The axial channel of the Chile Trench

(Estructuras sedimentologicas jovenes en la Fosa de Chile)

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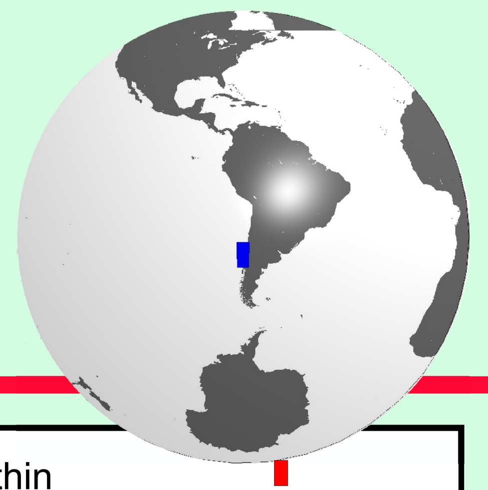
DEFORMATION PROCESSES IN THE ANDES



Abstract: Sedimentation patterns in the Peru-Chile Trench off Southern Chile are dominated by an interplay of channelled and free downslope and downtrench sediment transport. A more than 650 km long, winding axial channel is cut 200 m into the trench sediments. This structure serves as pathway for the northward flow of turbidity currents within the trench. The high sediment input from the continent is injected into the trench via five major and some minor submarine canyons some of which end in submarine fans with feeding channels connected to the axial channel.

The role of the central axial channel for sedimentation processes within the trench is reconstructed by combined interpretation of SIMRAD bathymetric data and PARASOUND- sediment echosounder data gathered on leg 4-5 of cruise 161 of the German Research Vessel SONNE.

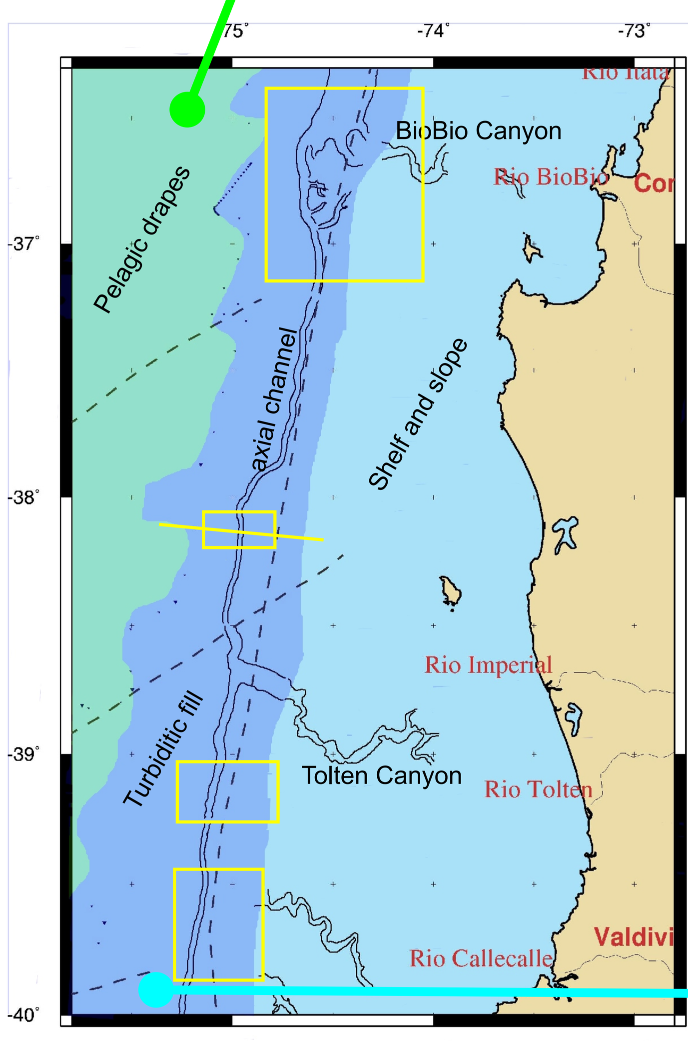


Fig 1: Course of the axial channel and distribution of sediments within the trench, position of figures

Geological Setting

The Nazca Plate subducts beneath the South America Plate with a direction of 56° and a velocity of ~66 mm/y. As the approaching plate is bent down into the subduction zone, it forms a bulge which is the seaward limit of the Chile Trench.

