Kaolin and quartz from extractive waste: the example of the Monte Bracco area (Piedmont, northern Italy)

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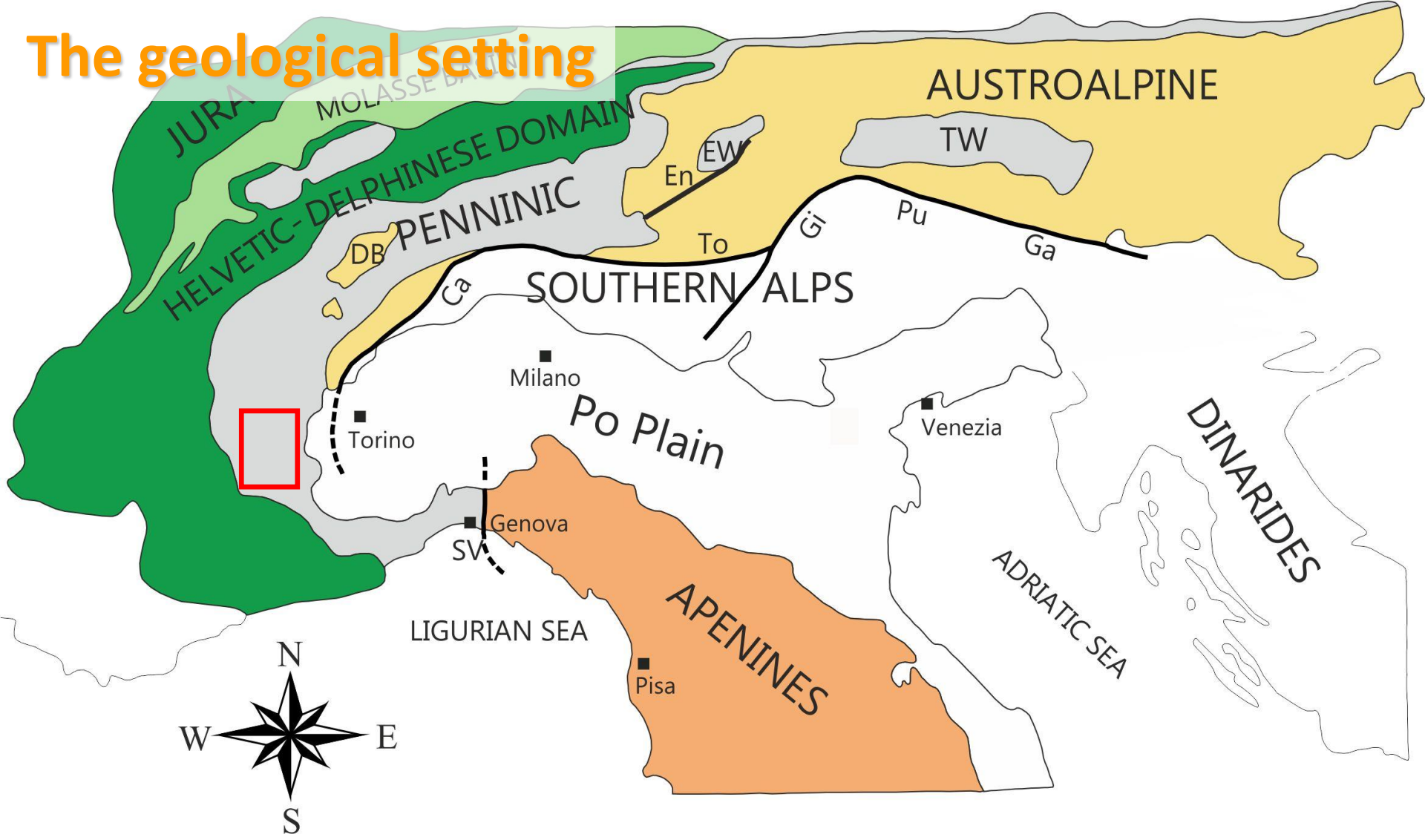
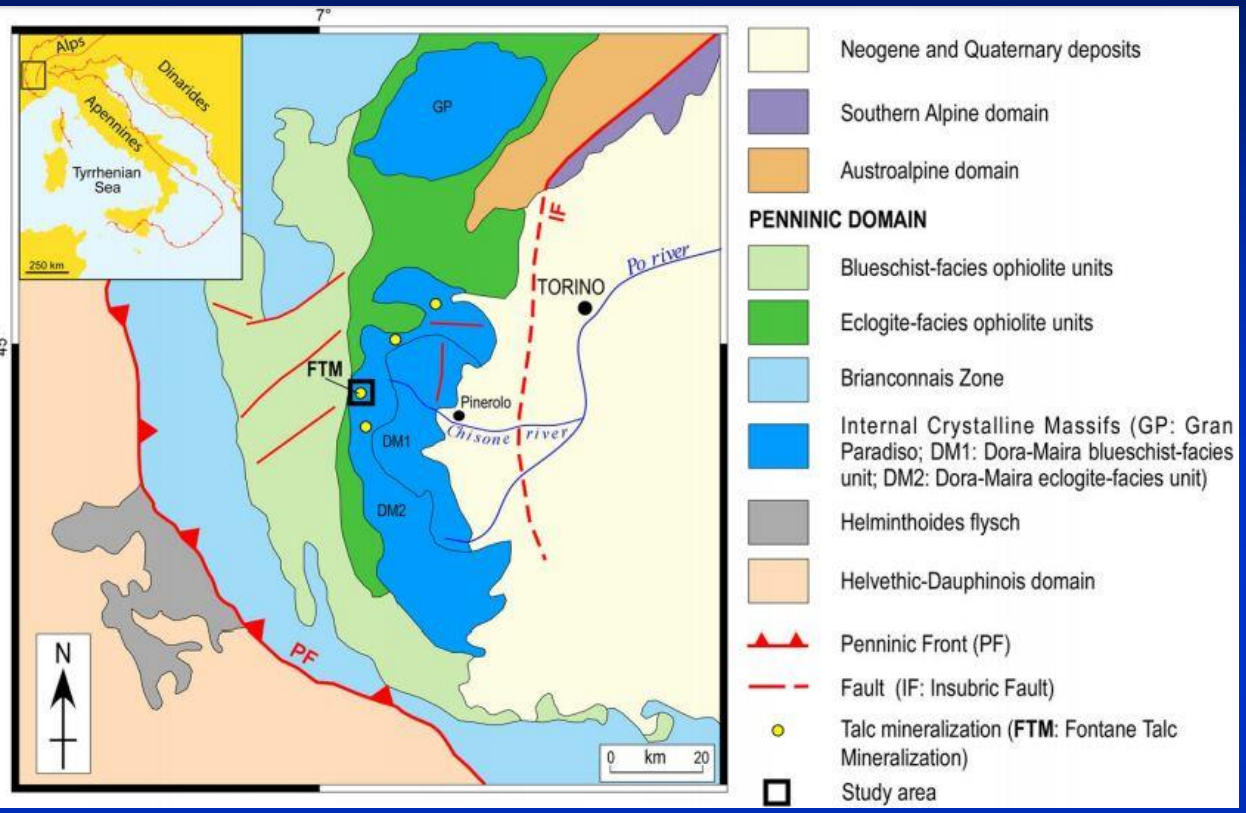
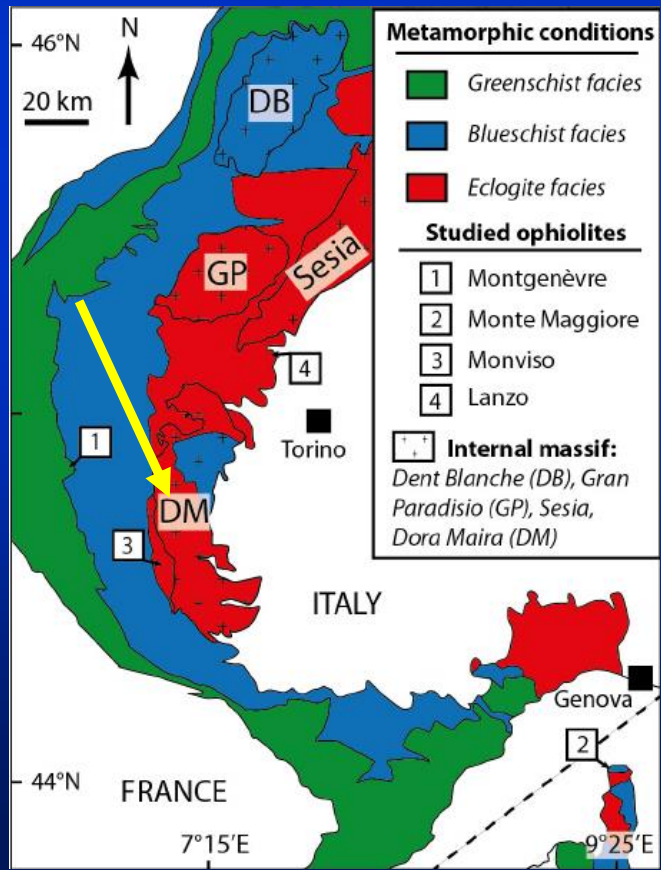
The geological setting



