Geophysical Research Abstracts
Vol. 18, EGU2016-16919, 2016
EGU General Assembly 2016

Asbestos quantification in track ballast, a complex analytical problem

Alessandro Cavallo

University of Milano-Bicocca, Department of Earth and Environmental Sciences, Department of Earth and Environmental Sciences, Milano, Italy (alessandro.cavallo@unimib.it)

Track ballast forms the trackbeb upon which railroad ties are laid. It is used to bear the load from the railroad ties, to facilitate water drainage, and also to keep down vegetation. It is typically made of angular crushed stone, with a grain size between 30 and 60 mm, with good mechanical properties (high compressive strength, freeze – thaw resistance, resistance to fragmentation). The most common rock types are represented by basalts, porphyries, orthogneisses, some carbonatic rocks and "green stones" (serpentinites, prasinites, amphibolites, metagabbros). Especially "green stones" may contain traces, and sometimes appreciable amounts of asbestiform minerals (chrysotile and/or fibrous amphiboles, generally tremolite – actinolite). In Italy, the chrysotile asbestos mine in Balangero (Turin) produced over 5 Mt railroad ballast (crushed serpentinites), which was used for the railways in northern and central Italy, from 1930 up to 1990. In addition to Balangero, several other serpentinite and prasinite quarries (e.g. Emilia Romagna) provided the railways ballast up to the year 2000. The legal threshold for asbestos content in track ballast is established in 1000 ppm: if the value is below this threshold, the material can be reused, otherwise it must be disposed of as hazardous waste, with very high costs. The quantitative asbestos determination in rocks is a very complex analytical issue: although techniques like TEM-SAED and micro-Raman are very effective in the identification of asbestos minerals, a quantitative determination on bulk materials is almost impossible or really expensive and time consuming. Another problem is represented by the discrimination of asbestiform minerals (e.g. chrysotile, asbestiform amphiboles) from the common acicular – pseudo-fibrous varieties (lamellar serpentine minerals, prismatic/acicular amphiboles). In this work, more than 200 samples from the main Italian rail yards were characterized by a combined use of XRD and a special SEM-EDS analytical procedure. The first step consists in the macroscopic petrographic description of the rock fragments, in order to identify and quantify the "green stones". The second step is represented by the "self-grinding" of the clasts (Los Angeles rattle test), and the powders (< 2 mm) are characterized by XRD (main rock-forming minerals) and quantitative SEM-EDS. Especially in serpentinic clasts with superficial slip-fibre chrysotile mineralizations, the "self-grinding" procedure allows to release a large part of the fibers. The third and last step consists in the total grinding of the bulk ballast sample ("self grinding" powders + remaining rock fragments), followed by quantitative SEM-EDS procedure. The most important aspects in the SEM-EDS procedure are represented by an accurate sample preparation (e.g. using ultrasound and a surfactant to avoid fiber agglomeration), as well as effective criteria for the distinction of asbestos fibers and non-asbestiform/pseudo-fibrous varieties (presence of fibril bundles, fibril diameter, splayed ends). The results show a great variability in the lithological composition of the ballast samples, and some critical issues in serpentinite-rich ballast, sometimes exceeding the legal threshold of 1000 ppm. On the other hand, the presence of metabasites (prasinites, amphibolites) is much less critical, because the presence of asbestiform amphiboles (especially tremolite - actinolite) is really rare.