The trench is slightly inclined to the North due to the subduction of the Chile Rise. This inclination of the trench floor causes northward sediment transport within the trench. The outer bulge and the gradient of the seafloor within the trench form the boundaries of the channels development, as it is forced to remain within this frame.

Distribution of turbidites

turbidites and pelagic sedimentation can be easily distinguished by their distinct echo pattern. The limit between the both is controlled by height above the trench floor: hills bear a cover of pelagic sediments, depressions are filled with turbidites.The transition occurs 350 m above the lowermost point of the trench (the axial channel), 300 m above the depth of the trench.
Turbidites cross the trench and axial channel and spread out on the elevated Nazca-Plate as far as 70 km and as high as 300 m from the trench floor

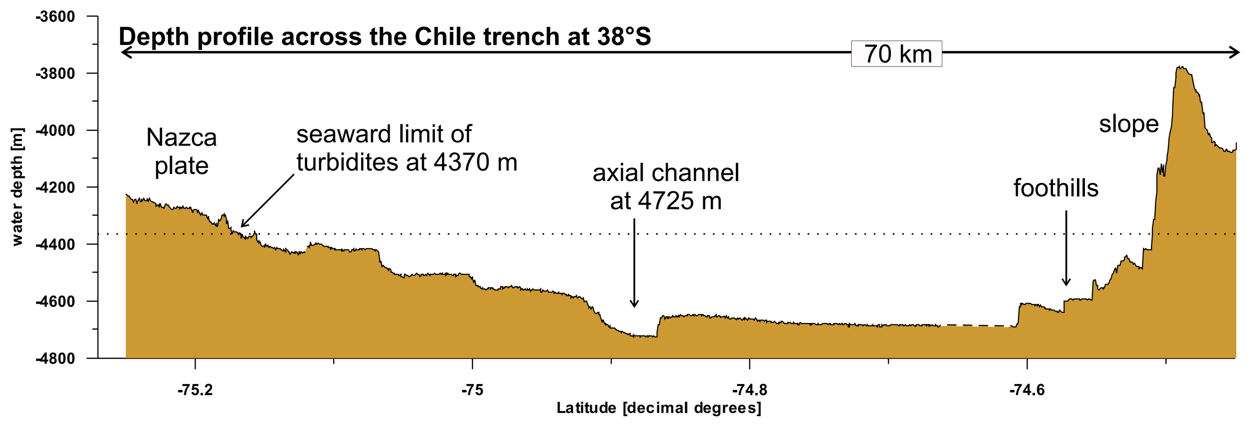


Fig 2: Depth profile across lower slope, turbidite-filled trench, axial channel and outer bulge.

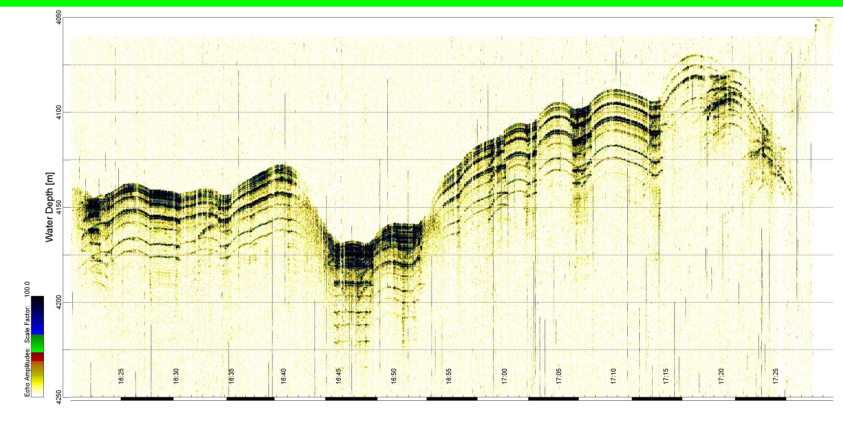


Fig 3: drapes of pelagic sediments produce a pattern of parallel, continuous and distinct reflectors. This pattern represents oceanic sedimentation, undisturbed by turbidites (green in Fig. 1)

