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Field Exkursion Rock Mechanics 2019 [220.156]

Fig. 1: FAULT ZONE AREA.

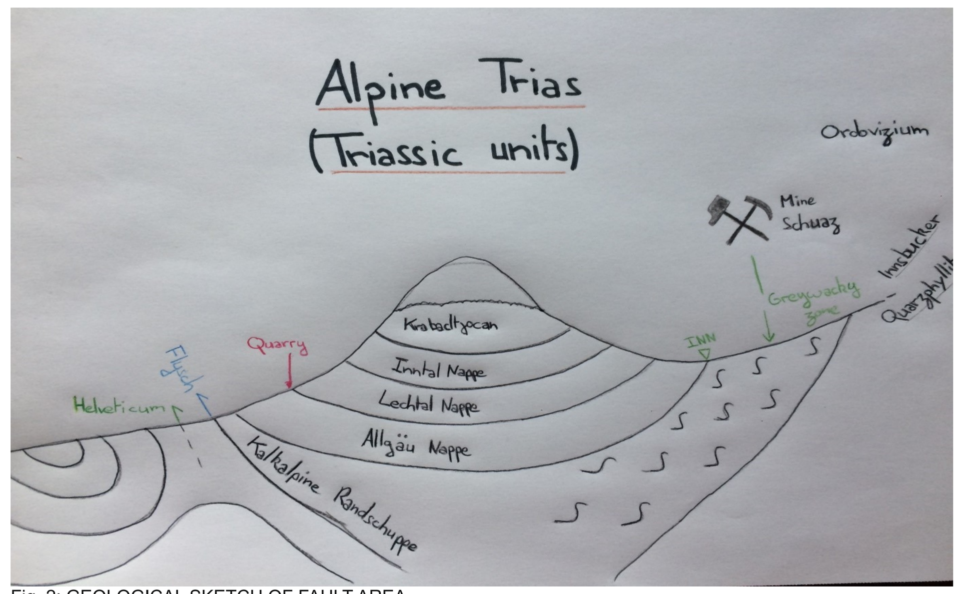

Fig. 2: GEOLOGICAL SKETCH OF FAULT AREA.

DAY 1 - Stop 1

Quarry in a fault zone

We visited a quarry, owned by the concrete company Rohrdorfer Group (Südbayerisches Portland-Zementwerk Gebr. Wiesböck & Co. GmbH), in which a big and prominent border between the Lechtal nappe and the Allgäu nappe is exposed as a fault zone (Fig. 1). In the quarry, dolomite of both of these units is mined. We could not access the quarry face because even if no activities were ongoing, rock falling could occur.

We were on a synclinal morphology with a riff very competent (erosion resistant) surrounded by easier erodable faces. We could see some spring exit in the steep cliff due to the excavation bringing water seepage from the surface. Those exits highlight a limestone or marl layer with lower permeability.

The tectonic units were sedimented during the Alpine Trias and therefore belong to the Triassic units. They were then tectonically detached and thrusted over each other in the alpine orogenesis (Fig. 2). Hereby, the Lechtal nappe, overlays the Allgäu nappe, which lies on the "Kalkalpine Randschuppe". Over the Lechtal nappe there is the Inntal nappe and some more smaller units that form together with the other plates the mountains and hills in the area (Fig. 2). This surrounding landscape with its valleys, steep mountain slopes, gravel sides and prominent peaks was then formed in the Quaternary due to glacial erosion and fluviatile sedimentation.

Several different glacial periods could be seen in the landscape or at least a difference in intensity, because it could be seen a plateau at half-height of the mountains. This plateau was due to a difference in ice height during the ages. This difference digs more the top than the bottom and creates an s-shape on each side of the valley.

As a conclusion, we have to remember that a fault of this kind is rarely exposed this clearly and acts as a window into the creation of the whole area, which makes it a geologically very interesting phenomenon.

Fig. 3: LEFT: ONE OF THE BIGGEST CAVERNS IN THE SYSTEM; RIGHT: TUNNEL FOLLOWING DISCONTINUITY

Fig. 4: VERTICAL SHAFT WITH ITS EQUIPMENT.

