A converted-wave experiment in Uganda

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ABSTRACT

We processed an experimental 3C survey acquired in Uganda. As there was concern that the azimuths of the 3C geophones were not exactly set in the planned field orientation, which was magnetic north, we performed rotation analysis on the data. The results were inconsistent and deviated too much from the planned orientation. Thus we rotated the data using a constant receiver orientation of magnetic north.

The PS data image the acoustic basement well but reflections shallower in the section have less continuity and are of lower amplitude. The PP data show more structure on the basement and much better resolution of the shallower reflectors. We picked two horizons on the migrated PP and PS sections by correlating first the basement reflectors then picking a shallower horizon on the PS data and matching that to a reflection on the PP data. The values of Vp/Vs calculated from the interval traveltimes measured on the PP and PS data were consistent with Vp/Vs values of 3.0–3.4 measured on logs from a nearby well.

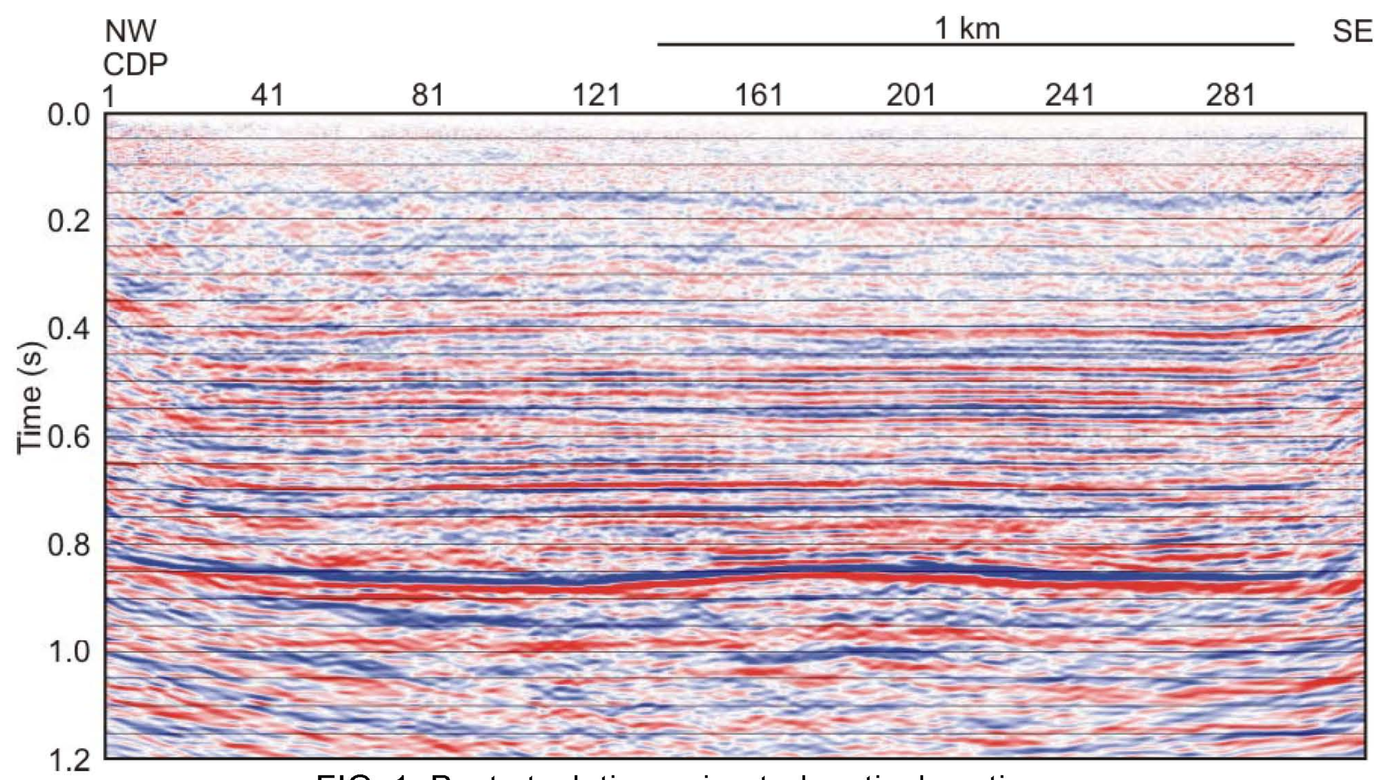

FIG. 1. Post-stack time migrated vertical section.

The vertical component was processed first and post-stack time migrated (Figure 1). The strong reflector near 0.9 s is the acoustic basement and the zone of economic interest lies within the overlying Miocene sediments.

Shot gathers from the two horizontal components, H1 and H2, exhibit opposite polarities for the positive and negative offsets and opposite polarities to each other (Figure 2). We performed rotation analysis on the data to try to determine the exact original geophone azimuth, which may not have remained exactly magnetic north since the geophones had been dropped into their holes. Automatic receiver orientation analysis calculated the original azimuth based upon rotation of the components such that the maximum horizontal energy appears on the rotated H1 component. The results were inconsistent (Figure 3), as were the individual results for the shots averaged into each receiver, and we considered them to be unreliable as they differ too much from the planned field orientation of magnetic north, which has a declination of 1°25´ East. Thus we rotated the components with the constant value of magnetic north. Figure 4 shows the H1, H2, radial and transverse components of one shot gather. We observe that the converted-wave energy between 2.0 and 2.4 s has been concentrated on the radial component and that all traces have the same polarity.

