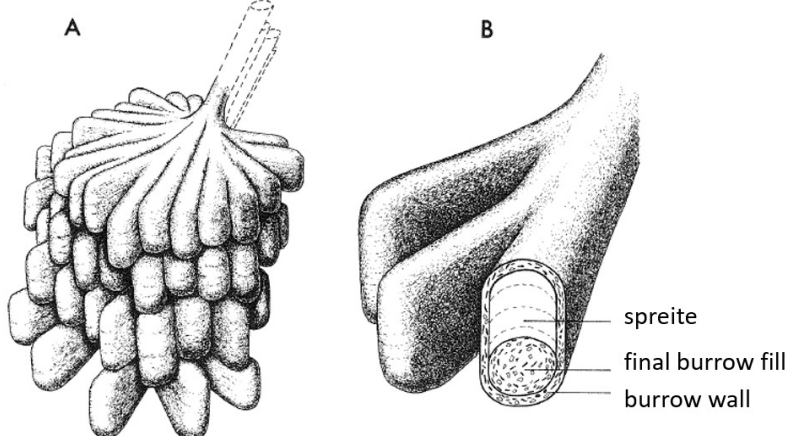
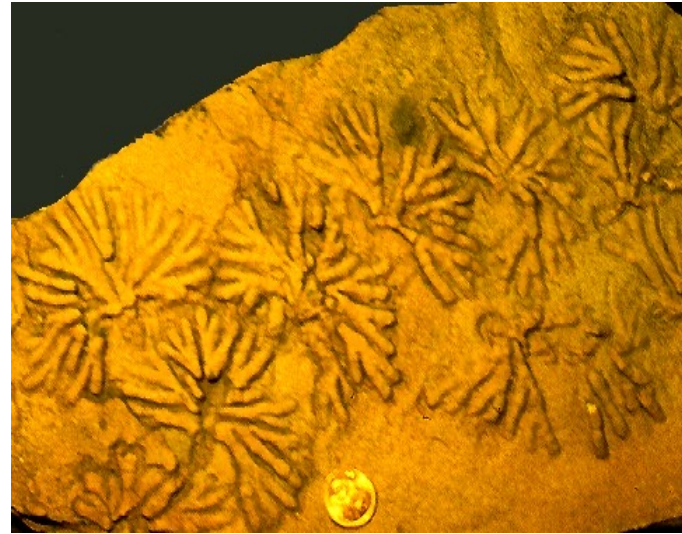
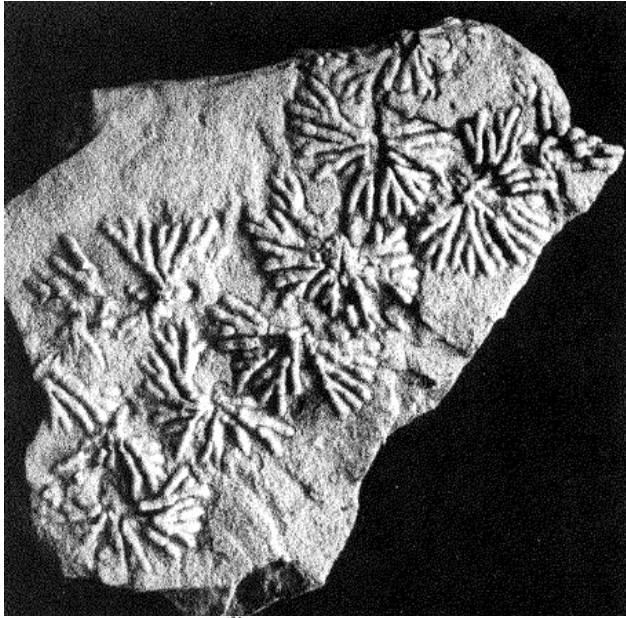
BIO-INSPIRATION FOR MINE LAYOUTS



