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Submarine Cable Protection and the Environment

*An Update from the ICPC, Written by
Marine Scientific Adviser, Dr Mike Clare*

**The longest avalanches
on the planet**

3

Editor's Corner

5

Introduction

8

The Congo Submarine Canyon

10

STUDY 1: Newly recognized turbidity current structure can explain prolonged flushing of submarine canyons

11

STUDY 2: Longest sediment flows yet measured show how major rivers connect efficiently to deep sea

14

STUDY 3: Time-lapse surveys reveal patterns and processes of erosion by exceptionally powerful turbidity currents that flush submarine canyons: A case study of the Congo Canyon

17

STUDY 4: Carbon and sediment fluxes inhibited in the submarine Congo Canyon by landslide-damming

18

STUDY 5: Globally significant mass of terrestrial organic carbon efficiently by canyon-flushing turbidity currents

20

STUDY 6: Seabed seismographs reveal duration and structure of longest runout sediment flows on Earth

22

STUDY 7: Ocean-bottom seismometers reveal surge dynamics in Earth's longest-runout sediment flows

23

STUDY 8: Hydroacoustic Signals Recorded by CTBTO Network Suggest a Possible Submarine Landslide in Trou Sans Fond Canyon

25

Lessons Learned for Subsea Cables

29

About the ICPC, Editorial Staff & References



SUBMARINE CABLE PROTECTION AND THE ENVIRONMENT

An Update from the ICPC, Written by the Marine

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By the very nature of the subsea cable industry, we are all quite aware that the oceans (and seabed) are a fascinating place. If you've ever looked at seafloor survey data in places like the Horn of Africa, or the Mendicino Ridge, or the mid-Atlantic Ridge, you'll know that the physiology of the seabed is not always as benign and sandy as one would hope it to be from a cable-routing perspective. And yet sometimes cables have to traverse through more challenging areas, particularly in the deep ocean. While we know that statistically not many cable faults occur in the deep ocean, it is prudent to understand what hazards exist, whether they be irregular seabed, ridge features, convergent or spreading margins, guyots, seamounts, or the last remnants of

submarine canyon flows.

Academic research has provided information on some of these risks, but it is the presence of cables that have put broader purpose behind understanding their mechanisms. After all, if a flow from a submarine canyon damages one cable (or many more), it is prudent to understand why that happened and how often one could anticipate it to occur. Furthermore, the deep sea isn't only interesting from this perspective. Though not necessarily touched on in this issue, the BBNJ treaty (Biodiversity Beyond National Jurisdiction) is aiming to set forward a framework to protect marine life in the deep sea. It is known now that deep sea life is not as nearly non-existent as previously thought. That is sometimes a shortcoming that progressive interest and investigation is looking

to fix—previous thought can always be improved, and the lack of understanding drives the interest for more understanding. For that reason, the subsea cable industry has always had substantial and collaborative intersections with academia and marine research, and this issue sets out even more evidence for why that is the case. Diversity of cable routes and landings continue to drive the need for further understanding.

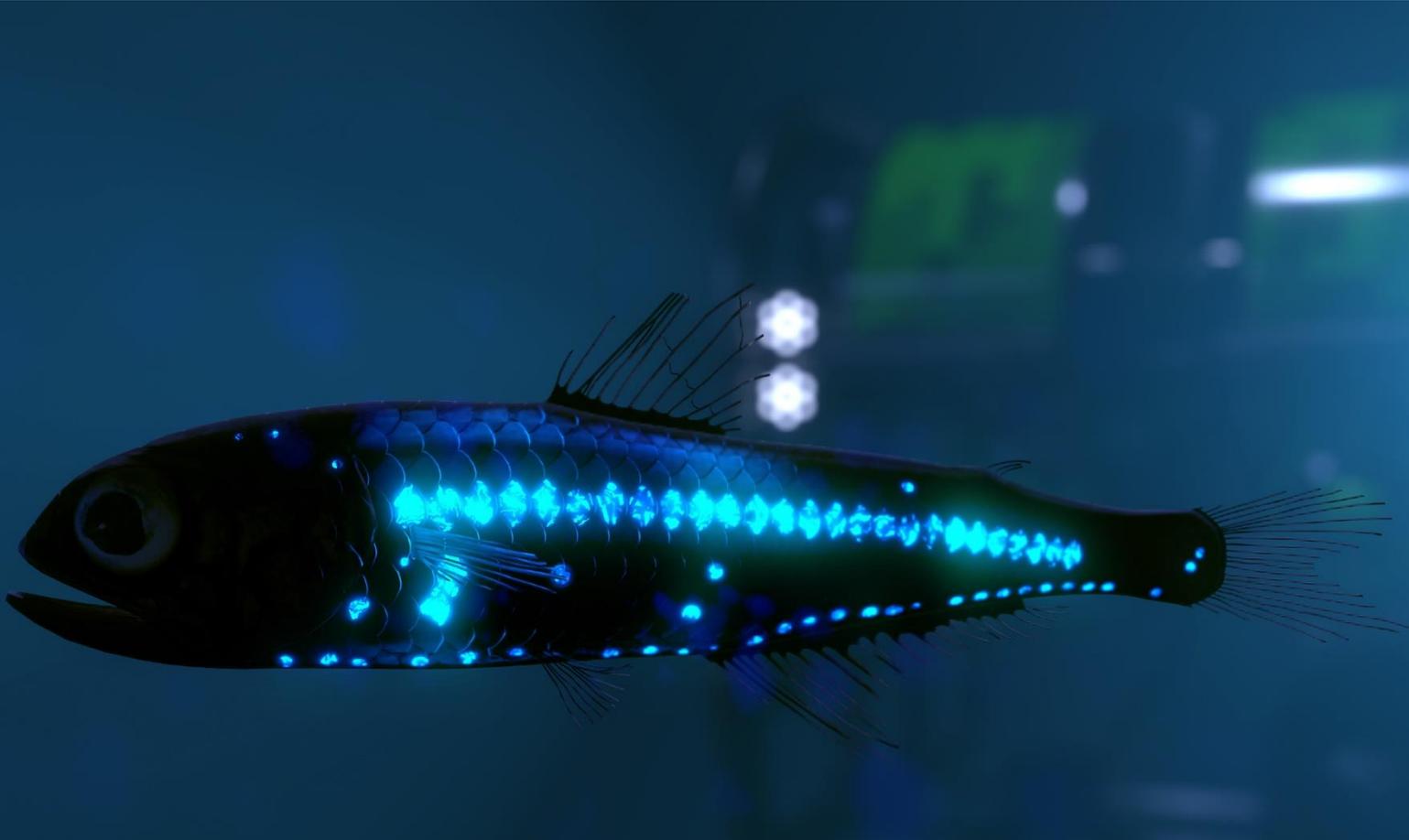
Collaboration through scientific research helps us better understand the hazards that exist which can aid us in building more resilient infrastructure, particularly in areas where cables have not been laid before.

Sincerely,

Ryan Wopschall

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INTRODUCTION

Looking at the ocean surface, it is hard to imagine what might lie in the depths below. While much of the deep ocean floor is relatively flat—covered by vast abyssal plains—there locally exist dramatic seascapes carved into deep trenches, piled up as steep mid-ocean ridges and seamounts, and underwater canyons that can rival or exceed the scale of major rivers on land. More than 9,000 such submarine canyons exist worldwide, cutting into the continental slope and providing an important connection between the shallow continental shelf and abyssal water depths. These deeply cut features are increasingly recognised as being critical to ocean biodiversity. Submarine canyons funnel organic debris and nutrients into the deep sea and are the focal point of upwelling for productive waters that support commercially important fish stocks. Such canyons can also concentrate pollution—as the same flows that convey other

natural particulate matter along canyons also carry human-created materials such as microplastics. A recent study found that high concentrations of microplastics are carried by powerful seafloor avalanches, known as turbidity currents (Chen et al., 2025). These seafloor sediment flows can reach speeds of up to 20 metres per second and can carry vast quantities of sediment—some of which rival or exceed that carried by the world's major rivers in a single year (Azpiroz-Zabala et al., 2017). Such canyons are therefore extremely important from a scientific and ecological perspective, but they are also important with respect to subsea cable protection.

Underwater canyons, and the turbidity currents that flow through them, are also important with respect to subsea cable protection. As a result of their speed and high sediment load, turbidity currents can, and have, damaged seafloor cables that

INTRODUCTION

cross submarine canyons. Subsea telecommunications cables have been damaged by turbidity currents in several submarine canyons due to triggering by earthquakes, tropical cyclones and volcanic eruptions that entered the ocean (Carter et al., 2014; Cattaneo et al., 2012; Gavey et al., 2017; Hsu et al., 2008; Clare and Yeo et al., 2024). The likelihood of turbidity currents occurring is heightened where canyons are fed by large amounts of sediment, such as offshore from major rivers that are directly connected to a canyon offshore; especially following major flooding events. One particularly clear example of this is the Congo Canyon, that extends offshore from the Congo River in West Africa. The head of

that canyon cuts back around 30 km inside the estuary of the Congo River—the second largest river in the world with regards to water discharge—and extends around 1200 km along its meandering course, until it reaches the abyssal plain at around 5 km water depth. The vast length of this canyon means that many subsea cables have been routed across it, due to prohibitive costs of routing into much deeper water which would require a much greater length of cable.

In this issue, we highlight some key scientific studies that have been published recently and summarise the key learnings with respect to subsea cable resilience that has relevance to the Congo



INTRODUCTION

Canyon and many other submarine canyons worldwide.

