

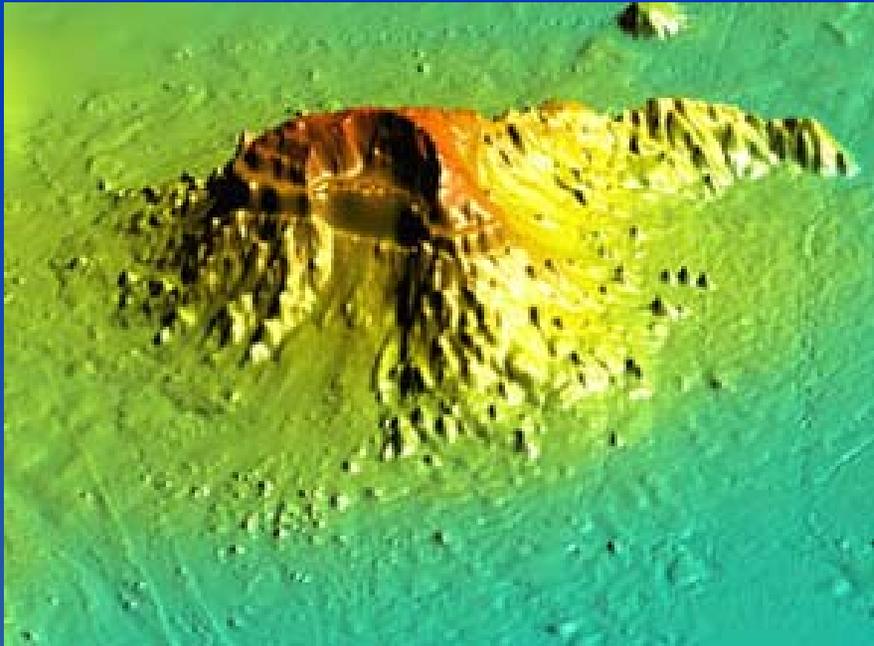
CANARY ISLANDS LANDSLIDES AND TSUNAMI GENERATION: MYTH OR LEGEND?

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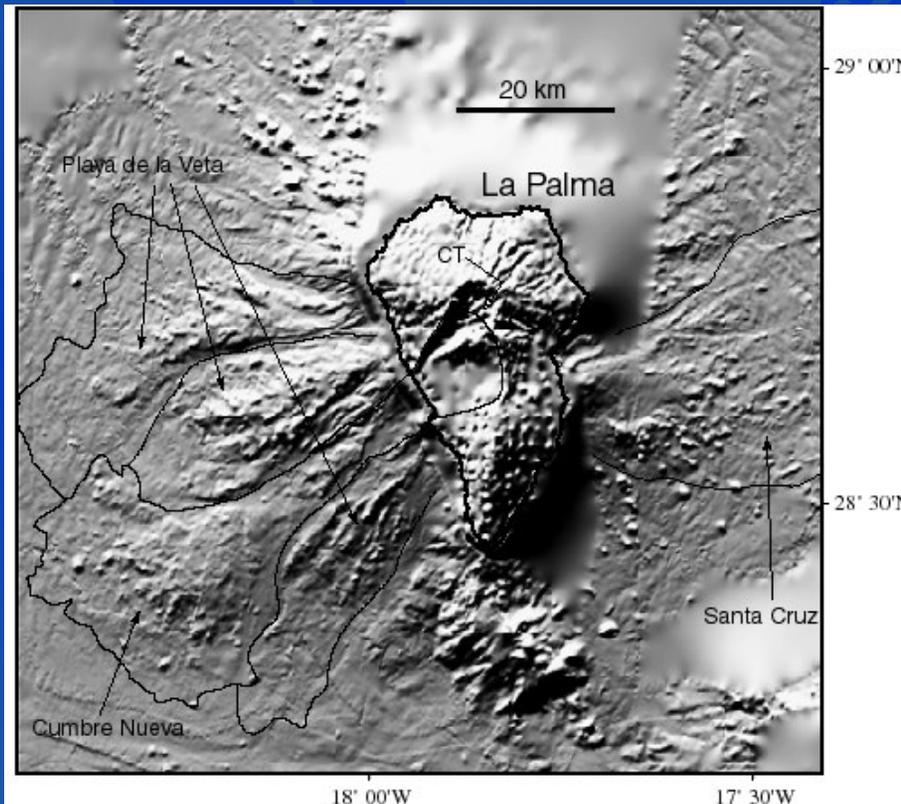


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BACKGROUND

A recent study has suggested that the west flank of La Palma in the Canary Islands is an unstable area that may develop into a future landslide, generating a catastrophic 'mega-tsunami' that could cause damage on both sides of the Atlantic Ocean. These results have inevitably attracted substantial media coverage, and actually caused serious concerns in the Canary Islands.



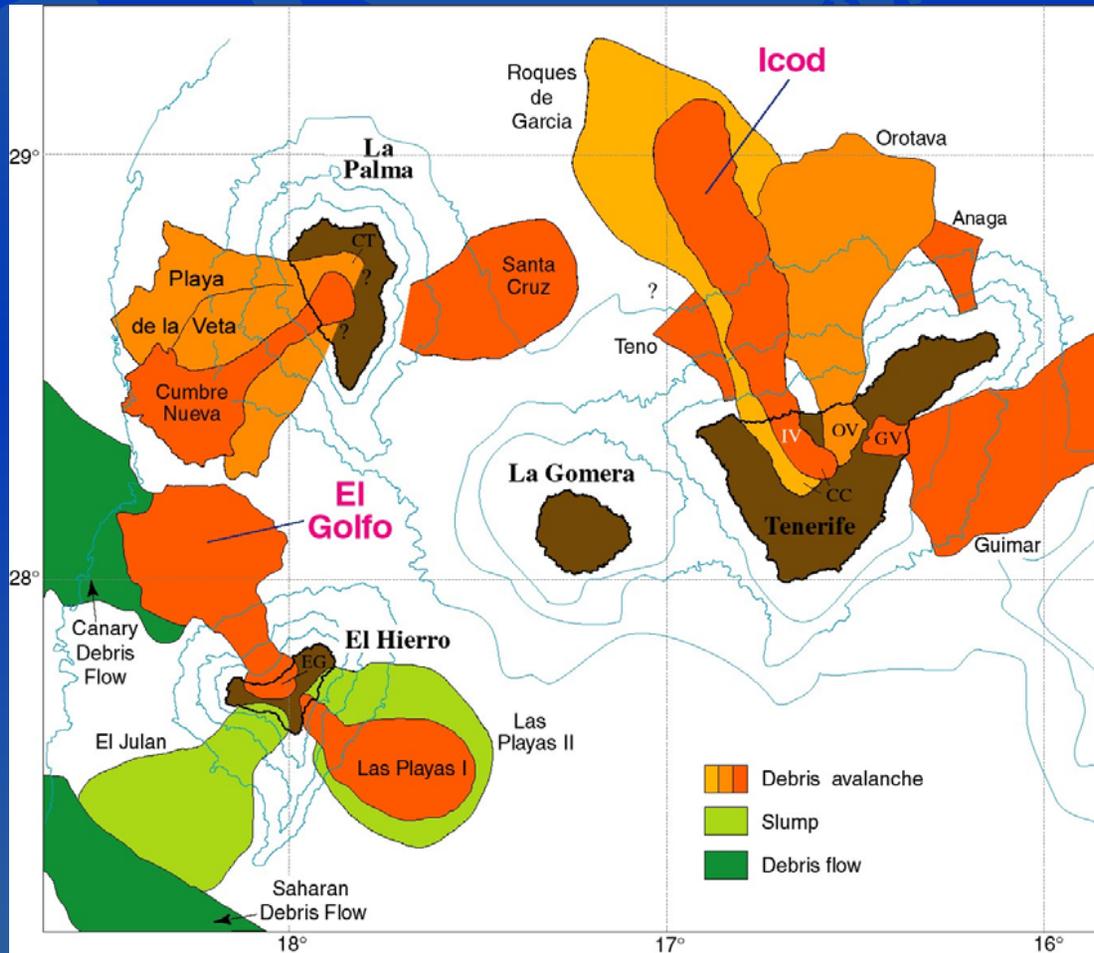
In this study, we actually look at the deposits of the two most recent Canary Island landslides, and use these observations to re-evaluate the potential tsunami hazard of any future landslide.....



