The Vertical Strong-Motion Stations of the Kentucky Strong Motion Network

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Introduction

The University of Kentucky operates a strong motion network of 9 stations and two cooperative stations (Fig. 1). The stations are installed in the remote area of central and northern New Madrid seismic zone. All the strong motion stations are accessed through dia-up telephone lines and equipped with 6- to 12-Channel Kinemetrics **K2**'s. The unique feature of the strong motion network is the vertical strong motion arrays that consist of one to two downhole accelerometers. Table 1 lists the vertical strong motion arrays. The first vertical strong motion recordings in the central and eastern United States was recorded at station VSAP from the February 5, 1994 southern Illinois earthquake (Fig. 2). Fig. 2 shows ground motion amplification by the near-surface soils.

Table 1. The vertical strong arrays.

STATION	CHANNEL	DEPTH (meters)
RIDG	6	0, 35
VSAB	6	0, 100
VSAO*	9	0, 23, 106
VSAP	9	0, 41, 100
VSAS	9	0, 30, 260

* U.S. Army Corps of Engineers station.

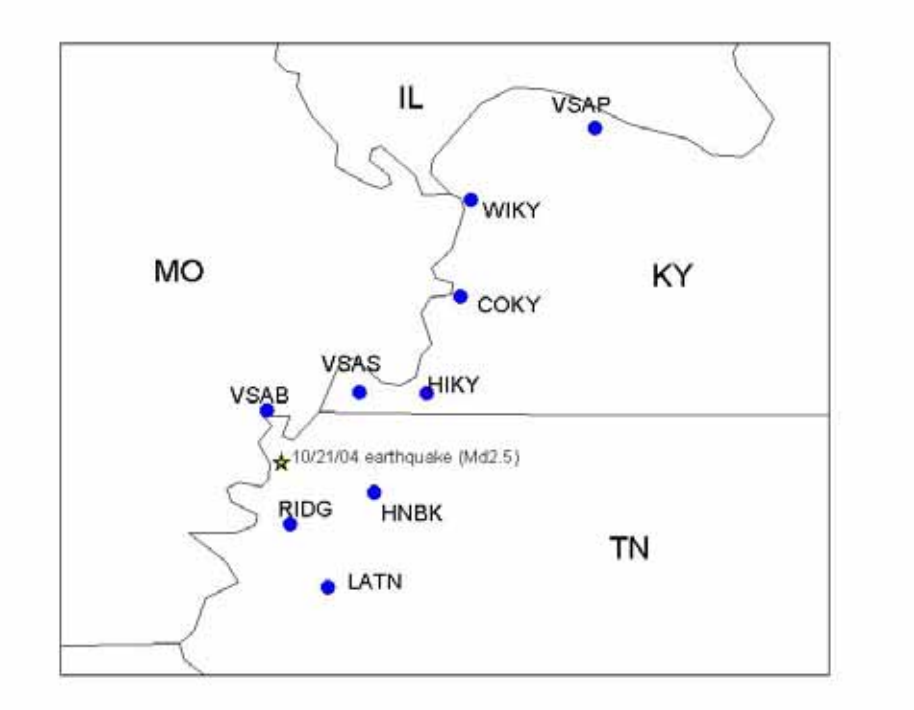

Figure 1. The Kentucky Strong Motion Network.