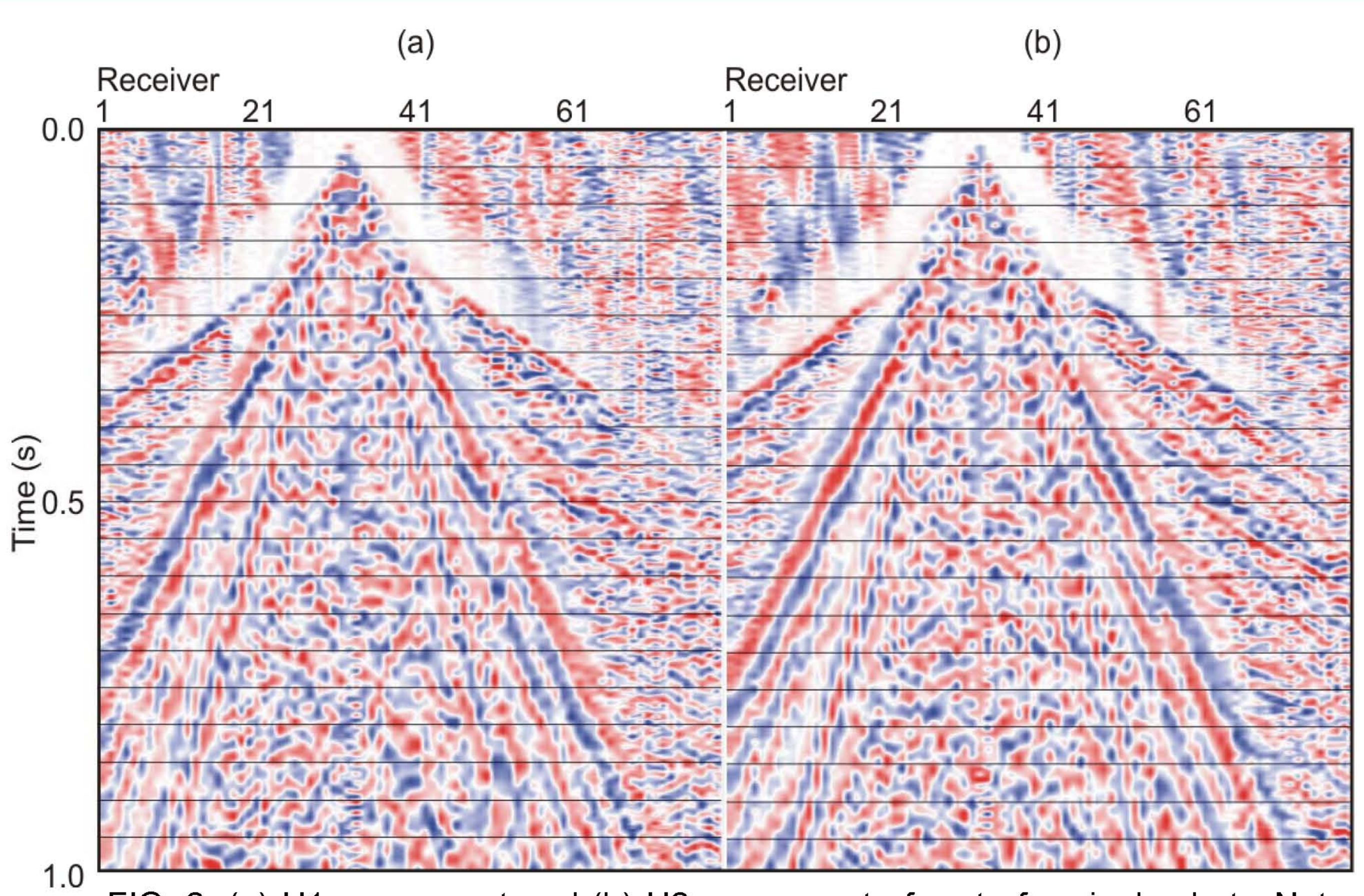

FIG. 2. (a) H1 component and (b) H2 component of part of a single shot. Note the polarity reversal of the first breaks for the leading and trailing spread on each gather and the polarity reversal between the two gathers.