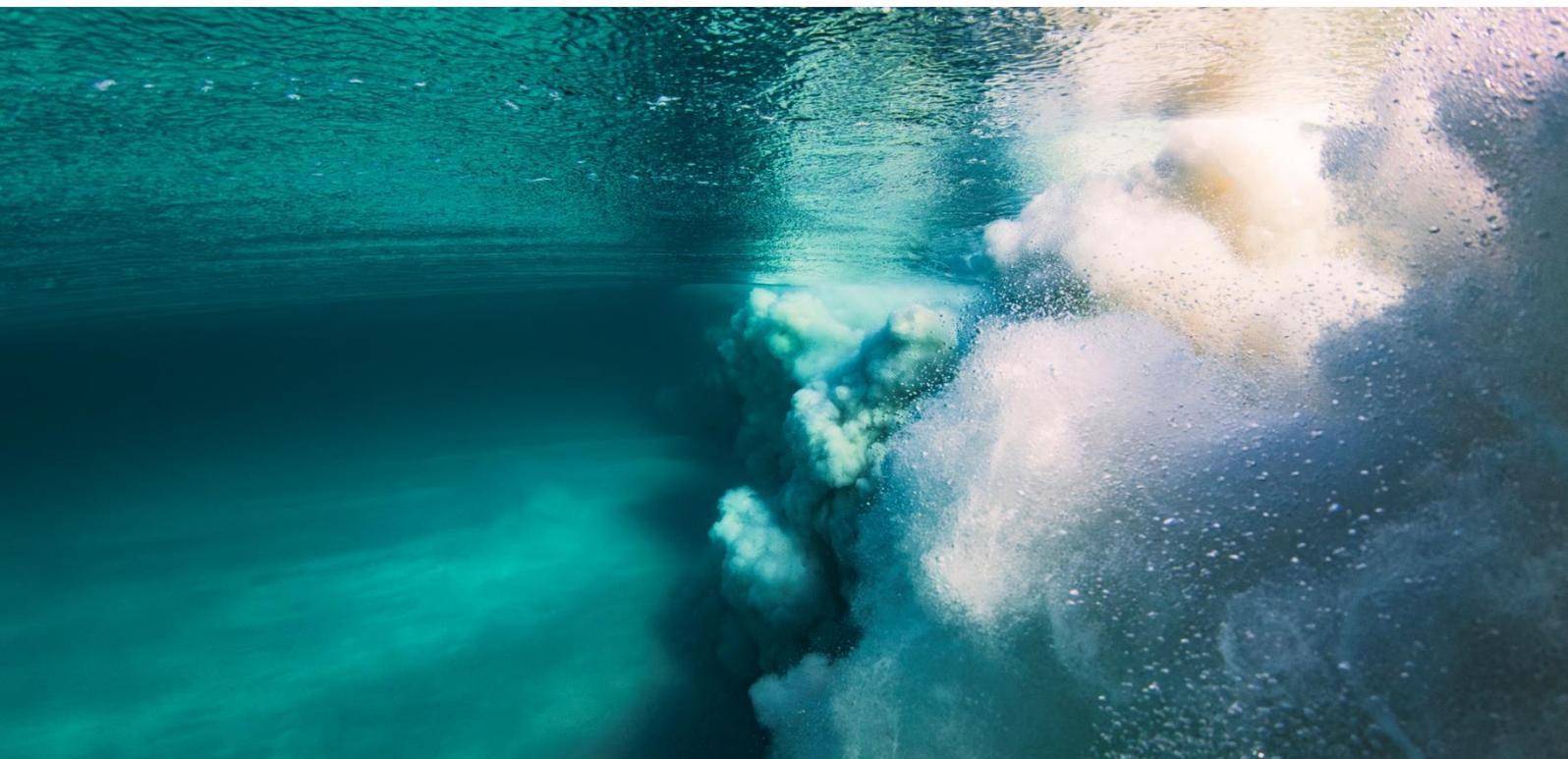
This work was supported by, and enabled through, collaborations between Angola Cables, the West Africa Cable Consortia, the International Cable Protection Committee and the UK Natural Environment Research Council.

- Recent instances of subsea cable damage have prompted collaborative research initiatives to investigate the causes.
- Fast-travelling, sediment-laden avalanches of sediment (called turbidity currents) are responsible for the cable damage within many submarine canyons—particularly the Congo Canyon.
- These flows can travel for more than one thousand kilometres into the deep sea, even speeding up several hundred kilometres from their source as they picked up seafloor sediment along their course.
- Powerful flows are fed by sediment delivered to the canyon head by large river floods, and can continue to recur months to years afterward such flooding events.
- Although some cables are broken in these powerful flows, other intervening cables survive, and it is important to understand why some cables break yet, others survive.
- It appears that waterfall-like knickpoints along the canyon axis can migrate for remarkable distances (up to 21 km) each year, and cables that encounter one of these knickpoints tend to break. Cables located away from knickpoints have a much better chance of survival.
- Advances in technology now allow us to monitor turbidity currents without placing expensive instruments in their path.
- Lessons learned are shared about the routing of subsea cables where it is necessary to cross such submarine canyons.

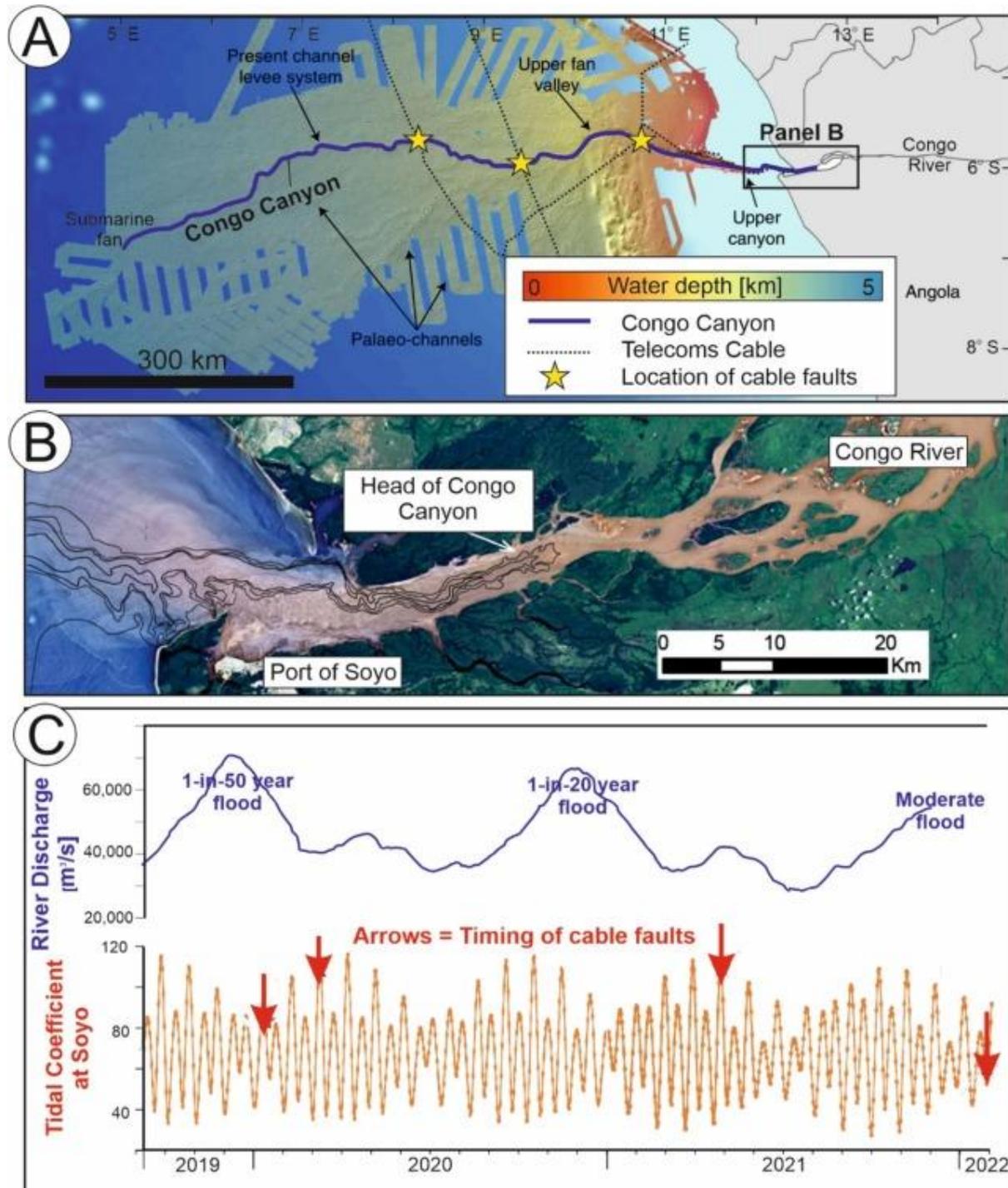
THE CONGO SUBMARINE CANYON

The Congo Canyon has long been the site of subsea cable crossings. Records of old telegraphic cables indicate that they were laid across the upper reaches of the canyon between 1883 and 1937 (Heezen et al., 1964). Those early cables were installed in water depths of less than 2 km, and experienced regular damage—occurring during periods of elevated flooding on the Congo River. This was amongst the first documented evidence for the occurrence of turbidity currents, but it was not until the 1950s that this was recognised to be the cause, with publications arising a decade after that (Heezen et al., 1964). More recently, subsea fibre-optic telecommunications cables

have experienced damage due to similar causes, with more than 16 instances of damage reported from cables that cross the canyon since 2020. These cables include systems that provide important connectivity to and across Africa, with the first in this series of recent cable faults occurring during the first COVID-19 lockdowns when data and telecommunications traffic were particularly important (Talling et al., 2021). These repeated instances of damage have motivated international research efforts to understand the timing, triggers and behaviour of the associated powerful turbidity currents, which represent some of the largest volume flows of any other process on Earth.



THE CONGO SUBMARINE CANYON



▲ **Figure 1:** Location of the Congo Canyon offshore West Africa (A), with detail on the head of the submarine canyon that cuts into the Congo River estuary (B), and timings of cable damage relative to river floods and tides (C). Note that several cables were damaged at the time of each arrow (from Bricheno et al., 2024; after Talling et al., 2022).

