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“Gronda di Genova” project (NW Italy)

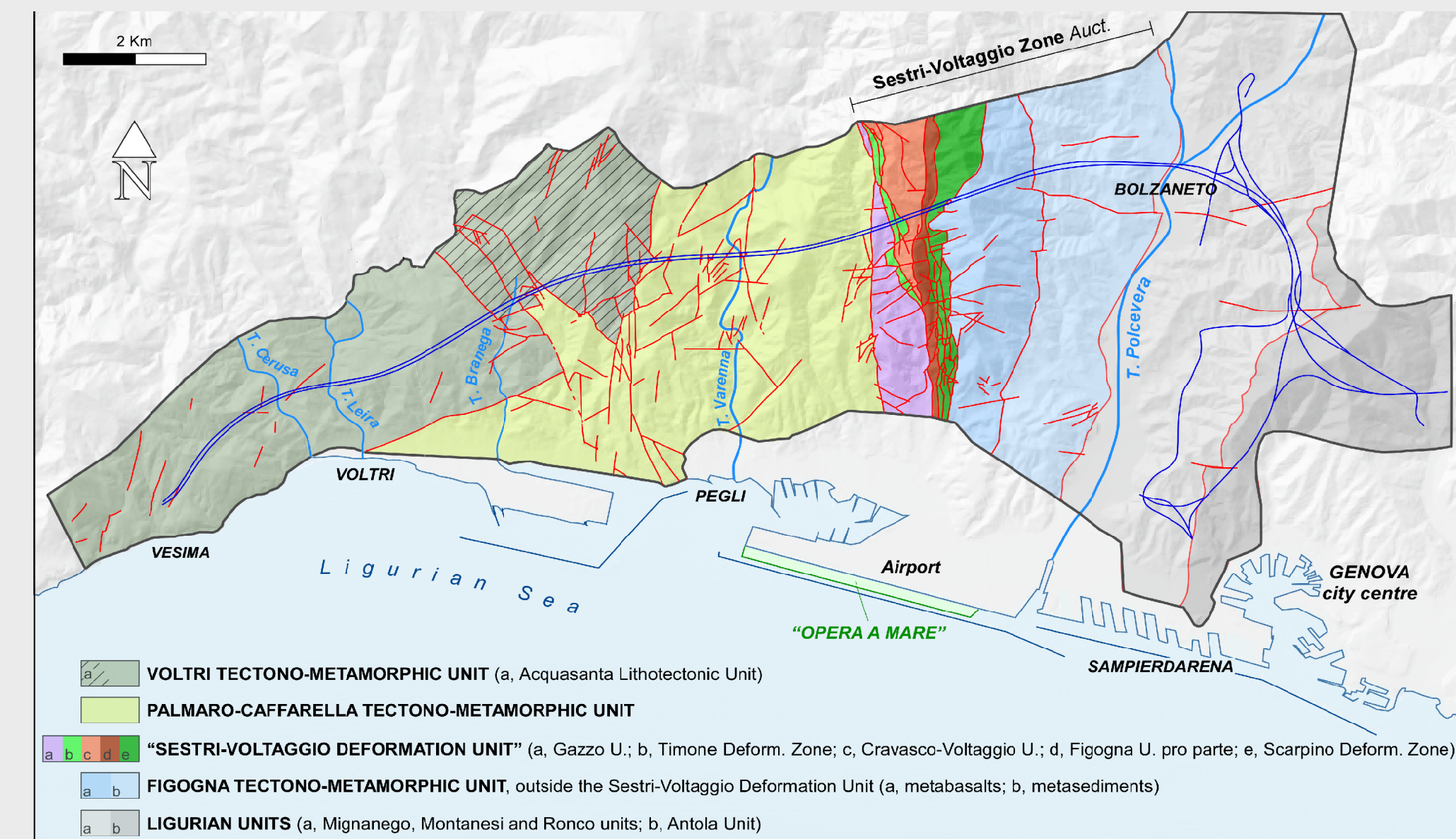
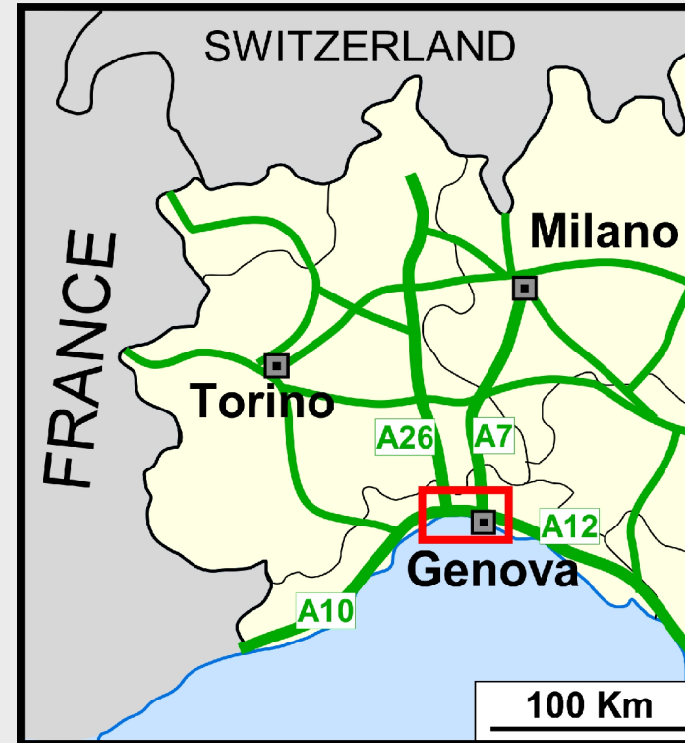


