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Hydrometry — Groundwater — Surface geophysical surveys for hydrogeological purposes

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National foreword

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Foreword

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The committee responsible for this document is ISO/TC 113, *Hydrometry*, Subcommittee SC 8, *Ground water*.

Introduction

Groundwater is available almost everywhere. Access to clean water is a human right and a basic requirement for economic development. The safest kind of water supply is the use of groundwater. However, its distribution is not uniform due to varying hydrogeological, topographical and climatic conditions. As a result, groundwater is not always available in the required quantity and/or quality, particularly in hard rock terrains where fractures and weathered zones are the primary conduits for groundwater storage and flow. Detailed knowledge on the extent, hydraulic properties, and vulnerability of groundwater reservoirs is necessary to enable a sustainable use of the resources. Therefore, collection of information on prospective groundwater zones, although costly, is essential. Geophysical methods are currently recognized as cost-effective techniques useful for collecting groundwater information. Measuring physical properties of the earth and their variation and then associating these properties with hydrogeological characteristics is the objective of groundwater geophysics.

Of the various geophysical techniques available today, the electrical resistivity method is probably most commonly used due to its relatively simple and economical field operation, its effective response to groundwater conditions and the relative ease with which interpretations can be made. This type of survey is occasionally supplemented by other techniques such as induced polarization, spontaneous potential, and Mise-a-la-Masse galvanic electrical techniques. Other geophysical methods in order of preference used for hydrogeological purpose are electromagnetic, seismic refraction, magnetic, gravity and seismic reflection surveys. More recently developed geophysical techniques include ground probing radar and nuclear magnetic resonance. Because surface geophysical surveys are carried out at the surface of the earth, the responses received from different precisional demarcations. Ambiguity exists in interpreted results and the effective application of these methods often depends on the skill and experience of the investigator, knowledge of local hydrogeological conditions, and the utility (and limitations) of the technique(s) themselves. The application of two or more geophysical techniques is a useful approach to reduce ambiguity. Integration of information from other disciplines, such as remote sensing, geologic mapping, hydrogeological characterization, chemical analysis of well water samples, etc., is also useful for interpreting geophysical field data.

Modern geophysical techniques are highly advanced in terms of instrumentation, field data acquisition, and interpretation. Field data are digitized to enhance the signal-to-noise ratio and computers are used to more accurately analyse and interpret the data. However, the present-day potential of geophysical techniques has probably not been fully realized, not only because such surveys can be expensive, but also because of the inadequate understanding of the application of relevant techniques in diverse hydrogeological conditions.

Hydrometry — Groundwater — Surface geophysical surveys for hydrogeological purposes

1 Scope

The application of geophysical methods is an evolving science that can address a variety of objectives in groundwater investigations. However, because the successful application of geophysical methods depends on the available technology, logistics, and expertise of the investigator, there can be no single set of field procedures or approaches prescribed for all cases. This Technical Report provides guidelines that are useful for conducting geophysical surveys for a variety of objectives (including environmental aspects), within the limits of modern-day instrumentation and interpretive techniques, are provided. The more commonly used field techniques and practices are described, with an emphasis on electrical resistivity, electromagnetic, and seismic refraction techniques as these are widely used in groundwater exploration. Theoretical aspects and details of interpretational procedures are referred to only in a general way. For full details, reference is intended to be made to specialized texts listed in the Bibliography.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
acoustic impedance
product of seismic velocity and density of a layer

2.2
anisotropy
variation in physical property with direction of measurement

2.3
apparent resistivity
ratio of measured voltage to input current multiplied by the *geometric factor* (2.16) for the electrode configuration

2.4
blind zone
layer having seismic velocity less than that in the layer overlying it

2.5
Bouguer correction
correction made in observed gravity data to account for the attraction (gravitational) of the rock between the datum and the plane of measurement

2.6
Bouguer anomaly
anomaly obtained after applying latitude, terrain, and elevation (free air and Bouguer) corrections to the observed gravity value and finally subtracting it from measured value at some particular station in the survey area

2.7
contact resistance
electrical resistance developed between an electrode planted in the ground and the ground material immediately surrounding it