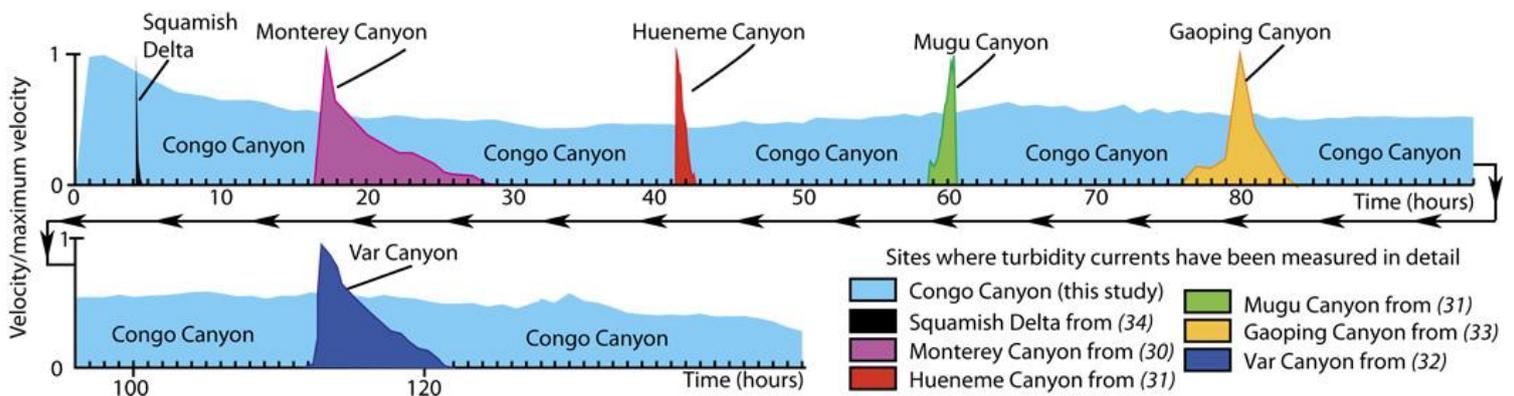
STUDY 1: Newly recognized turbidity current structure can explain prolonged flushing of submarine canyons (Azpiroz-Zabala et al., 2017).

Until this study, it was largely thought that making direct measurements of turbidity currents in major submarine canyons would be too challenging; however, a field deployment led by Chevron to assess the feasibility of a pipeline crossing the Congo Canyon provided a dataset that showed what can be achieved. A deep sea mooring was installed in the upper reaches of the Congo Canyon (at 1.5 km water depth), equipped with a downward-looking Acoustic Doppler Current Meter, that records a vertical profile of velocity and information on the concentration of sediment carried by the flow. Measurements

made between December 2009 and March 2010 revealed:

- Turbidity currents were found to occur for around 30% of the monitoring period.
- The sediment carried by an individual flow rivals that carried by the Mississippi River in a whole year.
- The duration of the turbidity currents was far longer than reported anywhere else in the world – with some flows lasting for more than a week, which means any impacts to subsea cables may be more sustained than simply the passage of the flow front.
- The flows were found to have a very fast and very dense frontal part, which drives the flows, accounting for their long run out and differing from previous models that were based on small-scale laboratory experiments.

▼ **Figure 2:** Duration of turbidity current recorded at 1500 m water depth in the Congo Canyon (light blue) revealing it lasts far longer than other turbidity currents measured in submarine canyon systems elsewhere in the world (from Azpiroz-Zabala et al., 2017).



STUDY 2: Longest sediment flows yet measured show how major rivers connect efficiently to deep sea (Talling et al., 2022)

This major study involved first of its kind repeated seafloor mapping and instrumentation of such a large submarine canyon. The study provided valuable new insights into the behaviour of powerful turbidity currents that travelled for more than 1000 km into the deep-sea, damaging cables including the SAT-3 system (South Atlantic 3, laid in 2001) at a water depth of around 3570 m, and two branches of the WACS cable (West Africa Cable System; laid in 2012), crossing at around 2000 m and 4000 m water depth. These cables had previously been undamaged for 18 years.

- Eleven deep sea moorings were placed along the Congo Canyon, equipped with Acoustic Doppler Current Meters that record velocity profiles through flows every 30 seconds, located between 30-150 m above the seabed. These sensors provided records of flows between September 2019 and 2022.
- In January 2020, a turbidity current broke both

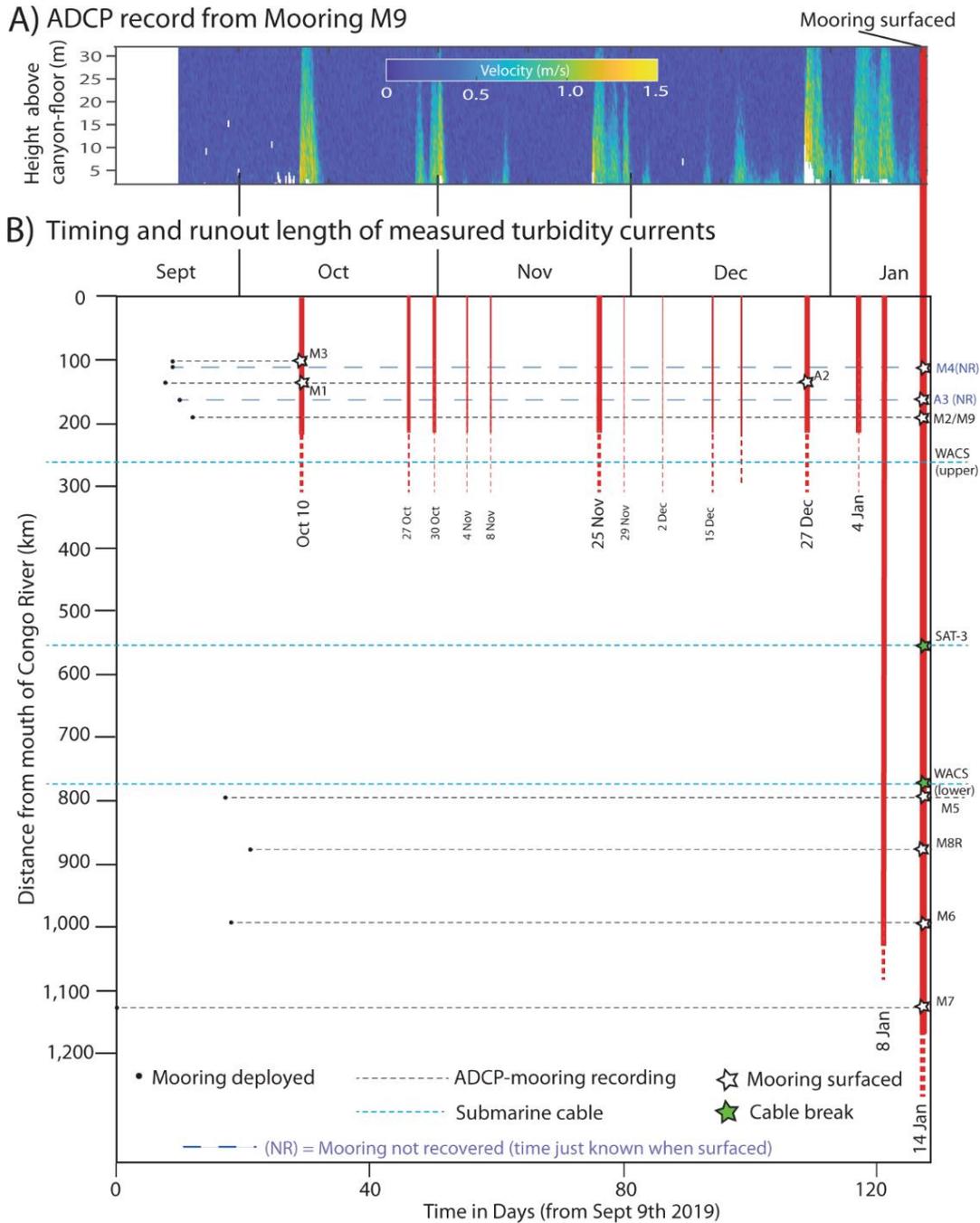
telecommunications cables connecting to West Africa. In addition to breaking cables, this powerful flow caused the seafloor instruments to cut free from their mooring lines and surface. Repeated flows occurred, breaking the cables again in March 2020, April 2021, and January 2022.

- The moored current meters recorded twelve turbidity currents between September 2019 and early January 2020, prior to the first cable-damaging event, but these were relatively slow and restricted to the upper part of the submarine canyon, and did not cause cable breaks.
- Repeat seafloor surveys performed between September 2019 and October 2020 show that the first powerful turbidity current ripped up 1338-2675 megatonnes of sediment from the seafloor, which is equivalent to 19-37% of the annual suspended sediment load carried by present day rivers worldwide.

STUDY 2: Longest sediment flows yet measured show how major rivers connect efficiently to deep sea (Talling et al., 2022)

- None of the turbidity currents recorded by cable breaks or ADCPs coincided with earthquakes or large wave heights, so flows are not triggered by such events.
- The January 2020 turbidity current travelled >1200 km along the canyon, accelerating from 5.2 to 8 m/s. This flow was actually speeding up 600-800 km from its source. Flows with an initial fast speed (>5 m/s) accelerate and run out further, otherwise they stop and deposit their sediment within the upper reaches of the canyon.
- Flow triggering is linked to river floods and tides. A 1 in 50-year river flood occurred (>70,000 cubic metres per second) in December 2019 preceded the first cable-damaging flow. The second cable damaging flow in March 2020 occurred 10 weeks after flood peak when discharge was low. A second major flood occurred in December 2020, followed by a third cable breaking flow in April 2021, and a fourth flow broke cables in January 2022, six weeks after a modest flood.
- The most powerful turbidity currents appear to be triggered by river floods, primed by rapid accumulation of sediment at the river mouth, and then triggered by spring tides that may occur weeks to months after the flood.
- The Congo River mouth seems to act as a 'capacitator'—storing sediment for several months, which then provides the material that can be remobilised by later flows.
- Evidence of older cable breaks (1883-1937) indicate clusters of cable breaks may continue to recur for several years after major river floods.
- The recurrence intervals for major floods on the Congo Canyon is 20-50 years and such events can trigger multiple flows that run the full length of the canyon, damaging cables. This is different to many other canyons where such flows may only recur every 100-1000 years.

STUDY 2: Longest sediment flows yet measured show how major rivers connect efficiently to deep sea (Talling et al., 2022)



▲ **Figure 3:** Initial monitoring of turbidity currents along the Congo Canyon to show their velocity based on measurements at a mooring located at 200 m water depth in the upper canyon (A), and the travel distance of different flows between September 2019 and January 2020 (B). The locations of cable breaks (WACS and SAT-3) are annotated, as are the arrival times at mooring locations. The 14th January flow travelled all the way along the canyon system, cutting loose the moorings and damaging several cables (from Talling et al., 2022).

STUDY 3: Time-lapse surveys reveal patterns and processes of erosion by exceptionally powerful turbidity currents that flush submarine canyons: A case study of the Congo Canyon (Ruffell et al., 2024).

