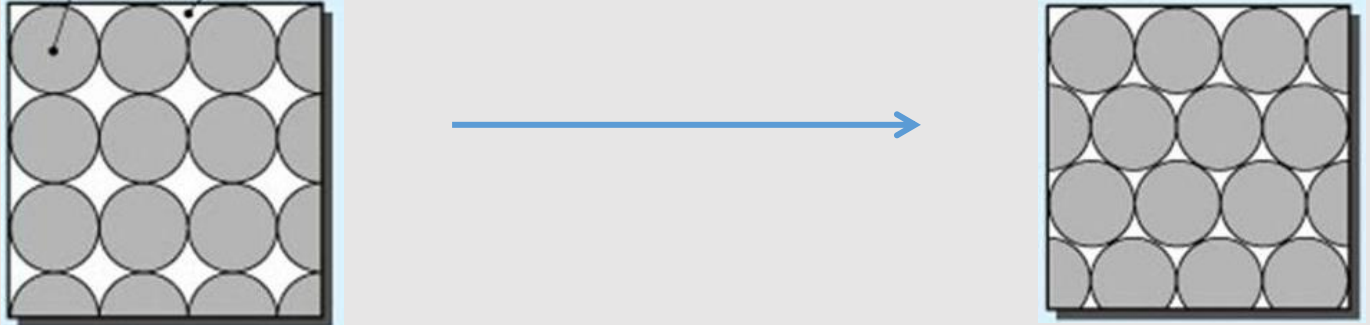


WATER STORAGE AND MOVEMENT IN ROCKS

WHY DOES SUBSIDENCE OCCUR?

Fluid in pore spaces provides an outward force, resisting compaction. Abstraction leads to a lower compressive strength, compaction, loss of pores and **permanently reduced capacity in an aquifer**.



WHAT ARE SPRINGS?

Springs occur where the water table intersects the ground surface. In practice, this is typically the boundary between impermeable and permeable lithologies.

When a line of springs occur along a boundary, we call it a spring line.

Springs are very important for sustaining river flow as well as water supplies. They are subject to variations in the height of the water table and so some may only flow intermittently. Springs are highly dependent on the rainfall of the season.

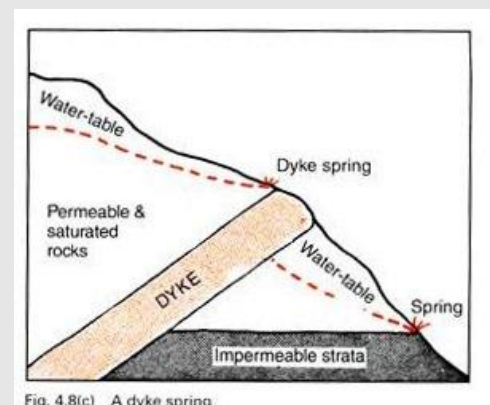
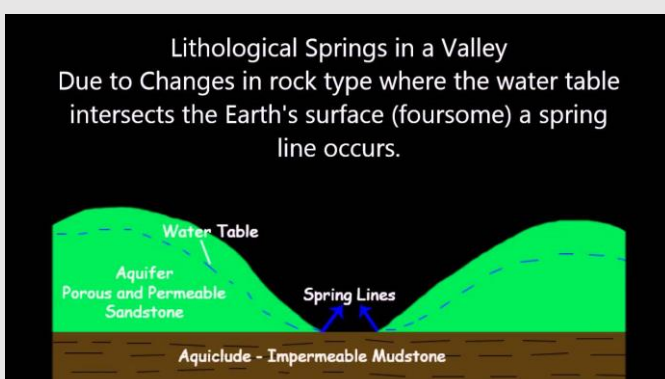
In dry, arid areas, oases of lush vegetation thrive where aquifers intersect the land surface. Such places have been extremely important for transport and trade routes.

TYPES OF SPRINGS

Lithological springs are the result of a change in rock type, occurring where porous & permeable rock overlies impermeable rock.

The water table intersects the land at the junction between the two rock types and a spring line develops along the base of the permeable bed.

