Morphology of a deep-sea channel within a trench: the axial channel off Southern Chile

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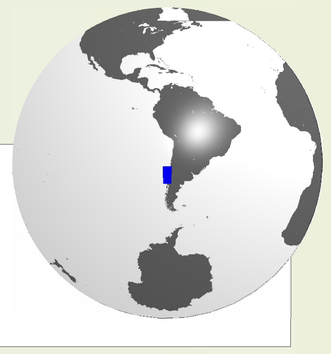
Collaborative Research Center 267
DEFORMATION PROCESSES IN THE ANDES



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 650km long, slightly winding axial channel is cut 200m into the trench sediments. This erosional structure serves as pathway for the northward flow of turbidity currents whithin 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 morphology and development of the central axial channel 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.

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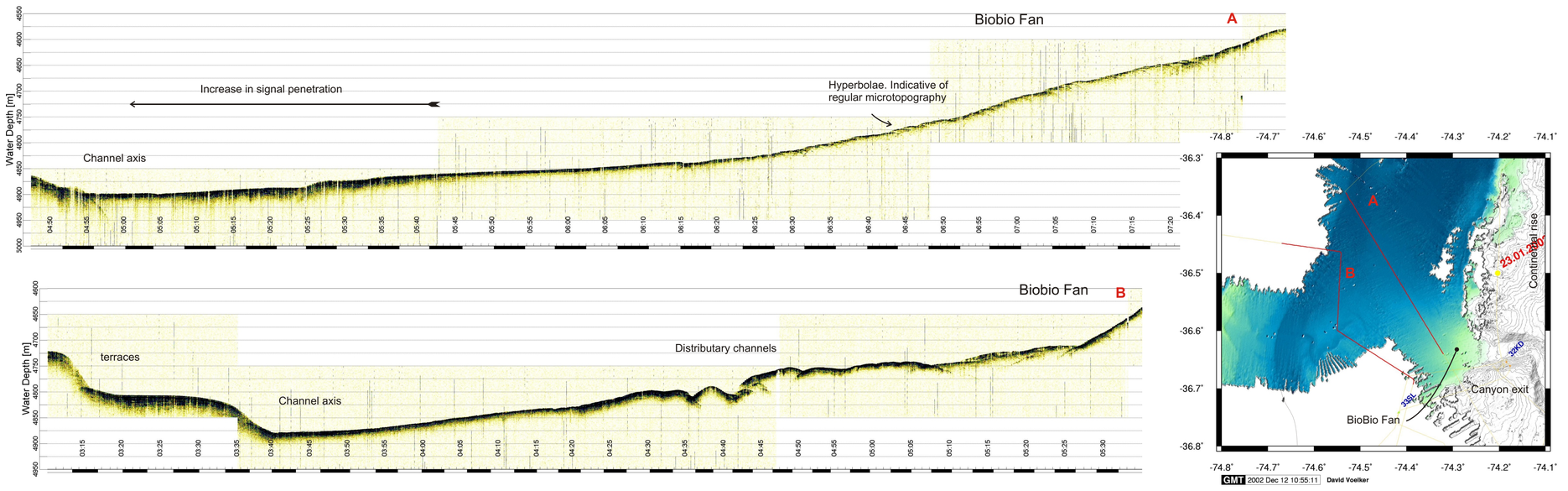


BioBio Fan

The BioBio Canyon forms a large regular conical fan which determines the course of the channel which curves around it. The channel has no defined landward wall as fan sediments onlap the channel floor with a low gradient. The fan deposits show a particular reflection pattern characterized by densely spaced hyperbolae. This is indicative of small-scale topography like mega ripples, too small to be resolved by bathymetric data (<200 m length, <15 m height). Undulating microtopography may be due to sediment transport within sediment-laden bottom water.