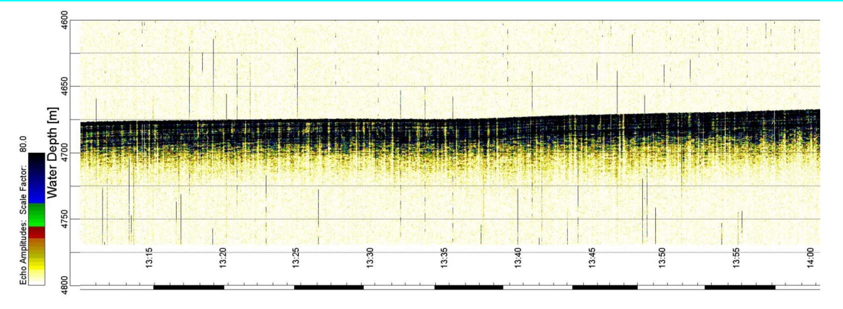
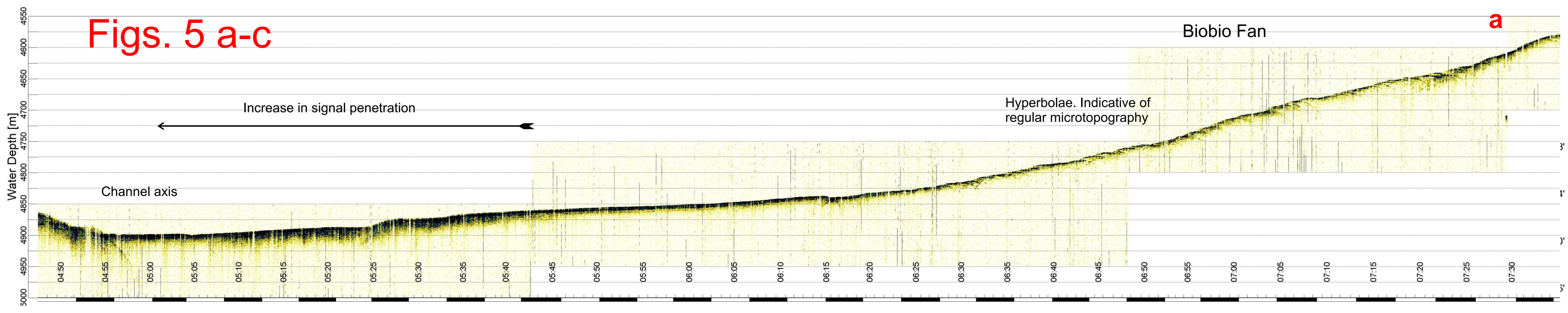
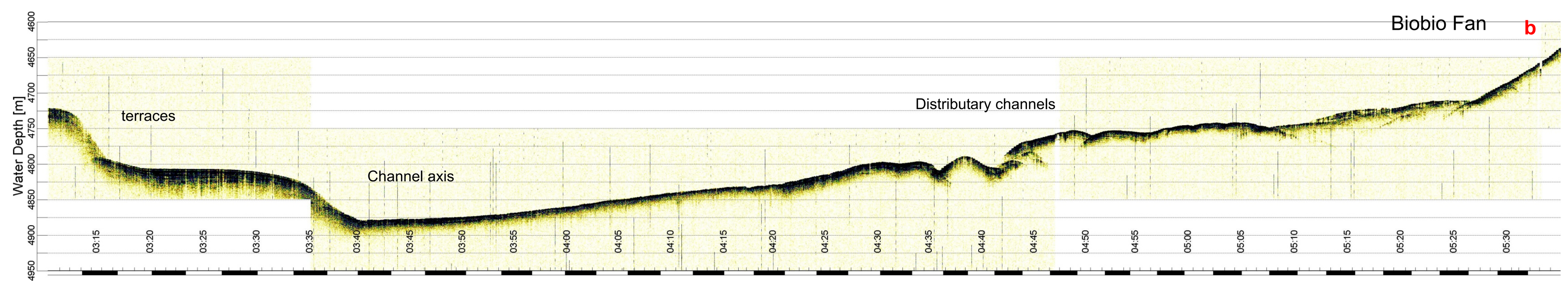


