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Fractures, Salt, Seismic, and Ice: Vital Research Components of America's Natural Gas Energy Future

Throughout the 20th century, natural gas was found in association with oil but commonly not explored for as an independent source of energy. During the 21st century, the United States will lead the world in transitioning away from coal and oil into methane and hydrogen. Tight gas, shale gas, and coalbed methane now account for 20% of U.S. consumption. Combine these existing unconventional sources with deepwater, subsalt, deep gas (15,000 ft), brine gas, and gas hydrates, and by 2020 more than 50% of U.S. gas consumption, representing a key component of total U.S. energy consumption, will come from unconventional natural gas sources.

Much of the upstream research and technology necessary to explore for and produce unconventional natural gas, especially the advanced understanding of fractures and salt, is in the early stages of understanding. Key goals include prediction, modeling, and flow simulation. Such technologies as physical, numerical, and geomechanical modeling algorithms and approaches, multicomponent seismic data and seismic-based research, and direct-observation methods including cathodoluminescent scanning electron microscopy will provide important input to describe and predict (1) fracture aperture, orientation, spacing, clustering, geometry, relation to lithology, and cementation and (2) salt origin, mechanics, geometry, movement, and petrophysical variation. Methane hydrates present several unique research challenges: (1) determining physical properties--how they form, evolve, and break down, and what controls gas concentration; (2) analyzing the effect of hydrates on sediment strength and seafloor stability; and (3) characterizing and exploring for hydrates—through remote sensing, improved simulation and modeling, and new production technology.