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# Frequency dependent AVO analysis of a Tertiary mass-transport deposit on the West African slope

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Amplitude versus offset (AVO) cross-plotting, partial-stack projection and red, green, blue (RGB) colour blending of frequency decomposed exploration 3D seismic data from West Africa has been used to map lithological and pore-fluid characteristics within a thin mass-transport deposit (MTD), advancing over a faulted clay/silt substrate.

The mapped palaeo-surface lies approximately 650m below seabed which itself lies in 2230m - 2530m water depth. A frequency decomposed RGB image of full-stack seismic data shows the MTD unit, which is <40m thick, extending downslope across the southern half the area and then splitting to flow either side of a raised faulted block. Sharply defined bright amplitudes lying within the MTD are interpreted as rafted blocks of a contrasting lithology to the MTD matrix and possibly gas-bearing. A narrow sinuous ribbon, associated with more bright responses is interpreted as a small turbidite channel, with a sand-rich overbank apron, emanating from a downslope part of the MTD. The clay/silt surface exposed across the northern half of the area is relatively featureless save for a network of fault-controlled scarps and ridges, with some large slope failure scars evident on the steepest slopes.

AVO analysis of the seismic was carried out by cross-plotting Intercept and Gradient derived from 3D seismic partial stacks. These were used to identify lithological and pore-fluid signatures across the surface. Previous work has shown that AVO pore-fluid signatures may be sensitive to frequency, therefore frequency decomposition of near and far stacks was carried out followed by construction of frequency decomposed Gradient and Intercept cross-plottins at discrete frequency bands to assist discrimination of fluid from lithological effects across the surface. Fluid responses are enhanced on frequency dependent AVO cross-plots at low to mid frequencies, whereas fluid effects are supressed at higher frequencies. This exercise resulted in the identification of a variety of lithological and fluid response signatures, all of which could be individually accentuated on a series of partial-stack projections optimised at Chi angles derived from the frequency dependent AVO cross-plot analysis. Further frequency decomposition and RGB blending of the individual projected stacks, coupled with co-blending of additional seismic attributes, resulted in a detailed map of lithological, structural and pore-fluid-fill characteristics across the site.

The MTD and the clay/silt substrate have been found to be lithologically similar, but the two are separated along the AVO fluid axis. The MTD is likely to comprise a clay/silt unit slightly less dense than the underlying substrate and with a slightly raised pore-fluid content. The rafted block seismic anomalies are shown to separate into a number of different 'families' probably reflecting their heterogeneous origins from higher up the slope and the turbidite over-bank apron is separated out as a unique depositional environment at this level. A highly distinctive lithological response localised in the southeastern part of the site is related to gas migration from depth, possible mud vulcanicity and gas-influenced carbonate diagenesis in the immediately overlying overburden.