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INTERNATIONAL GEOMORPHOLOGICAL MAP OF EUROPE on 1 : 2,500,000

The significance of geomorphological maps in further development of geomorphology and its practical application is generally recognized. The geomorphological map allows for the establishment of the form of the different geomorphological objects, their spatial distribution, their relationships and for the carrying out of the geomorphological regionalization. The geomorphological maps are of importance as the mean of the knowledge of the laws governing the structure and the development of the Earth's surface not only for geomorphology but also for many other natural sciences (geology, climatology, hydrology, soil science, biology, etc.). Geomorphological mapping supplies valuable data for the structural-geological analysis and the knowledge of neotectonic movements. Geomorphological maps are even of practical significance for constructions of various types, mining industry, transportation, agriculture, forestry, etc. The problems of geomorphological mapping have thus become mainly in recent years one of the main present-day questions of modern geomorphology. To the theory of representation of the appearance, genesis and age of the relief on maps is paid attention by thematic cartography.

The International Geographical Union (IGU) has also paid considerable attention to problems of geomorphological mapping in recent years. Within the frame of the IGU Commission on Applied Geomorphology (President Prof. J. Tricart) the Sub-commission on Geomorphological Mapping led by Prof. M. Klimaszewski was acting during 1962—1968. It elaborated the unified legend of detailed geomorphological maps and a recommendation for the unification of general (synoptic) geomorphological maps. In 1968 Commission on Geomorphological Survey and Mapping was founded by the International Geographical Union which accepted as one of its main tasks the compilation of the International Geomorphological Map of Europe on 1 : 2,500,000.

After World War II a great number of general geomorphological maps of individual countries and their parts was compiled. In the prevailing part of Europe geomorphological mapping became the main research method in geomorphology. The compilation of geomorphological maps requires the rendering geomorphological research methods more exact and leads thus to further progress in geomorphology as science. General geomorphological maps become an indispensable component of national and regional atlases. But the geomorphological maps compiled in various countries differ rather often in their conception and the means of representation. Three basic types of general geomorphological maps can be distinguished on Europe's territory, such as:

- a) maps of relief forms or their parts (e. g. the map of France on 1 : 2 mill., Emm. de Martonne, 1942, the map of Bulgaria 1 : 2 mill., Zh. Galabov et al., 1962, the Geomorphological Map of Soviet Arctic 1 : 2.5 mill., etc.)

- b) maps of morphographic relief types with selected relief forms (for instance the map of Poland 1 : 2 mill., J. Kondracki — J. Czaplicka, 1949)
- c) maps of relief types on the basis of morphostructures with selected relief forms (e. g. the map of Czechoslovakia 1 : 1 mill., Atlas ČSSR, 1966, the map of Hungary 1:1 mill., M. Pécsi 1970, etc.).

All these types of geomorphological maps have their advantages and disadvantages. The maps of concrete relief forms represent the objectively existing relief features which can be mapped and classified directly in the field. General geomorphological maps have thus the same content and mode of representation as detailed geomorphological maps. Therefore, they can be compiled easily by means of a relatively simple generalization of detailed geomorphological maps. On the other hand, the disadvantage of this type consists in the great number of small areas on maps and the difficult expression of the tectonic deformation of the relief, especially of archings. The maps of morphological relief types represent well the plasticity of the relief and, when completed by selected relief forms, even the modelling of the relief by exogenic processes. But they nevertheless do not supply a full idea of the development of the relief mainly as to the share of endogenic processes. The third type of maps involves the relief types on the basis of morphostructures completed by selected relief forms. Morphostructures (I. P. Gerasimov, 1946, p. 35) are large relief forms created by mutual activity of endogenic and exogenic processes in space and time the leading part being played by the endogenic agent — the tectonic movements. These maps represent well the dependence of main relief features on neotectonic movements and rock resistance. Sometimes, these maps are criticized for undue dependence on geological maps and small plasticity in the representation of morphographical features.

