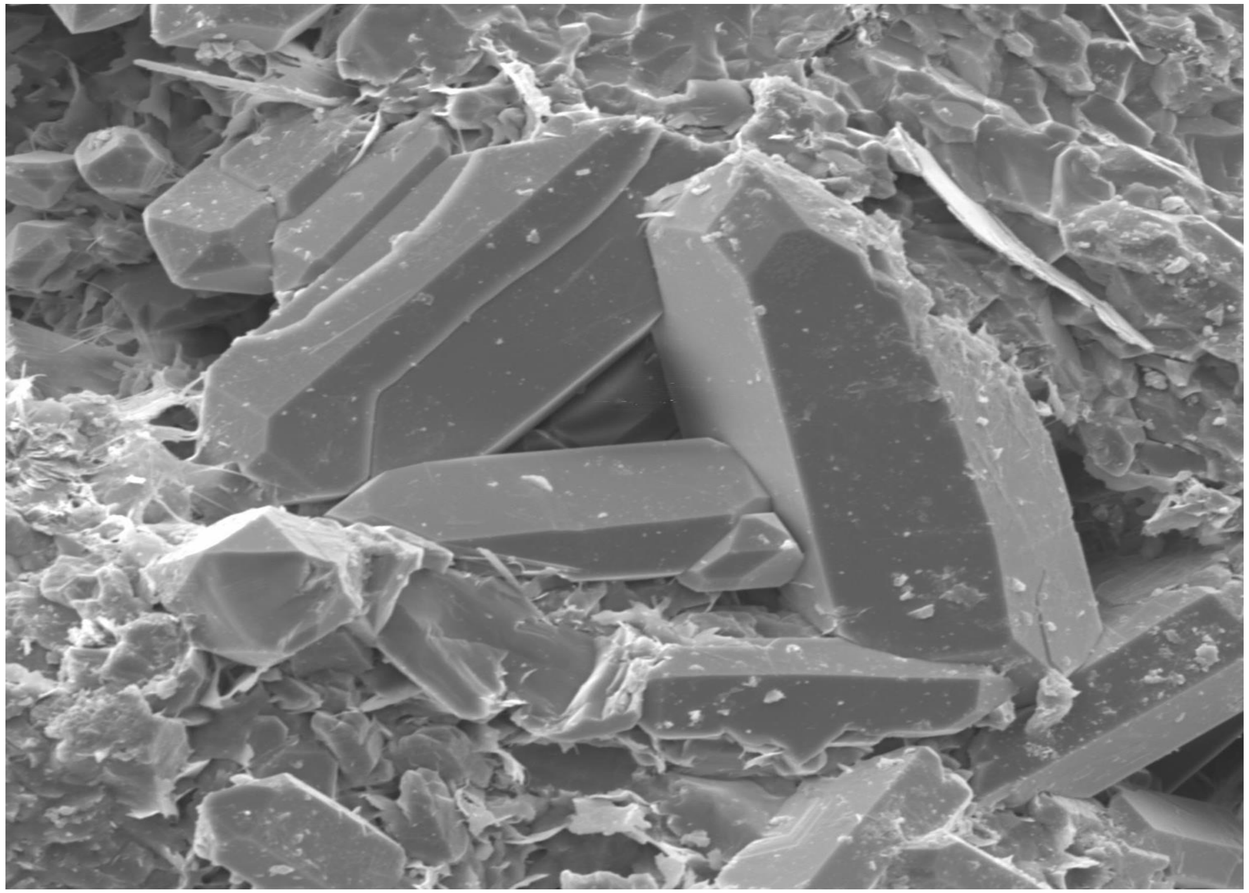
Mining the Future - status and progress



Prof. R. Galler

Montanuniversität Leoben, Austria

The "**Mining the Future**[CC-BY-ND]" **competition**

The competition is part of **WP 3 - Integrate Europe**

- WP3 optimizes the collider and infrastructure layout and placement.
- This includes resource efficiency and the management of environmental aspects from the beginning onwards.
- Particular focus is put on developing a plan to manage the about **9 million m³** of excavation materials,

Resource efficient sub-surface engineering, State-of-the-art:

- Today, in the EU countries and in Switzerland, excavation materials are considered "waste".
- For commercial USE, the materials need to be re-classified.
- This process is administratively complicated, linked to technical constraints and is costly.

