8. LOWER FAN INTRODUCTION AND SUMMARY[1]

Shipboard Scientific Party[2]

INTRODUCTION

The lower fan can be defined as the area between where the single channel–levee complex changes into a channel-switching mode and the deeper part of the basin where submarine fan deposits can no longer be recognized (Fig. 1). Both the upfan and downfan boundaries are gradual. The lower fan differs seismically from the middle fan in that the acoustically high-amplitude zone at the base of the channel fill and the indications of major channel erosion, both typical of the middle fan, are replaced by repeated sets of more or less parallel, slightly discontinuous reflectors that lack observable channel cuts.

The dimensions and the sinuosity of the most recent channel on the lower fan continuously decrease in a downfan direction. This channel displays some bifurcation at its distal ends before it becomes unrecognizable on side-scan sonar records.

Adjacent to the most recent channel, a zone is present with vague, narrow, sonar images that are interpreted as abandoned channel courses (Fig. 2). This combination of one distinct channel and several indistinct channels strongly suggests that frequent channel switching takes place, that each channel has a relative short life span, and that only one channel is operative at any given time.

Medium-penetration and multichannel reflection seismic profiles indicate that aggradation is common. A convex cross section is still observable on the lower fan, although it is far less distinct than on the middle fan. A gradual change in reflector patterns can be observed downfan, expressed in an increased parallellism of reflectors. Downfan of the area with channel terminations, the seismic patterns on medium penetration acoustical reflection records show alternations of sets of more or less continuous, parallel reflectors and zones with little or no acoustical returns.

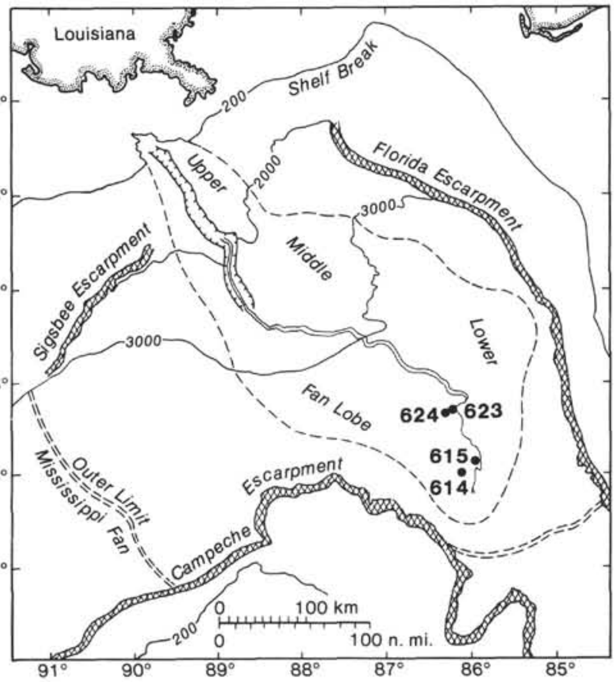

Figure 1. Mississippi Fan with general outline of the modern fan lobe and locations of lower fan drill sites.

Four sites were visited on the lower fan during Leg 96:

Site 623: upper part of the lower fan in the area of switching channel courses, adjacent to the most recently active channel.

Site 624: near Site 623 but 4.8 km away from the channel.

Site 615: distal part of the lower fan directly north of the area of channel bifurcations and adjacent to the most recently active channel.

Site 614: distal part of the lower fan in the area of channel bifurcations and terminations.

Much has been published about the sedimentary characteristics of lower fan deposits, especially from outcrop studies of ancient turbidite sequences. The locations of the sites were selected to identify the nature of seismic