Repeat seafloor surveys provide insights into the behaviour of turbidity currents, particularly identifying areas where flows have eroded seafloor sediments, which causes them to speed up, or deposited where they slow down. The nature of seafloor erosion is also important as it may expose buried cables; in extreme cases leaving cables hanging in suspension where they are no longer supported on the seafloor. This study analysed bathymetric surveys performed in 2019 and 2020 to quantify the change in elevation and represents the first detailed time-lapse surveys of any major submarine canyon-channel system worldwide. The study found:

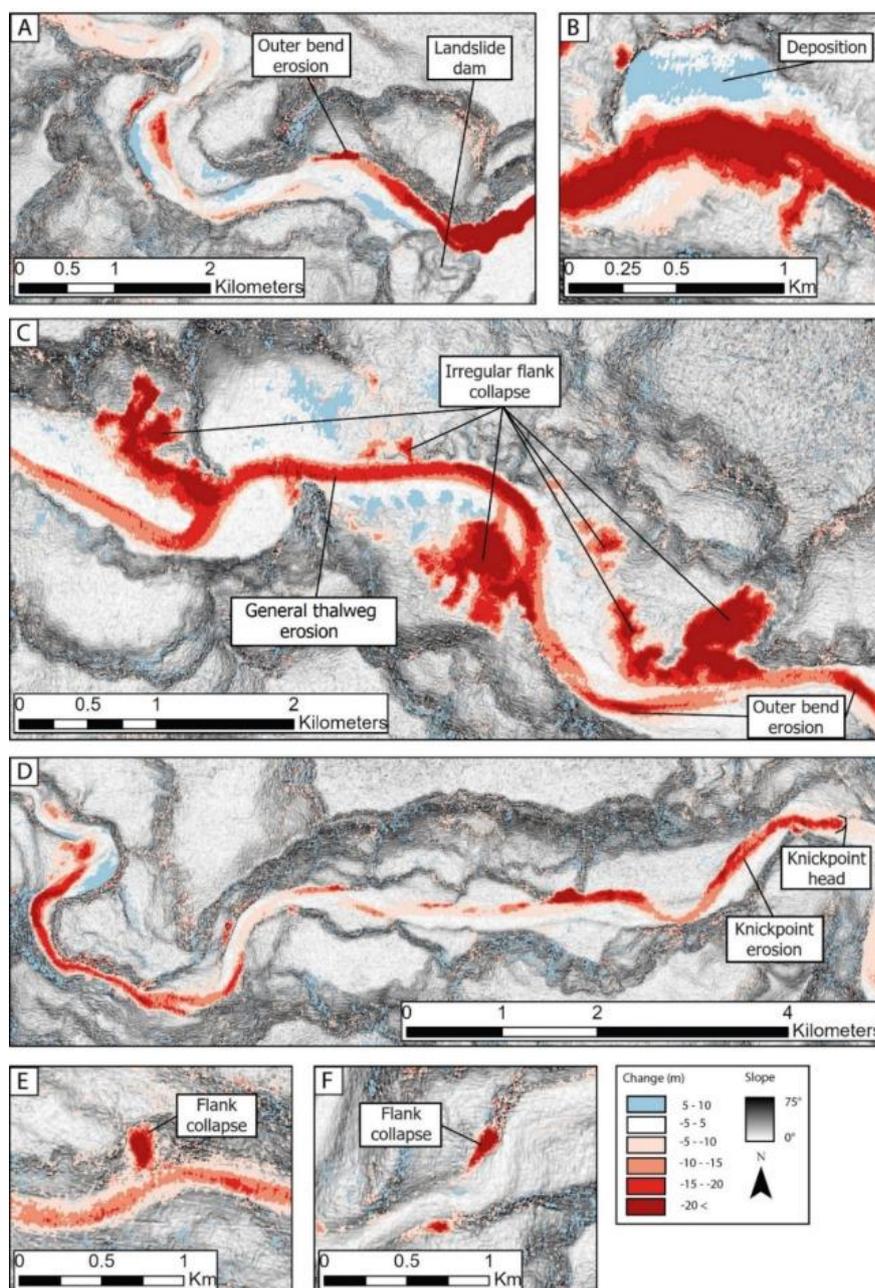
- Around 80% of the seafloor change was due to erosion (rather than deposition) and was focused in and adjacent to the canyon-channel axis.
- In some reaches of the channel, erosion often reached depths of up to 50 m below the previous seafloor elevation; however, erosion is highly localised and patchy, despite the relatively uniform flow speed of the January 2020 turbidity current that was responsible. Some reaches featured no resolvable erosion.
- The nature of erosion was extremely variable, with most eroded material relating to downcutting of the channel or the up-stream migration of steep-faced features called knickpoints.
- Knickpoints are found repeatedly along the length of the channel system, with some having migrated up to 21 km per year, resulting in a highly-eroded section of channel. This is about a million times faster than similar features migrate in rivers, showing there can be profound change in very short time periods in such submarine systems.
- Other types of erosion relate to the collapse of the canyon or channel side walls into the axis,

STUDY 3: Time-lapse surveys reveal patterns and processes of erosion by exceptionally powerful turbidity currents that flush submarine canyons: A case study of the Congo Canyon (Ruffell et al., 2024).

which likely occurs because of undercutting or destabilisation caused by the passage of a turbidity current.

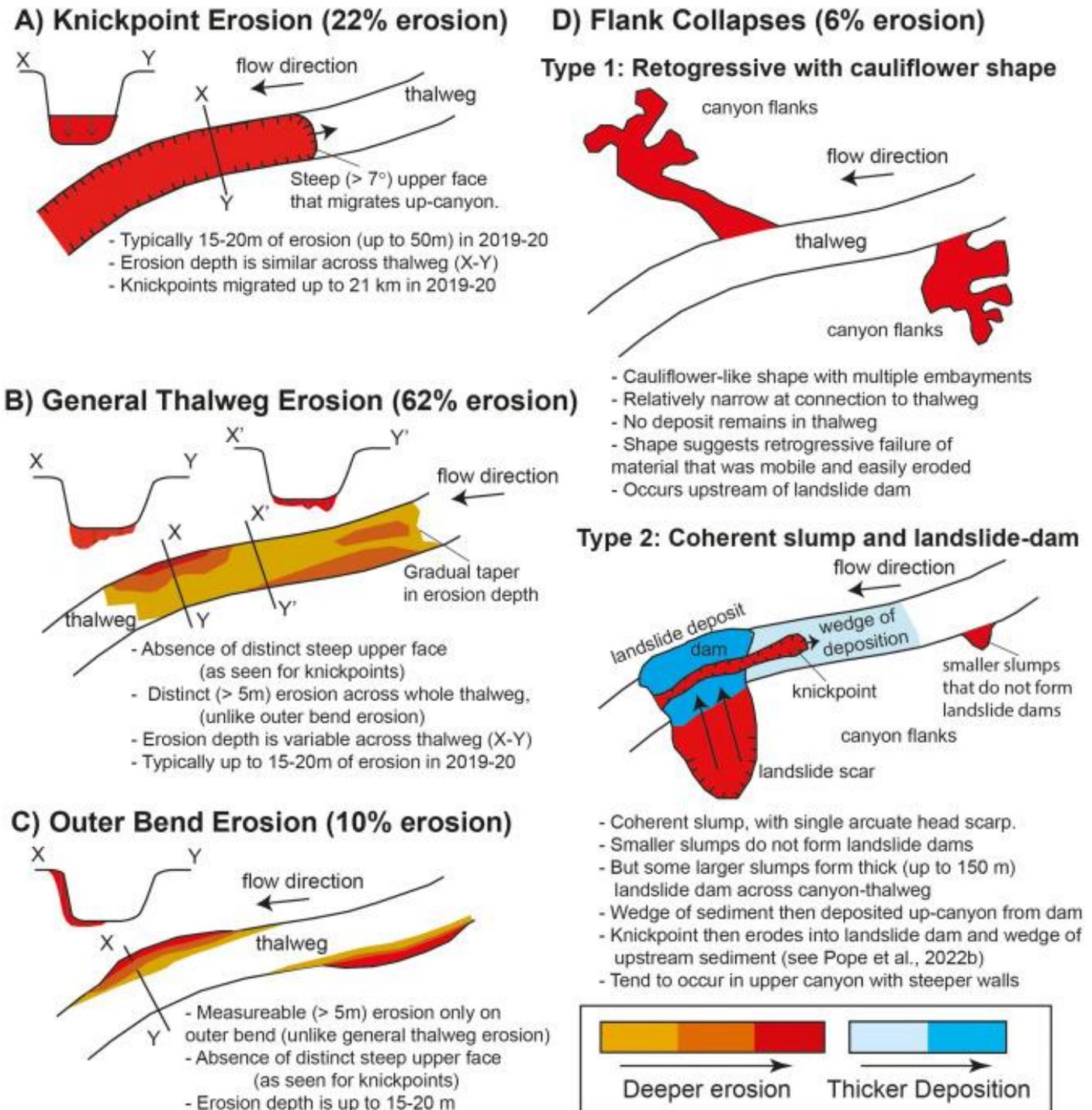
- These results show that there are many processes involved in the

sculpting of the seafloor, with the localised erosion potentially explaining why some cables were badly damaged by powerful turbidity currents, but others survived.



◀ **Figure 4:** Examples of seafloor change created by cable-damaging turbidity current as revealed by repeat seafloor surveys within the Congo Canyon. Areas of red represent removal of sediment, while blue indicates deposition. Erosion occurs as a function of different processes (from Ruffell et al., 2024).

STUDY 3: Time-lapse surveys reveal patterns and processes of erosion by exceptionally powerful turbidity currents that flush submarine canyons: A case study of the Congo Canyon (Ruffell et al., 2024).



▲ **Figure 5:** Schematics to show the different processes that explain erosion and deposition in the Congo Canyon, and which can pose different hazards to subsea cables (from Ruffell et al., 2024).

STUDY 4: Carbon and sediment fluxes inhibited in the submarine Congo Canyon by landslide-damming (Pope et al., 2022)

Pope et al. (2022) showed that sediment can become episodically trapped in the upper reaches of the Congo Canyon because of canyon flank collapses that effectively dam the system. Repeat seafloor surveys performed between 2005 and 2019 showed that a large landslide collapsed into the canyon axis, causing sediment carried downslope by successive turbidity currents to build up sediment.

- A 0.09 km³ landslide dammed the Congo Canyon, which caused

almost 0.4 km³ of sediment to build up behind it.

