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Geological assessing of urban environments with a systematic mapping survey: The 1:5000 urban geological map of Catalonia

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The ground features of urban areas and the geologic processes that operate on them are, in general, strongly altered from their natural original condition as a result of anthropogenic activities. Assessing the stability of the ground, the flooding areas, and, the health risk as a consequence of soil pollution, are, among others, fundamental topics of urban areas that require a better understanding. The development of systematic urban geological mapping projects provides valuable resources to address these issues.
Since 2007, the Institut Geologic de Catalunya (IGC) runs an urban geological mapping project, to provide accurate geologic information of county capitals and towns of more than 10000 inhabitants of Catalonia. The urban zones of 131 towns will be surveyed for this project, totalizing an area of about 2200 km2 to be mapped in 15 years. According to the 2008 census, the 82 % of the population of Catalonia (7.242.458 inhabitants) lives in the areas to be mapped in this project.
The mapping project integrates in a GIS environment the following subjects:
- Data from pre-existing geotechnical reports, historical geological and topographical maps and, from historical aerial photographs.
- Data from available borehole databases.
- Geological characterization of outcrops inside the urban network and neighbouring areas.
- Geological, chemical and physical characterisation of representative rocks, sediments and soils.
- Ortophotographs (0.5 m pixel size) and digital elevation models (5 meter grid size) made from historical aerial photographs, to depict land use changes, artificial deposits and geomorphological elements that are either hidden or destroyed by urban sprawl.
- Detailed geological mapping of quaternary sediments, subsurface bedrock and artificial deposits.
- Data from subsurface prospection in areas with insufficient or confuse data.
- 3D modelling of the main geological surfaces such as the top of the pre-quaternary basement.
All the gathered data is harmonised and stored it in a database. The analysis of the database allows to compile and print the 1:5000 scale urban geological map according to the 1:5000 topographic grid of Catalonia. The map is composed by a principal map, geologic cross sections and several complementary maps, charts and tables.
Regardless of the geological map units, the principal map also includes the main artificial deposits (such as infilled river valleys and road embankments), very recent or current superficial deposits, contours of outcropping areas, structural data and other relevant information gathered in stations, sampling points, boreholes indicating the thickness of artificial deposits and the depth of the pre-quaternary basement, contour lines of the top of the pre-quaternary basement surface and, water level data.
The complementary maps and charts may change depending on the gathered data, the geological features of the area and the urban typology. However, the most representative complementary maps that includes the printed urban map are the quaternary subsurface bedrock map and the isopach map of thickness of quaternary and anthropogenic deposits. The map also includes charts and tables of relevant physical and chemical parameters of the geological materials, harmonised downhole lithological columns from selected boreholes, and, photographs and figures illustrating the geology of the mapped area and how urbanisation has changed the natural environment.
The object of this systematic urban mapping survey is to provide a robust database to be used in targeted studies related to urban planning, geoengineering works, soil pollution and other important environmental issues that society should deal in the future.