Chapter 2
A Brief History of Mining in the Upper Silesian Coal Basin

The area of the Upper Silesian Coal Basin (USCB) is rich in deposits of various mineral raw materials, which, since the Middle Ages have been the subject of mining activities. Galena and silver mining has a thousand-year tradition and it marks the beginning of the economic development of the Silesian-Cracow region. Also, iron ores have been exploited since the Middle Ages. The main importance, in terms of production volume, has been given to coal mining, which has been developing intensely since the Industrial Revolution. At the turn of the nineteenth and twentieth centuries, Poland was one of the leading manufacturers of calamine in the world, thanks to calamine deposits in the USCB. The most important exploitation among the resource-rich rock materials was the exploitation of stowing sands; however, dolomites, limestone, marl, porphyry, melaphyry, and gravel aggregates were also mined. Chemical raw materials found in Miocene deposits, except for short-term mining of gypsum, are not subject to mining activities. Despite plentiful resources, methane is derived from coal beds to a relatively small degree.

In the area of the Upper Silesian Coal Basin, more than 13 billion tonnes of various mineral raw materials have been extracted. The greatest importance has been given to coal mining (80.5 %) and stowing sands (13.3 %). In the total output, the share of aggregate mining (2.3 %) or zinc and lead ores (1.5 %) has been insignificant. The exploitation of other raw materials has accounted for a total of 2.4 % of the total production. The extraction of mineral resources also includes waste rock output in the amount of about 2.1–4.3 billion tonnes.

2.1 Iron Ore Mining

The beginnings of mining in the Upper Silesian Coal Basin date back to the Iron Age and were associated with open-cast exploitation of shallowly deposited bog ores. The fundamental period of ore mining began in the thirteenth century with the

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exploitation of limonite deposits on outcrops of Triassic rocks, Miocene siderite clay, and Quaternary bog ores. The size of exploitation at that time is difficult to estimate. In the sixteenth century, 8–10 smelt mills operated, which benefited from local ores (Musioł and Płuszczewski 1960); one primitive smelting furnace consumed about 100 tonnes of ores per year (Radwan 1963). It was estimated that in about 300 years (the fifteenth—the seventeenth centuries), about 200,000 tonnes of iron ore were extracted.

In the eighteenth century, ores were exploited for the purposes of 10–12 smelt mills and 5 blast furnaces heated with charcoal (Piernikarczyk 1933/1934). A blast furnace produced less than 100 tonnes of iron per year, and the use of iron from the ore was 60–70 %. For smelt mills, these figures were 32 tonnes and 25–40 %, respectively (Radwan 1963). Limonite ore deposits in the vicinity of Bytom, Tarnowskie Góry, and Piekary Śląskie, accompanying ores of lead and silver in the ore-bearing dolomites, and ores occurring on the surface of Triassic limestones, among karst sediment, were of main importance (Żeglicki 1996). It is estimated that in the eighteenth century, 200–400 thousand tonnes of iron ore were extracted in the Upper Silesian Coal Basin. Traces of this exploitation have been preserved in the landscape to this day, such as in the vicinity of Bytom (Lamparska-Wieland 2003).

In the mid-nineteenth century in the western part of the USCB, in addition to the 20 furnaces heated with charcoal, 8 coke-heated furnaces already operated; this is why the demand for iron ore markedly increased (Musioł and Płuszczewski 1960). Several such furnaces also worked in the eastern part of the USCB in Dąbrowa Górnicza and Sosnowiec. The average annual production during this period amounted to 4,500 tonnes of pig iron for a charcoal-heated blast furnace and 41,000 tonnes for a coke-heated furnace (Czerminski 1992); the use of iron ore was respectively 60 and 80 %. The share of local ores in the blast furnace feed gradually decreased: 70 % in 1878 and only 25 % in 1906. After World War I, the deposits became exhausted and iron ore mining declined in importance. According to estimates for the USCB, a total of about 20 million tonnes of iron ore have been extracted, and the area under the impact of this mining industry covered about 7 km^2.

2.2 Zinc and Lead Ore Mining

Silver and lead ore mining traditions in Poland date back to the beginnings of the Polish state. This was confirmed when a furnace for melting lead was discovered in the north-eastern outskirts of the Upper Silesian Coal Basin, which dates back to the eleventh century (Rozmus and Bodnar 2004). Galena and calamine deposits occur in the Middle Triassic dolomite ore to a depth of about 200 m, occasionally up to 350 m. From the early Middle Ages to the turn of the fourteenth and fifteenth centuries, ores were mined on outcrops in the vicinity of Bytom, Tarnowskie Góry, Jaworzno and Chrzanów. Due to the flooding of mines with groundwater, longer or shorter production breakdowns occurred in ore mining. Exploitation of mineral deposits located below the groundwater table began in the late fifteenth century

with the construction of the first dewatering galleries, but still open-pit mining simultaneously continued. The scale of mining at the time is evidenced by thousands of small shafts on the hilltop of the Tarnowskie Góry Hummock, with a total area of approximately 44 km^2. The size of production in this period may only be roughly estimated. By assuming that on average 20,000 centals of lead and silver were produced each year (1 cental = about 58 kg) and considering 150 years of efficient production, then subtracting years of crisis, 174,000 tonnes of metal could be obtained from about 1 million tonnes of ore (assuming about 12 % ore density).

