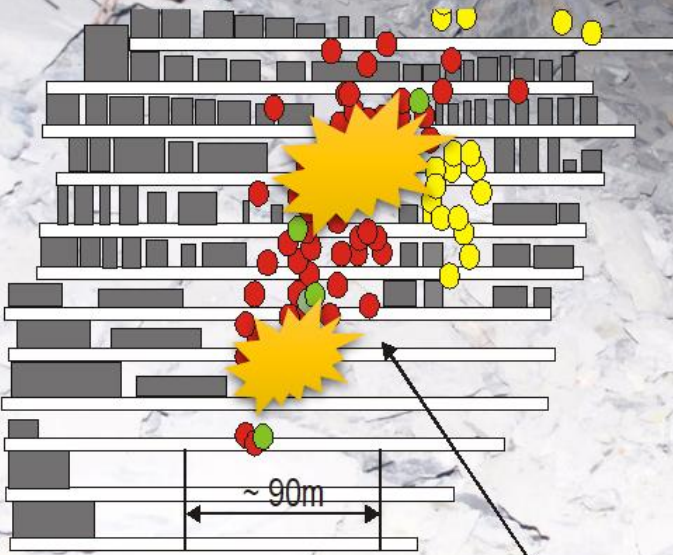


Maintaining the safety case in High Risk Mines

Alex Campbell
Beck Engineering

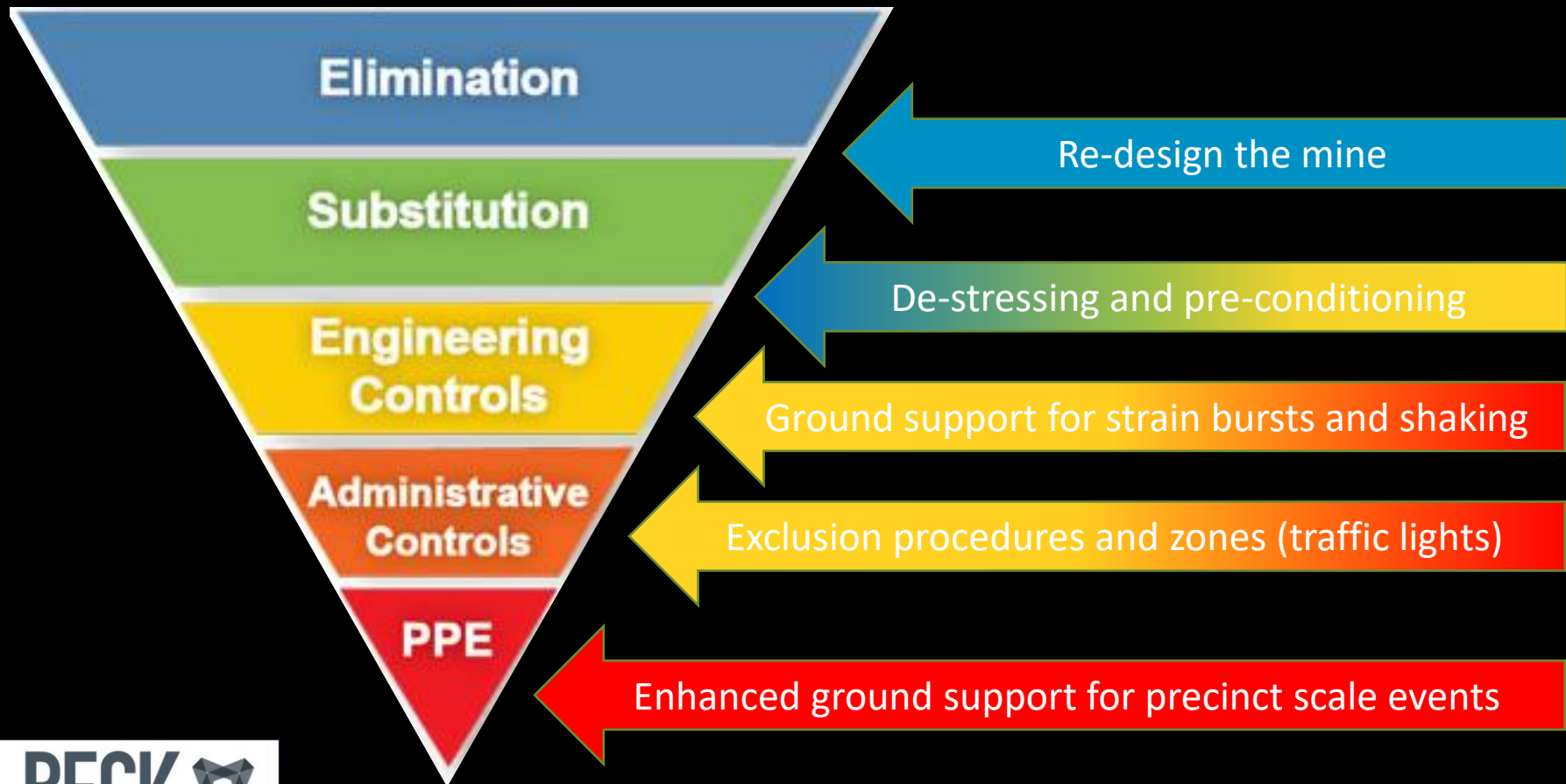
30 minutes

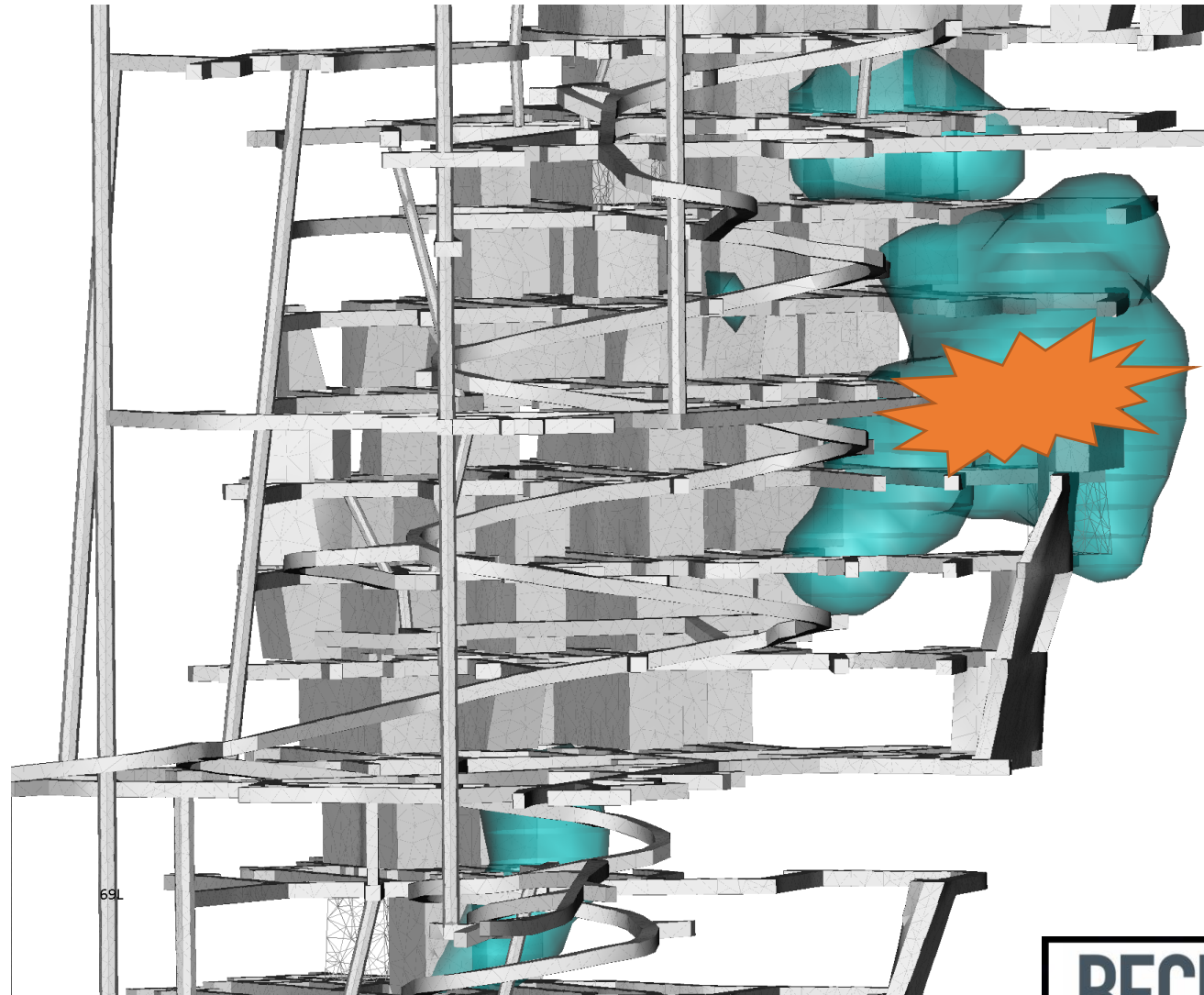




SHRINKING CENTRAL
ACCESS PILLAR

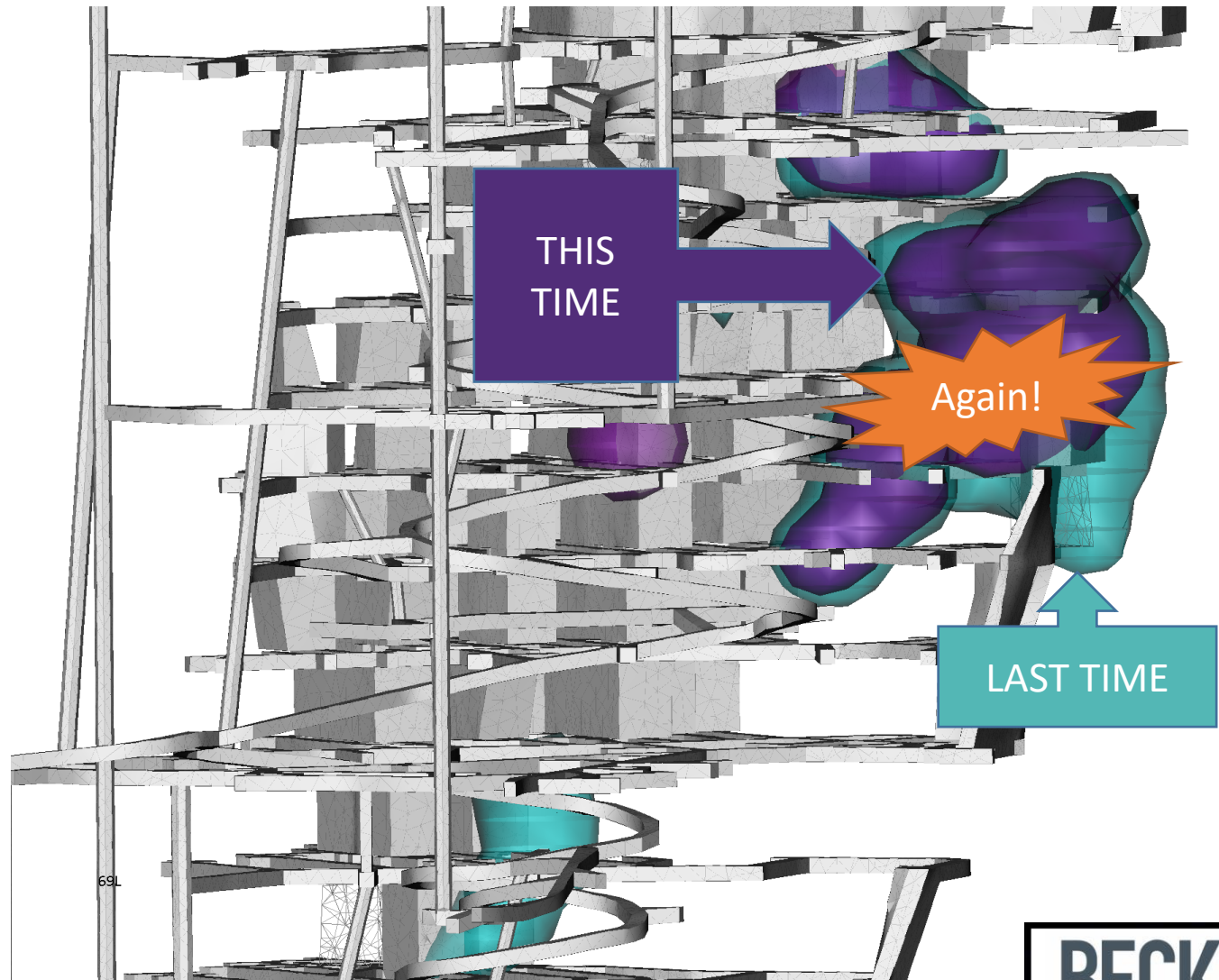
Immediate Action...





Big event...





Some years later...

What essential lesson does this teach us?



- We need to employ the OBSERVATIONAL METHOD
- This means
 - We make the best design we can
 - We rely on the best defensible assumptions
 - We implement control measures we think are sufficient
- BUT, we continuously evaluate whether:
 - The control measures are working
 - Our assumptions are correct
 - That things we never imagined are not evolving
- We update the plan when we have to
- Whenever we can't make a safety case, we stop and take the safe option.
(and it is the law too!!)

HOW THE \$%^& IS WATCHING DOTS ON THE SCREEN DOING THIS???

CONCLUSION...

The ongoing observational program confirming mine stability is an essential task in retaining a license to mine

OBSERVE+ MEASURE

Does the data match our stability hypothesis?

ANALYSE:

Is it working?

Has it changed?

What will happen next?

What is happening now?

Can we make a safety case?

Design the mine

De-stressing and pre-conditioning

Exclusion procedures and zones (traffic lights)

