BRIEF HISTORY OF THE GEOLOGICAL MAPPING PROGRAMS OF ROMANIA – 1882 TO PRESENT

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Abstract. Geological maps provide the most rapid geological knowledge of a territory; they are meant for analysis, decision and planning the management of mineral resources, environment protection and geological hazard assessment. As such, geological mapping is a key activity for geological surveying all over the world. The Geological Institute of Romania, founded in 1906, was authorized by law to provide the official geological maps of the national territory. The first geological map of Romania (The Old Kingdom), achieved in the frame of a mapping program financed by the government, was prepared by the Geological Bureau of Romania (1882-1889). This paper attempts to reconstruct the history of the main geological mapping programs of the country, covering more than a century (from 1882 to present).

Keywords: geological and geothematic maps, mapping history, Geological Bureau, Geological Institute of Romania.

INTRODUCTION

Almost all mapping programs of the Romanian national territory have been elaborated and accomplished by the Geological Institute of Romania (IGR), established in 1906 under the aegis of the Ministry of Agriculture, Industry, Commerce and Estates with the statute of geological survey of the country. The Law of establishment, amended by the Royal Decree no. 730 / 21 02 1906, stipulated as scope of the IGR activities the study of the soil and subsoil of Romania, the drawing up of geological and agrogeological maps, as well as to advise in all the matters concerning the soil and subsoil of the country. The fundamental role of IGR in the knowledge of the geology of the country and its mineral resources was recognized and reinforced through "The Law of Mines" in 1924, stipulating that all state-financed prospecting works should be done by IGR. Its director was a member of the High Council of Mines of the country, the organism that was granting or withdrawing the mining concessions. The Council should also get the recommendation of IGR in all the questions regarding the capitalization of the mineral resources of the country.

Geological maps are essential documents for analyzing, decision making and planning of the administration of mineral and energetic resources, as well as in related areas, like geological hazard assessment and protection of natural environments. Therefore, geological mapping is one of the main activities of the Geological Surveys from all countries in the world. From the classical geological maps based on geochronological criteria, various geo-thematic maps have been derived, specialized on various scientific or economic characteristics of geological formations. In order to keep pace with changes in geological theory and practice, as well as with the economic interest of new mineral and energetic resources, some ignored in the past, geologic and geo-thematic maps are periodically updated, usually every 20-30 years, so that geological mapping is a permanent activity.

Unfortunately, things are different in Romania, although most of its geological maps are at their first edition, scientifically obsolete and currently out of print. The mural geological map (scale 1:500 000) is represented by 12 sheets, from 50 to 70 years old. The 1:200 000 scale map is more than 40 years old, while the second edition of the office geological map scale 1:1 000 000 is over 30 years old. Printed maps of the detailed geological map at scale 1:50 000 are between 10-40 years old. Consequently, they are impossible to correlate and harmonize in a coherent map. Nevertheless, all governments after 1989 have ceased to finance the mapping programs running at the IGR, while financing new programs does not seem to be considered yet.

In this unfavourable political and economic context, a history of the geological mapping programs that contributed to the geological knowledge of Romania for over a century (1882 to present) can be useful. To my knowledge, the only

detailed historical presentations of the Romanian geological cartography were done by Macovei (1934), at the 25-th anniversary of the IGR and by Dumitrescu (1962), in the introduction to his course of structural geology.

1. GEOLOGICAL MAPPING PROGRAMS BEFORE THE FOUNDING OF THE GEOLOGICAL INSTITUTE

The main sources of information on the geological mapping of the national territory before the establishment of the IGR, were papers from the volume I of the Annuary of the Geological Bureau of Romania (Ştefănescu, 1883) and from volume V of the Annuary of IGR (Popescu-Voiteşti, 1912). The Geological Bureau of Romania (BGR) was established in 1882 and run under the aegis of the Ministry of Agriculture, Trade and Public Works, with the express mission to achieve the first geological map of the country. This map was requested from the Romanian state by the II International Congress of Geology, held in 1881, in Bologna, to be integrated in the international geological map of Europe scale 1: 1 500 000, map drafted and printed in Berlin during 1881-1913.

For internal use, the members of BGR under the management of the Professor Gregoriu Ştefănescu, had elaborated the map using a topographic map scale 1:175 000 in 54 sheets. The map has 12 colour separations, 7 for sedimentary rocks, at system level for the pre-Cretaceous rocks and at series level for the Cretaceous and younger rocks, one for metamorphic rocks and 5 for magmatic rocks. In the seven years of functioning (1882-1889), the BGR printed in Vienna 27 map sheets. Only in 1894, professor Ştefănescu received the necessary funding to print the other sheets and this work was finished in 1910, excepting for several sheets from Dobrogea, whose manuscripts were lost. Two copies of this map, one made of separate sheets, within a portfolio, the other with the sheets assembled in a large mural map, are found at the Palaeontology Chair of the University of Bucharest.