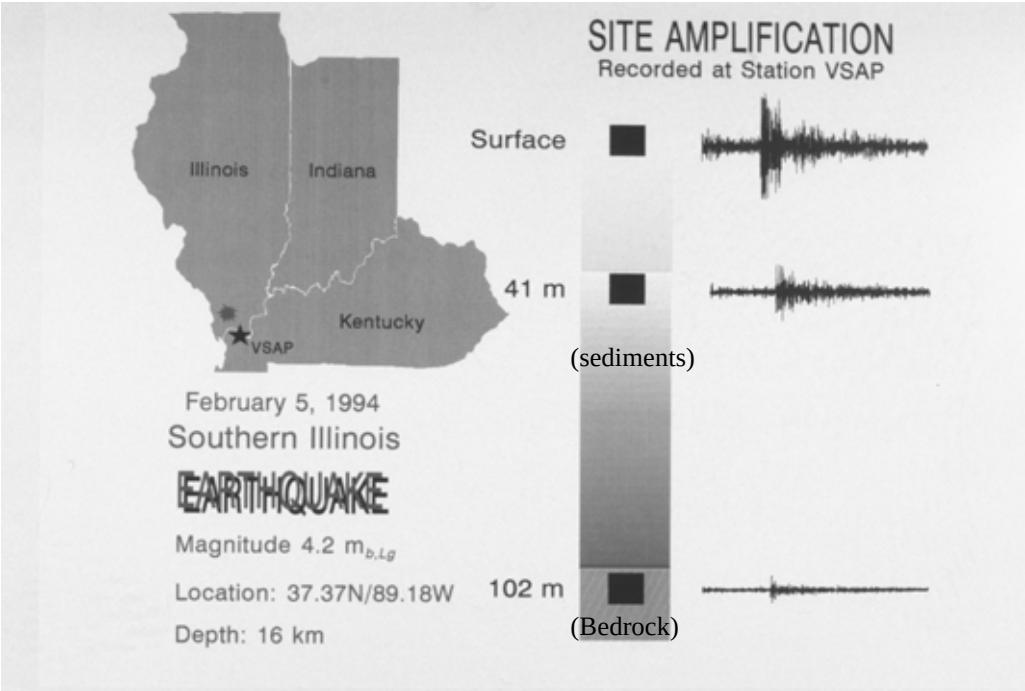

Figure 2. Site amplification at station VSAP from the February 5, 1994 southern Illinois earthquake.

The October 20, 2004 Earthquake Record at VSAS

The vertical strong motion array near Sassafras Ridge, Kentucky, at coordinates N36º33.139'/W89º19.784', VSAS (Fig. 1) is the deepest vertical array currently in operation in the central New Madrid seismic zone (Table 1). The station consists of three 3-component accelerometers, recorded on a 24-bit, 9-component accelerograph equipped with GPS timing (K-2). The "deep" borehole accelerometer was placed in a hole drilled to the top of the Paleocene-aged Porters Creek Clay 260 m below the surface at the proposed site (Fig. 3). The Porters Creek Clay is the first "stiff" layer as defined from seismic velocity measurements. The second borehole accelerometer was placed at the bottom of a 30 m geotechnical hole to evaluate the NEHRP empirical relationship for estimating the site-dependent seismic coefficients.

A small earthquake (Md2.5), occurred at 11:58:38 (UTC) on October 21, 2004), triggered VSAS. Figure 4 shows the recordings from accelerometers at the surface, 30m, and 260m deep. These are the first recordings from VSAS since it was installed in late 2003.

Summary

The University of Kentucky operates a strong motion network in the central and northern New Madrid seismic zone. The strong motion network includes 4 vertical strong motion arrays, VSAB, VSAP, VSAS, and RIDG. The vertical arrays start to accumulate recordings that will provide database for scientists to study the effects of the near-surface soils on the strong ground motion in the New Madrid seismic zone. Ground motion amplification by near-surface soft soils is a very important issue for seismic hazard assessment in the central U.S.; direct observations provide the only true method for constraining numerical modeling of this phenomenon.

