**Water in the Desert**

沙漠中的水源

Rainfall is not completely absent in desert areas, but it is highly variable. An annual rainfall of four inches is often used to define the limits of a desert. The impact of rainfall upon the surface water and groundwater resources of the desert is greatly influenced by landforms. Flats and depressions where water can collect are common features, but they make up only a small part of the landscape.

沙漠中并不是完全没有降雨，只不过是变数很大。通常一年以内降雨次数少于 4

次是定义沙漠的限定条件。降水对沙漠地表和地底的水资源的影响很大程度上取决于地貌。平原和洼地是水源聚集的共同地貌特征，不过他们只占地表的很小一部分。

Arid lands, surprisingly, contain some of the world’s largest river systems, such as the Murray-Darling in Australia, the Rio Grande in North America, the Indus in Asia, and the Nile in Africa. These rivers and river systems are known as "exogenous" because their sources lie outside the arid zone. They are vital for sustaining life in some of the driest parts of the world. For centuries, the annual floods of the Nile. Tigris, and Euphrates, for example, has brought fertile silts and water to the inhabitants of their lower valleys. Today, river discharges are increasingly controlled by human intervention, creating a need for international river-basin agreements. The filling of the Ataturk and other dams in Turkey has drastically reduced flows in the Euphrates, with potentially serious consequences for Syria and Iraq.

令人惊奇的是，干旱地区往往都存在着世界上最大的河流流域，例如澳大利亚的

墨累-达令河，北美洲的格兰德河，亚洲的印度河，以及非洲的尼罗河。这些河

流被称作和所在的流域因为河的源头在干旱地区以外而被称为“外流河”。他们对于全世界沙漠地区的生命的存活至关重要。几个世纪以来，尼罗河每年都会定期泛滥。举个例子，幼发拉底河和底格里斯河都会把大量的肥沃的泥沙和水源带给下游低洼地带的居民。现在，河水的流量越来越多的受到人类的干涉，产生了国际性的河流流域的协议。阿卡杜克水坝以及其他一些建在土耳其境内的大坝就极大的减少了幼发拉底河的径流量，潜移默化的给叙利亚河和伊拉克造成了严重的后果。

The flow of exogenous rivers varies with the season. The desert sections of long rivers respond several months after rain has fallen outside the desert, so that peak flows may be in the dry season. This is useful for irrigation, but the high temperatures, low humidity, and different day lengths of the dry season, compared to the normal growing season, can present difficulties with some crops.

外流河的径流量通常受季节影响。雨季过后，从外部流入沙漠区域的长河可以持

续好几个月，以便保持干旱时节的相对较少的径流量。这虽然有助于灌溉，但是

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Regularly flowing rivers and streams that originate within arid lands are known as "endogenous." These are generally fed by groundwater springs, and many issue from limestone massifs, such as the Atlas Mountains in Morocco. Basaltic rocks also support springs, notably at the Jabal Al-Arab on the Jordan-Syria border. ■Endogenous Rivers often do not reach the sea but drain into inland basins, where the water evaporates or is lost in the ground. ■Most desert streambeds are normally dry, but they occasionally receive large flows of water and sediment.■

通常发源地在干旱地区的河流和溪水被称为“内流河”。它们通常是又地下水的泉眼供给，也一些石灰岩断层中流出的水源供给，例如摩洛哥的阿特拉斯山。Basaltic 岩石也提供源头水，比较著名的就是约旦和叙利亚交接的Jabal Al-Arab.内流河通常都不会到达大海而是注入内陆的低地的同时蒸发或者消失在地表。大多数沙漠的河床通常都是干枯的，偶有比较大的径流和沉积物。

Deserts contain large amounts of groundwater when compared to the amounts they hold in surface stores such as lakes and rivers. ■But only a small fraction of groundwater enters the hydrological cycle-feeding the flows of streams, maintaining lake levels, and being recharged (or refilled) through surface flows and rainwater. In recent years, groundwater has become an increasingly important source of freshwater for desert dwellers. The United Nations Environment Program me and the World Bank have funded attempts to survey the groundwater resources of arid lands and to develop appropriate extraction techniques. Such programs are much needed because in many arid lands there is only a vague idea of the extent of groundwater resources. It is known, however, that the distribution of groundwater is uneven, and that much of it lies at great depths.

相比于地表所的湖泊和河流含有的水量，沙漠中地下水的贮藏量要大得多。不过只有一小部分地下水参与了河流的水循环，保持湖泊的水位，并通过地表径流和降雨进行再造（再注入）。近些年来，地下水作为沙漠住民的活水来源的重要性日益加重。美国国家环境总署和世界银行开始拨款尝试调查统计干旱地区的地下水资源并发展合适的开采技术。像这样的工程非常必要因为在干旱地区对于地下水资源的保有量的概念非常模糊。然而可以确定的是，地下水资源的分布非常不均匀，且大多埋藏在很深的地底。

Groundwater is stored in the pore spaces and joints of rocks and unconsolidated (unsolidified) sediments or in the openings widened through fractures and weathering. The water-saturated rock or sediment is known as an "aquifer". Because they are porous, sedimentary rocks, such as sandstones and conglomerates, are important potential sources of groundwater. Large quantities of water may also be stored in lime stones when joints and cracks have been enlarged to form cavities. Most limestone and sandstone aquifers are deep and extensive but may contain ground waters that are not being recharged. Most shallow aquifers in sand and gravel deposits produce lower yields, but they can be rapidly recharged. Some deep aquifers are known as "fossil waters. The term "fossil" describes water that has been present for several thousand years. These aquifers became saturated more than 10,000 years ago and are no longer being recharged.

地下水一般储存在多孔道的地区和连接岩层的未凝固沉积层或者是通过风华和

断裂形成的宽阔的孔洞。饱含水的岩石或沉积物被称为“蓄水层”。因为沉积岩的多孔性，比如砂岩和砾岩，都是地下水的重要潜在源头。大量的水资源也可能储存在石灰岩中，只要联结和裂口足够大到形成容器。大多数石灰岩和砂岩蓄水层很深且广大，但是保有的水资源是不能再生的。大多数沙石中的较浅的蓄水层只有较小的保有量，但是他们可以迅速的再生。一些深层的蓄水曾被称为“化石水”。“化石”的意思是说这里的水已经被保存了几千年之久。这些蓄水层充满水起码已经 1 万年以上了，而其他们在短期之内是无法再生的。

Water does not remain immobile in an aquifer but can seep out at springs or leak into other aquifers. The rate of movement may be very slow: in the Indus plain, the movement of saline (salty) ground waters has still not reached equilibrium after 70 years of being tapped. The mineral content of groundwater normally increases with the depth, but even quite shallow aquifers can be highly saline.

水在贮存在蓄水层中不是保持不流动的，而是通过泉眼或是渗漏进入其他的蓄水层，可以流动的比例可能很低；在印度平原，流动的含盐地下水在开发了 70 年以后依旧不能达到平静。矿石中保有的地下水通常会增加蓄水层的深度，但是较浅的安静蓄水层会饱含盐分。