The geological maps of the BGR reflect a low grade of geological and topographic knowledge of the country's territory and the scale is too large, considering the amount of information contained. Consequently, it is an exaggeratedly large map for an usual mural map. As a replica to this map, the Service of Mines and Quarries from the Ministry of Domains, prints in 1900 a mural geological map at an adequate scale (1:300 000), compiled by V. Popovici-Haţeg (Fig. 1). It is a professional map, superior to the BGR map from both cartographic and scientific point of view. The relief is suggestively expressed through hachures in sepia, while the geology is represented through 34 colour separations (Fig. 2), inhomogeneously distributed in the chronostratigraphic scale. For the sedimentary rocks, 24 unequal separations have been used, at the level of era (for Palaeozoic), system (for Triassic), series (for Liassic, Eocene and Oligocene) and stage (for the middle and upper Jurassic, Cretaceous and Neogene). The degree of knowledge is poorer for the magmatic (8 separations) and metamorphic rocks (only 2 separations). The full colours, in harmonious tones, slightly dark due to the shaded background, granted the map an aesthetical valence, enhanced by the patina of time (Fig. 3a, 3b). There is only one such a map, rather deteriorated, presently in a private collection.

Eventually, in 1904, the Commission of Oil from the Ministry of Public Works was editing a map of the oil fields at scale 1:1 000 000 (Mrazec *et al.*, 1904). To my knowledge, this would be the first geothematic map of the territory of Romania. Several copies, well conserved, should be found in private collections.

2. GEOLOGICAL MAPPING PROGRAMS OF THE GEOLOGICAL INSTITUTE

In the centennial history of the Geological Institute two large periods of activity can be distinguished. The first covers the time span from 1906, the year of its establishment, till 1950, the year when IGR was reorganized as Enterprise of Prospecting and Laboratories, coordinated by the Geological Committee. The Geological Committee was a governmental institution with a rank of ministry, which has functioned since 1950 until 1970, when it became department within the Ministry of Mines and Geology. Between 1950 and 1960, the Geological Institute was abolished as a juridical person, although its researchers continued to work either at the Prospecting Enterprise, or at the Geological Committee.

The second period lasted since 1960, when the Geological Institute was re-established in subordination to the Geological Committee, until 1994, when the Institute came out of the coordination of the Ministry of Industry to be subordinated to the ephemeral Ministry of Research and Technology. With this year the decline of the geological research, including mapping programm in the Geological Institute commences. In my opinion, the Law of Mines from 1998, which does no longer recognize any attributes of the Institute in the field of mineral and energetic resources, signed the retreat of the Geological Institute from the structure of the main economic ministry of the country, to which it belonged for 88 years, being equivalent with its auto-exclusion from the geological-mining decision community.

2.1. Geological mapping during 1906 - 1950

Data related to this time interval are found in the Annuaries of the IGR, most of them in papers from volumes IV (ex. Mrazec, 1911) and XVI (ex. Macovei, 1934). The first programs of geological mapping of the IGR were focused on accomplishment of geological maps at scales 1:500 000 and 1:50 000 and of some geognostic maps (geothematic in modern terminology), priority for the national economy being represented by agrogeological and mining maps for various mineral resources. An exhaustive presentation of these maps is almost impossible to make, because many of them are missing from the archives of the IGR and references are incomplete and sometimes contradicting.