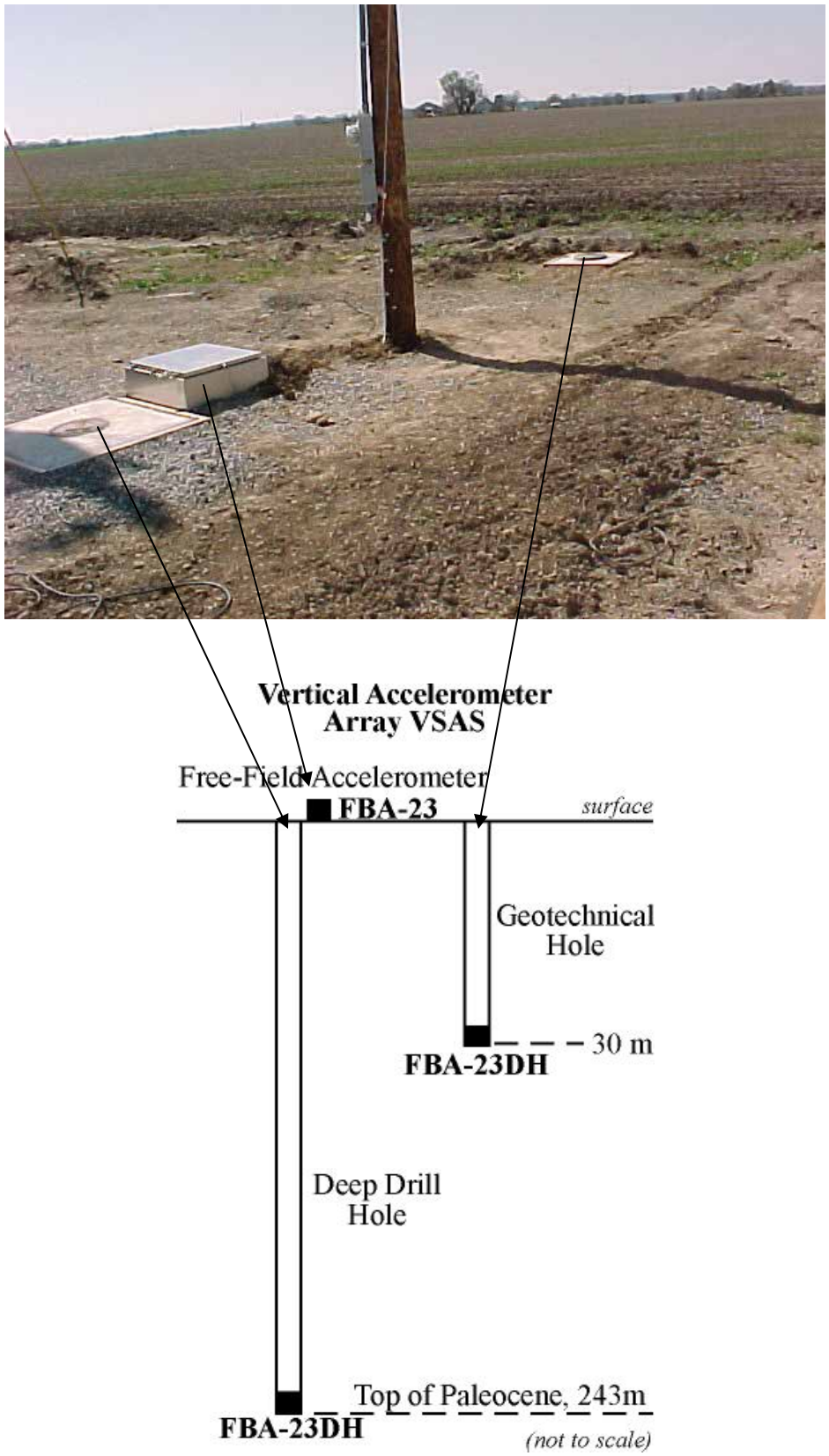

Figure 3. Geometry of the vertical accelerometer array, VSAS.

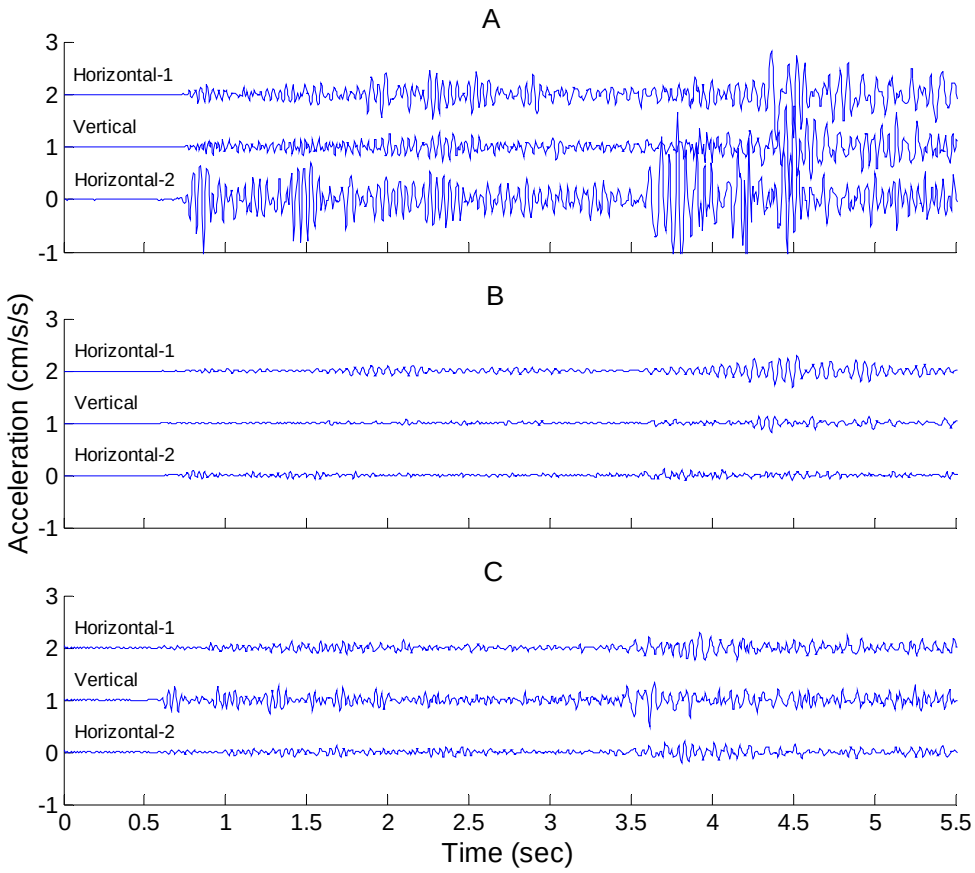

Figure 4. Recordings from the October 21, 2004 earthquake (Md2.5) at the vertical strong motion array, VSAS. (A) – surface, (B) – 30 m deep, (C) – 260 m deep.