Cone Penetration Test

Discuss the purpose of engineering geological mapping and indicate which aspects should appear on an engineering geological map

Discuss the use of magnetic methods in engineering geological surveys

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CONE PENETRATION TESTING

Introduction

The cone penetration test is one of the most popular types of in-situ techniques for investigating soil profiles, unconsolidated materials, near surface sediments which provide continuous profiling of geostratigraphy and soil properties evaluation. The presentation will cover different test procedures, test equipments, interpretation and application of the results obtained from the CPT.

Testing equipments

- Cone penetrometer
- Electrodes
- Hollow hydraulic pushing rods
- Cable or transmission device
- Depth recorder
- Data acquisition unit

Figure : Cone Penetration Test (CPT) equipment used at Krauthausen test site: 1. Cone penetrometer, 2. three electrodes, 3. hollow push rods (Tillmann *at el.* 2008).

Pushing equipments

On land

Over water

Testing procedures

- Pre-drilling
- Verticality
- Reference Measurements
- Rate of Penetration
- Interval of readings
- Dissipation Tests
- Calibration and Maintenance
- Pore water effects

Types of cone

- Mechanical cone
- Electric cone
- The piezocone
- The seismic cone

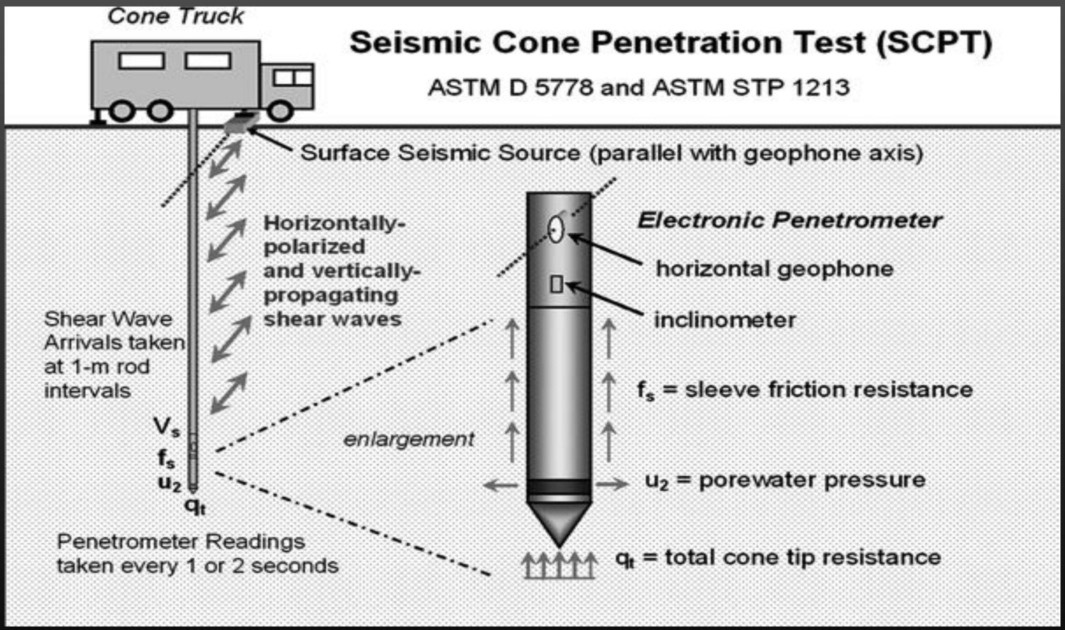


Figure: Setup and procedure for pseudo-interval seismic cone penetration testing (SCPT) (Mayne 2007).