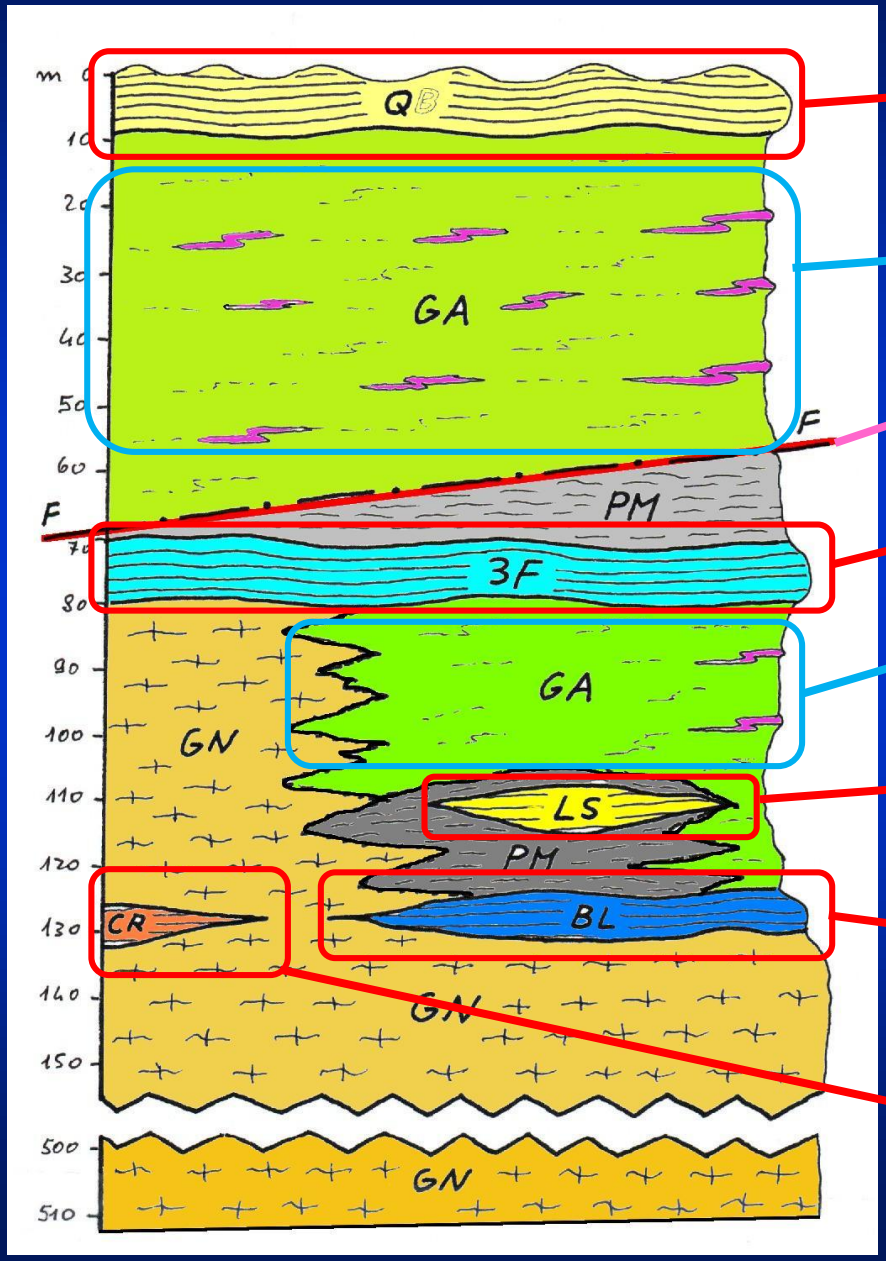
DB - Dent-Blanche; ***EW*** - Engadine Window;
TW - Tauern Window; **Periadriatic Lineament**: **Ca** - Canavese Line;
To - Tonale Line; **Gi** - Giudicarie Line ; **Pu** - Pusteria Line;
Ga - Gail Line; **En** - Engadine Line; **SV** - Sestri-Voltaggio Line.

