



CLOSE OUT SESSION CIVIL ENGINEERING

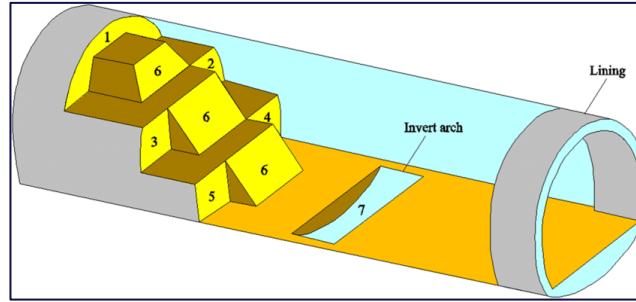
Timothy WATSON
Civil Engineering Coordinator

2 sessions with presentations by:

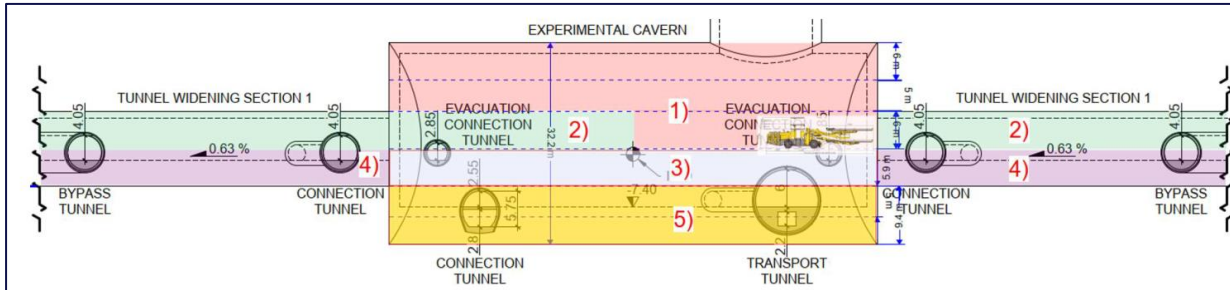
1. Liam Bromiley CERN SCE – Update on underground civil engineering
2. Tim Watson CERN SCE – strategy and look ahead
3. Roddy Cunningham CERN SCE – Site Investigations
4. Professor Andrea Moscariello UNIGE – De-risking design
5. Luisa Ulrici CERN HSE – Strategies for excavated materials
6. Professor Robert Galler (Montanuniversitat Leoben – online characterization of excavated materials

Experiment Cavern Construction

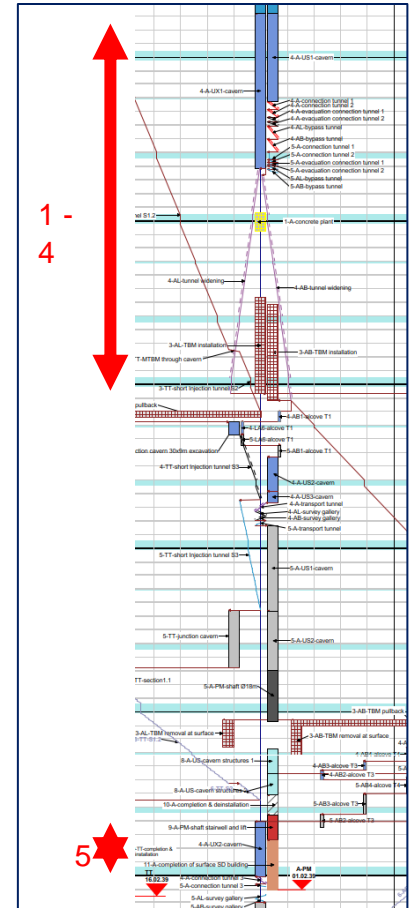
- Excavation split into phases
- Tunnel widening completed before full cavern excavation
- Allows for earliest possible TBM installation
- Phase 1 initiated end of 2033
- Phase 5 completed in 2038



Example of benched cavern excavation.
Credit: Geotech Geol Eng (2019); X, Deng et al.



