

Natural baseline quality in European aquifers:

a basis for aquifer management



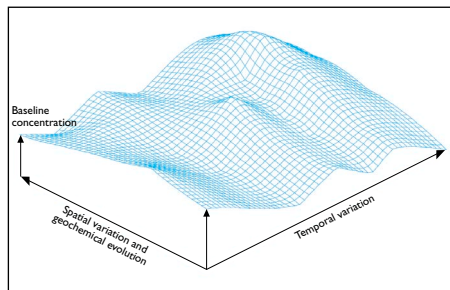
How good is our water quality?

Groundwater is traditionally looked on as pure water, excellent for drinking as well as feeding rivers and streams—but this perception seems to be changing. The BASELINE programme seeks to answer some of the questions about the current state of European groundwater quality, highlighting changes in recent decades.

Baseline concept

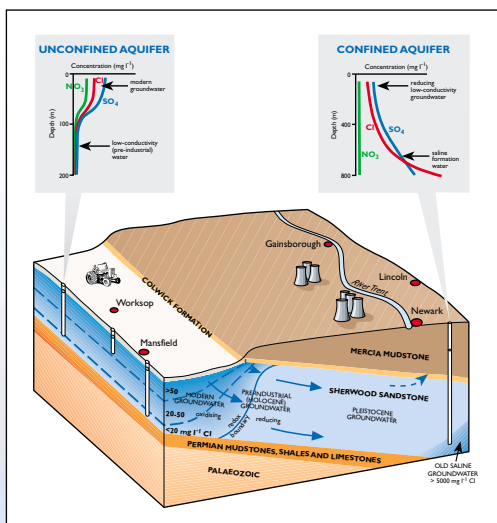
The BASELINE project aims to establish criteria for defining the natural groundwater quality background and to develop a standardised Europe-wide approach which may be used in the emerging Water Framework Directive. Such a standard, based on geochemical principles, is needed as a reference to be able to assess quantitatively whether or not anthropogenic pollution is taking place. Existing water quality limits may be breached by entirely natural processes for elements such as fluoride and arsenic. The project will also focus on time-scales influencing the natural processes and the rates at which natural processes are occurring. The extent to which pristine waters are being depleted by contaminated waters moving into the aquifer will also be assessed.

The natural baseline concentration varies spatially in relation to many factors such as geology and temporally with residence time.



Major and trace inorganic quality

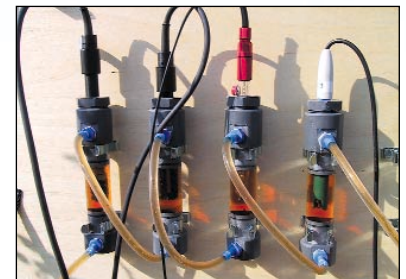
Representative reference aquifers in each country have been selected to evaluate sets of existing data and for resampling.



Three-dimensional distribution of water quality in the East Midlands Triassic sandstone of Nottinghamshire. Modern groundwater, with pollution indicators (NO_3^- , SO_4^{2-}), migrating downgradient. High quality natural fresh water occurs in this aquifer although some natural salinity starts to be found at depth.

Organic quality

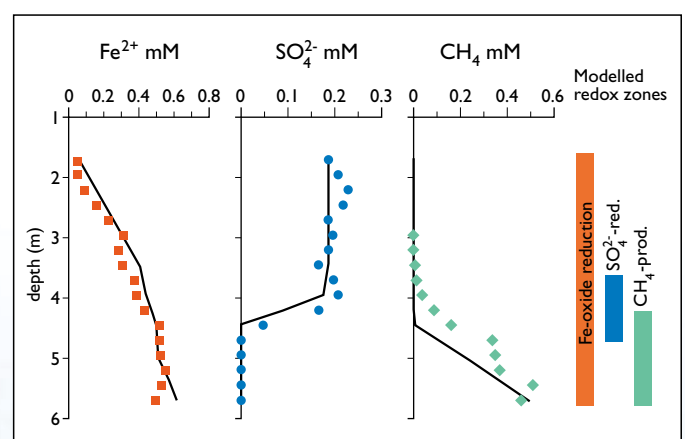
An overview of the naturally occurring dissolved organic carbon in the reference aquifers is being undertaken together with an investigation on the controls on its occurrence. Dissolved organic carbon (DOC) often occurs in groundwaters at natural concentrations of between 0.5–3 mg/L although in some cases natural concentrations of DOC can exceed 50 mg/L.