The geological setting





“Stratigraphy” of the deposit



Quarzite di Barge

Strongly argilliferous gneiss

Low angle fault

Quarzite Tre Fontane

Strongly argilliferous gneiss

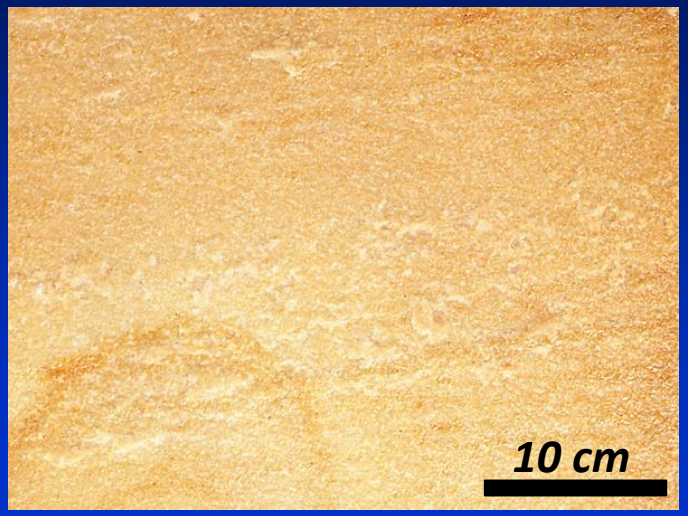
Quarzite lente di Savoia

Quarzite Barmalunga

Quarzite Combale Rinaudo

The “Bargiolina” varieties

- ***Golden yellow*** *(the most valuable)*
- *Pale yellow*
- ***Olive green***
- *Grey and white (the most common)*



Stupinigi hunting lodge (built 1729 - 1733)

Historical uses

- ***used since the prehistoric age as substituting material for chert;***
- ***exploited at least since the XIII century, peaking in the XX century (up to 300 kt/year);***
- ***at the beginning of the XX century, it was marketed in Northern Italy and exported to Russia and South America.***

