# A case of Converted-wave processing in complex area: near surface and imaging challenges

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## • INTRODUCTION

- Converted waves (C-waves) could have a more extended application in complex areas if some processing challenges were overcome. Multicomponent seismic data from Colombia, motivated the study presented here.
- The data was acquired over a valley with mild topography and with the presence of geological structures. A 2-D surface seismic line and an uphole survey provided the data.
- Processing of converted wave at this area can be divided in two main issues: the near surface (NS), and the depth imaging. The NS issue is related to the heterogeneity and the topography, and the depth imaging to the geological structures.
- To study the near surface issue tomography methods on the real uphole and surface data are investigated. To investigate the depth imaging methods a synthetic model without NS problems was created.

## FIELD DATA

The data was acquired at a valley in Colombia (Fig. 1), with alluvial sediments (Q) and Tertiary outcrops (T) A 2D 3C seismic line and an uphole provide the data, illustrated in Figs. 2 and 3.

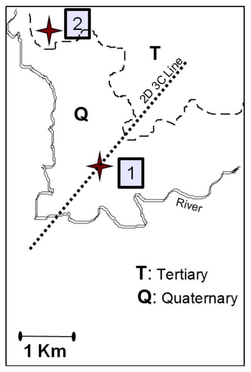


FIG. 1. Location of the seismic line and two uphole surveys, shown by numbers . Uphole 1 was used for this analysis.

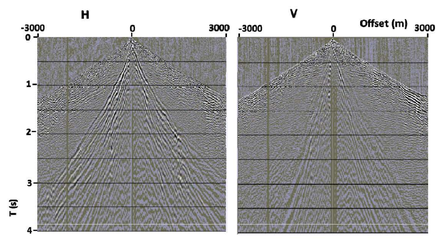


FIG. 2. Typical records of the Horizontal and vertical components, 2D line.

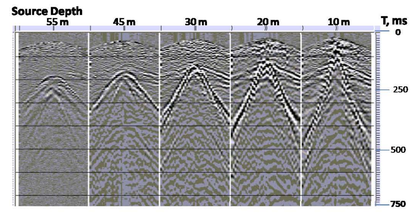


FIG. 3. Shot gathers of the uphole, radial component. The stronger event was identified as direct S-wave.

## THE NEAR SURFACE

Topographic and geological variations generated an heterogeneous NS. Tomography appears as an appropriate method, applied to events identified as S-waves (Fig. 3 and 4). The resulting models are in Figs. 5 and 6. Notice that they are compatible. However the uphole shows much slower velocities in the very shallow zone.

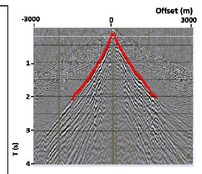


FIG. 4. Picking of events on the radial component (2-D line), assumed as S-refractions.

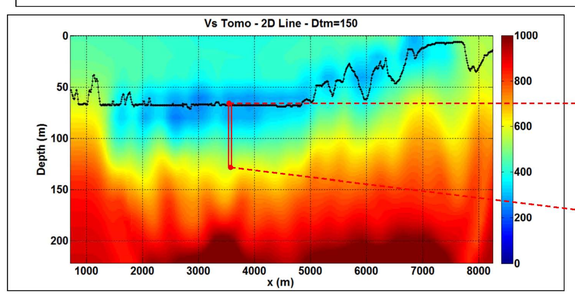


FIG. 5. Velocity model resulting from the tomography of the S-refractions (2-D line)

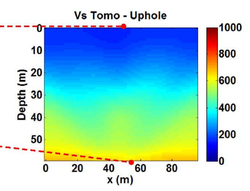


FIG. 6. Tomography of the S-wave uphole events.

## THE DEPTH REFLECTORS

A model of the geological structure was generated with the Finite Difference Method. It is illustrated in Fig. 7 with S-wave velocity. A converted wave stack using a simple CCP method (Fig 8) shows reasonable results. More test about that will be tried in the future.

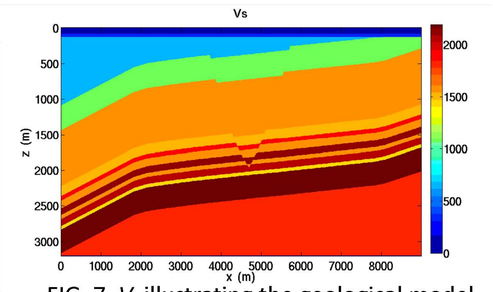


FIG. 7. $V_s$ illustrating the geological model.

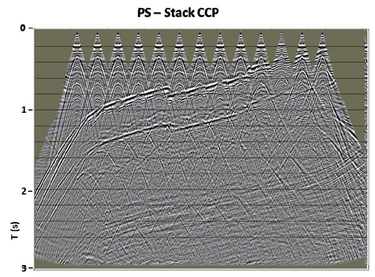


FIG. 8. Stack of the synthetic data, converted wave.

## CONCLUSIONS

- The S-wave near surface velocity model from tomography from the surface and uphole data corroborate each other.
- However uphole shows slower velocity at the shallower part, which is not possibly detected by the 2D line, and can be critical for the statics issue.
- The stack of synthetic data appears reasonably good, despite the simple method used. Migration and velocity analysis methods can be tested in the future on these data.

## ACKNOWLEDGEMENTS

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