Results Interpretation

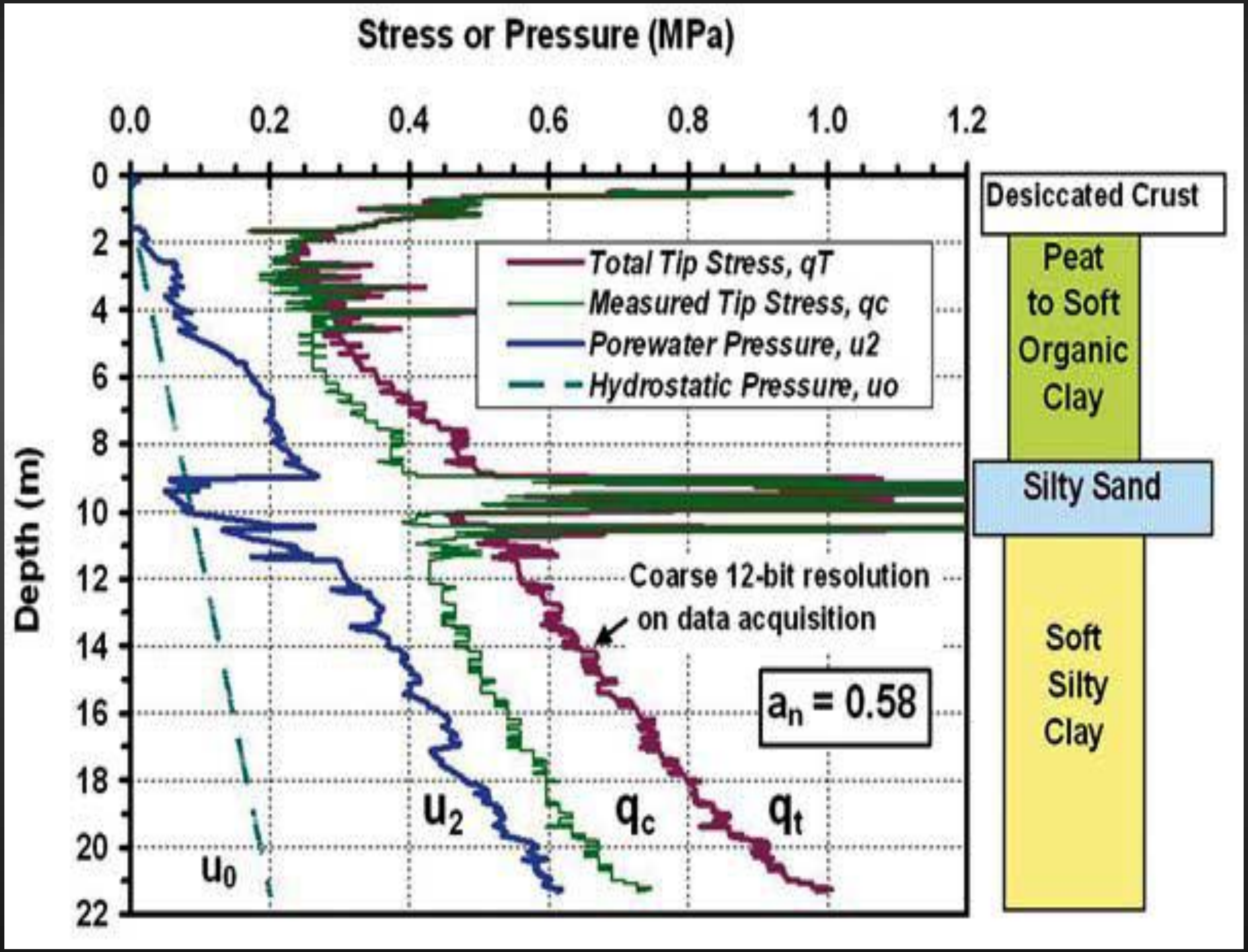


Figure: Example CPTu sounding showing uncorrected and corrected cone tip resistances (Mayne 2007).

Discuss the purpose of engineering geological mapping and indicate which aspects should appear on an engineering geological map