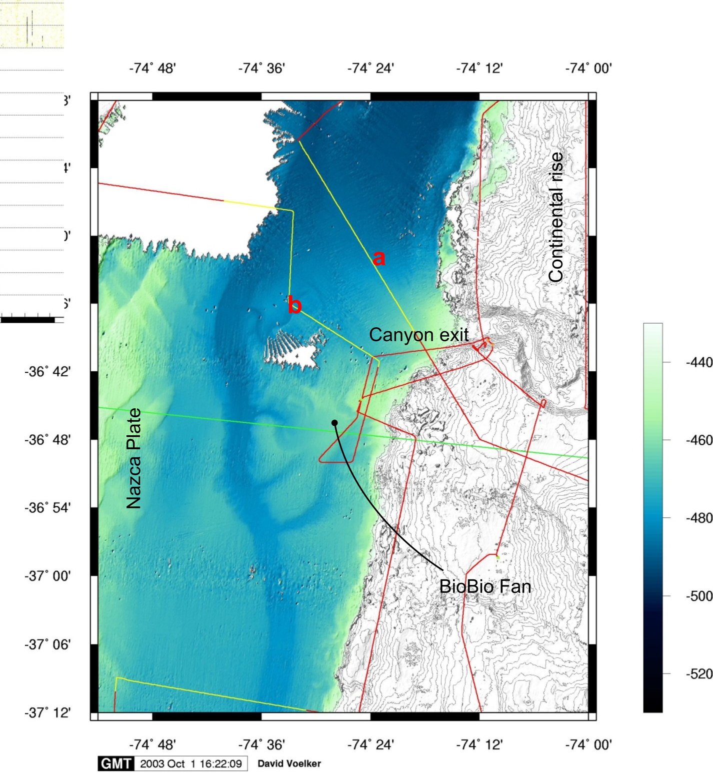
Fig 4: drapes of pelagic sediments produce a pattern of parallel, continuous and distinct reflectors. This pattern represents oceanic sedimentation, undisturbed by turbidites (green in Fig. 1)

Figs. 5 a-c





The BioBio Fan

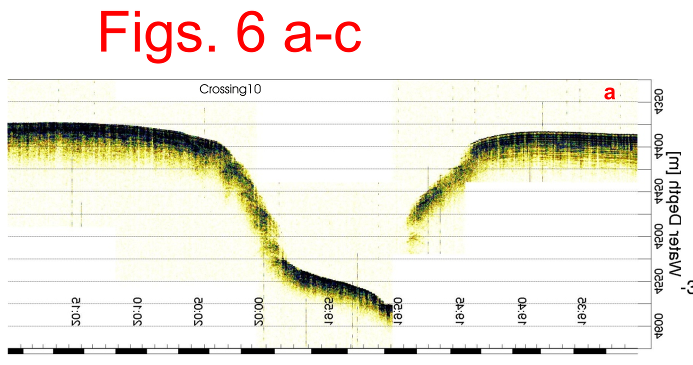


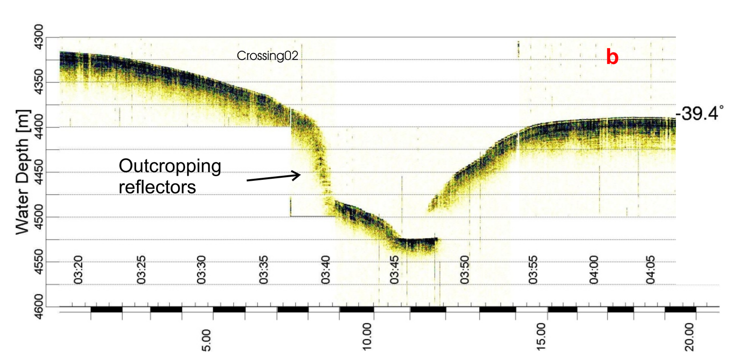
The BioBio Canyon forms a conical fan south of the canyon exit. Feeder channels and sediment banks are recognizable. This fan deviates the course of the channel, pushing it further seawards.