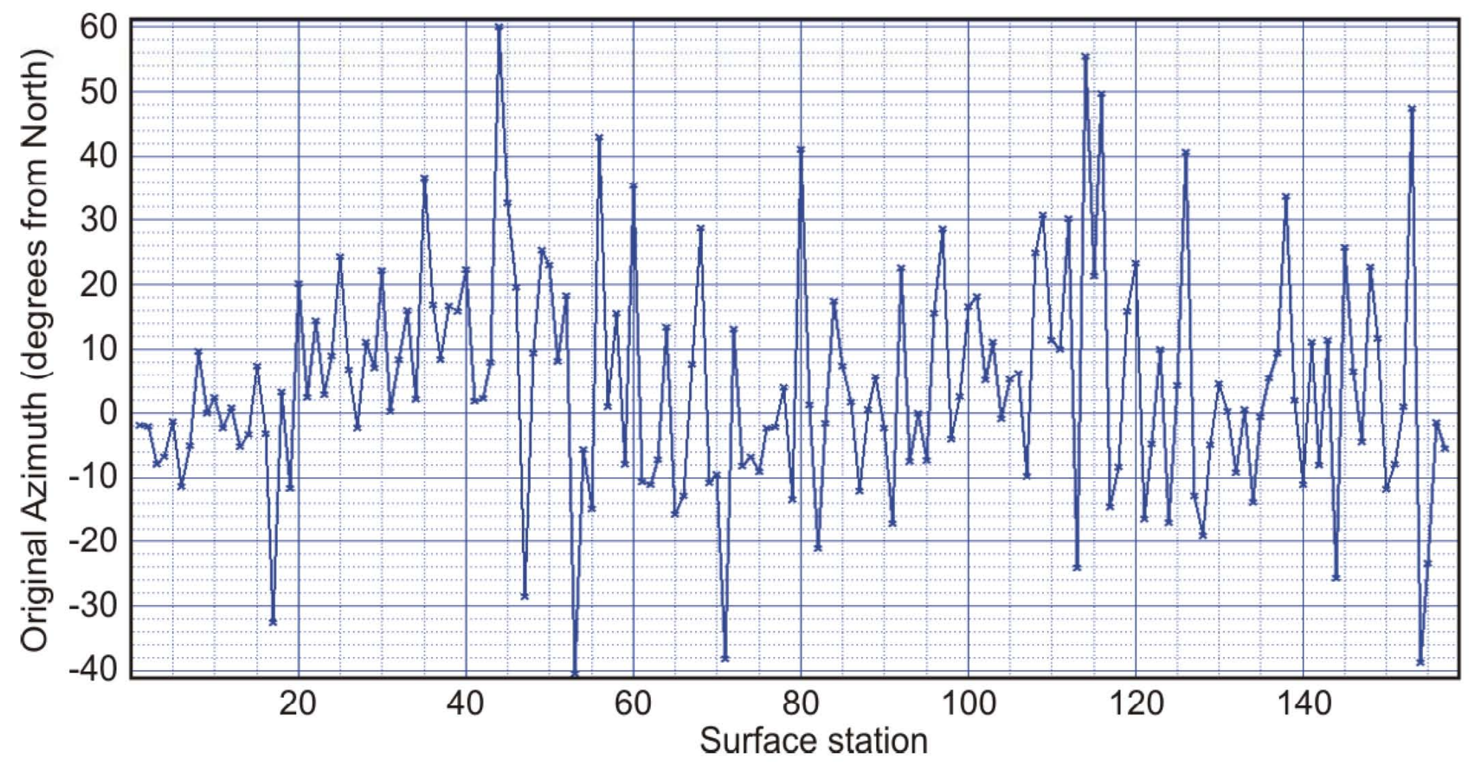

FIG. 3. The original geophone orientation calculated by rotation analysis for each receiver. These values are considered to vary too much from the planned orientation of magnetic north (1°25´ East) to be used.