Engineering geological map

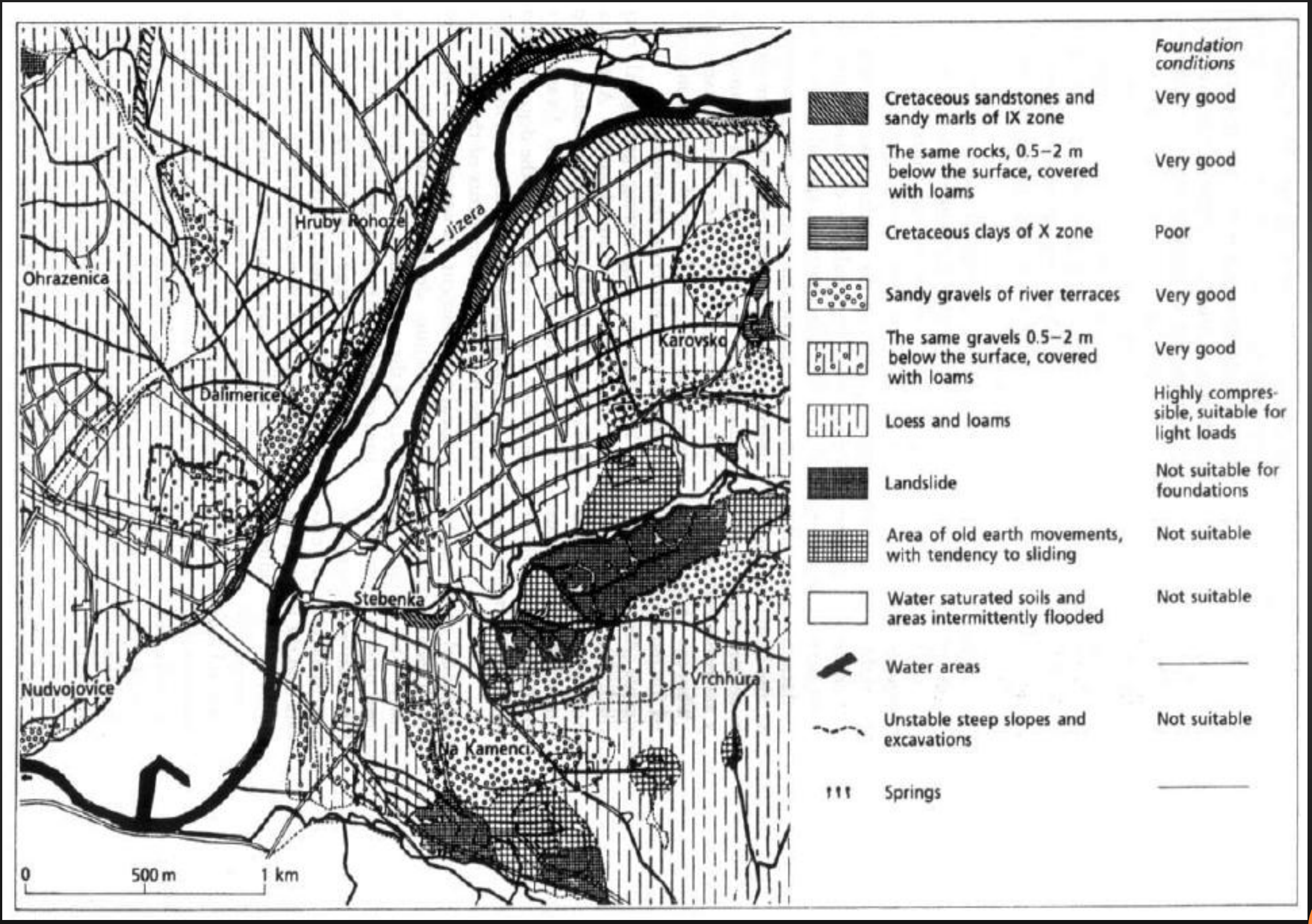


Figure: Engineering geological map of Turnov (Bell 1998).