Fig. 1 - Layout of the Gronda di Genova highway bypass (in blue)



Project website
(in Italian)



Highway bypass of the city of Genova

- Total lenght: 72 Km (54 Km tunnels)
- Current stage: working plan
- Project value: ~ 4,5 billion €

- About 30 km of tunnels in potentially NOA-bearing lithotypes (NOA: Naturally Occurring Asbestos): meta-ophiolites of Voltri ‘Massif’ and Sestri-Voltaggio Zone; Figs. 2,3

Spoil management

1000 mg/kg
(contamination threshold in
Italian regulation)

Spoils with NOA < 1000 mg/Kg:
tunnel invert filling, realization of filling works
in the stilling channel of Genova airport

Spoils with NOA > 1000 mg/Kg:
disposal at approved landfill

Total amount of spoils with NOA>1000 mg/Kg?

Goal: improve previous estimation of NOA-bearing rock volumes made since the early stages of the project (Turci et al., 2015)

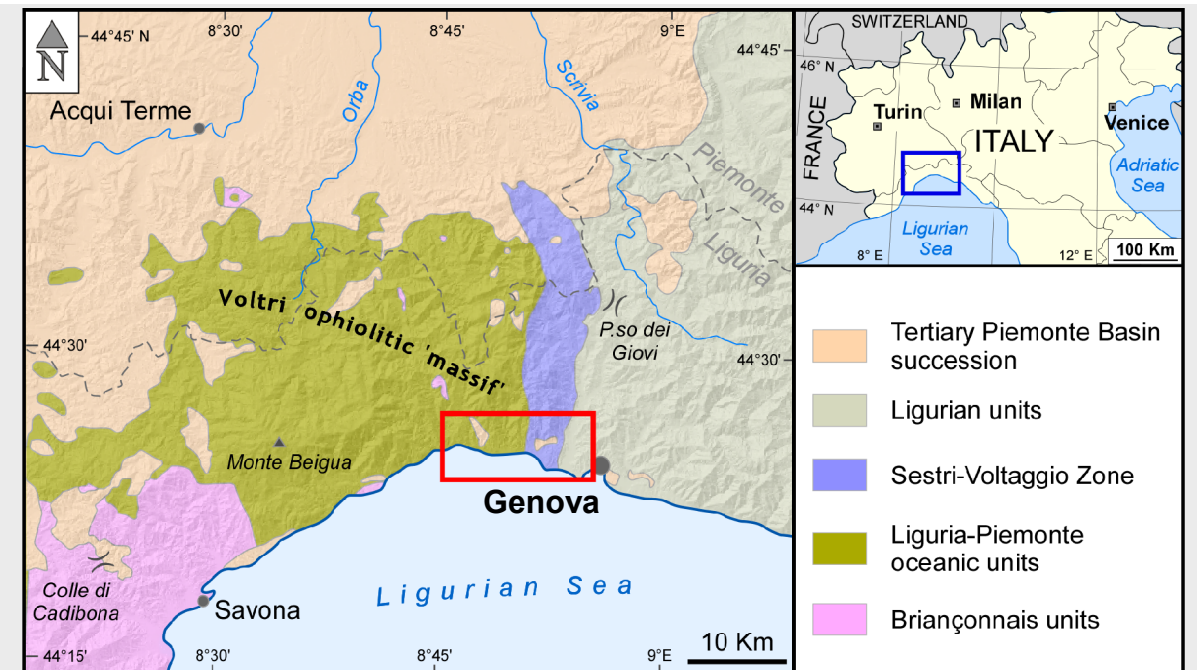


Fig. 2 - Geological scheme of the Genova area (red rectangle)

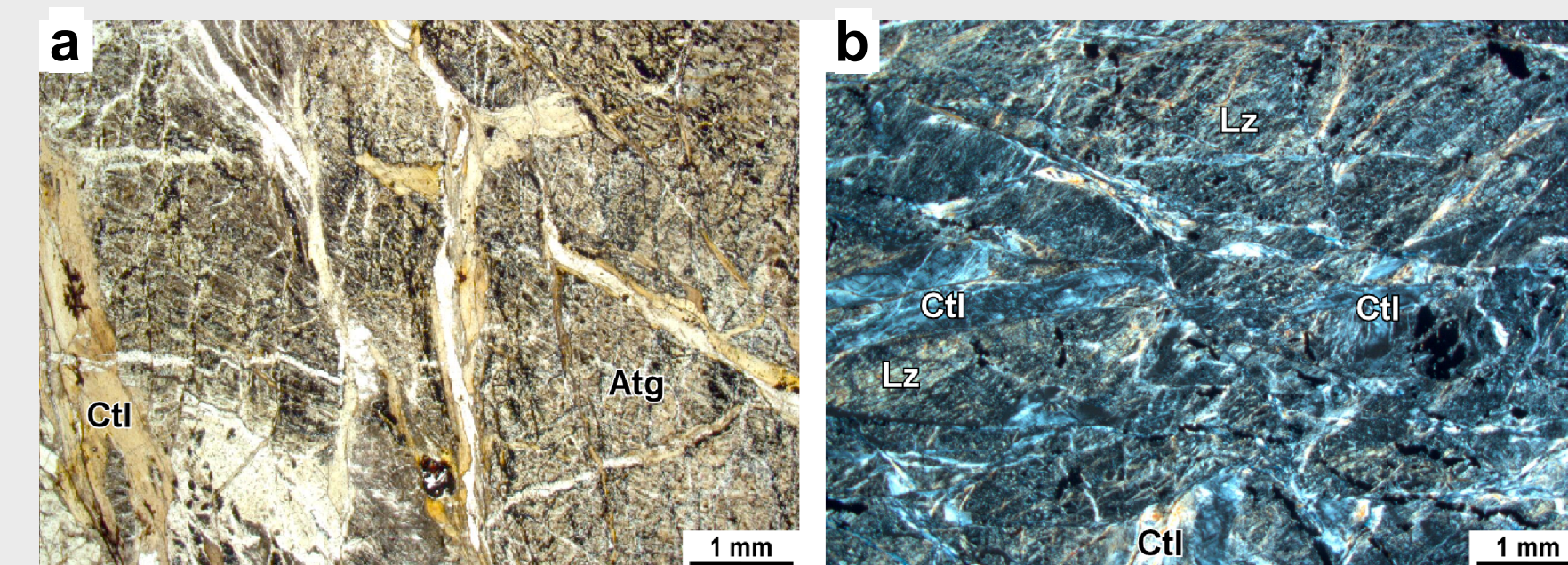


Fig. 3 - Thin section images of chrysotile-bearing antigorite (a) and lizardite (b) serpentinites from the ‘Gronda di Genova’ area