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The western Canary Islands have undergone regular catastrophic landsliding in the past one million years



This study will focus on the two most recent landslides:

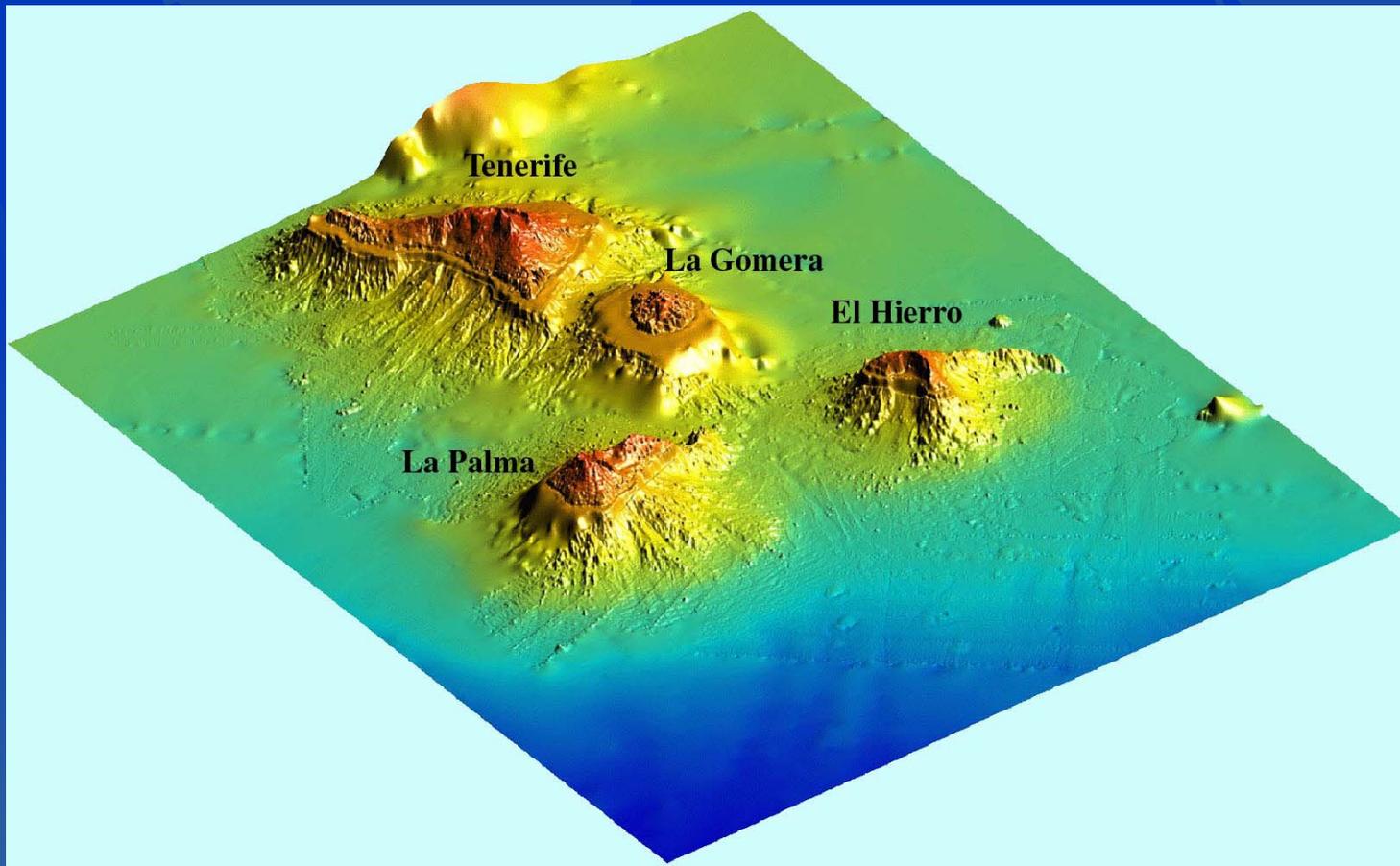
**El Golfo on El Hierro
and Icod on Tenerife**



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The El Golfo landslide (~15,000 years ago)

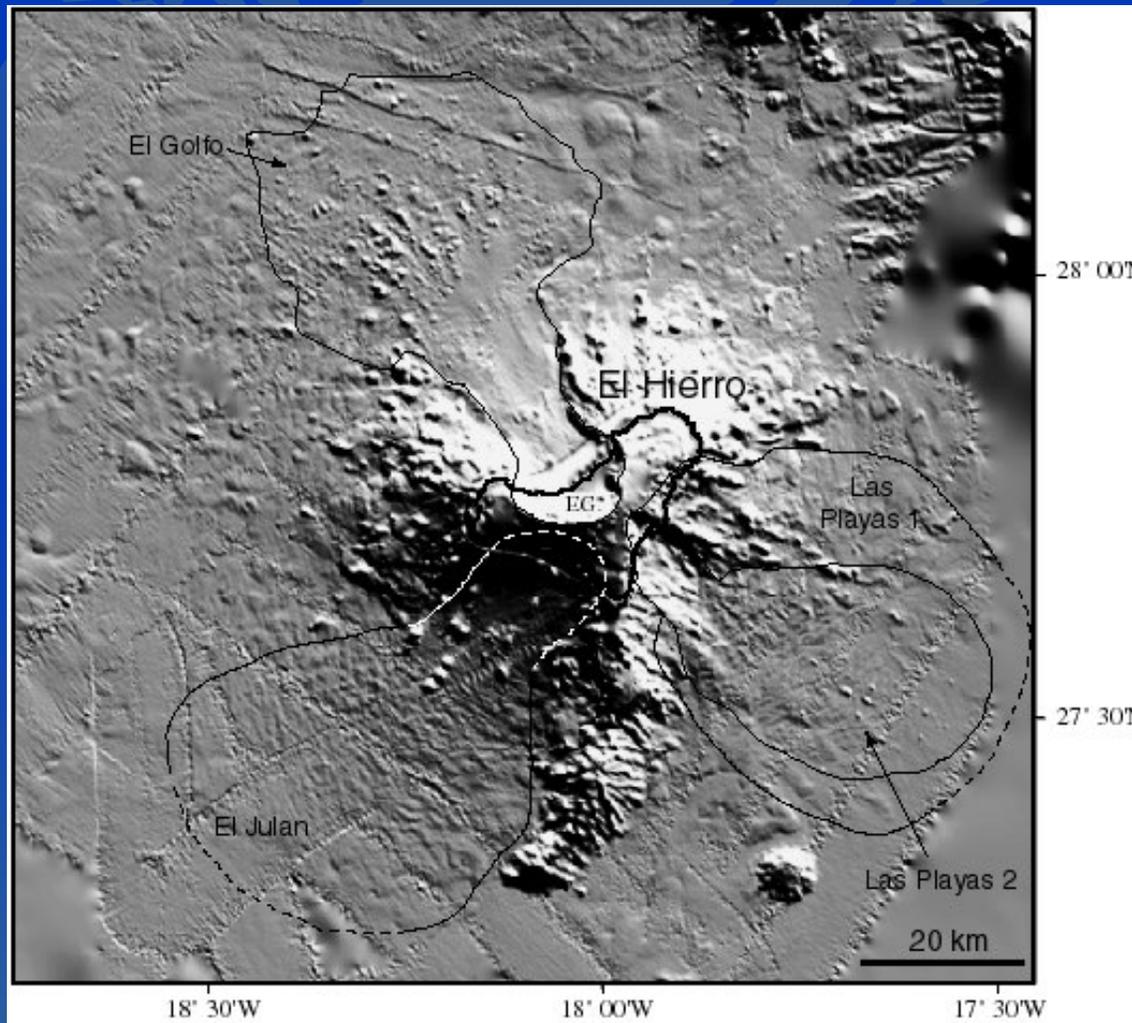




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Seafloor mapping of landslides



