

Research article

Airborne asbestos fibres monitoring in tunnel excavation



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ABSTRACT

Tunnelling across ophiolitic formation with Naturally Occurring Asbestos (NOA) can release fibres into the environment, exposing workers, and the population, if fibres spread outside the tunnel, leading to increased risk of developing asbestos-related disease. Therefore, a careful plan of environmental monitoring is carried out during Terzo Valico tunnel excavation.

In the present study, data of 1571 samples of airborne dust, collected between 2014 and 2016 inside the tunnels, and analyzed by SEM-EDS for quantification of workers exposure, are discussed.

In particular, the engineering and monitoring management of 100 m tunnelling excavation across a serpentinite lens (Cravasco adit), intercalated within calcschists, is reported. At this chrysotile occurrence, 84% of 128 analyzed samples (from the zone closer to the front rock) were above 2 ff/l. However, thanks to safety measures implemented and tunnel compartmentation in zones, the asbestos fibre concentration did not exceed the Italian standard of occupational exposure (100 ff/l) and 100% of samples collected in the outdoor square were below 1 ff/l.

During excavation under normal working conditions, asbestos concentrations were below 2 ff/l in 97.4% of the 668 analyzed samples.

Our results showed that air monitoring can objectively confirm the presence of asbestos minerals at a rock front in relative short time and provide information about the nature of the lithology at the front.

The present dataset, the engineering measures described and the operative conclusions are liable to support the improvement of legislation on workers exposure to asbestos referred to the tunnelling sector, lacking at present.

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1. Introduction

Tunnelling across rocks characterized by naturally occurring asbestos (NOA) represents a serious concern for environmental and occupational health (Hashim and Boffetta, 2014). Because of its carcinogenic nature and pneumoconiosis-generating properties, asbestos dust is considered one of the most dangerous types of dust for workers' health (Szeszenia-Dąbrowska and Wilczyńska, 2016; Abelmann, 2015).

More than 52 countries have banned or restricted the use of asbestos according to the World Health Organization (WHO) campaign to stop the use of all asbestos types, but controversies

about health impact, identification criteria and normative limits are still on-going (Finkelstein, 2013; Bernstein et al., 2013; Jargin, 2015; Baur et al., 2016). Furthermore the decline in asbestos usage by more developed countries is being offset by less-developed countries that are continuing to use asbestos (Baur et al., 2015; Marsili et al., 2016) and many countries have to deal with management of existing asbestos removal and naturally occurring asbestos (EU Parliament, 2012; Hashim and Boffetta, 2014).

In this perspective, the tunnelling of a new high speed-high capacity railway line in Northern Italy, between Genoa and Milan (hereafter: Terzo Valico) is highly challenging for environmental issues and for occupational safety, because it involves excavation across a complex geology with ophiolitic formations, potentially containing NOA deposits and leading to possible dispersion of fibres into the environment (Wylie and Candela, 2015). NOA refers to asbestos that has not been extracted and refined for commercial purposes, but rather has been exposed unintentionally by excavation activities (Harper, 2008; Lee et al., 2008; Wagner, 2015).

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The Terzo Valico will improve connections among the harbour system in Liguria, the main railway lines of Northern Italy and the rest of Europe. The project is part of the Rhine-Alpine Corridor,

within the trans-European transport network, connecting the most populated and industrialised European regions. The railway will be 53 km long (Map S1), 37 km of which under tunnels (Map S2),

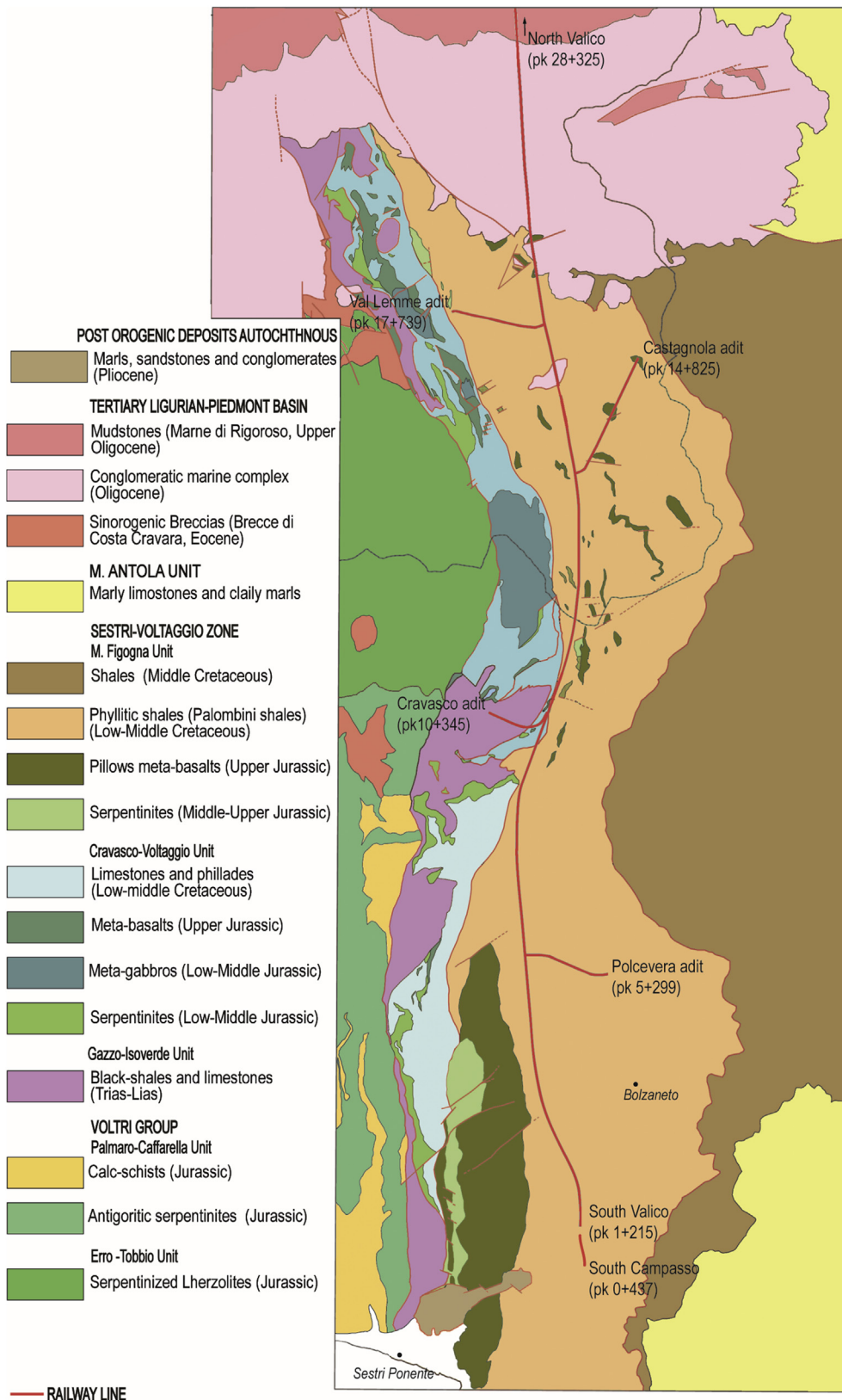


Fig. 1. Geological sketch map of the investigated area and railway line (modified from Terzo Valico Ferriovario dei Giovi, Protocollo Gestione Amianto, version 18. 03. 2014).

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