The beginning of the eighteenth century marked the collapse of lead ore mining. However, 100 years later, it was revived with all its intensity in connection with J. Ch. Ruhberg's invention of a method of zinc production from calamine. Then, it was mined in shafts hollowed one next to another, usually to a depth not exceeding 20 m. Large amounts of zinc ore were obtained by sifting and flushing heaps on old mining fields.

The dynamic development of ore mining, which occurred in the mid-nineteenth century, strengthened the division into mining regions: Bytom, Tarnowskie Góry (Bobrowniki) and Chrzanów-Jaworzno (Fig. 2.1). The Olkusz region, sizeable and

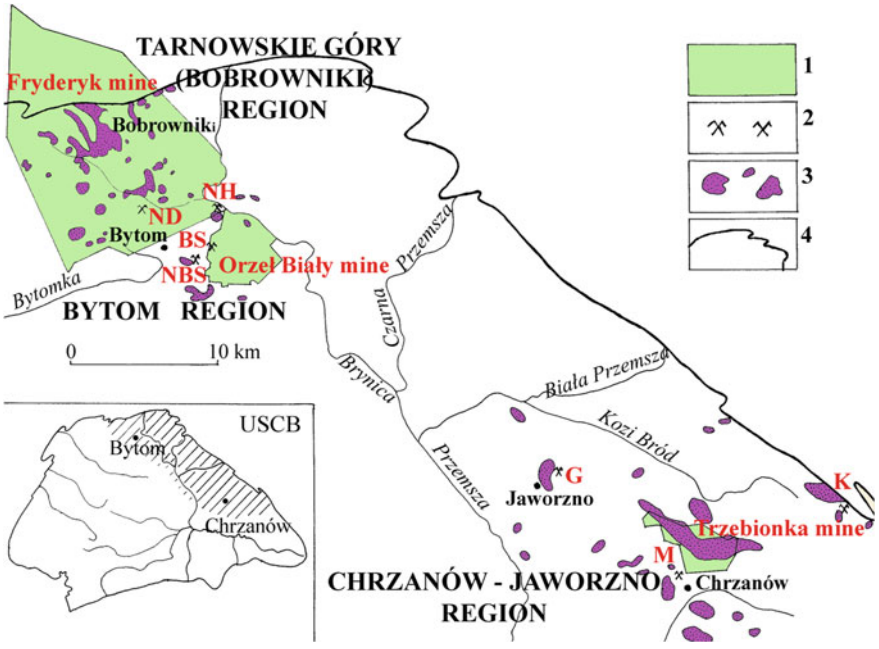

Fig. 2.1 Ore mining in the area of the Upper Silesian Coal Basin (based on Molenda 1972, Messtischblätter 1883). (**1**) Large underground ore mines, (**2**) small ore mines actives in the nineteenth and twentieth centuries: *BS* Biały Szarlej mine, *G* Galmany mine, *K* Katarzyna mine, *M* Matylda mine, *NBS* Nowy Biały Szarlej mine, *ND* Nowy Dwór mine, *NH* Nowa Helena mine, (**3**) main areas of ore mining in the sixteenth–eighteenth centuries, (**4**) north-eastern boundary of the Upper Silesian Coal Basin

important in terms of production, is located outside the USCB. In the Chrzanów-Jaworzno region in 1855, the Matylda mine was established, which operated intermittently due to flooding until 1972. The Katarzyna mine was active until 1912 and the Galmany mine was active until 1958 (Cabała and Sutkowska 2006). The ore mining tradition in this region continued in the years 1962–2009 in the Trzebionka mine, which, at the turn of the twentieth and twenty first centuries, had a reputation as one of the largest in the world, with production of 2.3 million tonnes a year. About 60 million tonnes of ore have been extracted there. In the Chrzanów-Jaworzno region, underground exploitation was carried out in an area of about 15 km^2 and open-pit exploitation in an area of at least 10 km^2.

