

Singapore at risk if lesser-known undersea volcanoes in region erupt

Researchers cite tsunami waves, tech outages as possible impacts

Shabana Begum

It has long been assumed that Singapore is sheltered from volcanic eruptions and tsunamis, but new research into 466 lesser-known undersea volcanoes in the region shows that the island state is not immune to rare, explosive events.

If a large, slumbering underwater volcano in the South China Sea were to erupt, it can set off tsunami waves that could reach Singapore's coastlines.

Volcanic ash can blow towards Singapore, blanketing the surface with fine ash, similar to an eruption of a land-based volcano. When the Philippines' Mount Pinatubo erupted in 1991, a layer of ash covered the ground, cars and even the floors of houses across Singapore.

Lava flows and volcanic rock avalanches can damage undersea cables in the region, causing internet outages and disrupting financial transactions.

"Singapore can be affected too because these cables are thousands of kilometres long, and Singapore has some of the main sub-sea cables and landing sites in South-east Asia," said Dr Andrea Verolino, a research fellow at NTU's Earth Observatory of Singapore (EOS).

The 2022 Hunga Tonga-Hunga Ha'apai mega eruption, which was hundreds of times more powerful than the Hiroshima atomic bomb, got Dr Verolino thinking about what could happen if a similar disaster happens in the region.

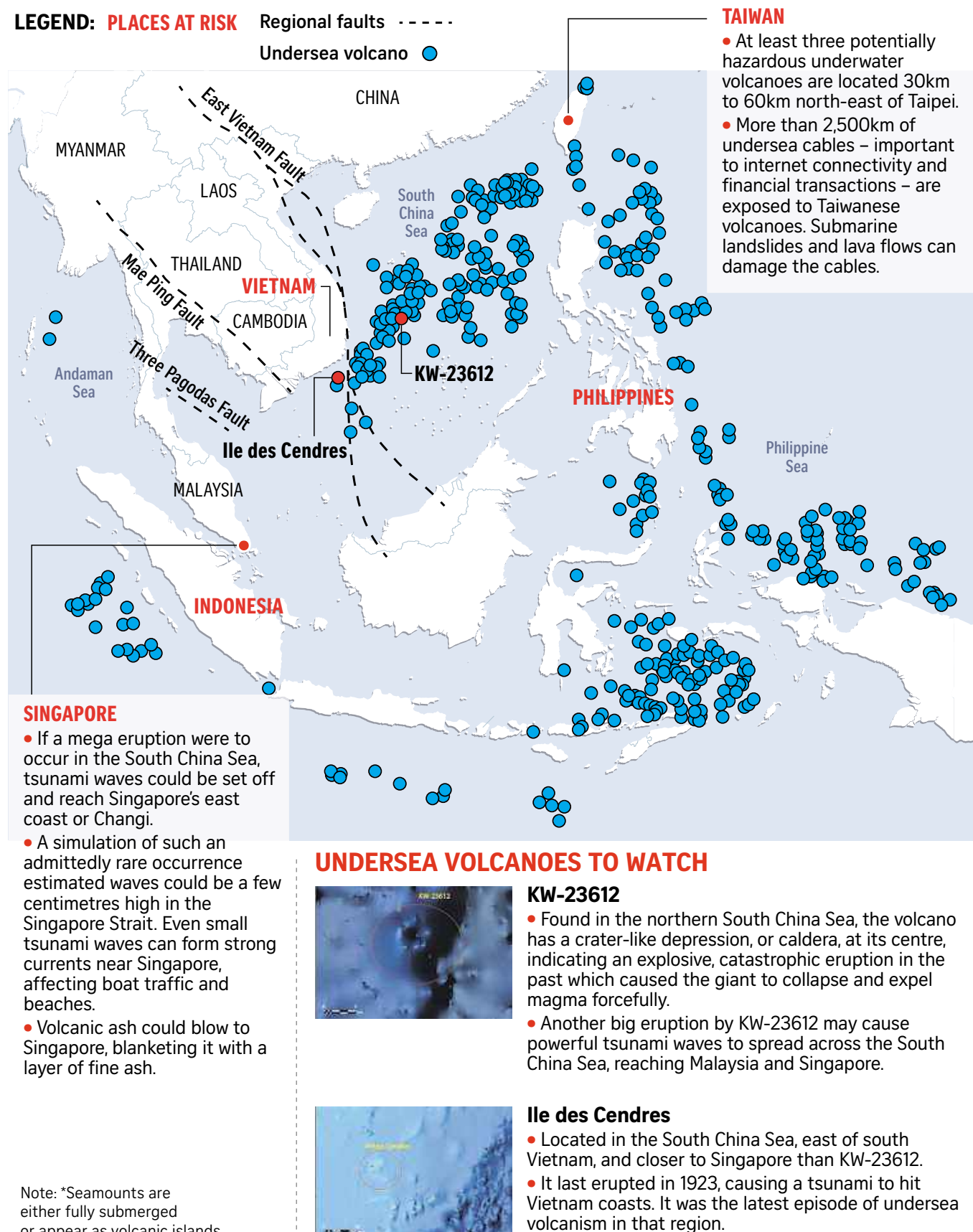
The explosion from the South Pacific Ocean seamount triggered far-reaching tsunamis that struck the shores of Japan, Peru, Chile and Russia. Tsunamis that swept onto Tongan islands reached as high as 20m, displacing more than 1,500 people and causing four deaths. In Peru, freak waves caused an oil spill from a tanker ship.