Importance of proper muck handling

- **cost reduction** by including the ideas of circular economy and thus the USE of excavation material from the very beginning of the project
- **environmental effects**
  - less disposal space needed
  - less quarries necessary
  - less transport leads to reduced emissions, e.g. CO_2

<u>Overall goal</u>: USE as much excavation material as possible to landfill as little as necessary!

The “**Mining the Future Future**[CC-BY-ND]” **competition**

Competition Overview

- The FCCIS Mining the Future® Competition has been launched by CERN and Montanuniversität Leoben Austria.
- Goal is to identify credible approaches for the innovative USE of the molasse materials that are expected to be encountered during the construction phase.
- A Judging Panel of international experts from subsurface-engineering, excavation materials use and innovation management will judge the competition to select the most promising applications.
- The winner of the competition will be awarded assistance for services required to advance the technology readiness level (TRL) of the proposed technology in terms of carrying out further needed tests and analysis activities for the proposed USE approach.
- **The competition started on 15 April 2021!**

The "**Mining the Future Future**[CC-BY-ND]" **competition**

Participation requirements

Participation in the Competition is open to the legal entities and natural persons from countries that are eligible to participate in the EU-funded Horizon 2020 framework programme.

- Individual persons;
- Non-profit, academic and higher education organisations;
- International European Interest Organisations;
- For-profit organisations, including companies and firm consortia which have their corporate headquarters in EU or Horizon 2020 associated countries.

Application process and deadline

Participants must submit their applications using the form that is made available on the Competition website through the following link:

http://cern.ch/registration-mining-the-future

The deadline for submission of applications is 31 October 2021!

The “Mining the Future Future[CC-BY-ND]” competition

Application Content & Criteria

Each application must meet the following criteria:

- The application must contain a credible and promising solution for the USE of molasse materials with a likelihood that the proposed technology can be turned into a product, service or industrial process by 2030.
- The solution must be originally developed or implemented.
- The application must explain all activities necessary to produce one or more end products or end-use processes or services using molasse that has resulted from a subsurface excavation process.

Remark:

The details of the construction methodology are not determined yet and may vary from conventional tunnelling using roadheaders and/or drill and blast, to mechanised tunnelling using tunnel boring machines, where the type of face and ground support is not determined.

The existing raw data from different laboratory tests does therefore not include an inventory of pollutants that emerge from the subsurface construction methods.

The **“Mining the Future Future**[CC-BY-ND]**” competition**

Further Application Content & Criteria

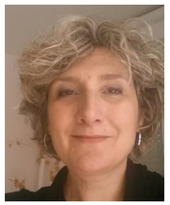
- The application must contain a description of the current technology readiness of the proposed technology including evidence of the feasibility in a controlled, laboratory environment.
- Only proposals that have successfully completed TRL 3 at the time of submission are eligible for participation in the competition.
- Demonstration of TRL 4 is required in Phase 2 of the competition.
- The technological process must be developed for non-military purposes only.

The Judging Panel – Evaluation of Applications

Prof. Robert Galler, Austria
Montanuniversität Leoben,
Head of the Jury

Dr. Guillaume Attard, France
Cerema, Lyon

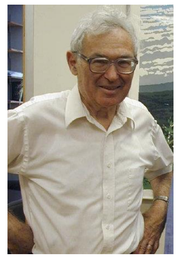
Jacques Burdin, France
Consulting engineer, Les Deserts



Dr. Laetitia D'Aloia Schwartzentruber, France
CETU, Lyon

Dr. Cédric Thalmann, Switzerland
B+G SA, Bern

Prof. Herbert H. Einstein, USA
Massachusetts Institute of Technology



Manuela Rocca, Italy
Sustainability and Safety director
for Tunnel Euralpin Lyon Turin

Alexander Wyss, Switzerland
Simatec Maschinenbau AG

Dr. Severin Seifert, Germany
Fraunhofer Institute for Building Physics IBP

Dr. Klaus Marhold, Austria
Institute for Entrepreneurship and Innovation
Vienna University of Economics and Business

The "**Mining the Future Future**[CC-BY-ND]" **competition**

Phase 2

- Phase 2 uses the same evaluation criteria as phase 1, namely:
  1. Technical feasibility
  2. Economic viability
  3. Societal value
  4. Project relevance
- The detailed review in phase 2 aims to further assess and clarify the ranking of the selected submissions in order to identify the most credible, promising and viable technology among them.
- In particular, the Judging Panel will verify the technical readiness of the proposed technology in the application by requesting demonstrations by the participants of their technologies in a controlled environment.