Aspects on engineering geological maps

Foundation areas and excavations

•Borehole and outcrops
•Geological boundaries and discontinuities

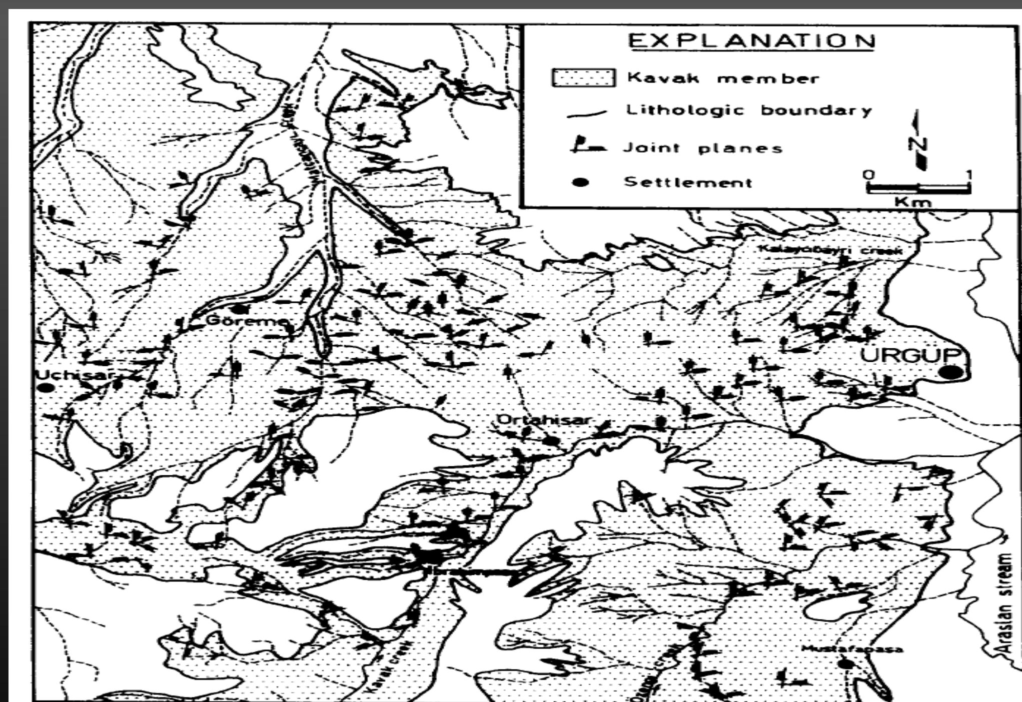


Figure: Map showing the distribution of joints in the Cappadocian tuff (Topal and Doyuran 1997).

Aspects on engineering geological maps

Expansive soils

- Highly expansive, low expansive or non-expansive soils

Figure: Distribution of potentially expansive materials in the United States(Unknown Authors 1988)

