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Combined P and SH Vibroseis profiling in the Isère valley near Grenoble, France

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Three Vibroseis profiles were recorded in the Isère valley north of Grenoble in November 2003 in order to determine the depth and geometry of the bedrock and to image the superficial post-glacial valley fill consisting of fluvio-lacustrine sediments. In addition to geological reconnaissance, our seismic investigations were also motivated by the extensive site effect studies carried out in the Grenoble area for many years. Indeed, the detailed knowledge of the near-surface geological conditions is of prime importance for the understanding of the site amplifications experimentally measured by using earthquakes, quarry blasts or seismic background noise. The information on the geometry and mechanical characteristics of the shallow subsurface is equally essential to the computation of realistic synthetic seismograms in three-dimensional structures, which demand a complete description of the models considered.

The seismic profiles recorded so far in the Grenoble area were obtained by using vertical geophones together with explosive or P-wave vibratory seismic sources. This equipment is well suited to our general exploration purposes but is less adapted to the study of site effects which are mainly governed by the shear wave velocity distribution within the sediments. In this respect, the use of shear-wave vibrators is not only useful to estimate the S-wave velocities in the alluvial fill, but we can also expect an improvement in seismic resolution, especially at shallow depths to detect near-surface heterogeneities. We report here the results of the operations performed along two orthogonal seismic lines, 600 to 1000 m long, among which one was successively studied with P- and SH-waves by using M22 and M13 vibrators. The measurements made in the area considered confirm the observations made elsewhere around Grenoble, namely, i) the valley bottom has a complex topography, ii) sediment thickness can reach 800 to 900 m, iii) The P- and S-wave velocity distributions inside the alluvial

fill are described by velocity gradients : the P-wave velocity varies between 1450 m/s and 2200 m/s approximately, and the S-wave velocity, between 220 m/s and 1000 m/s from the surface down to the bedrock. The analysis of Love waves picked up by the horizontal geophones gave good estimates of the shear-wave velocities in the upper layers.