

Overview of Groundwater in Africa

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[Jump to navigation](#) [Jump to search](#)

[Africa Groundwater Atlas](#) >> [Resource pages](#) >> Overview of Groundwater in Africa

Please cite page as: Africa Groundwater Atlas. 2019. Overview of Groundwater in Africa. British Geological Survey. Accessed [date you accessed the information]. *Weblink*.

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Contents

- [1 Groundwater in Africa](#)
 - [1.1 Advantages of groundwater as a water resource in Africa](#)
 - [1.2 Limitations of groundwater as a water resource in Africa](#)
 - [1.3 Hydrogeological environments in Africa](#)
 - [1.3.1 Basement aquifers](#)
 - [1.3.2 Volcanic aquifers](#)
 - [1.3.3 Consolidated sedimentary aquifers](#)
 - [1.3.4 Unconsolidated sedimentary aquifers](#)
 - [1.4 More Information](#)

Groundwater in Africa

Groundwater has many advantages as a source of safe, sustainable water in Africa. It is particularly suited to regions with large rural populations, where demand for water is dispersed across large areas. The main advantages and limitations of groundwater as a water resource are summarised below.

Advantages of groundwater as a water resource in Africa

- Groundwater can be found in most environments, at least enough to provide small domestic supplies. It is therefore usually available close to the point of demand.
- Groundwater usually has excellent natural water quality and is usually suitable for potable use with no prior treatment.
- Groundwater is naturally more protected from contamination than surface water/
- Groundwater provides large volumes of natural water storage. Seasonal variations in amount or quality aren't usually significant, so that groundwater is more drought resistant than surface waters.
- Groundwater lends itself well to principles of community management. It can be developed incrementally, often at relatively low cost/initial capital investment.

Limitations of groundwater as a water resource in Africa

- In some hydrogeological environments, considerable investment is needed to locate and

develop suitable sites for groundwater abstraction - dug wells, drilled boreholes or improved springs.

- In some hydrogeological environments, there can be natural groundwater quality problems - such as iron, fluoride or arsenic.
- As human development increases, the threat of groundwater pollution increases, and there is a greater need for awareness of, and action on, groundwater and aquifer protection.
- Groundwater can be vulnerable to over-abstraction, particularly in low productivity aquifers and/or as water demand and the ability to abstract large volumes of water both grow. Long term changes in rainfall patterns can also impact on groundwater recharge and renewal.
- As overall water supply coverage increases, more hydrogeologically difficult areas can remain unserved, and they become more costly to develop.

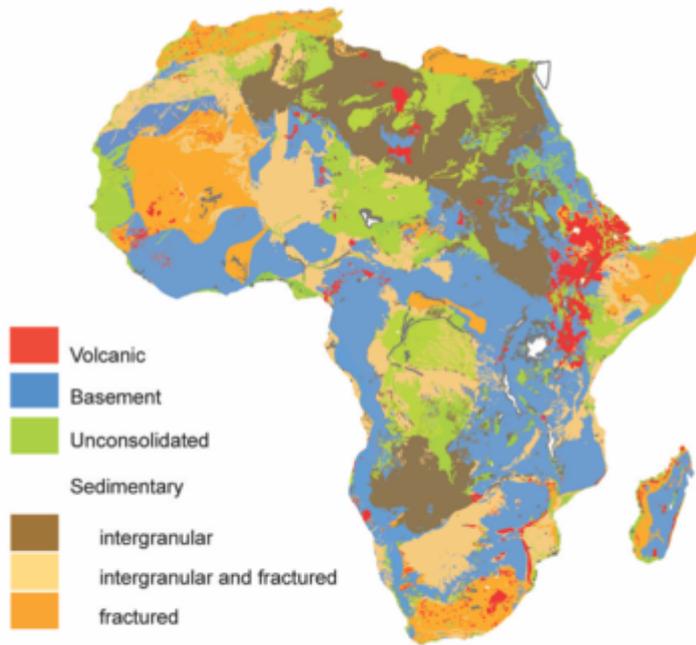
Hydrogeological environments in Africa

How and where groundwater occurs depends primarily on **geology, geomorphology/weathering, and rainfall** (both current and historic). The interaction between these three factors gives rise to complex hydrogeological environments, with countless variations in the quantity, quality, ease of access to and renewability of groundwater resources. Because the hydrogeology - how groundwater exists and behaves - is different in each environment, different methods are needed to find, abstract and manage groundwater. Successfully developing groundwater resources depends on a good understanding of the hydrogeological environment.

Africa is hugely diverse in its geology, climate and hydrology. As a result, the hydrogeology of Africa is also hugely variable. But at a continental scale, there are only four main types of **hydrogeological environment** (or **aquifer type**) - shown in the map, below:

- **basement** aquifers;
- **volcanic** aquifers;
- **consolidated sedimentary** aquifers (which can be dominated by either fracture and/or intergranular flow); and
- **unconsolidated sedimentary** aquifers.

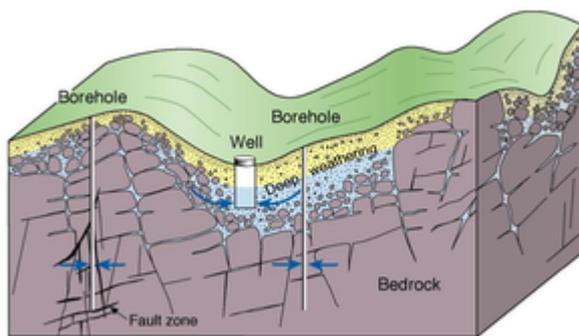
A detailed description of these environments is in [MacDonald and Davies \(2001\)](#); and a summary is below.



