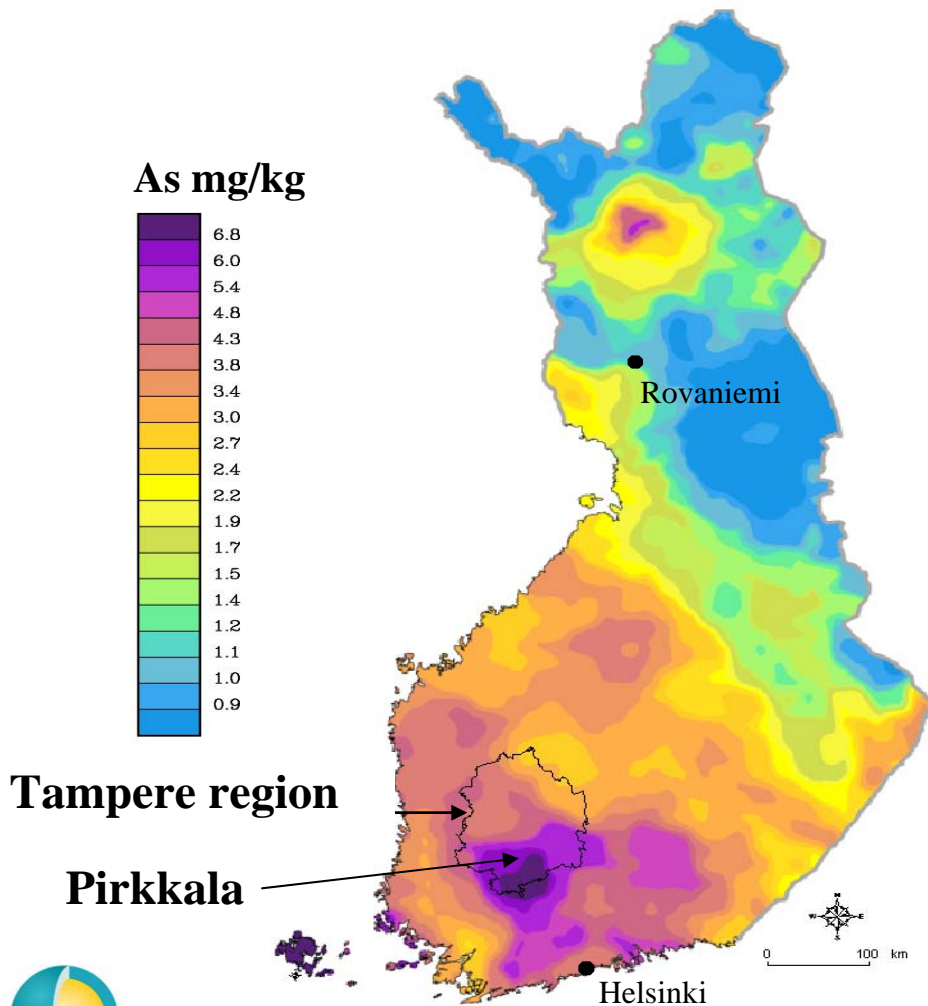


Finnish geogenic arsenic problems



- Geochemical mapping of Finnish soils in reconnaissance scale in early 1980's (map) revealed As anomalies
- Elevated concentrations of As were measured from groundwater during gold exploration
- In 1994 Ministry of Social Affairs and Health ordered an assessment of As concentrations in drilled bedrock well waters from GTK
- Elevated concentrations of arsenic were found in soil and in drilled bedrock water in the Southern Tampere region
- Arsenic risks in the Tampere region were studied in the EU Life RAMAS project in 2004-2007
- Municipality of Pirkkala is located in the anomalous Southern Tampere region

