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SEDIMENTARY ROCKS ASSOCIATED WITH THE COAL SEAMS OF THE SADDLE BEDS FROM THE CHWAŁOWICE TROUGH – WEST PART OF UPPER SILESIAN COAL BASIN

SKAŁY OSADOWE TOWARZYSZĄCE POKŁADOM WĘGLA WARSTW SIODŁOWYCH NIECKI CHWAŁOWICKIEJ – ZACHODNIA CZĘŚĆ GÓRNOŚLĄSKIEGO ZAGŁĘBIA WĘGLOWEGO

The results of investigation of the associated rocks with the Saddle Beds Coals Seams from Chwałowice Trough were presented in this article. The results of researches show that sandstones and mudstones dominate in the investigating profile. Claystones are situated mainly in ceilings and floors of coal seams. Grains of sandstones include mainly quartz, feldspars, micas and also quartzite's and gneiss's fragments. It is also possible to observe small grains of heavy minerals. Some of sandstones present bad compactness and are destroyed during transportation. This feature is connected with presence of little quantity of cement, especially in medium grained sandstones, which include more matrix than typical cement. The cement is built mainly of clay minerals, kaolinite and illite, carbonates and chalcedony but X-ray diffraction confirmed also the presence of halite in the cement of investigated sandstones.

Mudstones and claystones are composed mainly of clay minerals. It's also possible to find quartz and micas there. Higher amounts of quartz and micas are possible to find rather in mudstones.

The associated rocks with the Saddle Beds Coal Seams from Chwałowice Trough include also organic matter.

Keywords: sedimentary rocks, Saddle Beds, Upper Silesian Coal Basin, Chwałowice Trough

W artykule przedstawiono wyniki badań skał towarzyszących pokładom węgla warstw siodłowych Niecki Chwałowickiej. Wyniki badań wskazują, że w badanym profilu dominują piaskowce oraz mułowce. Iłowce natomiast występują głównie w stropach i spągach pokładów węgla. Okruchy piaskowców to głównie ziarna kwarcu, skaleni, mik oraz fragmenty kwarcytów i gnejsów. Można tu również zaobserwować drobne okruchy minerałów ciężkich. Niektóre piaskowce charakteryzują się obniżoną zwięzłością i podczas transportu ulegają rozpadowi. Cecha ta związana jest z niewielką ilością spoiwa, szczególnie w piaskowcach średnioziarnistych, w których matrix przeważa nad typowym cementem. Spoiwo zbudowane jest głównie z minerałów ilastych, takich jak kaolinit i illit, węglanów i chalcedonu, chociaż wyniki dyfraktometrii rentgenowskiej potwierdziły występowanie w spoiwie badanych piaskowców również halitu. Na podstawie składu mineralnego piaskowców, dokonano ich klasyfikacji, stosując podziały skał okruchowych Krynina (1948) i Pettijohn'a-Potter'a-Siever'a (1973). Według klasyfikacji Krynina badane

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piaskowce reprezentują szarogłazy (szarowaki). W klasyfikacji Pettijohn'a, próbki 6, 8 i 13 reprezentują arenity lityczne, natomiast próbki 3 i 10- waki.

Mułowce i iłowce zbudowane SA głównie z minerałów ilastych. Można w nich również spotkać ziarna kwarcu oraz miki. Wyższy udział kwarcu i mik jest jednak charakterystyczny dla mułowców.

Skały towarzyszące pokładom węgla warstw siodłowych Niecki Chwałowickiej zawierają również domieszki substancji organicznej.

Słowa kluczowe: skały osadowe, warstwy siodłowe, Górnośląskie Zagłębie Węglowe, Niecka Chwałowicka

1. Introduction

The results of investigation of the rocks associated with coal seams in Chwałowice Trough were presented in this article. Chwałowice Trough belongs to Upper Silesian Coal Basin. It is placed in the West part of Upper Silesian Coal Basin (USCB). This coal basin is built of Carbon sediments (Gabzdyl, 1999; Probierz et al., 2012). The formation includes clastic rocks- sandstones, mudstones, claystones and in some areas conglomerates interlayer by coal seams (Chodyniecka & Hanak, 1985; Chodyniecka & Probierz, 1985; Dopita & Kumpera, 1993; Kruszewska et al., 1977; Lipiarski & Muszyński, 2001; Stanienda, 2001; Wilk, 1979).

The samples of rocks were taken form Saddle Beds in Chwałowice Coal Mine. The Saddle Beds are mainly built of sandstones and mudstones. Claystones are situated mainly in ceilings and floors of coal seams. To characterize rocks macroscopic description and microscopic, chemical, thermal and X-ray analyses were executed. The results of analyses permitted to characterize petrographic composition of these rocks.

2. Geological building of Chwałowice Trough

Chwałowice Trough is situated in the West part of the Upper Silesian Coal Basin between Jejkowice Trough in the West and Jastrzębie Syncline and Anticline in the South-East.

Upper Silesian Coal Basin belongs to Euroamerican Coal Province. Deposits which include coal seams were formed in the North Hemisphere of Earth during the time of upper Carbon (Dopita et al., 1997; Gabzdyl, 1999). The coal basins formed this time in Europe are usually built of clastic rocks with interlayers of coal seams. In Upper Silesian Coal Basin strata of lower part of upper Carbon profile were formed in sea basin. It is Paralic Series (Table 1). Strata of upper part of this profile were formed in limnic conditions.

Chwałowice Trough is bordered by Orłowa-Boguszowice and Michałkowice Overthrusts. The Strata of Carboniferous which built the Trough are: from bottom Petřkovice Beds, Hrušov Beds, Jaklovec Beds, Poruba Beds, Saddle (Anticlinal) Beds, Ruda Beds to Załęże Beds in the top (Table 1). The profile of each series of rocks associated with coal seams in West part of the Upper Silesian Coal Basin, also in the Chwałowice Trough includes different content of sandstones, mudstones, claystones and conglomerates (Gabzdyl, 1999). Coals from West part of the Upper Silesian Coal Basin present types from 31 to 34. In the North and North-West part of the USCB is also possible to find anthracites. The coals from West part of the Upper Silesian Coal Basin are built of various macerals which present differentiated chemistry (Gabzdyl, 1999; Komorek et al., 2010; Kruszewska et al., 1977; Morga, 2011; Probierz et al., 2012).