The main hydrogeological environments in Africa

Basement aquifers

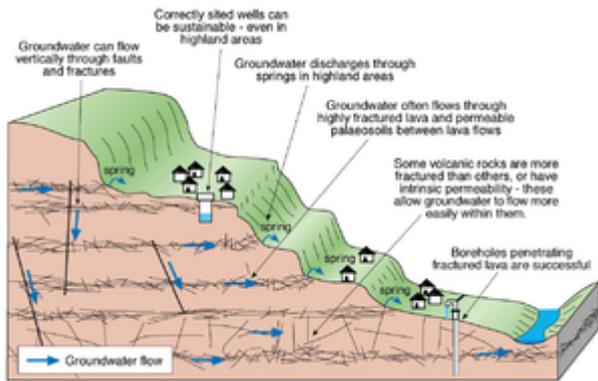
Crystalline basement rocks of Precambrian age underlie much of Africa. They form low productivity aquifers that provide small rural water supplies for tens, if not hundreds, of millions of people. Groundwater occurs where the rocks have been significantly weathered and/or in fracture zones, most of which are usually shallower than a few tens of metres depth. Borehole and well yields are generally low, but usually sufficient for rural demand.



Groundwater occurrence in a weathered basement aquifer

Volcanic aquifers

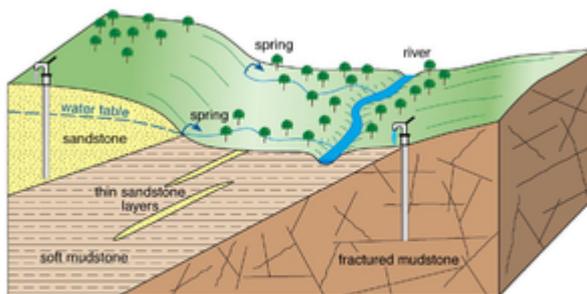
Volcanic rocks underlie a small but significant proportion of Africa's land area, and are an important water source for tens of millions of people, many of whom live in the drought stricken areas of the Horn of Africa. Groundwater in volcanic aquifers is found within palaeosoils and fractures between lava flows. Yields can be high, and springs are important sources in highland areas.



• Groundwater occurrence in a volcanic rock aquifer

Consolidated sedimentary aquifers

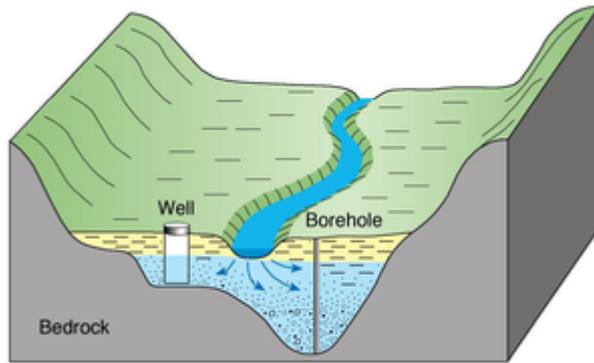
Consolidated sedimentary rocks underlie around one third of Africa's land area, and can form thick, highly productive aquifers. The most significant aquifers are sandstones and limestones, which can be exploited for large urban as well as rural supplies. Mudstones however, which account for about 65% of all sedimentary rocks in Africa, contain little groundwater, and careful study is required to develop groundwater supplies from mudstones.



• Groundwater occurrence in a consolidated sedimentary aquifer

Unconsolidated sedimentary aquifers

Unconsolidated sediments directly underlie much of Africa, and are extremely important for both rural and urban water supplies. Unconsolidated sands and gravels occur in most river valleys throughout Africa, and in many coastal areas. These deposits are often highly permeable and can store large volumes of groundwater at shallow depths, which is easy to exploit by traditional shallow wells and boreholes.



- Groundwater occurrence in unconsolidated valley alluvium

More Information

More information on geology and aquifer characteristics across Africa can be found in these [resource pages](#): [geology](#); [hydrogeology map](#); and [aquifer properties](#). More detailed information on aquifers in each country can be found in the [country pages](#).

Maps summarising the hydrogeology of Africa: [Quantitative Groundwater Maps for Africa](#)

MacDonald, A.M. & Davies, J. 2000. [A brief review of groundwater for rural water supply in sub-Saharan Africa](#). British Geological Survey Report WC/00/033.

MacDonald, A.M., Bonsor, H.C., Ó Dochartaigh, B.É. & Taylor, R.G. 2012. [Quantitative maps of groundwater resources in Africa](#). Environmental Research Letters 7(2).

MacDonald, A.M. & Calow, R.C. 2009. [Developing groundwater for secure water supplies in Africa](#). Desalination 248, 546-556. doi: 10.1016/j.desal.2008.05.100

[Africa Groundwater Atlas](#) >> [Resource pages](#) >> Overview of Groundwater in Africa

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- [Additional resources](#)
- [Africa Groundwater Atlas](#)

Navigation menu

Personal tools

- Not logged in
- [Talk](#)
- [Contributions](#)
- [Log in](#)
- [Request account](#)

Namespaces

- [Page](#)
- [Discussion](#)

Variants

Views

- [Read](#)
- [View source](#)
- [View history](#)
- [PDF Export](#)

More

Search

Navigation

- [Main page](#)
- [Recent changes](#)
- [Random page](#)
- [Help about MediaWiki](#)

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- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Permanent link](#)
- [Page information](#)
- [Cite this page](#)
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