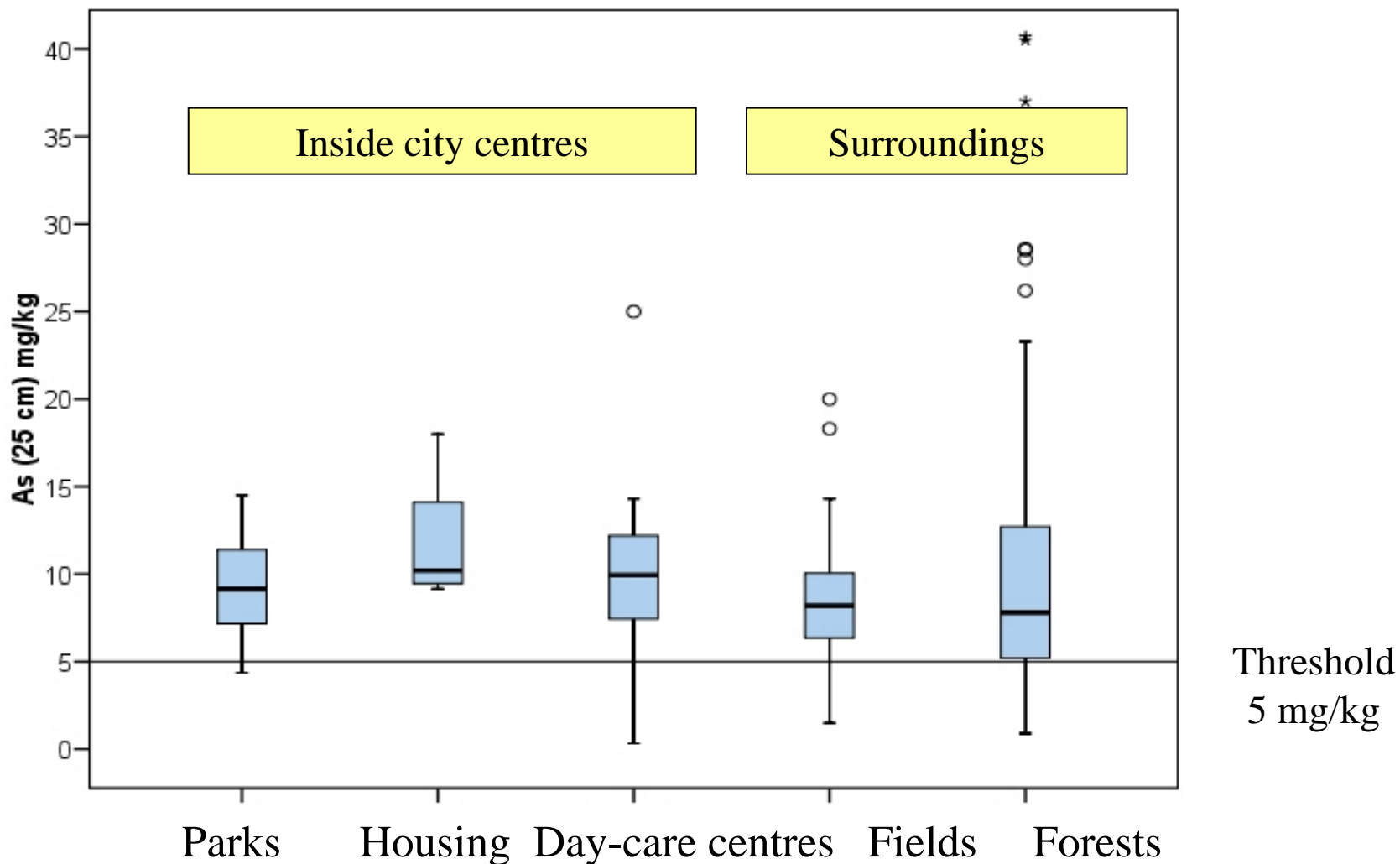
Natural arsenic in Finland and in the Tampere region

- The most important mineral is arsenopyrite (FeAsS), often associated with gold
 - Disseminated sulphides
 - Secondary minerals in cracks
- As occurs also in other minerals