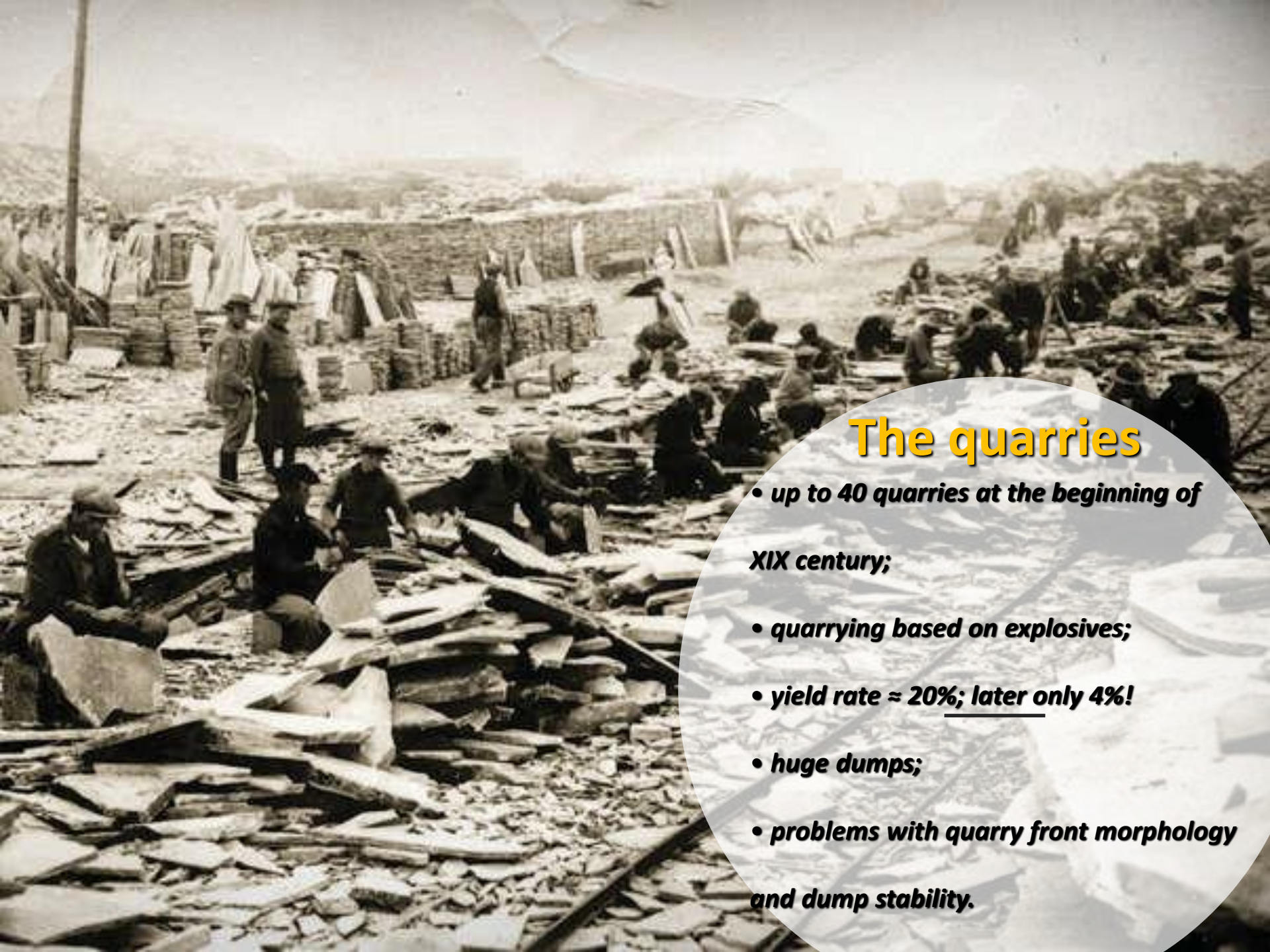
Filippo Juvarra (1678 – 1736)

Whole-rock geochemistry (EDXRF)

- SiO_2: 90 – 97% wt.
- Fe_2O_3: 0.17 – 0.48% wt.
- CaO: 0.13 – 0.3% wt.
- MgO: 0.05 – 0.35% wt.
- K_2O: 2.84 – 8.17% wt.
- Na_2O: 0.2 – 0.3% wt.

Outstanding technical properties

- Compressive strength: 300 – 350 MPa
- Flexural strength: 40.5 – 55.5 MPa
- Water absorption: 0.2 – 0.3%
- Impact resistance: 102 cm
- Abrasion resistance (Amsler coefficient): 0.67
- Excellent freeze – thaw resistance!



