LUDOVIC MRAZEC (1867-1944): FOUNDER OF MODERN ROMANIAN GEOLOGY

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Abstract. Ludovic Mrazec is one of the most important Romanian geologists because of his fundamental contributions to mineralogy, petrology and tectonics of the Romanian Carpathians and of the Dobrogea Units. He was the founder of the Department of Mineralogy at University of Bucharest (1894) and the founder and organizer of the Geological Institute of Romania (1906), where he started the activity of drawing up the geological map of Romania, scale 1: 500,000. He had fundamental contributions in deciphering the tectonics of the Romanian Subcarpathians by discovering the phenomenon of diapirism and its role in defining the petroleum structures. In the history of Roman*i*an geology, he is well known for his view of the relations between the two groups of crystalline schists in the Southern Carpathians and East Carpathians, through the theory of organic petroleum origin and by organizing the research activity and capitalizing on the Romanian mineral resources, following the elaboration of the first mine laws (1924).

Keywords: Mrazec, salt diapirism, petroleum, mineralogy, metamorphic petrology.

Rezumat. Ludovic Mrazec (1867-1944): fondatorul geologiei românești moderne. Ludovic Mrazec este unul dintre cei mai importanti geologi români datorită contribuțiilor sale fundamentale la mineralogia, petrologia si tectonica Carpaților românești și a unităților dobrogene. El a fost fondatorul Catedrei de Mineralogie de la Universitatea București (1894) și fondatorul și organizatorul Institutului Geologic al Romaniei (1906), unde a demarat activitatea de întocmire a hărții geologice a României, scara 1 :500.000. A avut contribuții fundamentale în descifrarea tectonicii Subcarpaților românești, prin descoperirea fenomenului de diapirism și al rolului său în definirea structurilor petrolifere. In istoria geologie românești a rămas prin concepția sa privind relațiile dintre cele doua grupuri de șisturi cristaline din Carpații Meridionali, prin teoria genezei organice a petrolului și prin organizarea activității de cercetare și valorificare a resurselor minerale ale României, urmare a elaborării primei legi a minelor (1924).

Cuvinte cheie: Mrazec, diapirism, petrol, mineralogie, petrologia șisturilor cristaline.

INTRODUCTION

Ludovic Mrazec was the third great Romanian geologist, after Grigore Cobâlcescu and Gregoriu Ştefănescu, whose name is related to the birth of various sub-domains in Romanian geology. He was also one of the most prominent European geologists at the turn of the 20th century and throughout the first few decades of the 1900s. He was also an efficient manager (administrator); he founded the Department of Crystallography, Mineralogy and Petrography of the University of Bucharest in 1894. Later in 1906, he founded the Geological Institute of Romania, whose director he was until 1927 (Fig. 1).

Figure 1. Ludovic Mrazec (1867-1944).

His fundamental scientific discoveries were diverse. Firstly, he was an important contributor to the recognition of the Alpine fold and thrust tectonics in the Southern Carpathians. The discovery of the Getic shear zone with his close collaborator Gheorghe Munteanu Murgoci (MUNTEANU-MURGOCI, 1905). His efforts then focused on fundamental research in petroleum geology and was one of the first promoters of the concept of diapirism in general and diapirism of salt in particular. Salt diapirism in particular and buoyancy-driven ductile deformation in general (in the lithosphere and asthenosphere) are important concepts in modern tectonics. Ludovic Mrazec was concerned about the economic aspect of geology, coining the economic geology in Romania.

EARLY DAYS

Initially Mrazec attended pharmacy courses, first in Bucharest and then at the University of Geneva, following the wish of his father Ludovic Valeriu Severin, who was an apothecary (pharmacist) in Craiova. In Geneva, he obtained a degree in physical-chemical sciences and a doctorate in mineralogy, with Professor of Mineralogy Louis Duparc as advisor, whom he trusted with a strong friendship and to whom he dedicated his fundamental work "The General Mineral Course and Year (1938). His doctoral dissertation was « La Protogine du Mont-Blanc et les roches éruptives qui l'accompagnent. Pétrographie » (1892), where he examined the petrography of the Mont Blanc granite massif (Fig. 2) and clarified the magmatic origin of the granite known as the protogene; he also studied the fan-like structure of the granite massif, which is an example of magmatic diapirism.