‘NOA petrofacies’ approach

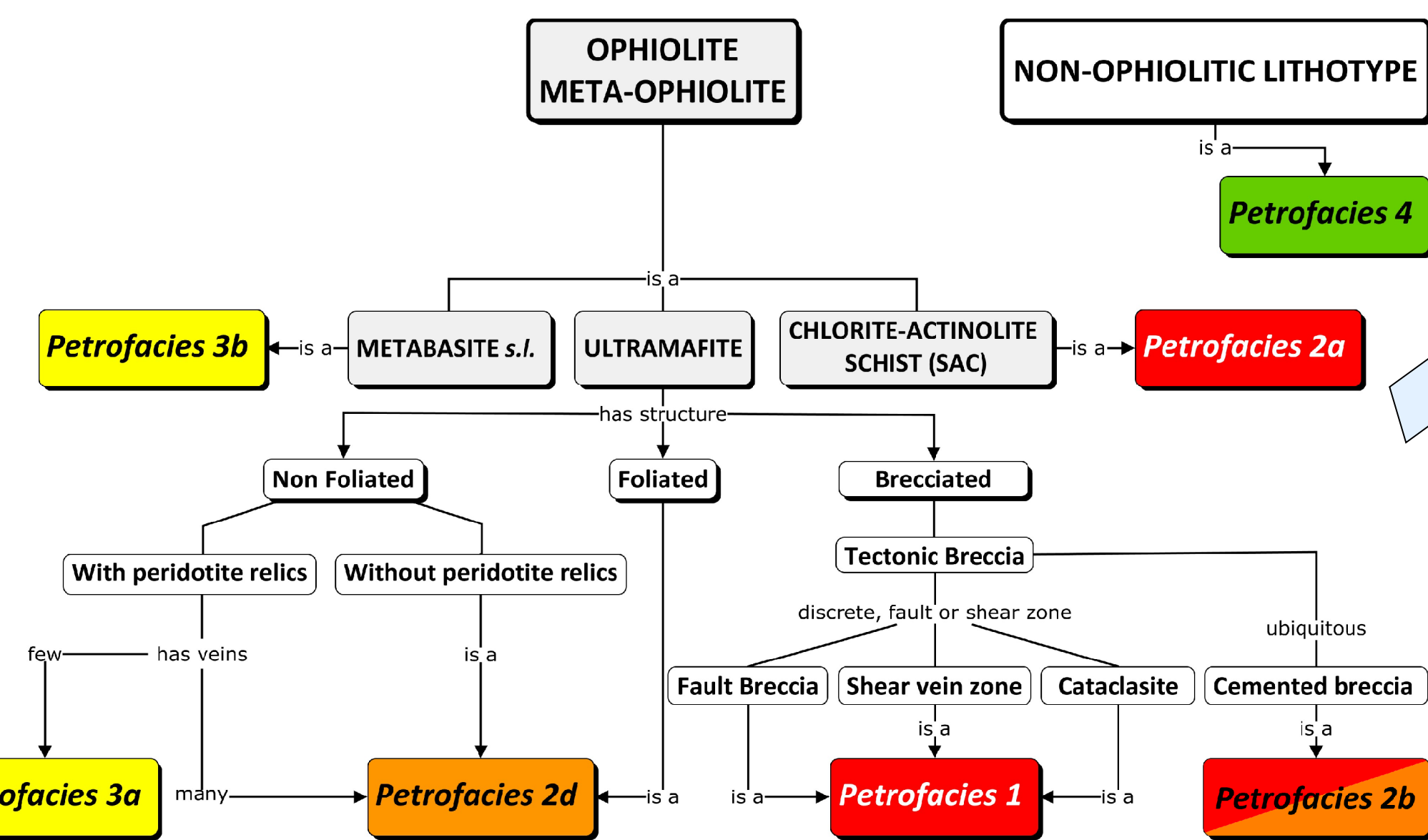
We defined ‘NOA petrofacies’ as ideal combinations of lithological and structural features corresponding to distinct asbestos-content classes (Botta et al., 2019).

