

Understanding the Characteristics of Tsunamis and Their Causes

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ABOUT THE STUDY

Tsunamis are natural disasters characterized by devastating waves that can cause widespread destruction and loss of life in coastal areas. These massive ocean waves are typically triggered by various geological events such as earthquakes, volcanic eruptions, and underwater landslides.

Understanding the characteristics of tsunamis and their causes is essential for early warning systems, disaster preparedness, and mitigating the impact of these destructive phenomena.

Characteristics of tsunamis

Wave formation and speed: Tsunamis are typically generated by a sudden displacement of water, commonly caused by an undersea earthquake. These displacements create a series of waves that travel across the ocean at remarkable speeds. The speed of a tsunami in deep water can exceed 500 miles per hour (800 kilometers per hour), allowing them to traverse vast distances before reaching the shoreline.

Wave height and energy: Unlike regular wind-driven waves, tsunamis have enormous wavelengths and relatively low wave heights in the deep ocean. However, as they approach shallow coastal areas, their wavelengths shorten, causing an increase in wave height. This transformation concentrates a substantial amount of energy within the waves, leading to the devastating impact observed upon landfall.

Longitudinal wave motion: While regular ocean waves move primarily in a circular or orbital motion, tsunamis propagate in a different manner. Tsunami waves exhibit a longitudinal wave motion, wherein water particles move predominantly in the direction of the wave's travel. This characteristic contributes to the destructive nature of tsunamis as they can penetrate inland with tremendous force, flooding large areas.

Wave period and arrival time: The period of a tsunami wave refers to the time interval between successive wave crests. Tsunamis have longer periods compared to typical wind-generated waves, often ranging from several minutes to an hour or more. As a result, the arrival time between the first and

subsequent waves can be significant, leading to multiple waves striking a coastal area over an extended period.

Drawback effect: One of the unique features of tsunamis is the occurrence of the drawback effect. As a tsunami wave approaches the shoreline, it often causes a temporary recession of water from the coast. This phenomenon can be misleading as it exposes the ocean floor, attracting people to explore the exposed area. However, this is a warning sign of an impending tsunami wave that follows shortly after the drawback.

Causes of tsunamis

Undersea earthquakes: The primary cause of tsunamis is undersea earthquakes, resulting from the sudden movement of tectonic plates. When an earthquake occurs beneath the ocean floor, the release of seismic energy causes the water above to displace, generating a series of tsunami waves that radiate outward from the epicenter.

Submarine volcanic eruptions: Volcanic eruptions occurring beneath the ocean's surface can also trigger tsunamis. These eruptions release a tremendous amount of gas, ash, and molten lava, causing the surrounding seawater to rapidly heat and expand. The resulting displacement of water generates tsunami waves that propagate across the ocean.

Underwater landslides: Large-scale underwater landslides, often triggered by seismic activity or slope instability, can generate significant tsunamis. These landslides displace enormous volumes of water and create powerful waves that propagate through the ocean, posing a severe threat to coastal areas.

Meteorological phenomena: Although rare, meteorological events such as meteor impacts or intense atmospheric disturbances like hurricanes can induce meteotsunamis. These are tsunami-like waves generated by the vertical displacement of water due to atmospheric pressure changes or strong winds. Meteotsunamis generally have smaller amplitudes than seismic tsunamis but can still cause localized damage.

Tsunamis are awe-inspiring natural phenomena that possess distinctive characteristics and causes. Their immense speed, energy, and longitudinal wave motion make them capable of

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causing catastrophic destruction along coastlines. Understanding these characteristics, along with the underlying causes such as undersea earthquakes, volcanic eruptions,

underwater landslides, and meteorological events, is crucial for implementing effective early warning systems, preparedness measures, and coastal management strategies.