Deposited soils

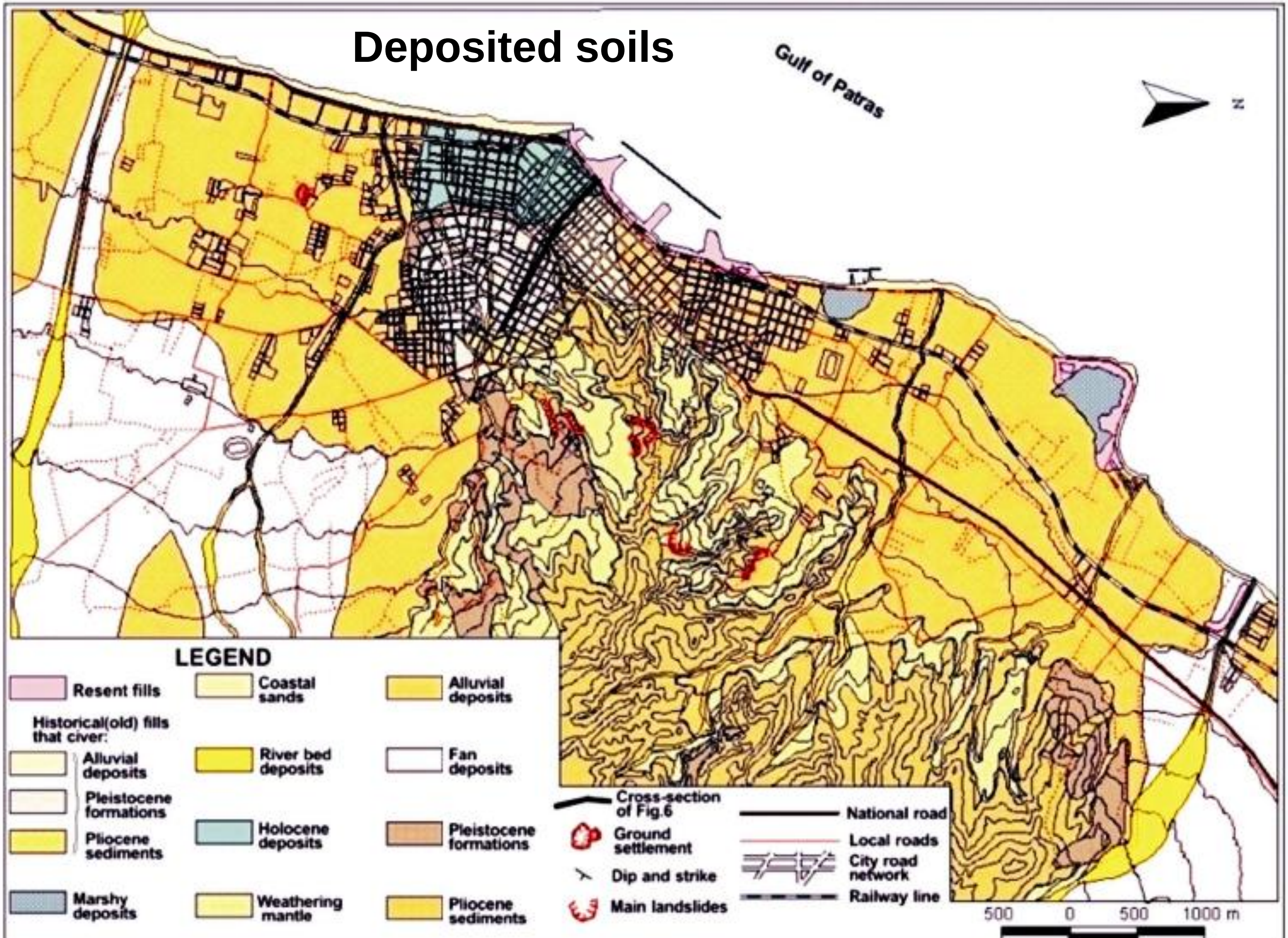


Figure: The engineering geological map of Patras city metropolitan area (Rozos *et al.* 2006)

Aspects on engineering geological maps

Residual soils

- Structure of the soil, engineering properties of residual soils

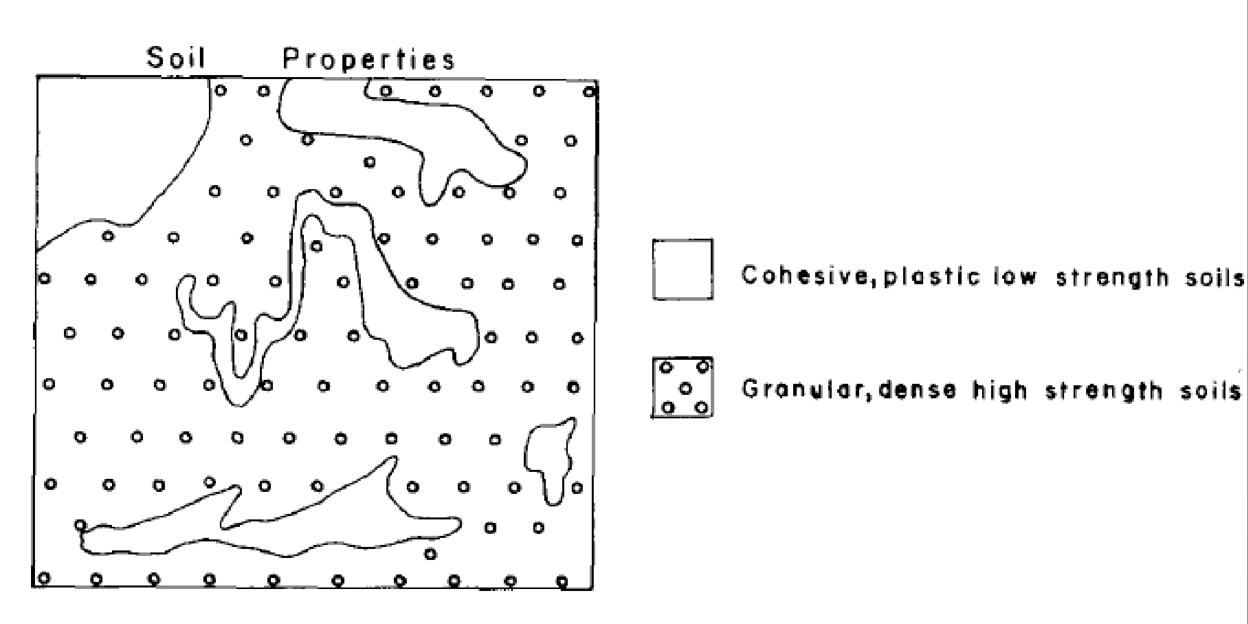


Figure: Idealized example of engineering geological mapping of residual soils. (Malomo *et al.* 1983)

