ГОДИШНИК НА МИННО-ГЕОЛОЖКИЯ УНИВЕРСИТЕТ "СВ. ИВАН РИЛСКИ", Том 48, Св. I, Геология и геофизика, 2005
ANNUAL OF THE UNIVERSITY OF MINING AND GEOLOGY "ST. IVAN RILSKI", Vol. 48, Part I, Geology and Geophysics, 2005

PHYSICAL AND MECHANICAL PARAMETERS VARIATION, IN RELATION WITH DEPTH AND ENE-WSW ORIENTATION OF EPICLASTICAL SEDIMENTS

Mircea Rebrişoreanu

University of Petrosani, Romania

ABSTRACT. The sedimentary rocks in wich the 21 coal seams from Valea Jiului are located were analyzed in the paper, on mining perimeters and physical and mechanical parameters were assessed. The results obtained had emphasized a variation of these parameters, both with depth and direction, the values growing from N-E to S-W. If on the vertical, the lithostatic pressure determines this growth, on the direction the main cause is represented by the tectonic factor wich, as suggested by the triangle shape of the basin, acted with maximum magnitude on the south-western point.

ВАРИАЦИИ ВЪВ ФИЗИЧНИТЕ И МЕХАНИЧНИТЕ ПАРАМЕТРИ ВЪВ ВРЪЗКА С ДЪЛБОЧИНАТА И ИСИ-ЗЮЗ ОРИЕНТАЦИЯ НА ЕПИКЛАСТИЧНИ СЕДИМЕНТИ

Мирча Ребришореану
Петрушански университет, Румъния

The Petrosani coal basin is located in the central area of Meridional Carpathians, in the SW of Romania, between 45°17' – 45°22' northern latitude and 20°13' – 20°33' eastern longitude. The basin has the shape of a sharpened triangle, oriented WSW/ENE, with a length of about 50 kilometers between the villages Rascoala, at east and Campu lui Neag at west. Its maximum width reaches 9 kilometers in the area of the towns Petrila – Livezeni, decreasing in the west side at Campu lui Neag. The Petrosani basin is a post Laramic tectonical depression, through an intense subsidence suggested by the high thickness of epiclastical sediments chock and high number of coal seams.

The sediments of the Petrosani basin (Fig. 1) are placed on the two major tectonic units of the Meridional Carpathians: the Danubian autochthonous and the Getic layer, being located in a minimal resistence area, activated by the Cerna-Jiu faults system.

The variation of physical and mechanical parameters

In order to define a rock massif and to foresee his behavior from geotectonical point of view, an appropriate knowledge of rock's geomechanical properties is required. To describe the behavior of rocks from the N-E and S-W sides of Petrosani basin, Petrila and Lonea perimeters, respectively Lupeni and Uricani, measurements were carried out at macroscopic and microscopic level on a high number of rock samples recovered from drill holes, in view of a complete characterization of rocks from Petrila and Lonea perimeters and, respectively Lupeni and Uricani.

The following parameters were determined:

- structural properties of rocks: structural weakening coefficient; fissuration degree.
- physical properties: specific weight; apparent specific weight; porosity and pore's number; humidity.
- mechanical properties: mono and triaxial compression resistance; traction resistance; cohesion; internal friction angle.
- elastical characteristics: elasticity module; Poisson's coefficient and constant.
- rheological parameters of rocks.

While the rocks in the massif are affected by different types of deformation, their resistance characteristics are usually lower than those assessed in laboratory conditions. In the goal of transposing the resistance properties determined by laboratory test and establishing the massif's properties the structural weakening coefficient was employed.

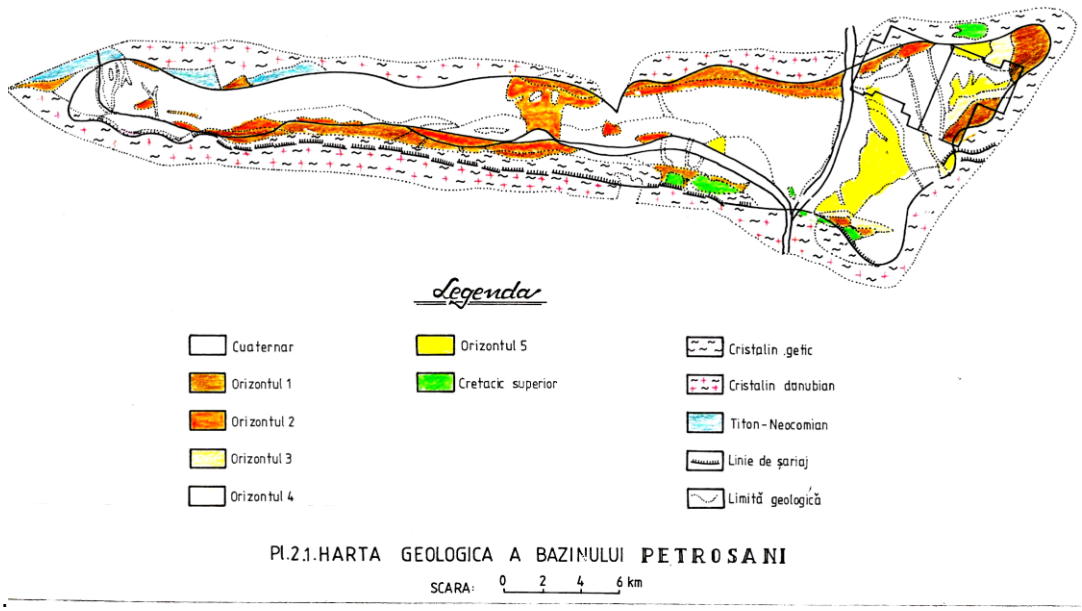

Fig. 1.