**El Hierro is only about
1 million years old.**

**Onshore slide scars
and submarine debris
avalanche deposits
indicate it is rapidly
disappearing into the
sea.**

**El Golfo is the most
recent failure.**

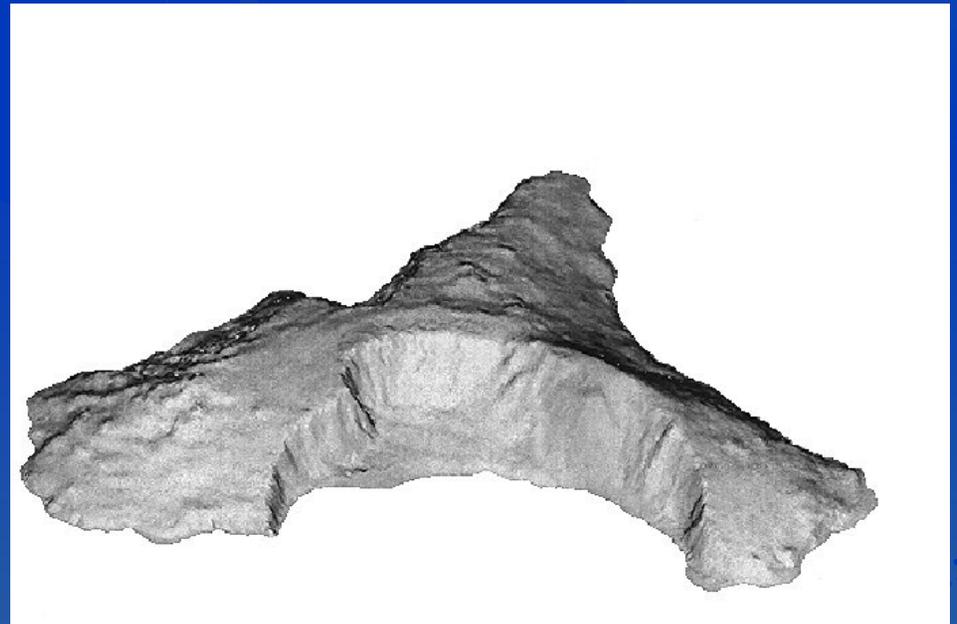


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Aerial images of El Golfo scar

These images highlight the dramatic impact mass-wasting processes have had on the morphology of the island