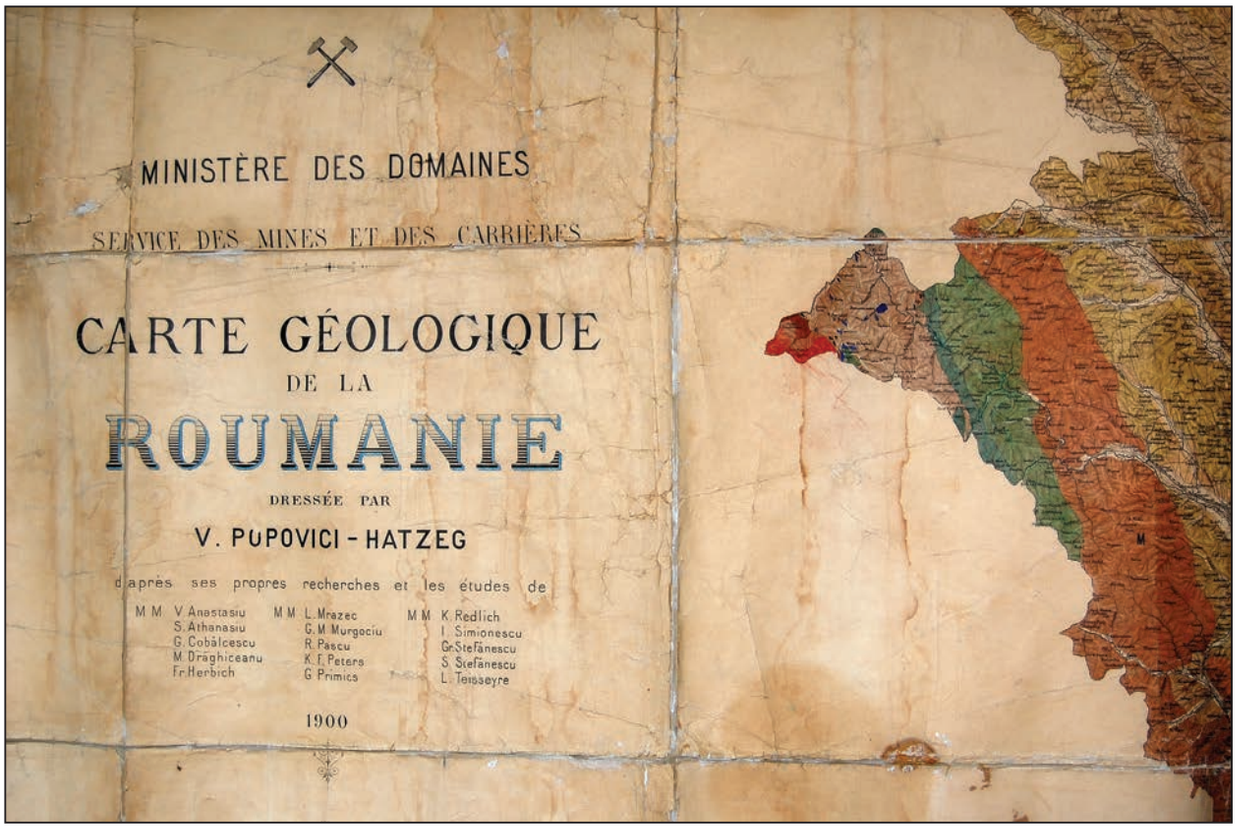

Fig. 1 Geological map of Romania (The Old Kingdom) scale 1:300 000, compiled by V. Popovici-Hațeg

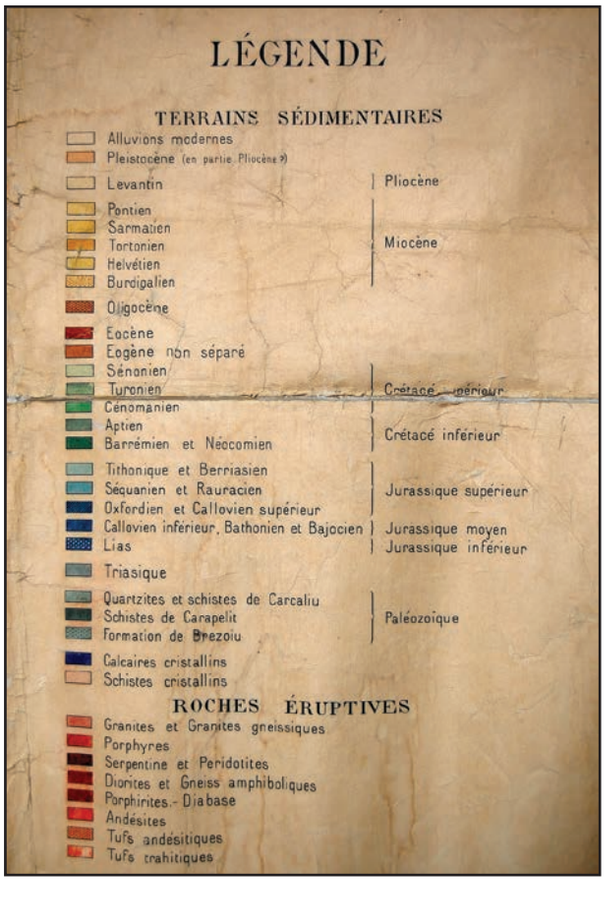

Fig. 2 The caption of the geological map of Romania scale 1:300 000 (V. Popovici-Hațeg, 1900)

Fig. 3a Section from the geological map scale 1:300 000 from 1900 (east of Muntenia and Dobrogea)

Fig. 3b Detail from he geological map scale 1:300 000 from 1900 (Central South Carpathians)

For detailed geological mapping, the Geological Institute used the topographic base of the Romanian army (scales 1:20 000 and 1:50 000), in Moldova, Dobrogea and the eastern part of Muntenia and of the Austrian army (scale 1:57 600), in Oltenia and western part of Muntenia. In the Romanian provinces integrated to the country after the First World War, Austrian military topographic maps were used (scales 1:25 000 and 1:75 000) in Transylvania, Banat and Bucovina, and Russian topographic maps (scales 1:42 000 and 1:100 000), in Basarabia.