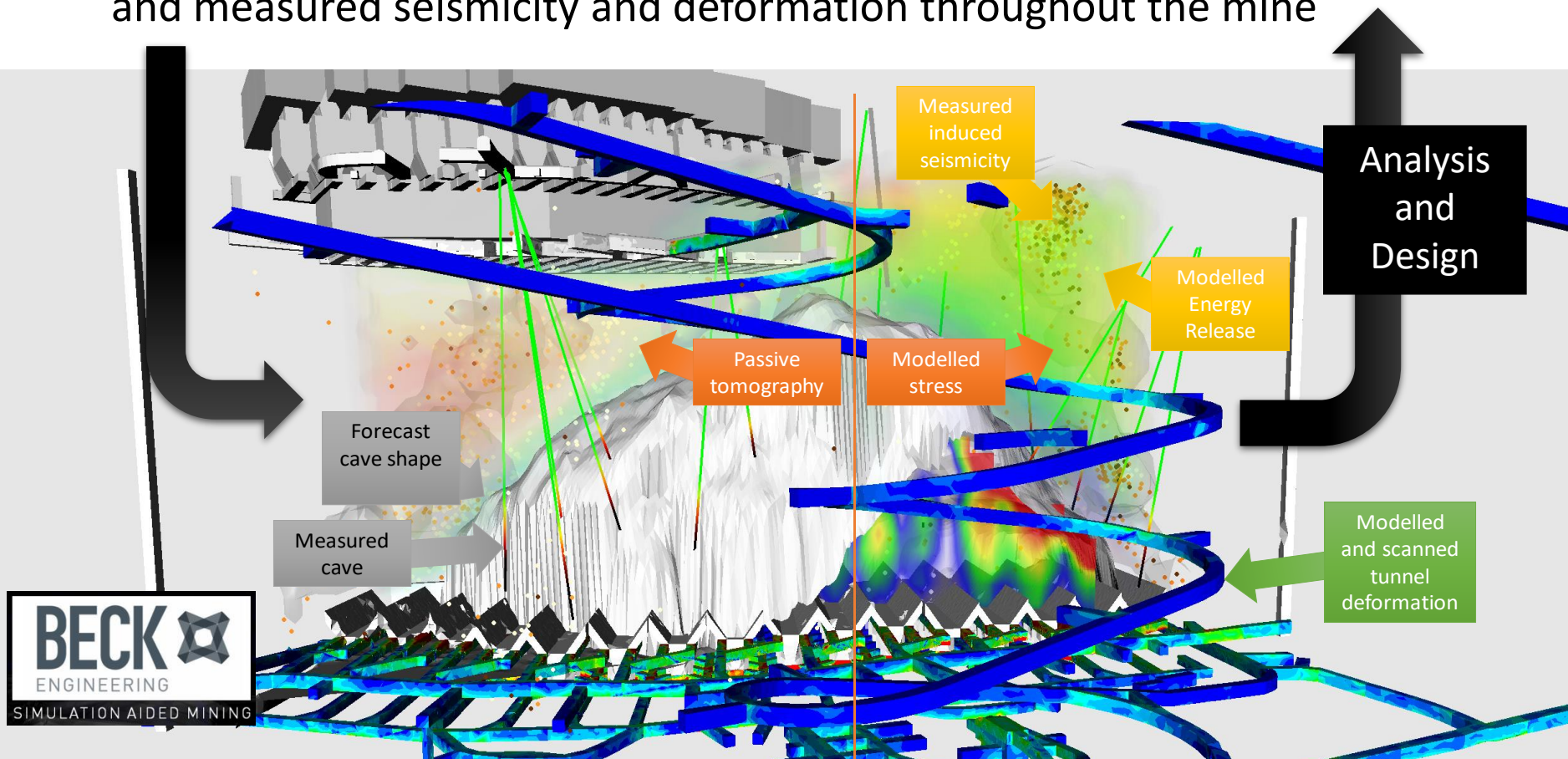
Enhanced ground support

RE-DESIGN

Parts of the observational program...

1. OBSERVATION AND MEASUREMENT:

Maintain a current and sufficient resolution 4d database of forecast and measured seismicity and deformation throughout the mine



Parts of the observational program...

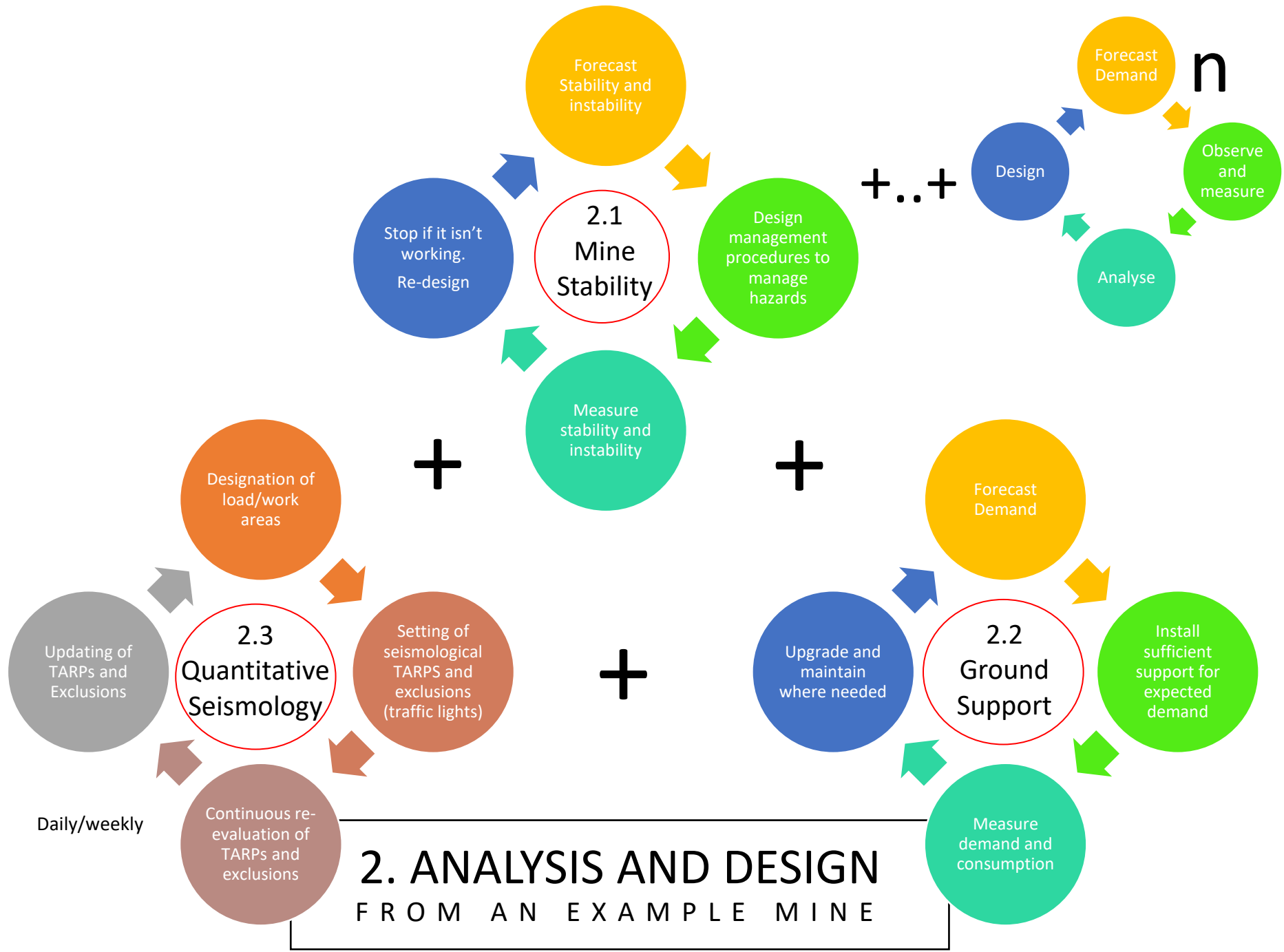
2. ANALYSIS AND DESIGN:

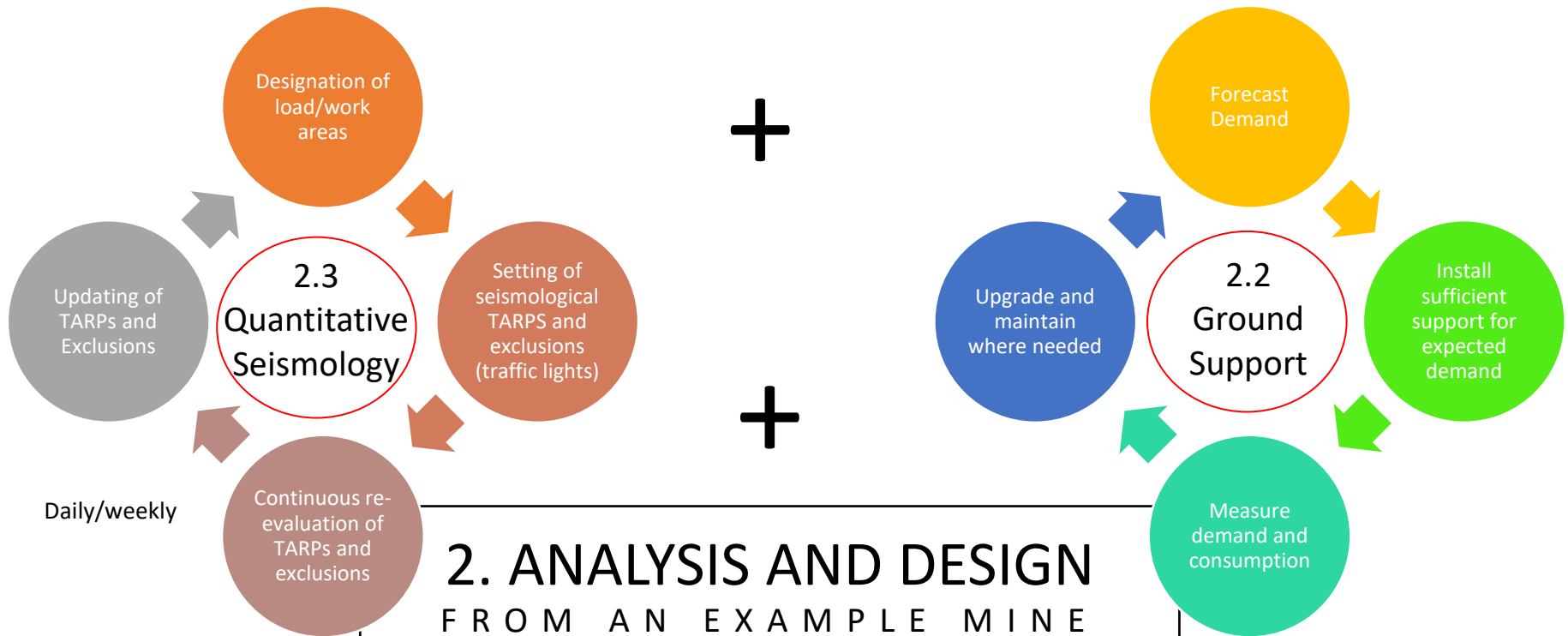
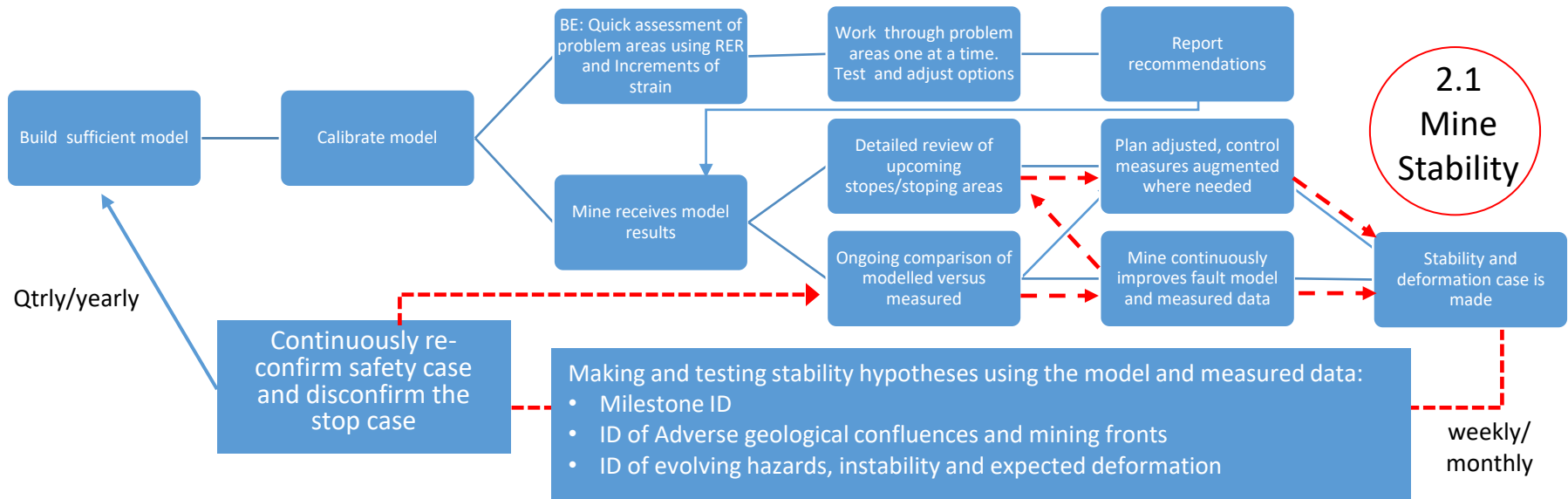
- Use the database to:
 - Make and test stability hypotheses:
 - Maintain an interpretation of the current and expected nature of instability in the mine
 - Confirm that the mine is evolving as expected and disconfirm other more adverse scenarios
 - Identify expected and new hazards and mechanisms for dynamic deformation in the mine, to trigger a response
 - Maintain the lower control measures:
 - Ground support
 - Exclusion procedures and TARPs
- Continuously evaluate efficacy and update all control measures whenever needed