- This sediment was up to 150 m thick and was emplaced over more than 26 km length up-canyon of the landslide-dam.
- Seafloor surveys performed since this study have shown that a knickpoint has subsequently cut through this landslide dam, flushing sediment into further water; revealing that the seafloor can be extremely dynamic indeed.



STUDY 5: Globally significant mass of terrestrial organic carbon efficiently transported by canyon-flushing turbidity currents (Baker et al., 2024).

The passage of sediment and organic carbon does not always remain trapped in the canyon and can be flushed to the deep sea, such as by the 2020 cable-damaging flow. A study by Baker et al. (2024) analysed sediment cores that sampled the deposits left behind by repeated turbidity currents. The study found that the deposits comprise a mixture of sand and mud, and represent processes that include very high concentration sediment flows, some of which featured. The study found:

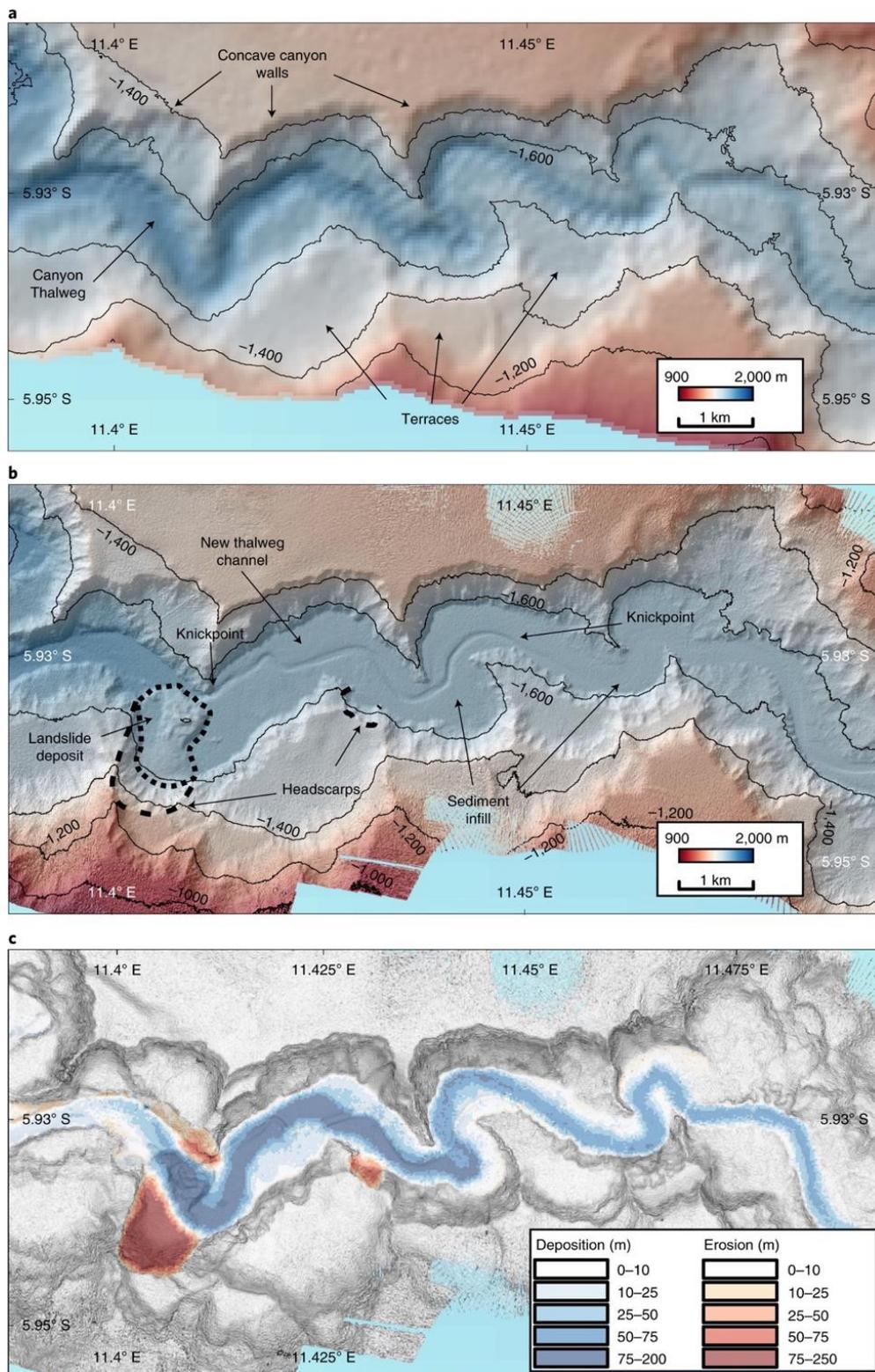
- The Congo River directly connects to the submarine Congo Canyon and is responsible for flushing major quantities of sediment into its head, which includes very fresh vegetation and organic debris that originated from land.
- In addition to posing a threat to subsea cables, the turbidity currents carry globally-significant volumes of organic carbon from land to the deep sea, playing an important but

previously-unrecognised role in the carbon cycle.

- It is estimated that 43 ± 15 Megatonnes of organic carbon was transported to the more than 5 km water depth by turbidity currents in one year, which is equivalent to 22% of the annual global particulate organic carbon export from rivers to oceans and 54%–108% of the predicted annual terrestrial organic carbon burial in the oceans.



STUDY 5: Globally significant mass of terrestrial organic carbon efficiently transported by canyon-flushing turbidity currents (Baker et al., 2024).



▲ **Figure 6:** Detail on repeat seafloor surveys from 2005 (A) and 2019 (B) that show the presence of a new landslide. Differences between those surveys show that the landslide dammed the submarine channel (from Pope et al., 2022).

STUDY 6: Seabed seismographs reveal duration and structure of longest runout sediment flows on Earth (Baker et al., 2024)

While the installation of Acoustic Doppler Current Profilers on moorings has been useful to monitor some turbidity currents, it has not been possible to observe the most powerful flows as they severed the mooring lines and caused the instruments to cut loose. In other submarine canyons, powerful flows have displaced, buried or damaged expensive scientific instruments meaning it has not been possible to monitor the most significant events with respect to subsea cable damage. This has led to the development of new approaches to monitor turbidity currents that take the lead from the field of seismology. New studies have shown that instruments known as seismometers, which are typically used to detect earthquakes, can also detect the ground motions that are generated by fast-moving events such as turbidity currents. Ocean-bottom seismometers were deployed along the length of the Congo Canyon system in 2019-2020, but unlike the ADCPs, were not placed inside the axis but instead outside of harm's way. This new

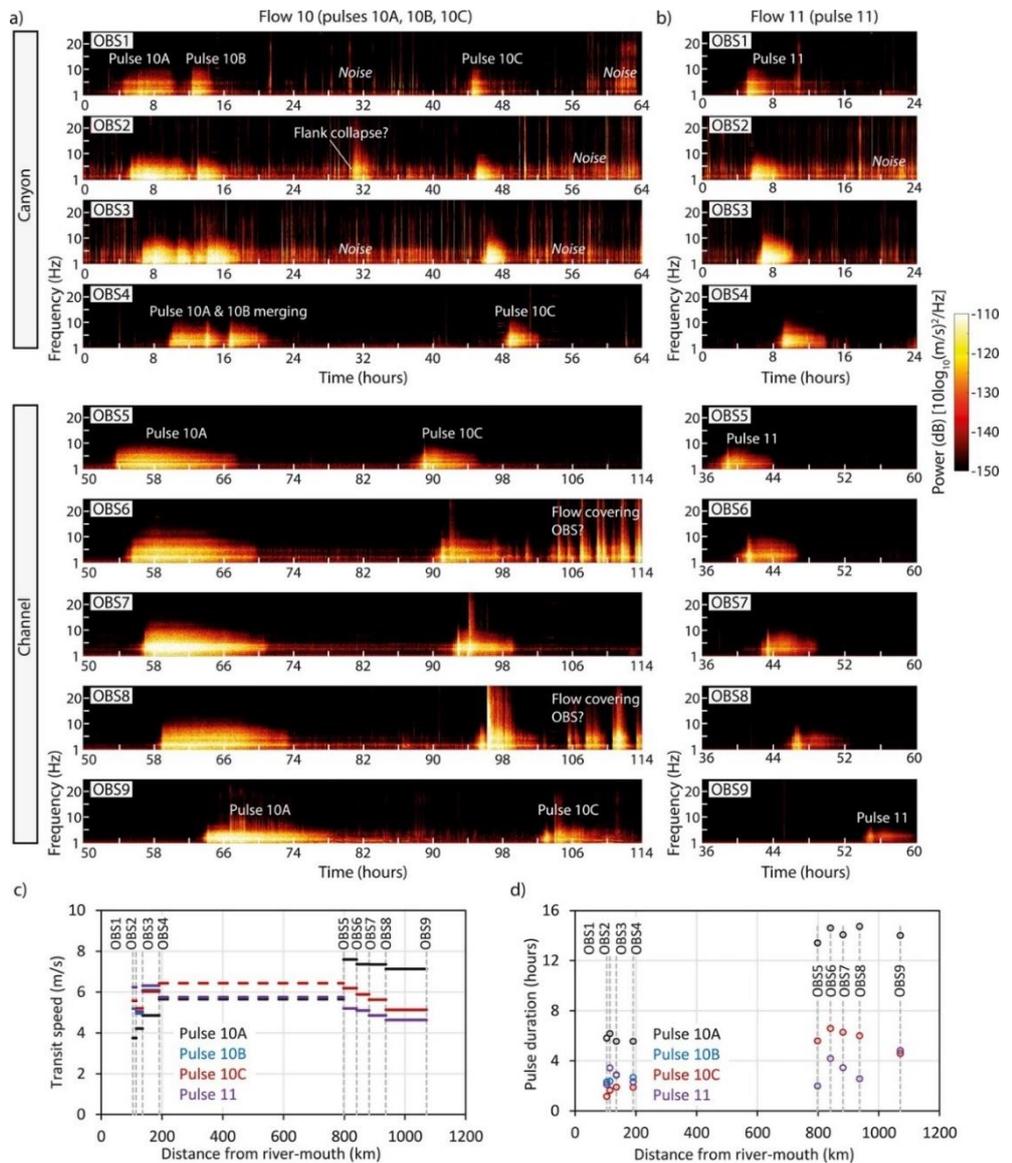
approach effectively 'listens' passively for turbidity currents, with two new studies revealing that this approach is not only possible, but can provide new information about how these flows behave.