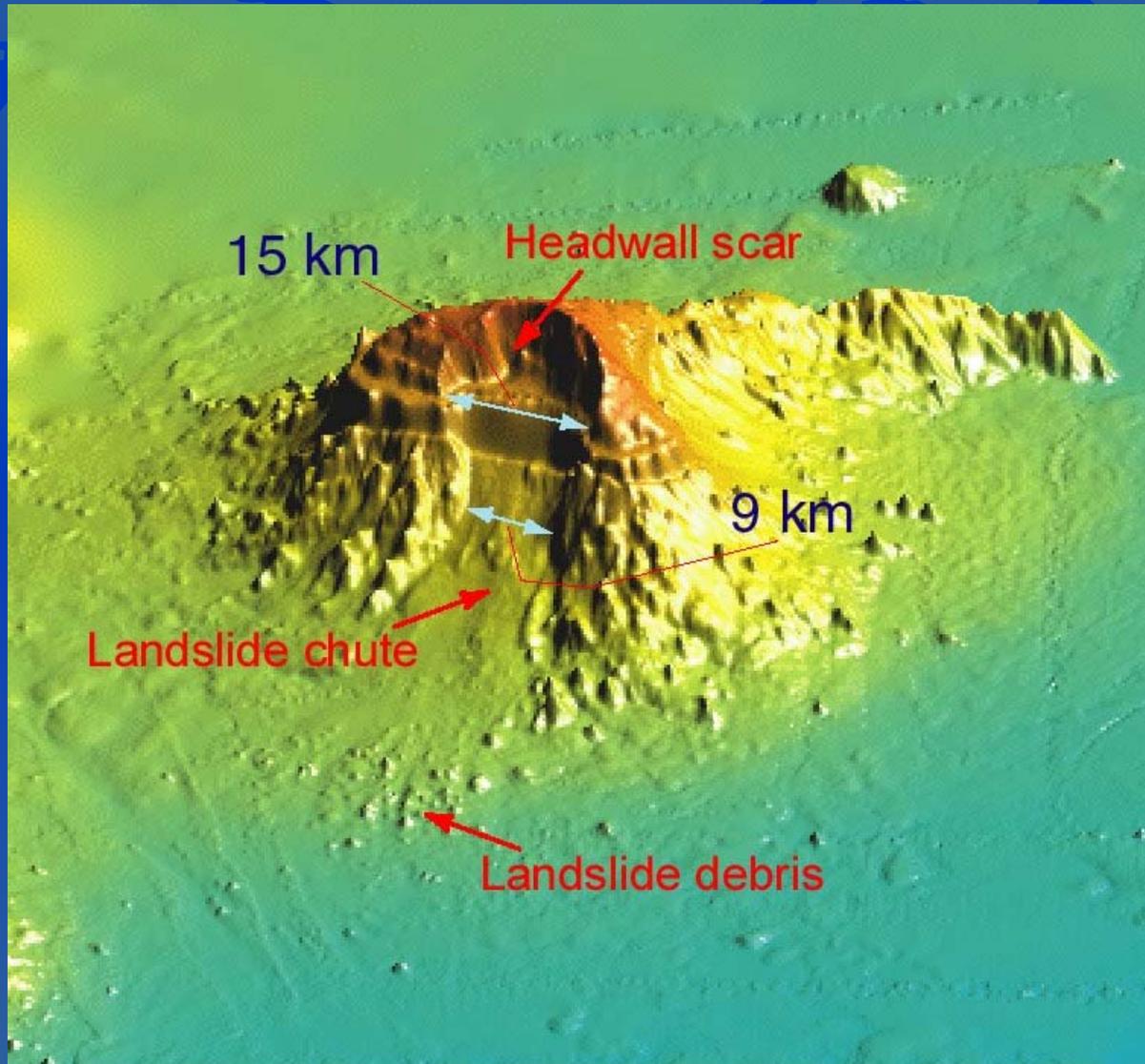




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El Golfo landslide scar



Width of chute is less than width of scar

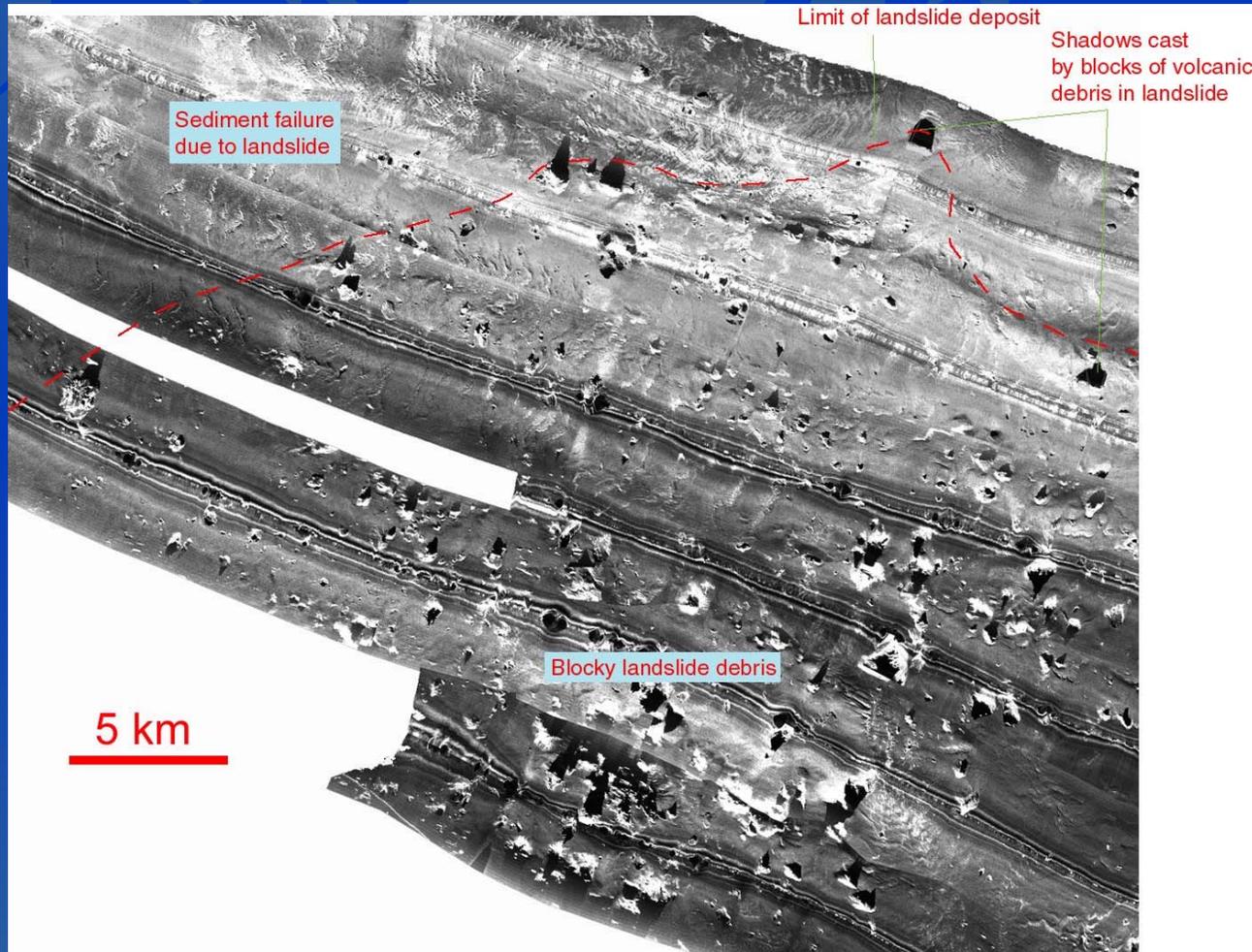
Is it possible for all the landslide material to pass through the chute as an intact block?



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TOBI sidescan mosaic of El Golfo



Landslide is well disaggregated by the time it is deposited

However, blocks up to 1 km across still remain intact

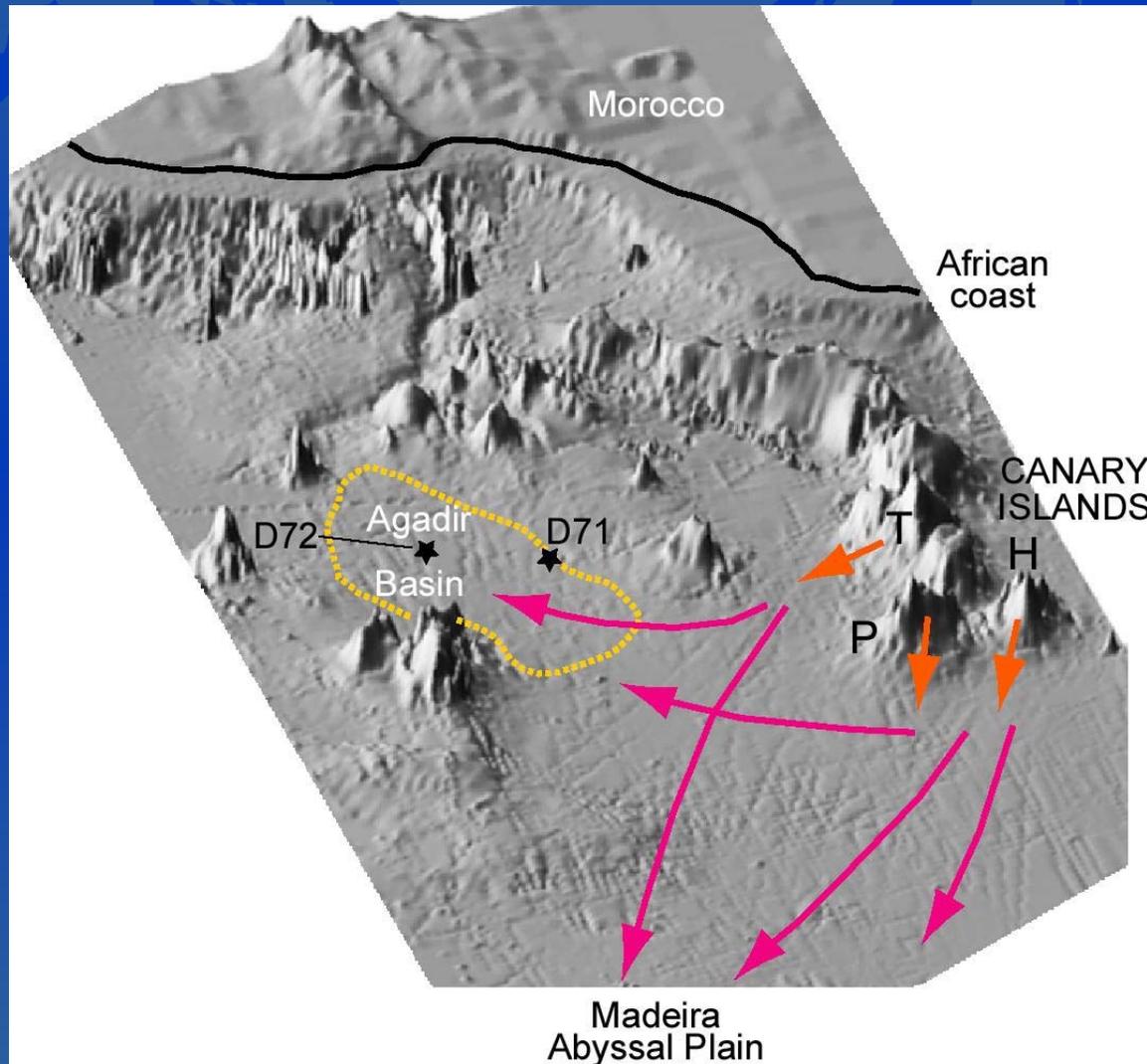
Evidence of progressive slope failure beyond landslide deposit



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Turbidity current pathways



Landslide emplacement causes slope failure leading to turbidity current initiation

