The Stratigraphic Evolution of Monterey Fan Area and Growth Patterns of Related Channel Complexes*

By

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General Statement

The modern Monterey submarine fan, which is one of the largest turbidite systems off the western US, encompasses as much as 600 meters of deposition that accumulated within less than a million years. The merging of all the seismic-reflection data available from the area of the Monterey fan (Figure 1) showed that the Monterey fan is, in fact, composed of two major turbiditic systems with different sources and timing of deposition (Figure 2):

- Lower Turbidite System (LTS).
- Modern Upper Turbidite System (UTS).

The UTS, which comprises much less than half of the total fan volume, includes four channel-levee systems that show a complex history of channel switching resulting from autocyclic and, possibly, tectonic influences. These channel-levee complexes are located in the northeastern quadrant, the best-documented area of the modern fan. The age of samples from the base of the modern Monterey channel wall collected with the submersible ALVIN indicates that the entire UTS is probably no older than 500 ka, and reflection profiles show that it is nowhere thicker than 600 meters (Figure 3). This recent depositional system, which is much less than half of the total fan volume, is present only in the eastern part of the study area and it wedges out toward the west, northwest, and southwest (Figure 3). The most recent deposits of the UTS are in the southern distal area, with a succession of southward-propagating lobes fed by rapidly shifting channels (Figure 2). The modern Monterey fan-valley is largely a by-pass zone funneling sediment to the southern lobe area, with a retrofit channel still evident in the transition from a leveed valley to the lobe depositional area (Figure 4).

The UTS is underlain by the more extensive LTS (Figure 3), which comprises a series of lower-relief, less well-defined channel, overbank, and lower-fan/basin-plain elements. The age of the LTS is unknown but its basal deposits may be as old as the age of oceanic crust underneath (early Miocene). The channel and overbank elements of the LTS do not have the high relief and distinctive character of those in the UTS deposits and constitute loosely defined sediment pathways. No clear feeder system(s) on the California margin

has(have) been identified for the LTS, but distribution of sediment pathways suggests that the source(s) for LTS lies(lie) north of the fan channels systems fed by the modern canyon systems. The inferred age of the LTS and the most recent plate boundary reconstruction suggest that its initial source was when the fan area was near the present Transverse Ranges.