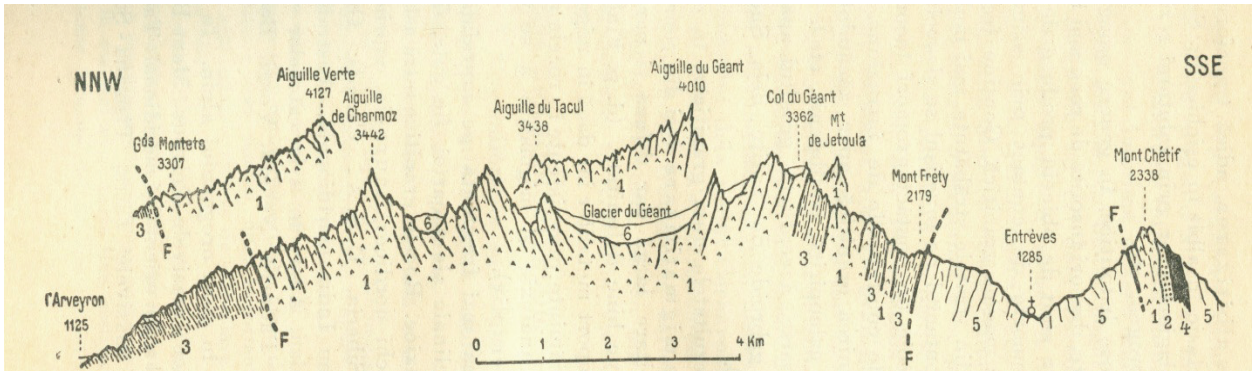

Figure 2. Profile of the central area of the Mont Blanc granite massif (MRAZEC, 1892).

FROM STUDENT TO PROFESSOR

Similar to his mentor L. Duparc, Mrazec started his career by solving physical-chemical problems in the study of minerals, rocks and ores, only to follow later in his career with a shift to tectonics and structural geology. After returning to Romania upon completing his doctoral degree, Ludovic Mrazec was hired as professor of the newly founded department of Mineralogy, whose leadership he held until 1937. Apart from teaching the courses, Mrazec took care of organizing and endowing the laboratory with mineral collections and rocks and analytical equipment. He also organized a specialized library within the department that included fundamental treatises and periodical collections (American Mineralogist, Economic Geology, etc.). The quintessence of his experience in teaching mineralogy courses and practical works is his "General Course of Minerals and Rocks'' (1938). The importance of mineralogy as a science could be illustrated through the words of professor Ludovic Mrazec: "We must not forget that the only purpose followed through mineralogic instruction is to know the minerals and their associations, their occurrence as well as their role in our economic life" (1938).

YEARS OF RESEARCH

The research directions approached by Professor Ludovic Mrazec covered a broad spectrum: Mineralogy, Magmatic and Metamorphic Petrology, Structural Cartography and Geology, Oil Geology, Sedimentary Petrology, Ore deposits. His first field campaigns and studies took place between 1893 and 1900 in the various areas of the Carpathian Mountains and Dobrogea and focused primarily but not exclusively on basement rocks. Highlights were studies of the ortho-gneisses at Cozia and of the coal deposits in the Jiu Valley.

The second stage of his research carried out between 1900 and 1930 concerned the Sub-Carpathian hills rich in salt and crude oil. In 1900, at the Paris International Exhibition, he presented the first map of salt formations in Romania. This was a result of the extensive field work he and a prominent Polish geologist, Wawrzyniec Teisseyre (1860-1939), carried out in the diapir fold zone, and it is regarded as his first major contribution to the study of Romanian salt (MRAZEC & TEISSEYRE, 1902).

MRAZEC & TEISSEYRE (1902) were the first to discuss the depositional environment, the age, the internal structures, the chemistry, and also the tectonics of the salt in the Romanian Carpathians. They also described the unconformity between the salt core and the adjacent layers with the notion that salt is mostly found associated with anticlines (Fig. 3).

