

Geophysical prospecting for geo-environmental applications.

G. Cassiani

Dipartimento di Geoscienze - Università degli Studi di Padova

The characterization of the shallow subsurface for environmental applications is a manifold challenge, as the specific subsoil characteristics we seek depend, obviously, on the relevant problem to be solved. Among the most common challenges are (a) the identification of hydraulic properties, (b) the identification of mechanical properties, and (c) the detection of contaminants. For instance, understanding the shallow subsoil from a hydrological point of view requires that the key hydraulic parameters be identified together with the main forcing/boundary conditions. Geophysical methods can provide a key contribution in this direction, especially thanks to the use of techniques that are sensitive to the changing states of water in the system, and particularly (broad-sense) electromagnetic methods. The resulting discipline, named “hydro-geophysics” aims for a quantitative use of (geo)physical measurements to constrain and calibrate hydrological models. The conceptual scheme that underlies this technical integration calls for the joint use of geophysical and traditional hydrological data to provide quantitative data for the calibration of a predictive model, and then to identify its relevant key parameters. The advantage of using geophysical data in addition to traditional data is especially in spatial coverage, potentially three-dimensional, which geophysics can provide and that perfectly integrates with the more direct, but generally point-wise, information produced by traditional methods. From the geophysical data we can get, if the measurements are repeated over time, information on: (1) the geometrical structure and geology of the site, i.e. its static characteristics; and (2) environmental and hydrological dynamics of the site, i.e. time-varying characteristics. Analogously, geotechnical problems call for spatially extensive high resolution information on the soil and subsoil mechanical properties, and consequently suitable geophysical methods are those that have some links to those properties, with a preeminence of seismics. Here too resolution shall be suitable to tackle the challenge at hand and a full understanding of the problem is a pre-requisite to the survey design and interpretation. Even more challenging appear the situations where environmental issues are linked to the presence of contaminants, whose geochemical and physical properties need to be fully understood to guide the choice of exploration methods, and success is far from being always guaranteed. In general, the shallow subsurface is a very challenging realm for geophysical prospecting not only because of the high resolution needed, but even more because of the diversity of issues that need to be tackled and that requires the geophysicists to make an effort at understanding the practitioners’ true needs, and vice versa should encourage the practitioners to use geophysics more extensively and with more confidence.

Bio

Giorgio Cassiani is Professor in Applied Geophysics at the Department of Geosciences, University of Padua, Italy. Since October 2015 he is member of the Board of Directors of OGS – Istituto Nazionale di Oceanografia e Geofisica Sperimentale. He graduated in Mining Engineering from the University of Trieste in 1991, has been awarded a PhD in Applied Geophysics from the same university (1996), an M.Sc. (1995) and a Ph.D. (1997) in Civil and Environmental Engineering from Duke University, USA. He worked at OGS Trieste and at ENI-Agip in Milan as an Environmental Specialist. From 1999 to 2001 he was Lecturer in Contaminant Hydrogeology at Lancaster University, UK. From 2001 to 2006 he was lecturer in Applied Geophysics at the Department of Geological Sciences and Geotechnology at University of Milan-Bicocca, Italy. From 2006 on he has served as Associate and then Full Professor at the University of Padua. He has been Principal Investigator and Co-Investigator in a number of funded projects at the national level in Italy and the UK, and at the international level, including 5 EU projects of the 7th Framework Programme. He has authored over 80 scientific papers in international refereed journals and over 200 papers and talks for scientific conferences. His H index is 20.