

Seismic attribute analysis to enhance detection of thin gold-bearing reefs: South Deep gold mine, Witwatersrand basin, South Africa

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Abstract

The gold-bearing Upper Elsburg Reef clastic wedge (UER) in the South Deep gold mine in the Witwatersrand basin (South Africa) hosts the highly auriferous basal conglomerate known as the Elsburg Conglomerate (EC) reef. The reef is less than 20 m thick and together with quartzite and conglomerate beds in the UER (1–120 m thick) is below the seismic tuning thickness, or the dominant quarter wavelength. They are extremely difficult to identify on migrated seismic sections using traditional amplitude interpretations. In order to enhance the detection of the EC reef and its subcrop position against the overlying Ventersdorp Contact Reef (VCR), complex-trace seismic attributes, or instantaneous attributes and volume attribute analysis were applied on prestack time migrated (PSTM) seismic sections. In particular, the instantaneous phase and paraphase allowed the clear identification of the continuity of the EC reef, and overlapping and interfering wavelets produced by the convergence of VCR and the EC reef. In addition, these attributes increased confidence in the interpretation of the EC, in particular its offsets (faults), and its depth. A high correlation between the seismically determined depth of the EC reef and borehole intersections was observed, with several depth discrepancies below the vertical seismic resolution limit (~25 m). This information can now be incorporated into the current mine geological model, thus improving the resource evaluation of the Upper Elsburg Reef in the South Deep gold mine.