TABLE 1

Series of sediments in Chwałowice Trough (Gabzdyl, 1999; Probierz et al., 2012)

Name of Series	Name of Strata	Numbers of coal seams
The Mudstone Series	Załęże Beds	328 to 364, 401 to 406
The Upper Silesian Sandstone Series	Ruda Beds	407 to 420
	Saddle (Anticlinal) Beds	501 to 508
The Paralic Series	Poruba Beds	600
	Jaklovec Beds	700
	Hrušov Beds	800
	Petřkovice Beds	900

Saddle (Anticlinal) Beds

Saddle (Anticlinal) Beds form the lower level of the Upper Silesian Sandstone Series (Gabzdyl, 1999; Chodyniecka & Probierz, 1985, Probierz et al., 2012). These strata include coal seams with numbers of 500. Their profile begins from eroded conglomerate and ends in the ceilings of 501 coal seam. The medium thickness of these strata is 339 m. The investigated profile had 300 m of thickness and its included rocks associated coal seam of Saddle Beds from 501/1 coal seam to 508 coal seam. Sandstones and conglomerates dominate in the profile of Saddle Beds. The total thickness of sandstone is 124 m (41,3%), mudstone – about 70 m (23,3%) and claystone – about 44 m (14,6%). The total thickness of coal seams is 62 m (20,6%). Coals from Saddle Beds are vitrain, durite or trimacerite type (507 coal seam) with variable content of other lithotypes (504 and 506 coal seams) (Gabzdyl, 1999; Kruszewska et al., 1977).

3. Methodology of researches

The samples were collected in the Chwałowice Coal Mine in the working floor 390, which is situated in the East part of mining area (Pl. 1, Pl. 2). Chip samples were taken in the East Cross-out I. Its length is 700 m. The sampling was executed along the cross-out, in places of rocks exposures. Fourteen samples were collected from here: 5 sandstones, 5 mudstones and 4 claystones.

Microscopic analysis was executed using Opton Axioplan Universal Microscope with Image Analyser K300, produced by Zeiss. The chemical analysis was executed on mudstone and claystone the contents of SiO_2, Al_2O_3, Fe_2O_3, FeO, CaO, MgO, Na_2O, K_2O, Cl^-, H_2O^- and roasting waste were examined.

X-ray diffraction was done by the Debye-Scherrer-Hull (DSH) method, using X-Ray Diffractometer M61, equipped with the cobalt lamp with the iron filter. Mudstones, claystones and cement of sandstones were investigated by this method.

The thermal analysis was executed using derivatograph F. Paulik-J. Paulik-L. Erdey, Parameters of the measurement: time – 100 minut, maximal temperature – 1000°C, sensitivity DTA and DTG – 1/10, TG – 500 mg, sample mass – 600 mg.

4. Results of researches

In Chwałowice Coal Mine 14 samples were collected: five sandstones (samples 3, 6, 8, 10, 13), five mudstones (samples 2, 4, 9, 12, 14) and four claystones (samples 1, 5, 7, 11) (Pl. 1 and 2).

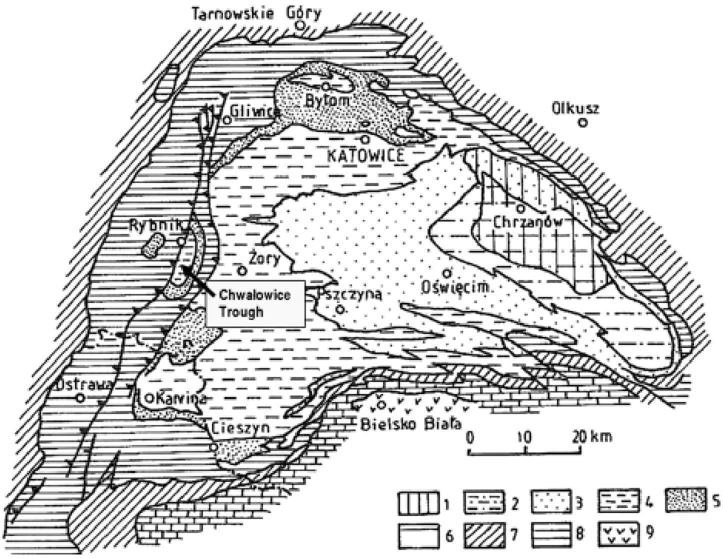

Plate 1. Map of Upper Silesian Coal Basin (Gabzdyl, 1999) with location of Chwałowice Trough
1 – Kwaczała Arcose, 2 – Libiąż Beds, 3 – Łaziska Beds, 4 – Mudstone Series, 5 – Upper Silesian Sandstone Series, 6 – Paralic Series, 7 – Marine diastrophic sediments, 8 – Devonian carbonate and clastic sediments, 9 – Devonian metamorphic rocks

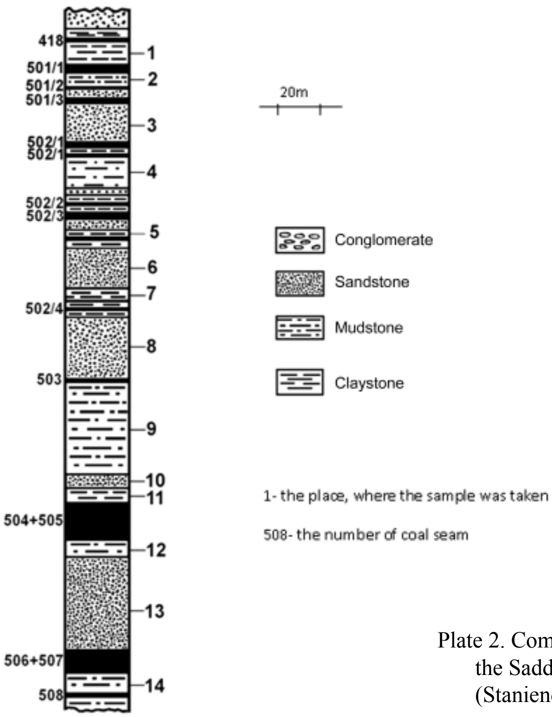

Plate 2. Comprehensive Geological profile of fragment of the Saddle Beds made according to map of the level 390 (Stanienda, 2001)

Sandstones are fair grey in colour (samples 6, 8, 13), sometimes beige (sample10) or dark grey (sample 3). They present psammitic texture, medium grained (samples 6, 8, 13) or fine-grained (samples 3, 10) and massive, disordered (samples 3, 6, 8, 13) or laminar (sample 10) structure (Pl. 3 – D, E). Lamination is connected with the presence of fair and dark strata, sometimes lamina with grains different in size and dark lamina of organic matter. Some of sandstones