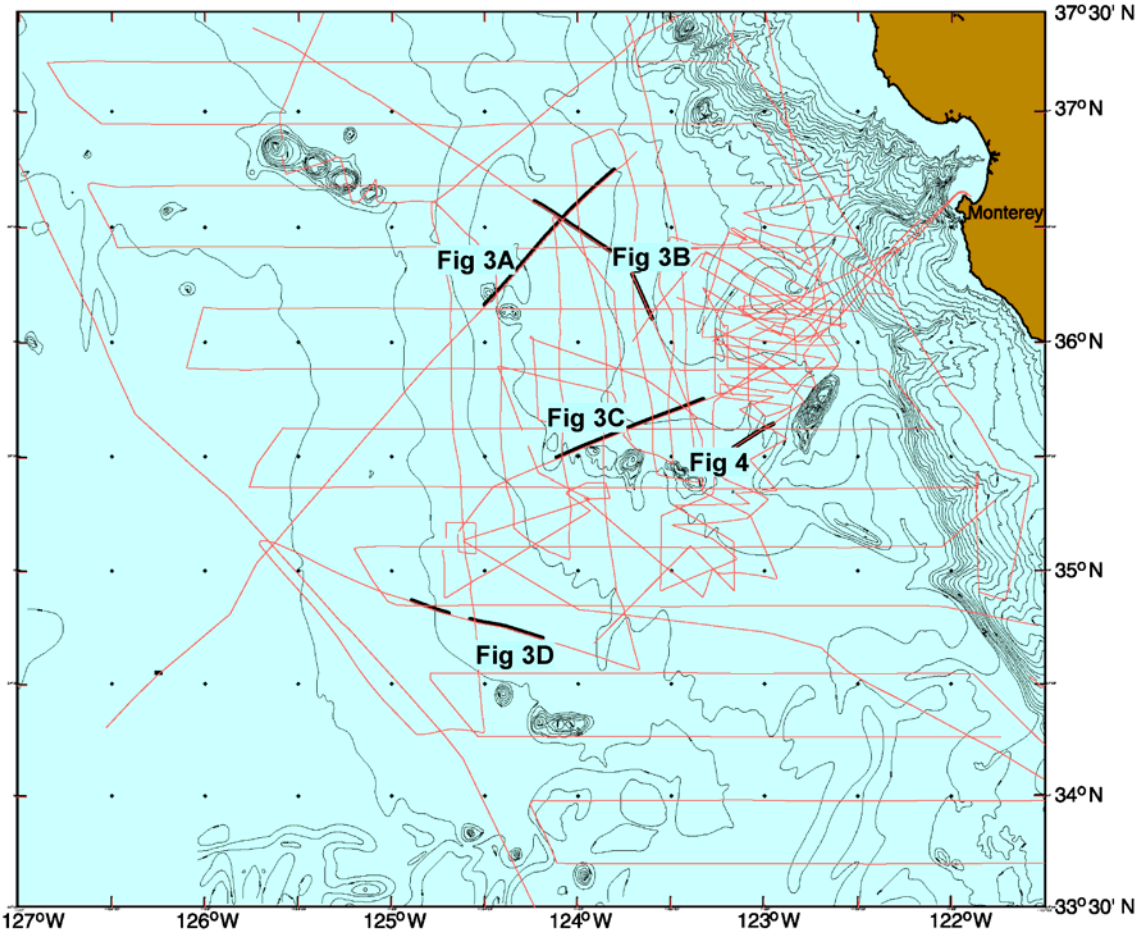

Figure 1: Trackline map of the USGS and Scripps Institution of Oceanography cruises over the Monterey fan area showing location of seismic-reflection data used in Figures 3 and 4.

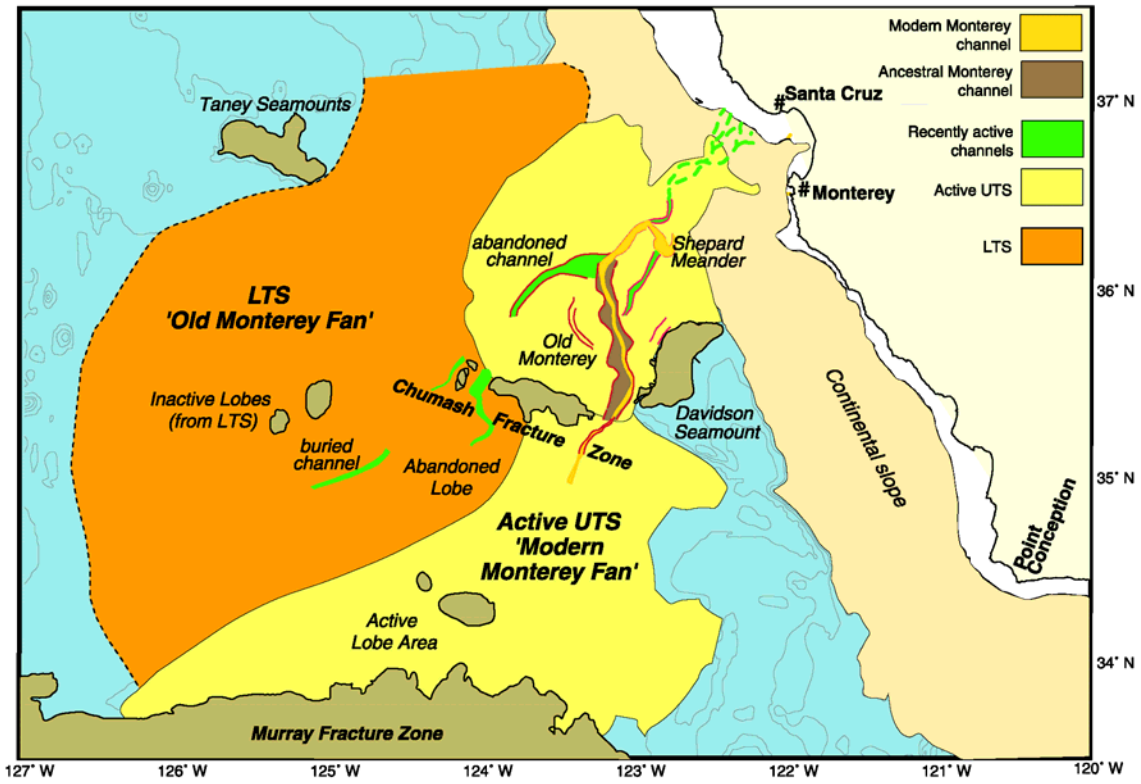

Figure 2: Schematic map of the area of deposition of the Monterey fan showing the areal distribution of the Lower Turbidite System (LTS) and the superimposed and most recently active Upper Turbidite System (UTS). Only channel systems with sea-floor expression are depicted in this cartoon.