- Twelve ocean bottom seismometers that include three geophones and a hydrophone were deployed the same time as the ADCP moorings in September 2019.
- Unlike the ADCP moorings which surfaced due to interaction with the turbidity current, the ocean-bottom seismometers were unaffected.
- Fast-moving turbidity currents could be clearly identified from their seismic signature, produced by the ground motions that were generated.
- The fast-moving dense frontal part of turbidity currents that travelled >1200 km were found to extend across distances of up to 400 km at a time—revealing that vast tracts of the canyon are affected by the fastest parts of these flows.

STUDY 6: Seabed seismographs reveal duration and structure of longest runout sediment flows on Earth (Baker et al., 2024)

- The duration of turbidity currents increases into deeper water (up to 21 days long), as the fast-moving frontal part runs away from the slower-moving body of the flow, and they effectively stretch.
- One of the cable-damaging flows is estimated to transport the annual organic carbon of the Congo River in an hour; hence, these large canyon-flushing flows are even more important than previously thought with respect to global carbon budgets.

▼ **Figure 7:** Spectrograms that recorded the seismic energy created by powerful turbidity currents (A&B) at Ocean Bottom Seismometers (OBS) that were deployed along the canyon length as shown in (C), that reveal the variable speed of turbidity currents and the pulsed nature of flow (D). From Baker et al. (2024).



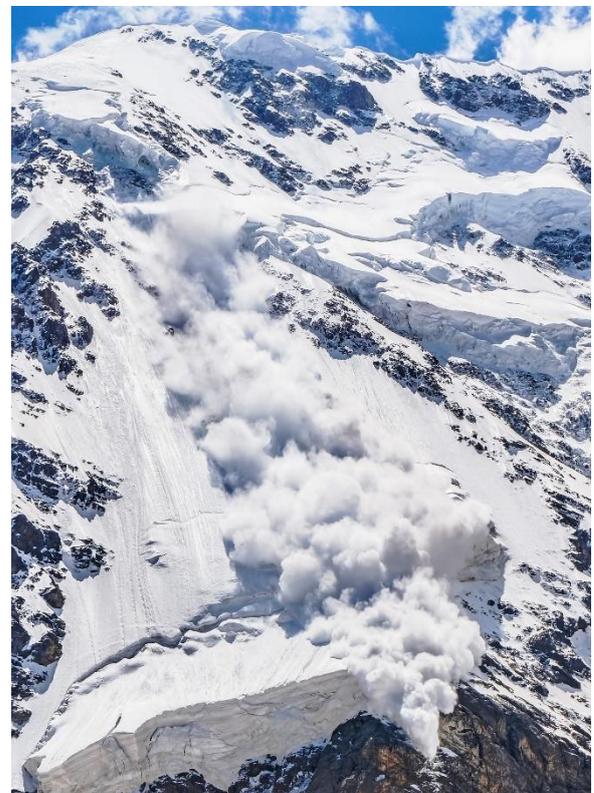
STUDY 7: Ocean-bottom seismometers reveal surge dynamics in Earth's longest-runout sediment flows (Kunath et al., 2025)

Following the analysis of Baker et al. (2024), this subsequent study used the same dataset to determine more detail on the internal structure of the long runout turbidity currents, comparing the signals with those recorded by river flows on land.

- Analysis of the seismic signals reveals that they are generated by a mixture of turbulent and bedload flow, suggesting complex flow behaviour.
- The turbidity currents occur as multiple surges, as a series of pulsed flows, rather than one uniform flow. Such surges, which represent the fastest part of a turbidity current may last for up to five hours and indicate that these parts of the flow are very highly concentrated and may behave more like a debris flow.
- The pulsed nature of the flows may relate to: i) sequential triggers, such as delayed slumping at the head of the Congo Canyon; ii) episodic erosion in the canyon that causes the flows to bulk up

along their course, similar to observations from snow avalanches; iii) or arising as roll waves as seen in granular flows on land. The study authors favour the latter explanation, due to the near-uniform spacing of surges between different flows.

- It is proposed these fast-moving surges that occur at the base of the long runout turbidity currents may explain the damage to seafloor cables, as they will exert the highest drag forces as well as being most erosive.



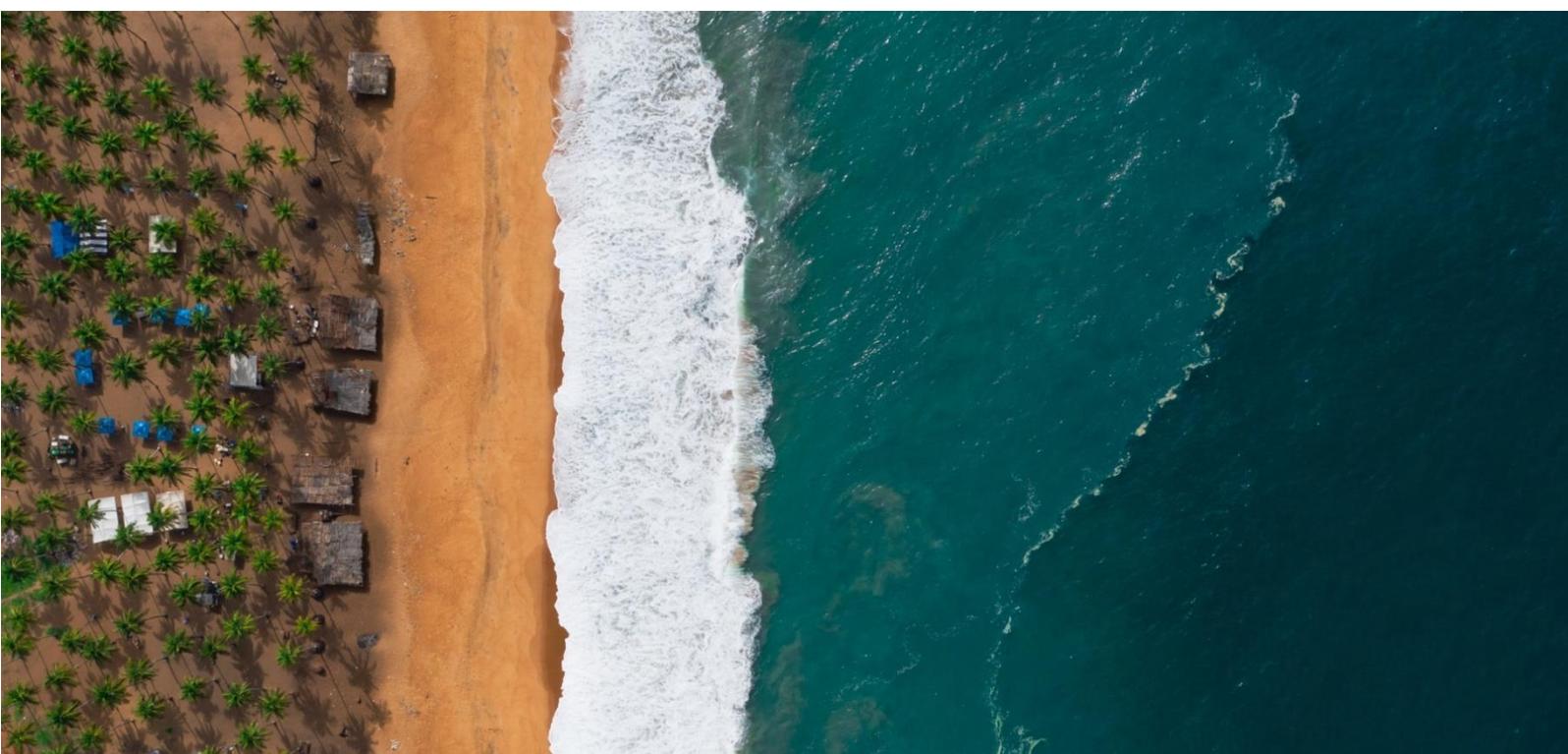
STUDY 8: Hydroacoustic Signals Recorded by CTBTO Network Suggest a Possible Submarine Landslide in Trou Sans Fond Canyon (Ingale et al., 2025)

It is not only seafloor seismometer arrays close to a canyon that can be used to detect cable-damaging flows.