Under the management of the polyvalent geologist who has been Gheorghe Munteanu-Murgoci, in short time the agrogeological map scale 1:500 000 of the Old Kingdom was mapped. In 1909, the map drafted at scale 1:1 000 000 was made to be presented at the Industrial and Fine Arts exhibition from Odessa and at scale 1:2 500 000 to be published in the volume of the first international agrogeological conference, held in that year in Budapest, subsequently also published in the Annuary of IGR (Murgoci, 1912). This is the first agrogeological map of Romania and the second in the world, after the map of Russia, published at the same scale. Until the first world war the manuscript of the geological map scale 1:500 000 (Mrazec *et al.*, 1912) (Fig. 4a,b) was finished, as well as four sheets of the geological map scale 1:50 000 (Vălenii de Munte, Câmpina, Moreni-Haimanale and Şoimari), out of which a provisional edition of the sheet Vălenii de Munte was printed (Fig. 5) (Teisseyre, 1911). The editing of the geological map scale 1:500 000 was much delayed because of the war and subsequent increase of the country's territory.

After 1918, the first national geological and geothematic maps appeared in the Physiographic and statistic Atlas of Romania (1926-1938), composed of physiographic (geological and physical maps) scale 1:1 500 000, printed in Berlin in an elegant final editions, and of a statistic map scale 1:1 000 000 published in provisional editions in the journal Technical and Economical Studies and edited by the Service of prospecting and applied geophysics of the IGR. From the physiographic maps scale 1:1 500 000 the following have been found: the first edition of the geological map (Mrazec *et al.*, 1926) and the second edition (Mrazec *et al.*, 1929), map of soils (Murgoci *et al.*, 1927), orographic map (1929, no authors mentioned), hydrographic map (1930, no authors mentioned) (Fig. 6) and the map of vegetation zones (Enculescu *et al.*, 1938). Among them, the map of mineral resources should have been done, but this never happened. Among the statistic maps scale 1:1 000 000 there were the map of coal, ores and reserves (Sofian, 1925), with no geological base and the map of ore deposits and of reserves of iron, chromium, manganese and pyrite (Ghiţulescu and Gavăt, 1931), with the geological background taken after the manuscript of the 1:500 000 scale map, existing at that date (Fig. 7).

In 1937, a provisional edition of the geological map scale 1 :500 000 was completed (Fig.8), with two sheets belonging to Dobrogea, the area with the highest degree of knowledge at that date, already printed in final editions (6a in 1936 and 6b in 1937). Despite the war, the printing of the other maps continues: sheets 3b (1939) and 3a (1940), from Basarabia, and sheets 5b (1941) and 5a (1942), pertaining to Muntenia and to the eastern half of Oltenia.

The printing of the geological map of Romania scale 1:500 000 was finished during the Geological Committee meeting, when sheets 2a and 2b (1957), 1a and 1b (1958) and 4a and 4b (1959) were printed. Changes of the eastern borders of Romania after the Second World War triggered the modification and reprinting, in 1963 and 1964, of the sheets pertaining to Dobrogea and Basarabia. The mural map 1:500 000, coherent and scientifically objective and rigorous from a cartographic point of view (Fig. 9), is a synthesis of the degree of geological knowledge of the country accomplished by the illustrious members of the old Institute. In the second half of the XXth century, this map has made a long career, covering the walls of all ministries, enterprises and faculties (with a geological-mining profile), in the country.

Before 1960, the Geological Committee initiated an ambitious program of detailed geological mapping for the geological map scale 1:100.000, in 86 sheets. That program was not accomplished. It is not known how many sheets have been performed, but only 15 of them (Arieşeni, Bârseşti, Braşov, Breţcu, Buzău, Câmpina, Cheia, Covasna, Dumitreşti, Moneasa, Sieni, Sighet, Şomcuţa, Târgul Ocna, Târgul Lăpuş şi Vălenii de Munte) have been printed, between 1957 and 1963.

2.2. Geological mapping during the 1960 – 1994 interval

Writing the history of this period is relatively easy, considering the large number of maps edited that are still in use. After 1960, the Geological Institute has deployed significant geological and geothematic mapping programs of the national territory at various scales (1:1.000.000, 1:500.000, 1:200.000. 1:100.000 şi 1:50.000). The first printed maps at scale 1:1.000.000 were the tectonic map, edition I (Dumitrescu *et al.*,1962), the map of the Quaternary, edition I (1964), the simplified geological map, with two editions (1964 and 1975), the geological map, edition I (1966) and the mineral resources map, edition I (1969). Between 1969 and 1985, the 15 sheets of the Geological Atlas of Romania scale 1:1.000.000 were published, an updated replica of the atlas between the world wars, containing: the hydrogeological map (1969), the 2nd edition of the tectonic map (Dumitrescu *et al.*, 1970), the neotectonic map (1970), the soils map (1970), the well known 2nd edition of the geological map (Săndulescu *et al.*,1978) and the 2nd edition of the mineral resources map (1983). In parallel with the geologic atlas, two magnetic maps (1983) and a gravimetric map (1991) have been published at the same scale of 1:1 000 000.

The 50 sheets of the geological map scale 1:200 000 were drafted and printed in record time, during 1964-1968.