DAY 1 - Stop2

Silver Mine Schwaz

In operation since the middle ages till 1999:
In the late Middle Ages, the mining area Falkenstein in Schwaz was the biggest and most lucrative silver mine in Europe. In 1554, around 7400 miners were working in the mine. From 1957 to 1999, Schwazer Dolomite had been excavated. The high-quality dolomite was mainly used for road construction. In 1999, the mining operations stopped, because of the formation of a sinkhole due to the collapses of a part in the mine in 1995 and a landslide at the mountain side above (Eiblschrofen) in1999. The stability of the mine could not be guaranteed any longer at its current state and could therefore not compete with current big market Still, the mine is owned by the Montanwerke Brixlegg AG.

500 km of tunnels:
The mine consists of 254 drifts and numerous of caverns. The biggest cavern is around 30 x 200 m and 150 m in height. In the Middle Ages and until modern mining, the tunnels were made very small in the cross section (Fig. 3, right), usually following some of the major discontinuities, making it easier to control the cross section and over-breaks.

Natural ventilation:
As there is a constant temperature of 12 °C in the mine, a natural ventilation system is used to get fresh air into the tunnels. Several vertical ventilation shafts, which are connected to the surface make this system possible. In summer the warmer and therefore lighter air from outside is cooled in the shaft and pushes the colder and heavier air coming from the mine down and creates a pressurized airflow. In winter, the ventilation works the other way around, the lighter air from the mine is able to get to the surface through the vertical shafts and creates a suction effect. Fresh air now gets in through the horizontal access tunnels Artificial ventilation was used during the operation as well. The ducts were made of steel to allow using the ventilation as both pressurized and suction systems. Suction system was mainly used to get fresh air to the tunnel face.

Research programs:
In the mine, a measuring station for seismic activities and magnet fields is installed. As the magnetic poles are changing right now, there is a big interest in measuring this process. It happened that the mine is the best place in Austria and lower Germany for measuring magnet fields.

DAY 2 - BBT

The Brenner Base Tunnel (BBT)

In order to develop European infrastructures and the network of Transportation, a European Commission policy has been directed towards the implementation by the Trans-European Transport Networks (TENT). Following the year 2013, nine Core Network Corridors were identified through Europe to facilitate the coordinated development of the TENT Core Network. The Brenner Base Tunnel (BBT) is the world´s longest rail tunnel with planned a length of 55 km. It is a critical zone in the Corridor SCAN-MED (Scandinavia-Mediterranean) path that would connect Finland to Malta (Fig. 5). The Brenner Base Tunnel will be constructed through the Alps Mountains at the border between Austria (Tulfes/Innsbruck) and Italy (Fortezza). The tunnel is planned for daily traffic of up to 264 trains in both main tubes with average speeds 120 km/h for freight trains and 250 km/h for Passenger trains. The BBT tunnel system is comprised of approximately 230 kilometers of tunnels.

The Brenner Base Tunnel consists of two main tubes. Each tube is equipped with a single track and there is a service tunnel 12 m below the main two tubes (Fig. 6). The main tubes are 8.10 m wide and 40 to 70 m apart from each other, while the service tunnel is 5 m in diameter. Nevertheless, for safety and emergency exit, the main two tubes will be connected by side tunnels at every 333 m (Fig. 7). At the beginning of the construction phase, an exploratory tunnel is set up for geological investigation with open shield TBM, which will be operated as the service tunnel at the operation start of the tunnel. The excavation amount during the construction of the tunnel would reach around 11 million meters cubic of which approximately 6.80 million meters cubic in the Austrian portion of the project (60% of the tunnel will be in Austria), (Fig. 8).