Award

Following the adjudication of Phase 2 of the Competition, the Judging Panel will announce a single or no winner in August 2022.

In the event that a winner is selected, an award ceremony is scheduled to take place in October 2022 at ZaB-Zentrum am Berg www.zab.at, an underground research centre.

FUTURE CIRCULAR COLLIDER

FUTURE CIRCULAR COLLIDER STUDY / DOCTORAL THESIS REPORT

Description of laboratory analyses performed at Montanuniversität Leoben (MUL) in Leoben, Austria

Revision no.	Date	Description	Written by	Edited by	Verified by
0	16/03/2020	Creation of document	Dipl.-Ing. Maximilian Haas & Prof. Dr. Nina Gegenhuber		
1	07/04/2021	Revision of document		Dipl.-Ing. Maximilian Haas	
2 (final)	09/04/2021	Review & approval of document			Prof. Dr. Robert Galler

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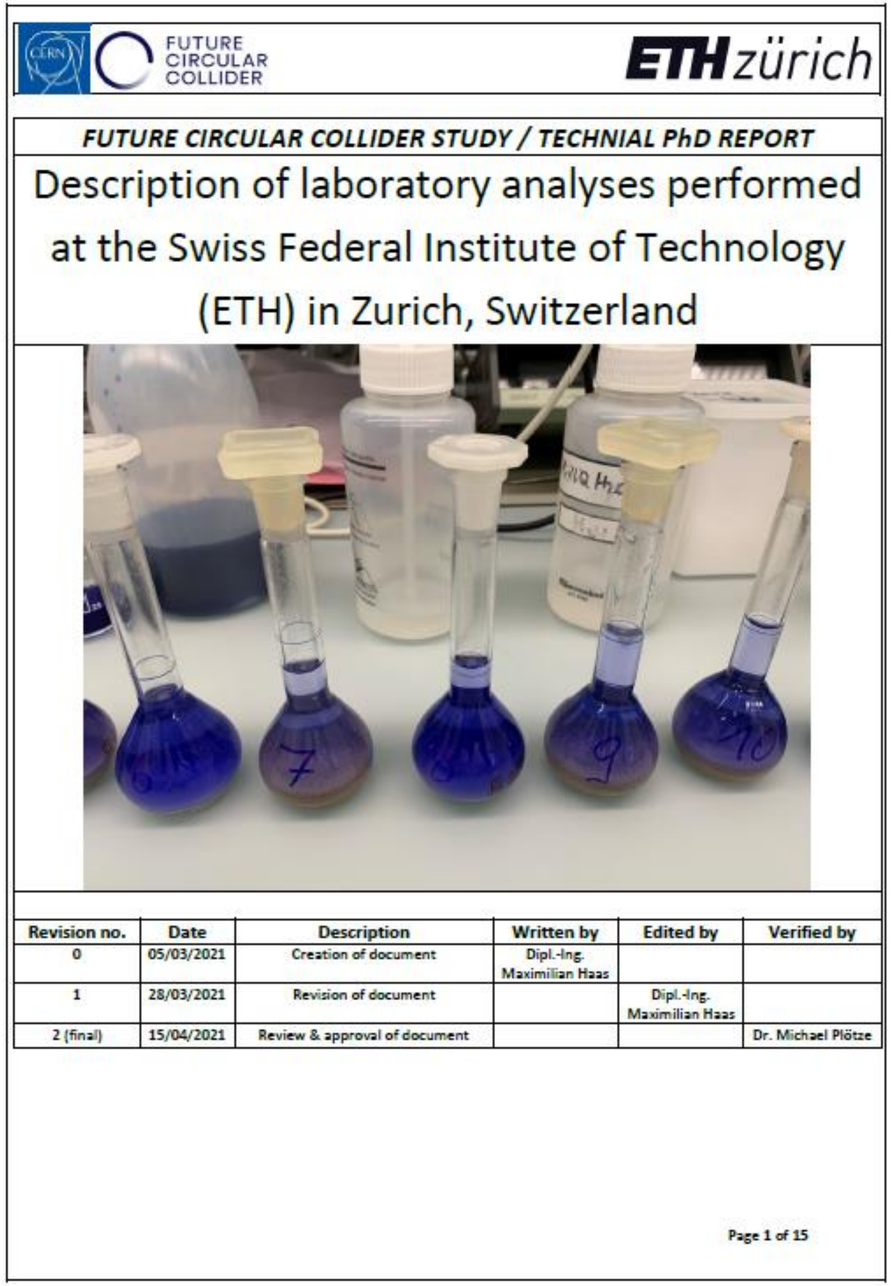
The following universities were involved to prepare data from lab tests:

- Montanuniversität Leoben, Austria
- University of Geneva, Switzerland
- ETH Zürich, Switzerland

The following data from lab-tests were prepared by Maximilian Haas, PhD candidate, by using samples from the project region; all results are available on the competition homepage.