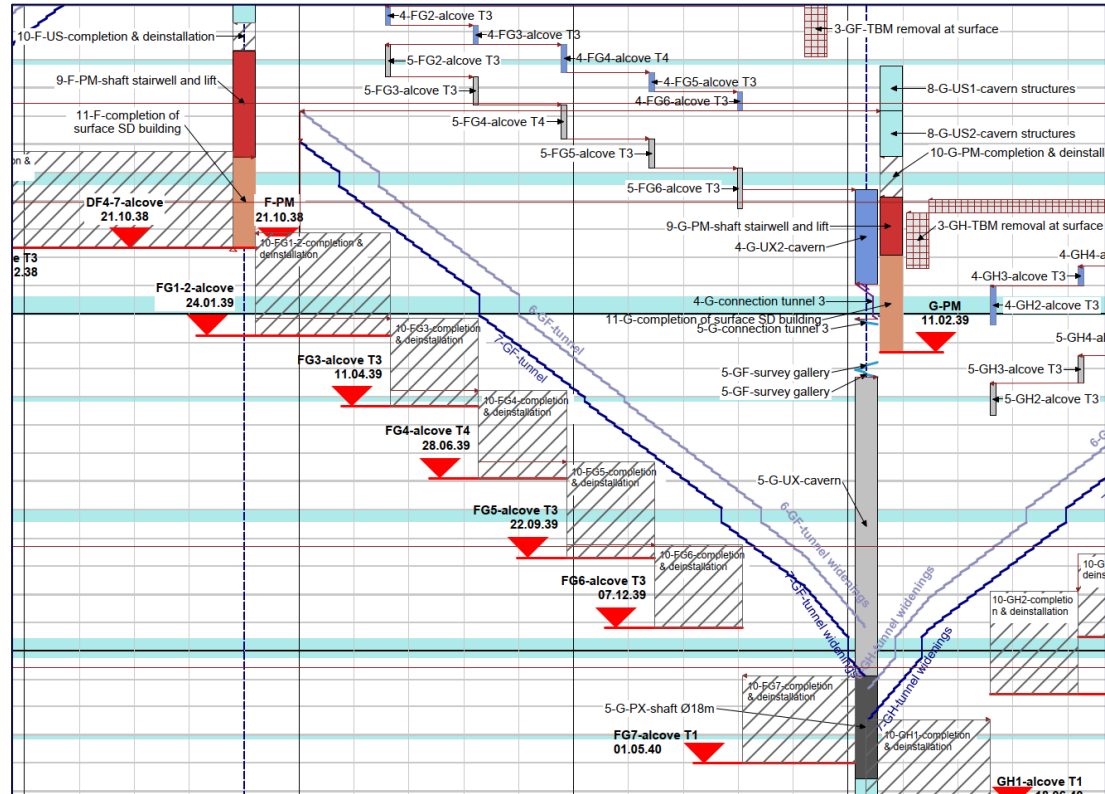
Cavern excavation phases



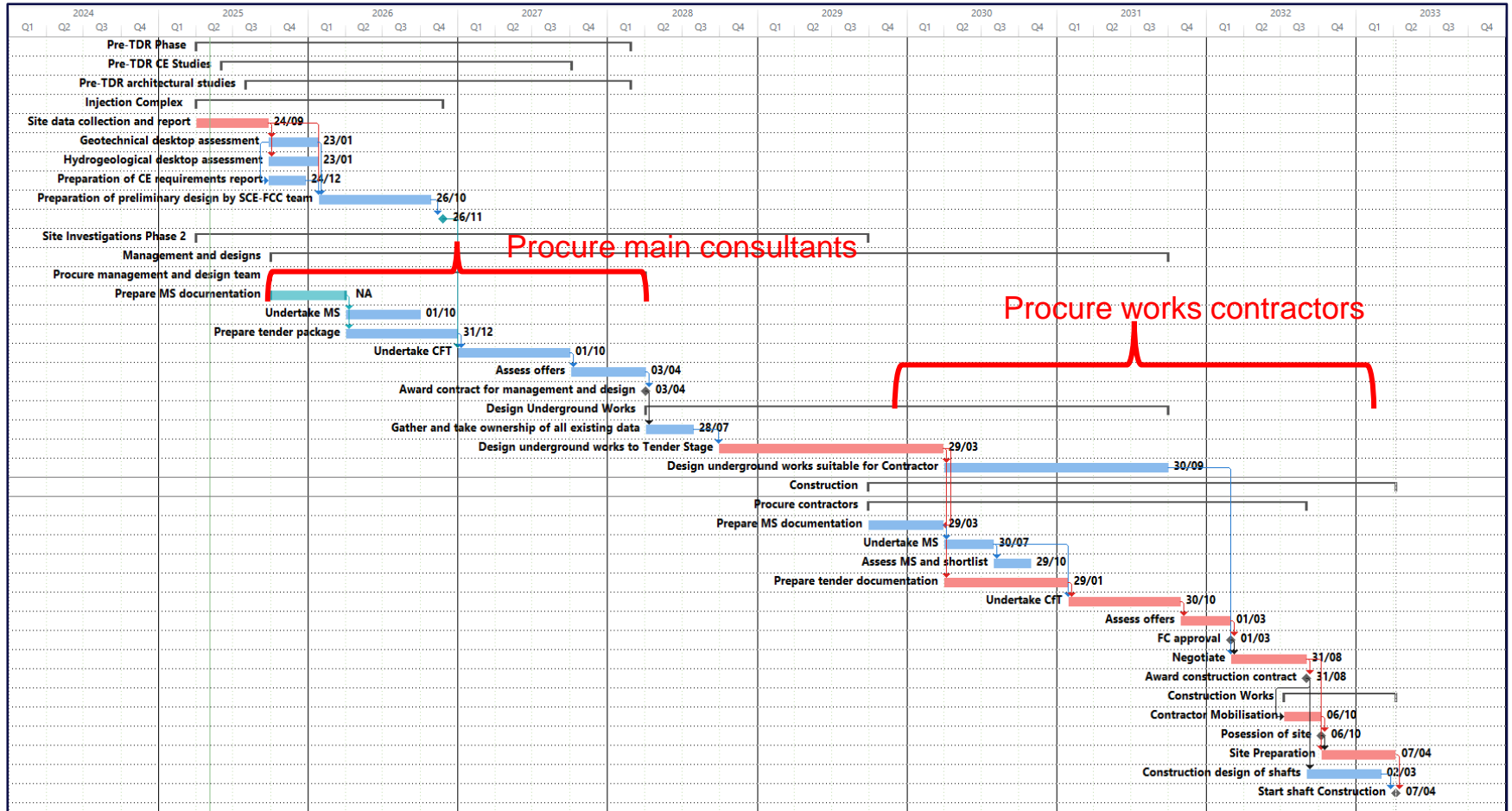
Construction schedule phases

Handover to CERN

- Staged handover to CERN along the arc sectors
- Allows earlier handover for infrastructure and machine installation (approx. 24 months)



Staged handover of tunnel sectors



Current staff

T. Watson – CE team leader

R. Cunningham – Geotech contract manager

P. Magnano – civil engineer injection complex

A. Mayoux – permitting and surface