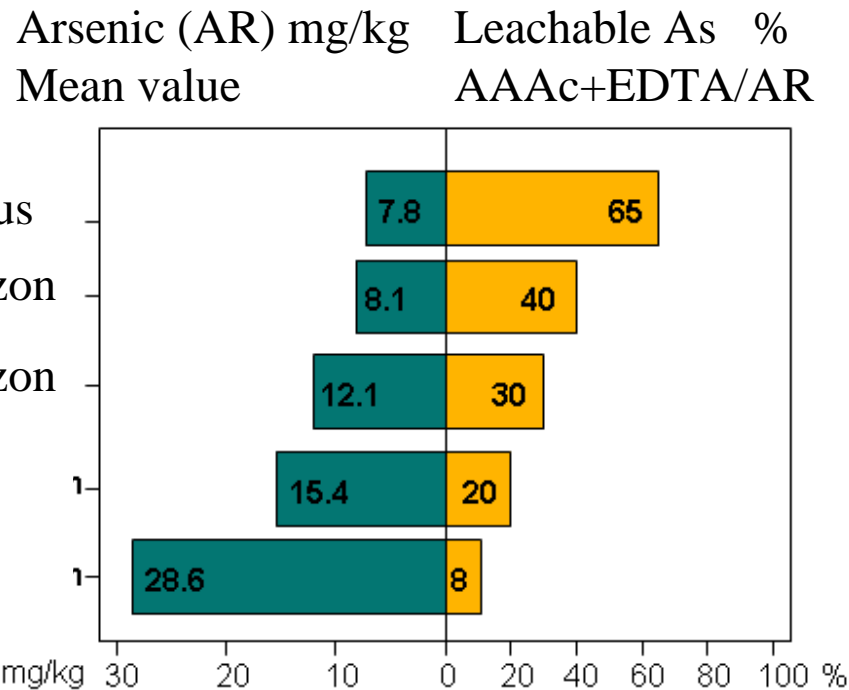
Photo: Jari Väättäinen, Geological Survey of Finland

- Mean As concentrations in whole Finland:
 - Bedrock 1 - 5 mg /kg
 - Soil 2.6 mg/kg
- Threshold value in the assessment of soil contamination 5 mg/kg
- In soils of the Southern Tampere region
 - 26 mg/kg for till
 - 15 mg/kg for clay
 - 29 mg/kg for sand.



Arsenic: naturally occurring potentially harmful element in the Tampere region

Results from the RAMAS project: Arsenic concentrations are higher in the deep soil layers in the Tampere region



- Total arsenic concentration is higher in the deep soil layers
- Arsenic was more easily leachable in the top soil (AAAC+EDTA extraction)
- Excavation and earth moving can pose problems in the arsenic risk areas
- Soil from the deep soil layers with low redox gets contact with oxygen rich, low pH rain water and surface water
- Mobility of As will increase

Source: Backman, B. et al. 2007. Arseenin luontaiset pitoisuudet Pirkanmaalla. Pages 21-42 in K. Loukola-Ruskeeniemi, T. Ruskeeniemi, A. Parviainen & B. Backman (eds.) Arseenin esiintyminen Pirkanmaalla, riskit ja niiden hallinta. RAMAS-hankkeen tärkeimmät tulokset. Espoo: Teknillinen korkeakoulu. Geoympäristötekniikka.

Preliminary investigation of the arsenic risks of the soils in Pirkkala municipality

- Pirkkala is situated in the arsenic anomaly area in the Tampere region
- Pirkkala municipality ordered an assessment of local arsenic risks from GTK in 2010
- Contents
 - Soil arsenic risk map for the whole municipality based on earlier mapping project results
 - New detailed soil sampling from three planning areas