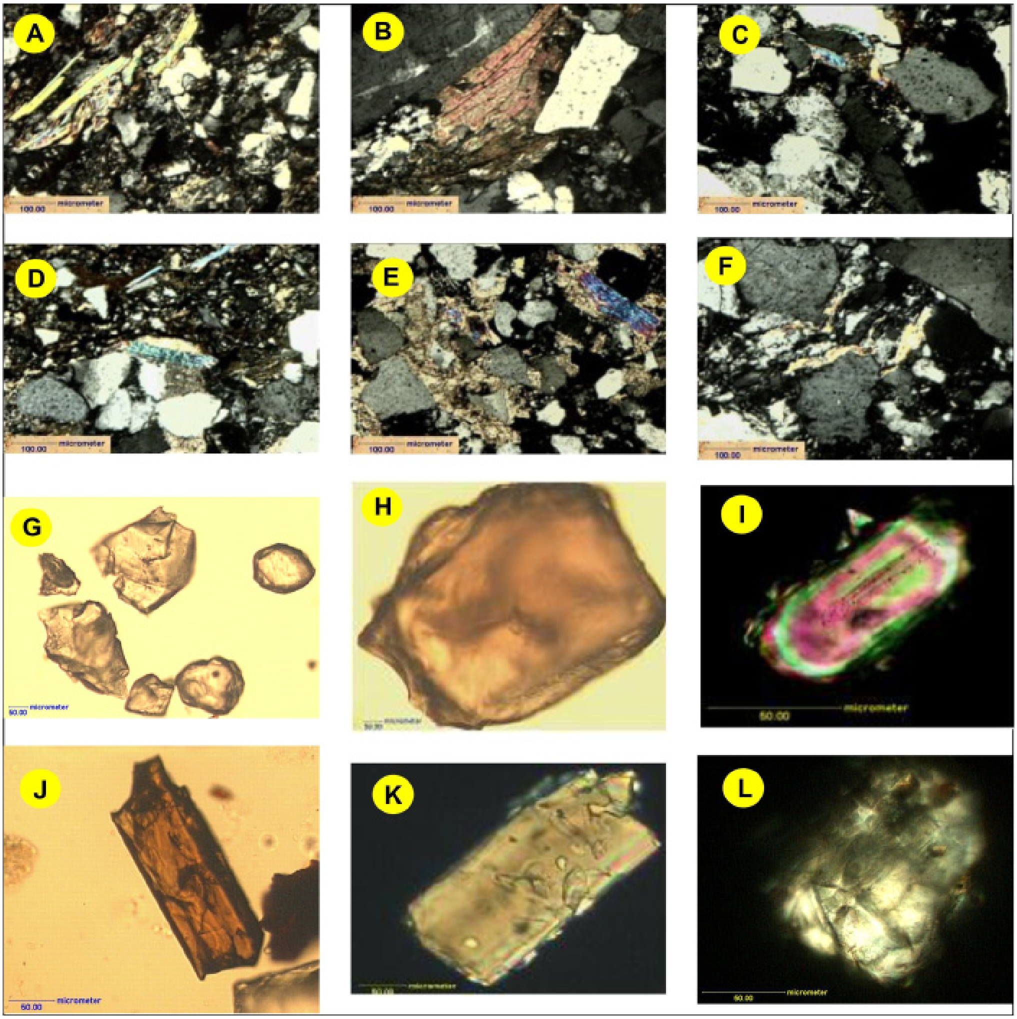

Plate 3. Microscopic views of sandstone samples (A – F) and heavy minerals (G – L).
Microscopic view of sample 3, XN, Magn. 100×; B – Microscopic view of sample 6, XN, Magn. 100×; C – Microscopic view of sample 8, XN, Magn. 100×; D – Microscopic view of sample 10, XN, Magn. 100×; E – Microscopic view of sample 10, XN, Magn. 100×; F – Microscopic view of sample 13, XN, Magn.100×; G – Transparent garnets in sample 8, 1N, Magn. 100× (Stanienda K., 2002); H – Pink garnet in sample 6, 1N, Magn. 100×; I – Zircon with zonal building, in sample 8, XN, Magn. 400×; J – Rutile in sample 6, 1N, Magn. 200×; K – Tourmaline in sample 8, XN, Magn. 200×; L – Apatite in sample 13, XN, Magn. 400×

present very week compactness (samples 6, 8,13). Among the grains quartz, biotite, muscovite, feldspars and rock grains dominate (Pl. 3 – Figs. A, B, C, D, E, F) (Stanienda, 2001). Moreover some of heavy minerals were also found (Stanienda, 2002).

The clasts are badly graded (Pl. 3 – C, D). The size of grains hesitates from 0,1 to 1,2 mm. Among the clasts quartz dominates. Its crystals are different in chipping (Pl. 3 – B, E). Some of them are rounded, and others are angular. Muscovite and biotite form plates different in size, sometimes bended and crushed (Pl. 3 – A, B, D, E). In samples 6, 8 and 13 two generations of biotite were observed. The first type includes plates with visible unidirectional cleavage (Pl. 3 – B). Its very easy to describe optical properties in this type of biotite. The second type is weathered biotite. Its not possible to observe the cleavage or analyse optical properties in these plates but its possible to notice the results of the weathering phases and even products of weathering- clay minerals or green plates of chlorite. Feldspars grains are usually big, different in shape and very often weathered, so its difficult to observe the cleavage in the crystals. Among rock grains quartzites, gneisses and silica rocks dominate (Stanienda, 2001).

In sandstones also heavy minerals like garnets (Pl. 3 – G, H), zircon (Pl. 3 – I), rutile (Pl. 3 – J), tourmaline (Pl. 3 – K) and apatite (Pl. 3 – K) were found (Stanienda, 2002). Their crystal are usually smaller than the other ones. It was possible to identify and describe them after separation from the samples using bromoform liquid and following prepare special powder samples for microscopic researches (Stanienda, 2002).

Sandstones present mainly contact in some areas of rock, porous (samples 6, 8, 13) or basic (samples 3, 10) cement (Pl. 3 – A, D, E) (Stanienda, 2001).

The cement includes typical cement small grains and bigger grain of matrix, which dominate in samples 6, 8 and 13 (Table 2). Matrix is mainly composed of quartz, feldspars and chlorite, but the cement in general is mainly built of clay minerals, carbonates and chalcedony. Clay minerals were identified by X-ray diffraction (Stanienda, 2001) and thermal analysis. Kaolinite and illite dominate in the cement (Pl. 4 – A to F). X-ray diffraction allowed also to identify quartz, chlorite, halite and small amount of feldspars (samples 6, 8, 13) (Pl. 4 – A, C, E).

Among carbonate minerals dominate siderite and dolomite, which was identified during microscopic researches by variable relief and high interference colours.

