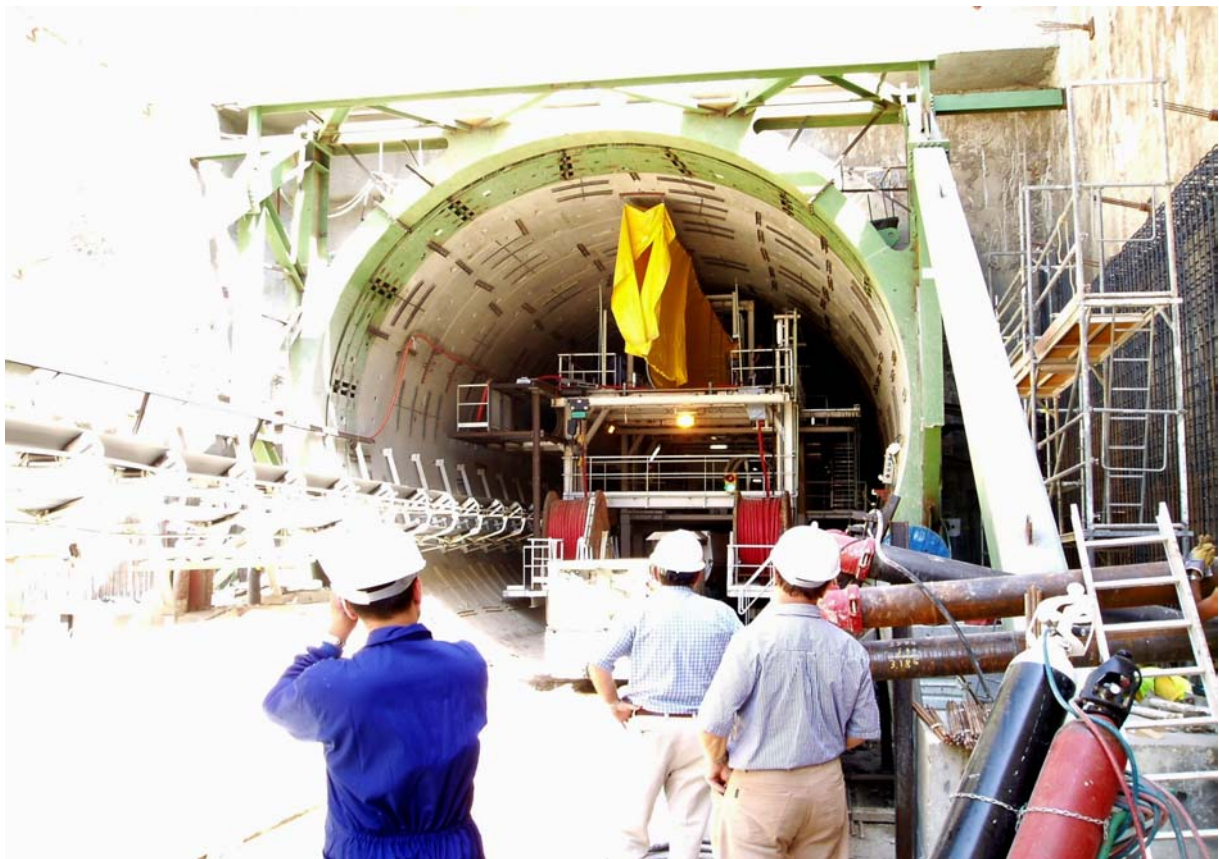


**Dipl. Ing Peter Simon**  
Minova Carbo Tech

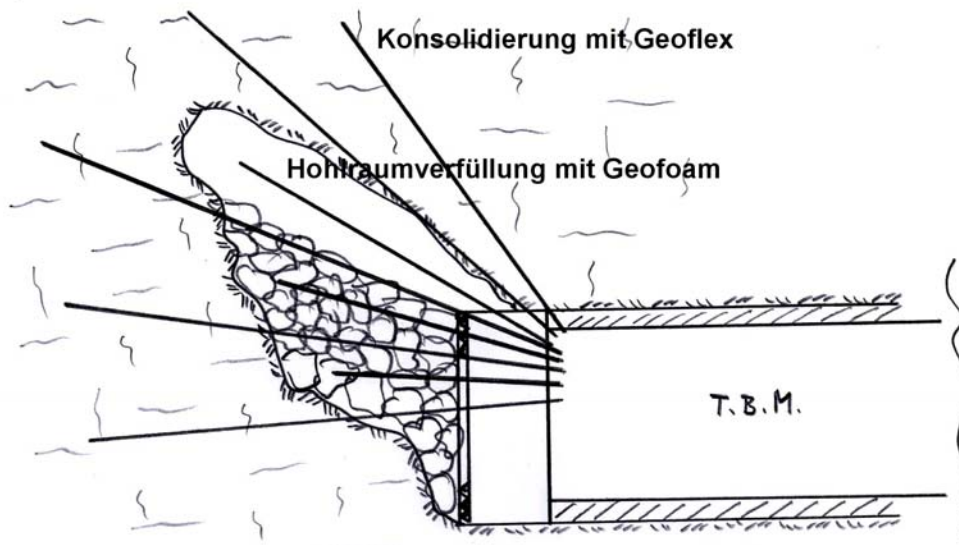
## **BARCELONA: METROLINE N° 9**

Consolidation, Water sealing, Cavity Filling

- Spain; Barcelona –
- Extention of Metroline N°. 9, TBM heading
- Company: FCC
- Carbotech CODIV
- Time: Start - July 2003      End: 2006



**Tunnel Entrance Northwest**



**TBM-Vortrieb Metro Linie N°.9 Barcelona**  
**Konsolidierung des Gesteins mit Geoflex**  
**Verfüllung der Hohlräume und Verfestigung des Bruchhaufwerks**  
**mit Geofoam - aus der Druckkammer der TBM**  
**Injektionsarbeit via Wiborex 30/11**

- The products:
- Consolidation: Geoflex ( 2-comp.-Silicat Resin )
- Cavity Filling: Geofoam ( 2-comp.-Silicat resin –high foam factor - ~30 )
- Injection pump: SK 90

The Metro Tunnel in Barcelona is situated along the coast of the Mediterranean Sea. Partially the Metro will be built under the Town of Barcelona, under the harbour and will have an important connection to the international airport. Based on this matter it is absolutely important to save the tunnel works against water inrush's, overbreak's – etc. Each break will be followed by a disaster – Buildings, Streets, Railway-lines and other Traffic systems can be destroyed.... The cost's for our applications and safety works are high, ...but everything what we do is cheaper than accidents...



- Metroline N°9 in a project drawing
- The area with our safety works, water sealings and consolidation is in the north west of the drawing.
- In heading of TBM is partially Dolomit, Gneis or Granit together with Sand and sable to find.
- This very unnormal Geology makes Problems of the roof and also in advance of the heading.
- Solution: Drilling and injection of roof and the advanced area from pressure chamber of TBM.
- Using Geofom and Geoflex were the cavities filled, consolidated and the water has been stopped( in combination of both products).
- The application of Geofom and Geoflex has been done by experienced people of our spanish partner Carbotech CODIV,
- All of the geotechnical problems, cavities , water have been solved by combined injection works. The roof and the advanced areas wer consolidated and the danger of more or bigger outrush´s could be reduced and the ground is stabilised.

Technical Supervising:  
 MINOVA Carbotech  
 MINOVA Codiv  
 Peter Simon  
 Diego Velez