Aspects on engineering geological maps

Hazard maps

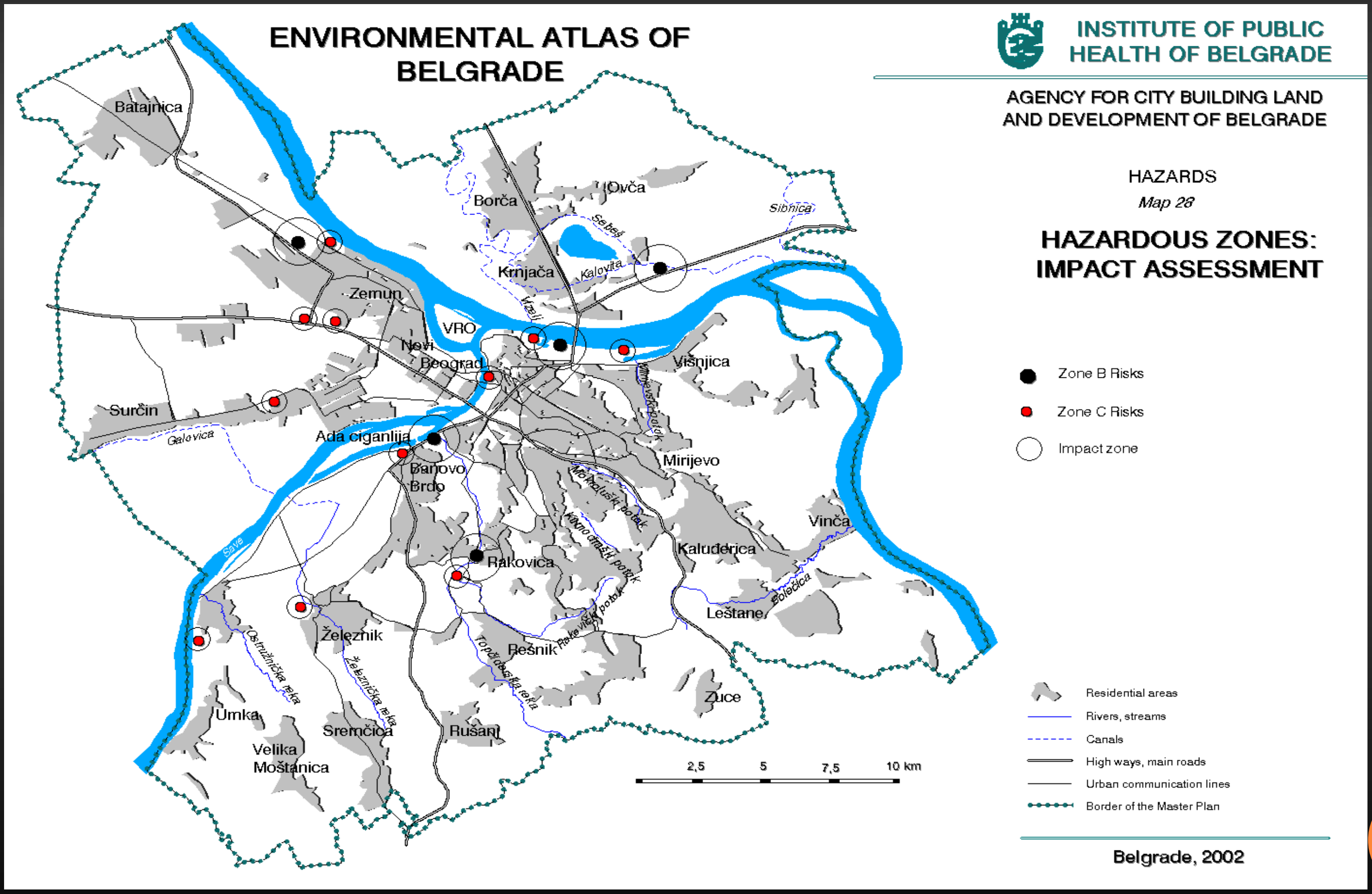
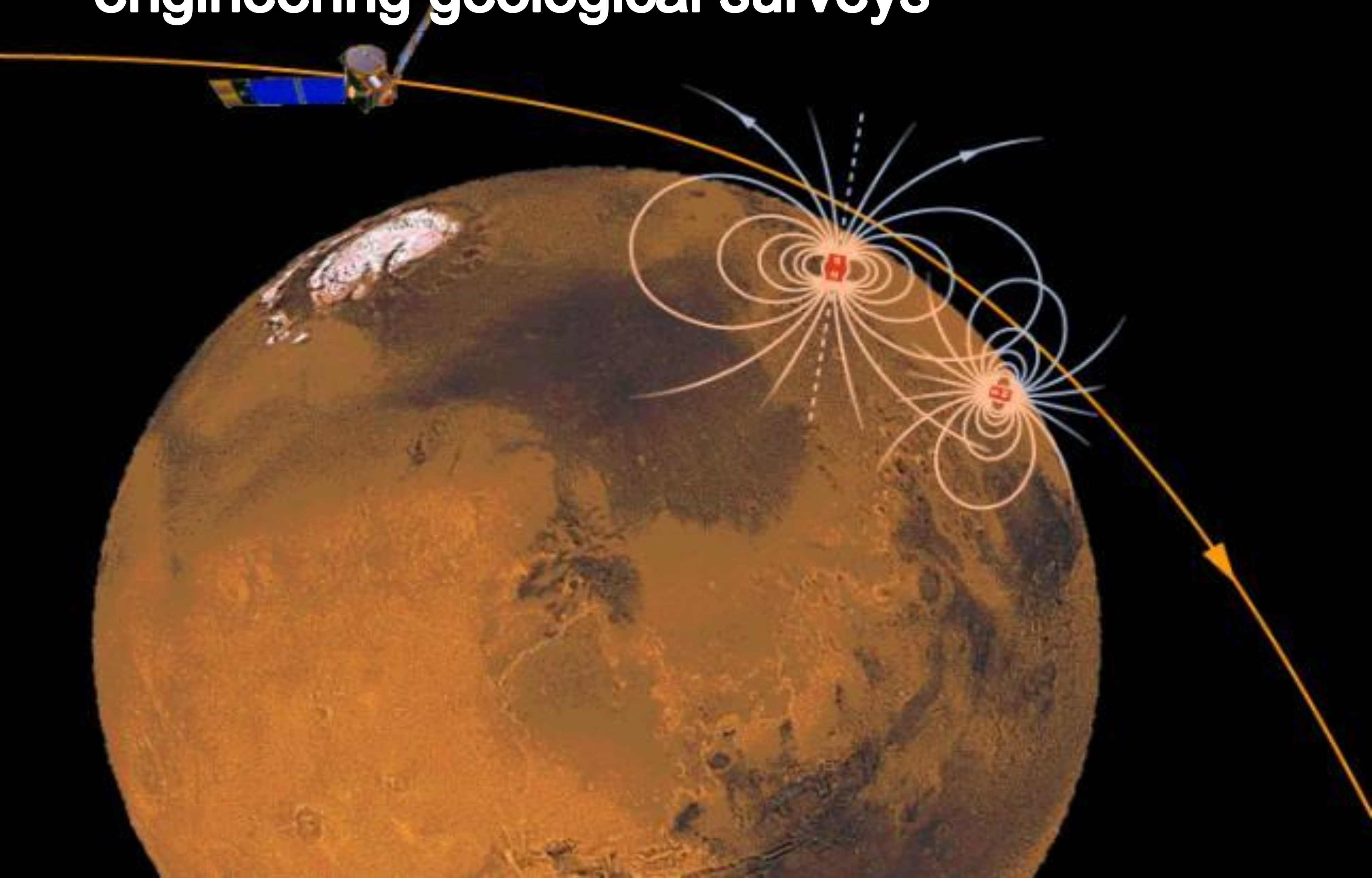