Monitoring of organic-rich waters provides criteria for understanding baseline concentrations.

Geochemical modelling

The water quality in pristine aquifers is the result of complicated interactions between the solid phase and water flowing through the rock. To enhance the understanding of the processes involved and their interactions, reactive transport modelling will be carried out along selected flowlines. The geochemical data (organic and inorganic)

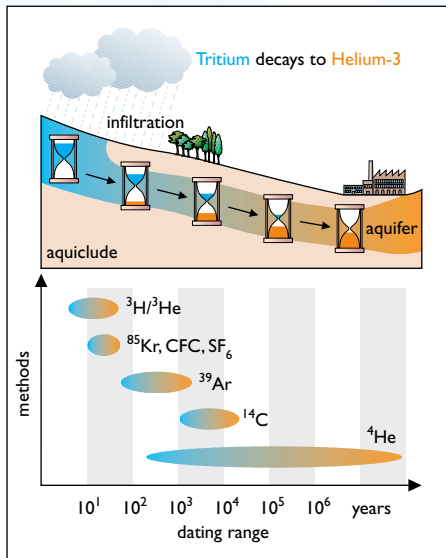


Modelling of evolutionary trends is important to understand past and future trends in baseline.

will be modelled using the state-of-the-art PHREEQC code taking into account the hydrogeology, groundwater residence time and mineralogy of the aquifer. This will provide a quantitative understanding of the main controls on baseline chemistry. Apart from providing an understanding of the evolution of water quality backward in time, such models will also enable us to predict changes in water quality in the future.

Timescales and tracers

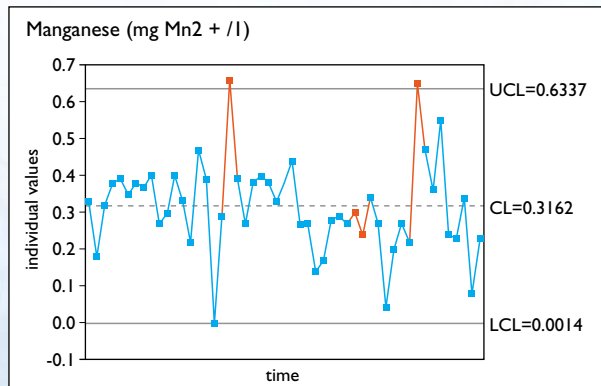
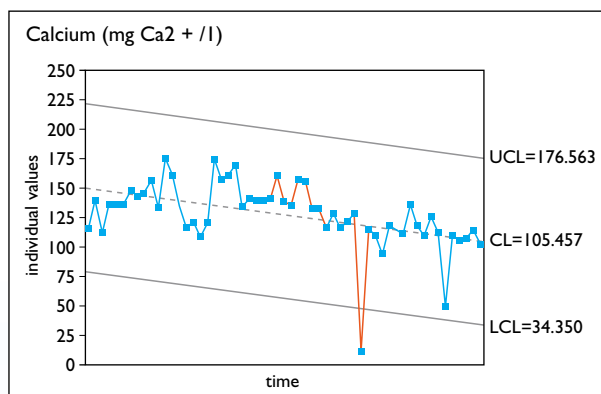
The residence time distributions in the reference aquifers are established using available data, and augmented using new dating and conservative tracer techniques (CFCs, $^3\text{H}/^3\text{H}$, ^{85}Kr , ^{39}Ar).



The age of water can be determined by measuring relative amounts of parent and daughter isotopes. Different methods, based on isotope and tracer techniques, are used in BASELINE to date waters of different ages.

Baseline trends

Historical data on groundwater quality and evolution for selected sites in the reference aquifers are being evaluated to interpret trends in quality over the decades since the aquifers began to be exploited.



Trends in water quality are important to understand changes in natural baseline and anthropogenic influences.

Policy and end users

BASELINE will provide a forum for discussion with policy makers and end users, including the regulators and the water industry. A strategic advisory group has been set up comprising end-users/policy makers from each of the consortium countries.



Baseline quality is relevant to a wide range of stakeholders.

Public awareness

The results of the project will be used to promote the mainly good quality of natural groundwaters.