Even today this is the only relatively detailed map that totally covers the national territory. Beside the geological map, 18 sheets of the pedological map have been printed (1964), as well as 20 sheets from the genetic map of mineral resources in provisional edition (1964-1970) and 20 sheets from the metallogenetic map (1968-1972). The scale 1:500.000 was used to draft the pedologic map in 6 sheets, printed in 1970 and 1971, while scale 1:100.000 was used for editing the hydrogeological map, out of which 49 sheets were printed during 1968 and 1992. Between 1979 and 1988, 20 sheets of the lithological map of Romania were drafted at the detailed scale of 1:25 000, accomplished on strictly petrographic criteria.

The most detailed and ample geological mapping program ever initiated in Romania is the one at scale 1:50.000. As the first maps were published in 1970, the program started, most probably, in 1968, and continued in force for more than two decades, to be sank down slowly, between 1994 and 2003, by lack of funding. The geological map at scale 1:50.000 includes 733 sheets, out of which 223 were finished, covering 38,4% of the surface of the country, mainly the mountainous areas; out of them 135 were published, covering 22,2 % of the territory. Although this program was not completed and some sheets do not correlate with each other, it contributed significantly to the increase of the geological knowledge of the country and to the implementation of new scientific concepts related to the geological structure of the bedrock, helpful for the plate tectonics theory.

Unfortunately, about half of the maps already completed and unpublished, in the phase of model, have disappeared from the Archives of the IGR, as can be seen from an inventory from 2003 (Table I). Therefore, part of the data that could be retraced are incomplete and some are unreliable, so that I welcome any input from my colleagues. I think that publishing these informations in this article represents a moral reparation act for the authors of those maps, who, by reasons independent of their will, could not see them published, although they have worked for years in the field, sometimes, in extremely difficult conditions.

3. CONCLUSIONS

In brief, the history of mapping programs of Romania is tightly linked to the history of the Geological Institute of Romania. During the XX-th century, this institute has been functioning in the normal parameters of a national geological survey, and its geological mapping programs were conducted according to the international standards, regardless of the political regime of the country. In times of transition from one regime to another, he IGR had to suffer, because its attributions of "watchdog" in the field of mineral resources could have disturbed the economical interests promoted by transition governments. This is why the present situation of the Geological Institute is, *mutatis mutandis*, similar to that from the 1950-1960 decade, and even worse. Although reorganization in the 50s lead to the temporary abolition of IGR, geological research and mapping programs have continued under the management of the Geological Committee, in fact a Soviet *alter ego* of the Institute between the two world wars. In the 90s, the issue was not to abolish IGR, since all EU countries have a Geological Survey, but its mapping activity was no longer funded from the budget. From this historical perspective we can anticipate a revitalization of the IGR in the near future. Until then, Romania remains the only European country with no genuine Geological Survey and updated geological maps.

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Fig. 4a Manuscript from 1912 of the geological map of Romania scale 1:500 000 (Prebalkans), annotated and signed by the director of the IGR, Ludovic Mrazec. Dated 07/20 nov. 1912

Fig. 4b Manuscript from 1912 of the geological map of Romania scale 1:500 000 (Oltenia)