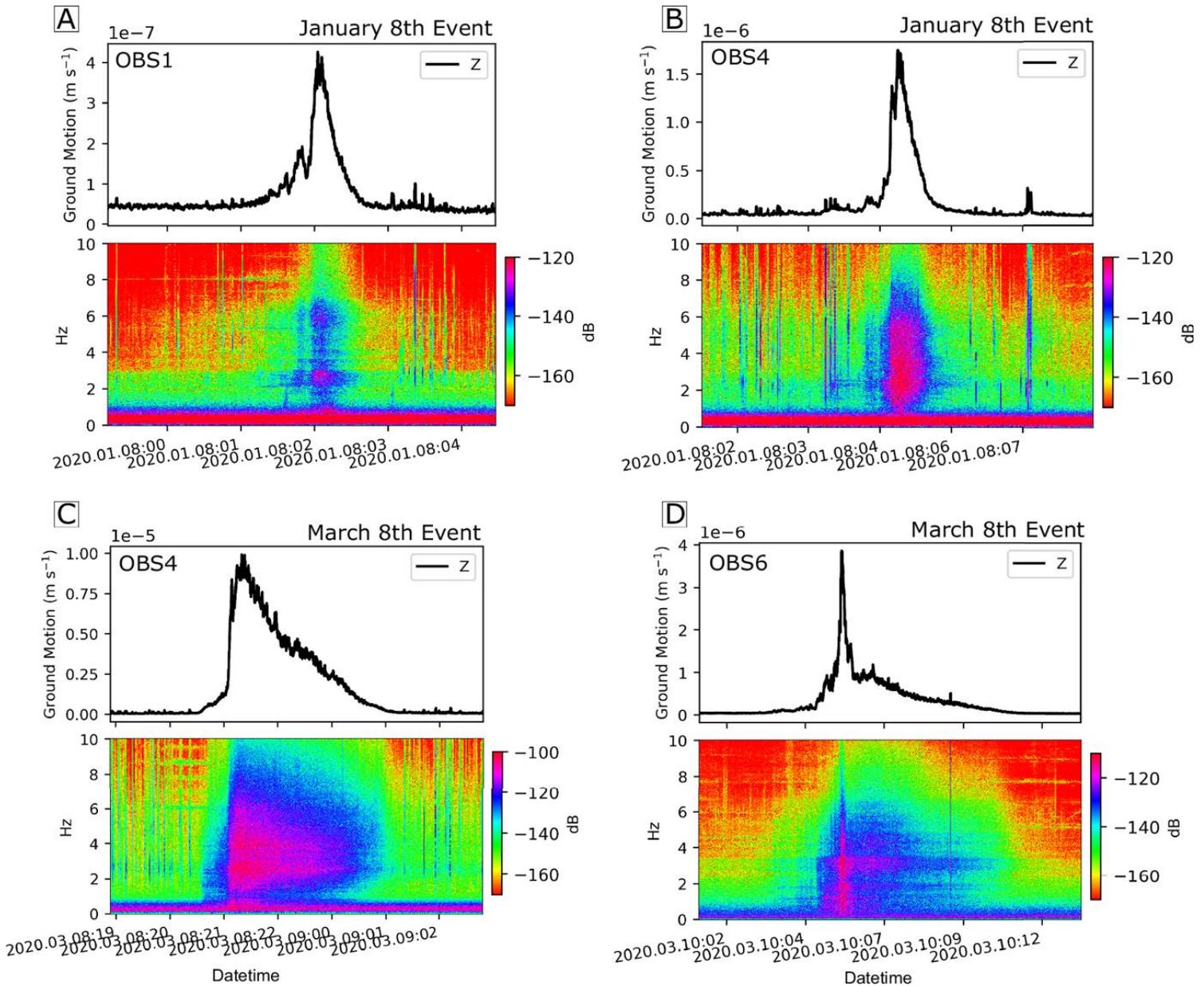
- In March 2024, several subsea cables were damaged offshore from the Ivory Coast, West Africa. This damage occurred in deep water, and was later found to be located within the axis of a major submarine canyon called the Trou Sans Fond Canyon that has many morphological similarities to the Congo Canyon.
- At the same time, low frequency acoustic signals were detected on hydrophones (part of the International Monitoring System of the Comprehensive Nuclear-Test-Ban Treaty

Organization) located near the Ascension Islands (Ingale et al., 2025).

- The acoustic signals could be localised to the points of cable damage and their signature appears to indicate a submarine landslide, explaining the damage caused, which had significant impacts for telecommunications connections across much of West Africa.
- This demonstrates that these hazards can be detected across long distances and provides new opportunities to use existing sensor networks, and potentially also submarine cables themselves to passively listen for such hazards.



STUDY 8: Hydroacoustic Signals Recorded by CTBTO Network Suggest a Possible Submarine Landslide in Trou Sans Fond Canyon (Ingale et al., 2025)



▲ **Figure 8:** Seismic signals of turbidity currents in the Congo Canyon recorded by Ocean Bottom Seismometers, showing different events revealed by their vertical ground motion, which is recorded 2 hours before the arrival of the turbidity current (from Kunath et al., 2025).

LESSONS LEARNED FOR SUBSEA CABLES

The new field studies from the Congo Canyon have provided a new view of turbidity currents and their behaviour for scientists, which have wide implications for the understanding of submarine canyons. These new insights also have specific relevance to the understanding of hazards that these flows posed to infrastructure such as submarine cables.

- Submarine canyons can be the focus of intense down-canyon flows of sediment called turbidity currents, which can damage subsea cables. As a consequence, the crossing of submarine canyons should be avoided (particularly where they connect to sediment-supplying river systems on land), but this is not always possible.
- River floods can deliver large quantities of sediment to the head of a submarine canyon, which can increase the likelihood of turbidity currents. Therefore, sudden increases in sediment transport by a river to the coast may mean that a cable-damaging event could be more likely, which may be useful to alert to a higher level of risk.
- Sediment delivered by a river flood may prime a canyon system to increased likelihood of a turbidity current, but the final trigger may be related to another process (e.g. extreme tides that cause sediment to be flushed offshore). As a result, a cable-damaging flow may be delayed after river floods—in some cases by weeks or months.
- The volume of sediment provided by a major river flood (e.g. 1 in 50-year events) may be so significant that the canyon may remain primed and capable of cable-damaging flows for a long period (potentially years). This means that cable-damaging flows may occur in clusters in time, and are not necessarily one-off events after large floods.
- Turbidity currents may last for more than a week—up to 21 days as determined from seismic

LESSONS LEARNED FOR SUBSEA CABLES

monitoring—hence, their impacts are not solely instantaneous and may be sustained. However, the fastest and densest part is towards the front of the flow, but may still be sustained for several hours.

- Turbidity currents in some submarine canyons slow down further from their source due to lower slope gradients or where the channel broadens out, which means that routing cables in deeper water exposes them to lower risk. However, in the case of the Congo Canyon (where channel width and gradient are typically similar along its course) this is not the case. Monitoring of flows in the Congo Canyon reveal that some canyon-damaging flows sped up at a distance of 600-800 km from their source due to erosion, causing greater hazard to cables further offshore.
- The only way to avoid the hazard may be to route into such deep waters that the submarine canyon and any

attached deep sea fan is avoided—as in the case of the new Equiano cable offshore West Africa, which is laid into >5 km water depth. This requires extremely long lengths of cable, however, and may be prohibitively expensive for some systems.

- Not all turbidity currents lead to cable damage. Indeed, many turbidity currents occur every year, which do not reach speeds (>5.5 m/s) that result in damage. Such flows may progressively bury some cables, which may protect them from later damage.
- Not all cables are damaged by the most powerful flows, but this is currently not fully understood. Timelapse seafloor surveys reveal very patchy erosion in the canyon axis, while seismic monitoring reveals a pulsatory nature of turbidity currents; hence it is likely that this spatially variable behaviour may explain why some cables have experienced no damage at all.

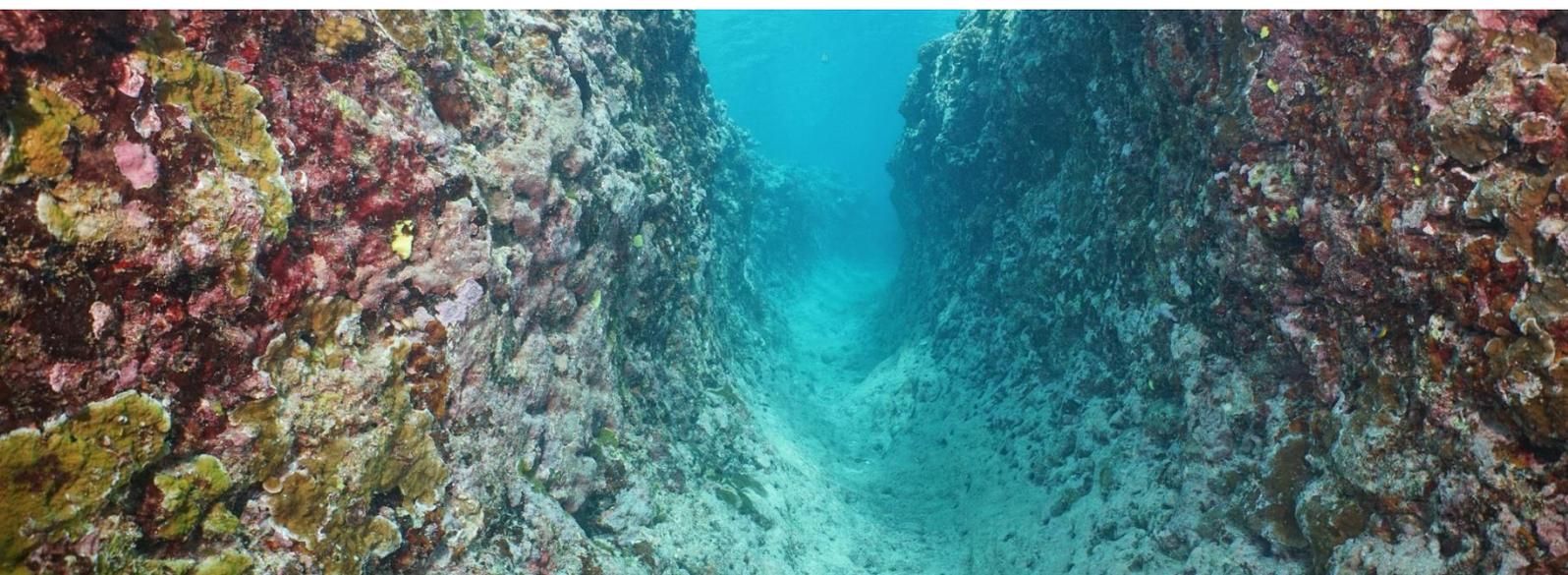
LESSONS LEARNED FOR SUBSEA CABLES

It is plausible that large flank collapses have buried some cables, protecting them from subsequent exposure and interaction with powerful flows.

- The damage to a cable may be caused by multiple aspects of a turbidity current, which may include the drag imparted by the flow, abrasion due to rubbing on the seafloor or material within the flow, snagging on the seafloor or by large vegetation debris carried within the flow, the impact of slumping into the canyon, or due to undermining of a cable by erosion (which may be up to 50 m deep) that leaves it suspended within the flow.
- Such deep erosion occurs in association with steep steps in the channel called knickpoints. These features can be up to

tens of metres deep, with erosion occurring over several kilometres within a single event. Subsea cables should avoid areas prone to deep erosion, which include areas upslope from landslide dams, near mapped knickpoints (particularly immediately upstream as that will be the site of most intense erosion), and immediately after the apex of a channel bend.

- Repeat seafloor surveys can help to identify whether there is active knickpoint migration within a section of canyon/channel that is the proposed site for a cable crossing.
- The frequency and magnitude of turbidity currents may change in future, particularly in light of climate change.



LESSONS LEARNED FOR SUBSEA CABLES

Climate-driven increases in rainfall in combination with land-use changes (e.g. deforestation) that make soil erosion more likely will enhance the sediment load of a river, which could enhance the likelihood and/or magnitude of turbidity currents in the Congo Canyon.

- Not all submarine canyons are the same, and are fed with sediment in different ways, experience different hydrodynamic conditions, and will feature differing types and magnitudes of hazards. This underlines a need to better understand these features and the processes that operate in them through detailed desk studies, surveys, monitoring and future research in collaboration between the subsea cable industry and academic researchers.

