ENVIRONMENTAL RISK ASSESSMENT OF THE ABANDONED ASBESTOS MINE AT DOBŠINÁ, SLOVAKIA: A MINERALOGICAL APPROACH

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The Dobšiná chrysotile asbestos mine is located in the Spiš-Gemer Portion of the Slovak Ore Mountains, where chrysotile asbestos formed in the cracks of a small serpentinised basic-ultra basic magmatite body. The abandoned open-pit mine is about hundred meters to the north from the township Dobšiná. Due to the mining activity, serpentinites and serpentinite debris (waste dumps) crop out in an area of approximately 0.2 km^2. The former processing plant is situated in the eastern side of the township. The mine and the plant were formally opened in 1927. The asbestos mine closed in 1998, with no land rehabilitation. The surroundings of the plant are neglected, but seemingly contain no heaps of debris or process dust.

Asbestos fibres were extracted from the excavated serpentinite in the processing plant: the rock was first crushed and ground, the debris was separated according to grain size on a moving sieve-series, then the fibres were sucked up by air from the sieves. The residual "rock flour" was deposited in the mining area. The deposited serpentinite weighs approximately three million tons, and has roughly 2% residual asbestos content. PV-panels have been set up on part of the former mine area, and there are some plans for the utilization of the waste material, too: production of silica is in the experimental phase, and there was a proposal to use the waste material for CO_2 capture. The oldest waste heap, on the eastern edge of the mine, has been taken back by nature without human interference: a thin layer of soil developed, and a young forest grew up in the last few decades.

Currently, the mine area is the only possible source of asbestos, it may contaminate both air and runoff water. The present study is aimed at checking these possibilities, especially as the township is in the closest vicinity of the mine. Raw (original asbestos-content), ungraded (variable grain size) loose debris, and ground waste material are the major source of asbestos fibres, they are piled up on a stepwise slope with ca. 6–7 levels. We tried to trace the dissemination routes of the fibres.

The most common spreading track of asbestos fibres is the transportation by rainwater. Rainwater flowing down from the hilltop erodes asbestos fibres from the lose serpentinite debris and the rock flour, and transports them downwards, in the direction of the township. Between the levels, water created small channels on the slopes. At the end of the channels, when the surface becomes horizontal again, the rainwater slows down and deposits almost exclusively the fibres, creating a few millimetres thick asbestos mat that cracks like mud upon drying. At the lowermost part of the mine, water is collected in a little pond with overflowing possibility, in order to avoid major erosion of the debris. Further on, overflowing water is directed into a creek that already runs in an open concrete channel in the settlement centre.

At a lower level of the mine, blocks of a serpentinite clast-rich breccia were found, which probably formed at the tectonic emplacement of the serpentinite body. These ungraded, matrix-supported breccia blocks have sometimes fine-grained multi-layered crusts, consisting of mm-sized serpentinite clasts embedded in an asbestos matrix. These crusts are interpreted as the petrified varieties of the asbestos mats forming recently at the hillfoot, implying that the current sedimentation pattern (asbestos concentrating effect of water) occurred in the past, too.

Samples were taken from the rock flour (processed serpentinite debris with residual asbestos content), the unprocessed serpentinite debris containing lose bunches of asbestos, the recent asbestos mat, accumulating at the foot of the slopes and the petrified asbestos mat. Samples were first studied under the stereomicroscope, followed by SEM+EDX analysis and X-ray powder diffraction.

The recent mat consists in large part of asbestos fibres and a subordinate amount of clay minerals (chlorite, illite, talc) and quartz. It is practically free of serpentinite clasts. The petrified version is crack-free, hosts a lot of serpentinite debris and is subordinately cemented by calcite. Asbestos fibres are well bound both in the recent and the petrified mat, with low probability of the fibres becoming airborne. Therefore these natural asbestos concentrates have a low potential to contaminate the air with asbestos fibres. The lose bunches of asbestos on the surface can be a potential source of airborne fibres, air sampling is in progress to test this possibility. Overflow water samples are also under study, to check if asbestos fibres escape the mine area with the runoff waters.