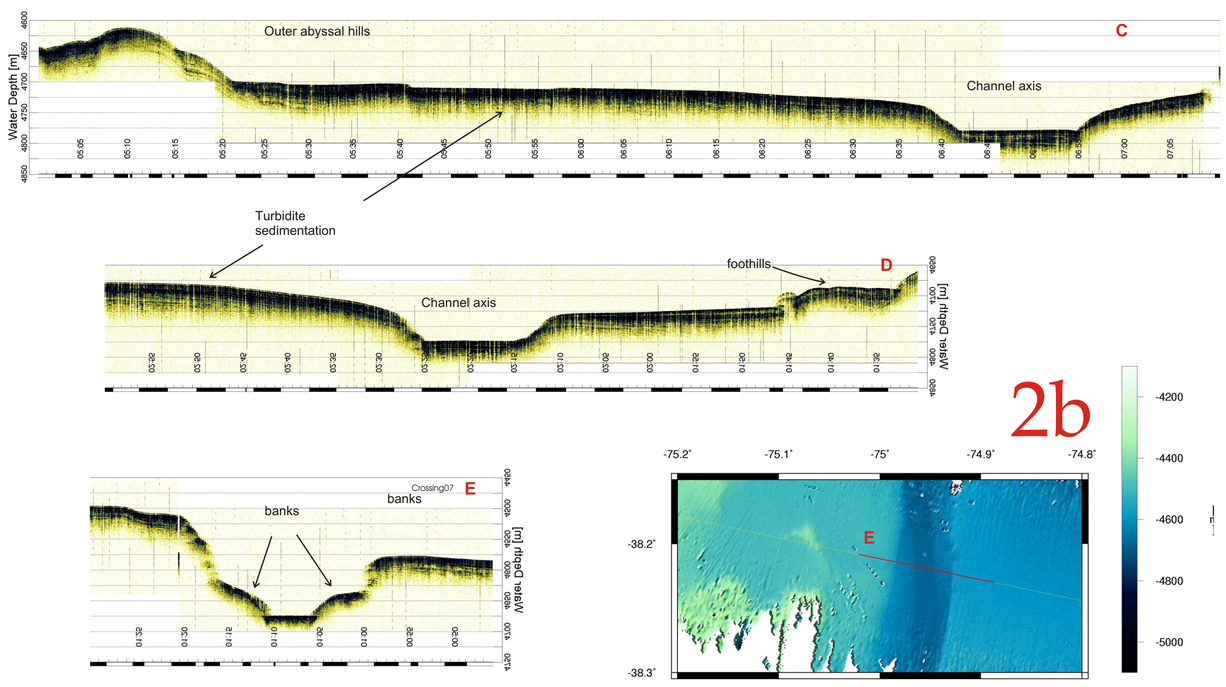
The most prominent feature on the fan is a feeder channel which forms banks.

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

Area 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.

The reflection pattern to both sides of the channel is characterized by flat-lying parallel reflectors which most probably are due to silt-sand-sized layers, the basal layers of sheet-like turbidites. 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.



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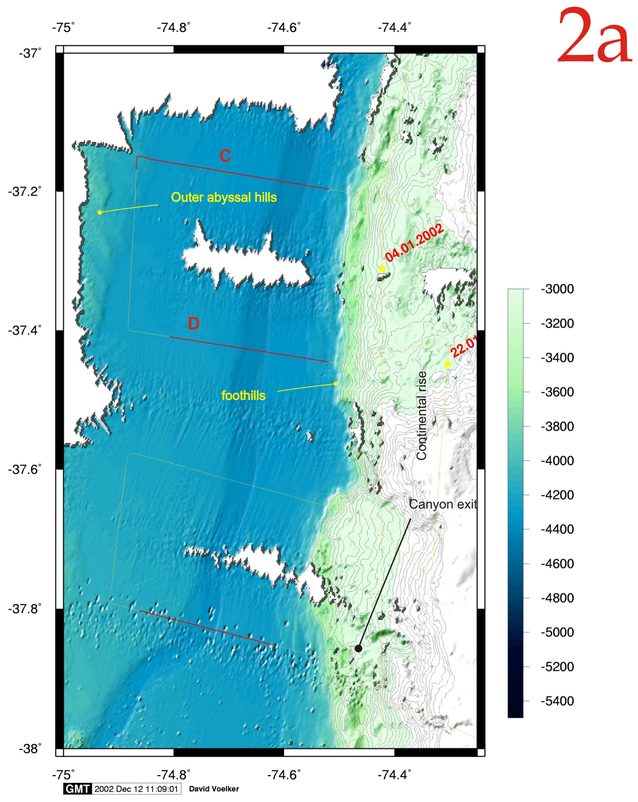