L. Bromiley – civil engineer underground

G. Guihlem (Geotech grad)

Designer support (1 FTE)

GIS support (0.1 FTE)

7.1 FTE

Staff needed during construction

CE Project Manager
Deputy Project Manager

Support Team

Team 1

Team 2

Team 3

Team 4

Team 5

Contract Manager
Engineer
Site supervisor

Contract Manager
Engineer
Site supervisor

Contract Manager
Engineer
Site supervisor

Contract Manager
Engineer
Site supervisor

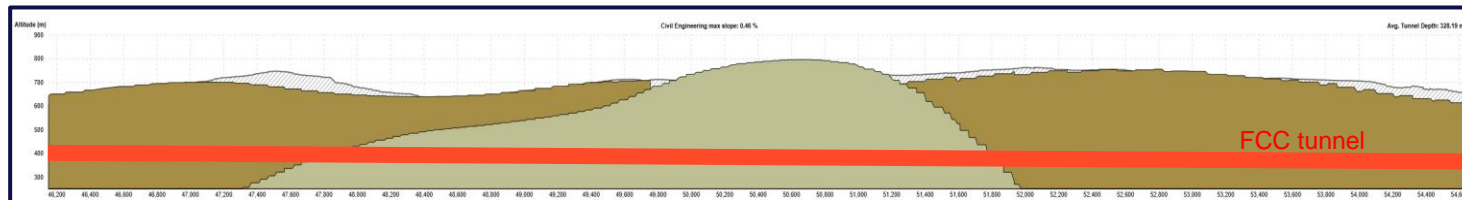
Contract Manager
Engineer
Site supervisor

