2001 Annual Conference of the International Association for Mathematical Geology

Technical Program - Session I (Poster)
Building National and Regional Geologic Map Databases

A Joint European GIS Under Construction: The 1:5 Million International Geological Map of Europe and Adjacent Areas (IGME 5000)

Kristine Asch

Federal Institute for Natural Resources (BGR), Stilleweg 2, 30655 Hannover
phone : ++49 +511 643 3324; fax : ++49 +511 643 3782; e-mail : k.asch@bgr.de
internet: www.bgr.de/karten/IGME5000/

Abstract

A major European GIS project: the 1:5 Million International Geological Map of Europe and Adjacent Areas (IGME 5000) is being managed and implemented by the Federal Institute for Geosciences and Natural Resources (BGR). The project involves over 40 European and adjacent countries

The aims of the project are to develop a GIS underpinned by a geological data-base and a printed map providing up-to-date and consistent geological information. A CD-ROM will be produced with a subset of the GIS and the related data-base. While the main theme of the GIS is the pre-Quaternary geology of both the land and offshore areas of Europe, it is planned to include additional themes, such as Quaternary geology – a key factor influencing the natural landscape.

The project is dependent on the numerous contributions of the many countries. An extensive multinational project like the IGME 5000 requires meticulous preparation and establishment of standards and protocols in order to provide the essential structure and guidelines for the data compilation e.g. a common term dictionary for the database. In addition a standard topographic base map was an essential prerequisite. In many areas the IGME 5000 is establishing basic standards where none exist.

The final GIS will hold significantly more information than the previous printed maps could ever provide. It will also offer versatility, e.g. to retrieve and present for the whole of Europe, information on age, petrography and structural and metamorphic features.

Eventually the IGME 5000 will provide the essential foundation for pan-European applied geo-environmental thematic mapping.

Objectives

The following major objectives define the project:

- Display current status of Europe's geology.
- Display the off-shore geology for the first time (and ensure its consistency with on-shore).
- Clarify correlation of European geology, both on-shore and off-shore.
- Establish and intensify co-operation between national geological institutions.
- Encourage new research subjects.
- Provide with Europe-wide usable guidelines and procedures.
- Establish simple European geological standards.
- Develop a robust and executable model for comparable projects.
- Provide internet accessibility to the data

Co-operation with international participants and scientific advisors

Because the project involves so many European and adjacent countries, mobilising the respective national geological surveys was essential. They were required to contribute draft maps of the pre-Quaternary geology of their on- and off-shore areas and therefore required common technical guidance on procedures and provision of standards. Four years on 48 Geological Surveys of Europe, North Africa and Middle East are involved in the IGME 5000. In addition a group of scientific advisors was formed and supports the project with scientific expertise e.g. not only on the geology of the Mediterranean Sea or the Variscan belt, but also on paleogeographical reconstructions. The group mainly consists of academic experts and members of other international geoscience institutions.

Organising the co-operation of 48 nations and compiling their input also is a considerable information management task. This comprises data acquisition, meaning in this context motivating the numerous participants to contribute. Subsequent data harmonisation and generalisation and thus coping with different interpretations, approaches to generalisation and drawing quality from the many individual national geological institutions as they establish what they believe should be displayed of their geology on a Europe-wide map. The ultimate goal is the unification of all data to build a harmonious whole of these individual pieces of the European geology.

Common base and standards

The "Guidelines": Preliminary legend and technical guidance
In order that the geological draft map could be created by each participant for the area of their country, a preliminary map legend (containing a provisional classification of the geological units) was developed. This legend defines the contents of the map (and at the same time places necessary constraints on the contributing geologists). A number of partly hierarchically organised tables of age, petrography and metamorphism of the rock units make up this legend. More basic, but nonetheless critical, was the distribution of simple technical guidance notes for the preparation of the draft maps. Guidelines were designed (Asch, 1997) which introduced a scheme for the draft map preparation, defined specifications which the submitted draft should meet, advised upon the level of generalisation and additionally contained the preliminary legend described above. The guidelines may also be downloaded on the IGME 5000 web site.

Common topographic base map
Of fundamental importance is a common topographic base map. For the IGME 5000 project a common topographic base map not only controls the spatial referencing of the data but also needs to be suitable for printing. The map is now available digitally for all participants for free on the IGME 5000 website. All IGME 5000 contributors were asked to use this common topographic base map and to submit their contributions on it, identifying their geological units using an individually created, unique identification number which would be related to the general legend. The submission of the draft maps was and is preferred in analogue form to avoid potential software incompatibilities and also to avoid the need for digitising at the partner institutions.