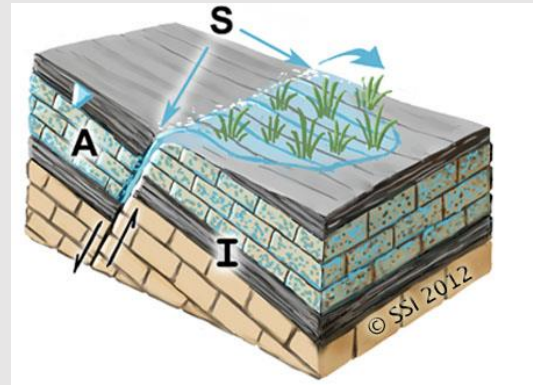
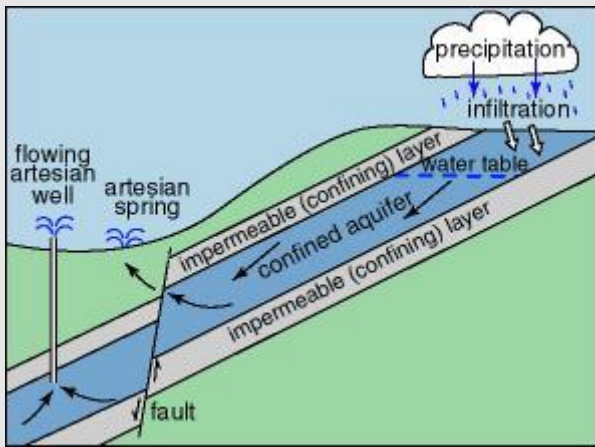
Lithological springs also result where impermeable igneous intrusions (especially dykes) cut through porous, permeable sedimentary rock. Springs occur where there is a contact between the two types that outcrops at the surface.



Springs at faults

Faults can produce springs provided they have moved porous, permeable rock into contact with impermeable rock. A spring line will occur where the fault plane intersects the land surface.

Faults like this will pressurise a confined aquifer further. This causes water to rise up the fault plane to the surface.



Springs at unconformities

If porous, permeable rock lies unconformably on top of impermeable rock, the spring will occur at the junction between the two rock types that intersects the surface.

A spring line develops along the plane of unconformity that intersects the land surface.

Lithological	Fault spring
<p>Lithological springs in a valley</p> <p>Lithological spring next to an igneous intrusion</p>	<p>Spring at a fault</p>
	<p>Unconformity spring</p>

THE ROMAN BATHS & ROMAN ENGINEERING

The city of Bath is famous for its geothermal springs.

Geothermal springs are special cases where the underlying geology has an unusually high geothermal gradient (from a variety of sources) and is consequently hot on exit.

Bath is the only place in the UK where you can bathe in the thermal water that comes directly from the natural hot springs deep beneath the city.

The Roman town of Aquae Sulis lies beneath the modern city of Bath in the valley of the river Avon. Mineral springs of hot water emerge from underground at a rate of over a million litres a day!

This vast amount of water is complimented by its warmth – 46° C to 49° C

The water we see today fell as rain 10,000 years ago and then percolated two miles into the earth, through a confined aquifer of carboniferous limestone. The water is added to by older water from Devonian sandstones and heated by an increasing geothermal gradient before rising up under hydrostatic pressure through fractures to emerge as thermal springs at Bath.

Long before the Romans, the Celts believed in the sacred healing powers of the spring and came to worship their goddess Sulis, believing in her healing power to cure illnesses through immersion in these hot springs.

The Romans arrived and were quick to recognise the importance of such a place. They erected a huge set of public baths for visitors. The Romans enclosed the sacred spring in a large reservoir lined with lead and surrounded by a simple stone balustrade. The bath complex was probably the most magnificent set west of Rome to this date!

The Roman temple is dedicated to Sulis Minerva, as the primary deity of the temple spa (a merge between the Celtic Sulis and Roman Minerva).

The thermal springs were believed to be good for rheumatism, skin conditions, respiratory illness and digestive disorders.

Solinus, de mirabilibus mundi 22

In Britain there are many great rivers and hot springs, adorned with sumptuous splendour for the use of mortals. Minerva is the patron goddess of these springs.

Tourism remains Bath's main industry and with signs "taking the waters" is making a comeback, a modern spa complex called the Thermea Bath Spa opened in the city in 2006.

