Miller, R. D., 2012, Near-surface seismic: More than a problem of scale [Abs.]: Abstracts of Lectures and Posters, GeoHannover 2012, October 1-3, p. 40.

Over the last 30 years, various seismic techniques have been successfully used to unravel some of the most intriguing and challenging near-surface problems faced by geologists, hydrologists, and engineers. In general, geophysicists define the near-surface as the upper few hundred meters of the Earth's surface. With the unique behavior and wavefield characteristics commonly observed on seismograms at time-depths as great as 1 km, I define the upper 1 km as near-surface for this discussion. Within this upper 1 km of the Earth's crust, many assumptions central to conventional exploration approaches are invalid. Adapting conventional seismic techniques to near-surface applications requires more than simple scaling to accurately and confidently image or characterize the shallow subsurface.

It seems intuitive that considerations, concepts, and workflows for the seismic wavefield should scale consistent with depth; however, making that assumption has led some to incorrectly conclude that inherent limitations of the seismic-reflection method make it unreliable at shallow depths and associated higher frequencies. High-frequency near-surface applications of the method do have some inherent limitations, but they are related to resolution. Resolution limitations stem from both the Earth's preferential attenuation of higher frequencies and its relatively rapid changes in physical properties, both vertically and horizontally, in the near-surface. In this talk, I present key aspects of both acquisition and processing, focusing on differences between the approaches and the most important considerations that distinguish high-resolution from conventional imaging.

The bane of both conventional and near-surface seismic-reflection surveying is surface waves. Over the last decade, surface waves have transformed from noise to signal for many near-surface applications. This evolution has allowed the entire seismic wavefield to become signal for near-surface practitioners. My presentation includes examples of enhancement techniques that have been and are being tailored to each wave type, providing better and more redundant characterization for an ever-increasing range of near-surface settings.

Seismic wavefield characteristics uniquely associated with the near surface include an extremely large velocity gradient, a high percentage of dispersive energy within the optimum recording window, high attenuation coefficients, lateral heterogeneity of physical properties, and minimal modal and wave separation. This talk will highlight some of the most troublesome problems and the associated solutions developed to accurately interrogate the near surface with seismic methods.