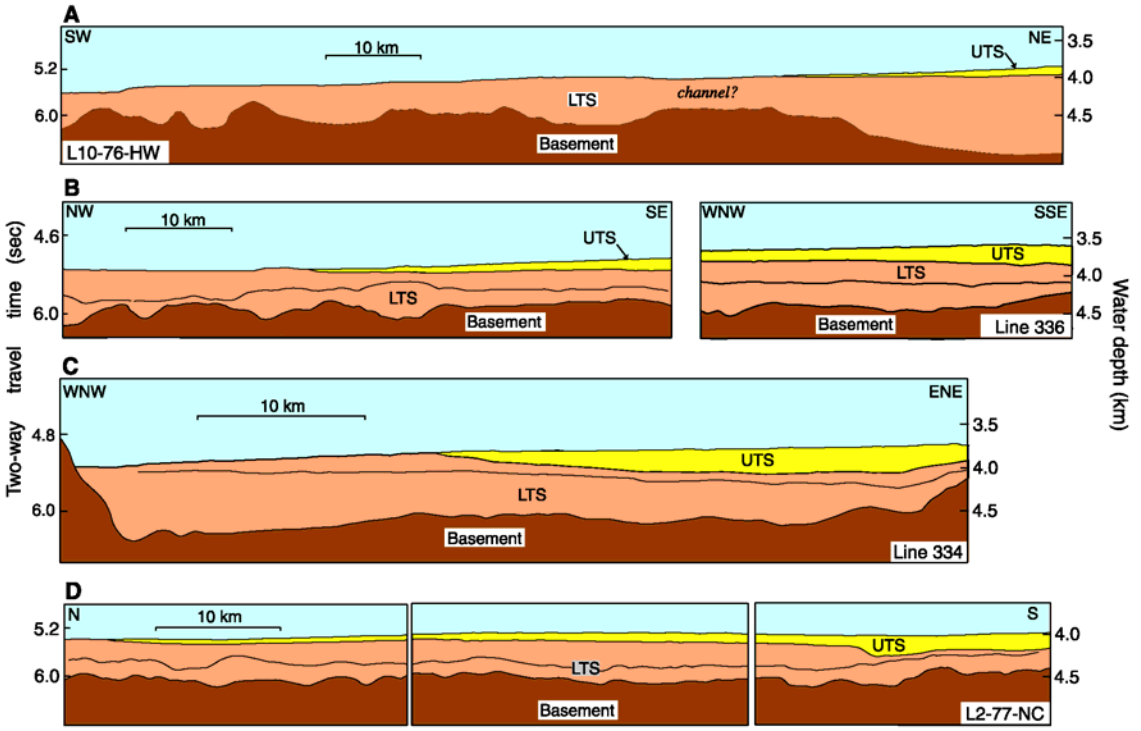

Figure 3: Line drawings of selected seismic-reflection profiles from the Monterey fan area showing stratigraphic relationships between the LTS and UTS. UTS tends to wedge out toward the west, southwest and northwest; LTS is composed by the largest amount of sediment in the study area and locally shows downlap to the east.

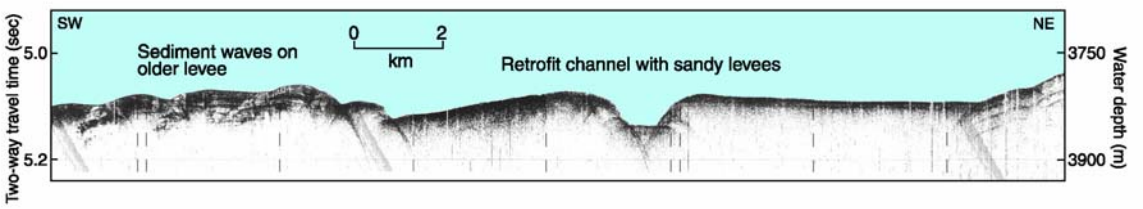

Figure 4: 3.5 kHz seismic-reflection profile across the modern Monterey channel, showing a larger channel (old Monterey) with its levee underlain by medium-scale sediment waves of finer-grained material. A retrofit channel (the present main Monterey channel) now occupies the floor of the larger channel and has levees composed of coarser material.