In the Tarnowskie Góry region, the big lead and silver mine Fryderyk was founded in 1784. It was a state mine; most of it was located within the limits of the Upper Silesian Coal Basin, which was called the Bobrowniki region. In over 126 years of activity (from 1910), this state mine produced 167,000 tonnes of pure lead bullion, whereas the total production of private mines amounted to just over 1 million tonnes (Nowak 1927). Obtaining such a quantity of bullion required the extraction of several million tonnes of ore. Traces of intense mining activity in the Bobrowniki region are still visible in the landscape (Lamparska-Wieland 2003).

In the area of Bytom, 4 zinc and lead ore mines were established: Nowa Helena (1841), Szarlej Biały (1853), Nowy Dwór (1881), and Nowy Biały Szarlej in Bytom (1928) (Fig. 2.1). On the basis of these mines, the Orzeł Biały Mining and Metallurgical Kombinat was founded in 1967, which was one of the largest plants of this type in Europe; its activity ceased in 1989. Zinc and lead deposits in the area of Bytom have been almost entirely exploited with the roof and pillar collapse extraction system (Bąk and Barańczuk 1989). Underground mines in Bytom carried out their operations in an area covering about 18 km^2, with 7 km^2 under the influence of open-pit mining. A total of 22.4 million tonnes of ore were extracted here in the nineteenth century, 32.3 million tonnes in the period of 1901 to 1944, and 48.3 million tonnes in the postwar period until 1984 (Minorczyk 1986).

Since the beginning of ore mining in the Upper Silesian Coal Basin, approximately 200 million tonnes of zinc and lead ores have been output, with 110 million tonnes after World War II. In total, the area under the influence of galena and calamine mining covered about 160 km^2. A significant amount of waste is produced in the process of zinc and lead ore mining and metallurgy—over a hundred million tonnes of it was accumulated. Since 2009, there has been no exploitation of metallic raw materials carried out within the USCB.

2.3 Hard Coal Mining

Hard coal was known to the inhabitants of the contemporary Upper Silesian Coal Basin as early as in the mid-sixteenth century. However, in mining documentation, its exploitation is confirmed only from 1740 at the Murcki mine, which is reported to be the oldest in the Upper Silesian Coal Basin (and still active). The origins of

coal statistics date back to 1769. The development of coal mining on the Polish territory occurred in the period of partitions. The borders of the occupying countries divided the USCB into three regions—the Upper Silesia, Dąbrowa and Cracow.

Until the mid-eighteenth century, coal was dug from primitive open pits on outcrops of seams (to the level of groundwater). The total production of pits at that time was only a few hundred tonnes of coal per year. In places of thicker overburden, the deposit was made available through shallow shafts or short galleries; an average depth of operation was only a dozen meters. Mines "wandered" on the ground; the exploitation was conducted within one mining field approximately for 1 year (Kossuth 1961). Coal was mainly used by forges, breweries, distilleries, brickyards, and lime kilns.

The development of coal mining dates back to the founding of the state mines—Król in Chorzów and Królowa Luiza in Zabrze in 1791—as well as the use of coal and coke in ironworks and steam engines that powered drainage pumps in the mines. Primarily, there was a need for bigger lumps of coal; fine coal was not mined for, which was the cause of many fires in the mines. The total coal output by the end of the eighteenth century was relatively small, amounting to 135,690 tonnes; taking into account the numerous small mines (active for a year or up to a few years), it was 308,280 tonnes (Table 2.1).

In the first half of the nineteenth century, in addition to the two large state-owned mines, there were still numerous small underground, sometimes open-pit mines, extracting coal by hand for petty customers. A vast area of shallow coal deposits

Table 2.1 Coal output in large and small mines in the Upper Silesian Coal Basin (USCB) in the years 1769–2009 (based on Luksa 1959; Jaros 1975 and statistical data from the coal industry)

Period	Output in the USCB (tonnes)	Output in large mines (tonnes)	Output in small mines		
			(tonnes)	% of output in USCB	Average (tonnes/year)
To 1800	308,280	135,690	172,590	56.0	5,567
1801–1825	3,796,902	1,832,984	1,963,918	51.7	78,557
1826–1850	15,235,087	6,223,751	9,011,336	59.1	360,453
1851–1875	109,203,807	58,625,284	50,578,523	46.3	2,023,141
1876–1900	445,562,847	364,846,582	80,716,265	18.1	3,228,651
1901–1925	1,013,868,379	951,070,479	62,797,900	6.2	2,511,916
1926–1950	1,497,136,028	1,483,503,421	3,632,607	0.9	545,304
Total 1769–1950	3,085,111,330	2,866,238,191	208,873,139	6.8	1,147,655
1951–1975	2,847,011,739	2,847,011,739	–	–	–
1976–2000	3,962,182,584	3,962,182,584	–	–	–
2001–2009	773,087,900	773,087,900	–	–	–
Total 1951–2009	7,582,282,223	7,582,282,223	–	–	–
Total 1769–2009	10,667,393,553	10,667,393,553	–	–	–

