Study reveals devastating power and colossal extent of a giant underwater avalanche off the Moroccan coast

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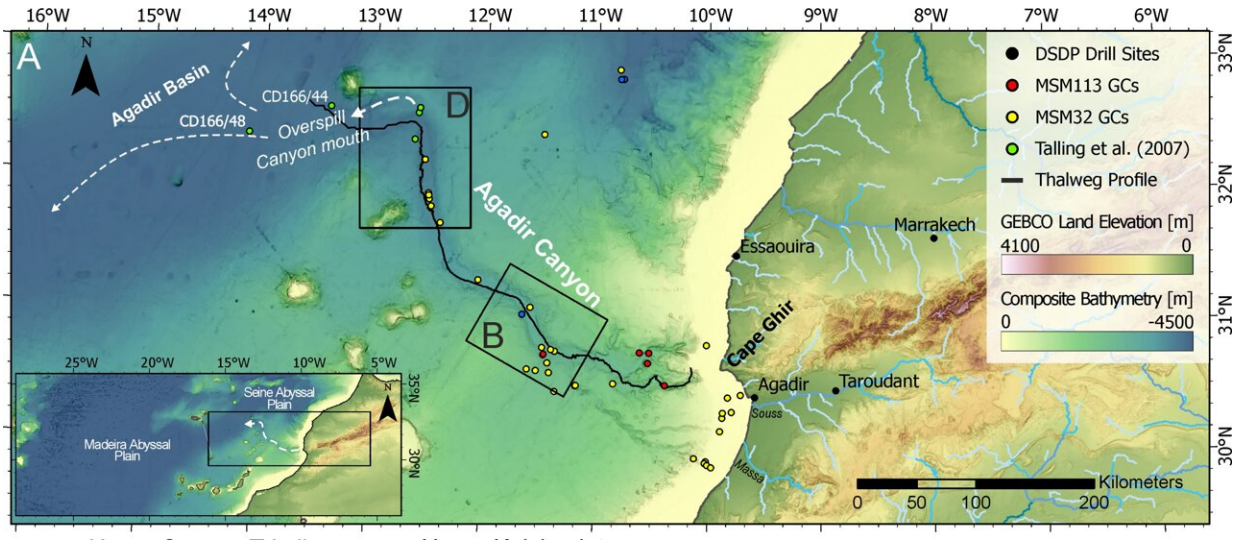


Overview map of North West African Margin showing the pathway of the event and its erosional marks on the seafloor. Credit: University of Liverpool

New research by the University of Liverpool has revealed how an underwater avalanche grew more than 100 times in size, causing a huge trail of destruction as it traveled 2,000km across the Atlantic Ocean seafloor off the North West coast of Africa.

In a study, titled "Extreme erosion and bulking in a giant submarine

gravity low" and published in the journal *Science Advances*, researchers provide an unprecedented insight into the scale, force and impact of one of nature's mysterious phenomena, underwater avalanches.

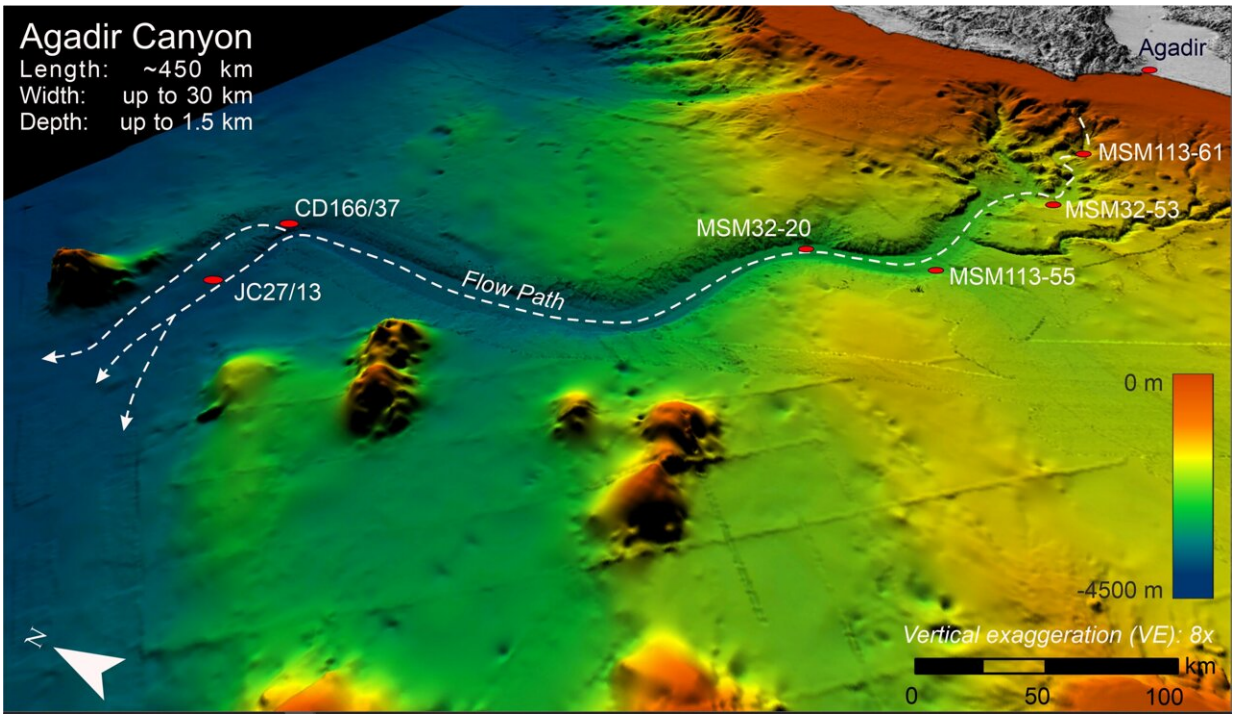
Dr. Chris Stevenson, a sedimentologist from the University of Liverpool's School of Environmental Sciences, co-led the team that for the first time has mapped a giant underwater avalanche from head to toe, which took place nearly 60,000 years ago in the Agadir Canyon.