Datasets used in the preliminary risk map

Data from exploration projects

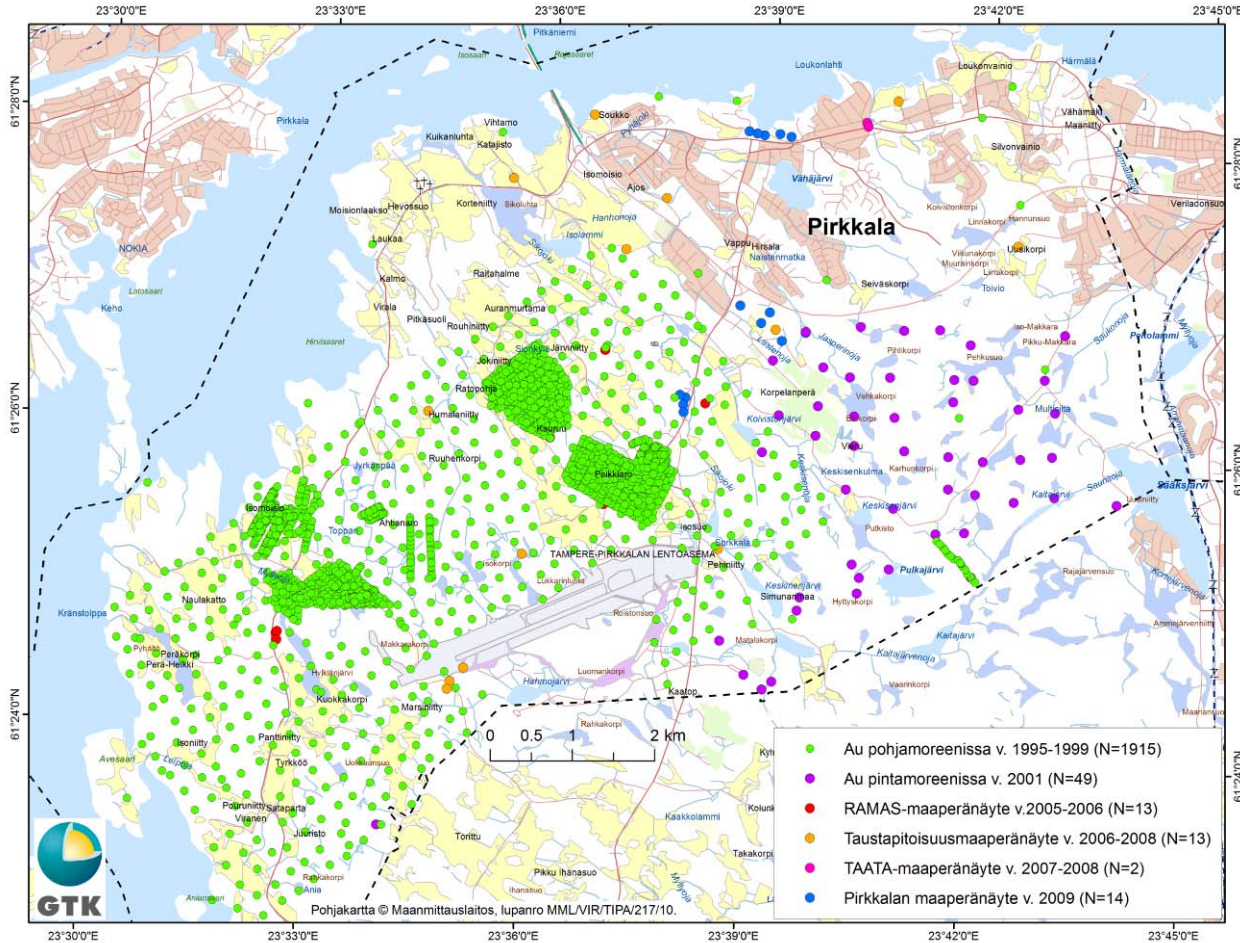
RAMAS project

Baseline mapping