ROCK
ENGINEERING

SEISMOLOGY

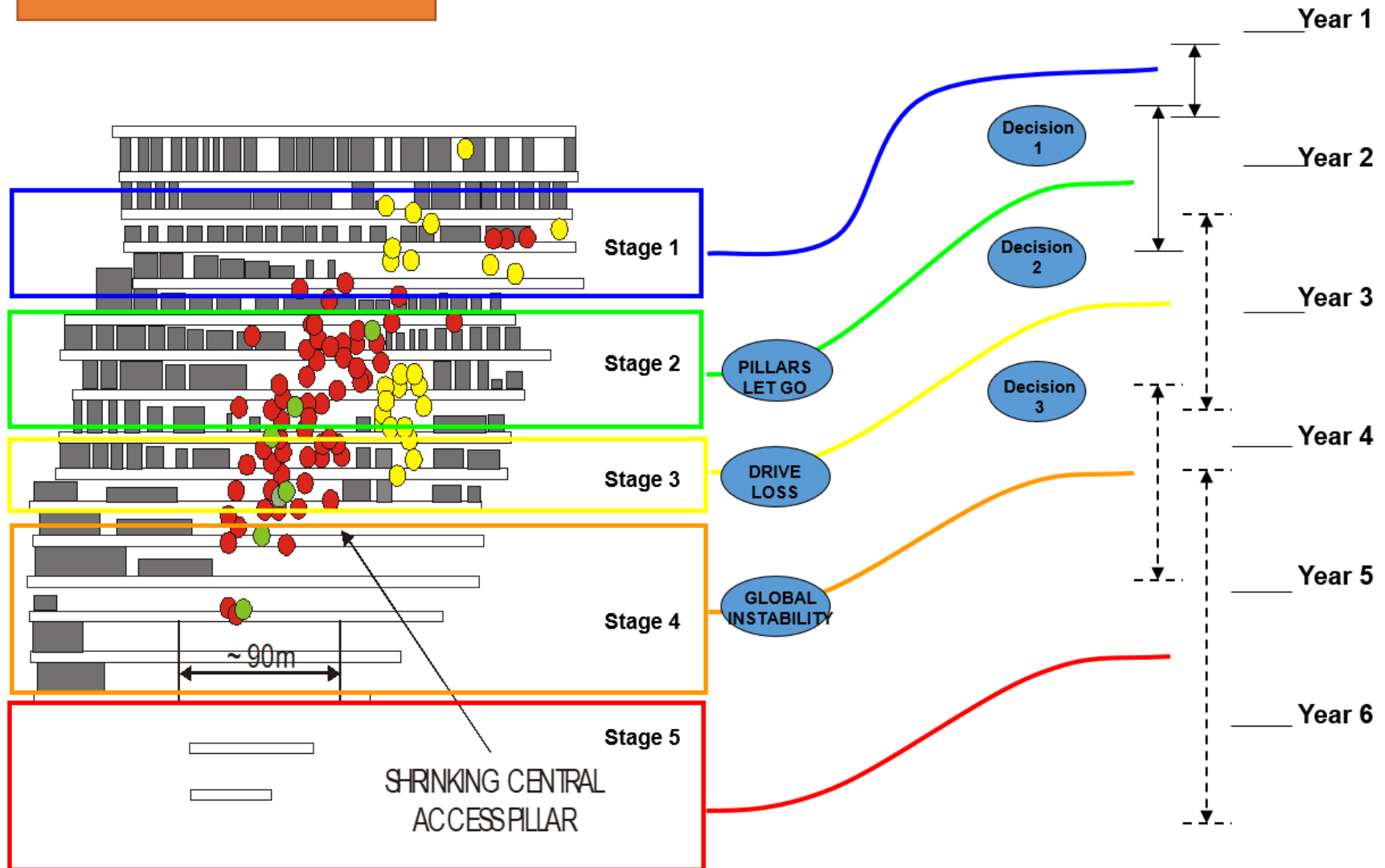
Observation
and
measurement



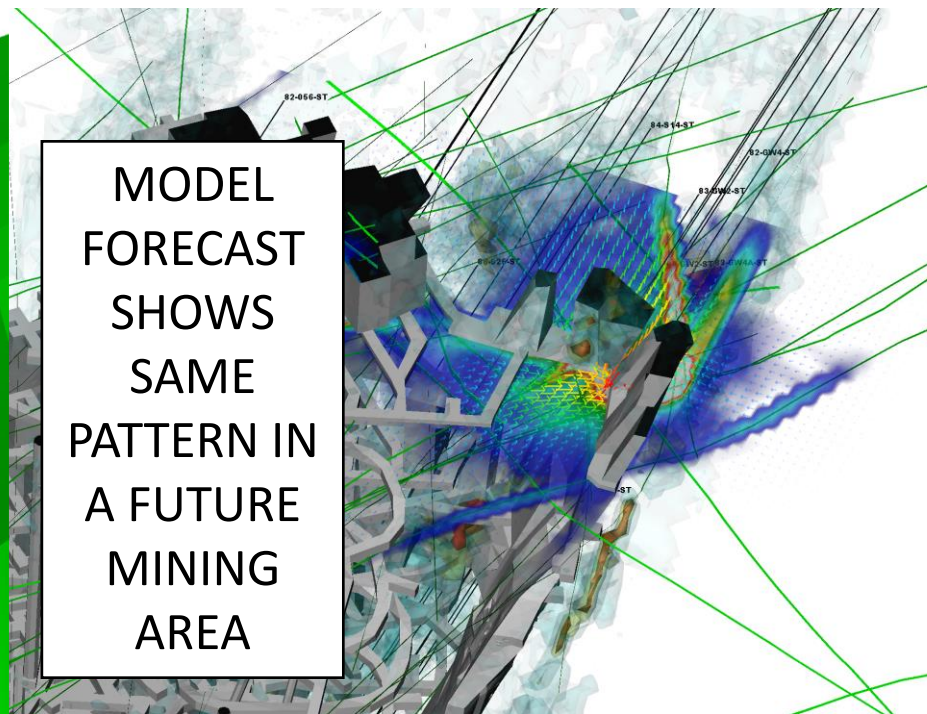
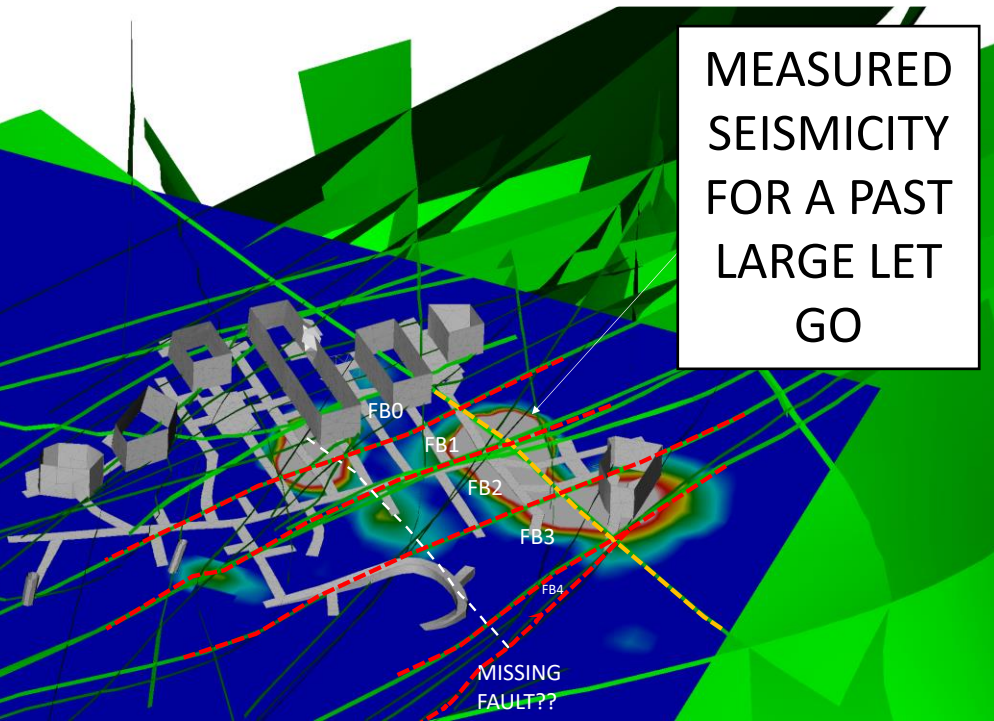


IMPORTANT:

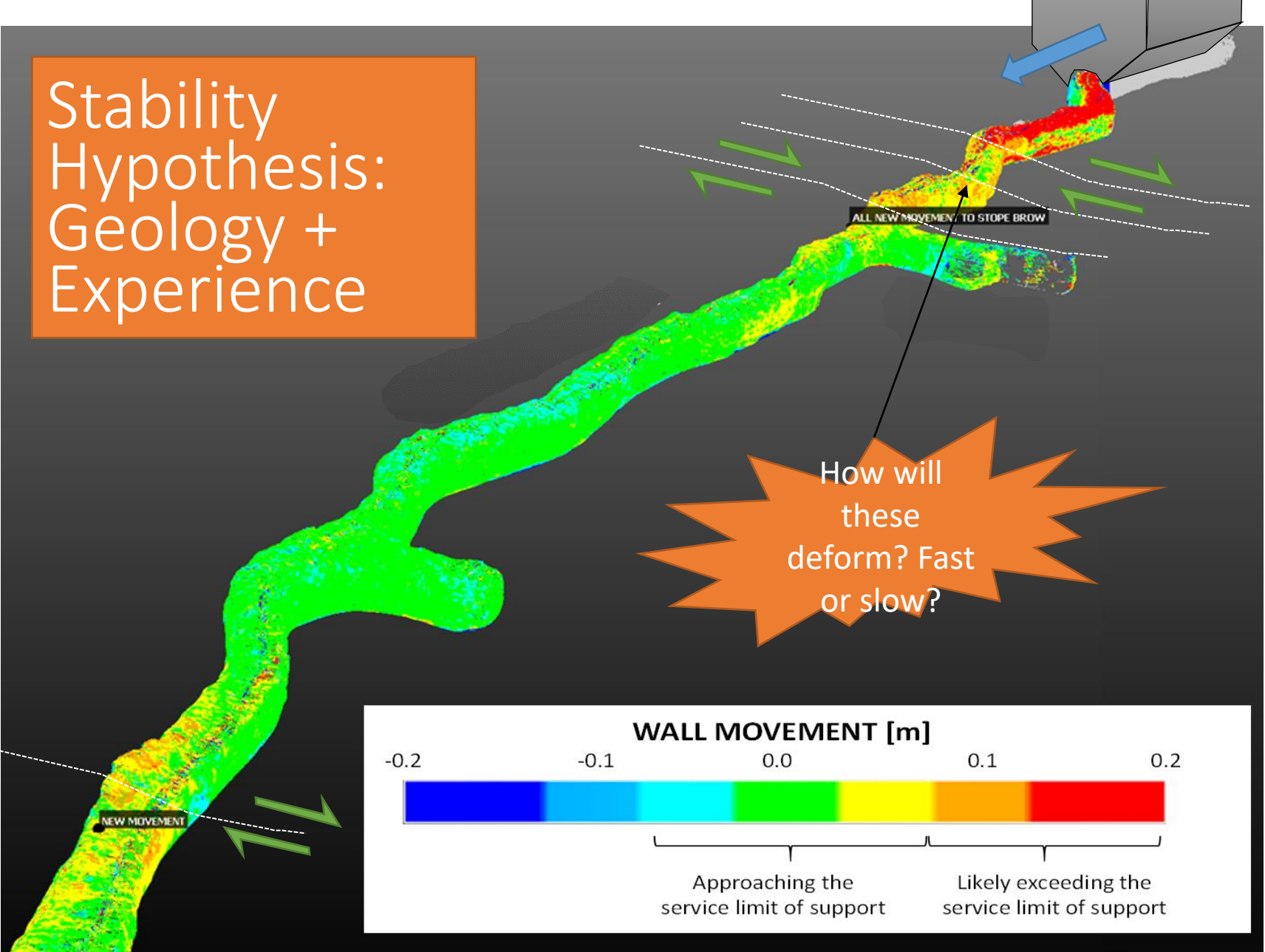
- The speed of the decision cycle must be faster than the rate that hazards can evolve
- This applies to TARPs, all decisions and all updates to engineering controls