Figure: shows a hazard map (Institution of public health of Belgrade 2002).

Discuss the use of magnetic methods in engineering geological surveys



Magnetic properties

Susceptibility

Magnetic susceptibility is the degree to which rocks, minerals, ores or a certain body is magnetized (Clayton *et al.*1995).

Remanence

Remanence magnetism is the residual magnetism or natural remanence magnetization which forms part of net magnetization in an object (Telford *et al.* 1990).

Field operation magnetic survey in engineering geology

Airborne Magnetic Surveys

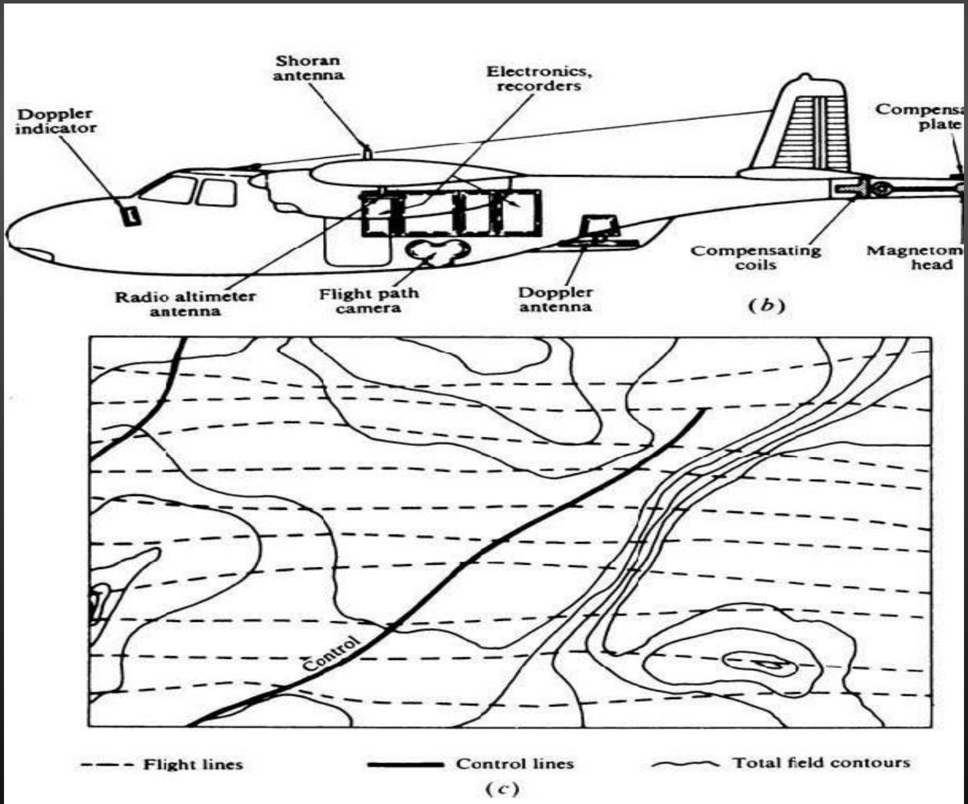


Figure: airborne magnetic. (b) Magnetometer in a tail mounting. (c) Flight pattern and magnetic map (Telford et al. 1990).

Field operation magnetic survey in engineering geology

Shipborne Magnetic Surveys

- Shipborne surveys can be applied in large-scale oceanographic surveys, petroleum search and in plate tectonics (Telford et al. 1990).

Ground Magnetic Surveys

- Commonly used for mapping and locating object (Hinze 1990).

Magnetic Instruments

Proton precession magnetometer

- Is an instrument designed to give direct reading of the field strength by use of the hydrogen nucleus (proton) (Griffiths and King 1981) and (Milsom 2003).

High sensitivity (alkali vapour) magnetometers

- Is a type of magnetic instrument with high sensitivity and commonly used for airborne observation of the total magnetic field (Hinze 1990).

Fluxgate Magnetometer

- The fluxgate magnetometer is a continuous reading instrument which measures the change in the earth's magnetic field (Kearey *et al.* 2002).

Gradiometer

- Magnetometer in which the spacing between the sensors is fixed and small with respect to a magnetic body under measurements (Kearey *et al.* 2002).

Application of magnetic methods in engineering geological survey

	Gravity	Magnetics
• Mapping subsurface voids	X	x
• Mapping bedrock topography	X	x
• Mapping steeply dipping geologic contacts	x	X
• Mapping regions of potential stress amplification (e.g. plutons and fault zone irregularities)	X	X
• Mapping potential zones of weakness (e.g. paleorifts, sutures, and faults)	X	X
• Mapping landfills	X	X
• Mapping archaeological sites (buried ferromagnetic objects, fire beds, burials, etc.)	—	X
• Locating buried well casings	—	X
• Locating buried drums, pipelines, and other ferromagnetic objects	—	X
• Locating coal burns	—	X
• Determining density (water saturation, porosity) of topographic feature	X	—
• Mapping groundwater cones of depression	x	—
• Determining volume of organic material in filled-in lakes	x	—
• Determining groundwater volume in basins	x	—
• Locating underwater ferromagnetic objects	—	X
• Locating sand and gravel deposits that contain heavy minerals (including magnetite)	—	X

Table: Potential applications of gravity and magnetic methods in engineering and environmental studies (x-major; x-minor) (Hinze 1990).

Conclusion

The cone penetration test is one of the most popular types of in-situ techniques for investigating soil profiles unconsolidated materials, near surface sediments which provide continuous profiling of geostratigraphy and soil properties evaluation and to survey the subsoil in detail by logging various physical parameters in the soil during and after soil penetration to the ground.

The purpose of engineering geological mapping is to provide detailed information on different engineering geological conditions and features such as the grade of weathering, joint patterns, mass permeability, foundation conditions, soil types, tunnels, mines, excavation.

The use of magnetic methods in engineering geological survey is mainly in mapping and locating engineering geological features.

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