Introduction

The main objective of the ASROCKS project is to provide guidelines and risk management tools for the exploitation of naturally high arsenic concentrations in bedrock and soil. The focus is on the Tampere-Häme region in southern Finland (Fig. 1 and 2). The guidelines and tools produced during the project will be of use to both aggregate producers and environmental authorities. The Geological Survey of Finland (GTK), Tampere University of Technology (TTY) and the Finnish Environmental Institute (SYKE) are participating in the ASROCKS project. The project is being carried out in co-operation with aggregate producers, municipalities and authorities.

Arsenic (As) occurs naturally in soil and bedrock. The long-term use of drinking water with a high As concentration is a risk to human health. One of the findings of a previous EU project, RA-MA (Risk assessment and risk management of arsenic in the Tampere region), was that arsenic can dissolve and be naturally transported to the groundwater in areas with high As in bedrock. The long-term use of drinking water containing high concentrations of arsenic may cause health risks. In areas with naturally elevated arsenic concentrations, such as the Tampere region, arsenic typically resides in the soil, near the surface of the underlying bedrock.

Study setting

The project is divided into separate actions. In the first action, ten production sites for crushed bedrock aggregates, seven sand and gravel excavation sites and four construction sites were selected for the sampling of rock, soil, aggregate products, groundwater and surface water. Concentrations of arsenic and several other potentially harmful elements were analysed, and the risk to human health and the environment will later be evaluated. Based on the results of the first action, two construction sites and two aggregate production sites were selected for a detailed investigation, which will be completed in 2013.

Sampling strategy

The basic sampling strategy was to collect samples of bedrock, soil, aggregate product piles, ground water and surface water at each production site. In bedrock quarries, about five samples were collected from points expected to contain arsenopyrite, e.g. sulphide-bearing rhyolites, the contacts of different rock types, adjacent to veins and dykes, shear zones and from the rhyolite surface on various fracture types. From aggregate product piles, six samples were collected from different points (Fig. 3) of which only one sample of each pile with the maximum As concentration measured by the portable XRF was sent to the laboratory for analysis. The same method was applied to the sampling of excavated, disturbed natural soil. Only one random sample was taken from undisturbed soil, and this method was essentially also applied to the surface and groundwater samples. The principal objective in the preliminary demonstration phase of the project was to find the areas with the maximum As concentrations in the bedrock, soil and aggregate products and where the arsenic was easily leachable.

Preliminary results and discussion

The variation in As concentrations was higher in the crushed bedrock aggregates than in sand and gravel products. Elevated As concentrations were measured from some sulphide-bearing veins and from the surfaces of cracks in the bedrock. The highest As concentrations in bedrock (up to 916 mg/kg) were measured from a planned construction site. Only a small proportion of the total As concentration was easily leachable. Only eight groundwater samples were taken in the first action, and the arsenic concentrations in them were with one exception lower than the guide value of 10 µg/l designated for household water. Arsenic concentrations in surface water were typical for the Tampere region, but higher than in stream water for the whole of Finland on average (Lahermo et al. 1996, Tenhola & Tarvainen 2008 and Backman et al. 2010). The highest arsenic concentrations in surface water were found at the production sites of crushed bedrock aggregates (Fig. 4).

In Finland, guidelines for assessing and managing the risks caused by naturally high arsenic concentrations are lacking, causing challenges in the process of granting environmental and construction licences. Based on the investigation carried out during the ASROCKS project, the transport of arsenic to groundwater and surface waters is being assessed and guidelines are being generated to assist in granting environmental licences for aggregate production. The guidelines will be available to both industry and to local and environmental authorities.

Acknowledgements

This project is co-funded by the EU Life+ Environment Policy and Governance programme (Grant: LIFE10 ENV/FI/000062 ASROCKS).

References


More information: http://projects.gtk.fi/ASROCKS