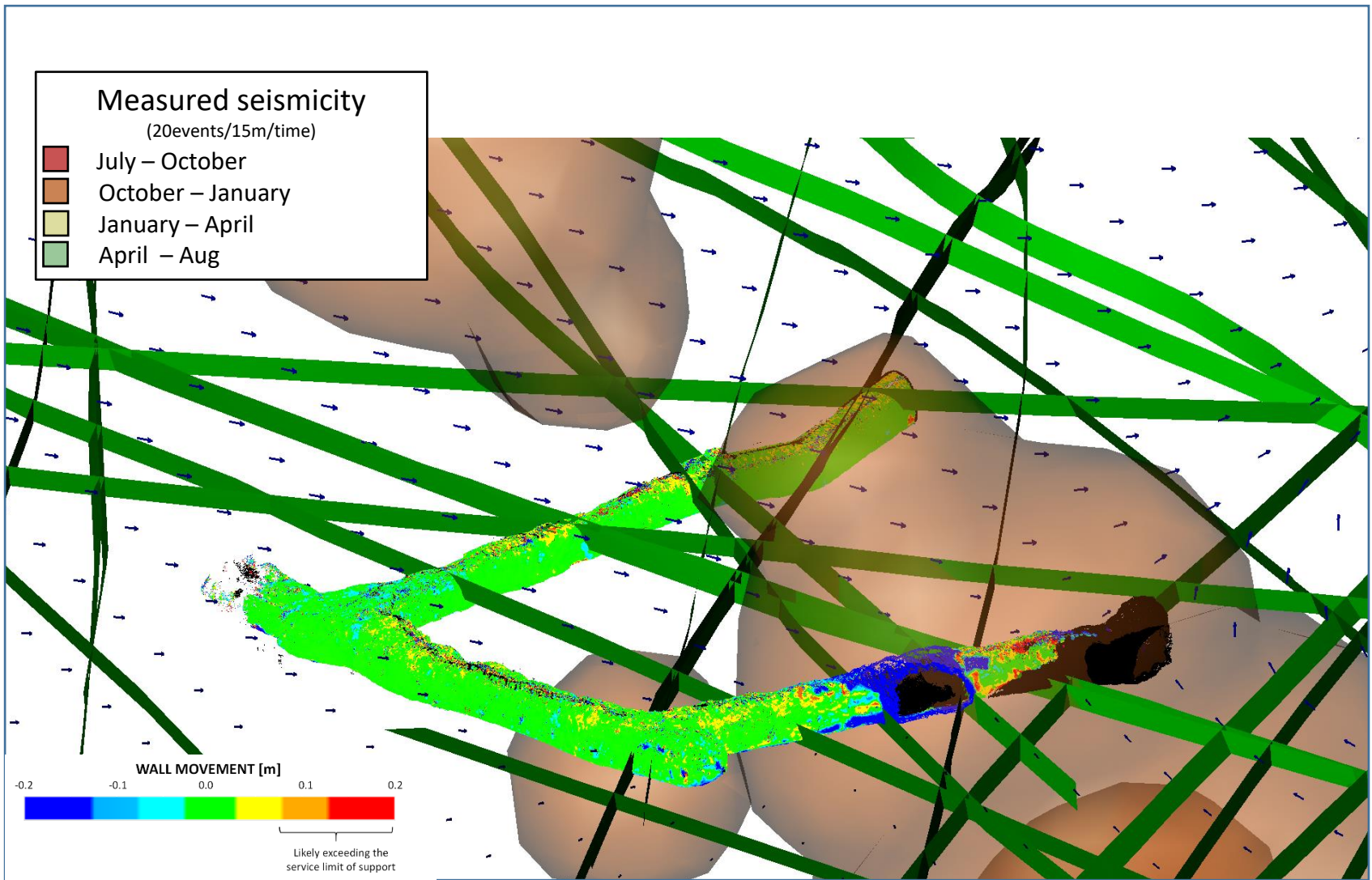
Stability Hypothesis: Model + Experience



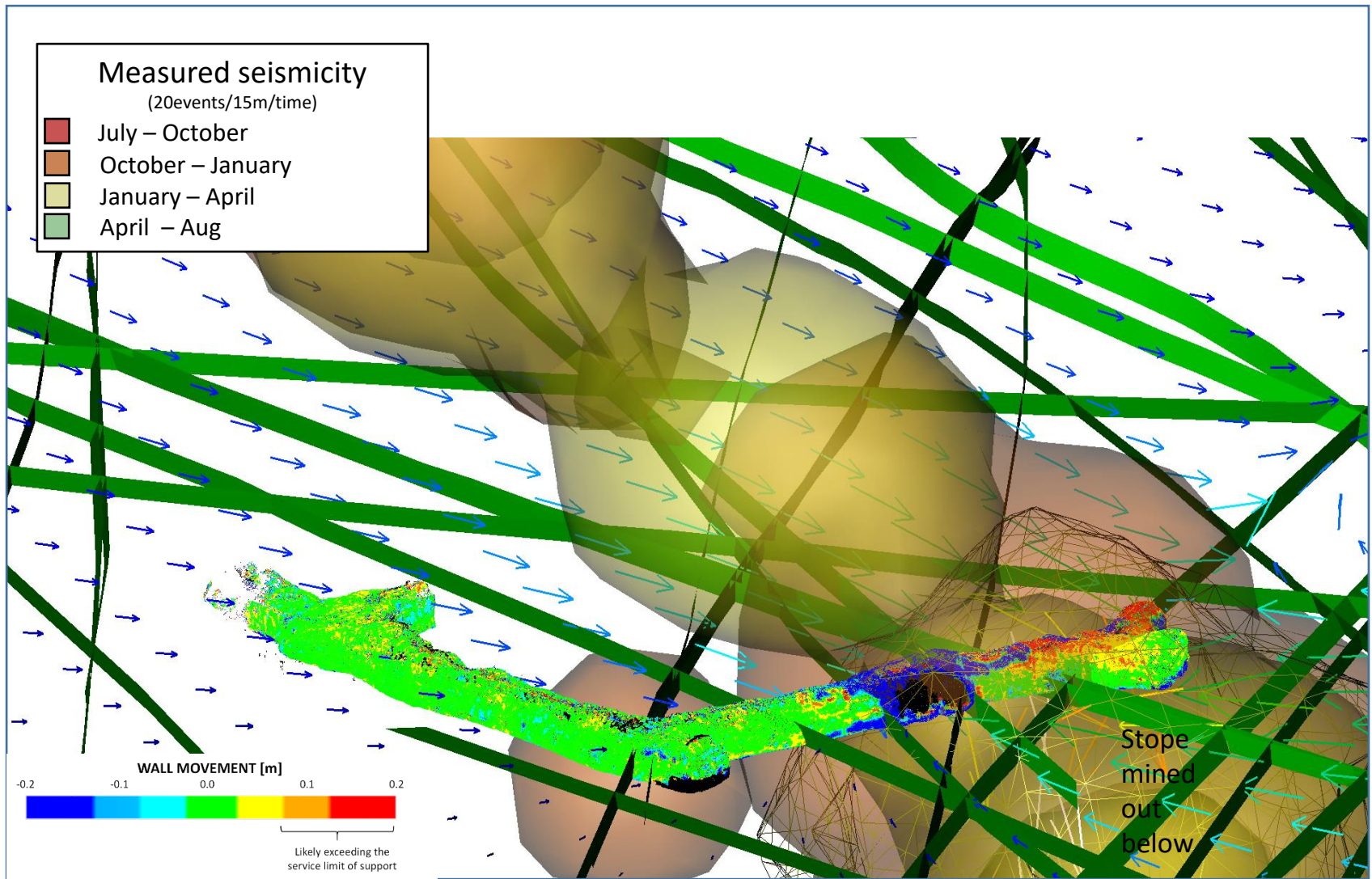
Stability
Hypothesis:
Geology +
Experience