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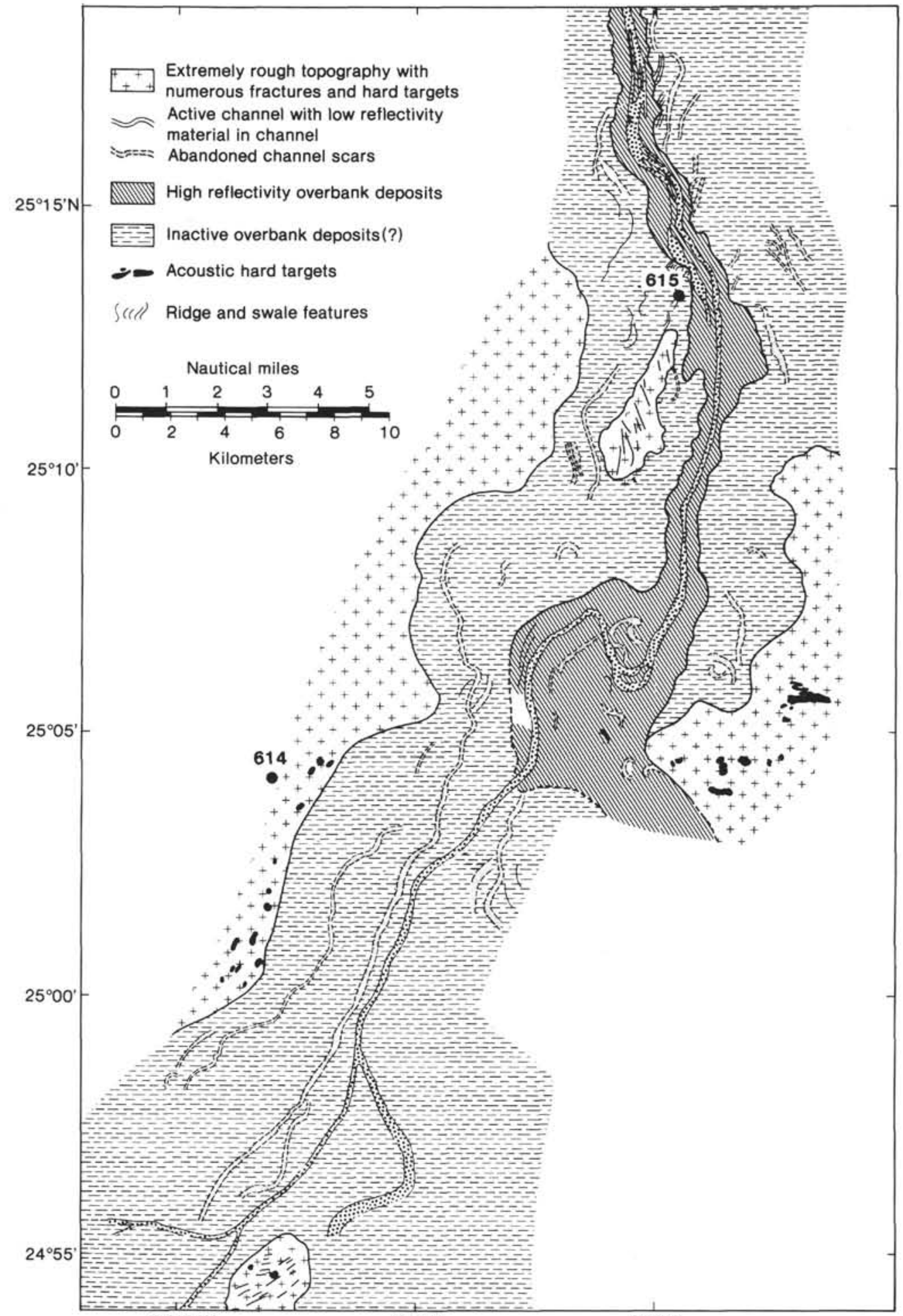

Figure 2. Morphology of lower fan drill Sites 614 and 615 based on interpretation of Sea MARC side-scan sonar data.

facies and to attempt to interrelate observations from the drilling with observations from ancient deposits. The major objectives of the drilling at these sites were

1. To characterize the lithologies of the seismic facies, specifically those of the laterally continuous reflector patterns.
2. To identify the sedimentary processes that emplaced the lower fan deposits.
3. To determine if sand-sized materials can be transported down to the distal area of the fan and establish if those amounts are significant.
4. To determine the time-stratigraphic framework of the lower fan sediments and of the sediment packages bounded by distinct seismic reflectors.
5. To investigate if the faunal assemblages have characteristic indigenous species to identify these deep-water deposits.
6. To determine if any sediment packages show sequences such as upward-thickening and upward-coarsening or compensation cycles reported in the literature.
7. To determine if the concept of switching channels can be observed sedimentologically and stratigraphically in cores.

SUMMARY

The single migratory channel that is characteristic of the middle fan changes to a shifting mode on the lower fan and finally becomes unrecognizable in approximately 3300 m of water. The drilling at four sites on the lower fan permits a number of significant conclusions to be drawn:

1. The middle fan channel acts as a conduit leaving behind a lag deposit. However, significant amounts of sand are transported onto the distal end of the lower fan, a transport distance in excess of 600 km.
2. In contrast to the single channel on the middle fan, the lower fan is characterized by a number of more or less parallel channels, only one of which seems to be active at any given time. This tends to change the confined channel deposits observed in the middle fan into interleaved or stacked thin and laterally more persistent channel deposits alternating and flanked by finer-grained overbank deposits.
3. The upper two fan lobes at the distal end of the fan contain a large percentage of net sand (40 and 65%). Each sequence commences with a coarsening-upward mud and sand unit, followed by bedded sands and topped by a thinner fining-upward unit.
4. The sediments contain a sparse microfaunal assemblage with only a few indigenous forms. The microfauna consist primarily of transported neritic forms. The high sedimentation rates are considered to be the main cause for this diluted faunal assemblage. Only in a few instances were trace fossils (burrows) observed in the core. Significant amounts of organic debris, mainly lignite, and mica were found in the coarser-grained sediments.
5. The Wisconsin (Ericson Zone X) section collected from the lower 40 m of Site 615 consists of a fining-upward carbonate sequence which is tentatively interpreted as a debris flow deposit. At its base it starts with a thin carbonate breccia that fines upward into a nannoplankton ooze. The carbonate facies is characterized by shallow water benthic species and also contains reworked specimens of Cretaceous and Tertiary age. Tentative seismic analyses suggest a source from the northeast along the central Florida Escarpment and adjacent Florida Platform.