Gas-Charging of Latest Pleistocene Shelf-Edge Delta Reservoirs by Possible Dissociation of Gas Hydrate, Northeastern Gulf of Mexico

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ABSTRACT

Stacked and laterally offset clinoform packages associated with lowstand deltas make up the Gulf of Mexico shelf edge, from the modern Mississippi River delta to DeSoto Canyon. Offshore Mississippi-Alabama, within the Lagniappe delta complex, thick sandy clinoforms display impedance contrasts recorded on high resolution seismic profiles that indicate significant gas charging. Carbon-14 dating places the Lagniappe delta at the shelf-slope transition only about 1,000 yrs before the latest Pleistocene glacial maximum. Thin heterolithic clinoform toes extend downslope to a channel-levee system that feeds by-passed sediment to a deep-slope fan. These laminated sand, silt, and clay units create effective capillary seals that inhibit vertical hydrocarbon migration while allowing lateral and updip transport. Clinoform toes extend downslope into the gas hydrate stability zone which acts as a regulator of updip hydrocarbon migration. During the approximately 100,000-yr glacioeustatic cycles typical of the Pleistocene epoch, concomitant reduction in hydrostatic pressure and increase in water temperature periodically occur at the top of the gas hydrate stability zone causing hydrate instability. Under rising-to-high sea level conditions, Loop Current intrusions raise bottom water temperatures on the upper slope (<1,000 m) causing near surface gas hydrates to decompose, making gas available for updip transport. Gas observed seeping from truncated clinoforms, and ^{13}C-depleted authigenic carbonates found in clinoform cores, strongly suggest that hydrocarbon migration is an on-going process. When sea levels fall, gas hydrates decompose, releasing gas into surrounding sediments where capillary seals encourage updip migration. An abrupt sea-level fall causes rapid gas hydrate decomposition and slope failures, mobilizing large volumes of sediment for transport to deep-water depositional sites.