2 Designers
Scheduler
Admin/doc control
Snr Geotech Engineer
Snr Underground
Engineer
Snr structural
engineer/architect
Claims/Disputes
manager

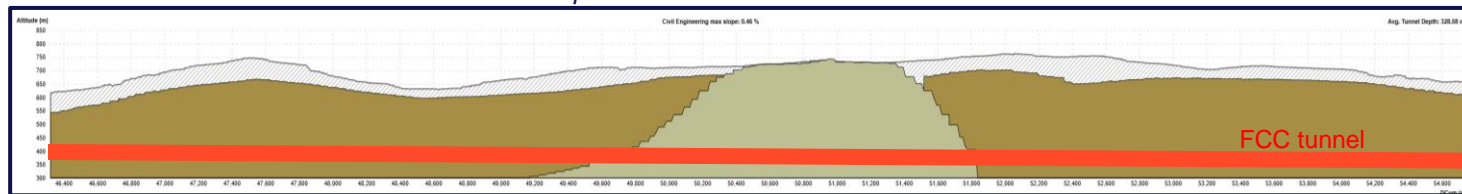
~25 FTE

Results from SSI: Mandallaz

Objective: Understand the characteristics and width of the limestone outcrop



Mandallaz profile based on baseline ILF/GADZ model



Mandallaz profile based on UNIGE v5. model



- Results positive suggesting the limestone is approx. 1.6km narrower than originally modelled at tunnel depth
- Geophysics show the presence of an inclined fault which boreholes did not reach at executed depths
- Karsts were encountered but were not filled with water
- Further targeted seismic and additional boreholes will be required to fully understand the nature of the faulting

Summary

Preliminary results from site investigations are positive

- In Vuache, Arve, Usses and Bornes the tunnel will remain entirely in molasse
- In Mandallaz the section of tunnel located in limestone is less than originally modelled
- No unforeseen geological features encountered so far

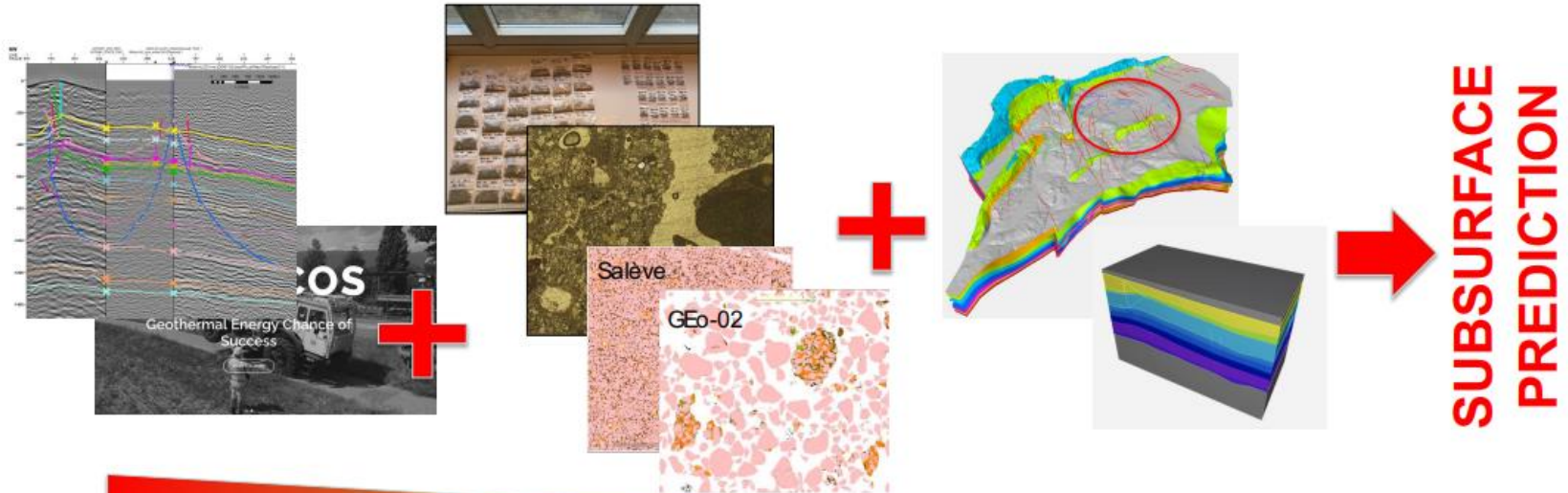
Challenges and uncertainties still to be resolved

