THE 1:5000 URBAN GEOLOGICAL MAP OF CATALONIA: MAPPING THE SUBSURFACE GEOLOGY OF THE URBAN AREAS IN DETAIL.

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INTRODUCTION

The Geologic Institute of (IGC) runs an urban geologic mapping project, at 1:5000 scale, to fill the gap of information on ground and underground geology of the major towns and cities of Catalonia.

The aim of the project is to provide accurate geologic information for urban planning, major city works and urban environmental issues.

The zones to map include the urban areas of county capitals and towns of more than 10000 inhabitants. The project commenced in 2007 and is planned to be finished by 2022. The urban zones of 131 towns will be surveyed for this project, totalizing an area of about 2109 km^2 to be mapped in 15 years (Fig. 1). According to the 2008 census, the 82% of the population of Catalonia lives in the areas to be mapped in this project

At present, in the area of Barcelona, two preliminary maps are already done, and works in the cities of Barcelona, Tarragona, Lleida and Girona are in progress.

Figure 1 – Map of Catalonia showing the urban areas to be mapped (coloured areas). Boxes depict ongoing urban mapping around province capitals, the grid is the 1:5000 topographic sheet distribution. Solid lines are the county borders.

The geological maps of this series will be published according to the 1:5000 topographic grid of Catalonia. A database with geological, geotechnical and geochemical data is currently under construction.

MAP CONTENTS

The 1:5000 scale urban geological map of Catalonia has to fulfill the following items:

- Outcrop inventory.
- Borehole inventory.
- Geotechnical properties of soils and rocks.
- Map the Man-made infilling materials map
- Subsurface bedrock geology map.
- Quaternary map.
- Thickness of Quaternary sediments and anthropic infilling.
- Environmental geochemistry of urban soils.

DATA GATHERING

In urban areas, acquiring geological data is a difficult issue. Former cropping out zones do no longer exist or are very scarce (Fig. 2). In this context, direct geological observation is very unlikely and can only be performed in few available outcrops and in borehole core collections. However, valuable information may come from historical geological maps, old aerial photographs, geotechnical reports and digital elevation models (DEMs).

Analyzing historical geological maps and old aerial photographs taken before the urban sprawl, provide relevant guidelines about the geology of urban areas now concealed by a layer of concrete and asphalt.

Geotechnical reports from city works are, with no doubt, the most valuable source of data for urban subsurface geology. Big cities are plenty of geotechnical studies which require a large number of boreholes and geotechnical tests to be achieved. The thickness of the geological units and the mechanical properties of rocks and soils underneath the urban network can be gathered from these reports.

Hillshade images derived from DEMs of old aerial photographs may depict geological or geomorphological elements that are either, hidden or destroyed by the urban sprawl. Man-made