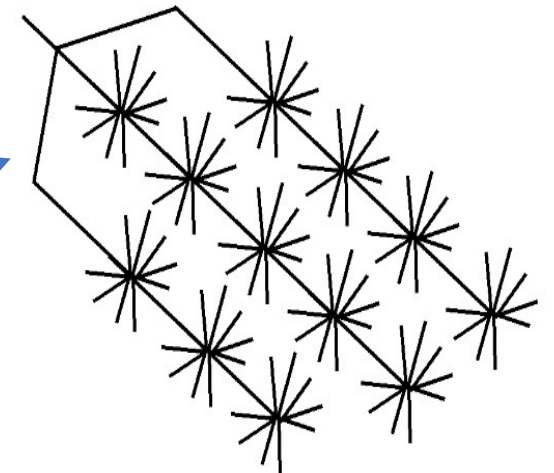


BIO-INSPIRATION FOR MINE LAYOUTS

- How trace fossils can suggest practical mining strategies

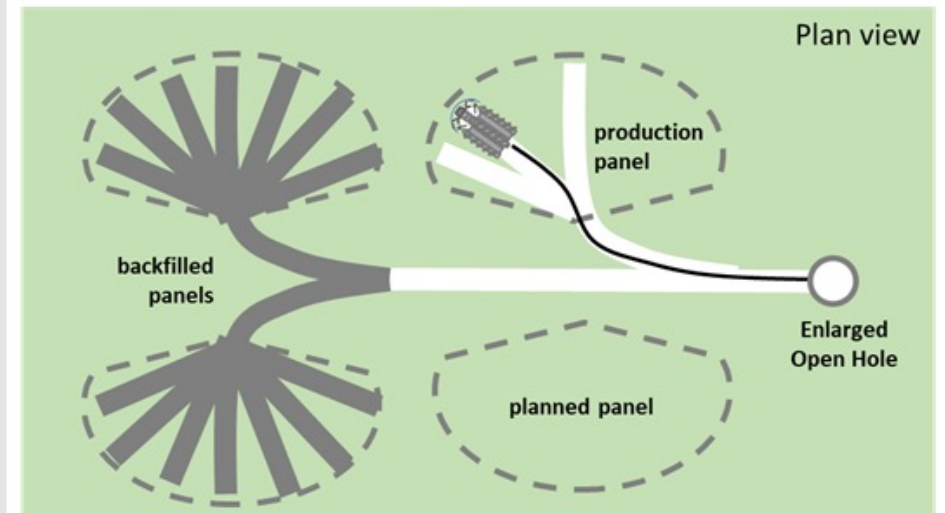
