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SEISMIC DIFFRACTION IMAGING FOR IMPROVED COAL STRUCTURAL DETECTION IN COMPLEX GEOLOGICAL ENVIRONMENTS

Binzhong Zhou[1], Weijia Sun[2], Peter Hatherly[3]*
CSIRO Energy, Binzhong.Zhou@csiro.au[1],Institute of Geology and Geophysics, Chinese Academy of Sciences, swj@mail.iggcas.ac.cn[2], Coalbed Geoscience Pty Ltd, Email: geophys@bigpond.net.au[3]

Faults and dykes are the most significant geological structures that have the potential to disrupt underground coal mining operations. Seismic reflection surveying, especially 3D seismic, is the primary technique for structural delineation ahead of any longwall development in the Australian coal mining industry. It is generally accepted that seismic reflection surveys have the ability to locate faults with throws greater than 5-10 m for 2D and 2-5 m throws for 3D seismic data, but detection of faults with smaller throws, shears and dykes with widths of a few metres remains a challenge to seismic methods. Near the seismic detection limit the risk of interpreting non-existent structures also increases.

In this paper, we describe a moving average error filter (MAEF) applied in the neighbouring traces to extract diffractions from post-stack reflection seismic data. The filter estimates the reflections with the average values of the neighbouring traces along the reflection direction or dip, which can be computed by the gradients of seismic data. The difference (or error) between the original data and the estimated reflections, yields the diffractions. By identifying diffractions, small faults and other minor features that are difficult to detect using conventional seismic reflection processing can be detected. Numerical and real data examples are used to illustrate the effectiveness of the proposed method in small coal seam structure detection by extracting diffractions from reflection seismic data in a relatively complex geological environment.