**Sediment budget for the levee-dominated deepwater Danube Fan in the Black Sea.**

The Late Pleistocene Danube Fan is an exceptional fan analog because of the large amount of published data, and because it is sufficiently small that single seismic lines can traverse it. Using published and newly released seismic lines a complete architecture of the entire fan is now possible. The seismic facies are calibrated with Ifremer drop cores and cored analogs from other similar fan.

The fan has four depositional facies:

**Mass Transport Complex (MTC)**: A chaotic deposit resting on the sequence boundary.

**Channels fills**: mostly confined by levees, and likely very sandy.

**Levees**: Both large and small, ranging from all mud to heterolithic.

**Lobes**: Lobes are formed by unconfined flow following an avulsion, and unconfined flow at the terminal ends of channels. They are sandy based on analogs and seismic response.

The Late Pleistocene fan, exclusive of the MTC, has three major morphologic zones.

**Proximal Zone:** Exclusively on the slope consisting dominantly of a single channel flanked by large levees up to 600 meters thick and 40 kilometers wide. Cores through the levees reveal they are composed of finely laminated mud interpreted to be deposited by turbidity currents that overtopped the channel. This zone extends from the shelf edge to the toe of slope at approximately 1,400 meters deep.

**Medial Zone**: This zone is composed of large channel/levee complexes that formed as the result of a few large-scale avulsions. Levees decrease in size distally along the channel paths from 40 to 5 kilometers wide. Levees also become increasingly sandy distally. This zone extends from approximately 1,400 meters to 2,000 meters of modern water depth.

**Distal zone**: This zone is dominated by terminal lobes overlain by small channel fills with small heterolithic levees. Many avulsions result in compensationally stacked level/channel/lobe complexes interpreted to form fining upward successions from the sandy lobe to the overlying levee.

Volumes of each of the primary depositional elements (levees, channel fills, and lobes) can be used to develop a mass balance calibrated by the Ifremer cores and sand estimates from other Pleistocene systems.

The Late Pleistocene fan has these proportions of facies. The percent sand is from Danube cores and cores from other analogous facies.

**Facies % fan vol. % silt - grvl**

Levee 51% 5%

Channel fill 2% 70%

Avulsion lobes 4% 50%

Terminal lobes 43% 50%

**Total percent grvl, sd, crs silt**  **28%**

Over half the fan volume is composed of levees, which get sandier distally (away from the shelf edge). Terminal lobes, which are very sandy, form an apron around the distal edge of the fan.

Bio

Howard has over 30 years of experience working on petroleum geology in exploration, production, development, and research. He spent 26 years in a wide range of geoscience positions in ExxonMobil, and before that spent 7 years in the Petroleum Section of the Kansas Geological Survey. He is currently an Affiliate Faculty in the Department of Geosciences, Colorado State University in Fort Collins. He has broad expertise applying the concepts of sequence stratigraphy and facies interpretation to reservoir architecture at a wide range of scales in all clastic settings.

Current interests include deepwater fan architecture and the importance of avulsions in producing predictable stratigraphic architecture, and in fluvial architecture. Howard has published research articles on petroleum geology in the Journal of Sedimentary Research, AAPG Bulletin, and several book chapters, and has co-edited an SEPM book on sequence stratigraphy.