Dr Verolino and his colleagues mapped out 466 submerged seamounts and volcanic islands in the waters of South-east Asia, Taiwan, and the Andaman and Nicobar Islands – with the help of published data sets and sea-floor topography information. Hundreds of them are ancient giants lurking in the deep, mostly overlooked and forgotten.

Only a handful of notable seamounts have been studied in de-

Giants lurking in the deep

The deep waters near South-east Asia and Taiwan are home to more than 460 little-known undersea volcanoes*. Can these hidden giants pose a threat to Singapore? **Shabana Begum** checks out the volcanoes to watch.



Source: ANDREA VEROLINO, NTU EARTH OBSERVATORY OF SINGAPORE STRAITS TIMES GRAPHICS



The 2018 eruption of Anak Krakatoa (above), located between Java and Sumatra islands, triggered a tsunami that killed more than 400 people and injured thousands. New research into 466 lesser-known undersea volcanoes in the region shows that Singapore is not immune to rare, explosive events. PHOTO: REUTERS

tail, and that is often after significant eruptions, added Dr Verolino.

One of them is the infamous Anak Krakatoa between Java and Sumatra islands. In 2018, its crater partly collapsed during an eruption, triggering a tsunami that killed more than 400 people and injured thousands.

Taking a preventive approach, the team looked at the 466 seamounts' shapes and heights to find "battle scars" from each volcano's potentially violent past.

One volcano of concern is called KW-23612, currently in deep slumber in the northern South China Sea. One battle scar it has is a 7km-wide crater-like depression, or caldera, at its centre. This is a sign of an explosive, catastrophic eruption in the past, which caused the volcano to collapse and expel magma forcefully.

The caldera is nearly twice as wide as that of the Tonga volcano and Mount Pinatubo, both of which are about 4km wide, noted Dr Verolino, who is part of EOS' coastal hazard group.

"For a volcano to grow that big and have such a hole in the middle means there was intense explosive activity," he added. The caldera's summit is also considered shallow, just 200m below the sea surface.

"Eruptions from such a large volcano may cause powerful tsunami waves spreading all over the South China Sea, including areas of the Sunda Shelf, potentially affecting countries farther away, such as Malaysia and Singapore. These are rare events and there is no such record for Singapore, but this is a topic we are doing active research on," said Dr Verolino.

The NTU investigations were published in the scientific journal *Natural Hazards and Earth System Sciences* in April.

A key purpose of mapping and classifying how hazardous the seamounts can be is to identify places at risk if any understudied volcano were to erupt. The researchers found that Taiwan is most at risk, followed by Indonesia, the Philippines and Vietnam.

This finding was based on the populations of these places, the amount of submarine cables nearby and ship traffic.

For Taiwan, there are three hazardous volcanoes located up to 60km north-east of highly populated Taipei.

More than 2,500km of subsea cables are exposed to Taiwanese volcanoes, which means that lava flows or submerged ash and rocks can damage the dense cables north and south of Taiwan, said the paper. Taiwan's ship traffic also appears to be the densest in the entire region studied, and floating volcanic rocks can disrupt navigation.

In ongoing research, Dr Verolino has done simulations to show how mega eruptions by KW-23612, for example, can lead to far-reaching tsunamis across South-east Asia.

Tsunamis of such scale are known as meteotsunamis, caused by shock waves or atmospheric disturbances.

This was last seen after the Tonga explosion, when air moved away from the volcano fast. This big movement of air pushed water away, setting off the far-reaching tsunamis.

Dr Verolino's simulations showed that tsunami waves of a few centimetres can reach Singapore's south or south-east coast, but the study has not yet been published and the results are being validated.

"Even centimetric tsunami waves can form strong currents near Singapore, affecting boat traffic, beach localities, and can lead to coastal flooding... For tsunamis coming from the South China Sea, the east will be first exposed, where Changi is," he noted.

Beyond tsunami waves, threats to Singapore's connectivity is another risk if subsea cables are damaged by volcanic activity.

Ms Nadya Melic, vice-president for product at GCX that invests in building subsea cables, said: "While Singapore is deemed a more protected location... any fault affecting an end-to-end cable segment could also affect connectivity on a certain segment of a cable that is directly linked into Singapore... Traffic can be redirected onto another system."

Dr Verolino is hoping that his research on the more than 460 volcanoes will spur more deep-sea exploration into these enigmatic seamounts.

"We wanted to help narrow down the search of notable volcanoes before an eruption. Identify a few volcanoes of interest to propose projects for funding and exploration."

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