Table 1

Rock denomination	Rock type	Structural weakening coefficient, C_s [%]
Gresie	Silicated sandstone	4.2
	Quartz sandstone	1.56
	Limestone sandstone	4.52
	Graywacke	7.25
	Schistous sandstone	5.16
Marl	Coal marl	51.5
	Compact marl	31.8
Clay	Compact clay	17.5
	Gritty clay	21.9
	Bituminous clay	13.33
	Montmorillonitic clay	14.75
Schist	Shale	4.2
	Compact schist	31.95
Conglomerate	Conglomerate	17.9
	Microconglomerate	15.3

The assessment of geomechanical properties variation with the mining depth was achieved by grouping the rock types and depth ranges from 100 to 100 meters. These determinations were carried out for Petrila and Lonea perimeters and respectively, Lupeni and Uricani.

Analysing the variation pattern of geomechanical characteristics for the rocks having the greatest weight in the basin, namely: silica sandstones, clay sandstones, clays and conglomerates, it was observed that in their great majority, these possess an increasing trend from east to west, and also this tendency is maintained for the depth's increase.

The apparent specific weight's increase is comprised between 0.01 and 0.09 x 10^4 N/m^3 for 100 metres raise of depth. The monoaxial compression breakage strength varies from 1.2 and 8.6 MPa of increase per 100 meters increase of depth, and the tensile breakage strength increase varies from 0.1 to 1.67 MPa. Rock cohesion values are increasing with values ranging from 0,17-1,26 MPa for a depth increase of 100 m.

Fig. 2. Graphical dependencies between physical and mechanical rock properties and mining depths were drawn, in the purpose of assessing their variation laws

Another factor inducing the variation of physical and mechanical parameters of Petrosani basin sediments is the stress who acted and generated a distension tectonical regime superposed on a phase when the tectonical regime turned in decompression, which is suggested by the northern plan of the basin, which in certain areas seems, to be overtuned. The variation of these physical and mechanical parameters is also related to the fact that the Petrosani basin can be interpreted as a pull-aport structure with N-E prograde (Rat Schabacher et al., 1993), successively constituted along the concave fracture plane of Cerna-Jiu fault system.

The variation way of geomechanical properties with the mining depth is represented in tables 2.1, 2.2 and 2.3. The best approximation of the related functions was done by linear equations having the following shape:

$$Y = A + B \cdot H \qquad (1)$$

Where: Y is the causal property; H – the mining depth; A and B – coefficients assessed for each rock tip, using the least square root method.

So, the apparent specific weight has a deviation comprised between 0 and $4.17.10^4$ N/m^3, the analiticaly determined monoaxial compression breakage strength is affected by a deviation of 0 to 64.4 N/m^2, the tensile breakage strength varies with values comprised from 0.3 to 15.77 N/m^2, cohesion presents differences ranging from 0.1 and 0.828 N/m^2 and the elasticity module has de variations comprised between 0 and 5.67 N/m^2.

As concluding remarks, it can be stated that the rocks composing the productive horizon of the Petrosani sedimentary basin are presenting significant variations of physical and mechanical characteristics with depth and direction. The increase of the physical and mechanical parameters values with depth is explained by the increase in lithostatic pressure value which, in turn, induces an increase of the sediments compactisation degree. Parameters variation with the direction is a consequence of higher intensities of tectonical forces at the WSW extreme limit, representing the peak of the pointed triangle which is the Petrosani basin.

References

Arad, V. 1995. *Geotehnică minie*ră. Editura tehnică, Bucureşti.

Arad, V. 2004. *Mecanica rocilor.* Editura tehnică.

Mutihac, V. 1990. *Structura geologică a teritoriului României*. Editura tehnică, Bucureşti.

Rebrişoreanu, M. 2005. *Geologie aplicată*. Editura RISOPRINT Cluj Napoca.

Todorescu, A. 1984. *Proprietăţile rocilor.* Editura tehnică, Bucureşti.