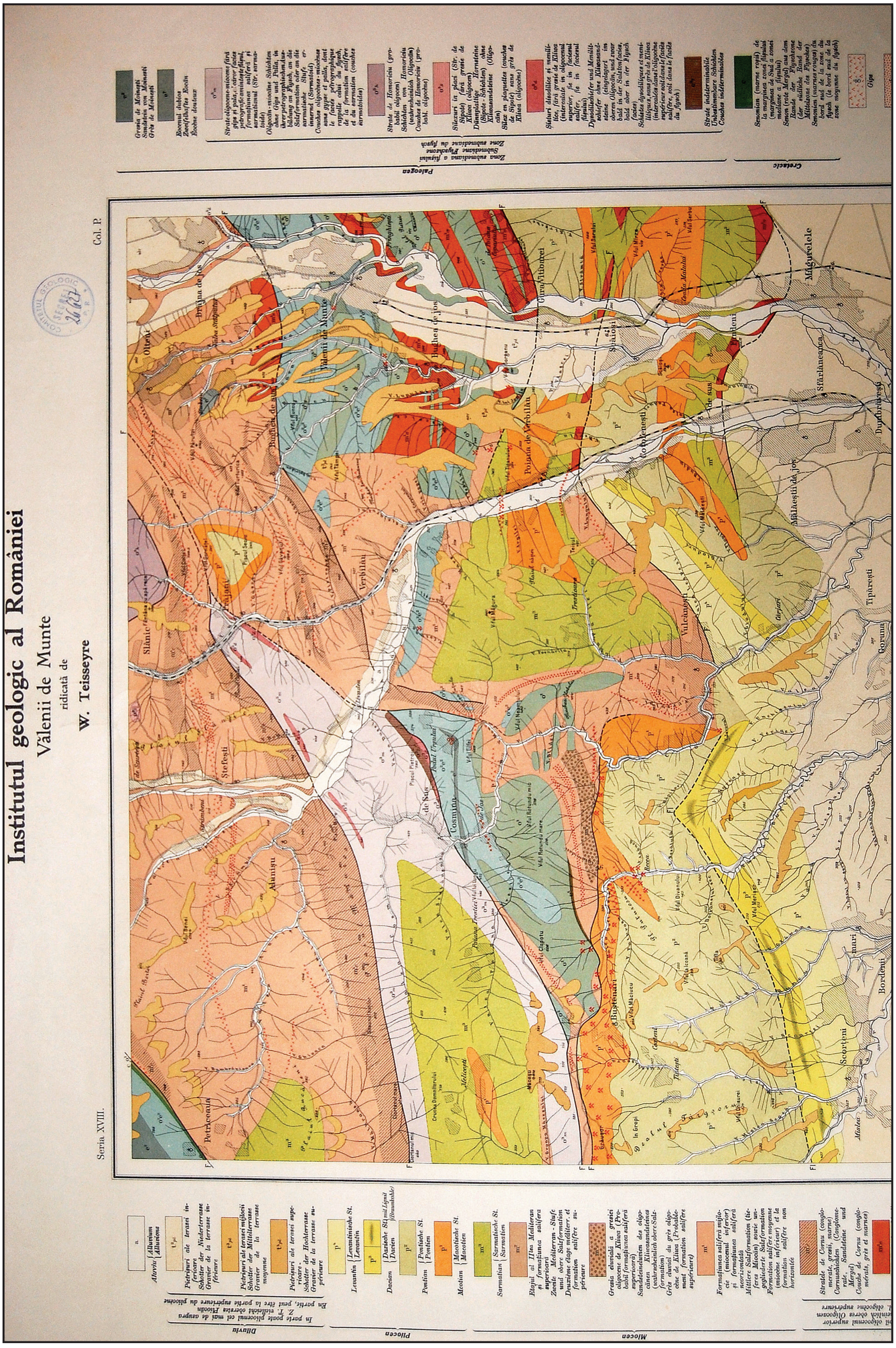

Fig. 5 Geological map of Romania (The Old Kingdom) scale 1:50 000, sheet Vălenii de Munte, provisional edition (W. Teisseyre, 1911)

