Sediment subduction offshore Central America

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What processes determine whether or not accretion will occur at convergent margins? Leg 170 was initiated with some indications of accretion, including apparent truncation of the uppermost layers of the lower plate sediment [*Shipley et al.,* 1990], a deformed lower slope wedge of sediment, and structural indicators of underplating [*Shipley et al.,* 1992; *McIntosh et al.,* 1993]. Comparison of a reference Site (1039) with lower slope Sites (1043 and 1040) show that little or no frontal accretion has occurred. In addition, penetration through the slope apron to high amplitude reflective layers below show that the underlying material has a close affinity to onshore Costa Rica geology, not to that of the incoming Cocos Plate stratigraphy [*Silver, Kimura, Blum et al.,* 1997].

Evidence for no frontal accretion included bio- and magneto-stratigraphy, physical stratigraphy, geochemistry and logging while drilling (LWD). The stratigraphy indicated that virtually the entire incoming section cored at Site 1039 was present in the underthrust section at Sites 1040 and 1043, with the exception of 4-5 m of turbidites. However, a 3.5 kHz profile run between these sites showed clearly that the upper 5 m at Site 1039 pinches out before reaching the base of the slope, probably due to the action of bottom currents. In addition, the youngest bio- and magnetostratigraphic picks at Site 1039 are present in the underthrust strata of Sites 1040 and 1043. A more detailed physical stratigraphic comparison can be made between the sites using the resistivity and gamma ray log data from the LWD results. These data are available in the underthrust section only for Site 1043, but comparison with Site 1039 suggests a possible difference of 9m between these sites. Because the upper 5 m of strata at Site 1039 are turbidites, the LWD data suggests up to 4 m of sediment scraped off near the toe in Site 1043. A similar inference can be made from the observations of pore water geochemistry.

The composition of sediments in the deformed wedge at Sites 1040 and 1043 is not representative of that from Site 1039. The latter has an upper layer rich in diatoms and a lower carbonate layer. The deformed wedge, in contrast, has no carbonate and is very poor in diatoms. It is largely a hemipelagic silty clay. The closest unit in the underthrust section to that of the deformed wedge is unit U2A, which is a sparsely fossiliferous hemipelagic silty clay. However, unit U2A has abundant volcanic ash layers compared with few ash layers in the deformed wedge. In contrast to the underthrust section, the sedimentary apron at Site 1041 has significant commonality with the deformed wedge. It is likely that the deformed wedge represents material of the sedimentary apron that has flowed downslope to the toe of the slope [*Baltuck et al.,* 1982] and has been deformed by rapid and long term subduction beneath it.

A further question concerns long term sediment accretion vs non-accretion on the Costa Rica margin. This question was tackled by drilling first at Site 1041 then at Site 1042 in order to penetrate into the high amplitude reflection surface beneath the sedimentary apron [*Shipley et al.,* 1992], material of which has recently been shown to have relatively high velocity [*Ye et al.,* 1996]. Site 1041 did not penetrate to this surface (550 mbsf) because of sticky (possibly due to high pressures) muds, so Site 1042 was drilled at a site where the surface lies at 325 mbsf. At Site 1042 we recovered a carbonate cemented sandstone breccia, whose seismic velocity satisfied that observed with seismic refraction studies. Beneath this sandstone breccia was a second breccia containing clasts of red chert and mafic rocks, similar to those found in the Nicoya complex onshore. The sequence of breccias was middle Miocene in age, present as fault slices overlying upper Miocene hemipelagic silty clays. The Miocene breccia sequence drilled at Site 1042 is similar to that reported from outcrops near the Osa Peninsula onshore [*M. Protti, oral communication,* 1996]. It is very likely that the material underlying the slope apron represents rocks with onshore affinities. The rocks we recovered do not have affinities to the reference section drilled at Site 1039.

Neither frontal accretion nor massive underplating characterize the Costa Rica margin. Further investigations are required to understand whether underplating occurs episodically over time, which would influence changes in vertical motions along the slope.

