

### Depositional Model for Submarine Fans

Sand deposition on the Dume submarine fan off southern California is localized in the prominent leveed channels on the upper fan and on suprafans. The sand-laden turbidity currents, confined to channels by high levees in the upper reaches of the fan, overtop the low levees in the suprafan area and deposit their loads in fan-shaped sheets across the middle and lower fan segments. Thus suprafans normally are formed on middle to lower fan areas and are characterized by sand sheets and numerous small distributary channels with no levees, or very low-relief levees. These channel-suprafan units form the basic building blocks of submarine fans and are the key to understanding their sedimentary facies distributions.

On high resolution sparker sections, the fan is internally characterized by discontinuous reflections and abundant diffractions resulting from the depositional relief produced by buried leveed channels. In detailed interpretations of the sparker sections, the fan complex can be divided into lobes and stratigraphic intervals related to different depositional processes. A three-dimensional fan model has been developed and applied in the interpretation of ancient fans recognized in outcrops and the subsurface.

MOIOLA, R. J., and E. L. JONES, Mobil Research & Development Corp., Dallas, TX

### Sedimentology of Brent Formation (Middle Jurassic), Statfjord Field, Norway-United Kingdom

The Brent Formation of Middle Jurassic (Bajocian-Bathonian) age is the primary reservoir in the 3-billion bbl Statfjord field which is located in the northern North Sea on the boundary between Norway and the United Kingdom. Averaging approximately 180 m in thickness, the Brent can be conveniently divided into three major units that are easily identifiable on electric logs. The lower unit is a coarsening-upward sequence that commences with shale and terminates with coarse-grained sandstone. Sandstones in this unit, with porosities as high as 33%, comprise the best part of the reservoir. Interbedded shales, sandstones, siltstones, and coals characterize the middle unit, and the upper unit consists of sandstones with minor thin shales and occasional coals.

Analysis of cores from 10 wells in the field and several wells in nearby areas indicates that the Brent Formation represents a lobate, river-dominated deltaic complex morphologically similar to the Lafource delta of the Mississippi River. The lower unit, in ascending order, consists of prodelta, distal bar, distributary mouth bar, and distributary channel deposits; the heterogeneous middle unit comprises a delta plain association of distributary channel, interdistributary bay, splay, and marsh deposits. The upper unit was also deposited in a delta plain setting, but in places exhibits evidence of marine reworking. Facies patterns and trends demonstrate that the deltaic sediments of the Brent Formation in the Statfjord area were derived from a source area to the south-southeast rather than from the East Shetlands Platform to the west.

MOLNIA, BRUCE F., U.S. Geol. Survey, Menlo Park, CA

### Glacial-Marine Sedimentation: A Model

Glacially eroded sediments are introduced into the marine depositional environment by rivers, ice rafting, ice-contact deposit, or rarely by eolian transport. Glacial-marine facies range from well-sorted unimodal stratified deposits to bimodal

or multimodal chaotic or massive deposits.

Position of the glacier terminus relative to the shoreline is the most important facies-determining factor in glacial-marine sedimentation. If the terminus is landward of the shoreline, as in the Gulf of Alaska, glacial-marine sediment is fluvially transported, in places rafted, and infrequently blown into the marine depositional environment. Deposits are generally unimodal, well sorted, stratified, and lack a coarse fraction. These deposits form in proximal environments, including beach, delta, and nearshore, and in a medial rock-flour-rich environment on the open shelf. If a glacier has an iceberg calving terminus in a fiord, or is grounded on the continental shelf, ice-contact deposition, ice rafting, and fluvial or current transport are the dominant processes. Ice-contact and ice-rafted deposits are poorly sorted, whereas fluvial and current deposits are well sorted and stratified. Ice-contact deposits accumulate where glacier ice contacts the continental shelf and slope. If the glacier terminus is floating, as is the Ross Ice Shelf of Antarctica, then all proximal glacial-marine facies and most medial facies on the open shelf are absent. The resulting deposit is a distal facies, typically ice-rafted in origin, which is almost everywhere bimodal or multimodal. The distal ice-rafted component has commonly been incorrectly identified as the only glacial-marine facies. Variations in ice-terminus position can cause rapid, radical changes in the resulting deposits. Depositional rates in proximal or medial deposits may range from 1 to 30 mm/year; short-term accumulation rates may exceed 4 m/year. Accumulation rates in distal ice-rafted deposits average less than 0.1 mm/year.

MOORE, GEORGE W., U.S. Geol. Survey, Menlo Park, CA

### Shelf-Slope Boundary at Active Subduction Zones

About 30 subduction-zone segments are identified worldwide by intermediate-focus earthquakes, calc-alkalic volcanic arcs, and lines of rapid mountain uplift. The total length of these active convergent plate boundaries is approximately 58,000 km. Of this length, 46% is of the Japan type, where the upper plate is relatively stable horizontally, 30% is of the Andes type, where the upper plate actively overrides the trench, and 24% is of the Himalaya type, where continental plates or microplates collide with continents.

Subduction zones of both the Japan and Andes types are marked by basement highs at the shelf break. Uplift of the crust and upper mantle at the edge of the upper plate causes these highs when a relatively low-density prism of accreted trench sediment is emplaced below. The accretionary prism usually forms within 5 m.y. after a new subduction zone is established, during the time that the megathrust at its sea-floor outcrop is evolving from an initial dip of 30 to 45° to a steady-state dip of about 10°. Except during this relatively brief initial period of accretion, trench sediment at subduction zones normally is carried deeply into the lithosphere.

Elongate sedimentary basins form on both sides of the shelf-break uplift, but compression generally removes the fluids from sediment on the lower trench slope before thermal maturation of oil precursors can occur. Elsewhere at the active margin, although the low geothermal gradient caused by subduction of cold oceanic crust delays hydrocarbon maturation, it can resume after continental collision or after subduction-zone realignment.

MOORE, GREGORY F., and JOSEPH R. CURRAY, Scripps Inst. Oceanography, La Jolla, CA