The quarries

- *up to 40 quarries at the beginning of XIX century;*
- *quarrying based on explosives;*
- *yield rate ≈ 20%; later only 4%!*
- *huge dumps;*
- *problems with quarry front morphology and dump stability.*

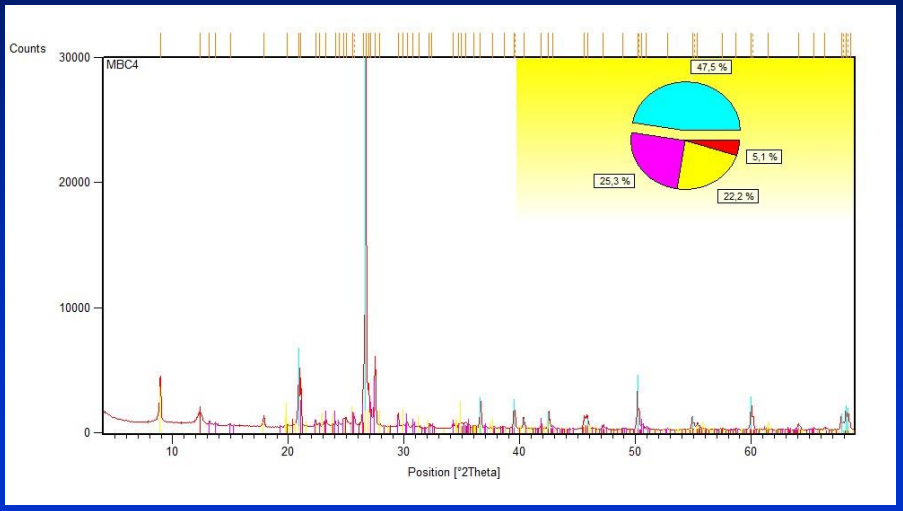
…and what about waste materials?

- *huge quarry dumps (estimated in 2,250,000 m^3);*
- *the quartzite waste could be used as a secondary raw materials for ceramics, refractories, abrasives and glass manufacturing.*

