THE EARTH'S SKIN IN CATALONIA. THE SOIL MAPPING PROGRAMMES IN THE INSTITUT GEOLÒGIC OF CATALUNYA.

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INTRODUCTION

The "Institut Geològic de Catalunya" (IGC) was established in December 2005. Among many other functions it was planned that the IGC would be responsible to carry out different activities directly related to the knowledge of the soils in Catalonia. In particular, the IGC must give technical advise to the Government of Catalonia in this field.

In order to perform this task, the IGC has to execute, in collaboration with other organizations and/or private companies when needed, different works related to soil mapping, land evaluation and soil protection

It is in this context that the IGC has decided to initiate a soil mapping project, as the best strategy to generate, store, process and spread the soils information of Catalonia.

The main aims of this project are:

- Soil mapping of Catalonia (scales 1:25.000 and 1:250.000)
- Integration of the soil data in the structure of the IGC databases
- Research (digital mapping, soil protection…)
- Popularization of soil information

THE SOIL MAPPING PROGRAMMES IN THE IGC

The soil mapping programmes in the IGC try, first of all, to carry out the soil map of Catalonia to the 1:25.000 scale.

This map is going to be made up of 304 maps (fig. 1), according to the official sheets of the topographical map.

In parallel, at the beginning of the program, it is also intended to obtain the soil map of Catalonia to the 1:250.000 scale. This product can be use as a guideline to predict and estimate the soil types that can appear on the different areas of Catalonia where soil information is not available so far. Furthermore the implementation of this map will enable to fit the production planning for the soil map to the 1:25.000 scale.

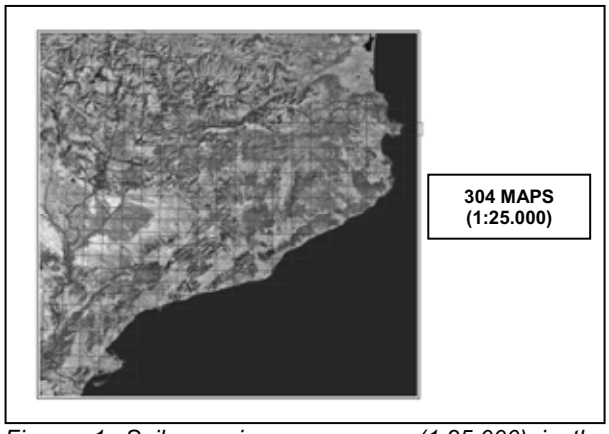

Figure. 1. Soil mapping programme (1:25.000) in the IGC (official sheets of the topographical map)

On the other hand, the IGC wants to participate in new projects and strategies related to earth sciences in general and to the soil science in particular, always involved in the policies of the European Community. In that respect the IGC is trying to be ready to give answers by establishing some memorandums of agreement with different entities and organizations related to these topics (Administration, Universities, Academies, private Companies).

THE STUDY AREA

Catalonia is a region located north-east of the Iberian Peninsula. It has a total area of 32.106,67 Km2 and a population of seven million. The climate is dry Mediterranean, with mild winters and hot summers. The mean altitude is 700 m above sea level, although it ranges between 3.404 m in the Pyrenees and sea level; this makes that 70% of the territory presents a slope steeper than 10%. This characteristic is directly related to land uses: forestry (70%), agriculture (29%), urban (6%) and others (5%).

From a physiographic point of view, Catalonia can be divided in three areas: the Pyrenees, the

Mediterranean system and the central depression. (Fig. 2)

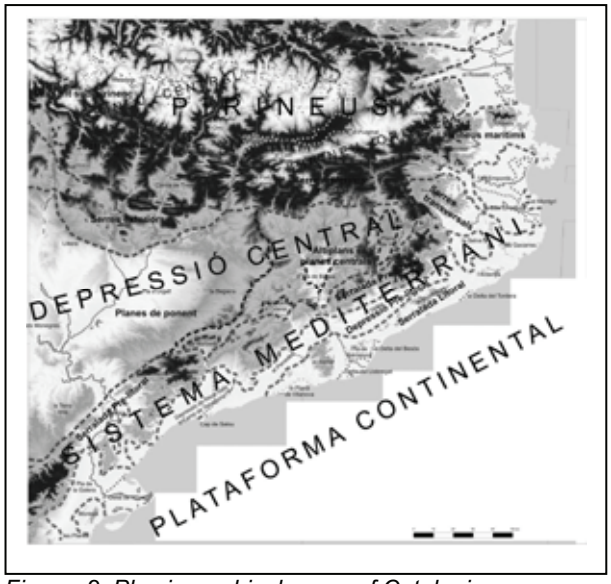

Figure .2. Physiographical areas of Catalonia

The Pyrenees are made up of a series of mountain chains ranging, in a parallel way, from west to east. They are characterized by high elevations, wild landscapes and dryness.