- Works permits in Switzerland are still to be issued
- In Jura section the interface between limestone and molasse still to be defined
- In critical Lake section interface between moraines and molasse still to be defined

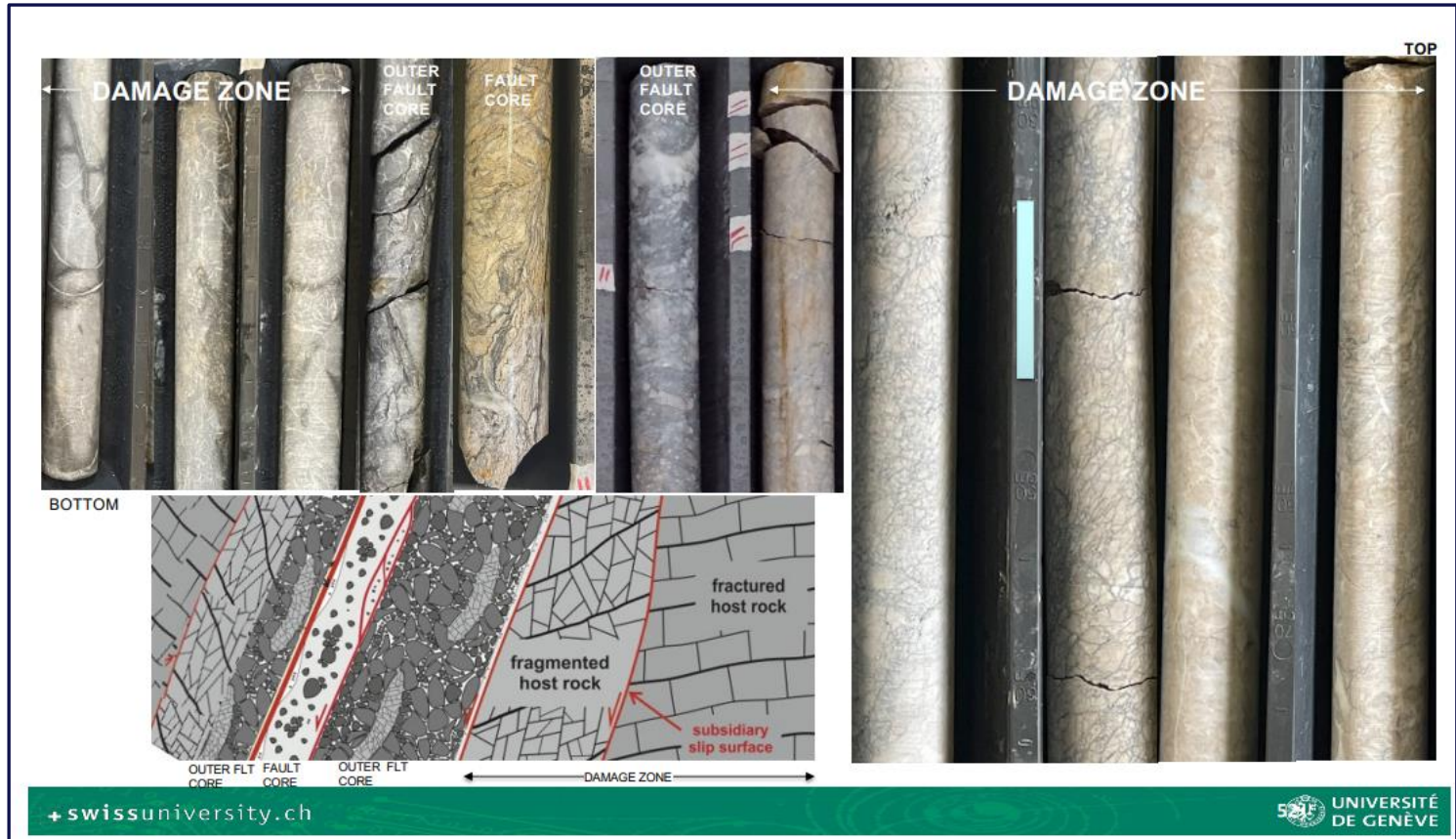
Future site investigations campaign being prepared