A disadvantage of the maps of the different European countries is their difficult comparison with respect to their various contents and various degree of generalization. The maps are not mutually linked up and it often occurs that their contents cannot be linked up mutually in border regions. An exception is only the Geomorphological map of the USSR on the scale of 1 : 4,000,000 which represents even the neighbouring parts of Europe behind the frontiers of the USSR. For some important parts of Europe (e. g. Scandinavia) general geomorphological maps are not available either.

As soon as in 1965 at the meeting of the IGU Commission on Applied Geomorphology in Czechoslovakia the compilation of a general geomorphological map of the whole continent on the basis of a unified legend and with the same details appeared to be necessary. The map should represent the basic morphological relief features, its genesis and age as the result of mutual antithetic effects of endogenic and exogenic processes. The original proposal of the IGU Commission on Applied Geomorphology accepted at the meeting in 1965 concerned the compilation of the geomorphological map on 1 : 500,000. The compilation of the general geomorphological map of Europe on this scale appeared impossible with respect to the present-day stage of geomorphological investigations carried out in Europe and also to technical and political reasons (cf. Report 1968). This is why at the 21st International Geographical Congress in New Delhi a proposal was made to publish an Interational Geomorphological Map of Europe on the scale of 1 : 2,500,000 (J. Demek, 1968) which was accepted as one of the main items of activities of the newly founded IGU Commission on Geomorphological Survey and Mapping.

The question of the content and conception of the International Geomorphological Map of Europe on 1 : 2,500,000 was very vividly discussed at the 1st Commission meeting held from March 19 to 21, 1969 in Brno (Czechoslovakia).

During the discussion the Commission members stressed the fact that the general geomorphological map must show the basic morphological features of the relief of Europe i. e. the distribution of mountain ranges, basins, lowlands, etc., better than the topographical or generally geographical maps do. But the geomorphological map must in addition represent the relief genesis.

After discussion it was decided that the map content will be the genetic relief types on the basis of morphostructures and the selected relief forms. The term „relief type“ means a more or less distinctly defined area on the earth's surface displaying equal forms, an equal absolute altitude and an equal relief genesis in dependence on the same morphostructure, the same complex of geomorphological processes and the same history of development (Report 1969).

The compilation of the maps should lead to the inventarization of the land-forms on the territory of Europe and the establishment of general and regional laws governing their development. For many European regions this will be the first geomorphological map and, therefore, even so far unknown laws of development of the relief of Europe may be discovered. The linking up and unification of information involved in maps can lead even in already mapped regions to new geomorphological knowledge.

At further Commission meetings (France 1969, Czechoslovakia 1970, Italy 1971, Hungary 1971) the legend of the map was further developed and made more exact. The approved legend is to a certain extent a compromise among the present-day opinion on the content and legend of general geomorphological maps. Proposals concerning even very different legends were submitted to the Commission. So, for instance, the legend submitted by the team of Leningrad geomorphologists headed by G. S. Ganeshin and I. I. Krasnov attracted considerable attention. But the compilation of the map of Europe on the basis of this legend would require such an extent of field work that it would hardly be possible to finish the map within the present decade.

The last (5th) version of the legend consists of four basic parts. The first part (A) involves the relief classes characterized on the basis of relative relief amplitude. The question of the relief classes was discussed in detail especially at the 4th Commission meeting at Abano Terme (Italy). The Commission arrived at the conclusion that the application of the relative relief amplitude is better than that of the absolute heights. The geomorphological map must above all represent the relative dissection and thus also the inclination of the relief. The fact if the very gently inclined flat relief occurs in a low or high altitude can be seen from spot-heights and contour-lines. The remnants of a flat relief with a small relief amplitude in various altitudes above sea level are important geomorphological indices and must, therefore, be stressed on the map. In the map 5 relief classes are distinguished, such as:

1. planes with the amplitude from 0 to 30 m on an area of 16 sq. km
2. hilly lands with an amplitude from 30 to 75 m on an area of 16 sq. km
3. uplands with an amplitude from 70 to 300 m on an area of 16 sq. km
4. mountains with an amplitude from 300 to 600 m on an area of 16 sq. km
5. high mountains with an amplitude over 600 m on an area of 16 sq. km

The second part of the legend (B) involves relief types on the basis of morphostructures divided into two large groups, such as:

1. types of subaerial relief
2. types of submarine relief

Types of subaerial relief (1.) are subdivided into:

- | | |
|------------------------|-----------------------------------|
| A) Destruction relief | B) Volcanic relief |
| C) Accumulation relief | D) Accumulation-denudation relief |

In the legend 6 basic morphostructures are distinguished, such as:

1. Relatively stable shields which are the oldest parts of the earth's surface built of crystalline and metamorphic rocks. In their development no or only slight neotectonic movements took part.
2. Relatively stable platforms which are regions consolidated by old folding and also built mostly of crystalline and metamorphic rocks, in the neotectonic stage of earth's development only slight movements occurred here.
3. Slightly activated epiplatform orogenic zones. This megamorphostructure was defined by N. V. Bashenina in the Ural region. On the basis of her knowledge it is a part of a platform which never got into the stage of a regionally developed planation surface due to continuous tectonic movements.
4. Orogenic regions of activated shields are parts of shields arched, uplifted and faulted by neotectonic movements.
5. Epiplatform orogenic regions are parts of platforms of relatively complicated structure (crystalline, metamorphic and old folded sedimentary rocks of the fundament, often with a younger sedimentary platform cover) arched, uplifted and faulted by neotectonic movements.
6. Young epigeosynclinal orogenic zones are zones of young (Mesozoic and Tertiary) Alpine mountains of Europe with a great extent of neotectonic movements.

In these basic megamorphostructures relief types develop due to rock properties (passive morphostructure), various intensity of neotectonic movements (active morphostructure) and due to erosion processes.

In the types of submarine relief the following megamorphostructures have been distinguished in the legend:

1. Submarine parts of present-day nongeosynclinal regions
2. Submarine parts of present-day geosynclinal zones
3. Floor of ocean
4. Mid-ocean ridges

Even in the relief forms the forms of subaerial relief (1) and those of submarine relief (2) have been distinguished in the legend. The landforms (1) are then subdivided into forms:

- 1.1 induced by endogenic processes
- 1.2 created by erosion processes.

The age of the relief is represented on the map according to the geological scale. The age of the accumulation forms is defined by the age of deposits of which they are built. The age of the forms of surface volcanism and mud volcanism is defined by the age of volcanic rocks. More difficult is the dating of tectonic forms and erosion-denudation forms. In more difficult cases a wider time interval is to be given (e. g. in the case of planation surfaces).

In the case of colour maps all three cartographical means are used — flat tint, coloured and grey stipples and symbols. The colour group corresponds to megamorphostructures. Relief types are represented by flat tints and fine tints and fine stipples giving the colour tint according to the principle the more dissected the relief the darker the tint. Grey thick stipples are used in representation of rocks. The individual relief forms are then represented by symbols-conventional colour signs. The used linear or dot signs are mostly identical with symbols used on detailed geomorphological maps. Letters and numerals are used for the representation of the age of the relief. It would be ideal if the legibility of the maps not only at close quarters but also at a distance could be achieved (for lessons, lectures).

The topographical base of the International Geomorphological Map of Europe is the new topographical World Map 1 : 2,500,000 published by the Cartographical and Geodetic Services of the socialist countries. The topographical base involves the river pattern, contour-lines, spot elevations, selected settlements and the transportation network. The map will appear in 10 sheets according to the reliability diagram of the World Map (sheets 35 London, 52 Madrid, 53 Rome, 36 Warszawa, 23 and 13 Helsinki, 54 Sofia, 55 Tbilisi, 14 Archangelsk, 24 Syktyvkar, 37 Moscow). The edition of the map in sheets will make possible its utilization in the field, airplane, etc. But even its wall edition is supposed.