Colour schemes and abbreviation codes
To display geological features on a map, in Europe, conventionally a colour scheme is used that is based on the colours of the spectrum for sedimentary rocks (see the IUGS stratigraphic chart, 2000). Also red tones are used conventionally for igneous rocks. The IGME 5000 follows this conventio(figue 1 a) so as to make the map readable to as many users as possible, even if they may not understand the language (English) of the map. However, in other continents such as North America or Australia, different colour scheme conventions are in use. To facilitate access for those users not familiar with the European convention, such options will be provided; this is possible because the IGME 5000 is digitally based. The

GIS will also allow the display of the rock units according to a lithological or stratigraphically oriented colour scheme. (Example: see Figures 1 a) and b)

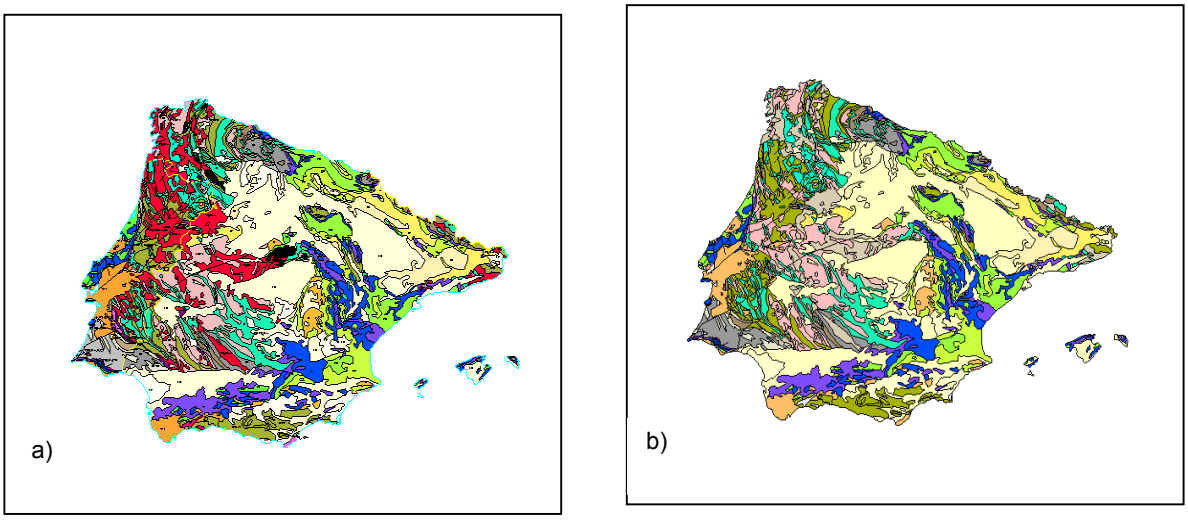

Figure 1 a) and b) The Iberian Peninsula with
a) rock units shown in the traditional way: i.e. spectrum colours for the age of sediments and shades of red for igneous rocks,
b) all the rock units coloured chronostratigraphically .

Term dictionary for a 1 : 5 000 000 scale

An essential part of any GIS is a well-designed database and thus definition of its content and structure are key tasks. The term dictionary was compiled on the basis of existing international standards as far as possible (e.g. for the classification of igneous rocks from Streckeisen, 1973, and 1980; the chronostratigraphic classification of sedimentary rocks from the IUGS, 1998.) Approximately 300 geological terms are listed so far, however, until the map is finished discussion on the definition of these terms will continue.

Data structure and data input mask

To facilitate the data acquisition and to involve the participating institutions in the population of the database, a data input screen (or template) using a MS Access runtime version was distributed to the IGME 5000 participants. Based on the term dictionaries and a comparatively simple data model, the screen provides information and limits on how the geological units may be described. Although simple, the data model had to be developed with the potential for later modification to a more sophisticated version and moreover it had to facilitate the necessary synthesis of the individual "country databases".

The descriptions provided are being collected in "country databases" at the participating geological institutions. When the data acquisition is complete, the mask system also includes functions to compress and copy the individual database for mailing or e-mailing back to BGR (and to create a back-up for local use).

Data harmonisation and synthesis

The project is currently at the stage of data harmonisation , synthesis and review.

Despite all the pre-emptive attempts to ensure consistency, after the national draft maps are sent back to the BGR, the geological linework,polygons and units still require cartographic harmonisation and generalisation. In addition, the digital attribute data which describe the geological units and which were entered into the "country databases", need to be combined and synthesised. After linking both the geological linework/polygons and the attributes, the geological data are meticulously scrutinised and geologically harmonised. Finally a print-out of the data (as a map) is being be sent to the project participants, and, at a later date to independent experts, for review in order to assure the scientific quality of the data.

