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## Integrated Site Investigation of Seafloor Features and Associated Fauna, Shenzi Field, Deepwater Gulf of Mexico

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### Abstract

The continental slope of the Deepwater Gulf of Mexico is characterized by complex seafloor topography caused in part by shallow salt deformation. Locally, faults provide pathways for hydrocarbon migration through the suprasalt sediments to the seabed. Seafloor hydrocarbon seep sites can provide habitat for unique biologic communities. Seafloor features and associated fauna present significant challenges to site selection for wells, moorings, subsea equipment, and flowlines associated with petroleum field developments. This paper documents a case study of how these challenges were addressed during development of the Shenzi Field through a series of site investigations beginning during the early planning phases of the project. The Shenzi case study presents a proactive approach for addressing deepwater marine biology during field development. Integrated site investigation yielded a successful development plan from both engineering design and regulatory permitting perspectives consistent with the Operator's charter commitment to sustainable development of petroleum resources in an environmentally responsible manner.

### Introduction

**Project Background.** The Shenzi Field was discovered in 2002 by the GC 654 #1 well. This discovery well was followed by five appraisal wells that confirmed commerciality of the field. The field development concept for the initial phase of production consists of multiple subsea wells around three drill centers tied back to a dedicated Tension Leg Platform (TLP) processing facility via production flowlines, gas lift/injection flowlines, and umbilicals. Third party oil and gas export pipelines will provide transportation back to market.

**Geologic Setting.** The Shenzi Field lies approximately 104 nautical miles south of Fourchon, Louisiana (Figure 1a), on the continental slope of the northern Gulf of Mexico (GOM) approximately 5 miles north of the Sigsbee Escarpment in Green Canyon Blocks 609, 610, 653, and 654. Water depths in Shenzi Field range from approximately 4,150 feet in the northeast quadrant of Block 653 to 4,480 feet in the southeast corner of Block 654.

### Site Investigations

**Desktop Study.** A shallow hazards desktop study was conducted during the Concept Phase of the Shenzi Project to identify seafloor and shallow geologic features pertinent to field development. This study was based principally on a spectrally enhanced 3-D seismic volume, existing shallow hazard reports submitted in support of Exploration Plans (EP) for well locations, and other readily available data.

Numerous fault scarps were evident from seafloor renderings derived from the Shenzi 3-D seismic volume. A zone of seafloor faults was apparent above a shallow salt ridge that extends from the northeast quadrant of Block 653 across the southern boundary of Block 610. An area of hummocky topography was apparent adjacent to fault scarps near the boundary between Blocks 653 and 654. A few isolated areas indicative of possible hydrocarbon seeps were identified from a seafloor amplitude rendering generated from the 3-D data.

Results of the desktop study were considered when devising preliminary field layout options. However, the inherent resolution limitations of 3-D seismic data inhibited characterization of conditions to the level of detail required for engineering design and regulatory permitting of facilities. Therefore, the desktop study also identified additional site