The organic matter present in sandstones form usually lenses, lamina or oval concentration of carbon, sometimes is dispersed.

TABLE 2

Results of planimetric analysis in voluminal percentages (Stanienda, 2001)

Numer of sample	**3**	**6**	**8**	**10**	**13**
quartz	25	18.1	19.6	21	23.4
feldspar	–	6.3	6.5	3.7	5.5
biotite	3.9	1.9	1.9	0.1	0.6
muscovite	4	1.5	0.2	1.4	0.5
rock grains	–	34.6	32.8	1.8	33.1
matrix	–	27.6	29	–	26.9
cement	42.1	10	10	66.9	10
organic matter	25	–	–	5.1	–
Total	100.0	100.0	100.0	100.0	100.0

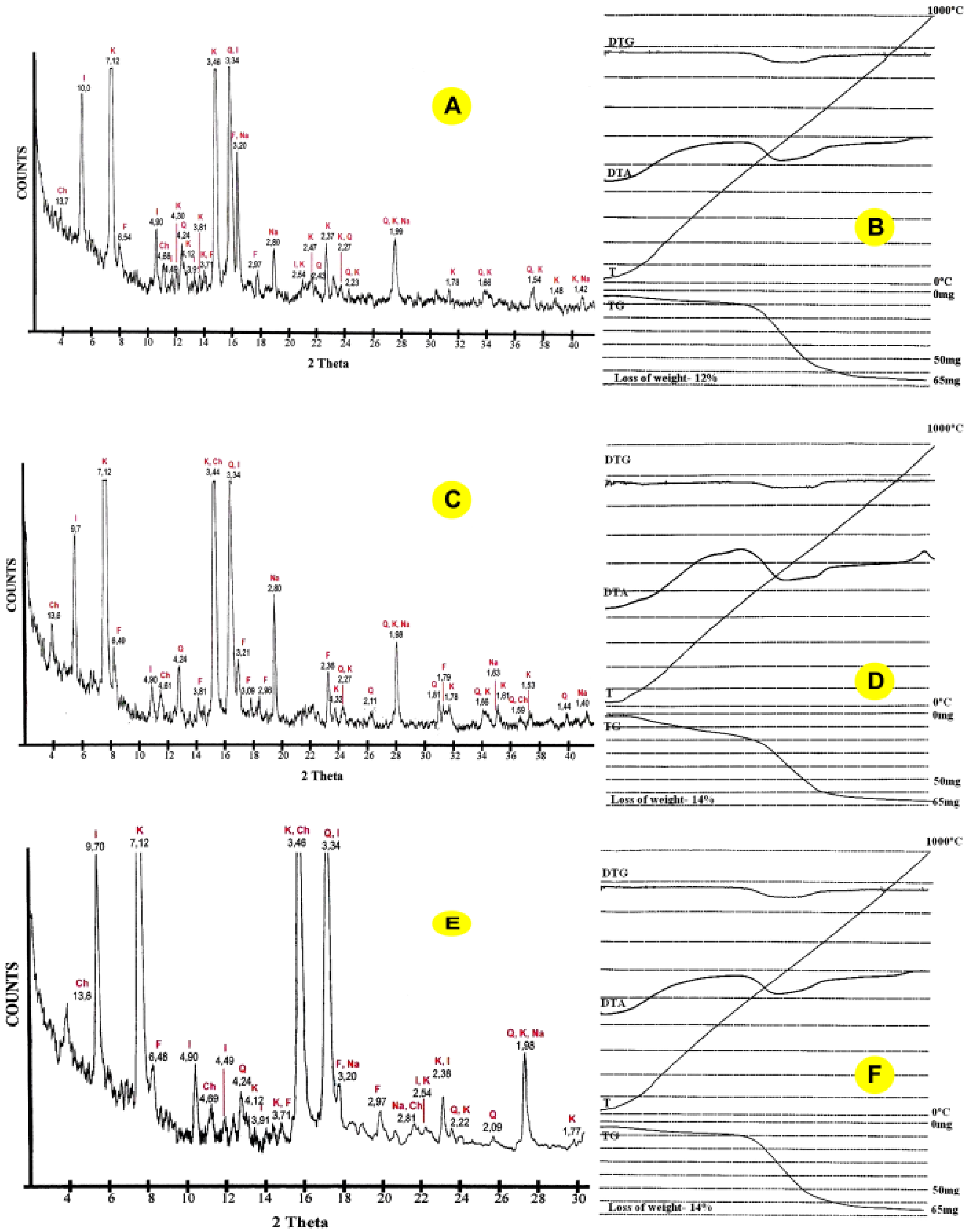

Plate 4. X-ray diffraction patterns and derivathograms of the sandstones' cements.
A – X-ray diffraction pattern of the sample 6 cement; B – Derivathogram of the sample 6 cement;
C – X-ray diffraction pattern of the sample 8 cement; D – Derivathogram of the sample 8 cement;
E – X-ray diffraction pattern of the sample 13 cement; F – Derivathogram of the sample 13 cement;
K – kaolinite, I – illite, Q – quartz, F – feldspar, Ch – chlorite, Na – halite

Based on the results of microscopic, planimetric analysis (Table 2), the sandstones were classified in classifications of Pettijohn-Potter-Siever 1973 (Pettijohn et al., 1973; Stanienda, 2001) (Pl. 5) and Krynin (1948) (Krynin, 1948; Stanienda, 2001) (Pl. 6).

According to Pettijohn-Potter-Siever classification, samples 6, 8 and 13, because of the presence of matrix and the cement content below 15%, represent arenites (Pl. 5). because of high content of rock grains, quartzites and gneisses, they are lithic arenites. Rocks 3 and 10, include above 15% of cement, so they represents wackes (Pl. 5). Sample 3 is lithic wack which is composed mainly of quartz and rock grains. Sample 10 is feldspathic wack. According to Krynin classification sample 3 belongs to greywacke sandstone group and samples 6, 8, 10 and 13 represent greywacke sandstones of lower order (Pl. 6).

