Bottled Water's Hydrogeochemical characteristics and Health Promotion Effect in Europe

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Water is an essential nutrient and plays a key role in the human body. Water has several crucial functions for the health of human people. The European Food Safety Authority (EFSA) recommends a daily water intake of 1.6 litres for women or 2.0 litres for men (assuming that food contributes on average 20% of the total water intake). In Europe, the importance of drinking adequate amounts of water is also acknowledged by national governments, public health institutes and agencies.

We define three types of bottled water whose characteristics are defined in the following Table.

Characteristics	Filtrated water	Spring water	Natural mineral water*
Origin	Multiple	Groundwater (multiple)	Groundwater (single)
Natural protection	Not required	Mandatory	Mandatory
Treatment	Partial filtration	No disinfection treatment	No disinfection treatment
Mineral content	Variable	Known, low fluctutations	Stable

*Table 1: characteristics of the various types of bottled waters. * exploitation and marketing of natural mineral waters are regulated by Directive 2009/54/EC (European Parliament 2009).*

Characteristics of groundwater are dependent on water-rock interaction, temperature and pressure at depth and transit time : they determine the mineralization and quality of water. The flow system of a classical groundwater reservoir is described at Figure 1 from the infiltration to the outlet.

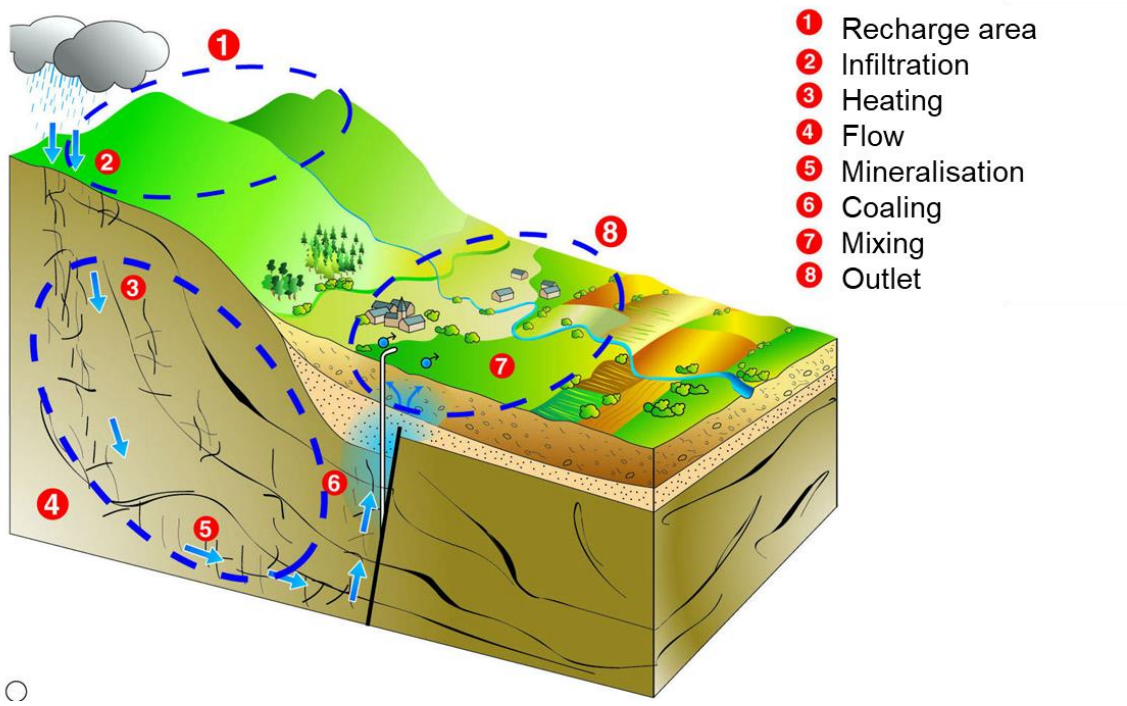

Figure 1: schematic water flow system in a groundwater reservoir (modified from Lopoukhine)

If the deeper part of the flow system is well protected from surface pollutions, the shallow infiltration (recharge) area and the outlet where water is abstracted are very vulnerable to human pollutions. Therefore, it is necessary to protect these two areas in order to keep good quality of water to preserve the health of water consumers.

The outlet area is quite easy to protect, defining protection perimeter where any human activity is forbidden. Good practices of abstraction using properly designed wells contribute to avoid local pollution due to mixing with shallow groundwater.

The recharge area, being much larger, is more difficult to protect. For classical drinkable water supply, municipalities preferred to implement curative measures, such as removal of nitrates and pesticides by building treatment plants, rather than to embark on preventive measures on recharge areas because of the societal difficulties and costs involved (de Marsily 2016). By contrast, the natural mineral water companies were forced to take preventive measures, since curative measures are not allowed. Municipalities also tried to relocate their wells to less contaminated zones, which is also impossible for natural mineral water.

Under certain conditions of feasibility, bottlers can acquire all or part of the land located in the recharge area of the water reservoir to preserve it. Initiatives in partnership, initiated and financed in part by the mineral water producers, bring together the various local actors (municipalities, farmers, authorities, etc.) to promote sustainable management of activities and ecosystems:

- With the farmers, non-polluting activities can be promoted concerning the use of phytosanitary, manure and manure, or the bringing to the standards of the buildings of breeding

- With the municipalities, the accent is put on the risks of occasional pollution related to the defective sanitation networks or the modification of the hydrological cycle resulting from demographic evolution and urbanization.

This necessitates to properly identify the recharge area of the mineral water system and well understand the various stages of the groundwater cycle described at Figure 1. Therefore BRGM is developing research projects with major industrial groups (Nestlé, Danone, Fabre) to ensure sustainable use of resources (Maréchal et al. 2014; Dewandel et al. 2016). The health benefits of mineral waters lie in an ever-deeper knowledge of the hydrogeological context: what is the water flowpath, with which rock is the water in contact, how long is the transit of the water, how is the groundwater reservoir protected, where is the recharge area...?

In order to response to these questions, a multi-disciplinary approach is carried out. Geological mapping and geophysics allow defining the geometry of the groundwater reservoir. Signal treatment applied on long time series of hydraulic and chemical data contributes to identify the main drivers of chemistry and hydrodynamics of the aquifer. Water budgeting compared to the geological model leads to the identification of the recharge area. Isotopes and natural tracers provide information about transit times and water-rock interaction. Finally, a conceptual model integrating all this information is proposed. Then it can be introduced into a numerical model of hydrodynamic and transport processes in order to simulate various pumping scenarios or climate change impact on the quantity and quality of the resource.

The major mineral water producers have well understood this point and they draw from these acquired scientific data the elements of communication that make it possible to show that this product (the mineral water) is unique and shows all the attentions so that tomorrow it is always healthy.

References

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