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# Modeling Subsalt Amplitude Variations

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## Abstract

A modeling study was used to investigate amplitude variations of a subsalt reflection after applying Kirchhoff and FX shot migration. This study built upon previous work investigating the applicability of WATS and XWATS acquisition geometries to the specific GOM exploration problem. There are very significant amplitude variations that must be associated with salt induced illumination variations. These variations were not only present in the stacked amplitudes but also in the offset amplitudes. Each offset required its own correction. It was possible to significantly increase the areal coverage of constant reflection strength within the subsalt reflection for the specific model investigated. Areas still existed where the amplitude was incorrect. This work suggests it may be possible to use model-based information to correct subsalt amplitudes within images of field data.

## Introduction

Over the last several years Wide Azimuth Towed Streamer (WATS) acquisition has been shown to provide significant improvement in imaging and multiple attenuation for complex geology (Regone, 2006; Sava, 2006; Barley, et.al., 2007, Beaudoin, et.al., 2007; Corcoran, et.al, 2007; Howard, 2007; Michell, 2007). Several service providers are now offering multi-client Exploration WATS 3D surveys. A previous study (Sinton, 2008) addressed application of XWATS and WATS acquisition geometries to the specific model used in this study. Amplitude variations within subsalt reflections were found to be significant. Albertin, et. al., (1999) and Bloor, et. al., (1999) discussed methods for correcting imaged amplitude and phase in Kirchhoff depth migration. New work was undertaken to investigate in more detail the amplitude variations and a model-based amplitude correction method applicable to any type of migration algorithm.

## Statement of Theory and Definitions

The modeling, computed shots and images discussed by Sinton, et. al. (2008) are the basis of the investigation into subsalt reflection amplitude variations. The image area covers a significant portion of a mini-basin and complex salt. A deep reflector was place in the model such that it was continuous within the mini-basin and under all the salt. The velocity within the deep reflector was adjusted so that it maintained constant impedance contrast with the surrounding media. Thus, the idea result from imaging should be constant reflection strength. The reflector represented a structurally simple, broad bump approximately centered within the model.

Images were computed using all 7,000 Wide Azimuth shots as discuss by Sinton, et. al. (2008). An FX shot migration algorithm produced a single image. A Kirchhoff migration algorithm produced image gathers each with 32 offsets. Amplitude maps were extracted from each image volume along the target sub-salt reflector surface. Correction maps were computed from the amplitude maps which could be applied to images of field data or more complex modeled data.

## Conclusions

This study shows that for the specific model of a GOM subsalt prospect imaging amplitudes require some type of amplitude correction. It is speculated the cause of the amplitude variations is the highly variable salt geometry. The particular FX migration algorithm use in this study produced amplitudes that were better behaved after correction that the particular Kirchhoff migration used in this study. Each Kirchhoff offset volume required its own amplitude correction function. Many questions still remain: are the amplitude variations due solely to the salt; do the corrected amplitudes in the offset volumes more closely approximate true AVO response; etc.? However, the results suggest it may be possible to correct subsalt