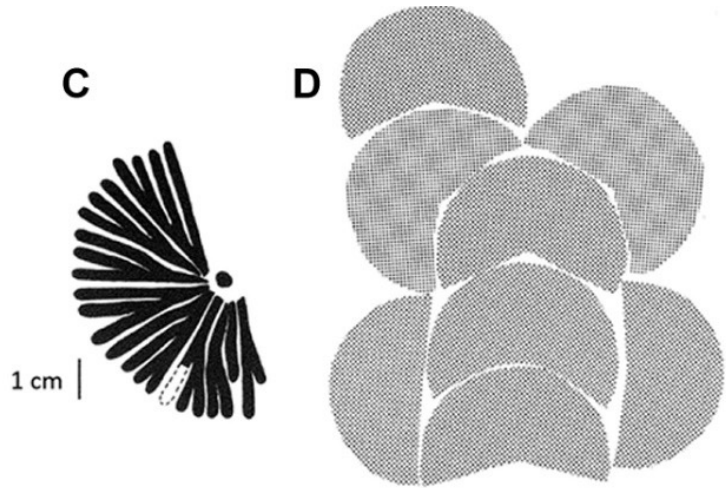
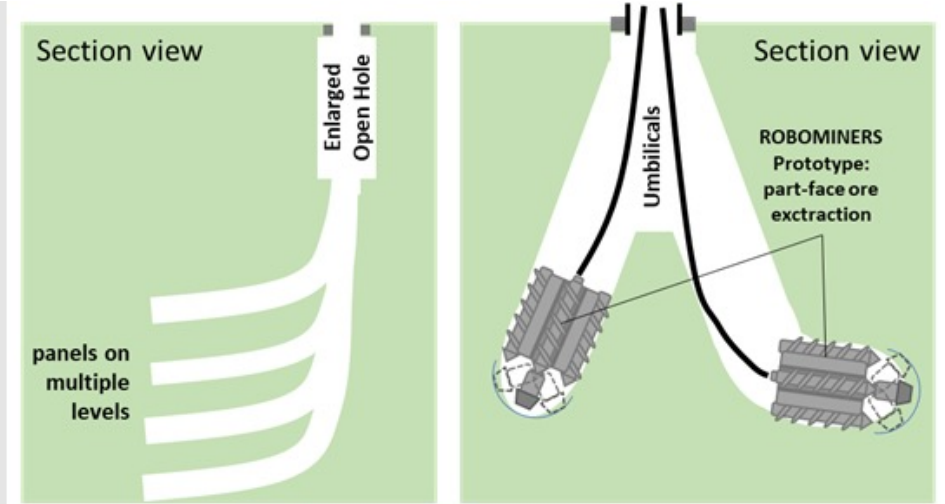
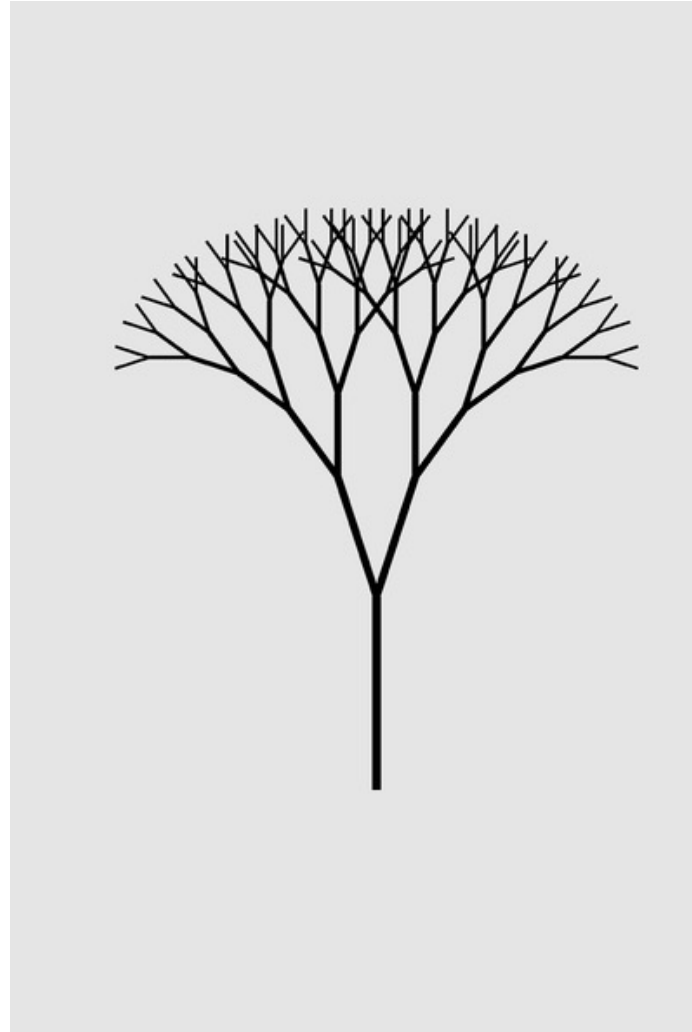
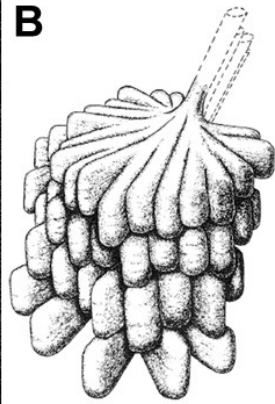
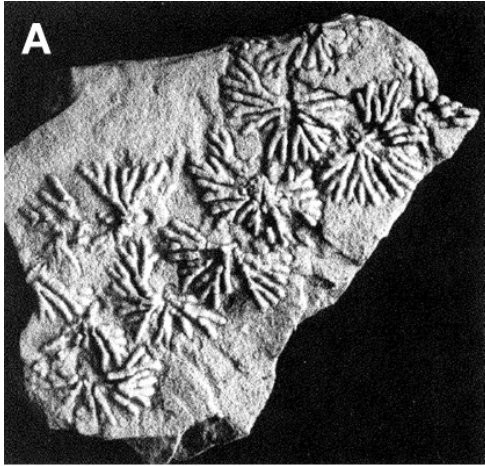


