HIGH NATURAL HEAVY METAL CONCENTRATIONS OF SAND AND GRAVEL AGGREGATES IN JOENSUU REGION IN EASTERN FINLAND

Olli BREILIN [1], Jari HYVÄRINEN [2] and Jouni PIHLAJA [3]
[1] Geologist, Geological Survey of Finland P.O.Box 96 FIN-02151 Espoo
[2] Geologist, Geological Survey of Finland P.O.Box 1237 FIN-70211 Kuopio
[3] Geologist, Geological Survey of Finland P.O.Box 77 FIN-96101 Rovaniemi

1. INTRODUCTION

In Finland the laboratory testing of physical properties of raw materials for aggregates have directives and guidelines. Also the concentration of asbestos in raw materials for aggregates has been given guidelines. Studies by Nikkarinen et al (2001) indicated high natural concentrations of asbestos material in soil and in bedrock outcrops. For heavy metal concentrations of sand and gravel aggregates have not been given any instructions or guidelines. However the Finnish Ministry of the Environment has defined the chemical target and limit values for contaminated soils (Puolanne et al 1994). In the early studies natural background concentrations of heavy metal in glacial till and lake sediments have been found to exceed limit values of contaminated soils in some regions in Finland (Salminen 1995, Nenonen & Nikkarinen 1995, Loukola-Ruskeeniemi et al 1998). Such areas are partly situated in low resistive rock type areas such as black shale rock type areas nearby Joensuu town, fig.1. As the origin of rocks in gravel are partly from such areas and gravel aggregates are used in many building purposes, it would be important to know also the natural background level of heavy metal concentrations.

2. THIS STUDY

This paper reports results of a pilot project that was carried out in the region of town Joensuu in eastern Finland, Fig. 1. The main target of this study was to find out the level of the chemical concentration of heavy metals (Co, Cr, Cu, Ni, Pb, Zn) in sand and gravel aggregates of active gravel pits. The results are compared to the chemical target and limit values for contaminated soil and natural heavy metal concentrations in glacial till. Based on these results of the pilot project the assessment for further research of heavy metals concentration of sand and gravel aggregates could be estimate.

3. GEOLOGY OF THE RESEARCH AREA

The crystalline bedrock of the study area is composed mainly of Archaean mica schists and black shale interlayers (Lehtinen et al (ed.) 1998). The low resistive rock type map is based on airborne geophysical data and bedrock maps, and it indicates possible areas of high heavy metal concentrations, Fig. 1. Glaciofluvial and ice marginal formations were deposited across these rock type areas during the melting of the Weichselian continental ice sheet. These glaciofluvial formations are the main source of sand and gravel aggregates in study area.

The rock types of glacial till and glaciofluvial gravel reflect the rock types in bedrock from flow direction of the glacier, which is E – N in study area, Fig. 1. The glacial transport distance of glaciofluvial esker material in Finland is 10-30 km. According to the field observations the proportion of black shales of rocks in different gravel layers could vary between 20 % - 100 % in same glaciofluvial formation. This is due to the variation of rock types, sedimentation dynamics and sedimentation cycles.

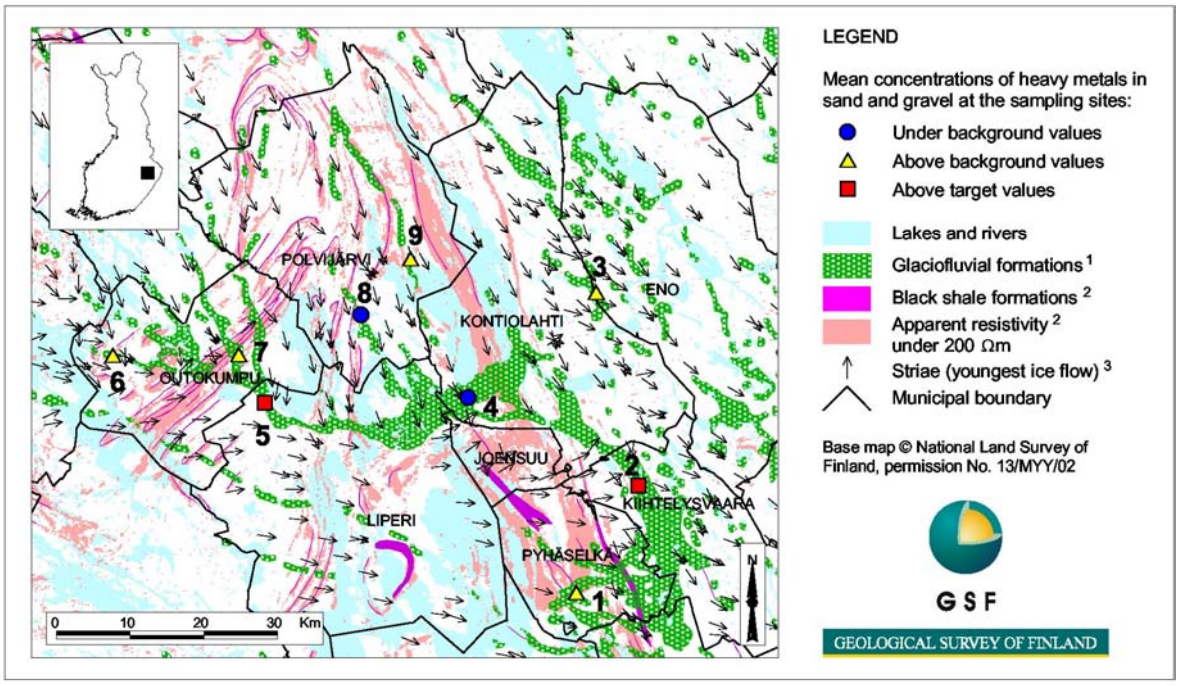

Figure 1. Study area and the sampling sites with geological information. [1] Niemelä (ed.) et al 1993, [2] Arkimaa et al 2000, [3] Bargel et al 1999.

4. SAMPLING AND LABORATORY MEASUREMENTS

The sample sites were located in nine active gravel pits. Sampling (ca. 5 kg) was made from fresh cuttings from an area of one square meter. The parallel sample was taken a little deeper from the same cutting. Samples were dried and screened under 2 mm fraction and aqua regia leached in 90º C. Elementary analysis were made using ICP-AES –techniques. Mean values of measured heavy metals concentrations were calculated from the results of parallel samples.

5. RESULTS AND CONCLUSIONS

The mean concentrations of heavy metals (Co, Cr, Cu, Ni, Pb, Zn) from each gravel pit were compared to the average background level of glacial till deposits and to the target and limit values of contaminated soil (Koljonen et al 1992, Puolanne et al 1994). About 44 % from total measurements of each heavy metal exceeded the average till backgrounds (Co, Cr, Cu, Ni, Pb, Zn). In two samples the concentration of Cu and Ni exceeds also the target

values of contaminated soil. Exceeding of the limit values of contaminated soil was not noticed.

Based on the chemical concentration of till and esker material used in this study it can be assumed that the chemical backgrounds of sand and gravel aggregates exceed the target and limit values of the contaminated soil in the low resistive rock type areas. When this kind of aggregates is used for building purposes the possibility of high chemical background contents should be noticed. For example when the soil is being studied as a possible contaminated soil site, the use of the aggregates that include high natural heavy metal concentrations can lead to situations that are difficult to interpret.

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