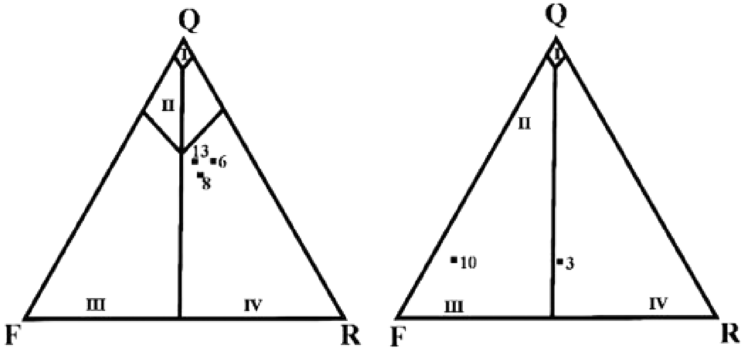

Plate 5. Position of sandstones in classification of Pettijohn-Potter-Siever (1973) (Pettijohn et al., 1973; Stanienda, 2001)
a) classification triangle of arenites: I – quartzose arenites, II – sublithic arenites, III – arkosic arenites, IV – lithic arenits; b) classification triangle of wackes: I – quartzose wackes, II – arkosic wackes, III – feldspathic wackes, IV – lithic wackes, Q – quartz, R – rock grains, F – feldspars

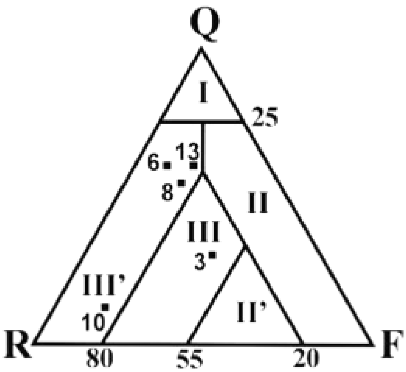

Plate 6. Position of sandstones in classification of Krynin (1948) (Krynin, 1948; Stanienda, 2001)
Q – quarz and silica rocks' grains, F – feldspars and kaolinite, R – micas, chlorites; I – quartzose sandstones, II – arkosic sandstones, III – greywackes, II' – arkosic sandstones of lower order, III' – greywackes of lower order

Mudstones (samples 2, 4, 9, 12, 14) are dark grey in colour. They have aleuritic texture and massive, disordered (sample 9) or laminar (samples 2, 4, 12, 14) structure. Lamination is connected with the presence of fair and dark strata, sometimes lamina with grains different in size (Pl. 7 – A) and dark lamina of organic matter or parallel plates of muscovite (Pl. 7 – B) (Stanienda., 2001). In mudstones, among the grains quartz, biotite and muscovite dominate (Pl. 7 – A, B, C, D, E). The size of grains hesitate form 0,1 to 0,2 mm. Quartz grains are badly graded (Pl. 7 – A, B, C). They are oval in shape (Pl. 7 – B, C). There are lots of muscovite plates, sometimes parallel to each other (Pl. 7 – C). Biotite plates usually weathered are smaller. The content of minerals which form grains in mudstones (Table 4) for samples 9 and 14 was calculate based on the results of chemical analysis (Table 3).

The cement of mudstones is basic and built of clay minerals (Pl. 7 – A, C, D, E), carbonates (siderite dominates) (Pl. 7 – C, D) and chalcedony (Pl. 7 – A, C, E). There is also lots of organic matter dispersed or forms lenses or lamina. The mineral composition of mudstones was confirmed by the results of chemical analysis and X-ray diffraction. According to these researches quartz, kaolinite and illite dominate in mudstones but chlorite and feldspars were also identified (Pl. 8 – A, B, C, Pl. 9 – A, B).

Claystones (samples 1, 5, 7, 11) are dark grey or black in colour. They present pelitic texture and massive, disordered (samples 5, 7) or laminar (samples 1, 11) structure (Stanienda, 2001) (Pl. 7 – F, G, H, I, J). Lamination is connected with the presence of fair and dark strata (sample 1), and dark lamina of organic matter (sample 11) (Pl. 7 – F, G, H). Clay minerals dominate in claystones, mainly kaolinite and illite, identified by X-ray diffraction and also quartz, muscovite and carbonates. Quartz grains are small and rounded. Plates of muscovite are different in size. There is also lots of organic matter dispersed or in forms of lenses or lamina.

The mineral composition of claystones was confirmed by the results of chemical analysis, X-ray diffraction (Pl. 9 – C, Pl. 10 – A, C, E) and thermal analysis (Pl. 9 – D, Pl. 10 – B, D, F). The content of minerals which form claystones (Table 4) was calculate based on the results of chemical analysis (Table 3). By X-ray diffraction quartz, kaolinite, illite and chlorite were identified (Pl. 9 – C, Pl. 10 – A, C, E) and by thermal method – mainly clay minerals – kaolinite and illite (Pl. 9 – D, Pl. 10 – B, D, F).

TABLE 3

Results of chemical analysis of mudstone and claystone samples collected in the 390 working floor (Stanienda, 2001)

	1 (claystone)		5 (claystone)		7 (claystone)		9 (mudstone)		11 (mudstone)		14 (mudstone)	
	mass %	molar relation	mass %	molar relation	mass %	molar relation	mass %	molar relation	mass %	molar relation	mass %	molar relation
1	2	3	4	5	6	7	8	9	10	11	12	13
SiO_2	41.90	6983	52.46	8743	52.07	8678	52.10	8683	52.01	8668	52.66	8777
Al_2O_3	25.08	2459	26.91	2638	24.67	2419	26.05	2554	24.28	2380	26.57	2605
Fe_2O_3	1.99	124	4.42	276	6.18	386	5.26	329	3.57	223	4.22	264
FeO	0.71	99	1.16	161	1.81	251	1.23	171	0.93	129	0.96	133
CaO	0.61	109	0.49	87.5	1.79	320	2.02	361	1.84	328	0.60	107
MgO	0.97	242	2.76	690	0.96	240	2.94	740	1.57	392	1.76	440
Na_2O	0.23	37	0.30	49	0.23	37	0.20	32	0.30	48	0.26	42
K_2O	0.14	15	0.21	22	0.12	13	0.11	12	0.16	17	0.18	19

1	2	3	4	5	6	7	8	9	10	11	12	13
Cl^-	0.30	84.5	0.23	67.8	0.29	81.7	0.21	59	0.24	67.6	0.22	62
H_2O^-	1.76	998	0.64	355	0.73	405	0.93	517	0.83	461	0.68	378
Roasting waste	24.97	1387	9.24	5133	10.89	6050	8.36	4644	14.28	7933	10.94	6078
Total	99.62		98.82		99.74		99.41		100.01		99.05	