Current status and future plans

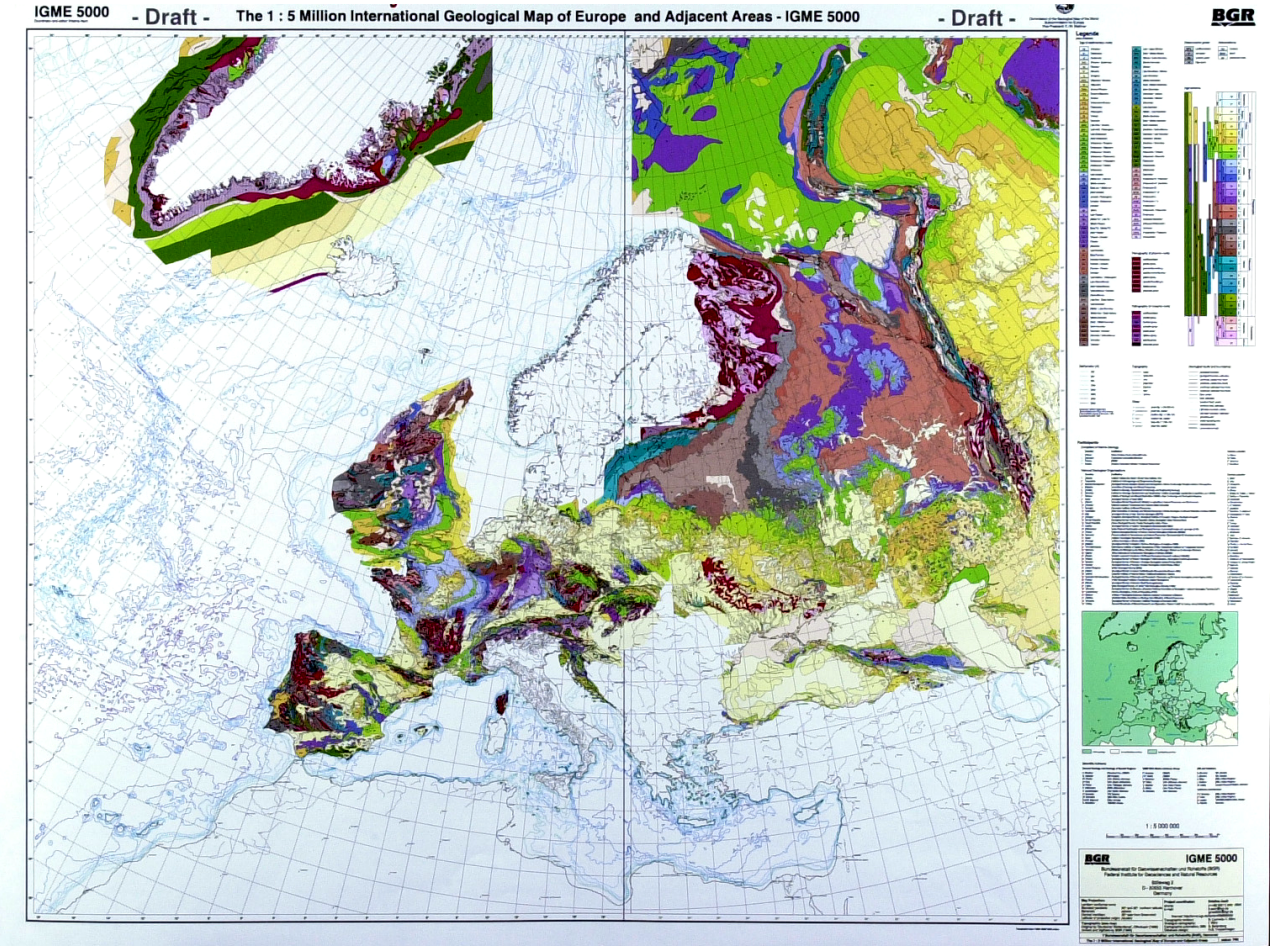

Figure 2. Output of the IGME 5000 project: a geological map "under construction".

To date the IGME 5000 project has achieved the following milestones:

- The digital topographic base map is available to all participants and associated projects on the BGR web server

- The term dictionary, continuously in the process of optimisation, is implemented as standard for the database.
- The data input mask ("template") has been programmed and distributed.
- The "proto" design and structure of the geological database is complete.
- A colour legend and abbreviation code has been developed and is available on the IGME 5000 web site (www.bgr.de/karten/IGME5000).
- Advisory groups on marine and alpine geology are established and active.
- The geological GIS and draft map are in the process of construction (figure 2).
- Cooperation with other European projects such as GEIXS, GESTCO and the Natural Gas Atlas is established.

The GIS that will result from the project will not only enable the production of a printed map, but also an provide an internet version, an interactive CD-ROM and extract maps to be produced on demand. Hopefully the map will be printed in 2002, with the complete web version being released that year, too. Finally it is hoped that the IGME 5000 project GIS may provide a much-needed foundation for further pan-European research, standardisation and geoscientific and environmental thematic mapping.

References

Asch, K., 1997, Guidelines for the Preparation of Draft Maps; Federal Institute for Geosciences and Natural Resources, Hannover

BGR and UNESCO, 1971, International Geological Map of Europe and the Mediterranean Region, 1 : 5 Million; Hannover

IUGS, 2000, International Stratigraphic Chart, Strasbourg

Streckeisen, A.L., 1973, Classification and Nomenclature recommended by the IUGS Subcommission on the Systematics of Igneous Rocks. Geotimes, 10/73, pp. 26 - 31

Streckeisen, A.L., 1980, Classification and Nomenclature of Volcanic Rocks, Lamprophyres, Carbonites and Melilitic Rocks. IUGS Subcommission on the Systematics of Igneous Rocks. Band 69, Vol. 1; pp. 194 - 207.