NOA petrofacies were distinguished through:

- 1) mesoscopic lithological and structural observations (outcrop scale)
- 2) optical microscopy and micro-Raman spectroscopy characterization
- and further characterized through
- 3) SEM-EDS quantitative determination of NOA concentration (Turci et al., 2020)

NOA content class	ACR (Asbestos content ratio)	NOA petrofacies
Very high content	ACR > 70%	1, 2a, 2b1
High content	70% > ACR > 30%	2b2, 2d1, 2d2
Low content	ACR < 30%	3a, 3b
Nil content	no NOA occurrence	4

Fig.4 - Hierarchy relations between the main “asbestos-oriented” litho-structural types and the relevant NOA petrofacies, distinguished into different NOA content classes (red to green, in the table)



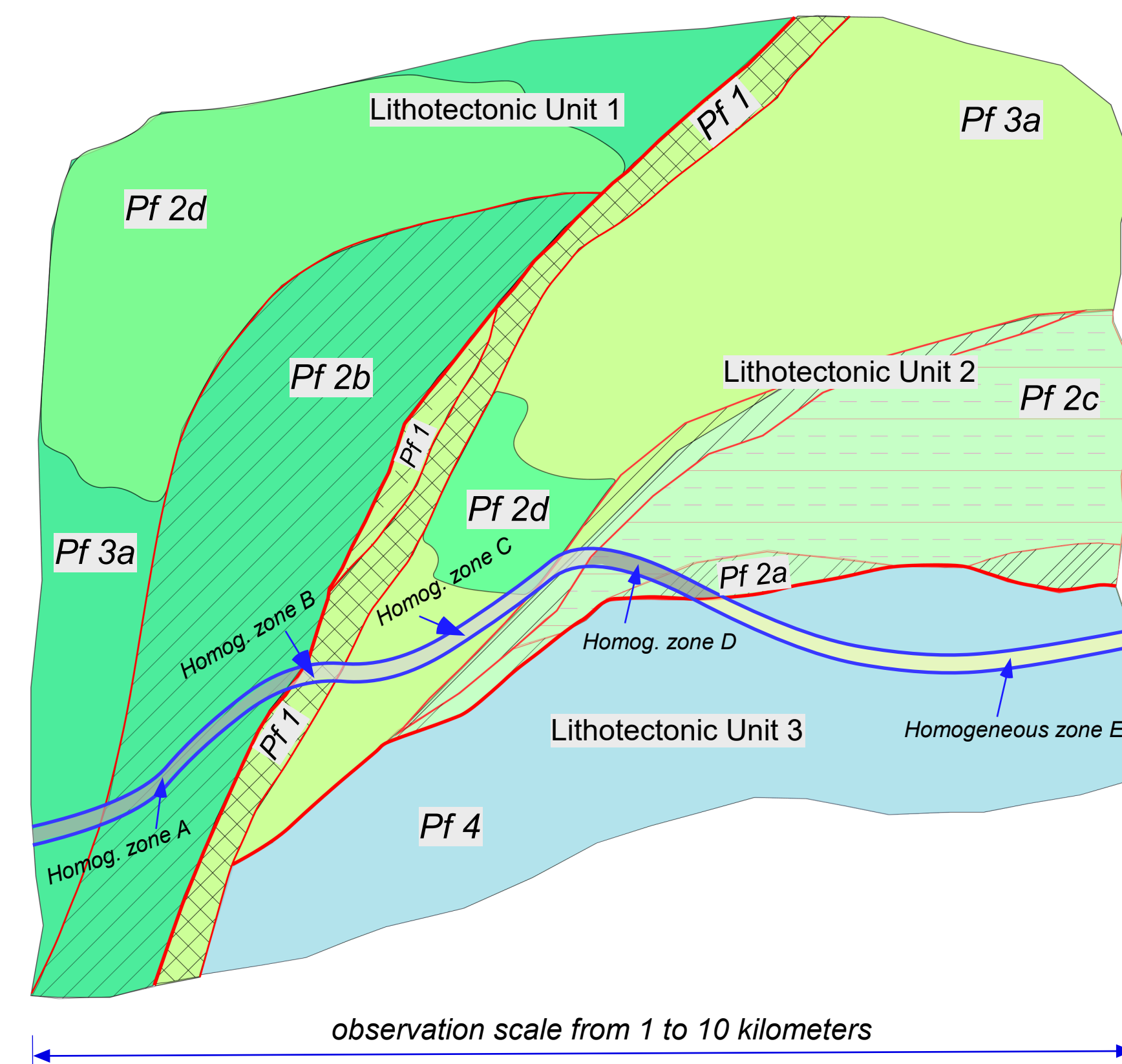
We calculated and Asbestos Content Ratio (ACR) for each NOA petrofacies as:

$$ACR = \frac{n \text{ of samples with NOA content } > 1000 \text{ mg/kg}}{n \text{ of analyzed samples}}$$

ACR approximates the ratio between the rock volume with NOA > 1000 mg/kg and the considered rock volume.

NOA petrofacies were subdivided into 4 NOA-content classes depending on ACR (Fig. 4)

Calculation of NOA-bearing rock volume

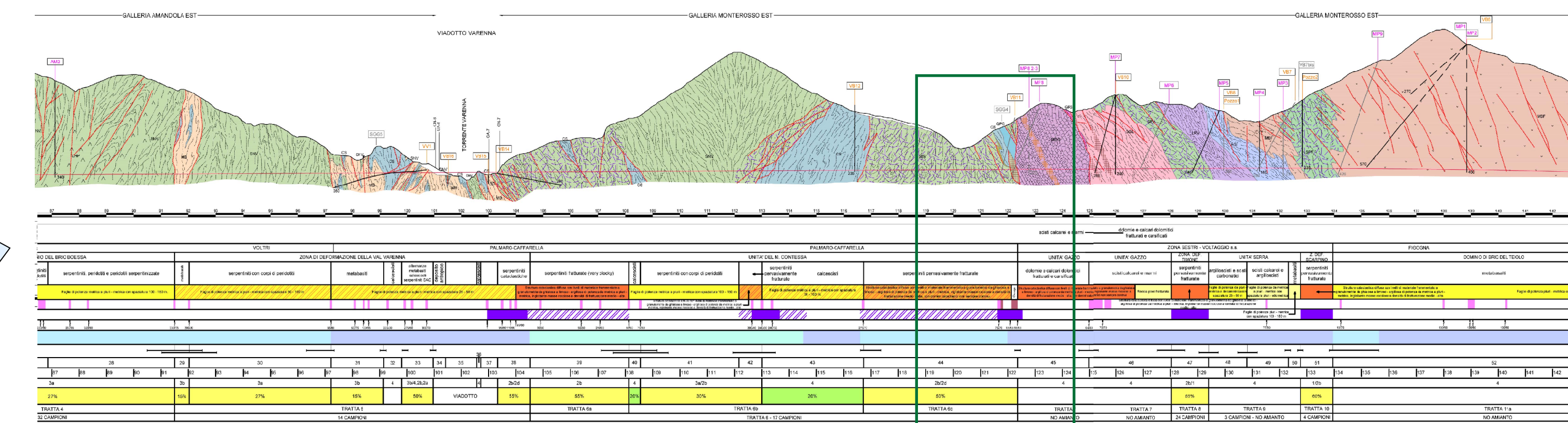


1) Detailed, NOA-oriented geological mapping: distribution of NOA petrofacies within lithotectonic units