- Unconfined compressive strength via UCS test
- Strength index determination via point load test
- Tensile strength determination via Brazilian tensile test
- Compressional and shear wave velocity via ultrasonic measurements
- Abrasivity behaviour via CERCHAR test
- Abrasivity behaviour via Laboratoire Central des Ponts et Chaussee (LCPC) test

[Maximilian Haas, PhD candidate]



FUTURE CIRCULAR COLLIDER

ETH zürich

FUTURE CIRCULAR COLLIDER STUDY / TECHNIAL PhD REPORT

Description of laboratory analyses performed at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland

Revision no.	Date	Description	Written by	Edited by	Verified by
0	05/03/2021	Creation of document	Dipl.-Ing. Maximilian Haas		
1	28/03/2021	Revision of document		Dipl.-Ing. Maximilian Haas	
2 (final)	15/04/2021	Review & approval of document			Dr. Michael Plötze

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The laboratory measurements at the IGT ClayLab, ETH Zurich included:

- Water content determination for <63 µm and <400 µm fractions,
- Leaching characteristics (eluate),
- Anion analyses,
- Effective cation exchange capacity (CEC),
- Exchangeable cations,

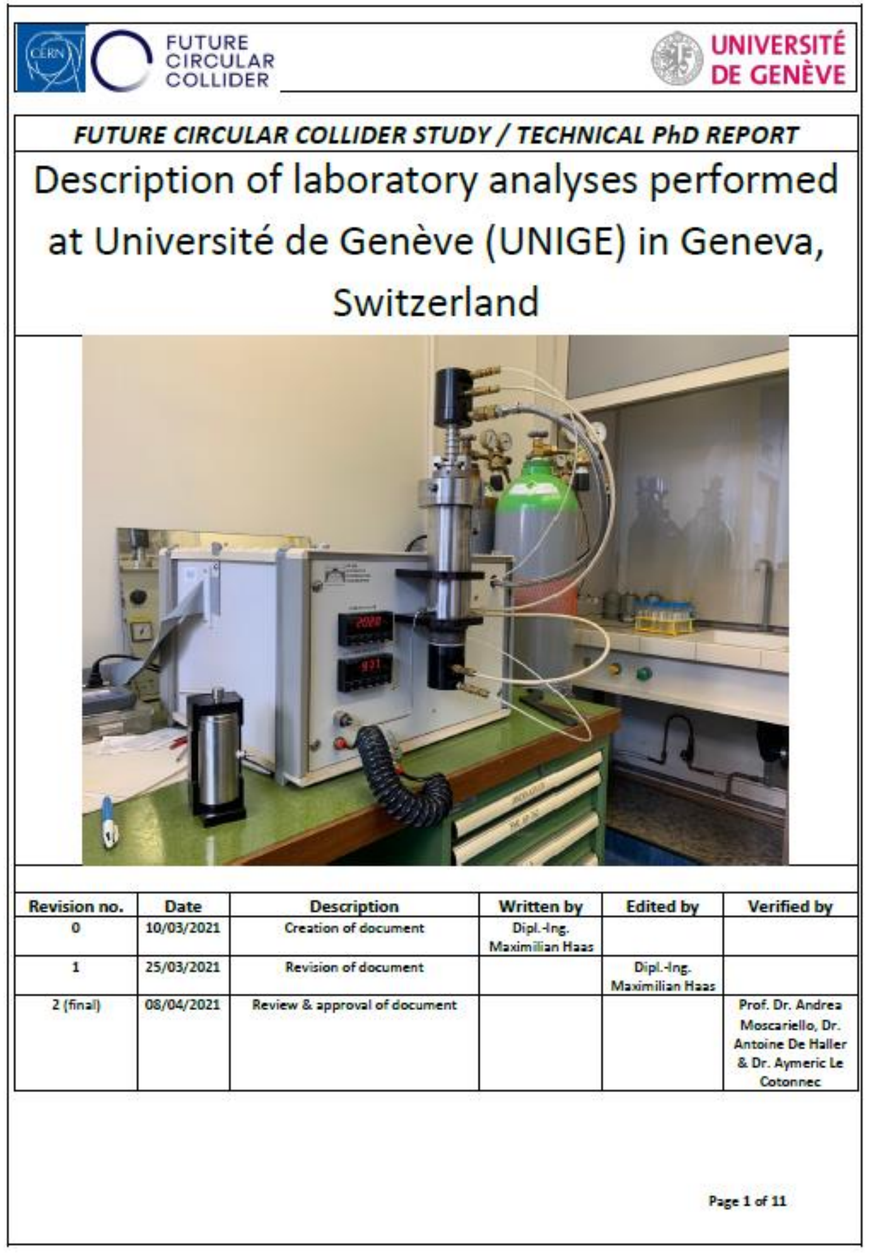
Mineralogical analysis:

- Fourier Transform Infrared (FTIR) spectroscopy,
- X-Ray diffraction measurements as powder (XRD-P) and textured (XRD-S) samples,

Others:

- N_2-adsorption for BET surface,
- Enslin-Neff free water uptake capacity (water absorption),
- Specific (inner crystalline) surface (water vapour adsorption),
- Mercury intrusion porosimetry (MIP)
- Carbon content determination.

[Maximilian Haas, PhD candidate]



FUTURE CIRCULAR COLLIDER

UNIVERSITÉ DE GENÈVE

FUTURE CIRCULAR COLLIDER STUDY / TECHNICAL PhD REPORT

Description of laboratory analyses performed at Université de Genève (UNIGE) in Geneva, Switzerland

Revision no.	Date	Description	Written by	Edited by	Verified by
0	10/03/2021	Creation of document	Dipl.-Ing. Maximilian Haas		
1	25/03/2021	Revision of document		Dipl.-Ing. Maximilian Haas	
2 (final)	08/04/2021	Review & approval of document			Prof. Dr. Andrea Moscariello, Dr. Antoine De Haller & Dr. Aymeric Le Cotonnec

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Geochemical analyses via XRF and ICP

- Portable X-Ray fluorescence (pXRF)
- Ultra-trace inductively coupled plasma mass spectroscopy & emission spectrometer (ICP-MS/OES)

Mineralogical analyses via QEMSCAN® and OMI

- Integrated automated mineralogy and petrography (QEMSCAN®)
- Optical microscopy (OMI)

Porosity, permeability & density analyses via gas expansion

[Maximilian Haas, PhD candidate]

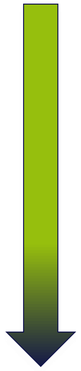
Fields of application

hard crystalline rock
- many fields of application
- likely to use without processing

soft/loose sedimentary rock
- less possibilities of usage compared to hard rock
- Based on the expected lab-data also more difficult to dispose

fault zone material
- mineralogy changes within a very short distance
- a consistent application of this material is not possible

Matching and Classification



Class 1:	Use as construction material on site (Aggregates for innerlining-, tubbing concrete and shotcrete, annular gap mortar, base layers, asphalt…)
Class 1a:	Use as construction material off site (railway ballast, …)
Class 2:	Use as industrial material (gypsum-, brick-, cement-, glass-, abrasive-, chemical industry, …)
Class 3:	Material for landscaping: dam fill, backfilling, embankment, …
Class 4:	Deposition (landfilling thresholds)

Aggregates for concrete

Since a big amount of concrete is necessary during the construction of tunnels, it is very likely to use the excavation material for aggregates – **if they are suitable**. Some basic requirements given in EN 12620-2002:

Temporary construction site purposes

- For most projects there is a need to implement constructional actions at the beginning such as establishing stable foundations for the plant, constructing access roads, achieving noise and dust protection
- A temporary road pavement in the tunnel itself is likely to be built with muck.

Possible usage of molasse material?

i. (temporary) construction site purposes
ii. embankments, foundations and landfill
iii. erosion, shore and slope protection
iv. earth dams, dams for flood protection
v. aggregates for agriculture
vi. backfill for landscape rehabilitation
vii. Others?