allowed for the transfer of operation along the outcrops of seams over a long period of time and not reaching deeper than the level of dewatering galleries, whose number was at least 75. The number of mines was variable but generally increasing: in the district of Upper Silesia in 1816, there were 27; in 1850, there were 71 (Luksa 1959). In order to increase profits, only thick layers were extracted, with thickness greater than 1 m. The main consumer of coal was zinc metallurgy. In the first half of the nineteenth century, 19 million tonnes of coal were extracted in the Upper Silesian Coal Basin, of which as many as 11 million tonnes were in small mines (Table 2.1).

In the second half of the nineteenth century, the development of coal mining was encouraged by the construction of railway lines, the concentration of capital and mine mergers, and rapid technological progress. Rail transport not only enabled the export of coal, but it also became its important recipient. Mines were located in a strip stretching from Zabrze in the west to Mysłowice in the south-east, along Saddle Beds, shallowly located and characterized by exceptional thickness and small or medium inclination. A smaller concentration of mines was formed in the vicinity of Rybnik in the south-western part of the USCB. During this period, mine drainage became a necessity. Stowing (slag, ash, sand, heap waste) began to be used occasionally in the late nineteenth century. Over 40 % of the output came from the mining of seams thicker than 4 m, mainly by the so-called Silesian pillar system. In the eastern part of the Basin, the Dąbrowa method was applied, which was the extraction of the entire thickness of the seam. Since 1857, in the Król mine and several others, thick layers were extracted by the checkerboard method, which resulted in very large losses of coal, even up to 40–50 %. Overall, the management of thick coal in Upper Silesia was wasteful. The dominating method was roof collapse excavation, which led to the destruction of large coal deposits in thinner seams (Kossuth 1965). The depletion of shallow deposits led to the stabilization of mines in the area: their number decreased by half in the late nineteenth century—from a maximum of 142 in 1873 (Popiołek 1965). In total, in the second half of the nineteenth century, 554.8 million tonnes of hard coal were extracted.

In the early twentieth century, coal production had already reached a high level of concentration. The depth of operation generally did not exceed 100 m (Jaros 1969). Still, mostly thick seams were exploited; seams thinner than 1.8 m were only exploited in exceptional cases (Kossuth 1968). Fine coal, which had formerly been wasted on heaps, started to be divided on assortments and purified in flushers. Hydraulic stowage was used for the first time in 1901 on a larger scale in the Mysłowice mine and in the following years in many other mines in Upper Silesia. On the eve of World War I, there were 103 active mines. Large mines in the Upper Silesia region (63) at the time produced more than 80 % of total output for the entire Basin. In the Dąbrowa region, half of the 32 mines were classified as small and shallow, while 8 coal mines in the Cracow region accounted for only a few percent of the whole mining production in the whole USCB (Jaros 1969). The largest war losses were experienced by the mines in the Dąbrowa region. The curve of coal production in the inter-war period reveals a series of leaps and crashes—periods of economic recovery were separated by periods of crisis, when some mines

were closed down. Unemployed miners illegally mined coal in illegal (poverty) pits, particularly in the areas of Dąbrowa Górnicza, Katowice, and Świętochłowice; in 1932, there were about 5,000–6,000 of these illegal pits in the region (Ziemba 1967).

During World War II, mines became included in the framework of German war economy and coal production greatly increased. During the 1944–1945 offensive, Polish mines suffered no serious damage, but the technical and mining condition of mines after the war was poor—the casing of workings was 90 % wood, and loading of the extracted material was carried out almost exclusively by hand (Górnictwo 1988). Almost half of the extraction came from a depth up to 300 m, and 42 % came from seams thicker than 3.5 m. About 70 % of extraction was roof-caving exploitation (Jaros 1973). In the first half of the twentieth century, 2.5 billion tonnes of hard coal were extracted (Table 2.1).

After World War II, for many years, coal constituted the foundation of the Polish energy sector and steel industry and played an important role in the balance of trade. Initially, the exploitation was concentrated in the central part of then the Upper Silesian Industrial Region (USIR). In 1947, a total of 66 mines were active, most of which were small, with the extraction not exceeding 1 million tonnes (Tkocz 1987). Due to the high demand for coal, several new mines were built in the USIR (e.g. Halemba, Staszic); in the 1960s and 1970s, many mines were founded in the Rybnik Coal District (e.g. Jastrzębie, Pniówek) in bedrock with particularly difficult geological and mining conditions—highly disturbed seams and one of the highest coalbed methane hazards in Europe (Górnictwo 1988). In total, in the postwar period, 22 new underground mines and 33 open-pit mines were established, including the largest—Brzozowica. The newest mine is Budryk. The locations of coal mines in the Upper Silesian Coal Basin are shown in Fig. 2.2.