At the beginning of the construction site visit, an introduction lecture was held in the main seminar room at the contractor company site office building. The main topic of the lecture was regarding was about tackled the main project overview facts points, historical background of the project, general layout of the project and the construction phase sequences. After that, a guided tour was held in the construction site. At the beginning of the guided tour started with an introduction about the safety precautions and hints regarding the procedures in case of incidents during the visit. The tour stations passed by the different construction procedures for the main tubes which are under construction such as waterproofing processes, rebars fixing work, tunnel formwork installation technique, reinforced concrete casting works for the final lining, curing, as well as the preparations and technique for moving work flow to the next final lining segment. In addition to visiting the tubes under construction, another visit for the finished segment of the project from main tube zones or the service tube was conducted. After visiting the main tubes, the engineer showed the segment of the service tube that was under construction (Fig. 9-11).

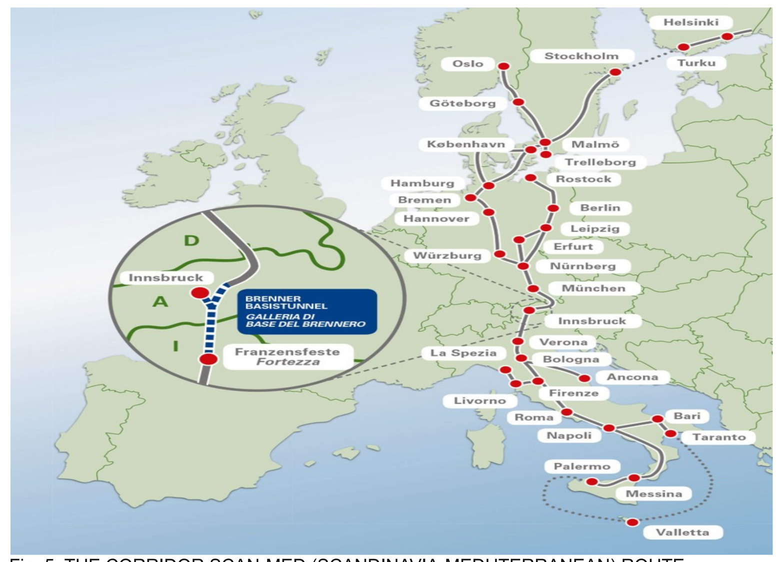

Fig. 5: THE CORRIDOR SCAN-MED (SCANDINAVIA-MEDUTERRANEAN) ROUTE.

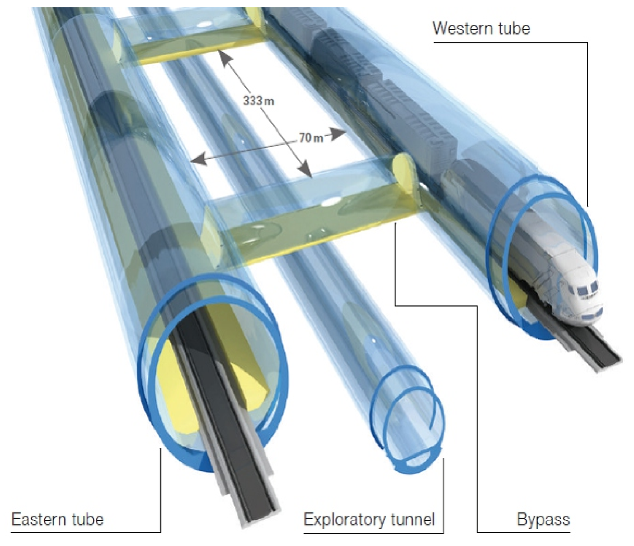

Fig. 6:TYPICAL CROSS-SECTION THE BBT TUNNEL.

