Geophysical Research Abstracts
Vol. 20, EGU2018-8950, 2018
EGU General Assembly 2018


# Enhancing Reflection Seismic Images Using Diffractions

Brydon Lowney (1), Ivan Lokmer (2), Chris Bean (3), Gareth O'Brien (4), and Michael Igoe (4)

(1) Irish Centre for Research in Applied Geoscience (iCRAG), O'Brien Science Centre, University College Dublin, Belfield, Dublin 4, Ireland, (2) School of Earth Sciences, Science Centre West, University College Dublin, Belfield, Dublin 4, Ireland, (3) School of Cosmic Physics and Geophysics Section, DIAS, 5 Merrion Square, Dublin 2, Ireland, (4) Tullow Oil Ltd, Central Park, 1, Carmanhall, Dublin 18, Ireland

Seismic images are created through interactions of P- and S-waves with subsurface boundaries. These interactions can take the form of reflections, diffractions, conversions, and refractions, or any combination of these. In conventional processing, the reflected portion of the wavefield is utilised while the rest of the wavefield is treated as coherent noise. This form of processing highlights continuous, uniform stratigraphy, whereas stratigraphy is rarely continuous and instead has abundant geological structures at a range of scales. Diffractions can be exceedingly useful device to both the geophysicist and the interpreter as they can highlight these geological structures. However, as conventional processing favours reflections in lieu of diffractions, alternative processing is required. Due to reflections having higher energies than the diffractions, up to an order of magnitude higher, the reflections must be separated or suppressed, and the diffractions and reflection images processed separately. Diffraction images are then used alongside conventional reflection processing to improve imaging on discontinuities, for example, faults, fractures, pinch-outs, and channels. This presentation aims to exhibit diffraction imaging through a novel utilisation of a straightforward f-k method suppressing the reflections through separation in the f-k space.

In the f-k domain, events are isolated based on their geometry and their phase velocity. Due to their geometry in a post-stack seismic image, reflections (which show up approximately linear in the f-k space) can be separated out, leaving the diffractions (which form fan shapes). These are then migrated utilising a standard post-stack migration plan to make a diffraction image.

This technique was applied to a simple synthetic model, a complex synthetic dataset, and a real dataset alongside a common existing diffraction imaging technique, plane-wave destruction. Plane-wave destruction estimates the dip of reflection energy between successive traces and will remove any energy which follows this estimation. The f-k method successfully diminished reflections in all examples, enabling the diffractions to be imaged. In comparison to the diffraction images created through plane-wave destruction, f-k suppressed diffraction images show clearer enhancement of previously unforeseeable discontinuities. This was especially noticeable on faults imaged in both the complex synthetic and real datasets and demonstrates the robustness of both diffraction imaging and the f-k method.