- Larger, targeted campaign envisaged to allow civil design works and construction tenders to be launched
- Market survey for consultants is out and invitation to tender foreseen over summer 2025
- Consultants contract to begin around March 2026 and site works if project given approval in 2028

Aquire – Analyse – Model -> Subsurface Prediction



Uncertainty Reduction



Take home messages

- Investigation campaign largely justified
 - Seismic and borehole results allowed us to revisit and correct the 3D geological model
 - Successfully addressed some of the data gaps
 - More to come
- Area of concerns still remain which will need to be addressed in future campaign(s)
 - Hydrogeology / Ground water
 - Pervasiveness of fracture network
- Data integration to produce update geomechanical model

Luisa Ulrici- CERN HSE Dept.

Focus on reuse

The **negative impacts created by landfilling** include degradation of the countryside, potential impacts on nature and potential degrade of the quality of life of surrounding residents.

According to the current regulation in France **excavated material is classified as waste** as soon as it exits the project site. This is why it is important that FCC is considered an **undividable, single project in a transnational context**.
Discussion with the authorities of the Host States.

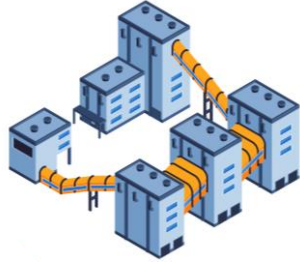
The five-step “waste hierarchy”, established in the EU Waste Framework Directive is applied. It establishes an order of preference for managing and disposing of waste.



The focus on finding reuse opportunities addresses the following aims:

- Reduce pressure on existing suitable deposits.
- Reduce the need for long transport (lowering the local nuisances and carbon emissions).
- Reduce the overall project costs.
- Contribute to the socio-economic benefits, beyond the project itself, by proposing innovative reuses.

Future roadmap



- Confirmation of the characteristics of the excavated material (subsurface investigations)
- Correlation between the material properties and the acceptance criteria of the potential receivers.
- Technical methods for the real-time analysis of the materials and their sorting.
- Regularly update of the regional treatment and disposal opportunities (e.g., quarries, final deposits, treatment facilities);
- Definition of the regulatory framework for the management of the excavated materials with the host States
- Study on the excavation material logistics (traceability, fluxes, conveyors etc.), including the evaluation of environmental and societal impacts and the potential limitations.
- Developing processes for using excavated materials including an evaluation of the environmental, economic and societal impact
 - reuse as construction or isolation materials.
 - Continuation of the OpenSkyLab for landscaping and forestry purposes