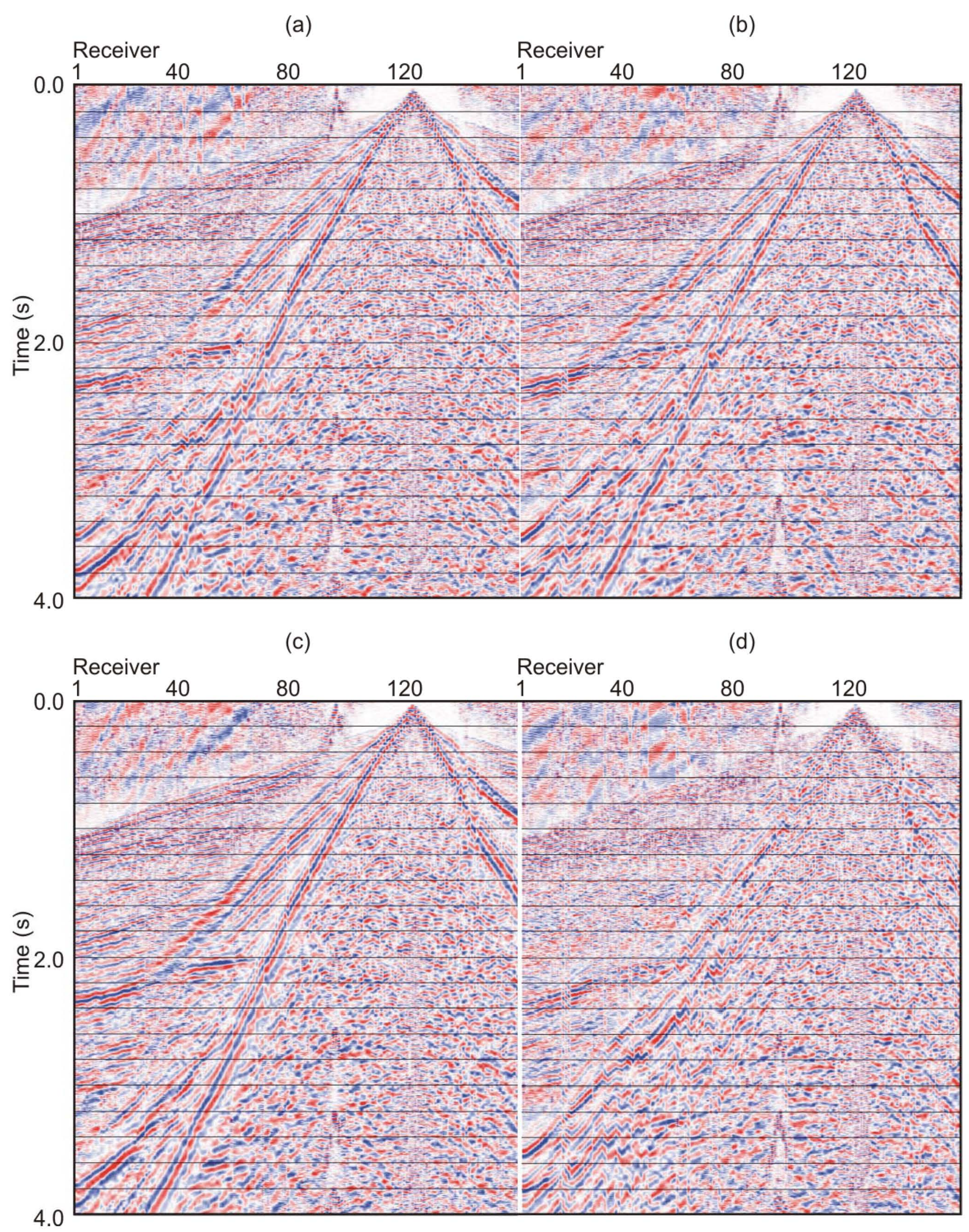

FIG. 4. (a) H1 component, (b) H2 component, (c) rotated radial component and (d) rotated transverse component for a single shot.

The radial component receiver gathers were processed to attenuate noise and enhance signal. We applied the shot statics calculated for the vertical component and estimated receiver statics by picking a horizon on the stacked receiver gathers, smoothing it, and calculating the static difference between the picked horizon and the smoothed horizon. The estimation of the receiver statics was difficult and there may still be some statics issues with the PS data.

The data were binned into common conversion point (CCP) bins using a Vp/Vs of 3.5, estimated from the arrival times of the basement reflector on the PP and PS receiver stacks, and stacked. Figure 5 shows the migrated PP and PS sections with the PS section scaled in time to align the basement reflectors. The PP section was bandpass filtered to match better the frequency content of the PS data. The acoustic basement reflector shows up well on the PS data at about 1.9 s but the reflectors in the section above it are discontinuous and of lower amplitude. There is another horizon at about 1.3 s which we picked and matched with a reflection on the PP data. However, synthetic seismograms should be used to properly correlate the reflectors. The basement reflector does not show as much structure on the PS section as on the PP section. This could be a velocity effect on the PP data or it might be the result of inaccurate receiver statics on the PS data.

We picked two horizons on each section and calculated Vp/Vs from the interval traveltimes between these horizons. These values of Vp/Vs are plotted beneath the sections. They are consistent with Vp/Vs values of 3.0–3.4 measured on logs from a nearby well. The drop in Vp/Vs seen in the NW end of the section is caused by the increased PP traveltime in that area.