Possible mining
strategy ideas





FRACTAL TREE MINE LAYOUT

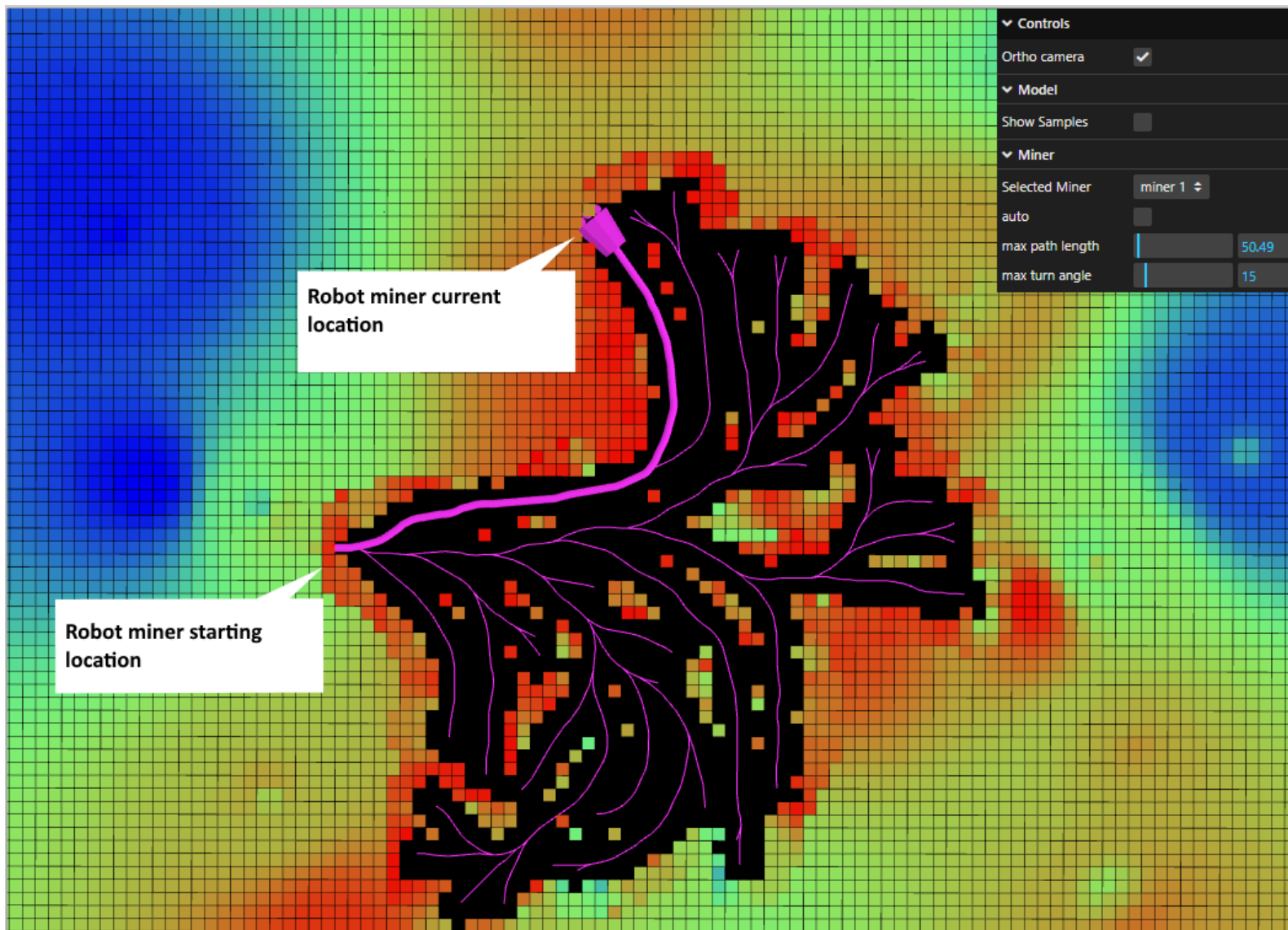
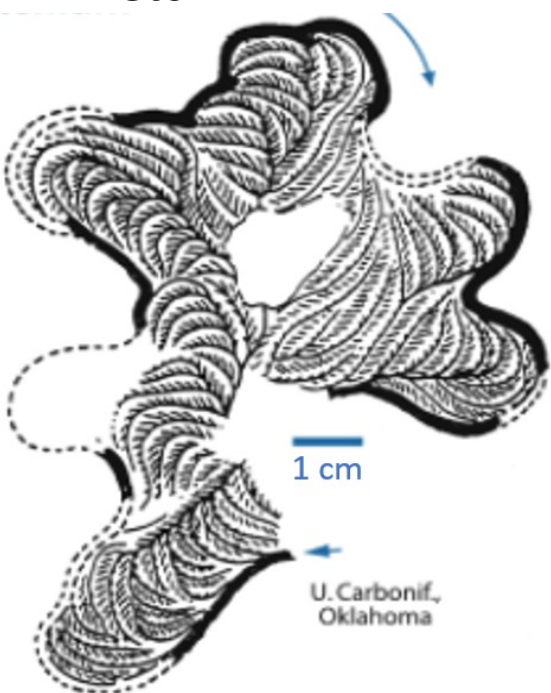