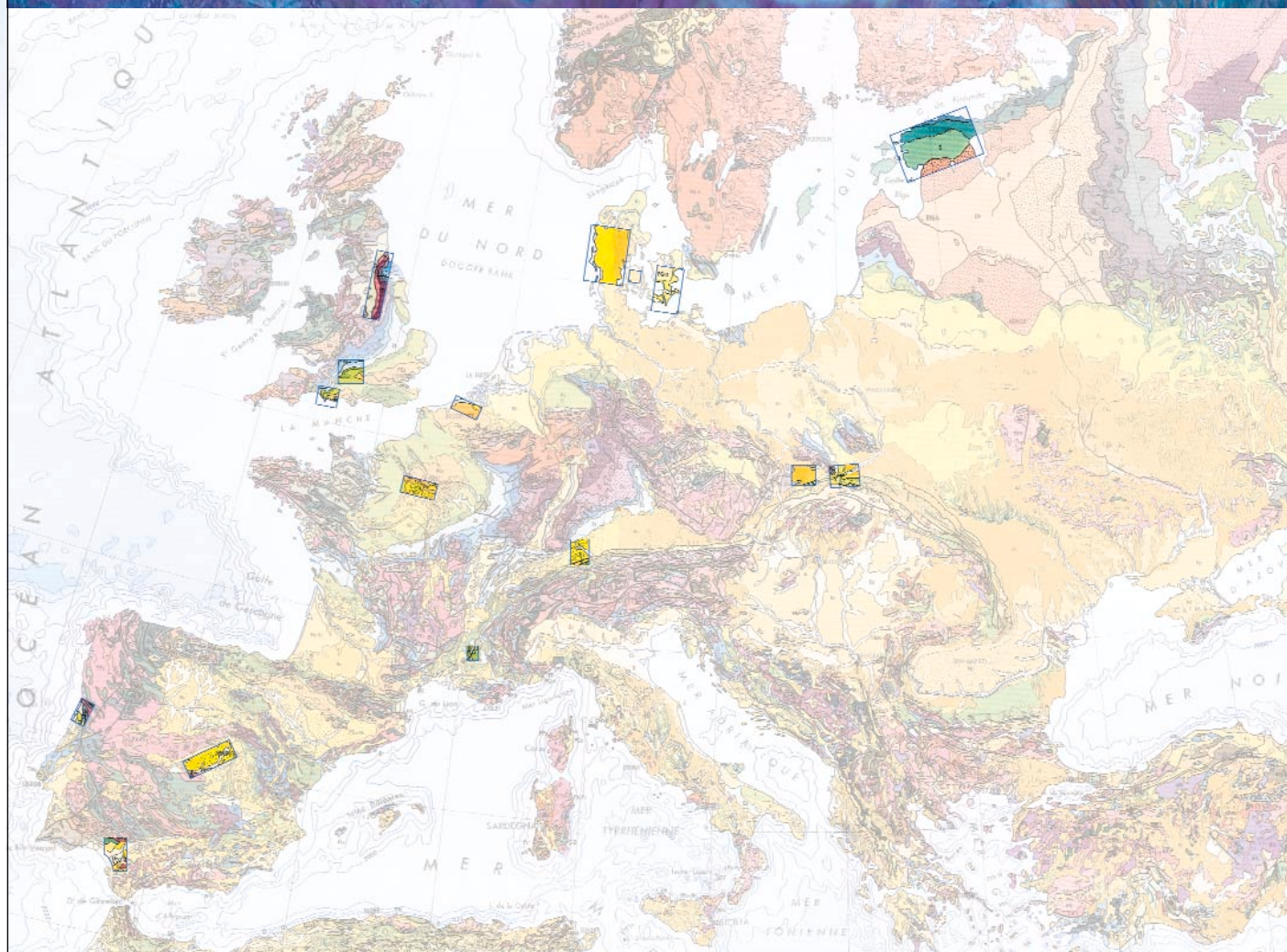
Public interest in water quality is high and dissemination of results forms an important part of the Baseline project.

Recommendations for monitoring

BASELINE aims to provide a basis for, and to select, optimum indicators for defining and monitoring natural waters.



● Field study areas (aquifers) for the BASELINE project



Map courtesy of the Commission For The Geological Map Of The World, <http://www.club-internet.fr/perso/ccgm>

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