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THE PRIMARY FEATURES AND INDICATORS OF SUBTERRANEAN WATER

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Annotation: *Understanding the dynamics and characteristics of underground water is vital for effective water resource management. The main aspects and signs of underground water encompass a range of geological, hydrological, and environmental factors. This includes the identification of subsurface aquifers through geophysical exploration, monitoring water table fluctuations, and recognizing visible manifestations such as springs and seepages. Additionally, groundwater quality indicators play a crucial role in assessing the health of underground water sources, ensuring sustainable utilization. The construction and monitoring of groundwater wells, combined with an awareness of the interactions between underground and surface water, contribute to a comprehensive understanding of this essential component of the hydrological cycle. Overall, a holistic approach to studying underground water involves the integration of geological, hydrogeological, and environmental sciences to inform responsible and sustainable groundwater management practices.*

Keywords: *subsurface structures, hydro stratigraphy, geological formations, aquifer dynamics, water table, confined aquifers, unconfined aquifers, aquifer recharge, artesian wells, boreholes, well construction, well screens, water table drawdown, interconnected systems, hypothec zone, groundwater-fed streams, groundwater monitoring, water table fluctuations, sustainable yield, aquifer management.*

Groundwater refers to the water present beneath the Earth's surface within the pore spaces of soil and rocks. It is a critical component of the hydrological cycle, representing the subsurface portion of the Earth's freshwater resources. Groundwater originates from precipitation that infiltrates the soil and percolates downward through unsaturated zones until it reaches the water table. The water table is the boundary between the unsaturated and saturated zones, where pore spaces in the soil or rock are filled with water.

Aquifers are geological formations capable of storing and transmitting significant amounts of water. They can be composed of various materials such as sand, gravel, or permeable rock. Aquifers are classified as unconfined (water table is at the top) or confined (sandwiched between impermeable layers). Two fundamental properties influencing groundwater flow are hydraulic conductivity and porosity. Hydraulic conductivity represents the ability of the subsurface material to transmit water, while porosity is the percentage of void space within the material.

The movement of groundwater follows Darcy's Law, which states that the flow rate is proportional to the hydraulic gradient. Groundwater typically moves from areas of higher hydraulic head to lower hydraulic head. Groundwater recharge occurs when precipitation or surface water infiltrates the ground, replenishing the aquifer. Discharge happens when groundwater flows to the surface through springs, seeps, or by human extraction through wells.

Seasonal variations, climatic changes, and human activities can influence the water table. Excessive groundwater withdrawal can lead to drawdown, creating a cone of depression around wells. Groundwater quality is influenced by the hydro geochemical composition of the aquifer and potential contaminants from anthropogenic activities. Monitoring parameters such as pH, dissolved oxygen, and specific ions is essential for assessing water quality. Groundwater and surface water are interconnected in various environments. The hypothec zone, where groundwater and surface water interact beneath streams and rivers, plays a crucial role in nutrient cycling and supporting aquatic ecosystems.

Geophysical methods, including resistivity surveys, seismic surveys, and ground-penetrating radar, are employed to map subsurface structures and identify potential groundwater reservoirs. Effective groundwater management involves monitoring water levels, implementing extraction regulations, and considering sustainable yield to ensure long-term availability without depleting the resource.

In summary, groundwater is a complex and crucial component of Earth's water cycle, impacting ecosystems, human activities, and overall water availability. Understanding its properties, movement, and interactions with other components of the hydrological system is essential for sustainable water resource management.

Groundwater - liquid, solid (ice), water in the form of vapor located in the pore spaces of rock layers in the upper part of the Earth's crust. Groundwater is part of the total water resources and is of great importance for the national economy as a source of water supply and irrigation. The melioration condition of irrigated lands is determined by the condition of ground water. The study of underground water is known as hydrogeology. Water can be transported by pressure changes or gravitational pull, and it can be constrained by molecular forces as well. Aquifers are rock layers that are saturated with free water; these layers are referred to as aquifer complexes. Depending on the type of accumulation in water-retaining rocks, groundwater is classified as pore water in soft rocks, vein (vein) in hard rocks, and karst (cave) water in fissure-karst-slightly soluble carbonate and gypsum rocks. The types of underground water vary depending on the location: ground water, which accumulates above the first impermeable layer closest to the earth's surface, interlayer (unpressured, pressurized, artesian aquifers located between impermeable layers), seasonal water (surface water; formed by precipitation or seepage of irrigation water on water-storing layers in the aeration zone), and soil water.

