Press Release

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Rare but devastating: When volcanoes trigger tsunamis

Expedition to Indonesia to study the landslide of the Anak Krakatau volcano

Kiel, 22 August 2023 - Volcanic eruptions and landslides have the potential to unleash destructive tsunami waves. In order to better understand the precursors of collapse and to identify vulnerable volcanic regions, Professor Dr Morelia Urlaub and her team from the GEOMAR Helmholtz Centre for Ocean Research Kiel are currently collecting data off the coast of Anak Krakatau in Indonesia.

The western flank of Anak Krakatau collapsed into the sea in December 2018. The resulting tsunami took the Indonesian coast completely by surprise, killing 430 people and leaving widespread devastation along the surrounding coastline. The question at the time was why the tsunami warning system failed.

"Most tsunamis are caused by strong earthquakes on the ocean floor, where tectonic plates suddenly move upwards, and warning systems are effective here. Occasionally, tsunamis are also generated by volcanic eruptions or landslides," explains Professor Morelia Urlaub, an expert in marine geomechanics at the GEOMAR Helmholtz Centre for Ocean Research Kiel. "Currently, there are no early warning systems for these volcanic tsunami events due to an incomplete understanding of many of the underlying processes."

Her PRE-COLLAPSE project aims to fill this research gap. This stands for "Slow sliding of volcanic flanks as PREcursor to catastrophic COLLAPSE". To detect signs of such catastrophes and identify vulnerable volcanic regions, she and her team are currently studying four island volcanoes from the summit to their base on the seabed. After Ritter Island (Papua New Guinea) and Mount Etna in Sicily (Italy), their latest expedition on the research vessel SONNE (SO299/2) has taken them to the Sunda Strait between Sumatra and Java in Indonesia. The title of the expedition: "Reconstruction of Eruptions and Volcanic Tsunamis at Krakatau Volcano", or "REE-T" for short.

The islands of the Krakatau archipelago are the result of many eruptions, including one of the largest volcanic outbursts in history in 1883. "As far as tsunamis caused by volcanoes are concerned, this event stands above all others," says Morelia Urlaub. "Tsunami waves of up to 30 metres devastated the coasts. An estimated 36,000 people died". To put the scale of the 1883 eruption into perspective, its energy can be compared to thirteen thousand times the power of the atomic bomb dropped on Hiroshima. This eruption is one of the greatest catastrophes of modern times.

The most recent collapse, in December 2018, has been closely monitored. Data capture the gradual sliding of the flank, volcanic activity and temperature before, during and after the collapse. Satellite images show that the western flank had been slowly moving seawards and downwards for several years before the actual collapse. "Surprisingly, this movement did not accelerate immediately before the collapse, contrary to expectations," says Urlaub.

During the current expedition, the team now wants to reconstruct the most important parameters for the formation mechanisms of the 1883 and 2018 tsunamis. To do this, the 16 researchers are focusing on a comprehensive investigation of the deposits from the 2018 sector collapse as well as

the pyroclastic flows released during the historic 1883 eruption. Using state-of-the-art geophysical and geological techniques such as seismic reflection profiling, sediment coring and photogrammetric drone surveys, the team will analyse the geological processes that trigger large tsunamis in order to better assess future hazards and develop warning systems.

The Expedition at a glance:
SONNE Expedition 299/2
Chief Scientist: Professor Dr Morelia Urlaub (GEOMAR)
Start: 15th August 2023, Singapore
End: 2nd September 2023, Port Louis (Mauritius)

Background PRE-COLLAPSE
The PRE-COLLAPSE project (Slow sliding of volcanic flanks as PREcursor to catastrophic COLLAPSE) will study two different types of volcanic collapse - slow sliding of volcanic flanks and catastrophic collapse. Four coastal or island volcanoes will be studied from summit to deep-sea base: Mt. Etna (Italy), Anak Krakatau (Indonesia), Ritter Island (Papua New Guinea) and Kilauea (Hawaii, USA). The results will help identify volcanic flanks at risk of collapse.

Project funding:
The PRE-COLLAPSE project is funded by a Starting Grant from the European Research Council (ERC), and the SONNE expedition is funded by the German Federal Ministry of Education and Research (BMBF).

Links:
https://www.pre-collapse.eu/ PRE-COLLAPSE homepage and blog
https://www.geomar.de/en/research/expeditions/detail-view/exp/364571?cHash=13a58517162309c8a4f5780308183dc5 Expedition information
https://www.ldf.uni-hamburg.de/sonne/wochenberichte.html Expedition Booklet, Weekly Reports and Short Cruise Report
https://www.geomar.de/en/discover/marine-natural-hazards Marine Natural Hazards
https://www.geomar.de/en/research/core-themes/seafloor-hazards-and-benefits Hazards and benefits of the seabed

Images:
Images are available for download at http://www.geomar.de/n9079-e

Contact:
Ilka Thomsen (GEOMAR, Communications & Media), Tel.: +49 431 600-2802, media@geomar.de