



UNIVERSITI PUTRA MALAYSIA

***DELINEATION OF KARST TERRAIN
USING RESISTIVITY METHOD***

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**DELINEATION OF KARST TERRAIN
USING RESISTIVITY METHOD**

By

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DELINEATION OF KARST TERRAIN USING RESISTIVITY METHOD

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ZEINAB BAKHSHIPOUR

March 2011

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Faculty: Faculty of Engineering

This thesis describes the application of the Electrical Resistivity (ER) method in delineation subsurface of structures and cavity carried out in Kuala Lumpur Limestone within Batu Cave area, Selangor Darul Ehsan, Malaysia. The Kuala Lumpur limestone is well known for its highly erratic karst features. ER methods have proven to be efficacious in many studies involving environmental and engineering problems, and have been used in order to locate and delineate subsurface features and estimate the physical properties associated with the soil. In fact the major advantage of the ER method is that the soundings can be performed in a relatively short time and in a confined space. ER surveys can map high conductivity anomalies over filled sinkholes and soil pipes that penetrate the unconsolidated cover. Inverted ER sections made over these anomalies can depict filled sinkholes, fractures and cavities as conductive zone over deeply weathered bedrock.

Wenner electrode configuration was employed for the field survey which was carried out for seventeen profiles to provide continuous coverage. The ER profiles (1520m in total length) were measured using a Wenner electrode configuration with 2m spacing. Color-modulated sections of resistivity versus depth were plotted for all lines, giving an approximate image of the subsurface structure. The field survey was accompanied by laboratory work. The resistivity of rock, soil and water samples taken from the field was determined in the laboratory and resistivity formation factors were obtained. The relationship between resistivity and formation factors for all samples was established.

The porosity of the each sample was also calculated and a relationship between the porosity and formation factor was established. The established relationship was applied to the data obtained in the field in order to calculate the porosity values of the formation present within the exploration area. The porosity values were plotted and contoured. Depth to the bedrock for each line was obtained from the electrical resistivity in the field work. A 2-dimensional (2D) and 3-dimensional (3D) representation of the subsurface topography of the area was prepared using commercial computer software. The use of the software also enabled visualization of the subsurface features of the limestone investigated in the present work.

Abstrak tesis ini dikemukakan kepada Senat Universiti Putra Malaysia untuk memenuhi keperluan ijazah Master Sains

**PENANDAAN KAWASAN KARST MENGGUNAKAN KAEDAH
KERINTANGAN ELEKTRIK**

Oleh

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Tesis ini menerangkan tentang kaedah aplikasi Resistiviti Elektrikal (RE) di dalam eksplorasi dan penyiasatan permukaan kaviti pada batuan batu kapur di Batu Caves, Selangor Darul Ehsan, Malaysia. Batuan Batu Kapur Kuala Lumpur terkenal dengan permukaan “karst” yang mempunyai ciri-ciri yang sangat unik dan beralun. Kaedah RE telah terbukti sangat efektif di dalam menyelesaikan masalah dalam kajian alam sekitar dan kejuruteraan. Kaedah ini telah digunakan untuk menentukan kedudukan dan ciri-ciri permukaan “karst” dan menganggar kekuatan fizikal yang berkaitan dengan tanah. Kelebihan utama kaedah RE adalah kebolehnya untuk mendapatkan data “sounding” pada jangkamasa yang singkat dan tempat yang sempit. Kaedah “survei RE” boleh memeta anomali konduktiviti pada “lubang benam” dan paip tanah yang boleh ditembusi dengan kadar yang tinggi. Seksyen “Inverted RE” yang dibuat daripada anomali ini

dapat mengesan “lubang benam”, retakan dan kaviti yang terletak di atas lapisan batuan terluluhawa kerana permukaan tersebut adalah zon konduktif.

Konfigurasi elektrod Wenner telah digunakan dalam penyiasatan tapak dalam kajian ini untuk mendapatkan data bagi 17 profil tanah supaya permukaan tanah dapat dianggar secara keseluruhannya. Profil RE (jumlah panjang sebanyak 1520 m) telah diukur dengan menggunakan konfigurasi elektrod Wenner dengan jarak selang 2 m. Seksyen modul-berwarna yang menunjukkan data resistiviti berlawanan dengan kedalaman tanah telah di plot untuk semua garisan, dengan memberikan anggaran imej struktur permukaan tanah. Penyiasatan tapak ini telah dilakukan bersama dengan kajian makmal. Resistiviti untuk sampel batu, tanah dan air yang diambil daripada kawasan kajian telah ditentukan di makmal dan faktor formasi resistiviti telah dihasilkan. Hubungan resistiviti dan faktor formasi untuk semua sampel telah ditentukan.

Kadar Keronggaan untuk setiap sampel telah dikira dan hubungan di antara Keronggaan dan faktor formasi telah ditentukan. Hubungan telah digunapakai dalam analisis data yang diambil dari kawasan kajian supaya nilai “Keronggaan” pada formasi yang ada pada kawasan yang dikaji dapat dikira. Nilai Keronggaan ini telah diplot dan dikontur. Kedalaman tanah hingga ke permukaan batu untuk setiap garisan telah diperolehi dengan kaedah RE di kawasan tapak. Analisis permukaan topografi kawasan kajian telah disediakan dalam bentuk analisis 2D dan 3D dengan menggunakan perisian komputer. Kegunaan perisian itu juga membolehkan visualisasi secara jelas struktur subpermukaan batu kepur yang telah dijalankan dalam kajian ini.

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I certify that a Thesis Examination Committee has met on 11-3-2011 of viva voce to conduct the final examination of Zeinab Bakhshipour on her thesis entitled “Delineation of Karst Terrain by Using Resistivity Method” in accordance with Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citation which have been duly acknowledged. I also declare that it has not been previously and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or other institution.



ZEINAB BAKHSHIPOUR

Date: 11-March-2011

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