Their analysis reveals the event, which started as a small seafloor landslide about 1.5 km in volume, grew over 100 times in size, picking up boulders, gravel, sand and mud as it traveled through one of the largest submarine canyons in the world before traveling a further 1,600 km across the Atlantic Sea floor.

The avalanche was so powerful that it eroded the entire 400 km length of the canyon and several hundred meters up the sides—about 4,500 km in total—and was so strong it carried cobbles more than 130 m up the side of the canyon.

Unlike a landslide or snow avalanche, underwater avalanches are impossible to see and extremely difficult to measure. However, they are the primary mechanism for moving material such as sediments, nutrients and pollutants across the surface of the earth and present a significant geohazard to the seafloor infrastructure such as internet cables.

The research team analyzed more than 300 core samples from the area taken during research cruises over the last 40 years. This, alongside seismic and bathymetry data, enabled them to map out the giant avalanche.



3D image of giant underwater avalanche which took place nearly 60,000 years ago in the Agadir Canyon. Credit: Dr. Christoph Bottner, Aarhus University

Dr. Stevenson said, "This is the first time anyone has managed to map out an entire individual underwater avalanche of this size and calculate its growth factor."

"What is so interesting is how the event grew from a relatively small start into a huge and devastating submarine avalanche reaching heights of 200 meters as it moved at a speed of about 15 m/s ripping out the sea floor and tearing everything out in its way.

"To put it in perspective: that's an avalanche the size of a skyscraper, moving at more than 40 mph from Liverpool to London, which digs out a trench 30 m deep and 15 km wide destroying everything in its path. Then it spreads across an area larger than the UK, burying it under about

a meter of sand and mud."

Dr. Christoph Bottner, a Marie-Curie research fellow at Aarhus University in Denmark, who co-led the team, said, "We calculate the growth factor to be at least 100, which is much larger compared to snow avalanches or debris flows which only grow by about four to eight times. We have also seen this extreme growth in smaller submarine avalanches measured elsewhere, so we think this might be a specific behavior associated with underwater avalanches and is something we plan to investigate further."

Professor Sebastian Krastel, head of Marine Geophysics at Kiel University and chief scientist aboard the cruises that mapped the canyon, added, "Our new insight fundamentally challenges how we view these events. Before this study, we thought that big avalanches only came from big slope failures. But now, we know that they can start small and grow into extremely powerful and extensive giant events.

"These findings are of enormous importance for how we try and assess their potential geohazard risk to seafloor infrastructure like internet cables that carry almost all global internet traffic, which are critical to all aspects of our modern societies."

The most recent cruises mapping the Agadir Canyon were led by the Institute of Geosciences, Kiel University, Leibniz Institute for Baltic Sea Research and GEOMAR Helmholtz Center for Ocean Research, Germany.

A suite of archive core data was analyzed from the British Ocean Sediment Core Repository at NOCS Southampton, which was collected aboard NERC ships over the past 40 years.

More information: Christoph Böttner et al, Extreme erosion and

bulking in a giant submarine gravity flow, *Science Advances* (2024). DOI: 10.1126/sciadv.adp2584.
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