The story is continuing with a recent (8th April 8th to 12th May 2025) research cruise that has again been supported strongly by

Angola Cables and the West Africa Cable Consortia. Congo Telecom is also thanked for assisting with the authorisation to work in Republic of Congo Waters. This latest cruise found the very end of the entire Congo Canyon-Channel is highly active with flows for 15% of the total time, despite being over one thousand kilometers from the Congo River Mouth. These flows each lasted for a week to a month and reached speeds of > 1 m/s. Repeat mapping and sub-bottom profiling also showed how the channel had extended for ~5 km in just one year. All of this work has been supported by the UK's Natural Environment Research Council, with field data collected using their outstanding scientific research vessels. New insights from direct measurements, repeat surveys and sediment coring will undoubtedly provide a greater understanding of the behaviour of the longest runout sediment flows on the planet and help enhance the resilience of subsea cable networks that underpin our daily lives.



Sharing seabed and oceans in harmony

[The International Cable Protection Committee \(ICPC\)](#) was formed in 1958 and its primary goal is to promote the safeguarding of international submarine cables against human made and natural hazards. The organisation provides a forum for the exchange of technical, legal and environmental information about submarine cables and, with more than **235 MEMBERS** from over **70 NATIONS**, including cable operators, owners, manufacturers, industry service providers, and governments, it is the world's premier submarine cable organisation. The ICPC comprises of an 18 Member Executive Committee (EC)-led organisation voted in by its Full Members. In addition to the Marine Environmental Adviser (MEA), General Manager (GM) and Secretariat team, the ICPC also has an appointed International Cable Law Adviser (ICLA) as well as a United Nations Observer Representative (UNOR).

Prime Activities of the ICPC:

- Promote awareness of submarine cables as critical infrastructure to governments and other users of the seabed.
- Establish internationally agreed recommendations for cable installation, protection, and maintenance.
- Monitor the evolution of international treaties and national legislation and help to ensure that submarine cable interests are fully protected.
- Liaison with UN Bodies.

Recommendations:

- Taking into account the marine environment, the ICPC authors [Recommendations](#) which provides guidance to all seabed users ensuring best practices are in place.
- Educating the undersea community as well as defining the minimum recommendations for cable route planning, installation, operation, maintenance and protection as well as survey operations.
- Facilitating access to new cable technologies.

Advancing Regulatory Guidance:

- Promoting United Nations Convention for the Law of the Sea (UNCLOS) compliance.
- Championing uniform and practical local legislation and permitting
- Protecting cable systems and ships.
- Aiding education of government regulators and diplomats.

Working with Science:

- Supporting independent research into cables.
- Publishing reviews for governments and policy makers.
- Working with environmental organisations.
- Effective public education via various media.

**To learn how to become
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REFERENCES

1. Azpiroz-Zabala, M., Cartigny, M.J., Talling, P.J., Parsons, D.R., Sumner, E.J., Clare, M.A., Simmons, S.M., Cooper, C. and Pope, E.L., 2017. Newly recognized turbidity current structure can explain prolonged flushing of submarine canyons. *Science advances*, 3(10), p.e1700200.
2. Bailey, L.P., Clare, M.A., Rosenberger, K.J., Cartigny, M.J., Talling, P.J., Paull, C.K., Gwiazda, R., Parsons, D.R., Simmons, S.M., Xu, J. and Haigh, I.D., 2021. Preconditioning by sediment accumulation can produce powerful turbidity currents without major external triggers. *Earth and Planetary Science Letters*, 562, p.116845.
3. Baker, M.L., Hage, S., Talling, P.J., Acikalin, S., Hilton, R.G., Haghypour, N., Ruffell, S.C., Pope, E.L., Jacinto, R.S., Clare, M.A. and Sahin, S., 2024a. Globally significant mass of terrestrial organic carbon efficiently transported by canyon-flushing turbidity currents. *Geology*, 52(8), pp.631-636.
4. Baker, M.L., Talling, P.J., Burnett, R., Pope, E.L., Ruffell, S.C., Urlaub, M., Clare, M.A., Jenkins, J., Dietze, M., Neasham, J. and Silva Jacinto, R., 2024b. Seabed seismographs reveal duration and structure of longest runout sediment flows on Earth. *Geophysical Research Letters*, 51(23), p.e2024GL111078.
5. Bricheno, L., Yeo, I., Clare, M., Hunt, J., Griffiths, A., Carter, L., Talling, P.J., Baker, M., Wilson, S., West, M. and Panuve, S., 2024. The diversity, frequency and severity of natural hazard impacts on subsea telecommunications networks. *Earth-Science Reviews*, p.104972.
6. Carter, L., Gavey, R., Talling, P.J. and Liu, J.T., 2014. Insights into submarine geohazards from breaks in subsea telecommunication cables. *Oceanography*, 27(2), pp.58-67.
7. Cattaneo, A., Babonneau, N., Ratzov, G., Dan-Unterseh, G., Yelles, K., Bracène, R., Mercier de Lepinay, B., Boudiaf, A. and Déverchère, J., 2012. Searching for the seafloor signature of the 21 May 2003 Boumerdès earthquake offshore central Algeria. *Natural Hazards and Earth System Sciences*, 12(7), pp.2159-2172.
8. Chen, P., Kane, I.A., Clare, M.A., Soutter, E.L., Mienis, F., Wogelius, R.A. and Keavney, E., 2025. Direct evidence that microplastics are transported to the deep sea by turbidity currents. *Environmental Science & Technology*.
9. Clare, M., Lintern, D.G., Rosenberger, K., Clarke, J.E.H., Paull, C., Gwiazda, R., Cartigny, M.J., Talling, P.J., Perara, D., Xu, J. and Parsons, D., 2020. Lessons learned from the monitoring of turbidity currents and guidance for future platform designs, Geological Society of London.
10. Clare, M.A., Yeo, I.A., Watson, S., Wysoczanski, R., Seabrook, S., Mackay, K., Hunt, J.E., Lane, E., Talling, P.J., Pope, E. and Cronin, S., 2023. Fast and destructive density currents created by ocean-entering volcanic eruptions. *Science*, 381(6662), pp.1085-1092.
11. Gavey, R., Carter, L., Liu, J.T., Talling, P.J., Hsu, R., Pope, E. and Evans, G., 2017. Frequent sediment density flows during 2006 to 2015, triggered by competing seismic and weather events: Observations from subsea cable breaks off southern Taiwan. *Marine Geology*, 384, pp.147-158.
12. Heezen, B.C., Menzies, R.J., Schneider, R.J., Ewing, W.M. and Granelli, N.C.L., 1964. Congo submarine canyon. *AAPG bulletin*, 48(7), pp.1126-1149.
13. Hsu, S.K., Kuo, J., Chung-Liang, L., Ching-Hui, T., Doo, W.B., Ku, C.Y. and Sibuet, J.C., 2008. Turbidity currents, submarine landslides and the 2006 Pingtung earthquake off SW Taiwan. *TAO: Terrestrial, Atmospheric and Oceanic Sciences*, 19(6), p.7.
14. Hage, S., Baker, M.L., Babonneau, N., Soulet, G., Dennielou, B., Silva Jacinto, R., Hilton, R.G., Galy, V., Baudin, F., Rabouille, C. and Vic, C., 2024. How is particulate organic carbon transported through the river-fed submarine Congo Canyon to the deep sea?. *Biogeosciences*, 21(19), pp.4251-4272.

REFERENCES

15. Ingale, V.V., Parnell-Turner, R., Fan, W., Talling, P.J. and Neasham, J., 2024. Hydroacoustic Signals Recorded by CTBTO Network Suggest a Possible Submarine Landslide in Trou Sans Fond Canyon, Offshore Ivory Coast, March 2024. *Seismol. Res. Lett*, 20, pp.1-11.
16. Kunath, P., Talling, P.J., Lange, D., Chi, W.C., Baker, M.L., Urlaub, M. and Berndt, C., 2025. Ocean-bottom seismometers reveal surge dynamics in Earth's longest-runout sediment flows. *Communications Earth & Environment*, 6(1), p.147.
17. Pope, E.L., Heijnen, M.S., Talling, P.J., Jacinto, R.S., Gaillot, A., Baker, M.L., Hage, S., Hasenhündl, M., Heerema, C.J., McGhee, C. and Ruffell, S.C., 2022. Carbon and sediment fluxes inhibited in the submarine Congo Canyon by landslide-damming. *Nature Geoscience*, 15(10), pp.845-853.
18. Ruffell, S.C., Talling, P.J., Baker, M.L., Pope, E.L., Heijnen, M.S., Jacinto, R.S., Cartigny, M.J., Simmons, S.M., Clare, M.A., Heerema, C.J. and McGhee, C., 2024. Time-lapse surveys reveal patterns and processes of erosion by exceptionally powerful turbidity currents that flush submarine canyons: A case study of the Congo Canyon. *Geomorphology*, 463, p.109350.
20. Simmons, S.M., Azpiroz-Zabala, M., Cartigny, M.J., Clare, M.A., Cooper, C., Parsons, D.R., Pope, E.L., Sumner, E.J. and Talling, P.J., 2020. Novel acoustic method provides first detailed measurements of sediment concentration structure within submarine turbidity currents. *Journal of Geophysical Research: Oceans*, 125(5), p.e2019JC015904.
21. Talling, P.J., Baker, M., Pope, E., Cula, C.A., Cartigny, M., Faria, R., Clare, M.A., Simmons, S., Jacinto, R.S., Heijnen, M. and Hage, S., 2021. Novel sensor array helps to understand submarine cable faults off West Africa.
22. Talling, P.J., Baker, M.L., Pope, E.L., Ruffell, S.C., Jacinto, R.S., Heijnen, M.S., Hage, S., Simmons, S.M., Hasenhündl, M., Heerema, C.J. and McGhee, C., 2022. Longest sediment flows yet measured show how major rivers connect efficiently to deep sea. *Nature communications*, 13(1), p.4193.
23. Talling, P.J., Cartigny, M.J., Pope, E., Baker, M., Clare, M.A., Heijnen, M., Hage, S., Parsons, D.R., Simmons, S.M., Paull, C.K. and Gwiazda, R., 2023. Detailed monitoring reveals the nature of submarine turbidity currents. *Nature Reviews Earth & Environment*, 4(9), pp.642-658.

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