The Mediterranean system consists of two complex mountain chains ranging, in a parallel way, from north-east to south-west. They present a long a narrow valley in between. The mountains range from 1700 m in the inner chain to 500 m in the outer one. The valley is thickly populated and very rich from an agricultural point of view.

The central depression is formed by flat or almost flat areas in between the Pyrenees and the Mediterranean system. It presents young and soft parent materials where rivers have excavated big valleys and erosion basins.

METHODOLOGY

The 1:25.000 and 1:250.000 soil maps of Catalonia are going to be carried out by the IGC with the support of private companies. To that effect, the IGC has created a soil group that is going to perform the planning, the supervision and the acceptance of the different studies. Furthermore, the IGC has appointed a Correlator that is responsible for:

- Analyzing the schedule presented by the consultant at the beginning of the studies and to establish the frequency of the meetings.
- Checking the fieldwork of the consultants
- Take the minutes in the meetings where the different problems, solutions and agreements will be gathered, as well as ensuring their fulfilling.
- Recognizing, establishing and naming new soil types to keep up to day the soil catalogue
- Supervising the legends proposed by the consultant, correcting any inadequacy or ambiguity.
- Checking the quality of the final report, that must include a technical memory and the map, as well as the implementation of the database.

At present, roughly 25% of Catalonia has been mapped, to the 1:25.000 scale, by technicians of the Agricultural Department. These maps can be considered taxonomically and cartographically detailed, and have been carried out basically in agricultural areas. (Fig. 3)

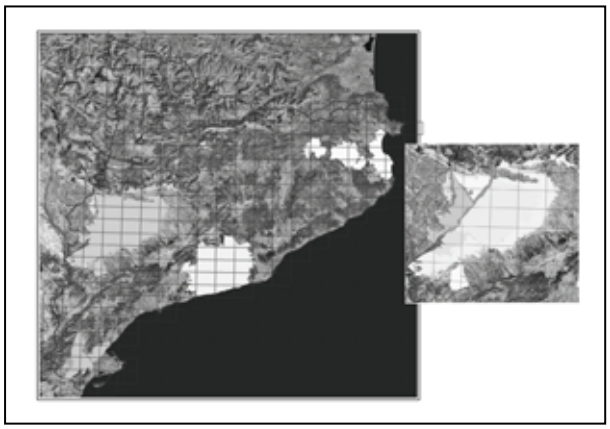

Figure 3. Soil map (scale 1:25.000) of Catalonia. Information contributed by the Department of Agriculture (1.984-2.007)

With the purpose of facilitate the mapping process to the external companies (gathering of background information and previous reports of the study areas, hiring of qualified technicians, asking for permission to dig the profiles…), it has been thought that the municipalities (946 in Catalonia) are the best work units when considering soil studies to the 1:25.000 scale, and that the "*comarques*" (41 in Catalonia) are the best when considering soil studies to the 1:250.000 scale. In this way, more companies, usually of small to middle size, can participate of the project because they can adapt their characteristics to the requirements of the programs.

TERMS OF REFERENCE AND OTHER TECHNICAL SPECIFICATIONS

The terms of reference are based on those established in Soil Survey Manual (SSS, 1.993). The nomenclature that is been used for soil description was gathered in the "*Sistema de información edafológica agronómica de España (SINEDARES)*"(CBSA, 1983), although it has been

modified and enriched in order to be adapted to this type of detailed and systematic cartography.

The soil maps to the 1:25.000 scale presents a site intensity of 0,5/cm2 of the final map (16/100 ha) , in agricultural lands, and 0,25/cm2 of the final map (8/100 ha), in forest areas. The rate of dug pits to other type of soil exposures (mini pits, augers, road cuts…) is 2:5 in agricultural lands and 2:10 in forest areas. These figures try to keep an appropriate and homogeneous quality for the maps.

As a general rule, the soil map of Catalonia applies a free survey methodology. The pits are distributed according to the aerial photographic interpretation, in representative areas. The coordinates of these positions are integrated in the geodatadatabase.

The pits are dug out, when possible, by mechanical ways and to a depth of 2 m, unless lithic or cemented horizons are found. They are filled trying to conserve the natural order of the different horizons, this is why the epidepon is separated from the rest of the soil material during the excavation.