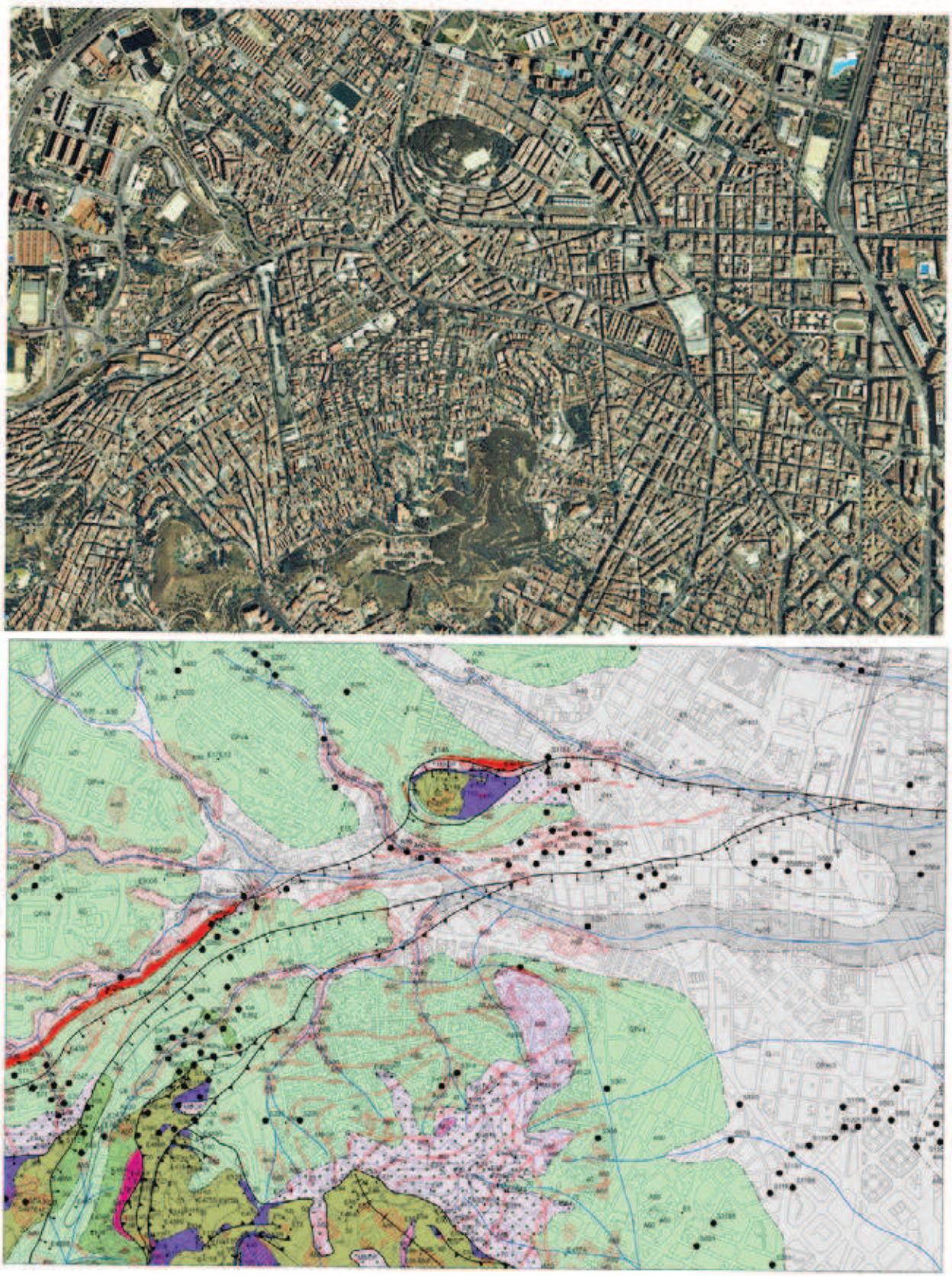

Figure 2 – Orthophotoimage and the corresponding 1:5000 urban geological map (sheet 289-124, Barcelona-Horta). Most of the mapped area is blanketed by the urban network. Cropping out zones are restricted to two spots in the upper and lower central parts of the sheet. The black dots in the map are the boreholes used for the underground geological reconstruction.

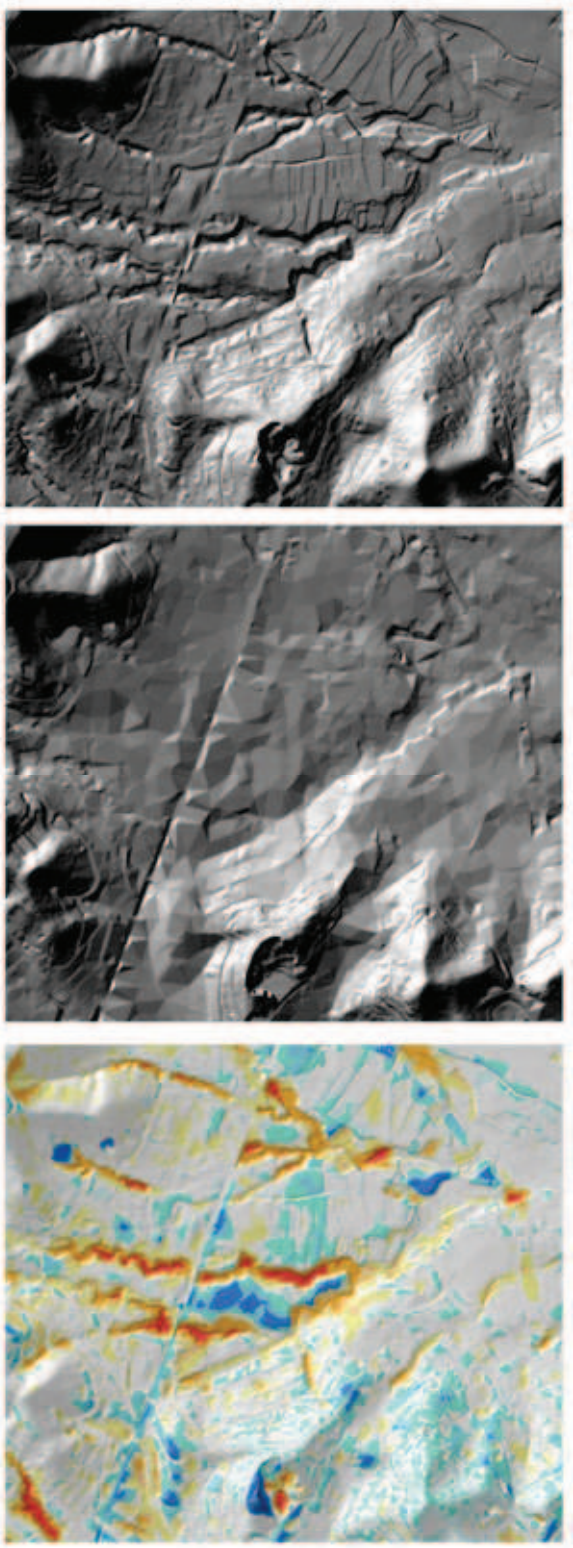

Figure 3 –. The upper image is a hillshade depicting the landscape that existed in 1961. A deeply incised stream network can be observed. The image of the middle is a hillshade derived from a 2008 DEM, in this image the former stream network does not exists anymore. The lower image has been obtained by subtracting the elevation data of the two DEMs (1961 and 2008). Red and orange colours point out man-made infillings, mainly localized in the former streams.

infilled zones can be portrayed by the subtraction of two DEMs realized by means of different aerial photograph flights (Fig. 3).

BENEFITS TO SOCIETY

The knowledge of the subsurface geology of urban areas is essential for planning and designing major underground works involving tunneling. For instance, in the city of Barcelona there are 47 km of underground railway currently under construction and, in the next 6 years 64 km of deep tunnels will be drilled.

Mapping man-made infilling is particularly important for urban planning. In most cities, filling temporary streams with waste materials, has been a common practice to gain terrain for housing. Which may result in subsidence problems and unexpected floods in built areas.

Geochemical mapping of hazardous elements from urban soils is critical to prevent health problems. Large parts of the cities have been built on former industrial areas. Thus, a high part of the population is exposed to the effects of contaminated soils.

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