In 1974, most mines had an average extraction of 2–4 million tonnes; 10 years later, 13 mines extracted more than 5 million tonnes, including Ziemowit and Piast with more than 7 million tonnes (Tkocz 1987). In the late 1980s, the USCB supplied 98.5 % of the Polish coal production. The increase in coal output was related to the technological revolution in Polish mines initiated by the introduction of mining shearers for wall exploitation: in 1950, there were 6 of them, whereas in 1985, there were 765. The main exploitation system became the exploitation of longwall faces, with the roof-collapse method or hydraulic stowage. After the war, the problem of excavating seams under whole cities, primarily under Bytom, was academically researched (Krupiński 1956). In 1952, experimental exploitation of the protection pillar under the Pokój steelworks was initiated (Skinderowicz 1963); later, pillars under the city of Bytom, steel mills, and some shafts were exploited. In the 1960s, about 35 % of extraction came from protective pillars; since 1966, some mines achieved most of their production from them, such as the Pokój mine (Jaros 1973). The recovery of millions of tonnes of coal, which had formerly been thought to be lost, had its price in the form of vast mining damages on the surface. Coal output at individual mines for the years 1769–2009 is shown in Table 2.2.

As a result of the restructuring of mining, since the 1990s, unprofitable mines were closed down or merged into larger mining plants. In 2014, there were 27

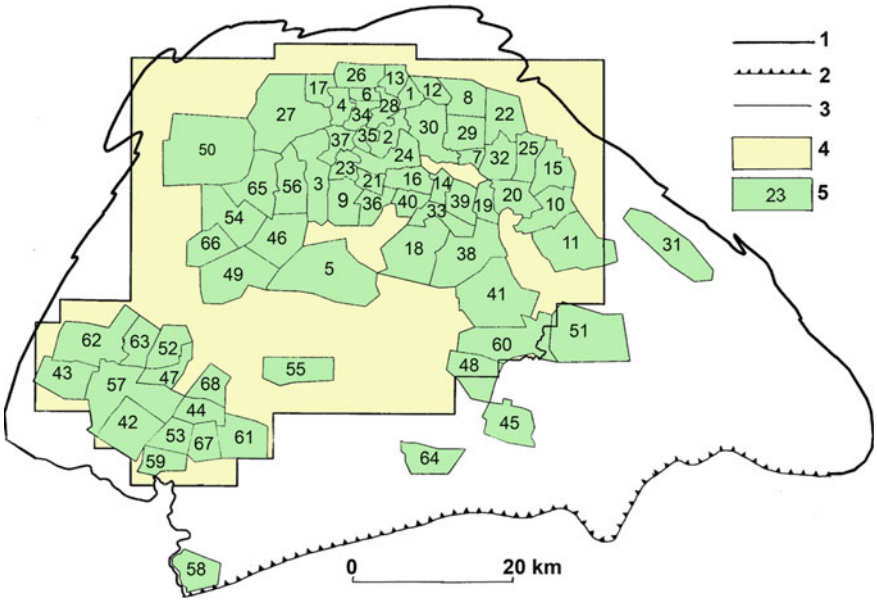

Fig. 2.2 Mining areas of coal mines in the Upper Silesian Coal Basin in 1993 (after Dulias 2013). (**1**) Boundaries of the Upper Silesian Coal Basin after Doktorowicz-Hrebnicki 1968, (**2**) Carpathian thrust, (**3**) the Polish-Czech border, (**4**) detailed-study area, (**5**) coal mines (the numbering of mines consistent with the numbering in Table 2.2): *1* Andaluzja, *2* Barbara-Chorzów, *3* Bielszowice, *4* Bobrek, *5* Bolesław Śmiały, *6* Centrum, *7* Czeladź-Milowice, *8* Grodziec, *9* Halemba: *10* Jan Kanty, *11* Jaworzno, *12* Jowisz, *13* Julian, *14* Katowice, *15* Kazimierz-Juliusz, *16* Kleofas, *17* Miechowice, *18* Murcki, *19* Mysłowice, *20* Niwka-Modrzejów, *21* Nowy Wirek, *22* Paryż, *23* Pokój, *24* Polska, *25* Porąbka-Klimontów, *26* Powstańców Śląskich, *27* Pstrowski, *28* Rozbark, *29* Saturn, *30* Siemianowice, *31* Siersza, *32* Sosnowiec, *33* Staszic, *34* Szombierki, *35* Śląsk-Matylda, *36* Śląsk, *37* Wawel, *38* Wesoła, *39* Wieczorek, *40* Wujek, *41* Ziemowit, *42* 1 Maja, *43* Anna, *44* Borynia, *45* Brzeszcze, *46* Budryk, *47* Chwałowice, *48* Czeczott, *49* Dębieńsko, *50* Gliwice, *51* Janina, *52* Jankowice, *53* Jastrzębie, *54* Knurów, *55* Krupiński, *56* Makoszowy, *57* Marcel, *58* Morcinek, *59* Moszczenica, *60* Piast, *61* Pniówek, *62* Rydułtowy, *63* Rymer, *64* Silesia, *65* Sośnica, *66* Szczygłowice, *67* Zofiówka, *68* Żory

