XXXVIII IAH Congress

Groundwater Quality Sustainability

Krakow, 12–17 September 2010

Extended Abstracts

Editors:
Andrzej Zuber
Jarosław Kania
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University of Silesia Press 2010

abstract id: **524**

topic: **5**
Data processing in hydrogeology

5.3
Groundwater mapping — approach and results

title: **Determining natural background values with probability plots**

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keywords: natural background values, hydrochemistry groundwater, geo-statistical evaluation, probability plots

The implementation of the European Water Framework Directive requires knowledge of regional natural or normal background values of groundwater substances to assess correctly the chemical status of groundwater bodies. But the chemical composition of groundwater is always a mixture of different natural and anthropogenic influences, where the combination of natural influences — with the exception of geogenic ore mineralisation — normally leads to a more or less uniform and lognormally shaped distribution form, whereas anthropogenic influence predominantly acts on the higher range of concentrations. The first step to identify the anthropogenic load therefore has to be to separate the anomalies from the background population.

In exploration geochemistry, for anomaly identification the probability net has been used successfully since a long time (Lepeltier, 1969; Sinclair, 1976; Van den Boom, 1981). Its fundamental characteristic is the distorted representation of the axis with the sum percentage of the distribution in order to achieve a straight cumulative curve. This distortion can be achieved by a transformation of the values to standard distribution. A cumulative percentage value can then be attributed to every z-value.

If data are normally (or log-normally) distributed, they lie on a straight line when plotted against their z-values. Any deviation from the straight line leads to the conclusion that the data at least partly do not follow the chosen distribution. When in a sample populations with different means and/or standard deviations are mixed, they appear as two interconnected straight lines, whose particular intercept (z =0 or cumulative sum = 50%) is equivalent to the mean of the respective subpopulation and the slope to its standard deviation. Therefore, it is easy to derive the respective subpopulation's statistical distribution parameters and to identify normal and anomalous components.

An Excel-tool has been developed that iteratively fits a trend line to the bulk portion of the distribution, excluding anomalies on both sides of the distribution. Based on the resulting distribution parameters, the 90^{th} or the 95^{th} percentile is calculated as relevant background value. Goodness of fit is tested by comparing the correlation coefficient to the correspondent critical values (Ryan, Joyner, 1976). Additionally, a strong normality test, the d'Agostino-Pearson-Test, is also calculated.

Values below detection limit have to be taken into consideration proportionally, so that original slope and intercept of the trend line are preserved. Even for data sets with considerable proportions of values below detection limit (up to 40–50%), reasonable values for mean and standard deviation and therefore background values can be derived, as long as there is no reason to reject the basic assumption of (log)normality for the distribution of the data set.

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International Association of Hydrogeologists

AGH University of Science and Technology

2-vol. set + CD
ISSN 0208-6336
ISBN 978-83-226-1979-0