Turbidity currents flow downslope to basins (up to 500 km away)

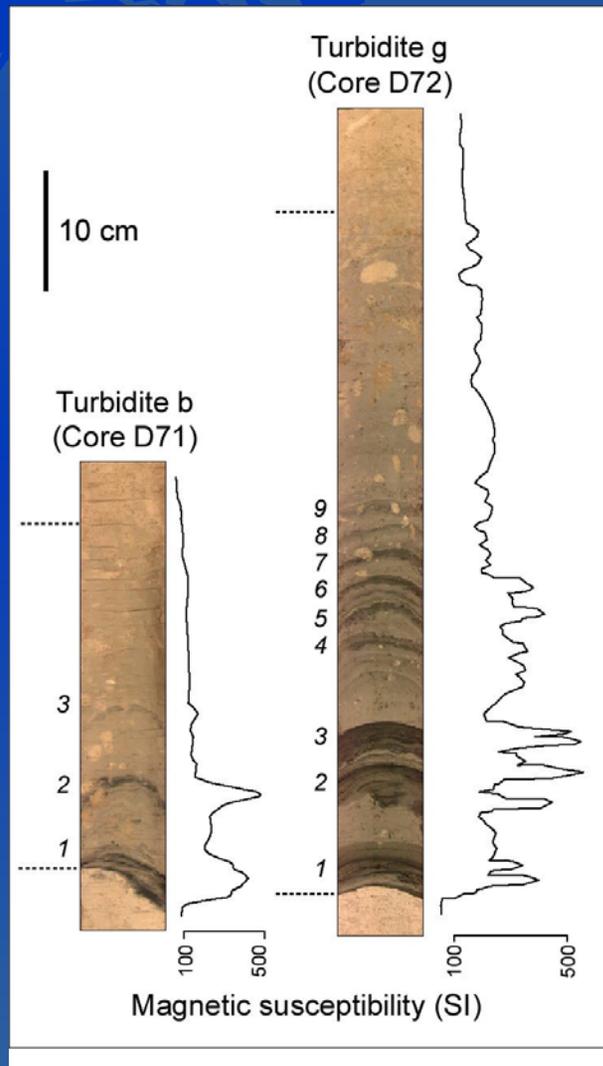
Cores recover turbidites in Agadir Basin (core D71)



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Turbidite correlation and sedimentology



TURBIDITE B = EL GOLFO (~15 ka)

Correlation:

- Various methods (sand composition, mud geochemical signature, isopachs) all indicate west Canaries source

Sedimentology:

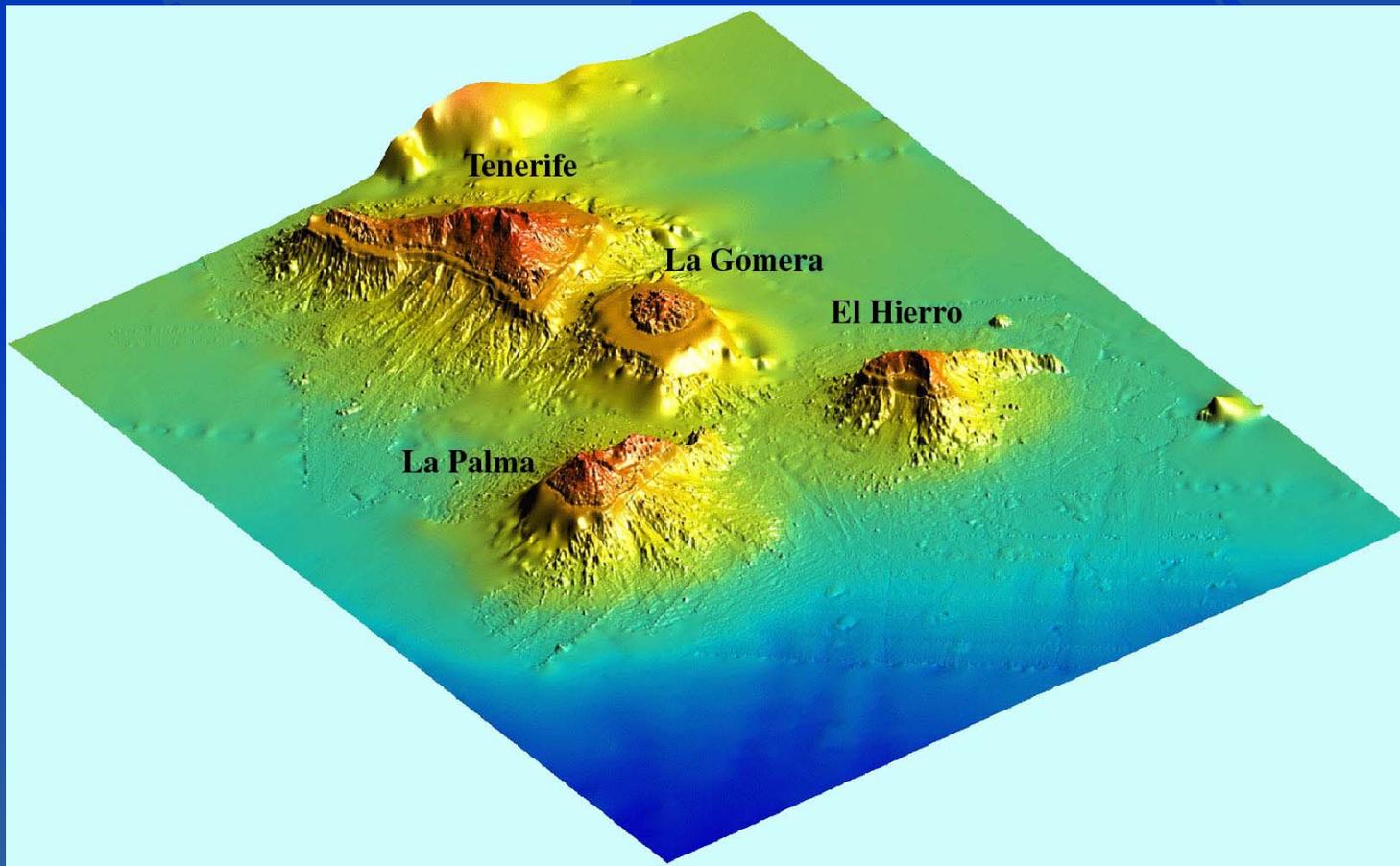
- Turbidite bounded by pelagics
- Within turbidite are three distinctive stacked fining-upwards sequences
- Not due to flow reflection etc
- We think this may indicate multiple stages of landslide failure....?