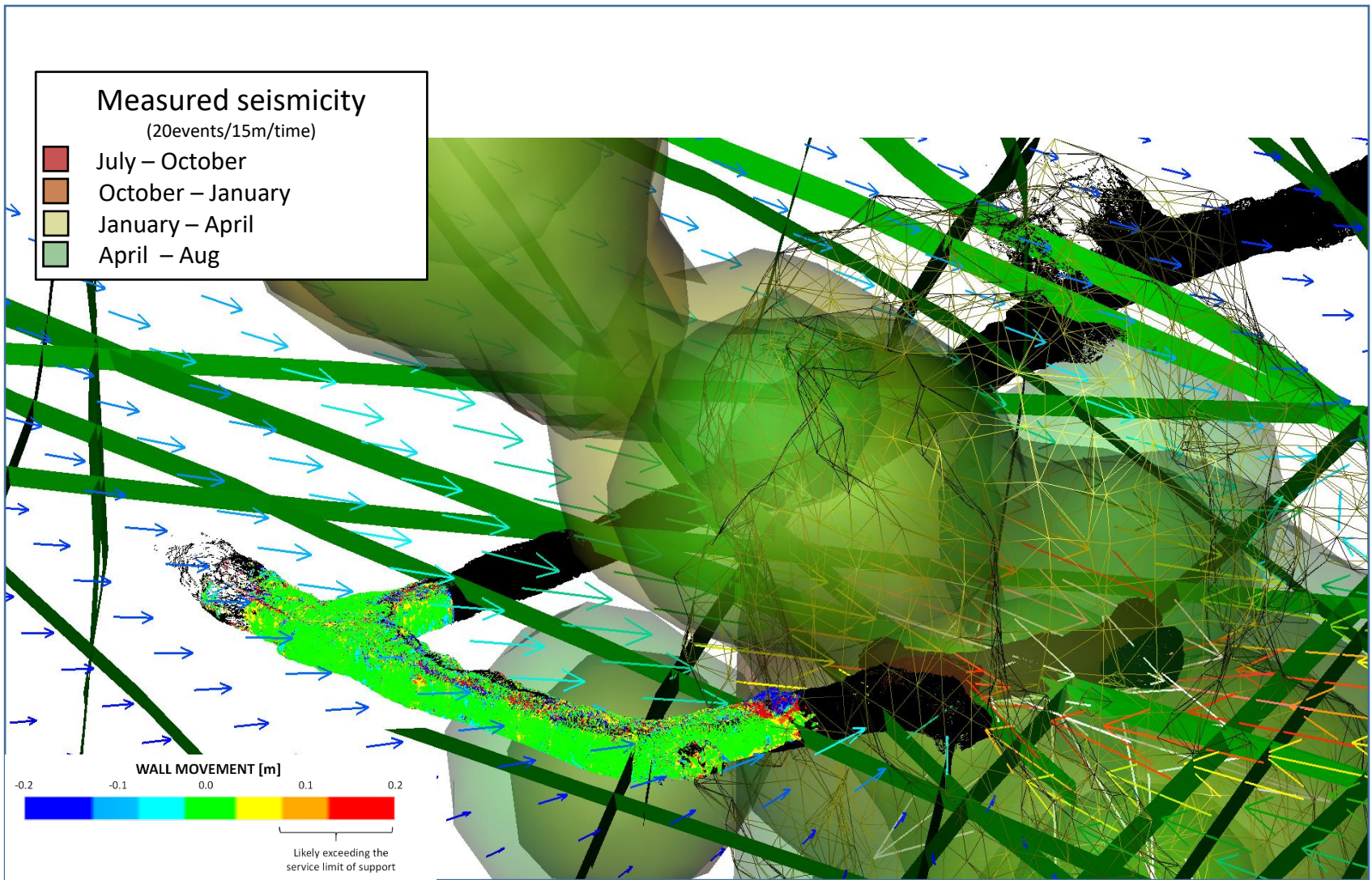
Faults and seismicity, measured displacement, modelled displacement

