Grain Size, TOC, and TS in Gas Hydrate Bearing Turbidite Facies at Green Canyon Site 955, Gulf of Mexico

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9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Marine gas hydrate is often hosted in turbidite depositional systems on continental margins. These depositional settings contain variable sedimentary facies across and within canyons, channels, and levees. Recent pressure coring during the UT-GOM2-1 expedition revealed a gas hydrate-rich, levee reservoir system dominated by sandy silt beds with variable interbeds of silty clay. Examination of the full sediment grain size distribution (laser diffraction, Malvern Mastersizer 2000) on bulk sediment and TOC (total organic carbon)-free sediment samples reveals that even in the coarsest sandy silt facies, there is a fine fraction (fine silt and clay) of particles, a reminder of the graded nature of turbidite deposition. Measured TOC (CHN elemental analysis) in the sediments rarely exceeds 1 wt. % and is greatest in samples with a predominance of the fine (clay) fraction, as both fine TOC and clay settle in the same energy regime. Average del ^{13}C of bulk sediment TOC is -25 per mil, reflecting a mixture of terrestrial and marine organic carbon. Bulk sediment grain size and TOC-free (peroxide-treated) grain size data, measured from the same samples, also reveals differences that suggest the fine fraction is where most of the measured TOC resides. These relationships document the variable energy regime and TOC load in the levee facies at this site. TS (total S) and bulk S isotopes (del 34S) reveal enhanced pyritization associated with AOM (anaerobic oxidation of methane) in two broad regions within the reservoir facies. The upward jumping of these paleo-SMTZs (sulfate-methane transition zones) may have been triggered by a change in sedimentation rate or methane flux. Identification of paleo-SMTZs and enhanced pyritization within the

reservoir facies suggests an early gas charge, where AOM occurred in the presence of significant methane and sulfate, within the shallow subseafloor shortly after sediment deposition.