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The Icod landslide (~170,000 years ago)





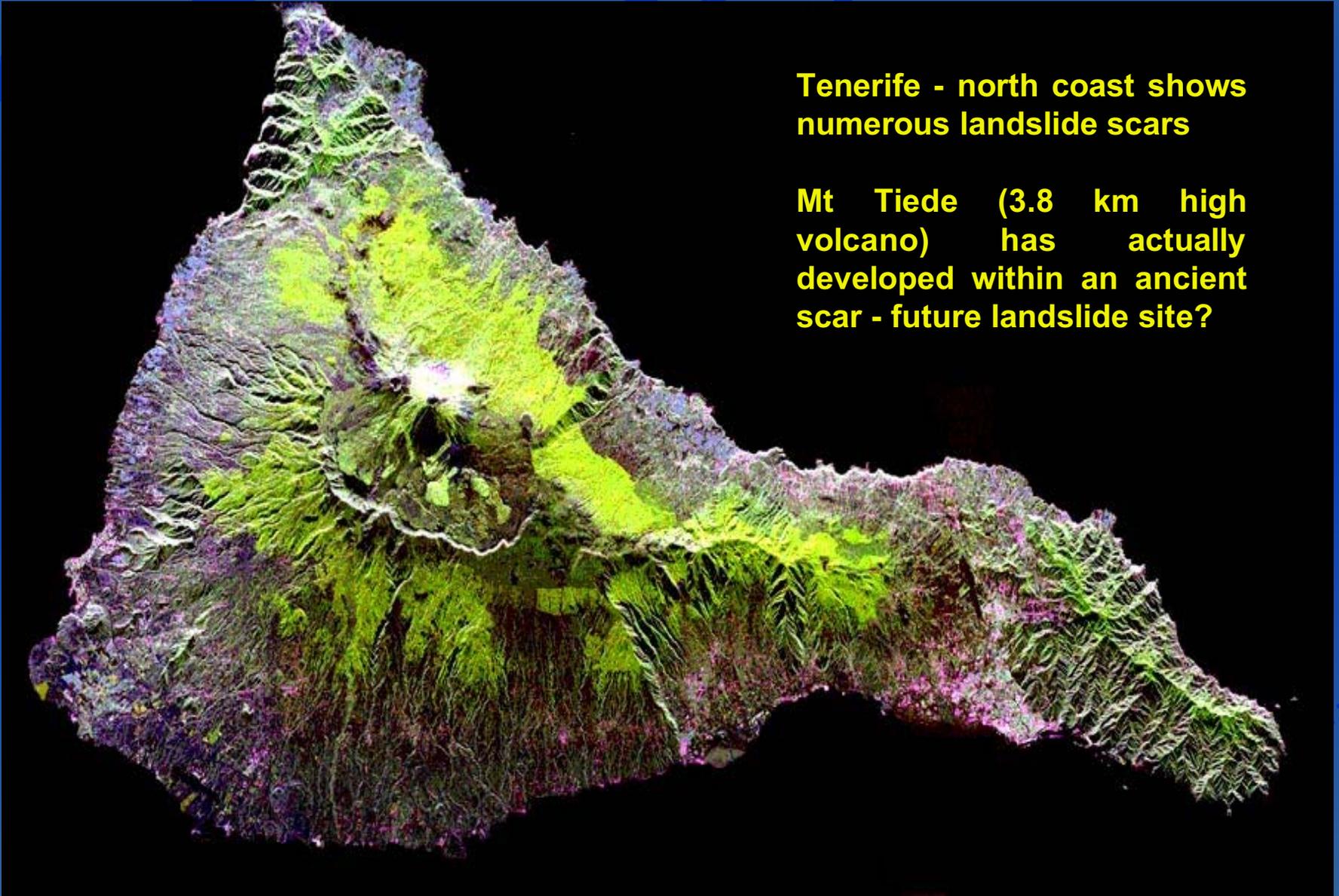
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Satellite view of Tenerife

**Tenerife - north coast shows
numerous landslide scars**

**Mt Tiede (3.8 km high
volcano) has actually
developed within an ancient
scar - future landslide site?**

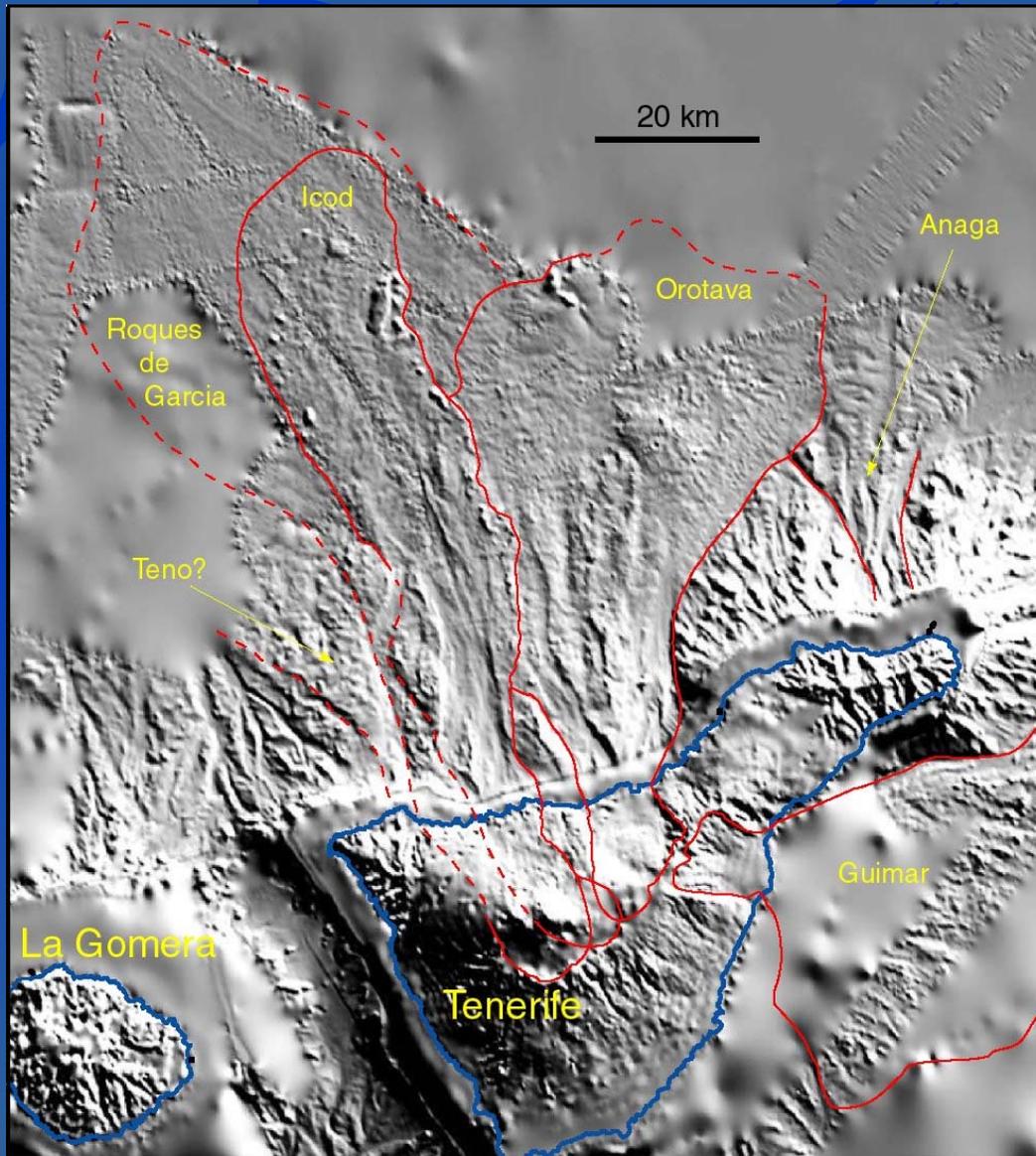




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Landslide mapping around Tenerife