Regional geological project of the Tampere region

New samples

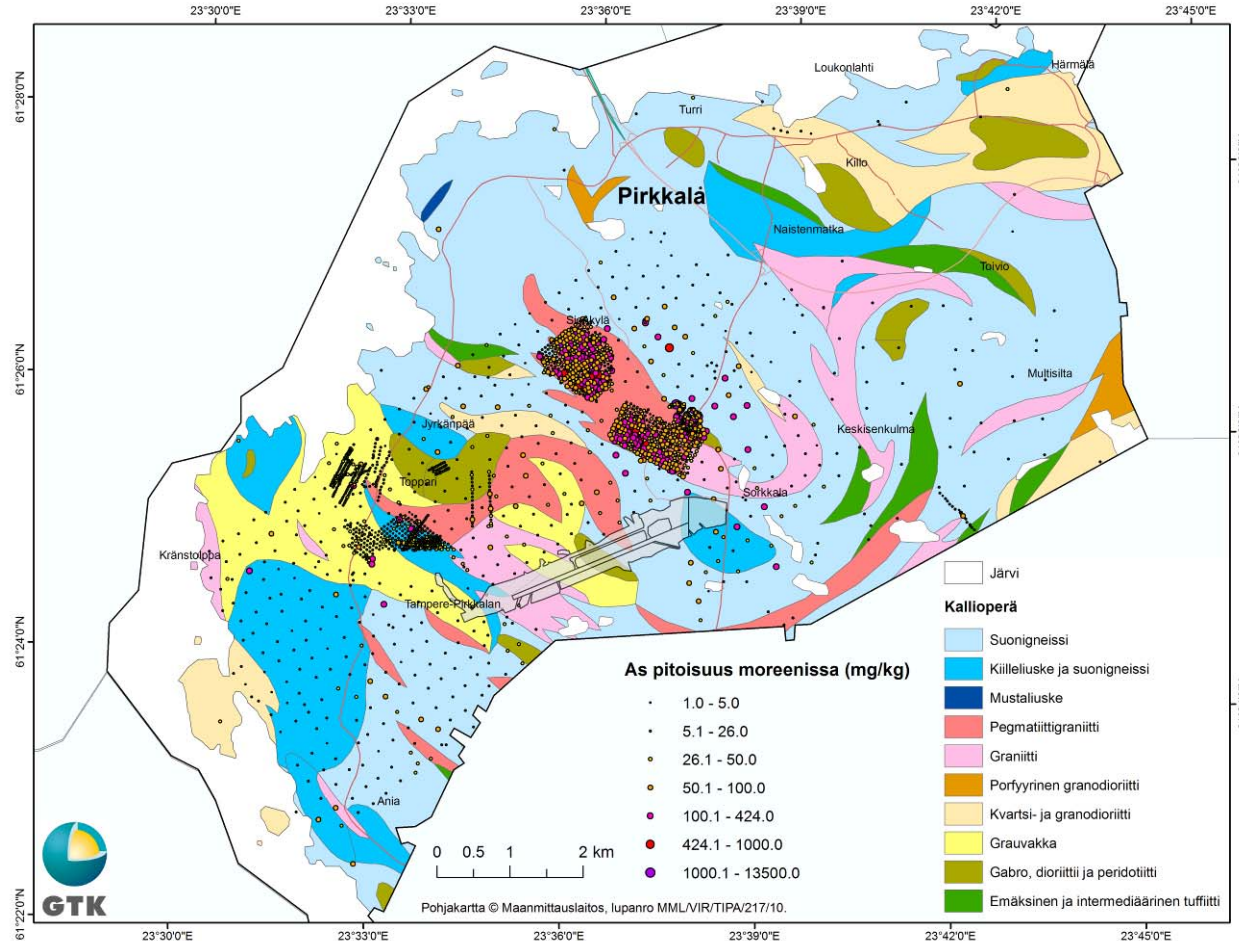
Total 2006 samples



GTK

