**Groundwater**

**地下水**

Most of the world’s potable water—freshwater suitable for drinking—is accounted for by groundwater, which is stored in the pores and fractures in rocks. There is more than 50 times as much freshwater stored underground than in all the freshwater rivers and lakes of Earth. At greater depths within Earth, the pressure of the overlying rock causes pores and cracks to close, reducing the space that pore water can occupy, and almost complete closure occurs at a depth of about 10 kilometers. The greatest water storage, therefore, lies near the surface.

世界上绝大部分饮用水——可以饮用的淡水——都是地下水，它们储藏在岩石孔隙和裂缝中。储藏于地下的淡水是地表淡水河流和湖泊中总水量的50倍。大约50%的地下水存在于地下深1000m以内的地层中。随深度增加，上覆岩层压力使岩石孔隙和裂缝闭合，减少了水的储存空间，而超过10公里深的地下孔隙几乎全部闭合。因此绝大部分水储存于接近地表的地层中。

Aquifers, Porosity, and Permeability

Groundwater is stored in a variety of rock types. A groundwater reservoir from which water can be extracted is called an aquifer. We can effectively think of an aquifer as a deposit of water. Extraction of water depends on two properties of the aquifer: porosity and permeability. Between sediment grains are spaces that can be filled with water. This pore space is known as porosity and is expressed as a percentage of the total rock volume. Porosity is important for water-storage capacity, but for water to flow through rocks, the pore spaces must be connected. The ability of water, or other fluids, to flow through the interconnected pore spaces in rocks is termed permeability. Fractures and joints have very high permeability. In the intergranular spaces of rocks, however, fluid must flow around and between grains in a tortuous path; this winding path causes a resistance to flow. The rate which the flowing water overcomes this resistance is related to the permeability of rock.

水层，孔隙度和渗透率

地层水储存在多种岩石中。可以取出的地下水的聚集层叫做水层。我们可以认为水层即水的聚集地层。从地层中取水取决于水层的两个因素：孔隙度和渗透率。沉积颗粒之间的空间可以储存水，这种孔隙空间由孔隙度表征。孔隙度是岩石孔隙体积与总体积的百分比。孔隙度对地层储水能力尤为重要，但欲使水从岩石中流出，孔隙之间必须相互连通。水或其它流体从相互连通的孔隙中流动的能力即为渗透率。在粒间孔发育的岩石中，流体必须在颗粒周围的曲折通道中流动;这种曲折通道会对流动产生阻力。水克服阻力流动的速率与岩石渗透率相关。

Sediment sorting and compaction influence permeability and porosity. The more poorly sorted or the more tightly compacted a sediment is, the lower its porosity and permeability. Sedimentary rocks—the most common rock type near the surface—are also the most common reservoirs for water because they contain the most space that can be filled with water. Sandstones generally make good aquifers, while finer-grained mudstones are typically impermeable. Impermeable rocks are referred to as aquicludes. Igneous and metamorphic rocks are more compact, commonly crystalline, and rarely contain spaces between grains. However, even igneous and metamorphic rocks may act as groundwater reservoirs if extensive fracturing occurs in such rocks and if the fracture system is interconnected.

沉积物的分选性和压实程度影响其渗透率和孔隙度。岩石分选越差或压实越紧则其孔隙度和渗透率越低。沉积岩——地表最常见的岩石——也是最常见的水储集层，因为它们常带有最多的可以储水的孔隙空间。砂岩一般是最好的储水层，但小颗粒的泥岩则通常不可渗透。不渗透岩层都称为隔水层。火成岩和变质岩压实更紧，通常有结晶，并几乎没有粒间孔隙。但是即便是火成岩和变质岩也可因裂缝大量发育并相互连接而成为储水层。

The Water Table

The water table is the underground boundary below which all the cracks and pores are filled with water. In some cases, the water table reaches Earth’s surface, where it is expressed as rivers, lakes, and marshes. Typically, though, the water table may be tens or hundreds of meters below the surface. The water table is not flat but usually follows the contours of the topography. Above the water table is the vadose zone, through which rainwater percolates. Water in the vadose zone drains down to the water table, leaving behind a thin coating of water on mineral grains. The vadose zone supplies plant roots near the surface with water.

地下水位

地下水位指地层岩石裂缝和孔隙充满水的边界。某些情况下，地下水位可能到达地表，在那里它以河流、湖泊或沼泽地的形式存在。但通常情况下地下水位位于地面数十或数百米以下。地下水位不是水平的，而是通常沿着地势起伏。地下水位以上称为包气带，在这里降水得以过滤。包气带中的水会沉降到地下水位，只在矿物颗粒表面留下一层水膜。包气带为地表附近植物根部提供水分。

Because the surface of the water table is not flat but instead rises and falls with topography, groundwater is affected by gravity in the same fashion as surface water. Groundwater flows downhill to topographic lows. If the water table intersects the land surface, groundwater will flow out onto the surface at springs, either to be collected there or to subsequently flow farther along a drainage. Groundwater commonly collects in stream drainages but may remain entirely beneath the surface of dry stream-beds in arid regions. In particularly wet years, short stretches of an otherwise dry stream-bed may have flowing water because the water table rises to intersect the land surface.

因为地下水位表面并非水平，而是沿着地势起伏，地下水和地表水受到重力影响的模式相同。地下水沿着下倾地层流向地势低洼处。如果地下水位与地表相交，地下水将以喷泉的形式流出地面，要么就地聚集，要么沿排水通道流向更远的地方。地下水通常在小溪中聚集，但在干旱地区也可能全部停留在干涸河床下。在特定湿润的年月里，一段干涸的河床下游可能有水流动，因为地下水位抬升到了那里的地表以上。