Sandy-Mass-Transport Deposits (SMTD) in Deep-Water Environments: Recognition, Geometry, and Reservoir Quality

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Sandy-mass-transport deposits (SMTD), composed of sandy slides, sandy slumps, and sandy debrites, are common in both modern deep-water environments and in ancient rock record. Petroleum-producing SMTDs have been documented from the Bay of Bengal, West African margin, North Sea, offshore Mid-Norway, Gulf of Mexico, California, and Brazil. The following criteria for recognizing SMTDs have been developed from description of over 10,000 m of conventional cores and outcrops (1:20 to 1:50 scale), which include cores from 32 deep-water sandstone petroleum reservoirs worldwide, and related seismic and wireline-log data.

In conventional cores and outcrops, sandy slides are recognized by their (1) basal primary glide planes, (2) basal shear zones, (3) sand injectites, (4) internal secondary glide planes, (5) internal fabric changes, (6) deformed layers, and (7) sharp upper contacts. Sandy slumps are identified by (1) slump folds, (2) chaotic sandy units, and (3) sand injectites. Sandy debrites are characterized by (1) thick amalgamated massive sands, (2) sharp basal contacts, (3) inverse grading, (4) pockets of quartz granules, (5) floating mudstone clasts, (6) floating armored mudstone balls, (7) planar and random clast fabrics, (8) internal contorted layers, (9) sand injectites, and (10) sharp to irregular upper contacts. On RMS seismic amplitude maps, SMTDs exhibit variable planform geometries, but show sharp margins. Sandy debrites exhibit both sinuous and lobate planform geometries. Cross-sectional geometries vary from sheet to lenticular types. On wireline logs, SMTDs exhibit a wide range of log motifs (e.g., blocky, upward-fining, upward-coarsening, etc.).

In the offshore Krishna-Godavari Basin (Bay of Bengal), upper-slope petroleum reservoir sands of Pliocene age are composed of SMTDs. Frequent tropical cyclones, tsunamis, earthquakes, shelf-edge canyons with steep-gradient walls of more than 30°, and seafloor fault scarps are considered to be favorable factors for triggering mass movements. Sandy debrites occur as sinuous canyon-fill massive sands, intercanyon sheet sands, and canyon-mouth lobate sands. Reservoir sands, composed mostly of amalgamated units of sandy debrites, are thick (up to 32 m), low in mud matrix (less than 1% by volume), and high in measured porosity (35-40%) and permeability (850-18,700 mD). Popular deep-water sedimentologic and stratigraphic models are irrelevant to suddenly emplaced SMTDs.