active mines. Currently, the longwall exploitation method is used, predominantly by roof-collapsing (85 %). The lengths of the walls are 100–200 m (up to 275 m), and their progress reaches an average of 40 m per month (up to 200 m in the Staszic mine; Kowalski 1996). The number of active mining walls, however, decreased from 766 in 1999 to 142 in 2004, but an average output from the wall increased from 863 tonnes a day (1990) to 2,920 tonnes a day (2004) (Karbownik and Włodarski 2005). Some shafts of the liquidated coal mines have been transformed into deep well shafts, which pump groundwater out to remove the water hazard in active mines. Cessation of mine dewatering and restoration of the natural groundwater level would create flooding and water reservoirs in areas of major subsidence, including the centres of Silesian cities (Kotyrba 2005).

Table 2.2 Coal output in the mines of the Upper Silesian Coal Basin (USCB) in the years 1769–2009 (based on Luksa 1959 and statistical data from the coal industry)

No.	Coal mines (named by the state in 1993)	Coal output								Year of start of mining	Years of activity since the begining of miming statistic
		to 1882[a]		1883–1993		1994–2009		Total	% of output in USCB		
		mln tonnes	%	mln tonnes	%	mln tonnes	%	mln tonnes			
Silesian Upland											
1.	Andaluzja	–	–	131.5	84.2	24.7	15.8	156.3	1.49	1911	99
2.	Barbara-Chorzów	5.9	4.3	132.2	95.7	–	–	138.1	1.34	1791	125
3.	Bielszowice	19.0	4.1	396.4	85.4	48.8	10.5	464.3	4.44	1791	213
4.	Bobrek	–	–	165.1	86.1	26.7	13.9	191.8	1.83	1907	100
5.	Bolesław Śmiały	2.2	1.2	144.2	82.9	27.6	15.9	173.9	1.66	1779	205
6.	Centrum	–	–	151.1	85.7	25.2	14.3	176.3	1.69	1865	109
7.	Czeladź-Milowice	1.1	0.8	140.3	98.7	0.7	0.5	142.1	1.36	1822	174
8.	Grodziec	–	–	52.0	93.1	3.9	6.9	55.9	0.53	1823	105
9.	Halemba	–	–	116.7	69.1	52.3	30.9	169.0	1.62	1954	56
10.	Jan Kanty	–	–	70.5	92.2	6.0	7.8	76.5	0.73	1766	81
11.	Jaworzno	5.1	2.0	216.5	83.0	39.3	15.0	261.0	2.50	1795	214
12.	Jowisz	–	–	85.9	94.3	5.2	5.7	91.1	0.87	1912	89
13.	Julian	–	–	79.5	79.2	20.9	20.8	100.4	0.96	1955	55
14.	Katowice	1.7	1.4	112.9	92.7	7.2	5.9	121.8	1.16	1822	133
15.	Kazimierz-Juliusz	–	–	115.4	88.4	15.1	11.6	130.5	1.25	1875	116
16.	Kleofas	–	–	178.5	91.5	16.6	8.5	195.2	1.87	1845	117
17.	Miechowice	–	–	128.7	98.4	2.2	1.6	130.9	1.25	1902	94
18.	Murcki	2.4	1.5	119.6	74.3	39.0	24.2	161.1	1.54	1740	240

(continued)

Table 2.2 (continued)