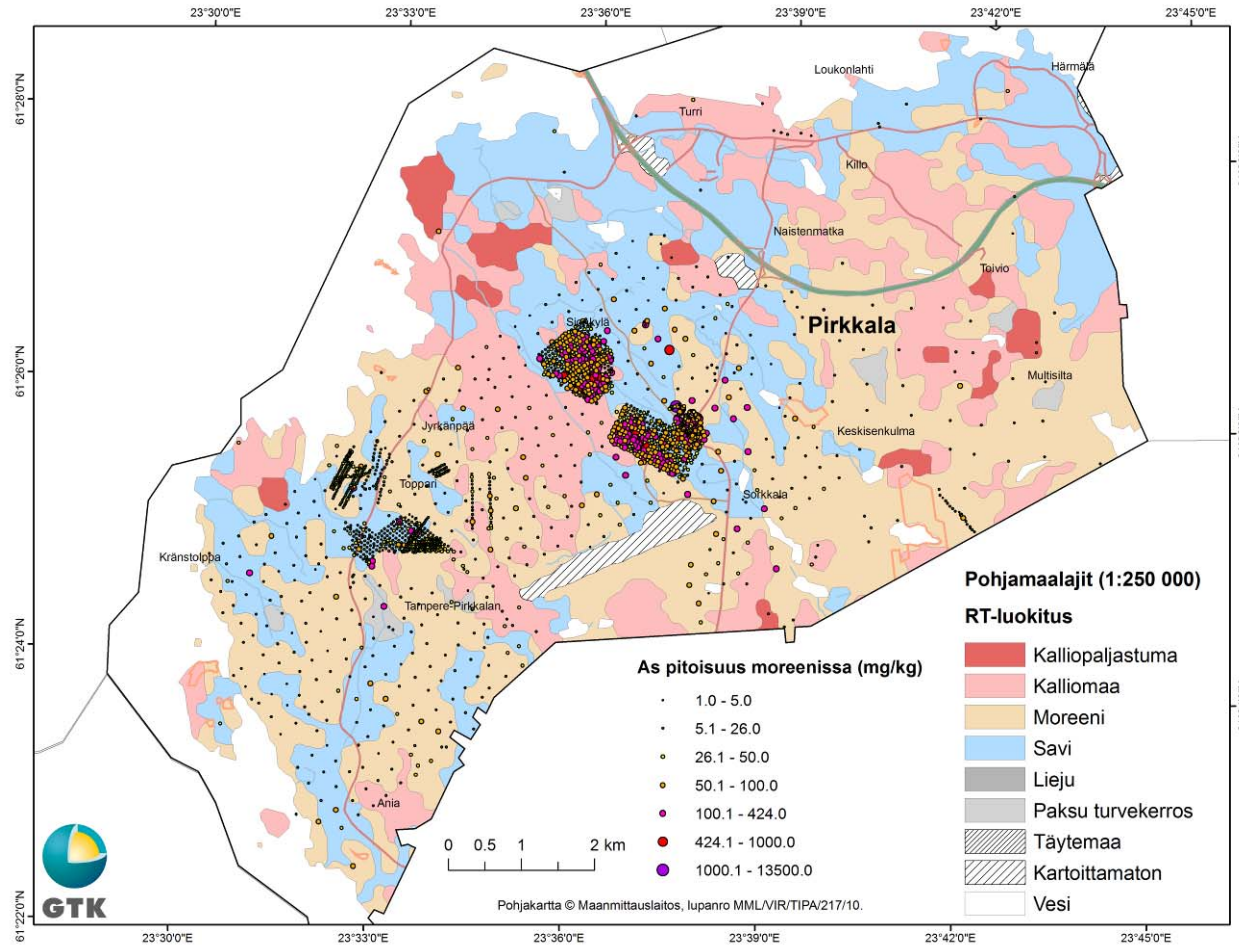
Bedrock in Pirkkala

Much variation in bedrock types. Bedrock map could not explain the distribution of arsenic in topsoil