"GREEDY ALGORITHM" ORE-FOLLOWING

Automated ore following,
subject to control parameters –

- Turning radius
- Tether length
- Tunnel dimensions
- Ascent/descent gradients
- etc





THE "GREEDY ALGORITHM"

The screenshot displays a 3D visualization of a network algorithm applied to a geographical area, specifically Ireland. The terrain is rendered in a reddish-brown color. A network of green lines is overlaid on the map, representing the output of a greedy algorithm. A vertical green line is also visible, possibly indicating a specific path or constraint. The interface includes a top toolbar with various icons, a right-hand settings panel with numerous sliders and checkboxes, and a bottom layer management table.

Name	Layer	Colour	Draw Range	Z Range	Y Range	Z Range	Opacity	Size	Style	Actions
Transmissions										
L_msa_solid										
L_tunnels										
Collieries										

Lisheen mine - Ireland



ROBOTIC MINER SIMULATION

The screenshot displays the RoboMiners simulation environment. The main window shows a 3D perspective view of a mine with dark grey rock walls and a light grey floor. A small robot is visible on the right side of the floor. The top right corner of the window features the 'ROBOMINERS' logo. Below the main view, a terminal window displays the following log output:

```
[action_server-1] [INFO] [1686641385.431685822] [robosiner_dbpath_action_server]:  
Configuring node  
[action_server-1] [INFO] [1686641422.275237797] [robosiner_dbpath_action_server]:  
Received target pose ID 1  
[action_server-1] [INFO] [1686641422.275596497] [robosiner_dbpath_action_server]:  
Executing goal  
[action_server-1] [INFO] [1686641422.275647997] [robosiner_dbpath_action_server]:  
Querying for the target checkpoint  
[action_server-1] [INFO] [1686641422.543478298] [robosiner_dbpath_action_server]:  
Target XY from DB : 8.5 and 3.5  
  
[action_client-1] [INFO] [1686641423.145339475] [robosiner_dbpath_action_client]:  
Current Robot Position Y: 2.49422  
[action_client-1] [INFO] [1686641423.445146368] [robosiner_dbpath_action_client]:  
Current Robot Position X: 0.961178  
[action_client-1] [INFO] [1686641423.445239868] [robosiner_dbpath_action_client]:  
Current Robot Position Y: 2.49422  
[action_client-1] [INFO] [1686641423.745382961] [robosiner_dbpath_action_client]:  
Current Robot Position X: 0.961179  
[action_client-1] [INFO] [1686641423.745376461] [robosiner_dbpath_action_client]:  
Current Robot Position Y: 2.49422
```

Thank you

