



## Mains Practice Question

Q. What are earthquake swarms? How do they differ from typical mainshock-aftershock sequences? (150 words)

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### Approach

- Introduce the answer by defining earthquake swarms
- Give Causes of Earthquake Swarms and Examples
- Highlight the Key Differences Between Earthquake Swarms and Mainshock-Aftershock Sequences
- Conclude by highlighting adaptation measures. .

### Introduction

**Earthquake swarms** are sequences of **small to moderate quakes** occurring in quick succession, without a distinct mainshock.

- Unlike typical earthquakes, which follow a **mainshock-aftershock pattern**, swarms consist of **multiple quakes of similar magnitude**.

### Body

#### Causes of Earthquake Swarms:

- **Fluid Movement:** Fluids released from magma or circulating within active geothermal systems can **lubricate faults**, triggering earthquakes.
  - These fluids move through **cracks and fractures**, causing multiple small-scale seismic events.
- **Active Volcanism:** Magma movement beneath the surface creates stress, leading to **fracturing of the crust** and swarm-like activity.
  - Earthquakes in such cases typically occur **near the crack tip** where magma is pushing through.
- **Slow-Slip Events:**
  - These are **slow-motion earthquakes** involving gradual fault movement over weeks or years.
  - They are commonly observed in **subduction zones**, such as the **Hikurangi Subduction Zone near New Zealand**.

#### Examples of Earthquake Swarms:

- **India:** Since November 2018, an earthquake swarm has been observed in Dahanu, **Maharashtra**, with **10-20 quakes daily**, typically of magnitude **<3.5**.
- **Philippines:** A swarm occurred in **Batangas (April-August 2017)**.
- **Europe:** The **Western Bohemia/Vogtland region (Czechia-Germany)** experiences recurrent

swarms.

- **Central America:** In **El Salvador (April 2017)**, nearly **500 earthquakes** were recorded in two days in Antigua Cuscatlán.

### Key Differences Between Earthquake Swarms and Mainshock-Aftershock Sequences

Parameter	Mainshock-Aftershock Sequence	Earthquake Swarm
<b>Main Shock</b>	Has a definite <b>mainshock</b> (largest event)	No distinct <b>mainshock</b>
<b>Aftershocks</b>	Occur after the mainshock, decreasing in frequency over time	No clear <b>aftershock pattern</b>
<b>Duration</b>	Can last for days, weeks, months, or even years (for large events)	Typically <b>shorter-lived</b> but can last weeks to months
<b>Location</b>	Associated with tectonic fault movement	Occur in <b>volcanic, geothermal, or hydrothermal areas</b>
<b>Cause</b>	Sudden release of built-up seismic stress	Triggered by <b>fluid movement, magma activity, or slow-slip events</b>

### Conclusion

Despite their smaller magnitude, the frequency and unpredictability of **earthquake swarms** can pose significant risks. Therefore, **focused monitoring and timely adaptive measures, such as early warning systems and seismic preparedness**, are crucial for minimizing potential damage and ensuring public safety in areas prone to swarming seismic activity.

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