Recommended for publication by Department of Geology and Prospecting of Mineral Deposits, Faculty of Geology and Prospecting

Table 2.1

Rock's denomination	Property	Property's symbol	Measuring unit	Depth	Perimeter			
					Petrila	Uricani	Lonea	Lupeni
Greywacke	Apparent specific weight	γ_a	x10^4 N/m^3	0 – 1	2.55	2.6	2.41	2.52
				1 – 2	2.64	2.62	2.43	2.61
				2 – 3	2.64	2.69	2.45	2.62
				3 – 4	2.61	2.75	2.52	2.63
				4 – 5	2.62	2.75	2.53	2.58
				5 – 6	2.59	-	-	2.61
				6 – 7	2.62	-	2.58	-
	Compression breakage strength	σ_{rc}	MPa	0 – 1	19.7	19.5	17.6	31.5
				1 – 2	34.4	25.5	32.7	42.8
				2 – 3	36.1	29	32.5	36.4
				3 – 4	34.2	30	33	40.1
				4 – 5	35.7	30,9	30.5	50.5
				5 – 6	46.5	-	-	56.3
				6 – 7	51.2	-	48.9	-
	Tensile breakage strength	σ_{rt}	MPa	0 – 1	1.43	3.1	-	3.8
				1 – 2	3.85	4.7	2.6	4.1
				2 – 3	5.04	5.5	3	3.7
				3 – 4	3.81	7.4	4.1	3
				4 – 5	4.91	8	3.5	3.5
				5 – 6	5.22	-	-	7.8
				6 – 7	6.11	-	4.8	-
	Cohesion	C	MPa	0 – 1	2.6	3.7	4.5	3.8
				1 – 2	6	4.2	5.2	6.8
				2 – 3	6	6	7.5	8.8
				3 – 4	6.3	7	8.1	9.1
				4 – 5	6.12	7.5	7.9	8
				5 – 6	6.5	-	8	7.8
				6 – 7	7.1	-	8.3	-

Table 2.2

Rock denomination	Property	Property's symbol	Measuring unit	Depth	Perimeter			
					Petrila	Uricani	Lonea	Lupeni
Clay	Apparent specific weight	γ_a	$x10^4$ N/m^3	0 – 1	2.57	2.73	2.47	2.58
				1 – 2	2.6	2.62	2.53	2.63
				2 – 3	2.58	2.72	2.53	2.6
				3 – 4	2.62	2.7	2.55	2.72
				4 – 5	2.6	2.73	2.52	2.55
				5 – 6	2.61	-	2.5	-
				6 – 7	2.62	-	2.56	-
	Compression breakage strength	σ_{rc}	MPa	0 – 1	20.8	17.9	3.6	25.6
				1 – 2	19.2	23.9	12.1	39.7
				2 – 3	21.5	34.3	17.1	49.4
				3 – 4	20.8	30	19.1	54.1
				4 – 5	23.7	37.9	18.8	58.2
				5 – 6	31.2	-	24.3	-
				6 – 7	34.3	-	26	-
	Tensile breakage strength	σ_{rt}	MPa	0 – 1	2.49	5.8	1	3.1
				1 – 2	3.62	6	1.9	8.2
				2 – 3	-	7.3	2.12	6.5
				3 – 4	3.37	7.5	3.0	8
				4 – 5	3.37	11.8	3.25	8.2
				5 – 6	3.75	-	3.14	-
				6 – 7	5.35	-	3.67	-
	Cohesion	C	MPa	0 – 1	3.05	5.6	3.11	2.8
				1 – 2	3.11	6	3.05	2.1
				2 – 3	3.6	7.5	4.25	2.2
				3 – 4	4.15	7.5	4.11	5.2
				4 – 5	4.25	8	4	6.9
				5 – 6	4.32	-	4	-
				6 – 7	4.57	-	3.5	-

Table 2.3

Rock denomination	Property	Property's symbol	Measuring unit	Depth	Perimeter			
					Petrila	Uricani	Lonea	Lupeni
Silicated sandstone	Apparent specific weight	γ_a	$x10^4$ N/m^3	0 – 1	2.47	2.63	2.52	2.42
				1 – 2	2.57	2.7	2.55	2.45
				2 – 3	2.56	2.7	2.20	2.51
				3 – 4	2.6	2.69	2.59	2.56
				4 – 5	2.59	2.55	2.43	-
				5 – 6	2.61	-	-	2.61
				6 – 7	2.59	-	2.57	-
	Compression breakage strength	σ_{rc}	MPa	0 – 1	35.7	38.4	19	32
				1 – 2	64.9	41	30	41.8
				2 – 3	16.3	41.2	32.6	50.2
				3 – 4	36	40	20	61.6
				4 – 5	45.5	42	23.2	-
				5 – 6	47.1	-	-	65
				6 – 7	51.5	-	49	-
	Tensile breakage strength	σ_{rt}	MPa	0 – 1	5.5	4.7	6	3
				1 – 2	5.33	6.5	6.5	3.5
				2 – 3	1.5	10.2	7.5	3.9
				3 – 4	5.5	8.5	6.7	9.5
				4 – 5	6.18	9	2.3	-
				5 – 6	7.15	9	-	8.5
				6 – 7	-	-	-	-
	Cohesion	C	MPa	0 – 1	7.5	10.5	5.2	3
				1 – 2	8	10.8	7.1	3.2
				2 – 3	7.5	11.2	8.9	2.9
				3 – 4	8	11.9	9	8.5
				4 – 5	7.9	12	8.5	-
				5 – 6	8.2	-	9.2	8
				6 – 7	8.5	-	9.5	-