

## Mineral and thermal waters in the UK, Sian Loveless and Pauline Smedley

### Introduction (230 words)

In the UK groundwater provides a significant proportion of the public water supply, locally up to 70%. Groundwater classified as mineral or thermal waters is often promoted as benefiting our well-being, over and above providing a vital water resource. Where some of these waters emerge as springs at the ground surface, they have historically been important sites for bathing or drinking.

In the UK thermal water (warmer than the 10-12°C average annual air temperature) is uncommon because the crust in this part of the world is cold with no significant tectonic activity. Water can be heated naturally if it travels to great depths where the earth's temperature is higher, or through rocks that emit their own heat. However there are few pathways to bring warm water to the ground surface. Only one natural thermal bathing spa exists in the UK today, at Bath in southwest England.

Bottled mineral waters have become increasingly popular in the last 30 years however. Bottled waters are sourced from across the country from different geological formations, resulting in varying tastes. The taste derives from the composition of the water. The composition is strongly dependent on reactions with the host rocks and on the length of time it has spent within them. Therefore mineral and thermal waters are intimately linked with geology.

### Why is it special and good for our well-being? (1170 words)

Over history thermal and mineral waters have been considered beneficial for health, from the very early civilisations through to more recent times. Before modern medicine mineral and thermal waters were used to treat a great variety of ailments, from infertility to gout (Robins & Smedley, 2013). Health tourism was popular in Roman-occupied Britain and entered a renaissance in the 1700s and 1800s when people would travel across the country to "take the waters" (for bathing or drinking) (Downing, 1998).

Health benefits were generally believed to be attributed to the many and varied dissolved minerals within the waters. Water rich in magnesium and sulphate (Epsom salts) was popular as a laxative in the 17<sup>th</sup> century. Apart from causing a general purging of the body it would also reduce side effects from treatments such as Venice Treacle, a preventative for the plague. Nonetheless, it is likely that the greatest benefit conveyed by these waters was as a vital source of clean water or as a placebo cure (Robins and Smedley, 2013). There is some evidence that bathing in spring waters can help to ease rheumatism (joint pain) though it is difficult to separate medicinal properties from the more general effects of hydrotherapy. Thermal waters are now used for relaxation.

### Use of the resource

"Taking the waters" has much declined in the UK since the 19<sup>th</sup> Century but this has been superseded by the bottled water industry. Many people consider drinking bottled mineral water preferable to tap water because it is minimally treated (not disinfected) and so perceived to taste better. The practice of bottling and selling of mineral waters first became popular in the 1900s for the rehabilitation of soldiers from World War 1. Nowadays over 2 billion litres of bottled waters are produced by the UK each year, 1.4 billion litres being natural mineral water abstracted from 65 different UK sources (BSDA, 2014, DEFRA, 2014), although the average consumption of bottled water of 37 litres per person per year in the UK is much lower than the European annual average of 115 litres per person. The rise of the bottled water industry should be in the context of growing environmental concerns over food miles and waste (bottle) disposal.

Most bottled mineral waters in the UK originate from minor aquifers in older rocks (nearly 50% of sources originate from rocks more than 300 million years old) and often in uplands (Smedley, 2010). A number of UK mineral waters are world-famous, for example: Malvern water, west England, flows through fractures in ancient igneous rocks and is known for its low solute content. It was prescribed by the National Health Service until this was stopped by cost-cutting measures in 1993 (Robins & Smedley, 2013). Harrogate waters, north England, emerge as springs from a complex aquifer system in deformed Carboniferous rocks. Close to 100 springs associated with the source have differing compositions depending on the residence time of the water in the underground system (Downing, 1998).

Thermal waters of the UK have usually travelled via fractures to great depths in the earth's crust where they are heated by earth's heat energy. This is a slow process so the emerging thermal waters are usually very old. Some 1.25 million litres per day flow from three thermal springs to supply the thermal spa at Bath, with an average temperature of 46.5°C (Atkinson & Davison, 2002). This water infiltrated into the rocks of the Mendip Hills to the south of Bath some 10,000 years ago, circulating to 3km depth, probably flowing back to the surface via a geological fault. The cooler thermal waters at Buxton, north England (27°C) (Smedley, 2010), and Taff's Well, Wales (21°C) (Farr, 2014) no longer supply spas but still yield 1 million and 87 thousand litres per day respectively, with waters estimated to be 5,000 years old.

### Threats and protection

As with any groundwater, bottled mineral water resources are dependent on rainfall. In the exceptionally dry year of 2006 the Malvern Spring stopped flowing altogether. Subsequent rainfall flowed too quickly through the fractures to be adequately filtered, requiring installation of filtration equipment and losing the water its natural mineral water status (Connell, 2007). While such responsiveness to rainfall is an extreme example, long term changes in precipitation (due to climate change, for example) might affect the availability of other bottled water resources.

Over-abstraction of groundwater resources from major aquifers is unlikely to pose a major threat to bottled water resources since the latter are generally sourced from minor aquifers. Some local laws exist to protect the immediate vicinity around sources such as the Bath Springs. Government agencies responsible for the environment license groundwater abstractions for use from aquifers though this authority does not extend to dewatering for mine or quarry works. In this case planning regulations might protect groundwater sources. There is concern in Bath that local quarry dewatering could reduce the temperature or flow of the thermal springs (Atkinson & Davison, 2002).

Pollution measures to protect mineral water springs are stringent because natural mineral water cannot be treated or altered and protection zones can cover vast areas of land. Rules regarding the protection of mineral water springs are detailed in The Natural Mineral Water, Spring Water and Bottled Drinking Water Regulations 2010 (England; SI433; based on European Commission Directives 2009/54/EC and 2003/40/EC).

### Myths and stories

Mineral and thermal waters have a mystique that has rendered them sacred throughout the ages. One of the most notorious tales is of the discovery of Bath spa by Prince Bladud, who was later to become the mythical God-King, father to King Leir (or Lear, in the Shakespeare play). The young Prince was banished from his father's Royal Court after contracting Leprosy. Whilst working as a swine-herdsman he noticed that his pigs enjoyed wallowing in the hot muddy waters around Bath but also did not have common skin diseases. Prince Bladud began to bathe with the pigs and found himself cured. He returned to the Royal Court and founded the city of Bath in 863BC. Bath has

remained popular, being the location of the Roman “Aquae Sulis”, a sanctuary within a sophisticated series of baths with a temple to Goddess Sulis Minerva and was a source of archaeological wonder into the Saxon era and Middle Ages.

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