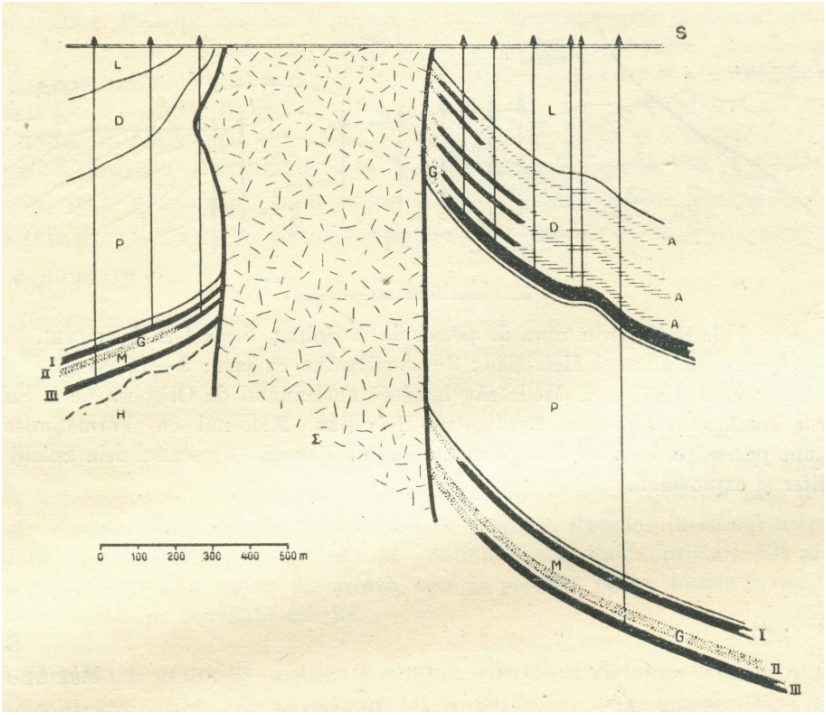

Figure 3. Cross-section of the Moreni-Tuicani anticline, a perfect example of a salt diapir (MRAZEC & ATANASIU, 1927).

Mrazec referred to these structures as "anticlines with salt core" or "folds with piercing core". He coined the term "diapir" and the phenomenon of "diapirism" (plastic deformations and salt lifting by breaking up the formations above the deposit) for raw salt, demonstrating that they can provide an effective trap for oil and gas pools. Salt diapirism was firstly mentioned by Ludovic Mrazec at the Third International Petroleum Conference, in 1907 (MRAZEC, 1910).

Following the Third International Petroleum Congress, Mrazec summarized his theories in a paper in 1915, which issued in print in 1926. In this context, Ludovic Mrazec explained the distribution of hydrocarbon accumulations in the sub-Carpathian Neogene area. Given the limited data sets (wells and outcrops) of the time, it is remarkable that Mrazec put forward an internally coherent salt tectonics model and that some aspects of his model are still valid. Furthermore, he explained the appearance of petroleum in organic matter, demonstrating that the organic raw material the oil originated from was the plankton of the sea.

MODERNIZING THE ROMANIAN GEOLOGY

On June 19, 1906, the Geological Institute of Romania was established by Royal Decree, the first Director being Ludovic Mrazec, one of the initiators. He led this institute from 1906 until 1930, succeeding in imposing a climate of collaboration and understanding. Under his leadership, the first geological map of Romania was developed in 1920, and the oil and gas fields of Transylvania were evaluated. In 1924, Ludovic Mrazec proposed that the geological maps made on scales 1: 1,000,000 and 1: 500,000 should represent deep structures using the borehole data. Also, on his own initiative, one of the topics discussed at the International Drilling Congresses held between 1925 and 1939 should concern the methodology of using drilling data for the study of the lithosphere. In 1926, under Mrazec's coordination, the geological map of Romania, scale 1: 1,500,000 (printed in 1927), was made and exhibited at the International Geological Congress in Madrid.

LEGACY FOR FUTURE GEOLOGISTS

Ludovic Mrazec retired at the age of 63, in 1930, despite his contributions and his ability to conduct new research. In the remaining years of his life, he devoted his energy to the organization of scientific meetings, the publishing of a scientific bulletin, actions that have led to the increase of Romania's scientific prestige. Subsequently, he held conferences on topics related to the gold mines in Romania, the classification of the Carpathian flysch, the sulphur deposits in Romania, the origin of the salt lakes, the loess origin, etc. Every scientific community, including the

Romanian geosciences has an iconic father figure, responsible for placing geology on the map of that country. Ludovic Mrazec through his own work and dedication succeeded in writing a golden page in the history of the Romanian geology and worldwide petroleum geology.

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