The general geomorphological map of Europe, i. e. of the geomorphologically best investigated continent, should be compiled on the basis of the available material. This is not only the geomorphological material proper but also for instance various thematic maps of Europe on the same or similar scale published in international cooperation, such as for instance the International Quaternary Map of Europe 1 : 2.5 mill., the International Geological Map of Europe on 1 : 1.5 mill., the International Hydrogeological Map of Europe 1 : 1.5 mill., etc. But it is already evident that in some regions the map will not be able to be compiled without completing field investigation. This holds mainly in border regions where the squaring of the contacts is impossible without field research (e. g. the course of glacial forms in Northern Europe, etc.).

The unification of the opinions of geomorphologists as to the content and legend of the International Geomorphological Map achieved at Commission meetings 1969—1971 was necessary for the starting of work on the sample map sheet 36 Warszawa. It should be stressed that the unification of opinions concerning the legend of other international maps of Europe took much more time (cf. H. W. Walther, 1969, p. 20).

In 1971 the compilation of the sample sheet Warszawa was launched. The authors' originals were elaborated by Commission members of the different countries (Sweden — Prof. S. Rudberg; GDR — Prof. J. F. Gellert; Poland — Prof. R. Galon, Prof. L. Starkel; Czechoslovakia — Ass. Prof. J. Demek, Austria — Prof. J. Fink, USSR — team of workers of VSEGEI in Leningrad headed by G. S. Ganeshin and I. I. Krasnov). The sample sheet will be submitted at the 22nd International Geographical Congress in Canada, 1972. On the basis of the experience with this sample sheet the compilation of the whole map will be carried out.

The compilation and publication of the International Geomorphological Map of Europe on 1 : 2.5 mil., were involved by the General Assembly of the UNESCO into the program of activities. The moral and financial supports of the UNESCO have considerably accelerated the work connected with the preparation of the map.

In conclusion, it can be stated that the work on the compilation of the International Geomorphological Map on 1 : 2.5 mill. contributes:

- to the development of international cooperation of geomorphologists, mutual understanding and unification of opinions, terminology and research methods
- to the progress in geomorphological research, mainly in parts of Europe less investigated so far where geomorphological maps have not yet been compiled
- to the establishment of new and less known laws of the relief development of the whole continent
- to the establishment of the laws of the natural environment in Europe by comparison with other general maps of natural environment compiled under the aegis of UNESCO
- to the obtaining knowledge for compilation of geomorphological maps of other continents, especially regions less known from the geomorphological point of view; in such regions even a general geomorphological map can be of immediate practical significance
- to the development of the theory of thematic mapping.

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MEZINÁRODNÍ GEOMORFOLOGICKÁ MAPA EVROPY 1 : 2,5 MIL.

V článku autor podává zprávu o přípravě Mezinárodní geomorfologické mapy Evropy v měřítku 1 : 2,5 mil. Návrh na vydání mapy byl předložen na XXI. mezinárodním geografickém kongresu v New Delhi (Indie) v roce 1968 (J. Demek, 1968). Příprava mapy se stala jedním z hlavních bodů pracovního programu IGU-Komise geomorfologického výzkumu a mapování. V období 1969—1971 se Komise sešla na 5. zasedáních a připravila koncepci a obsah Mezinárodní geomorfologické mapy Evropy. V mapě budou znázorněny třídy reliéfu, typy reliéfu na základě morfostruktur a vybrané tvary reliéfu Evropy. V roce 1970 bylo sestavení mapy zařazeno mezi akce podporované UNESCO. V současné době se připravuje vzorový list mapy Warszawa, který má být předložen na XXII. mezinárodním geografickém kongresu v Montrealu (Kanada) v roce 1972.