**Icod is the most recent
landslide on north Tenerife**

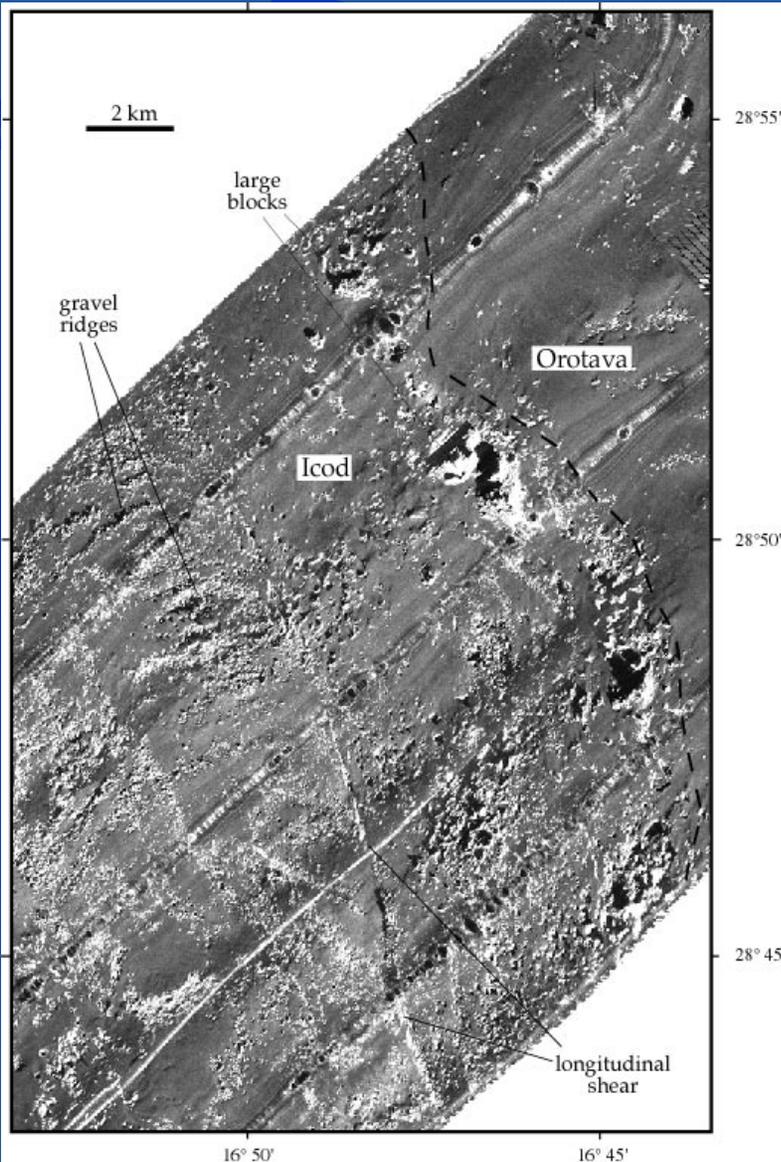
**More tongue-shaped than El
Golfo, suggesting it has
higher mobility**



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TOBI image of landslide surface



Icod landside shows several interesting features:

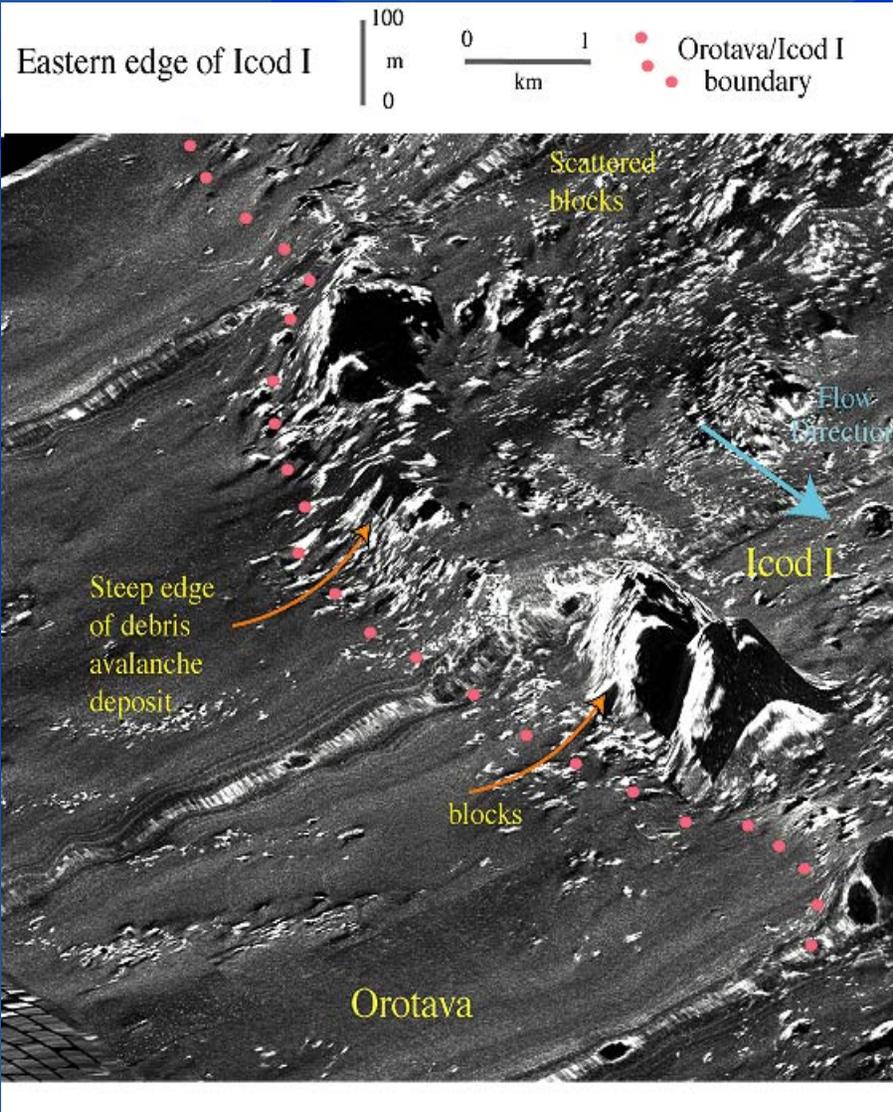
- Longitudinal shears
- Gravel (pressure) ridges
- Concentration of large blocks at margin



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TOBI draped over 3D bathymetry



Highlights the concentration of blocks at the edge of the landslide deposit

Again, all this data indicates that the landslide is well disaggregated by the time it is emplaced on the seafloor