Once the pit is prepared for description, some digital photographs must be taken of the surroundings, of the profile and of special features and characteristics that can be observed during the process. This photographs, properly identified and classified, will be an important part of the documentation required by the IGC.

Soil description and sampling must conform to the terms of reference established in the “Guidelines to elaborate the Soil Map of Catalonia”. These guidelines are based on those developed years ago by the DAR, and have been updated after the promotion of the mentioned memorandum of agreement DAR-IGC.

Sampling must take into account all horizons in the profile, although each sample is going to undergo and individual treatment. The samples, placed into plastic bags and perfectly identified, are sent to the laboratory where are going to be analyzed according to the Official Soil Analysis Methods of the Spanish Ministry of Agriculture. Although the contracted laboratories present all the international standards of quality, during the survey some samples are collected in order to proceed to additional quality controls. The IGC is going to prepare a soil bank with the purpose to store all the soil samples gathered during these surveys.

Soil information for the representative pedons is completed, when needed, with other chemical analyses. Furthermore some physical properties and characteristics or the soils (bulk density, hydraulic conductivity and infiltration) are also determined because they are the basis for most of the interpretations required by the map users.

The taxonomic unit for the soil map of Catalonia (scale 1:25.000) is the serie (Soil Taxonomy, 1.999) since it is considered the most interesting for detailed surveys. IGC and DAR are bringing the Soil Series Catalogue of Catalonia up to day. This catalogue is based on the one developed by the DAR in 1993 (Herrero et al., 1993). The correlation system is Soil Taxonomy System (SSS, 1.999), although all the series are also classified according the soil units of the World Reference Base (WRB, 2.006)

The basic map units are consociations of soil series, although complexes of soil series are also allowed if it is justified by the patterns of soils distribution. All the mapping units must be checked in the field.

The legend is organized taking into account the physiography and geomorphology of the area; the homogeneity of the map units (Consociations, complexes…), and the development and limitations of the soils. The different phases that appear in the map are also organized according to their limitations to the use.

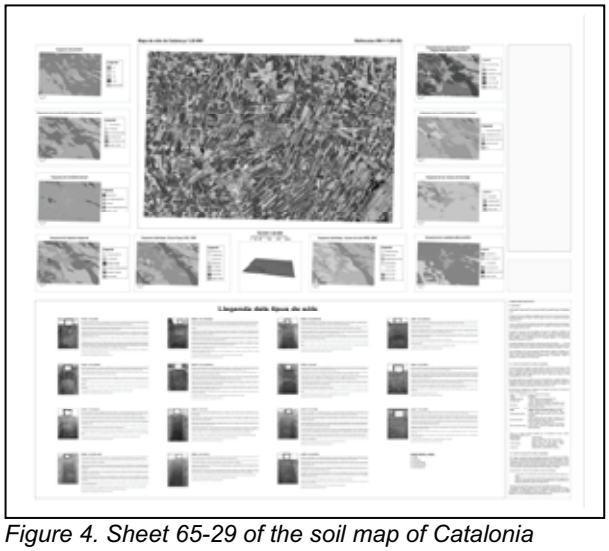

Figure 4. Sheet 65-29 of the soil map of Catalonia

All the information gathered and generated during the different soil surveys must be integrated in the IGC database. In this way, storage, processing, analysis, recovery and presentation of the information is enormously facilitated.

The thematic information is stored in a database (Microsoft ACCESS) developed by the

IGC. This database presents different tables containing information related to the soil profiles, analysis, soil exposures, legends…Geographical information (soil maps, pit sites, other soil exposures) are digitized as shapefiles (ESRI).

All the geographical information used as a reference (aerial photographs, topographic maps and ortophotos to different scales) belong to the "Institut Cartogràfic de Catalunya (ICC)".

In the near future, it is planned that all this information is going to be integrated in the general database of the IGC. In this way, access to this information on the internet is going to be faster and easier.

With regard to the Soil Map to the scale 1:250.000, it has been established a site intensity of 1/cm2 of the final map (1/625 ha), in agricultural lands, and of 0,5/cm2, in forest areas. The taxonomic unit is the sub-group (Soil Taxonomy, 1.999) since it is considered the most appropriate for this scale. The basic mapping units are the associations of sub-groups. The legend is organized taken into account the phisiography and geomorphology of the area and the development and limitations of the soils. All the information gathered and generated must be integrated in the IGC database.

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