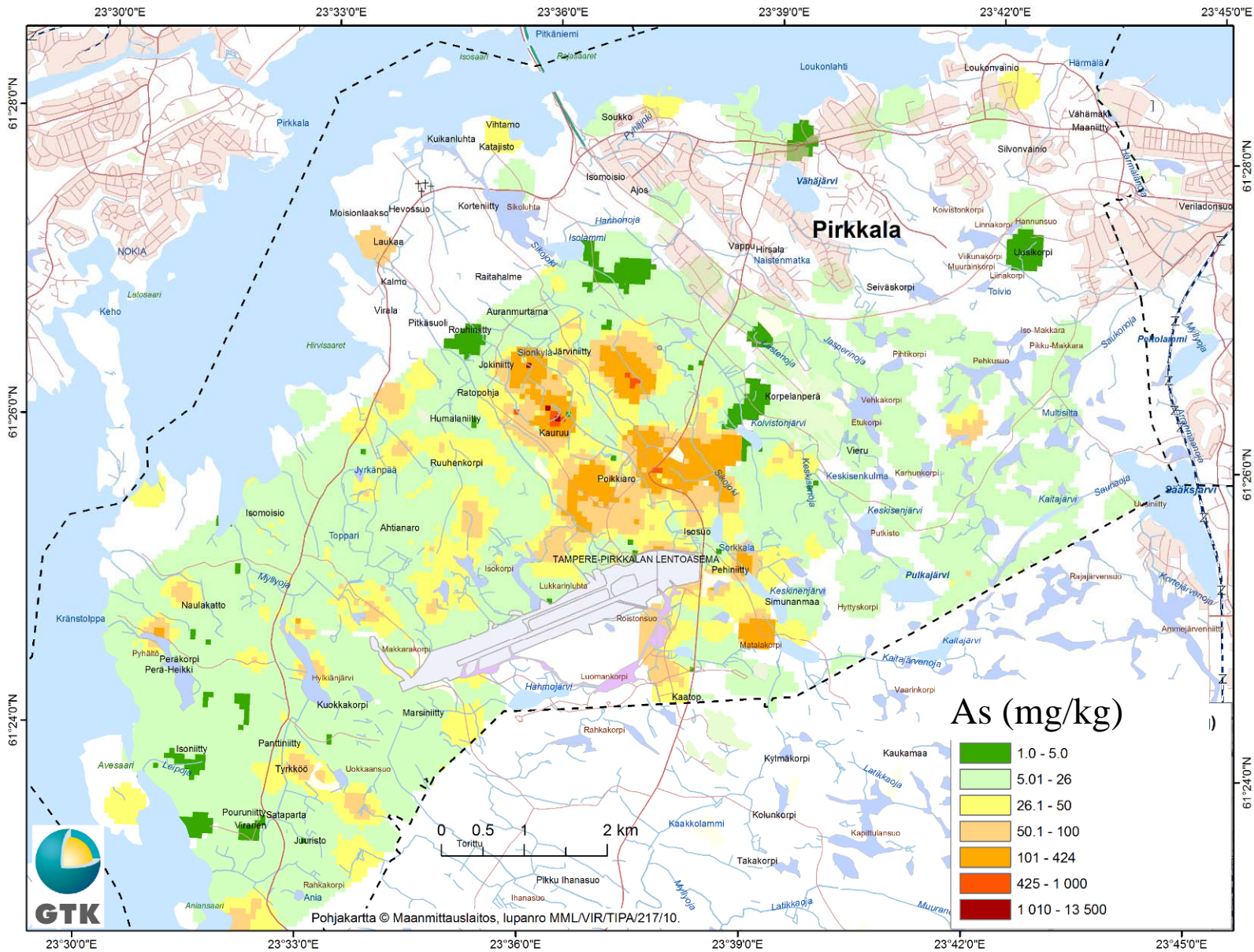
Soil parent material in Pirkkala

The most common soil types were till and clay.
Geochemical samples mostly from till.



Classification of the arsenic concentrations in the risk map:

- 5 mg/kg – Threshold value of the Decree
- 26 mg/kg – Upper limit of baseline variation in the Southern Tampere region till soils
- 50 mg/kg – Lower guideline value for contaminated soils in Finland
- 100 mg/kg – Upper guideline value for contaminated soils in Finland
- 424 mg/kg – Health based limit value for As in soil (Reinikainen 2007)
- 1000 mg/kg – Limit value for dangerous waste (Ympäristöministeriö 2007 Liite 14)
- Interpolation: 50 m x 50 m grid cells, 250 m radius for interpolation using inverse distance weighting



Arsenic risk map for Pirkkala



GTK

Birgitta Backman 13.8.2009

www.gtk.fi

Uncertainty

- Samples mostly from till, much less from other soil types
- Dense targeted sampling in gold exploration areas, data missing from NW and East
- Part of the analysis are made from <0.06 mm size fraction, the others from <2 mm size fraction. Elevated concentrations in the fine fraction?
- Varying sample depths. Probably higher arsenic concentrations in the deeper layers.

Conclusions

- Elevated arsenic concentrations in soil are common in the Southern Tampere region. Upper limit value of the baseline variation is 26 mg/kg for till, 15 mg/kg for clay and 29 mg/kg for sand.
- GTK made an arsenic risk map for the municipality of Pirkkala. In some parts of the municipality, arsenic concentrations are even higher than in other parts of the Tampere region. The highest concentrations exceed the upper limit value.
- According to the health authorities of Pirkkala, elevated arsenic concentrations have been measured from well waters in the soil arsenic risk areas.

Conclusions

- Sampling density is very low in the East and NW parts of the municipality. More samples would be needed to get a good coverage for the whole Pirkkala.
- The known arsenic risk areas will be taken into account in the city planning and construction in Pirkkala.
- Local arsenic risk map and associated measures will be included in the new building code of Pirkkala that will be in force on 1 January 2012.



Thank you

timo.tarvainen@gtk.fi