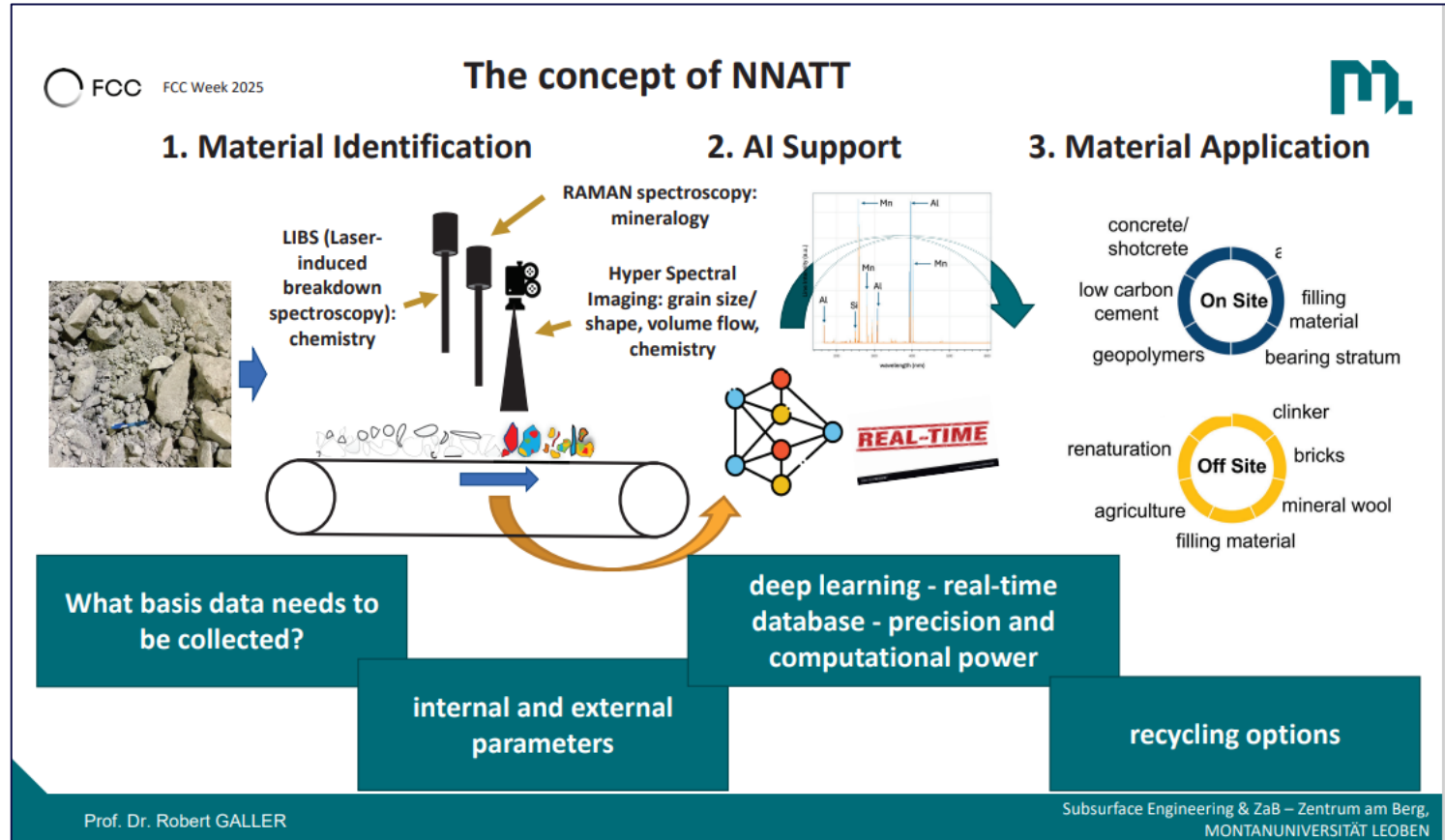
Professor Galler MontanUniverisitat

Online characterization of excavated materials on conveyor belts

Prof. Dr. Robert GALLER

Subsurface Engineering & Underground Research Center ZaB-Zentrum am Berg
MONTANUNIVERSITÄT LEOBEN, Austria







Prototype for grain size and chemical analysis

**Online X-ray –
Fluoreszenz – Method**

On-line X-Ray for mineralogical composition

**Photooptical grain size and
grain form analyses**

tested grain size fraction 6.3 to 63 mm

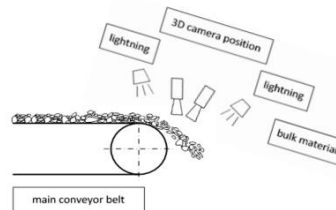
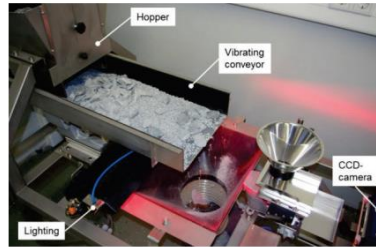
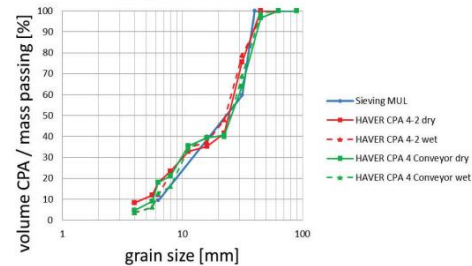


Photo optical analysis for grain size analysis

Conclusions

- Lots of exciting things going on directly and indirectly related to Civil Engineering
- Completion of current Site Investigation is critical to enable final tunnel altitude to be fixed and further work on material re-use/disposal to move advance
- Working with experts to make sure FCC civil engineering is state of the art
- Procurement activities for Pre-TDR tasks are underway
- Need to be ready to “hit the ground running” as soon as FCC becomes an approved, funded Project..
- Lots of work to be done to reach that state....



Thank you