Mineral classifikation

1 **Minerals that can be used with little effort and have few requirements**

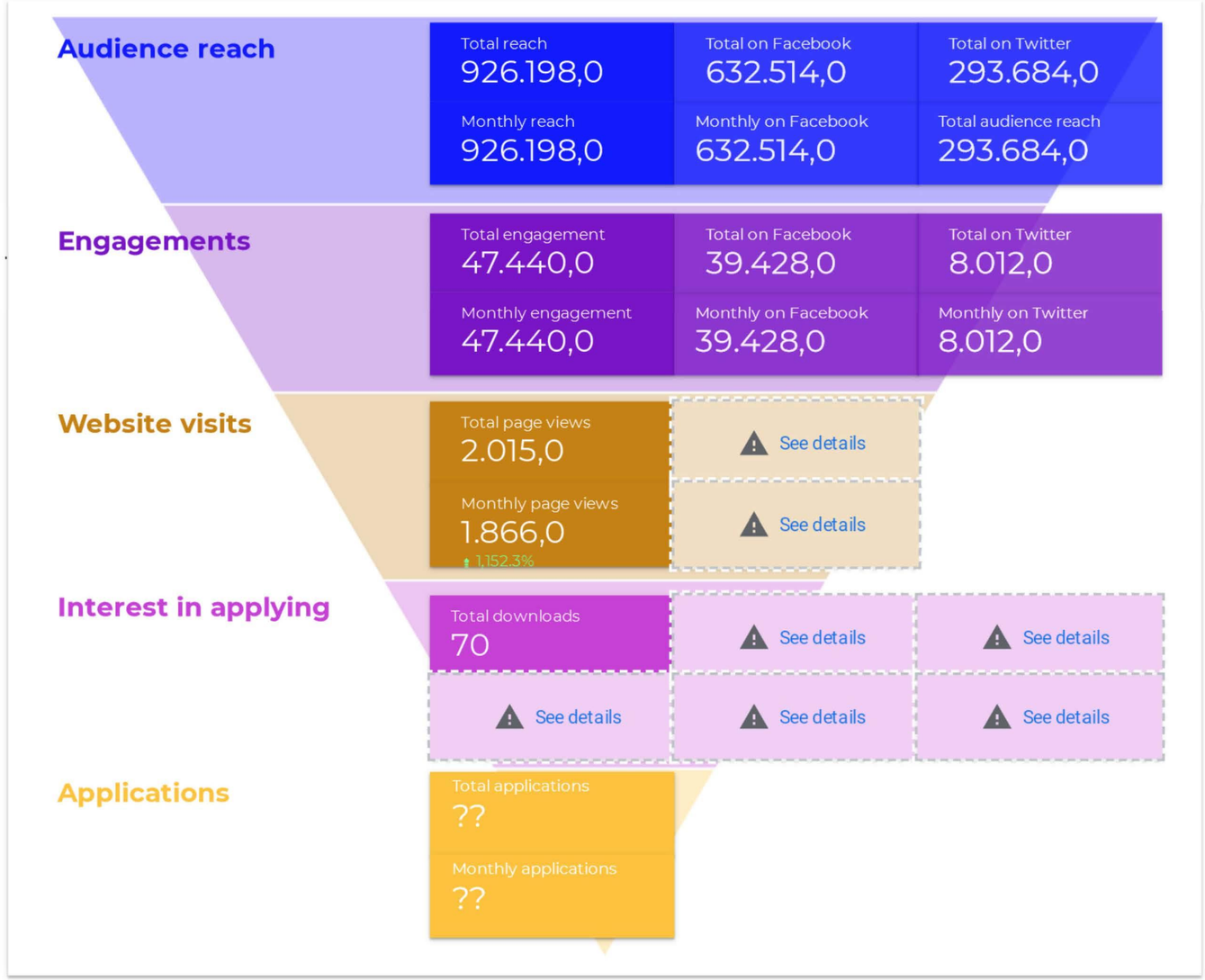
2 **Minerals that can be used with medium to large effort so that requirements can still be met**

3 **Minerals that can only be used with great effort, since their requirements can hardly be met**

[DRAGON]

The “**Mining the Future Future**[CC-BY-ND]” **competition**

Main Results



*Social media data reflects only sponsored results, not organic traffic.

[Panagiotis Charitos]

The “**Mining the Future Future**[CC-BY-ND]” **competition**

The “open to the world” factor can significantly improve the value of a company.

By using “molasse-sediments” as the primary raw material, a company would make a significant contribution to reduce the ecological footprint.

Are you interested to join the competition?

If so, please follow: www.miningthefuture.web.cern.ch

Your contribution is highly appreciated!

Don’t forget: **Deadline for submission of your application: 31 October 2021!**

Thank you for your attention

Questions?