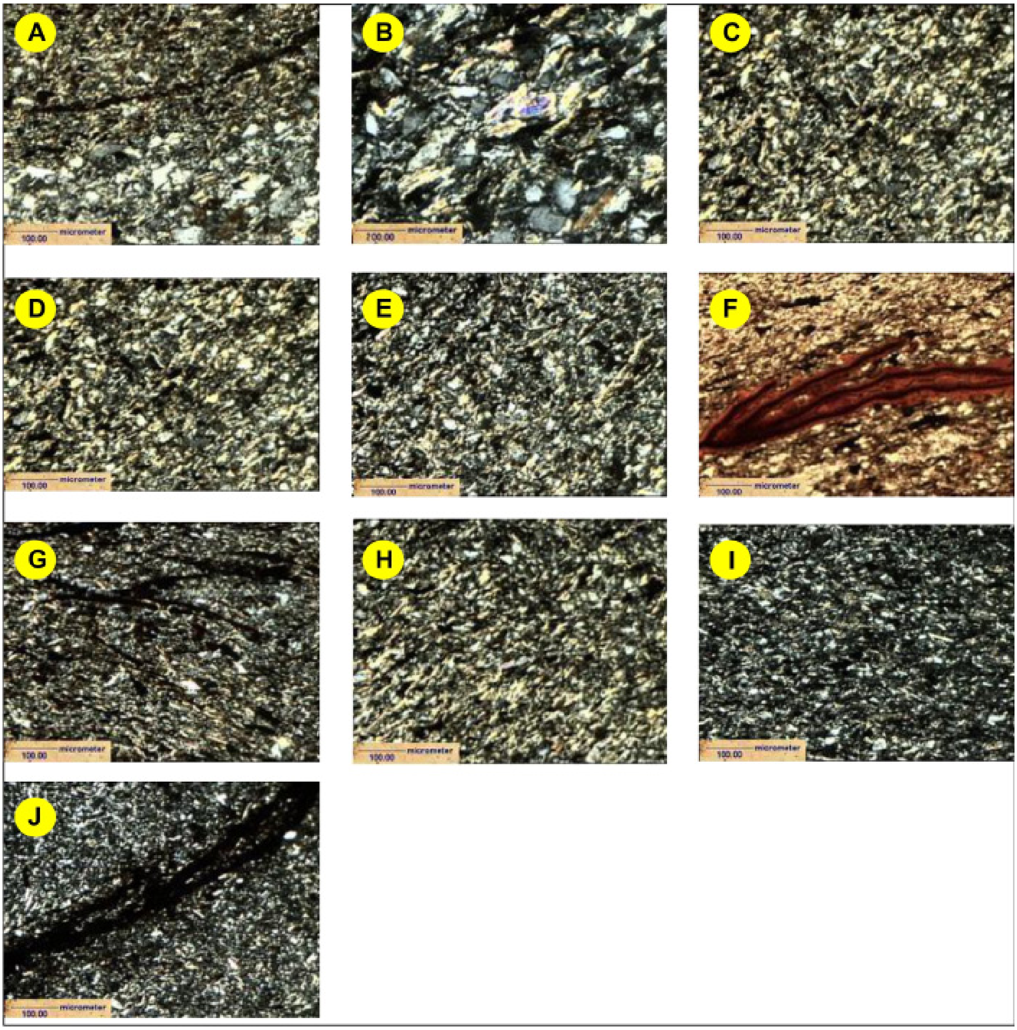

Plate 7. Microscopic views of sandstone samples (A-F) and heavy minerals (G-L).
Microscopic view of sample 2, XN, Magn. 100×; B – Microscopic view of sample 4, XN, Magn. 200×; C – Microscopic view of sample 9, XN, Magn. 100×; D – Microscopic view of sample 12, XN, Magn. 100×; E – Microscopic view of sample 14, XN, Magn. 100×; F – Microscopic view of sample 1 1N, Magn. 100×; G – Microscopic view of sample 1 XN, Magn. 100×; H – Microscopic view of sample 5 XN, Magn. 100×; I – Microscopic view of sample 7 XN, Magn. 100×; J – Microscopic view of sample 11 XN, Magn. 100×