No.	Coal mines (named by the state in 1993)	Coal output								Year of start of mining	Years of activity since the begining of miming statistic
		to 1882[a]		1883–1993		1994–2009		Total	% of output in USCB		
		mln tonnes	%	mln tonnes	%	mln tonnes	%	mln tonnes			
19.	Mysłowice	0.2	0.1	135.5	82.7	27.8	17.2	161.5	1.54	1837	137
20.	Niwka-Modrzejów			101.4	91.8	9.0	8.2	110.4	1.06	1815	106
21.	Nowy Wirek	3.9	3.5	105.7	95.3	1.4	1.2	110.9	1.06	1849	123
22.	Paryż	6.6	4.2	150.3	95.4	0.6	0.4	157.5	1.51	1785	211
23.	Pokój	1.0	0.5	157.6	83.1	31.0	16.4	189.6	1.81	1865	145
24.	Polska	23.3	7.8	251.2	83.8	25.0	8.4	299.6	2.86	1791	219
25.	Porąbka-Klimontów	–	–	148.0	97.5	3.8	2.5	151.8	1.45	1806	105
26.	Powstańców Śl.	0.5	0.2	223.7	95.7	9.5	4.1	233.8	2.24	1871	125
27.	Pstrowski[b]	6.0	1.5	390.5	97.5	4.0	1.0	400.5	3.83	1792	148
28.	Rozbark	5.9	2.8	192.6	89.7	16.0	7.5	214.6	2.05	1824	143
29.	Saturn	–	–	74.8	99.4	0.5	0.6	75.3	0.72	1887	109
30.	Siemianowice	6.3	2.0	298.4	96.1	5.8	1.9	310.5	2.97	1788	212
31.	Siersza	1.5	1.0	139.9	94.8	6.2	4.2	147.7	1.41	1804	196
32.	Sosnowiec	1.9	1.6	119.2	96.4	2.5	2.00	123.7	1.18	1806	193
33.	Staszic	–	–	95.8	64.3	53.2	35.7	149.0	1.42	1960	50
34.	Szombierki	1.7	0.9	193.4	99.1	–	–	195.1	1.87	1865	125
35.	Śląsk-Matylda	7.2	6.3	106.6	93.7	–	–	113.8	1.09	1857	117
36.	Śląsk	–	–	44.6	64.9	24.2	35.1	68.8	0.66	1974	36
37.	Wawel	6.7	2.8	229.1	96.9	0.8	0.3	236.6	2.26	1752	130
38.	Wesoła	–		161.7	74.8	54.5	25.2	216.2	2.07	1785	96

(continued)

Table 2.2 (continued)

No.	Coal mines (named by the state in 1993)	Coal output								Year of start of mining	Years of activity since the begining of miming statistic
		to 1882[a]		1883–1993		1994–2009		Total	% of output in USCB		
		mln tonnes	%	mln tonnes	%	mln tonnes	%	mln tonnes			
39.	Wieczorek	7.9	3.0	225.6	86.2	28.2	10.8	261.7	2.50	1826	176
40.	Wujek	–	–	144.9	81.7	32.4	18.3	177.4	1.70	1900	110
41.	Ziemowit	–	–	217.8	74.9	73.1	25.1	290.9	2.78	1893	117
Silesian Upland		118.2	1.6	6453.8	87.9	770.9	10.5	7342.9	70.2	1740	240
Racibórz-Oświęcim Basin											
42.	1 Maja	–	–	68.3	95.8	3.0	4.2	71.3	0.68	1953	43
43.	Anna	–	–	128.5	82.2	27.8	17.8	156.2	1.49	1832	127
44.	Borynia	–	–	54.0	59.6	36.7	40.4	90.7	0.87	1971	39
45.	Brzeszcze	–	–	130.6	78.3	36.2	21.7	166.7	1.59	1907	102
46.	Budryk	–	–	–	–	41.6	100.0	41.6	0.40	1994	16
47.	Chwałowice	–	–	96.4	70.0	41.4	30.0	137.7	1.32	1906	104
48.	Czeczott	–	–	19.2	45.7	22.8	54.3	42.0	0.40	1984	19
49.	Dębieńsko[b]	–	–	100.1	90.5	10.5	9.5	110.6	1.06	1899	102
50.	Gliwice	–	–	59.9	90.9	6.0	9.1	65.9	0.63	1911	89
51.	Janina[b]	–	–	91.6	72.5	34.8	27.5	126.4	1.21	1907	98
52.	Jankowice	–	–	128.5	69.2	57.2	30.8	185.7	1.78	1916	94
53.	Jastrzębie	–	–	73.8	62.4	44.4	37.6	118.3	1.13	1963	47
54.	Knurów	–	–	158.6	78.0	44.8	22.0	203.4	1.94	1906	104
55.	Krupiński	–	–	11.1	24.9	33.6	75.1	44.7	0.43	1985	25

(continued)

Table 2.2 (continued)