Sedimentary rocks are divided into two categories: washing waters that emerge from the Earth's mantle when magma cools, and sedimentary waters formed as a result of the burial of sea waters during the formation of sedimentary rocks. Groundwater is classified as infiltrative because it is formed as a result of atmospheric precipitation, absorption of river and irrigation water, condensation resulting from condensation of water vapor in rock layers. A spring is the naturally occurring release of subterranean water to the earth's surface; it can be classified as either seepage or boiling (hot spring).

A naturally occurring solution, groundwater has nearly every known chemical element. Groundwater is classified as fresh (up to 1.0), shallow (1.0-10.0), salty (10.0-50.0), and non-aquatic (from 50 many) based on mineralization (total amount of compounds dissolved in water, g/l). It is chilly (4–20°), warm (20–37°), hot (37–42°), boiling (42–100°), and very hot (over 100°) in terms of temperature. It is separated into subterranean waterways.

In nature, infiltration water is prevalent, but pure forms are extremely uncommon. Groundwater is utilized for a variety of purposes, including heat generation (hot water), industry, pastures, medicine (mineral water), and the provision of different salts and chemical elements (iodine, boron, bromine, etc.). Land becomes salinized and flooded by groundwater. Bore wells and open and closed horizontal drains are dug to counter this. In deserts, groundwater was commonly exploited. The pastures of Karakum, Kyzylkum, and Ustyurt are primarily fed with subsurface water.

In Central Asia, more than 150 sizable subterranean water reserves have been found. More than 1500 m3/s of operational reserve is refreshed annually, with fresh water contributing close to 1000 m3/s. The remaining portion is mineralized to variable degrees (between 2-3 and 15 g/l). In Central Asia, there are more than 40,000 active bore wells, of which 5,000 are artesian wells that shoot out water; these wells are mostly utilized for crop irrigation.

Pressurized subsurface water known as artesian aquifers is created between impermeable strata and emerges from boreholes as fountains when it opens. The French province of Artois is where the Artesian waters were first found in Europe, hence their name, Artesian. These kind of wells have long been recognized in Egypt and China. The irrigated zone of Central Asia is a part of the Turan Payette artesian basin system, which is made up of several relatively minor basins that are separated into the Amu-Darya and Syrdarya groups. Each major artesian basin contains fluids with varying horizons that range in chemical composition from low-mineralized hydro carbonate-type waters to highly mineralized chloride-type saline waters. The first kind of artesian waters is typically found in the basin's deepest regions and provides thermal and mineral waters; the second type is found in the upper horizons and is used to irrigate crops, provide drinking water, and supply water to pastures (like Kyzylkum pastures and the Karshi desert, among other places).

In conclusion, groundwater stands as a hidden yet invaluable component of the Earth's hydrological system, playing a pivotal role in sustaining ecosystems and supporting human activities. The complex interplay of geological formations, hydrological processes, and human interventions shapes the dynamics of groundwater. As a resilient reservoir of freshwater, groundwater contributes to global water balance, serving as a vital resource for agriculture, industry, and domestic use.

The challenges associated with groundwater, such as over-extraction, contamination, and fluctuations in water tables, underscore the need for comprehensive management strategies. Sustainable practices, informed by scientific understanding and technological advancements, are imperative to ensure the continued availability and quality of groundwater resources.

Effective groundwater management requires a multidisciplinary approach, integrating geological, hydrogeological, and environmental sciences. Continuous monitoring, coupled with the application of geophysical exploration and modeling techniques, enhances our ability to comprehend the intricate subsurface processes.

The importance of recognizing the interconnectedness of groundwater and surface water cannot be overstated. The hypothec zone, where these two realms converge, exemplifies the delicate balance that sustains aquatic ecosystems and influences nutrient cycling.

As the global demand for freshwater rises, responsible stewardship of groundwater resources becomes paramount. Balancing extraction rates, implementing regulations, and safeguarding against contamination are central tenets of sustainable groundwater management. Collaboration among scientists, policymakers, and local communities is essential to develop effective strategies that prioritize the longevity and resilience of this invaluable water source.

In essence, the scientific understanding and responsible management of groundwater are essential components in securing a sustainable water future. Groundwater's hidden depths demand our attention, respect, and a commitment to ensuring its wise and equitable use for generations to come.

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