GEOHINT - The hydrochemical geological background of groundwater bodies in Austria

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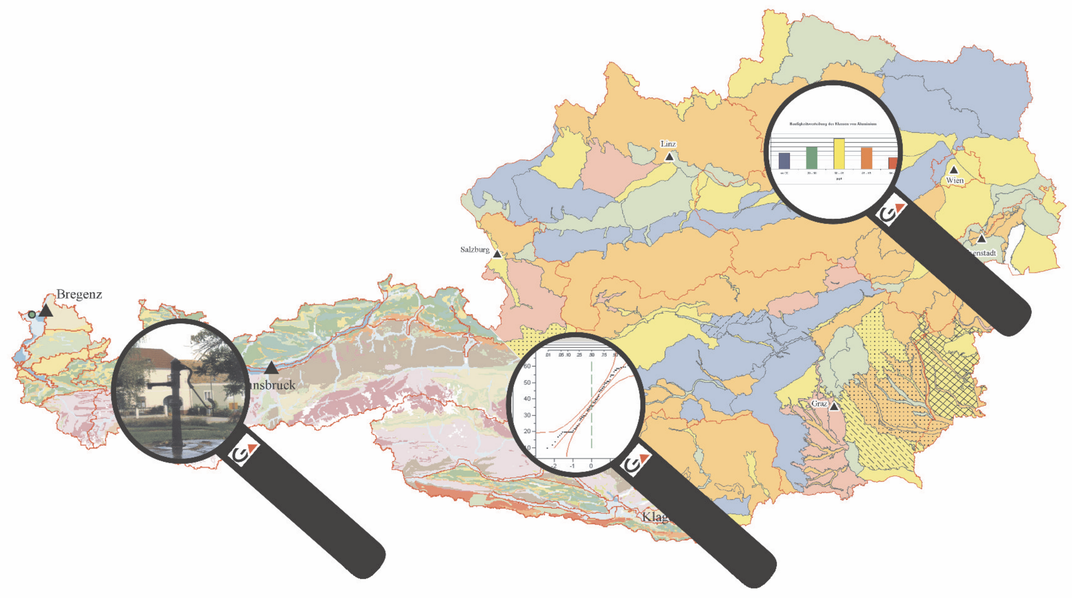
Introduction

The Water Framework Directive of the EU (2000/60/EG) as well as the future "Groundwater Directive" comprise the determination of national background levels. These background levels are necessary to exclude anthropogenic input of chemical parameters into the groundwater. The aim of this study is to determine geogenically induced background values with the help of available hydrochemical, geochemical and other data. This study shall serve as basis for the estimation of anthropogenic influences when assessing the quality of groundwater bodies.