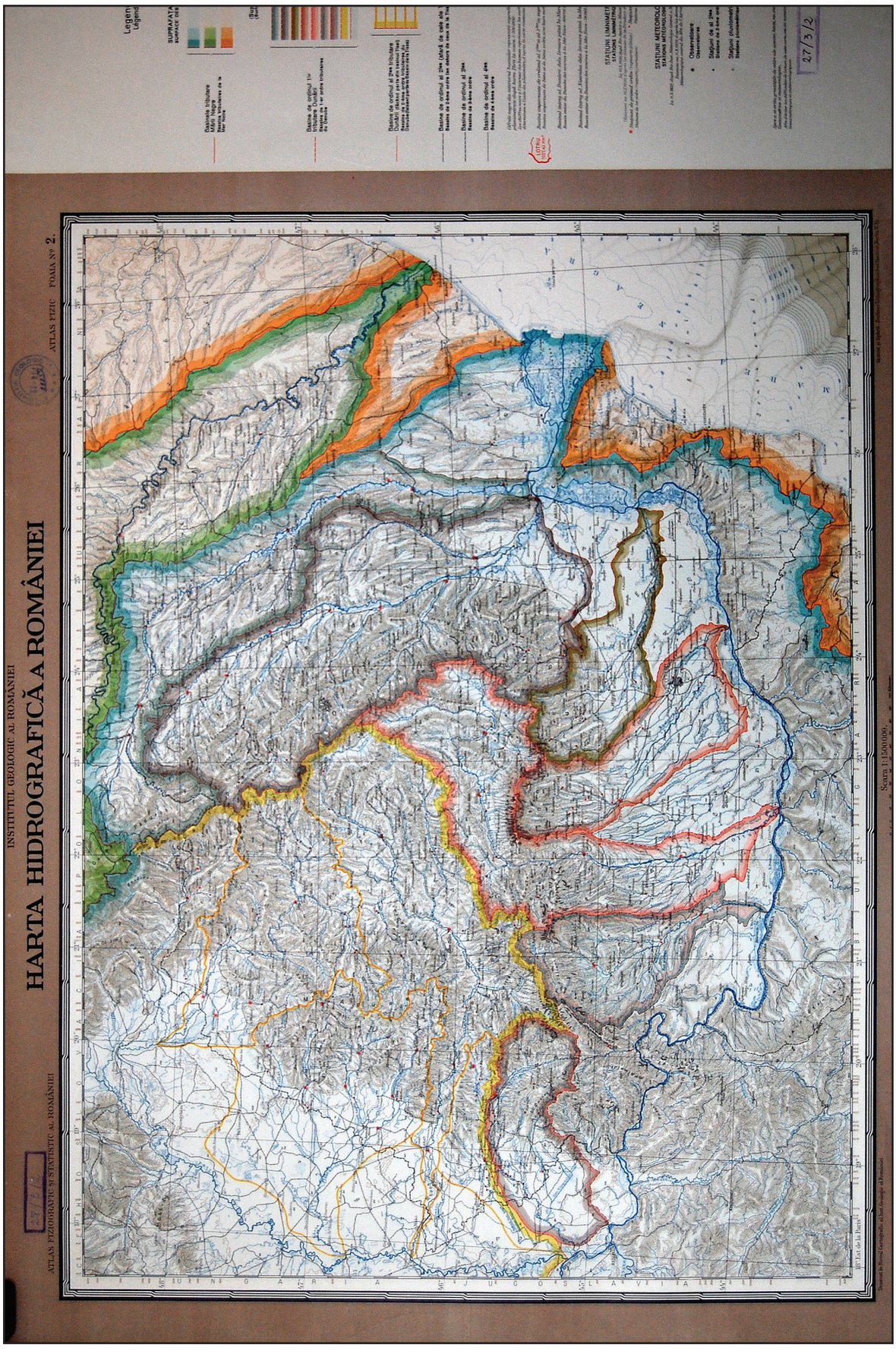

Fig. 6 Hydrographic map of Romania (Big Romania) scale 1:1 500 000, edited by IGR and printed in Berlin in 1930

Fig. 7 Model from 1926–1930 of sheet 5a of the geological map of Romania (Big Romania) scale 1:500 000, edited by IGR