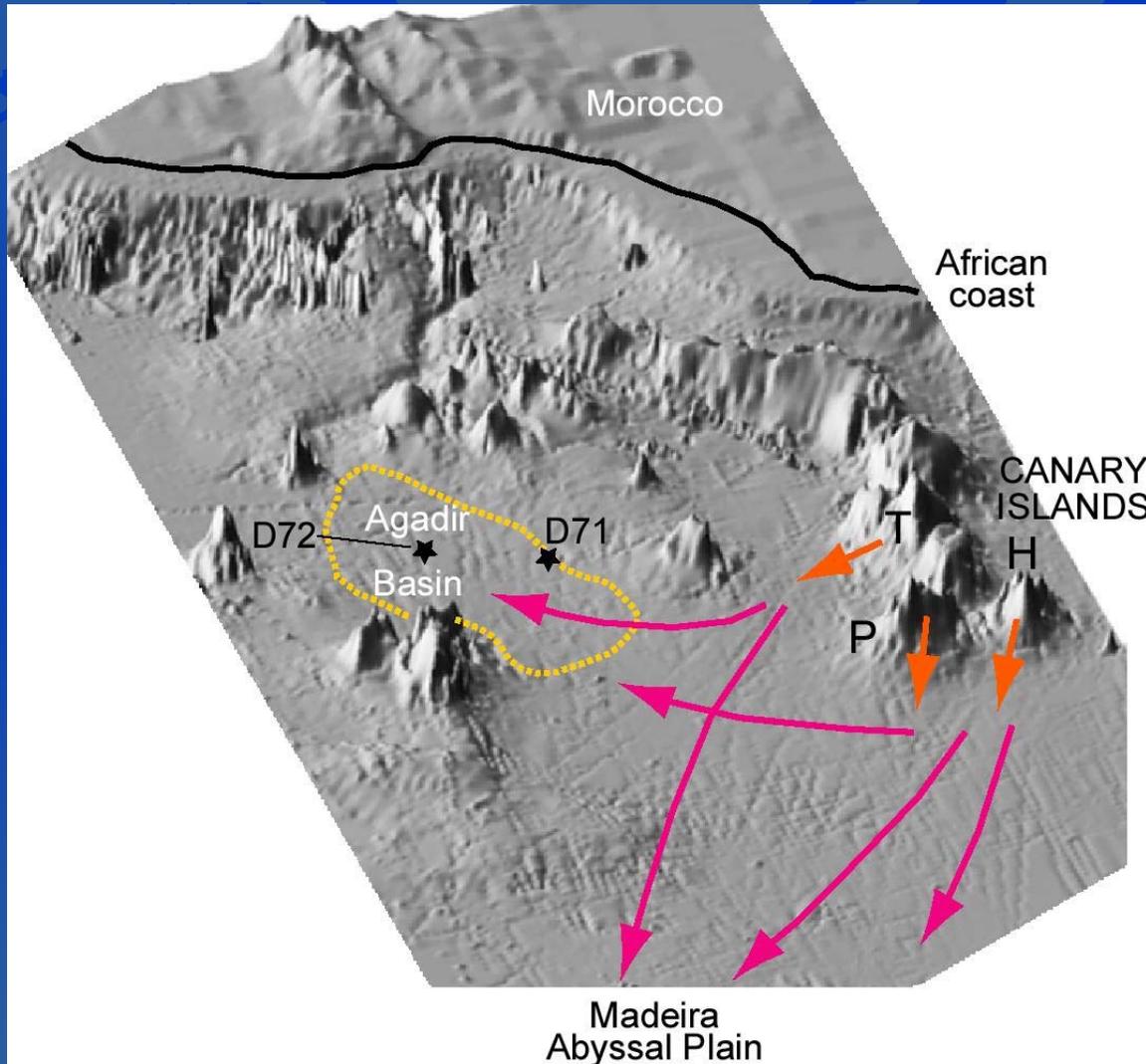
But, do we have evidence for multiple stages of failure of the Icod event....?



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Turbidity current pathways



Emplacement of Icod landslide also triggered turbidity currents

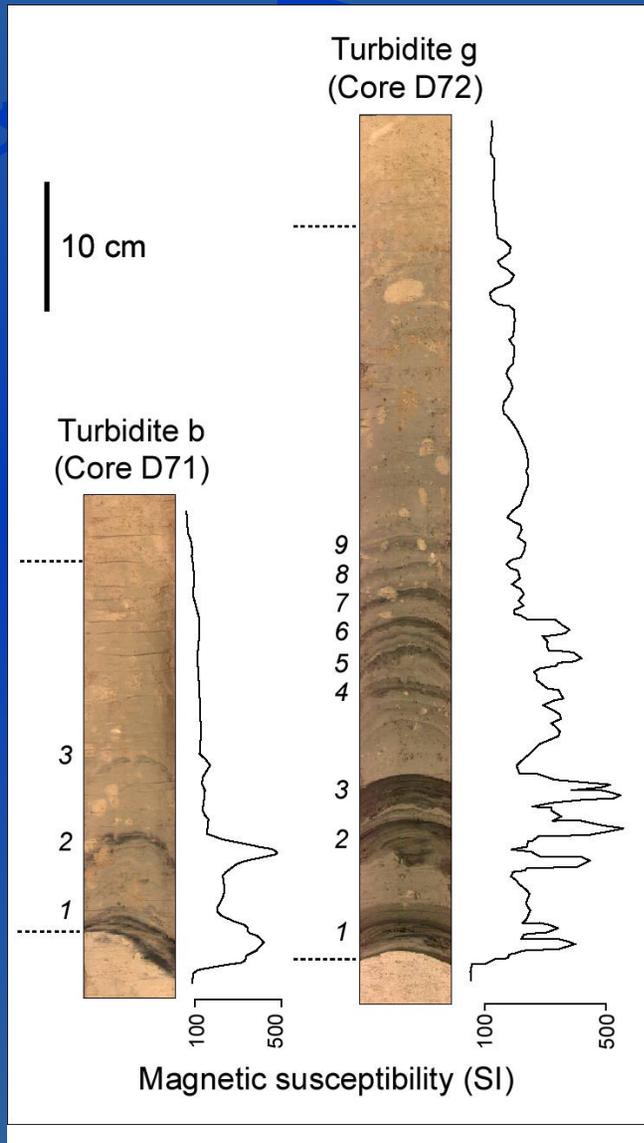
The turbidite deposits have been cored in the Agadir Basin (core D72)



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Turbidite correlation and sedimentology



TURBIDITE G = ICOD (~170 ka)

Correlation:

- Various methods all indicate Tenerife source

Sedimentology:

- Within this turbidite are at least nine stacked fining-upwards sequences
- Again, we interpret this to indicate multiple stages of landslide failure....
- Similar turbidite sequences have been reported from deposits linked to Hawaiian landslides



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So what is the tsunami hazard from a future landslide (myth....?)



Ward and Day (2001) modelled a potential tsunami resulting from failure of west flank of La Palma

Their model assumed a 'worst case scenario', i.e. that the landslide was a fast-moving block (500 km^3 in volume moving at peak velocities of 100 ms^{-1}) that remained intact as it hit the water



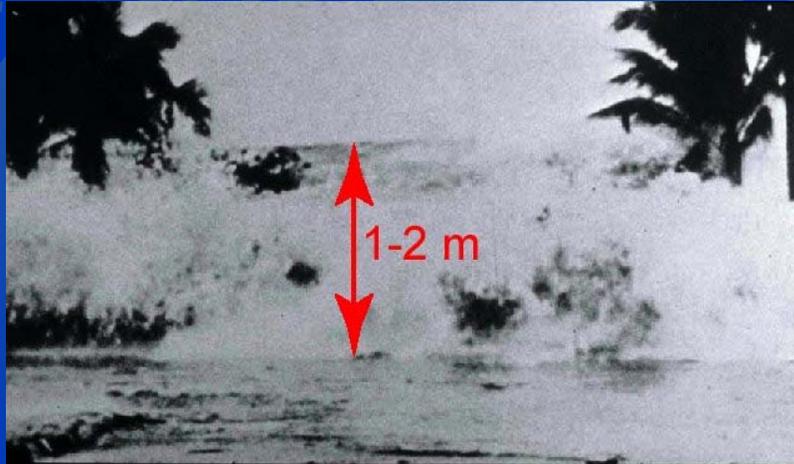
The results suggested that a 'mega-tsunami' would be generated, capable of reaching the eastern US coast (20-25 m high) or even the UK (5-7 m high)



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So what is the tsunami hazard from a future landslide (legend....?)



Our data suggests that the two most recent landslides may actually have occurred in multiple stages, which would significantly reduce the potential tsunami hazard. Similar evidence for multiple stages of failure has been presented from the Hawaiian Islands.

A future Canaries event could still produce a damaging tsunami adjacent to the source area, although it would be unlikely to significantly affect the eastern US coast or southwest England

However, the exact relationship between landslide and turbidity current is complex. A future cruise should obtain more cores and enable us to test these ideas further.....

In summary.....

Evidence from deep-sea sediments suggests that giant volcanic island landslides may occur in multiple stages, which would significantly reduce the potential tsunami hazard. However, more work is required to better understand landslide-tsunami linkage, and how turbidity currents relate to landslide events.

Giant turbidity currents in the Moroccan Turbidite System are capable of eroding huge areas of seafloor on their passage downslope. They can travel up to 1500 km across almost flat seafloor, making them highly efficient.