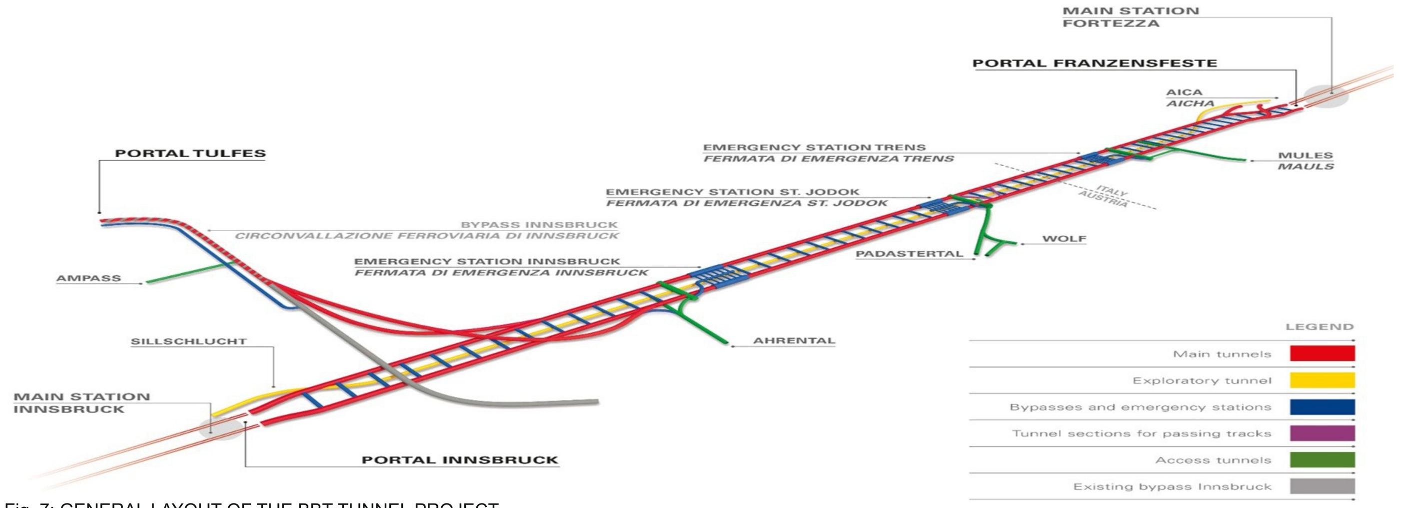

Fig. 7: GENERAL LAYOUT OF THE BBT TUNNEL PROJECT.

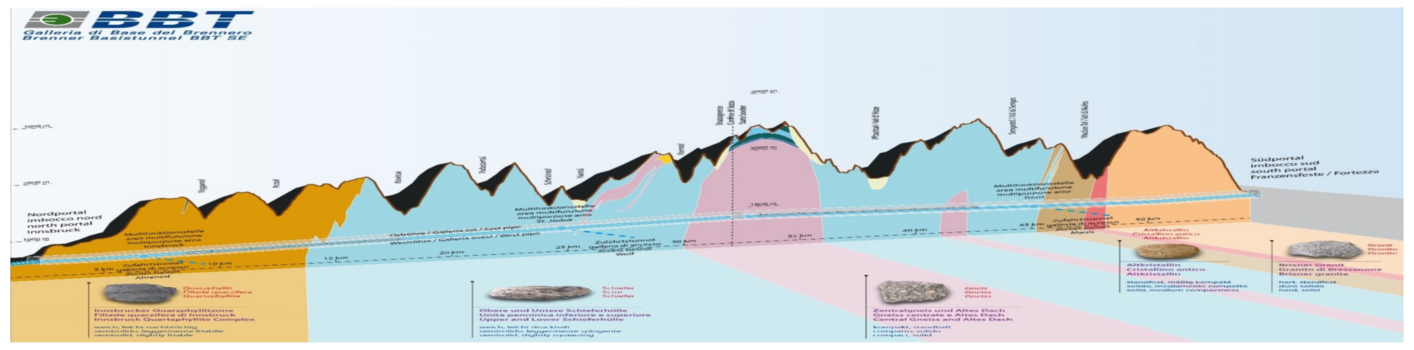

Fig. 8: LONGITUDINAL GEOLOGICAL SECTION OF THE BBT TUNNEL PROJECT.

Fig. 9: FORMWORK STAGE FOR BBT TUNNEL FINAL LINING.

Fig. 10: FINAL LINING CURING STAGE FOR BBT TUNNEL.

Fig. 11: FINAL LINING LAYER IN THE BBT TUNNEL.

Fig. 12: MEMORIAL PHOTO OF THE EXCURSION PARTICIPANTS.