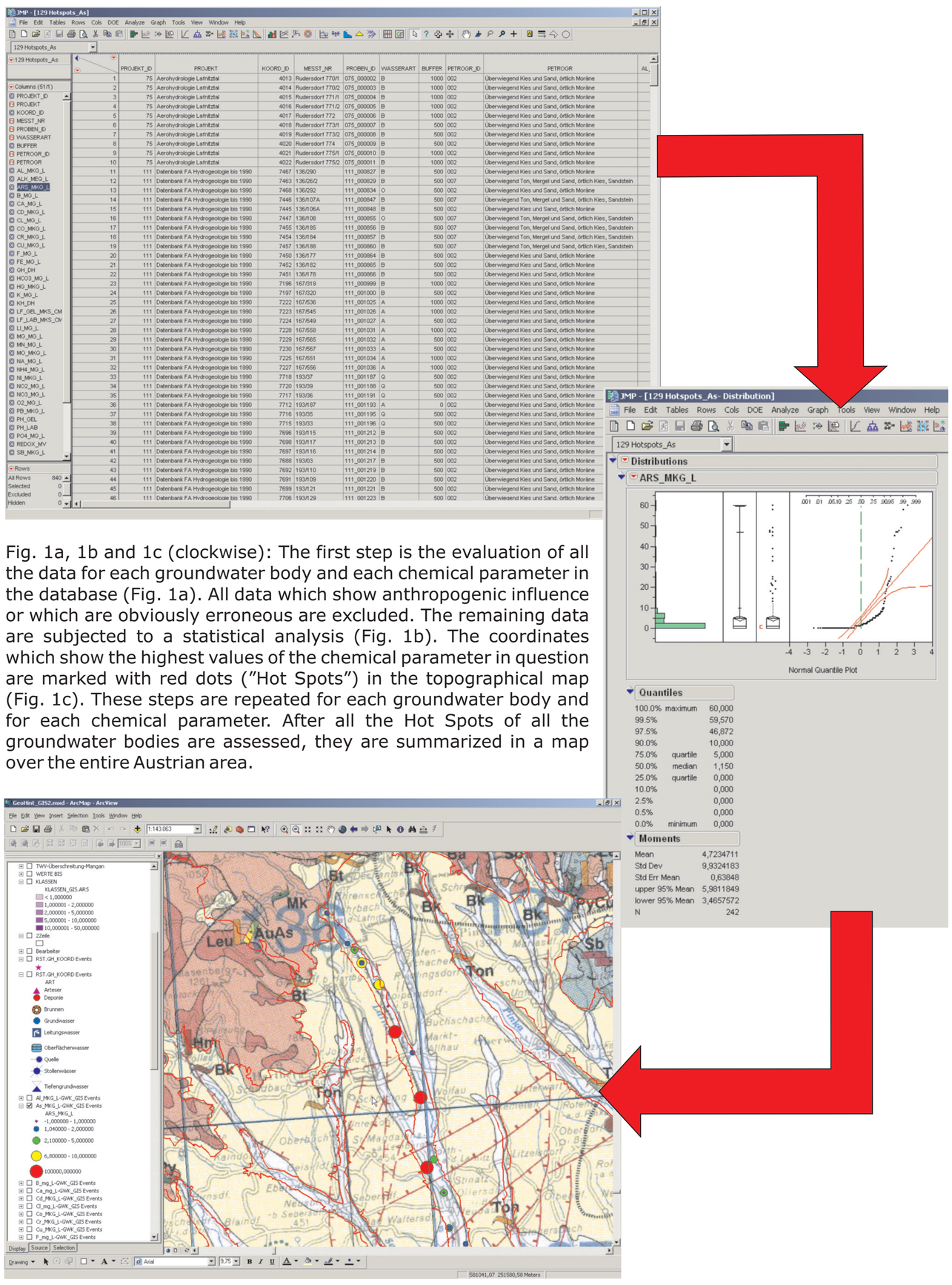


Fig. 1a, 1b and 1c (clockwise): The first step is the evaluation of all the data for each groundwater body and each chemical parameter in the database (Fig. 1a). All data which show anthropogenic influence or which are obviously erroneous are excluded. The remaining data are subjected to a statistical analysis (Fig. 1b). The coordinates which show the highest values of the chemical parameter in question are marked with red dots ("Hot Spots") in the topographical map (Fig. 1c). These steps are repeated for each groundwater body and for each chemical parameter. After all the Hot Spots of all the groundwater bodies are assessed, they are summarized in a map over the entire Austrian area.

Materials and Methods

The background values were determined with the help of a stepwise interpretation of geostatistical, hydrogeological and hydrochemical parameters. The resulting values were illustrated in maps. As basis for the determination of the background values the following hydrochemical and geochemical data were used:

1. Data from the implementation of the Water Quality Monitoring Ordinance
2. Data from hydrochemical analyses from the Federal States
3. Data from research projects of research institutions
4. Data from the Geochemical Atlas of Austria (stream sediments)

All in all, about 2,6 million hydrochemical analyses of 27625 measuring points in the groundwater bodies as well as about 3 million geochemical analyses of about 60000 measuring points were included in this study.

Apart from these data, additional sources like the map of the groundwater bodies, land registers of mining areas and waste dumps, Corin-maps of land use, geological maps etc. were used. All hydrochemical data were then combined in a GIS-database (Fig. 1a). Thereafter, all data were analysed with statistical methods (Fig. 1b). Subsequently, the data were checked on the basis of hydrochemical, hydrogeological and geological considerations. Measurements which showed anthropogenic influence or which were obviously erroneous were singled out and excluded from further processing. The resulting data correspond to the natural background values in the groundwater.

Results

A thorough examination of the data showed, that the background values within one groundwater body can be different due to geological or hydrogeological conditions on a local scale. Therefore it is necessary to distinguish between "global" and "local" background values. The global background is valid for the entire groundwater body, whereas local backgrounds are confined to local conditions. Higher values are referred to as "Hot Spots". One example for Hot Spots are the higher arsenic values in the groundwater body "Lafnitztal" (Burgenland) (Fig. 2a). These higher arsenic values are due to arsenic-bearing ores which occur in the mountains northwest of this groundwater body (Fig. 2b). Such Hot Spots were also taken into consideration and visualized in the GIS.