Northward of the canyon exit (downstream), the well defined axial channel turns into a very wide and deep structure. Here, deposits show a particular reflection pattern characterized by densely spaced hyperbolae. This is indicative of small-scale topography like mega ripples. Undulating microtopography may be due to sediment transport within sediment-laden bottom water.

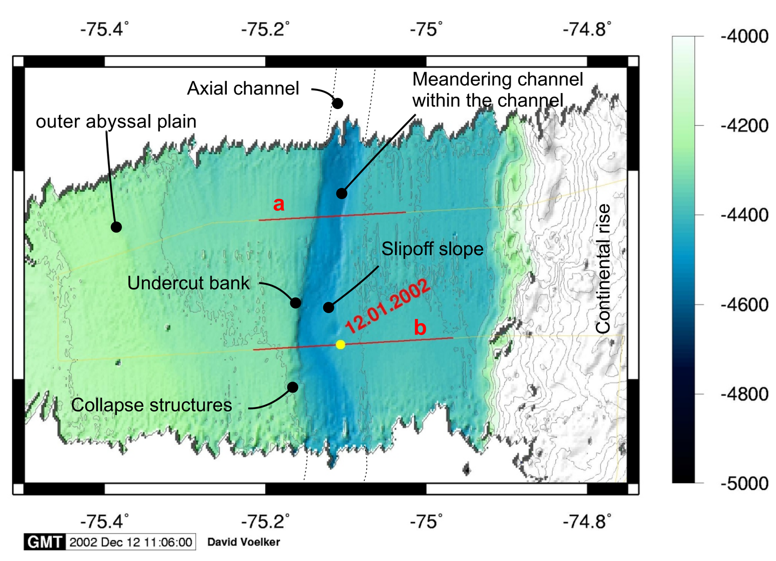
The terraces which form the seaward limit of the channel are produced by faulting as the Nazca Plate is bent into the suduction zone.

Figs. 6 a-c





Between CalleCalle and Tolten



The channel has defined walls, a flat bottom, a depth of 100-150 m relative to the respective sides and 3-4 km width. The main channel meanders within this bed, eroding the channel wall on the one side and forming bank deposits on the other. The erosion is seen by the truncation of reflectors which crop out at the seaward channel wall. Bathymetric data shows gullies and failure structures.

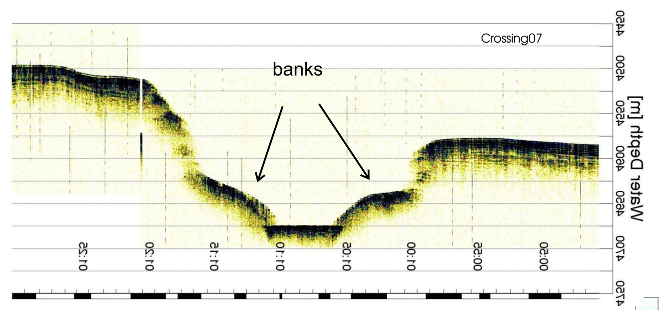
The echo character of the sediments to both sides of the channel is dominated by flat-lying continuous, closely spaced parallel acoustic laminae, probably the basal layers of turbidites that spread into the abyssal plain.

