ABSTRACT

Social representation of a profession and the recognition of its importance by other professional categories depend on the skill level of those who practice it, their competence and professionalism.

The assignment of a university professor is not only about transmitting information, but also about creating it. Therefore, research plays a major role in personal development and, implicitly and cumulatively, in the development of the universities.

The present habilitation thesis is a synthesis of the didactic and research activity conducted by the author after the public presentation (in November 1999) of the doctoral thesis entitled "Optimizing the parameters of the mining methods of thick seams with great dip in order to reduce the risk of coal self-ignition", elaborated under the scientific coordination of prof.dr.doc.eng. Covaci Ştefan.

The **first chapter** of the thesis briefly presents the most relevant results obtained by the author in didactic activity and scientific research after presenting the doctoral thesis. As far as the teaching component is concerned, I held courses at the following subjects: underground mining of the mineral deposits; open cast mining; optimization of the mining methods and technologies; mining techniques and technologies, etc. The didactic activity took place in both undergraduate and master studying programs. For a period of time I have been teaching as an associate member of the Technical University of Moldova, Chisinau, where I have taught subjects dealing with the exploitation of useful minerals.

Also in this chapter there are presented the permanent preoccupations for documentation and improvement in the fields of didactic and research activities: underground and open cast mining of the mineral deposits; improvement and technical-economic optimization of exploitation methods and technologies; health and safety at work; mine closure.

Chapter 2 deals with the *"deformation of the ground surface following the underground exploitation of mineral deposits"*. There is presented the behavior of the rock mass above the mining area, after which the movement of the layers around the underground cavity is analyzed, as well as the influence area created on the surface. The displacement of the overburden strata depends on the properties of the rocks and has various forms of manifestation: the rocks falling from the direct and main roof, the movement of the rock seams under the action of their own weight, the compaction of the mass of rocks under the weight of the overburden strata, the displacement of the rocks following their bedding planes, etc. The formation mechanism of a continuous subsidence bed and the stages it can go through with the advance of the coal face.

Chapter 3, entitled "*Continuous subsidence*", analyses the occurrence and manifestation of this type of deformation when the coalfield is mining with underground longwall face. Starting from the behavior of the roof above and behind the longwall face, the phases of its collapse and the distribution of the vertical tension around the longwall face are highlighted. The issue of fracture the roof or the coal bed is dealt with. In this regard, a

conceptual model is presented for the top coal mining method and a pattern of displacements occurring in the roof of the longwall face. There were identified the fracture mechanisms of the floor and the tensions that appear in it. Further on, the geodynamic phenomenon produced in coal layer no. 3 at the Petrila mine in 2008 was studied. Following this event, the coal self-ignition process took place, producing a tragic event with casualties. It is presented in detail the whole mechanism of the coal's self-ignition at that time and the causes that led to its occurrence, starting from the mutual influence of the two working fronts. After description of the small-scale physical model designed to simulate the fracture and the displacement of the roof layers, a synthetic model of rock mass representation is proposed, continuing with the modeling and simulation of the roof fractures.

Chapter 4, "*Discontinuous subsidence*", details these types of deformations, which is an well known problem in areas where underground mining activities have taken place, and then continues to model the sinkholes. The new numerical methods allow the study of sinkholes and pits occurring at the surface of the land taking into account numerous important parameters with a significant influence on the deformation of the ground surface. First, there is presented the analytical modeling (general geomechanical models, simple geometric models) and then their numerical modeling (a widely used method in many particular cases, such as open cast mining, building engineering, natural and artificial slope stability analysis, etc.)

Starting from the two phases of the numerical modeling (the conceptual model and the numerical model), I have detailed the operations to be covered in each of them and elaborated the logical scheme to elaborate a conceptual model. The conceptual model begins with an analysis and modeling of the tasks, of the available database and includes several stages: pre-planning, sizing, building, monitoring, further analysis, stages detailed in the thesis. I have also drafted the logical scheme of numerical modeling. The model configuration begins by defining the initial and limit conditions, the calculation sequence, the constituent laws specifications and their parameters in the form of an input script or a menu-oriented dialog. Finally, we designed a verification and validation algorithm to develop software.

We have presented the numerical modeling of sinkholes applied in a case study of the discontinuous subsidence phenomenon, at Lupeni mine.

"*Prognosis of ground surface deformation*" is the title of **chapter 5**, which starts with a brief analysis of the subsidence, and then extensively deals with the progression of vertical movements. A method of prognosis presented in the thesis and used for a long time in Romania was that of the profile functions, elaborated by the researchers from I.C.P.M.C. Petrosani in collaboration with teachers from the Institute of Mines from Petrosani (current university) and with specialists from other research institutes. The method allows the prediction of the subsidence phenomenon, the safety depth calculation, and the design of the pillars, as part of the group of profile functions methods that attempt to define the subsidence profile through the graph of a mathematical function. Numerical 2D prediction models of subsidence are created for the extraction of a single seam and of double-seams, taking into account different properties of the overburden strata. We analyze the occurrences of both the cavity model and the use of the goaf model. Further on, the results of the 3D forecasting, obtained on the basis of a logical scheme of the modeling process, confirm that the anticipated

subsidence profile following the simulation is comparable to that obtained from in situ measurements.

Chapter 6, whose title is "*Plan for the development of the academic career and scientific research activities*", briefly outlines the general directions of academic career development and sets out the main objectives of the research activity.