

USING HORIZONTAL TO VERTICAL SPECTRAL RATIO (HVSr) TECHNIQUE TO MAP BEDROCK TOPOGRAPHY, KALAMAZOO COUNTY, MI

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The Horizontal to Vertical Spectral Ratio (HVSr) technique was used to map bedrock topography in the Portage and Schoolcraft NW 7.5-minute quadrangles, Kalamazoo County, MI. The study area is dominated by glacial landforms and deposits due to multiple advances and retreats of the Laurentide Ice Sheet (LIS).

The objective for this study was to locate any tunnel valleys hidden in this area. Tunnel valleys are erosional features formed by subglacial meltwater, which can sometimes incise down into bedrock. Some can be identified by linear surface depressions. Aquifers may also be located within these features, making tunnel valleys valuable water resources. The HVSr method measures the ratio of horizontal to vertical ground motion over a wide range of frequencies, excited by ambient seismic noise, resulting in a peak at the resonance frequency, which is used to determine the sediment thickness. Recordings were taken at 308 locations using a three-component Tromino Zero 3G seismometer. Sediment thicknesses were calculated using a calibration curve empirically derived from the relationship between sediment thickness and resonance frequency at 13 control wells. This relationship is given by the power law regression equation $Z = af_0^b$, where the constants a and b were determined to be 99.909 and -1.393, respectively. Results of this investigation reveal bedrock relief of 370 ft (112 m), including bedrock valleys in both quadrangles. Within the Schoolcraft NW quad, a bedrock valley with sharp relief is located under a linear trend of surface depressions and lakes, oriented parallel to the direction of ice flow from the Saginaw Lobe of the LIS (NE-SW).

In the Portage quad, however, a bedrock valley is found to be oriented NW-SE, perpendicular to Saginaw Lobe flow direction. The origin of this valley is unknown, but could be a remnant of pre-glacial terrain.