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## The Setting and Possible Mechanism of the 2006 Green Canyon Seismic Event

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### Abstract

On February 10 2006, a significant seismic event occurred in the Gulf of Mexico within an area of vital interest for hydrocarbon exploration companies. The location of the event, in Green Canyon Block 344, is close to discoveries and producing fields, including Allegheny, Front Runner, Bison, K2, Marco Polo and Holstein, among others.

This paper describes the structural context of the February 2006 event and reviews possible seismogenic process that could operate within the region.

### Introduction

In order to define the possible influence of such an event on exploration or production, we need to know the strength, depth, displacement, rupture area, surface effect and likely recurrence interval of the event responsible. We cannot predict this from historical seismicity, because there is little historical data on natural seismic activity in the area, and the focal mechanism and depths are poorly defined. Therefore the best way to predict potential future activity is to understand the geological setting and structural mechanism of this event.

### Seismological signal

The limited information made available by the USGS<sup>1</sup> gives a location (27.632°N, 90.144°W, with lateral error +/- 10.8km) and an approximate depth (5km, with no vertical error margin quoted) but no information on focal mechanism. Assuming vertical positioning error is similar to the horizontal, the information provided by the USGS does not distinguish between an event at sea floor, one within the sediment sequence, or one at a shallow depth in the basement.

The seismic effect of the earthquake was fortuitously detected by an OBS network in place over the Atlantis field. Dellinger<sup>2</sup>

*et al.* (2006) described the nature of the signal of the event as seen on the OBS data. An analysis of the teleseismic data by Nettles<sup>3</sup> (2006) supports the general conclusions on the earthquake source, confirming the that general location lay within southeastern Green Canyon protraction area, with an indication that the source may have been 5-10 miles further north than reported by the USGS.

Nettles also concluded that the seismic signal does not permit a precise definition of the source signature, but the nature of the signal indicates that it is not that of a conventional deep seismic rupture (an effectively instantaneous slip event giving rise to the classic double-couple “beachball” with clear compressional first motion seen in two quadrants). Instead the signal is compatible with a seismological “landslide-type” mechanism. In this mechanism the movement takes a discrete length of time, such that the initiation of movement gives rise to a “beachball” with one polarity, and the cessation of movement gives rise to a signal of the opposite polarity. This is illustrated by the sequence of sketches shown in figure 1. The net effect of this as seen at a distance is a more confused signal, combining the responses from the start and end of movement, which does not have a conventional double-couple signature.

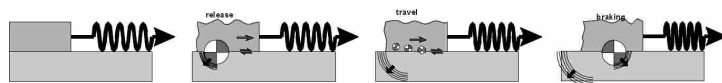


Fig. 1 mechanism of the “landslide-type” source

Given its name, it is not surprising that the seismological “landslide-type” signature is commonly generated by true landslides (catastrophic gravitational failures of the near-surface in which all edges of the slip surface intersect the ground surface). However, it is important to recognize that this is not the only source mechanism.

It is generally considered that the most likely requirements for development of a landslide-type source are

- (i) relatively shallow faulting (within a few kilometers of the ground surface)
- (ii) movement on a failure surface which is subhorizontal or has a low angle of dip
- (iii) material within the transported block which is broken or unconsolidated/poorly lithified.

In the vicinity of the 10th February event, examination of the local structure and stratigraphy indicates that these conditions