EGG
EUROPEAN GROUNDWATER GEOCHEMISTRY: BOTTLED WATER

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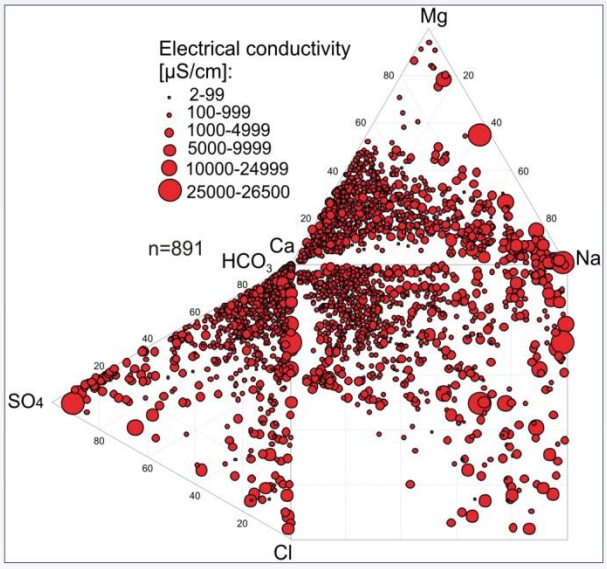
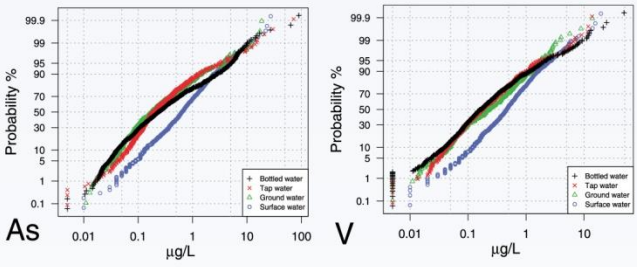
1785 "samples" of bottled water were purchased in supermarkets all over Europe, representing 1247 wells at 884 locations.

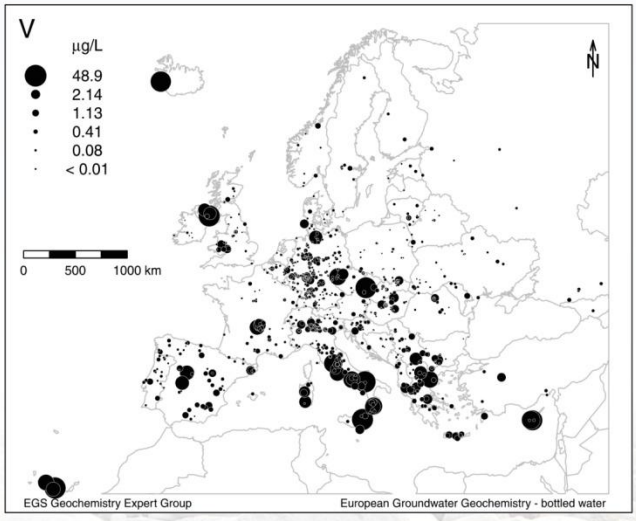
All samples were analyzed for more than 70 parameters. The dataset is used to gain a first impression about the natural concentration of, and variation in, the determined chemical elements and additional parameters in groundwater at a European scale.



The Durov diagram shows the enormous spread of water types being sold as bottled water in Europe.



The concentrations of 70 elements in four datasets (European bottled water, surface water and tap water and Norwegian bedrock groundwater) are compared.



The regional distribution of Vanadium in 884 European bottled water samples demonstrates that high values are connected to active volcanic areas and the occurrence of basalts.

Results are presented in a Geochemical Atlas published by Borntraeger Science Publishers in September 2010.

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Collecting representative groundwater samples at a European scale is not an easy task, and may be prohibitively expensive if performed at a high sample density. It was against this background that the EuroGeoSurveys Geochemistry Expert Group put forward the idea that “groundwater” can be bought ready sampled in supermarkets throughout Europe, and suggested that the Group network should collect bottled water as a first proxy for groundwater. Though the idea met some resistance, it was in the end decided that it “was worth a try”.

The data are presented in a geochemical atlas which can be used to gain a first impression of the natural variation of the analyzed elements in water at a European scale. Natural variation is enormous, usually spanning three to four and occasionally up to seven orders of magnitude.

For some elements the reported concentrations can be influenced by bottle material. However, only for Sb is bottle leaching in comparison to the natural concentrations of the element in water so serious that the results can no longer be mapped or taken to represent the natural concentration and variation of Sb in Europe. In general, glass bottles leach more elements to the water than the PET bottles. All values observed during the leaching tests were well below all MAC values as defined for drinking water in Europe. The bottle leaching test demonstrated the existence of bottles that do not leach measurable concentrations of any of the indicated elements to the water.

Geology is one of the key factors influencing the observed element concentrations for a significant number of elements. Examples include: high values of Cr clearly related to the occurrence of ophiolites; Be, Cs, Li showing high values in areas underlain by Hercynian granites; F, K, Si related to the occurrence of alkaline rocks, especially near the volcanic centres in Italy, and V indicating the presence of active volcanism and basaltic rocks.

Some elements, as observed in the bottled water, are clearly not representative for “normal” shallow groundwater, but tend to exhibit unusually high concentrations, typical for "mineral water", e.g. B, Cs, F, Ge, Li, Na, Rb, Te, Tl and Zr.

In terms of water standards, most bottled water samples fulfil the requirements of the European Union legislation for mineral (and drinking) water. For some elements, a few samples exceed the potable water standards. European tap water is characterized by considerably higher concentrations of Cu, Pb, and Zn than the bottled water – a likely indication of contamination from plumbing and well installations. With very few exceptions all values are, however, well below the MAC values as defined by European legislation.

There exist a number of elements that have been indicated for having health effects in the international literature, but for which no MAC values are defined in the European Union. Some of these exhibit a very large natural variation in the bottled water: examples include Be, I, Li, Th, Tl and U.

All in all, it can be concluded that the idea of using bottled water as a first proxy for groundwater quality at the European Scale was not as ridiculous as it might, at first glance, have appeared. Despite all the potential problems, it has been shown that natural variation in groundwater quality is much larger than the impact of any secondary consideration. Thus, on many maps, the importance of geology and other natural processes for the composition of groundwater is clearly visible. In any case, this survey has provided valuable experiences and should provoke productive proposals for a more thorough and truly systematic investigation of groundwater quality at the European scale.

The results are presented in a geochemical atlas. The book is accompanied by a CD-ROM containing the original datasets.

Reimann, C. and Birke, M. (eds.), 2010. Atlas of European Groundwater Geochemistry: Bottled Water Composition. Borntraeger Science Publishers. Stuttgart – available September 2010.