Conclusions

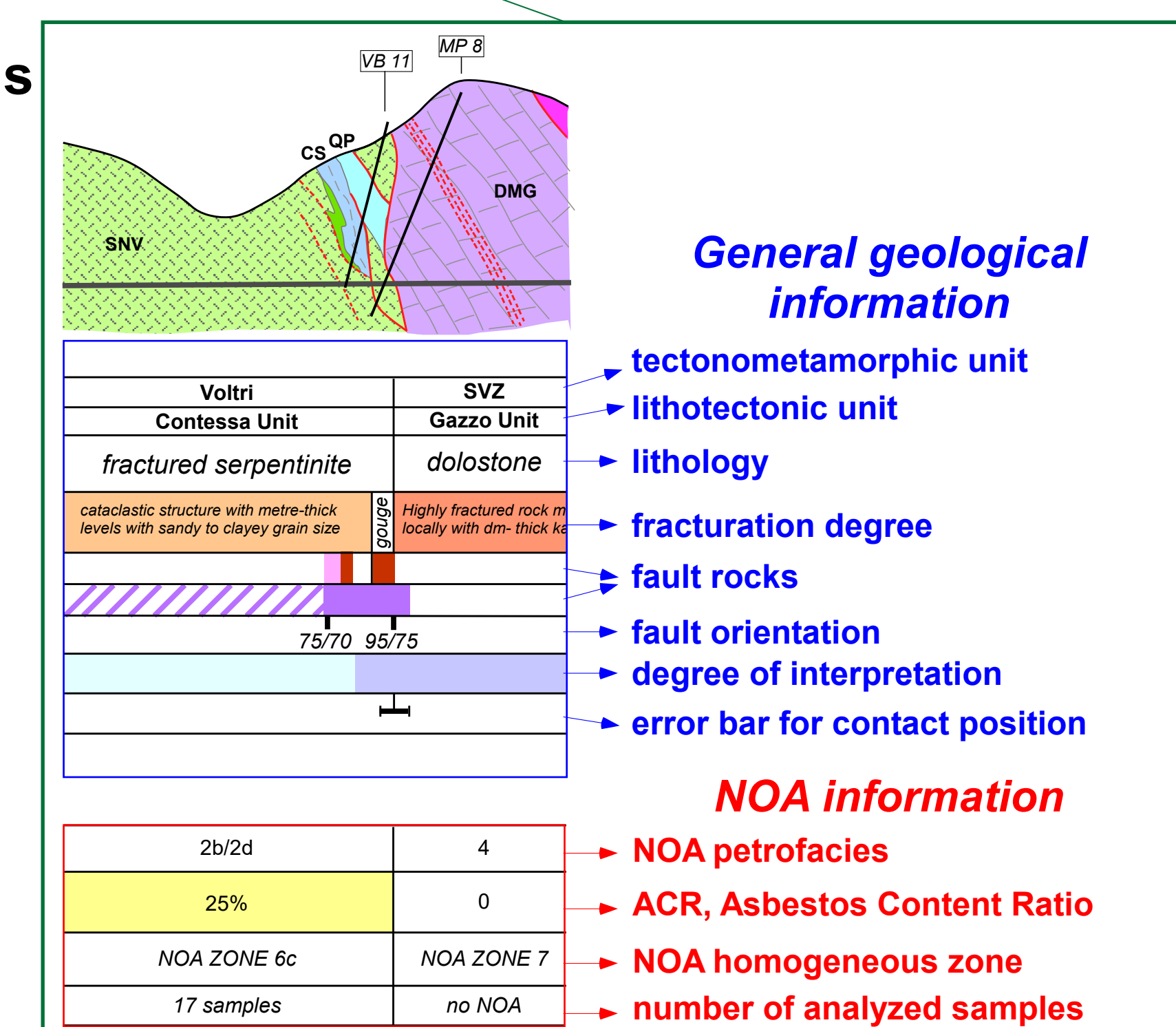
Our researches for the geological model for NOA content prediction in the “Gronda di Genova” highway project highlight the importance of:

- a NOA-oriented geological model to define structural domains and as a constraint for representative sampling.
- the definition of NOA petro-structural facies as a powerful tool to predict distribution and volume of NOA-bearing rocks within rock volumes in complex geological settings.



2) Realization of 1:5000 scale geological sections along tunnels

3) Adding geological and NOA-content information to geological sections: individuation of NOA homogeneous zones, i.e. tunnel segments characterized by one or more NOA petrofacies.



4) Calculation of NOA-bearing rock volume: for each homogeneous zone separately, based on the ACR of NOA petrofacies and their relative amounts within that zone

References

- Botta et al. (2019) Bull. Engin. Geol. Environ., 79(2020), 185–204, doi:10.1007/s10064-019-01539-6
Turci et al. (2015) In Lollino et al., Engineering Geology for Society and Territory vol.5, Springer, 619–622, doi:10.1007/978-3-319-09048-1_120
Turci et al. (2020) Environ. Engin. Geosci., 26 (1), 113-120, doi:10.2113/EEG-2272