The results from this project will be published in the "Hydrogeological Atlas" by the University of Natural Resources and Applied Life Sciences Vienna in cooperation with the Federal Ministry of Agriculture, Forestry, Environment and Water Management and in a separate publication by the Geological Survey of Austria.

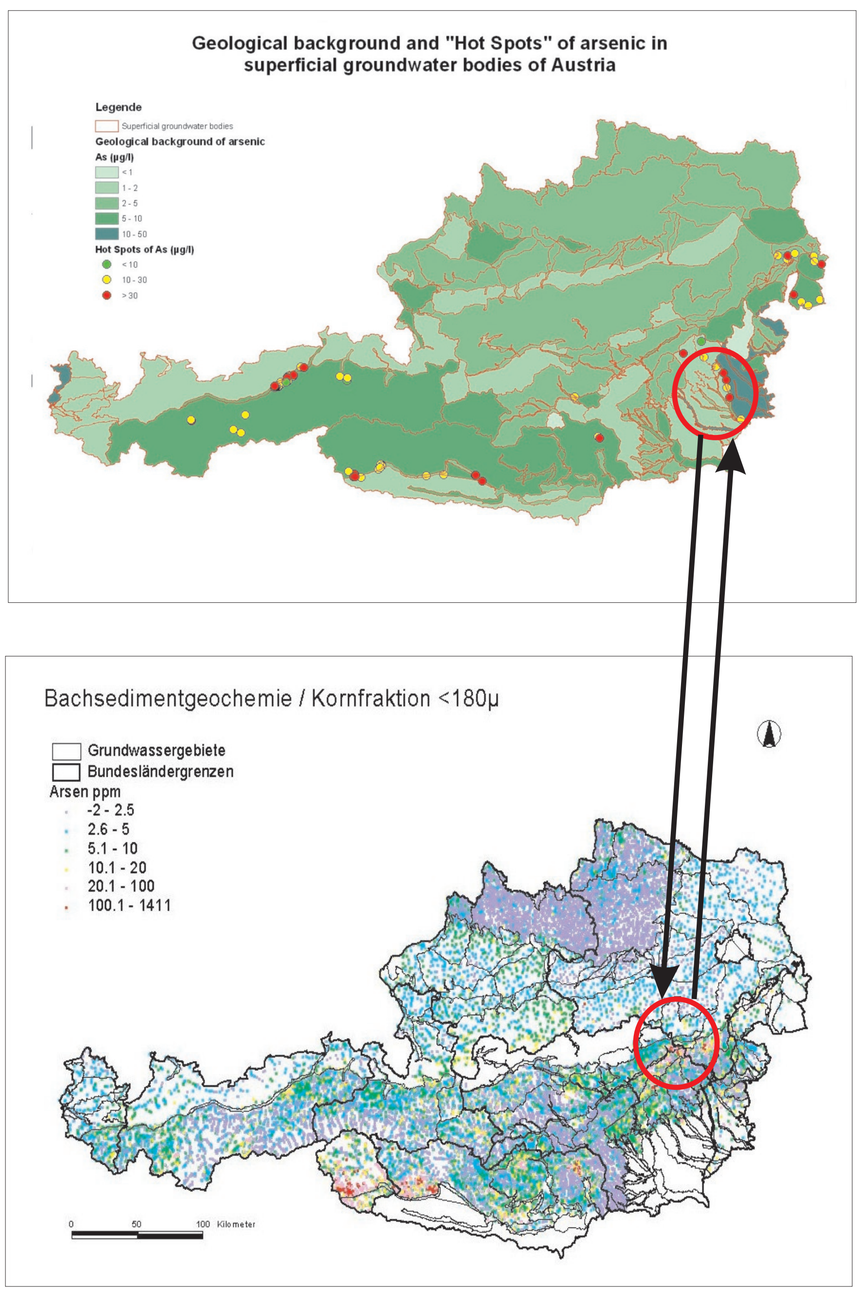


Fig. 2a (above) and 2b (below): Comparison of trace element distribution of the stream sediments (Fig. 2b) (potential sources) and the hydrochemistry of the groundwater bodies (Fig. 2a) (potential flow patterns). The example, indicated by red circles, shows the Hot Spots of arsenic in the groundwater body "Lafnitztal" (Fig. 2a) and the possible sources in the hinterland of this groundwater body.