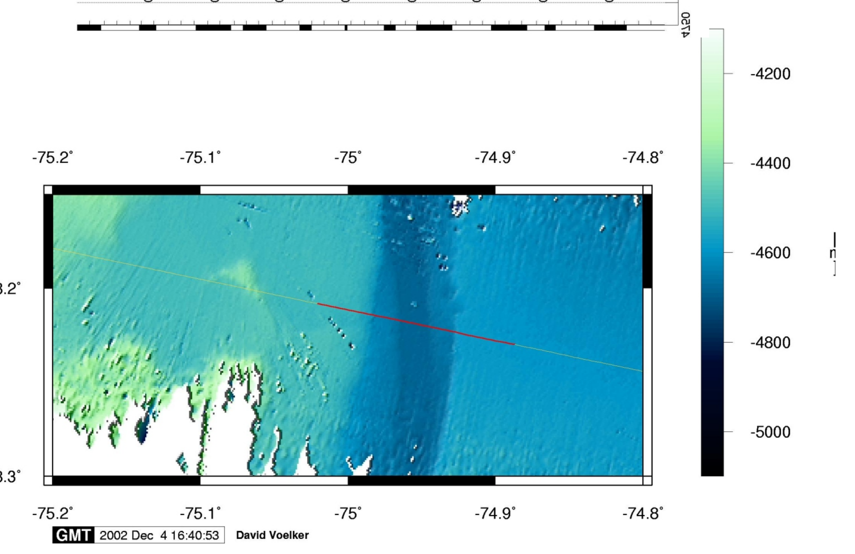
The area seaward of the channel seems to receive widespread turbidite sedimentation, probably the more distal parts of the turbidites channeled by the CalleCalle. As the channel itself makes a very young impression it must though be active in passing a part of the sediment on to the North

Between 37°S & 38°S

In this sector no major fan enters the trench. The seafloor within the trench and seaward of it is relatively flat and the channel meanders freely within the trench fill. Obiously there are several phases of channel development as we can distiguish **a channel within the channel** which forms bank deposits and produces undercutting of the alternative channel walls as it meanders within its bed. This is probably due to phases of more and less active transport within the channel with periodic "flood events" scouring the bed and less active phases with a winding central channel.

There is no general distinction between sedimentation patterns on either side of the channel, so this this kind of sedimentation is not blocked by it. Either turbites shoot across the channel or they are deposited by overspill from transport within the channel.