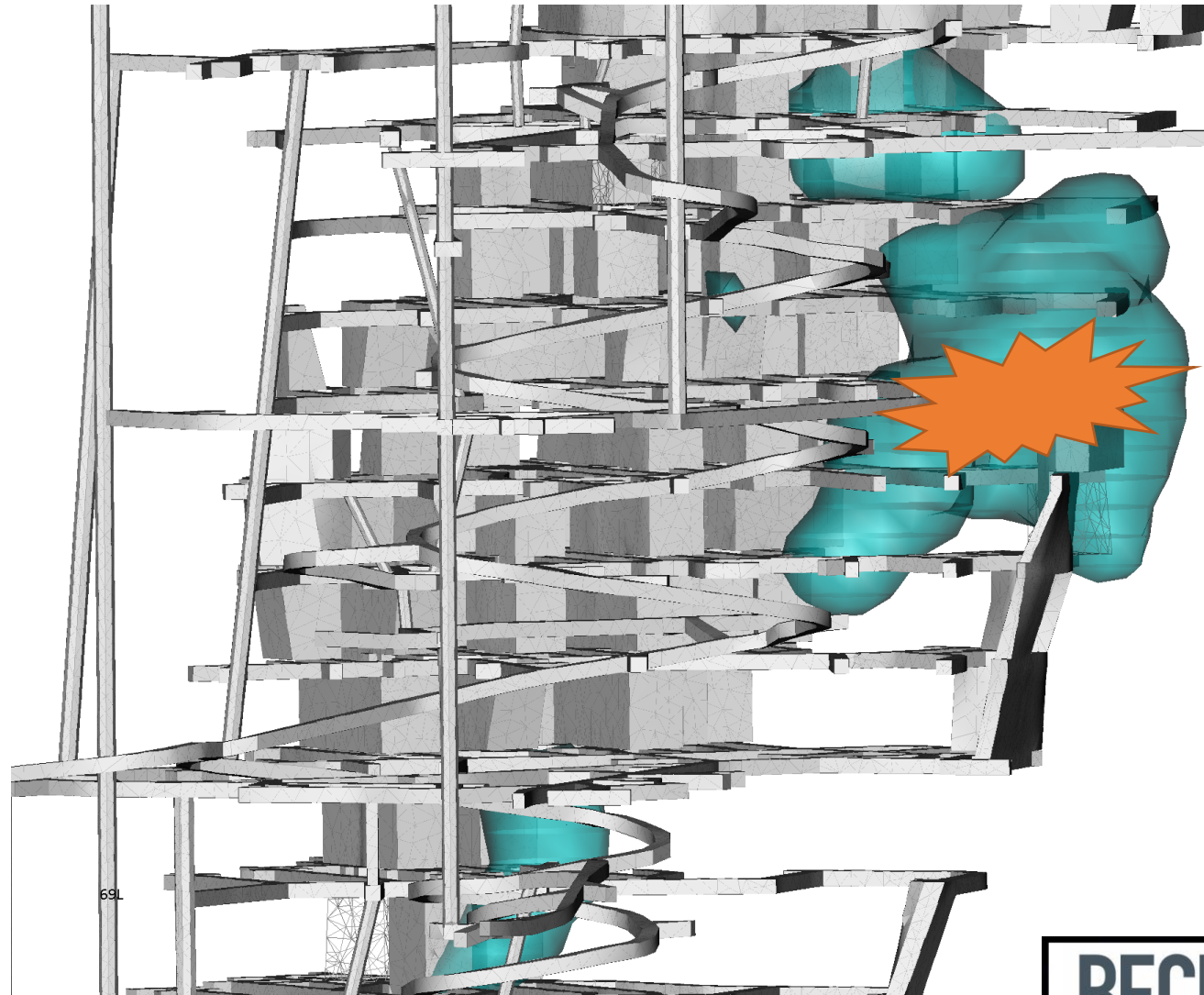


Faults and seismicity, measured displacement, modelled displacement



Faults and seismicity, measured displacement, modelled displacement



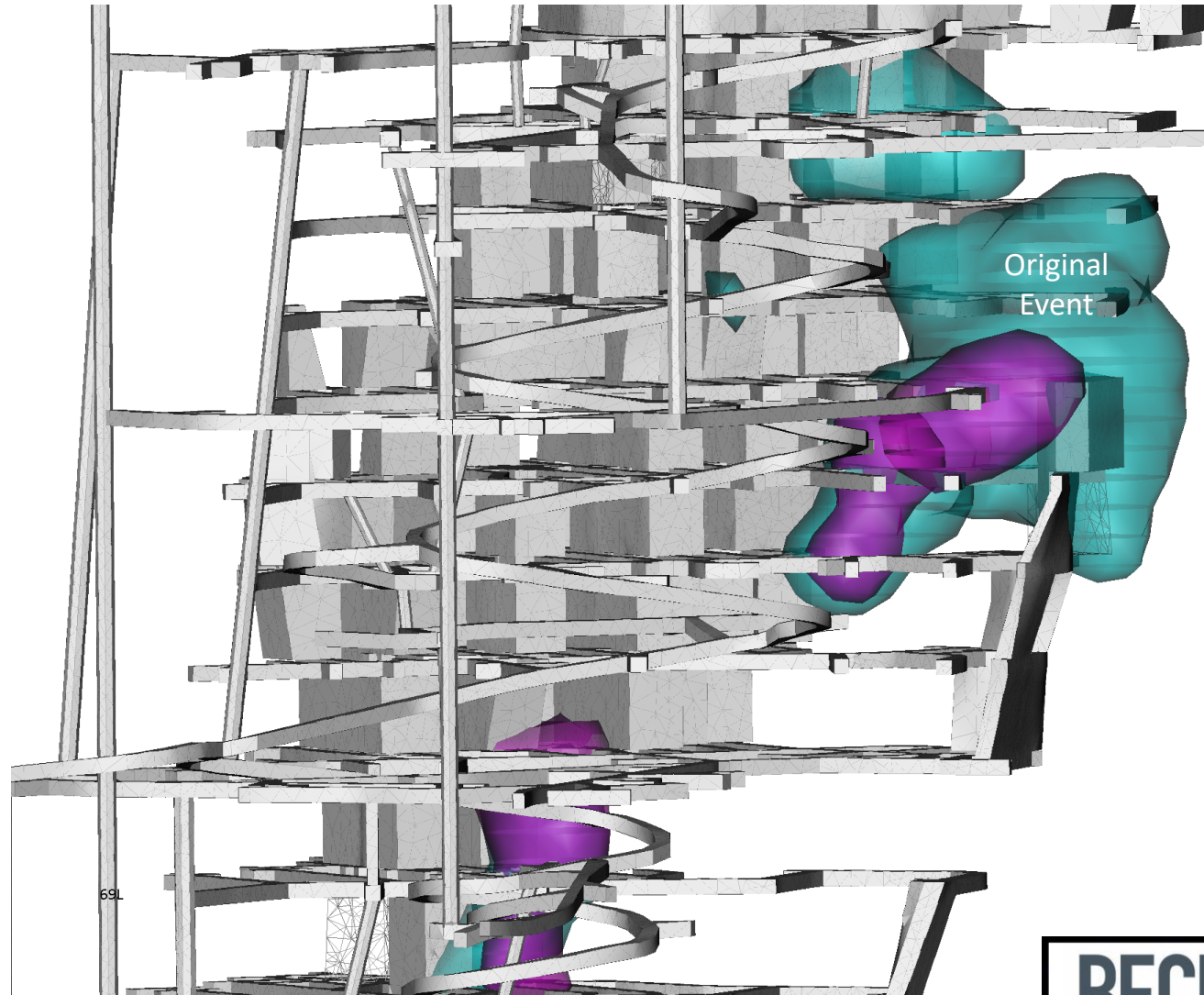


Big event...

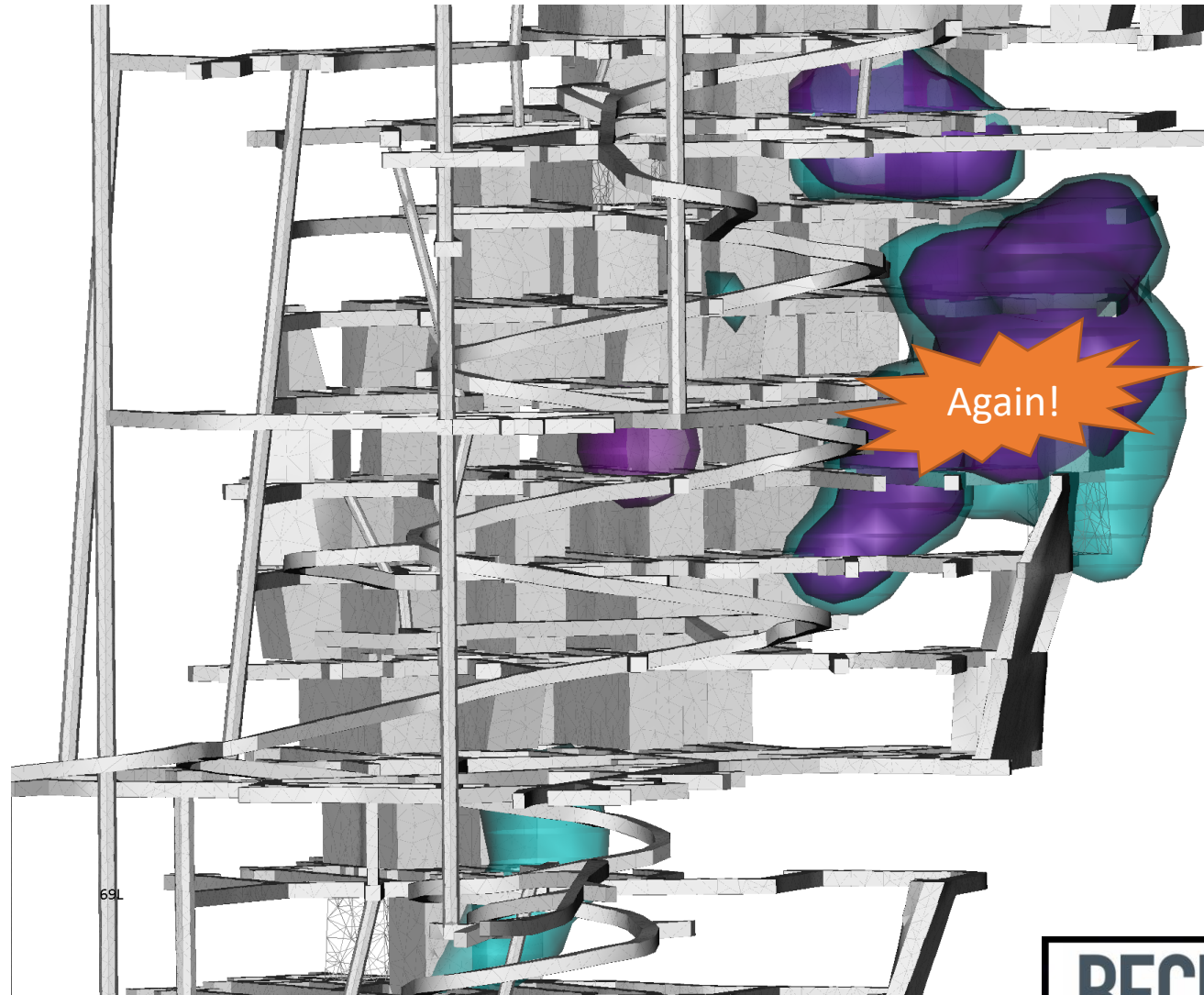




+a few more months



and then??



Some years later...



CONCLUSION...

The ongoing observational program is an essential task in retaining a license to mine

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