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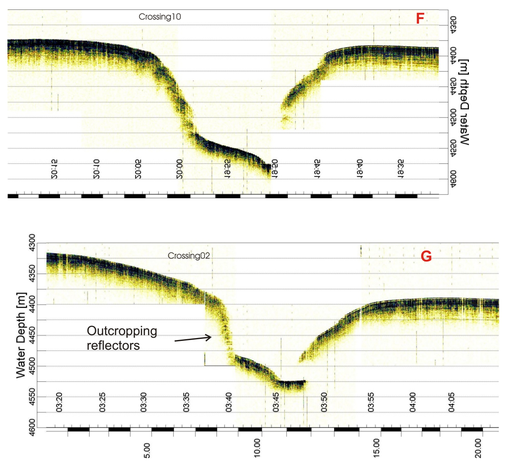
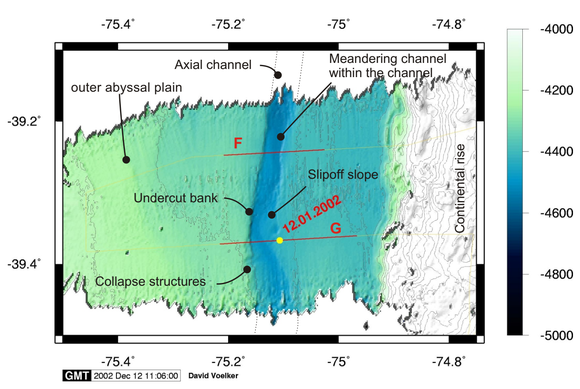




Region between CalleCalle Fan and Tolten Fan (39°00'S to 39°30'S)

At 39,2°S the channel has clearly defined walls to the sea- and landward side, a flat bottom, a depth of 100-150m relative to the respective sides and 3-4km 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. We do not see any pronounced overspill sedimentation to the sides of the channel.

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.

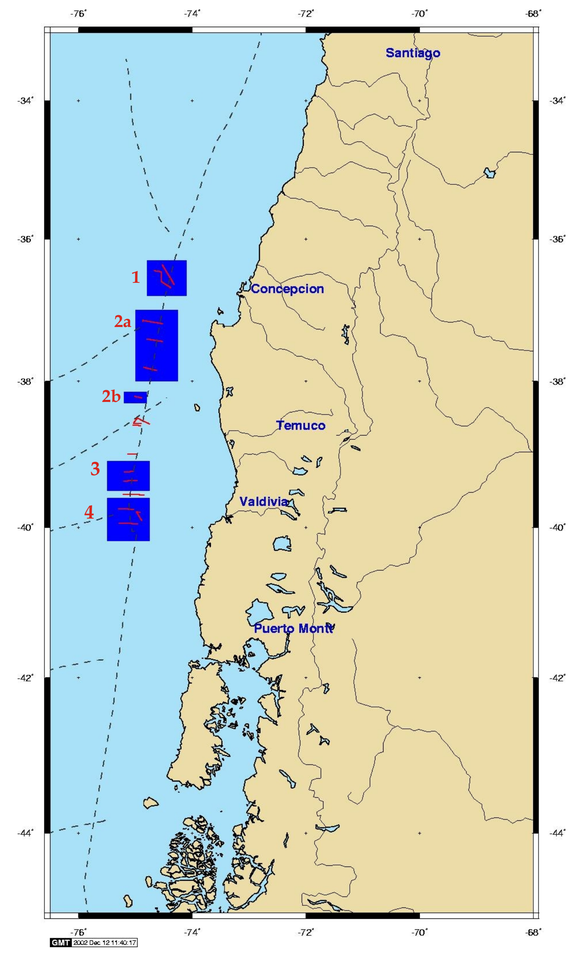
The area seaward of the channel seems to receive widespread turbidite sedimentation, probably the more distal parts of the turbidites channeled by the CalleCalle. As the channel itself makes a very young impression it must though be active in passing a part of the sediment on to the North

Tectonic Setting & Profiles

The Nazca Plate subducts beneath the South America Plate with a direction of 56° and a velocity of 8.44 cm/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 sediment-filled Peru-Chile Trench is slightly inclined to the North. This gradient is supposed to be due to the subduction of the Chile Rise to the South and gives rise to the 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.

Lage der Profile



Calle Calle Fan (39°30'S to 40°00'S)

The Chile-Peru 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 and another unnamed canyon. A small conical fan which turns into an elongate sediment ridge lies directly below the mouth of the southern canyon exit. 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.

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