References

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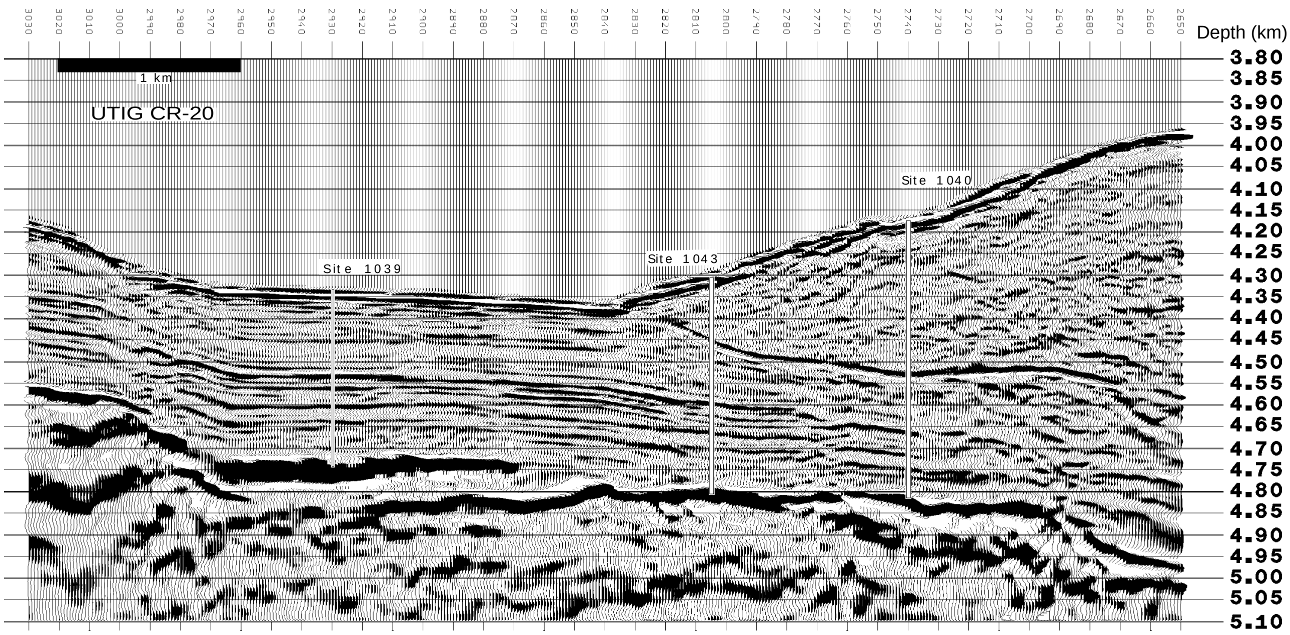
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3.85
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4.00
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4.15
4.20
4.25
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4.65
4.70
4.75
4.80
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5.00
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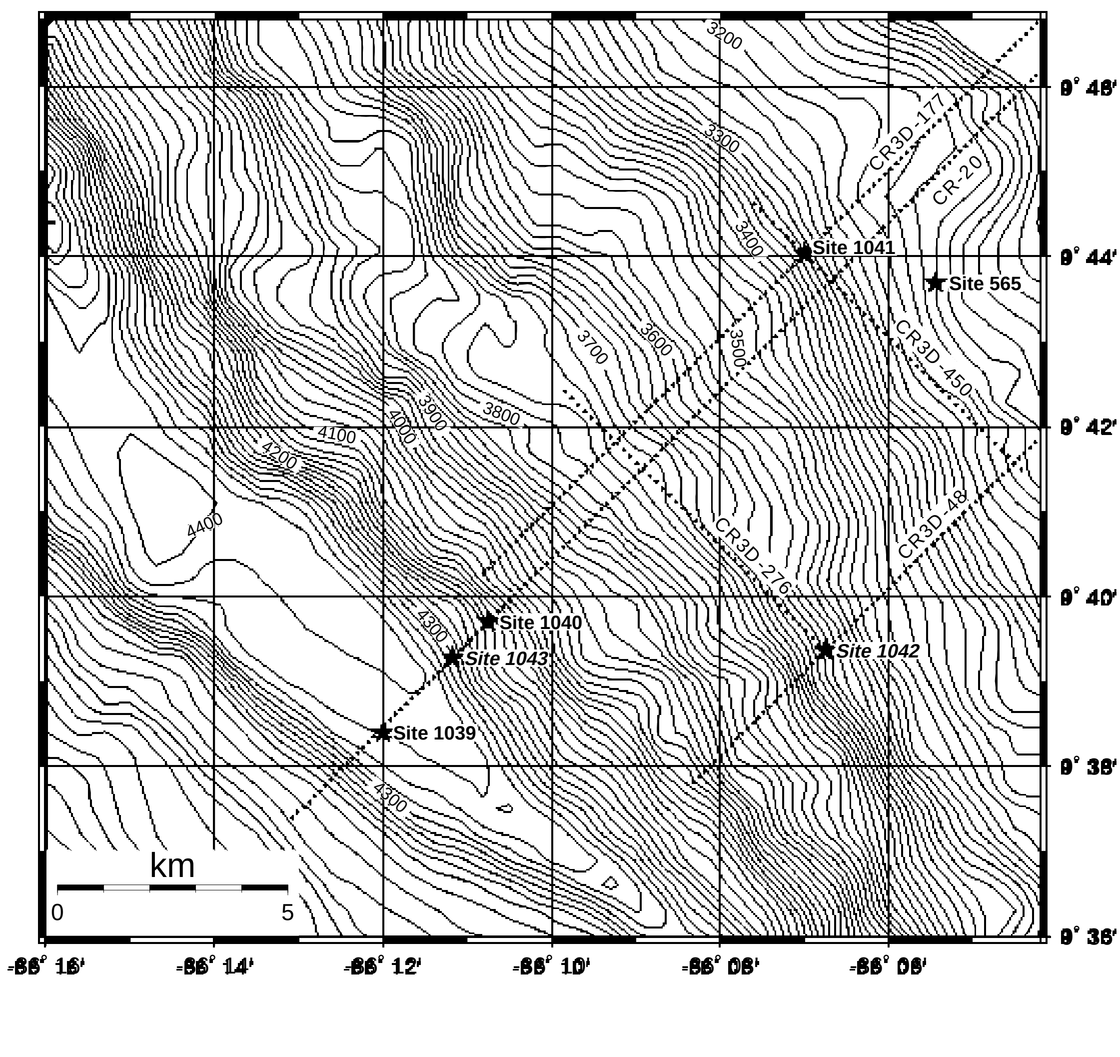
5.10
1 km
UTIG CR-20
Site 1039
Site 1043
Site 1040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CR3D-177
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CR3D-450
CR3D-276
CR3D-48
Site 1041
Site 565
Site 1040
Site 1043
Site 1039
Site 1042
km
0
5
9° 44'
9° 42'
9° 40'