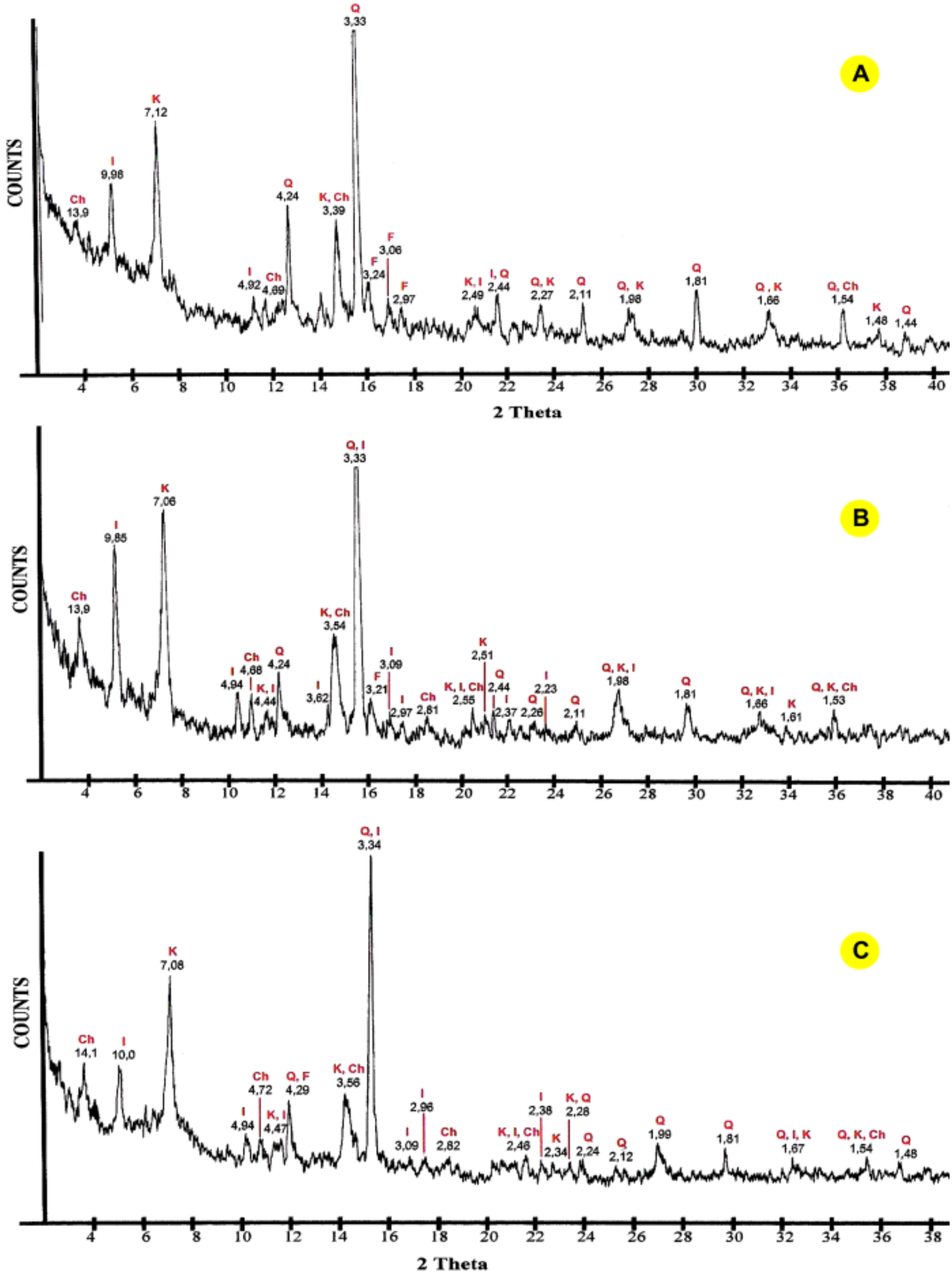

Plate 8. X-ray diffraction patterns of mudstones.
A – X-ray diffraction pattern of the sample 2; B – X-ray diffraction pattern of the sample 4;
C – X-ray diffraction pattern of the sample 9;
K – kaolinite, I – illite, Q – quartz, F – feldspar, Ch – chlorite

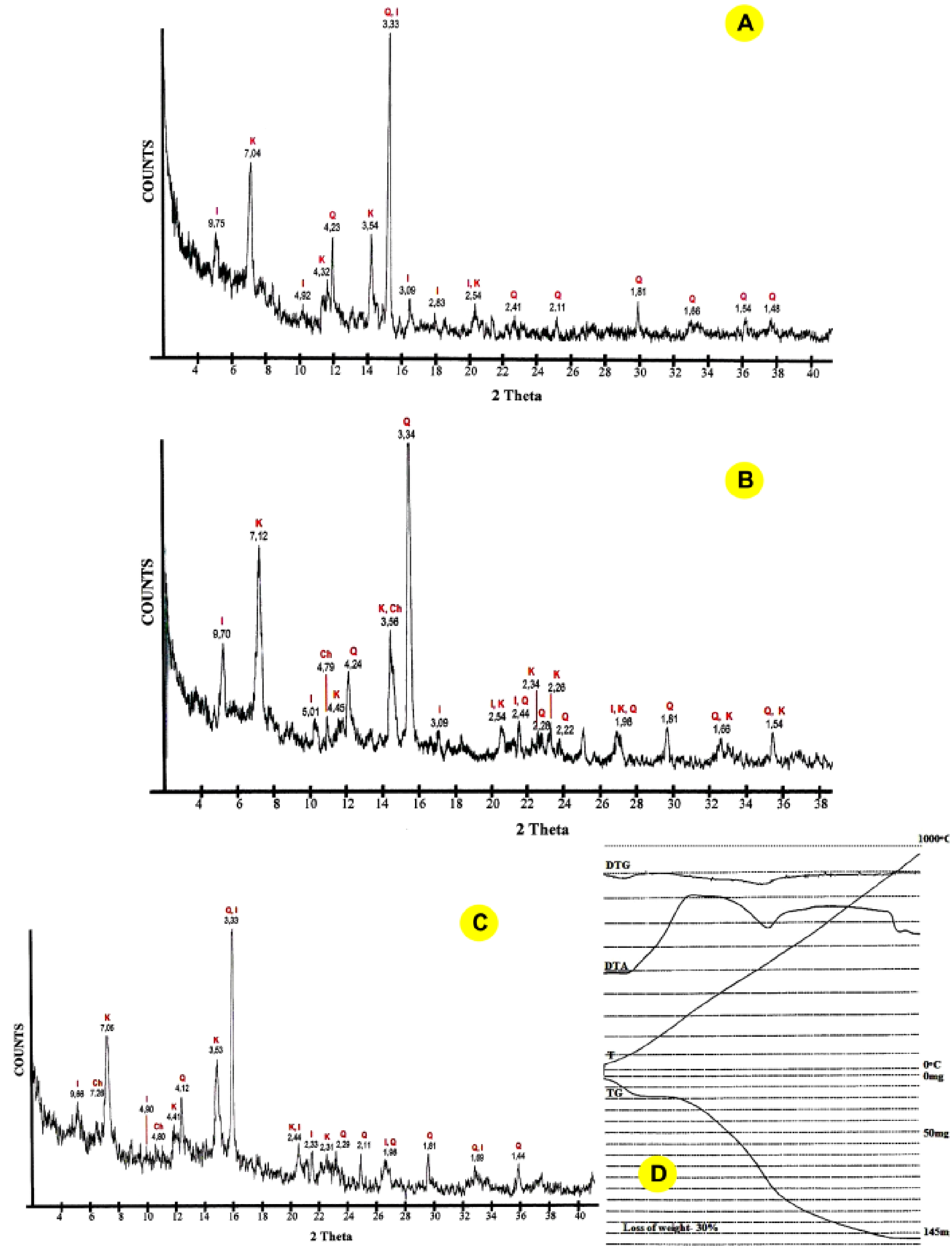

Plate 9. X-ray diffraction patterns of samples 12, 14 (mudstones) and 1 (claystone) and derivathogram of sample 1.
A – X-ray diffraction pattern of the sample 12; B – X-ray diffraction pattern of the sample 14;
C – X-ray diffraction pattern of the sample 1; D – Derivathogram of the sample 1;
K – kaolinite, I – illite, Q – quartz, Ch – chlorite