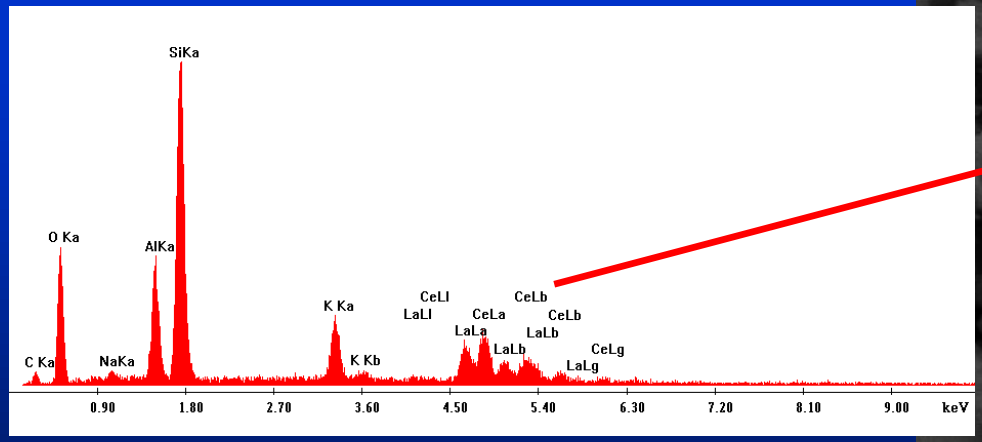
Kaolinitic gneisses

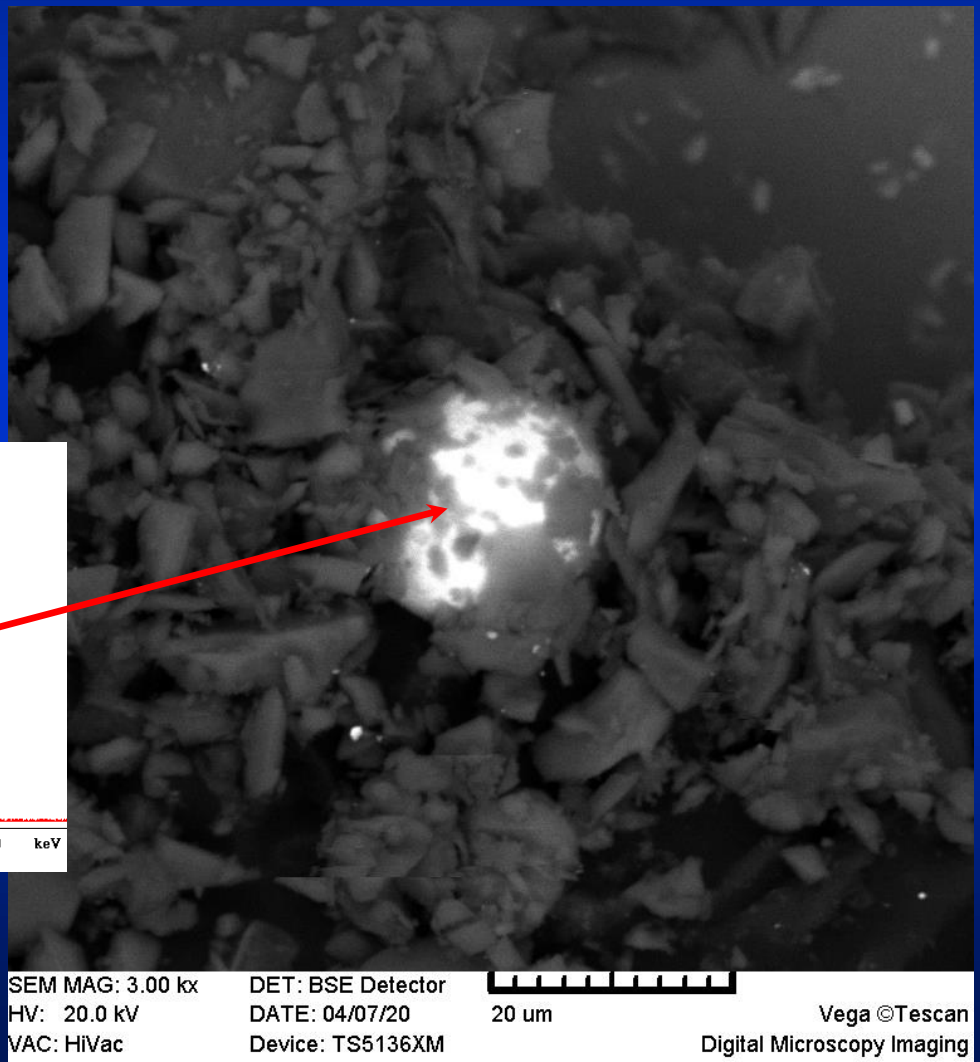
- ***Reserves: 3,765,000 m^3***
- ***Probable resources: 22,027,600 m^3***

Preliminary investigations by XRPD and SEM-EDS



- *Qtz + Kao (8 – 25 % wt.) + WM ± Kfs*
- *Kaolin is enriched in LREE!*





Conclusive remarks

- *The volume of the kaolinitic gneisses should be further evaluated by targeted field and geophysical surveys, followed by core drilling.*
- *In the perspective of a sustainable mining, it is important to move towards the integrated exploitation of the Monte Bracco area, contemporary mining both the quartzite waste and the kaolinitic gneiss (first category materials, industrial minerals), as well as the quartzite benches (second category materials, dimension stone).*
- *Does the kaolinitic gneiss host a REE ore deposit?*

For further details see **Cavallo, A. & Dino G.A. (2019)** - ***The Bargiolina, a striking historical stone from Monte Bracco (Piedmont, NW Italy) and a possible source of industrial minerals.*** **Sustainability, 11, 4293, 195 – 202; doi: 10.3390/su11164293.**