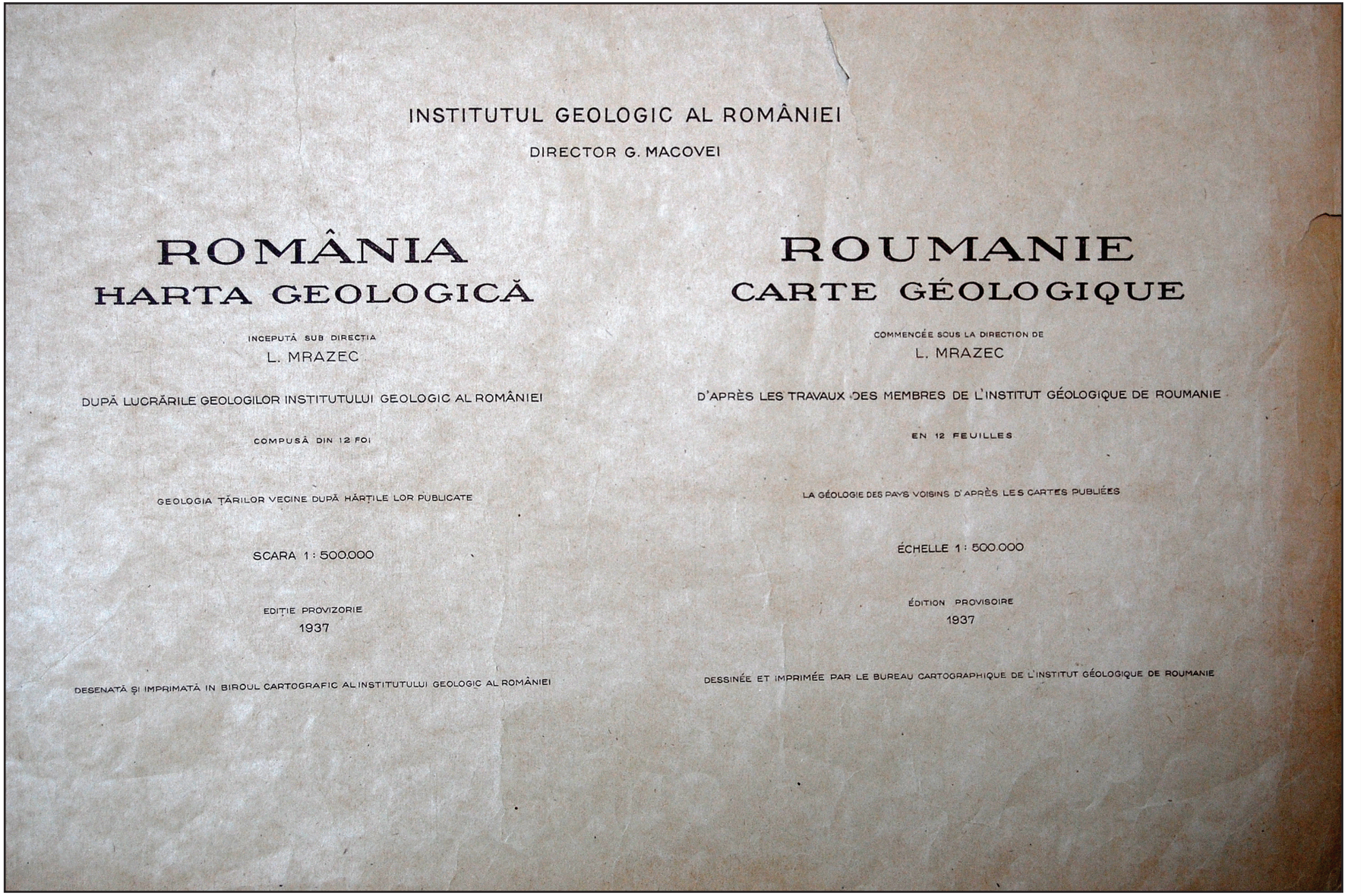

Fig. 8 Cover of the portfolio with the sheets of geological map scale 1:500 000, provisional edition from 1937

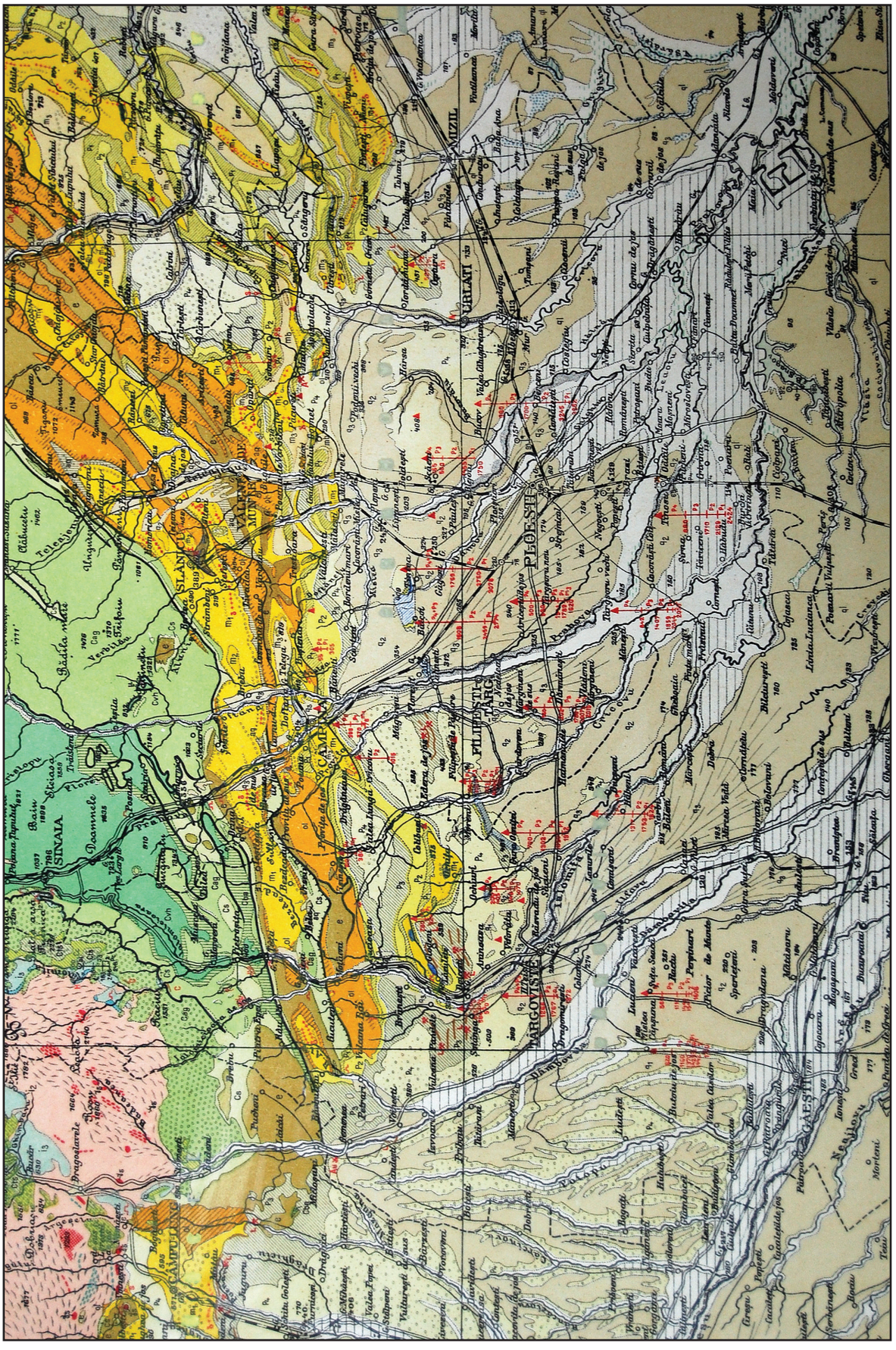

Fig. 9 Section from the geological map scale 1.500 000, sheet 5a (printed în 1942)

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******* 1929. Harta orografică a României, scara 1:1 500 000. Atlasul fiziografic şi statistic. IGRIGR Archives.

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