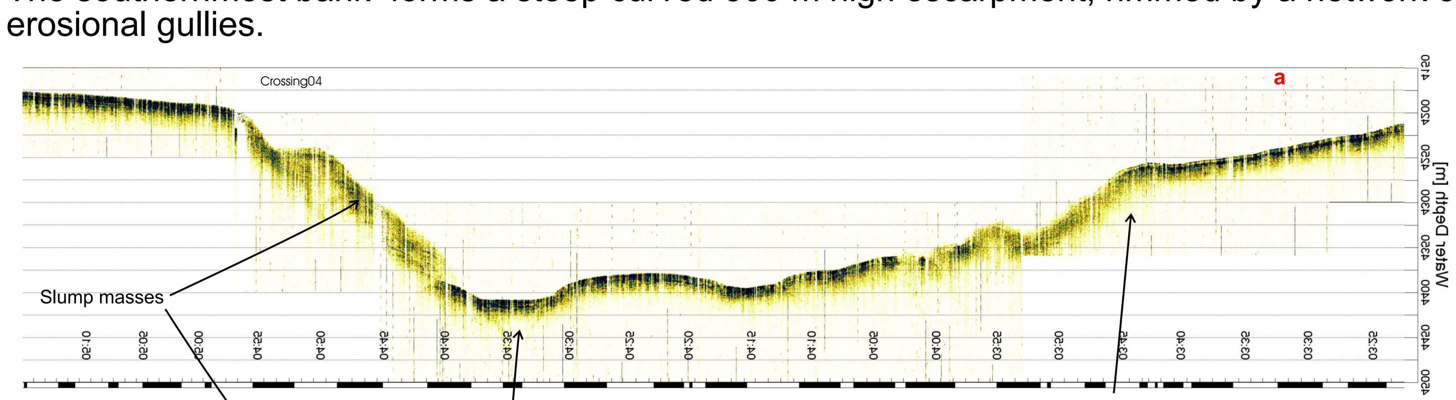


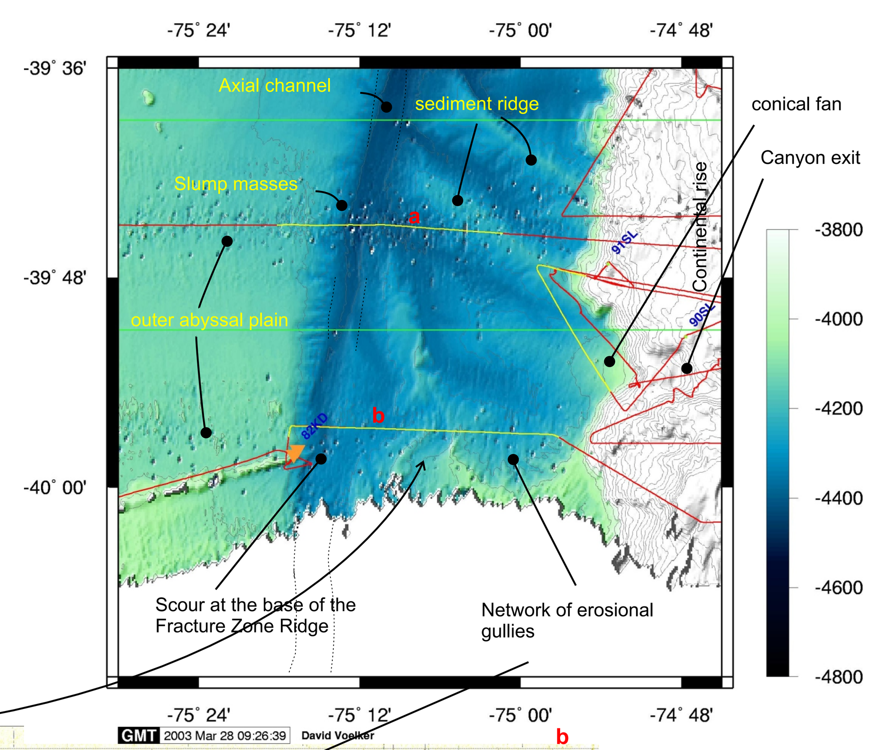


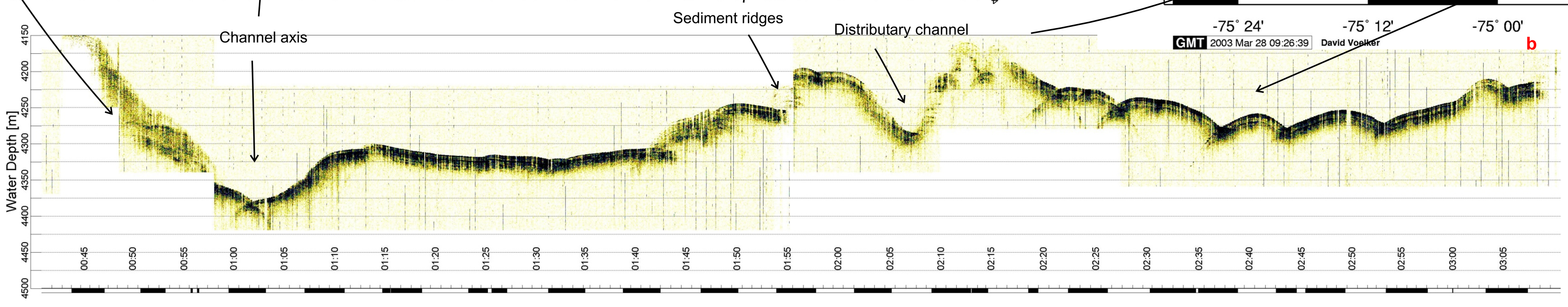
Figs 7 a-b

Calle Calle Fan

The trench is limited seawards by a 200 m high wall which guides the course of the channel and is scarred by erosional gullies and covered by slump masses.
The sediments in the trench form elongate subparallel sediment ridges of 300 m height, alternating with troughs that connect the continental rise with the central axial channel. This bathymetry represents the sediment fan of the CalleCalle Canyon. The fan forces the turbidity flow by its geometry to bifurcate and form the two separate channels. The elongate subparallel ridges are consequently seen as their bank deposits.
The southernmost bank forms a steep curved 500 m high escarpment, rimmed by a network of erosional gullies.







Figs 8 a-c