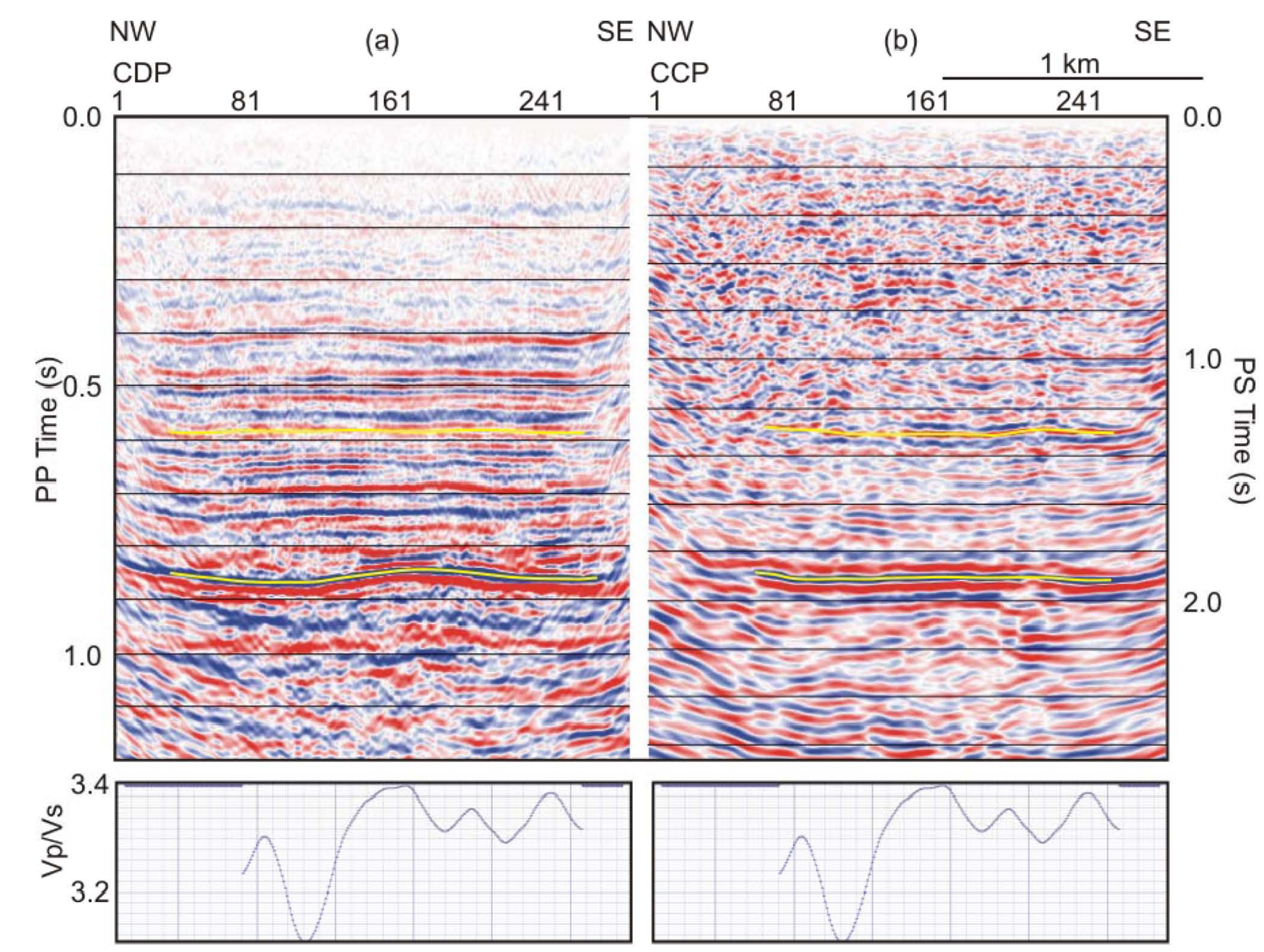

FIG. 5. PP post-stack time migrated section (a) and PS post-stack time migrated section (b). The PS section has been scaled in time so that the basement reflectors line up. Vp/Vs is calculated from the interval traveltimes of the two picked horizons.

ACKNOWLEDGEMENTS

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