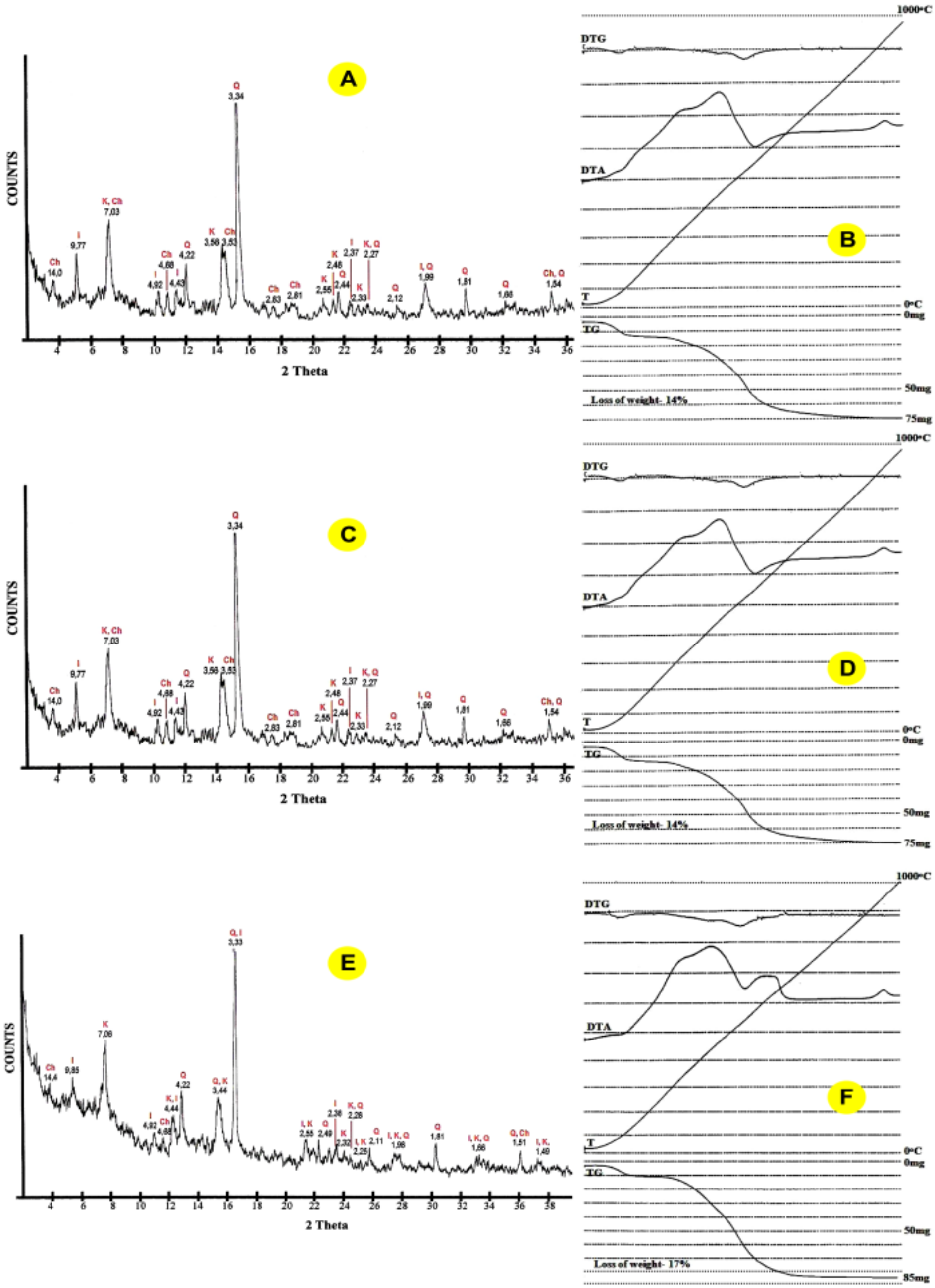

Plate 10. X-ray diffraction patterns and derivathograms of claystones (samples 5, 7, 11).
A – X-ray diffraction pattern of the sample 6 cement; B – Derivathogram of the sample 6 cement;
C – X-ray diffraction pattern of the sample 8 cement; D – Derivathogram of the sample 8 cement;
E – X-ray diffraction pattern of the sample 13 cement; F – Derivathogram of the sample 13 cement;
K – kaolinite, I – illite, Q – quartz, Ch – chlorite

TABLE 4

Mineral composition of mudstones and claystones determined based on chemical analysis results (content in %)

Mineral	Number of sample					
	1	5	7	9	11	14
Quartz	30-40	30-40	50-60	50-60	30-40	50-60
Kaolinite	50-60	50-60	30-40	50-60	50-60	50-60
Illite	30-40	30-40	30-40	30-40	30-40	30-40
Biotite	0	0	0	10-20	0	10-20
Chlorite	0	10-20	10-20	10-20	10-20	10-20
Calcite	10-20	10-20	10-20	10-20	10-20	10-20
Halite	10-20	10-20	10-20	10-20	10-20	10-20

5. Conclusions

Petrographic building of rocks associated coal seams of the Saddle Beds in Chwałowice Trough was presented in this work. Chwałowice Trough is the structure which belongs to Upper Silesian Coal Basin. Saddle Beds are sediments of the Upper Carbon.

The results of executed analyses permitted to characterize petrographical composition of the investigated rocks.

The results of the investigations show that sandstones and mudstones dominate in the investigating profile (66,4%). The claystones (14,6%) are situated mainly in ceilings and floors of coal seams. It is typical for Saddle Beds not only of Chwałowice Trough but also for other areas of Upper Silesian Coal Basin.

The sandstones are composed of quartz, feldspars, micas and also of quartzite's and gneiss's fragments and heavy minerals. The presence of quartzite and gneissic grains can indicate that alimentation areas of sandstones were built mainly of metamorphic rocks and old granitoides (Stanienda, 2002). The types of heavy minerals confirms this theory. Zircon is typical mineral for granites, garnets are usually present in metamorphic rocks. Rutile can be observed in both, magmatic and metamorphic rocks. Some sandstones present a very bad compactness. They are being destroyed during transportation. This feature is connected with presence of little quantity of cement, especially in medium grained sandstones, which include more matrix than typical cement. The cement is built mainly of clay minerals, kaolinite and illite, but X-ray diffraction confirmed also the presence of halite in the cement of investigated sandstones (Stanienda, 2001). According to Anna Wilk (1979) salty waters, which are present in coal mines could also influence the bad compactness of sandstones.

The mineral composition of sandstones permitted to classify them in two petrographical classifications, classification of Krynin (1948) and classification of Pettijohn-Potter-Siever (1973). According to Krynin (1948) classification (Stanienda, 2001) sandstones represent greywackes. In Pettijohn classification (1973) samples 6, 8 and 13 are situated in the field of lithic arenites and samples 3 and 10 in the field of wackes (Stanienda, 2001).

The sandstones of Chwałowice Trough are similar to sandstones from area of Mikołów which were investigated by L. Chodyniecka and K. Probierz (1985) and also to sandstones form Murcki Coal Mine which were investigated by L. Chodyniecka and B. Hanak (1985).

Mudstones and claystones are composed mainly of clay minerals. It's also possible to find quartz and micas there. The rocks from Chwałowice Trough include also organic matter. Petrographic building of the Saddle Beds rocks is typical not only for rocks of this formation from Chwałowice Trough but also for rocks of this formation which occur in other areas of Upper Silesian Coal Basin.

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