Press Release

64/2023 **K** **olumbo in the**
1650 triggered a destructive tsunami that was described by historical eye
group of researchers led by Dr Jens Karstens from the GEOMAR Helmholtz
an Research Kiel has now surveyed Kolumbo's underwater crater with modern
ology and reconstructed the historical events. They found that the eyewitness
he natural disaster can only be described by a combination of a landslide
explosive eruption. Their findings are published today in the journal *Nature*
***ns*.**

k island of Santorini, the eruption had been visible for several weeks. In the late
, people reported that the colour of the water had changed and the water was boiling.
ometres north-east of Santorini, an underwater volcano had risen from the sea and
glowing rocks. Fire and lightning could be seen, and plumes of smoke darkened the
ater suddenly receded, only to surge towards the coastline moments later, battering
to 20 metres high. A huge bang was heard more than 100 kilometres away, pumice
he surrounding islands, and a deadly cloud of poisonous gas claimed several lives.

e details of the historic eruption of Kolumbo because there are contemporary reports
iled and published by a French volcanologist in the 19th century," says Dr Jens
e geophysicist at GEOMAR Helmholtz Centre for Ocean Research Kiel. But how did
ng events come about? To find out, he and his German and Greek colleagues went
gean Sea in 2019 to study the volcanic crater with special technology. Karstens: "We
rstand how the tsunami came about at that time and why the volcano exploded so
eth Crutchley, co-author of the study: "This allows us to look inside the volcano." Not
imaging show that the crater was 2.5 kilometres in diameter and 500 metres deep,
ly massive explosion, the seismic profiles also revealed that one flank of the cone
rely deformed. Crutchley: "This part of the volcano has certainly slipped." The
n took a detective's approach, comparing the various mechanisms that could have
ami with the historical eyewitness accounts. They concluded that only a combination
lowed by a volcanic explosion could explain the tsunami. Their findings are published
rnal *Nature Communications*.

D seismics with computer simulations, the researchers were able to reconstruct how
would have been if they had been generated by the explosion alone. Karstens:
is, waves of six metres would have been expected at one particular location, but we
eports of eyewitnesses that they were 20 metres high there". Furthermore, the sea
first receded at another point, but in the computer simulation a wave crest reaches

the coast first. Thus, the explosion alone cannot explain the tsunami event. However, when the landslide was included in the simulations, the data agreed with historical observations.

Jens Karstens explains: "Kolumbo consists partly of pumice with very steep slopes. It is not very stable. During the eruption, which had been going on for several weeks, lava was continuously ejected. Underneath, in the magma chamber, which contained a lot of gas, there was enormous pressure. When one of the volcano's flanks slipped, the effect was like uncorking a bottle of champagne: the sudden release of pressure allowed the gas in the magma system to expand, resulting in a huge explosion". Something similar could have happened during the 2022 eruption of the Hunga Tonga undersea volcano, whose volcanic crater has a similar shape to Kolumbo's.

The study thus provides valuable information for the development of monitoring programmes for active submarine volcanic activity, such as SANTORY, which is led by co-author Prof. Dr Paraskevi Nomikou of the National and Kapodistrian University of Athens (NKUA). "We hope to be able to use our results to develop new approaches to monitor volcanic unrest," says Jens Karstens, "maybe even an early warning system, collecting data in real time. That would be my dream".

About 3D Marine Reflection Seismics

3D seismics is a geophysical technique that exploits the fact that sound waves are partially reflected at the boundaries of layers. This makes it possible to create cross-sectional profiles of the subsoil by [illegible] 32.4