No.	Coal mines (named by the state in 1993)	Coal output								Year of start of mining	Years of activity since the begining of miming statistic
		to 1882[a]		1883–1993		1994–2009		Total	% of output in USCB		
		mln tonnes	%	mln tonnes	%	mln tonnes	%	mln tonnes			
56.	Makoszowy	–	–	180.3	80.3	44.4	19.7	224.6	2.15	1906	103
57.	Marcel	–	–	123.1	73.3	44.8	26.7	167.8	1.60	1883	127
58.	Morcinek	–	–	5.2	45.3	6.3	54.7	11.5	0.11	1987	12
59.	Moszczenica	–	–	78.7	97.9	1.7	2.1	80.4	0.77	1966	29
60.	Piast[b]	–	–	94.8	55.7	75.4	44.3	170.2	1.63	1976	34
61.	Pniówek	–	–	54.1	49.3	55.6	50.7	109.7	1.05	1974	36
62.	Rydułtowy	1.9	1.0	155.9	81.8	32.9	17.2	190.7	1.82	1792	171
63.	Rymer	–	–	81.3	98.8	1.0	0.2	82.3	0.79	1896	99
64.	Silesia	–	–	47.8	77.2	14.1	22.8	61.9	0.59	1907	97
65.	Sośnica	–	–	157.6	78.6	42.8	21.4	200.4	1.92	1917	93
66.	Szczygłowice	–	–	103.2	70.9	42.4	29.1	145.6	1.39	1961	49
67.	Zofiówka	–	–	66.0	62.4	39.8	37.6	105.8	1.01	1969	41
68	Żory	–	–	10.4	89.8	1.2	10.2	11.6	0.11	1979	18
Racibórz-Oświęcim Basin		1.9	0.06	2278.6	72.94	843.0	27.0	3123.5	29.8	1792	171
Mining area		120.1	1.2	8732.4	83.4	1613.9	15.4	10466.4	100.0	1740	240

[a]Research periods were established according to the editions of topographic maps used in the morphometric analysis
[b]The mine is located on the border of the Silesian Upland and the Racibórz-Oświęcim Basin

In the Upper Silesian Coal Basin, by 2009, nearly 10.7 billion tonnes of hard coal were output, of which up to 71 % after 1950. Waste rock mining is difficult to estimate. Assuming an average production of 0.2 to 0.4 tonnes of rock per 1 tonne of coal produces a number of 2.1–4.3 billion tonnes. The total output of hard coal and waste rock from the bedrock of the USCB amounted to 13–15 billion tonnes. In the three periods, analysed in the following part of the book, the exploitation was as follows: from 1769 to 1882 (i.e. within 114 years), 120.1 million tonnes of coal were extracted, which was 1.2 % of the output up to date (If small coal mines are included, the numbers are 277.2 million tonnes and 2.6 %). Almost all the coal production then came from the area of the Silesian Upland (98.4 %); an insignificant part of the coal was extracted in the Racibórz-Oświęcim Basin. In the period of 1883–1993 (111 years), more than 8.732 billion tonnes of coal were extracted in the research areas, or 83.4 % of total production (If including production from small coal mines, it would be 8.81 billion tonnes, or 82.3 %). Coal mining was still concentrated in the Silesian Upland (73.9 %). In the period of 1994–2009, just over 1.6 billion tonnes of coal were extracted in the USCB (15.4 % of the up to date output). In contrast to previous periods, a majority of production came from the Racibórz-Oświęcim Basin (52 %). In 2014, industrial resources of coal were estimated at 3.44 billion tonnes. In that year, 76.75 million tonnes were extracted (In the period not considered in this work, from 2010 to 2014, a total of 330 million tonnes of coal were extracted).

2.4 Rocks Resources Mining

In the second half of the nineteenth century, the mining of solid rock—limestone and marl—developed in the area of the USCB for the lime and cement industries, dolomite for metallurgy and dimension, and crushed stones (limestone, dolomite, porphyry, melaphyry, and diabase) for various purposes, mostly construction (Fig. 2.3). Mining areas coincide with outcrops of Triassic and Jurassic and locally Permian rocks. Exploitation was concentrated in the south-eastern and northern parts of the USCB. Of the 110 quarries, currently only 8 remain active.

Triassic dolomites occurring in the USCB are characterized by very good quality parameters for metallurgical purposes. For over 115 years (1883–1997), they were exploited in the Bobrowniki-Blachówka and Gródek quarries (Fig. 2.4). Since 1918, dolomite has been extracted from the Żelatowa deposit in Pogorzyce. It is one of four currently active dolomite quarries in Poland; in 2009, 0.676 million tonnes of raw materials were extracted there (23 % of national production).

Triassic limestone mining has developed for purposes of the cement industry from the Sadowa Góra, Żychcice, Rogoźnik, Górka and Płaza deposits (Table 2.3). The last of these deposits has been exploited in two large excavations since 1887, but currently only on a small scale (18,000 tonnes per year). In other quarries, mining was abandoned even though it used to be significant; for example, about 7.2 million tonnes of rocks were extracted from the Sadowa Góra deposit in the years

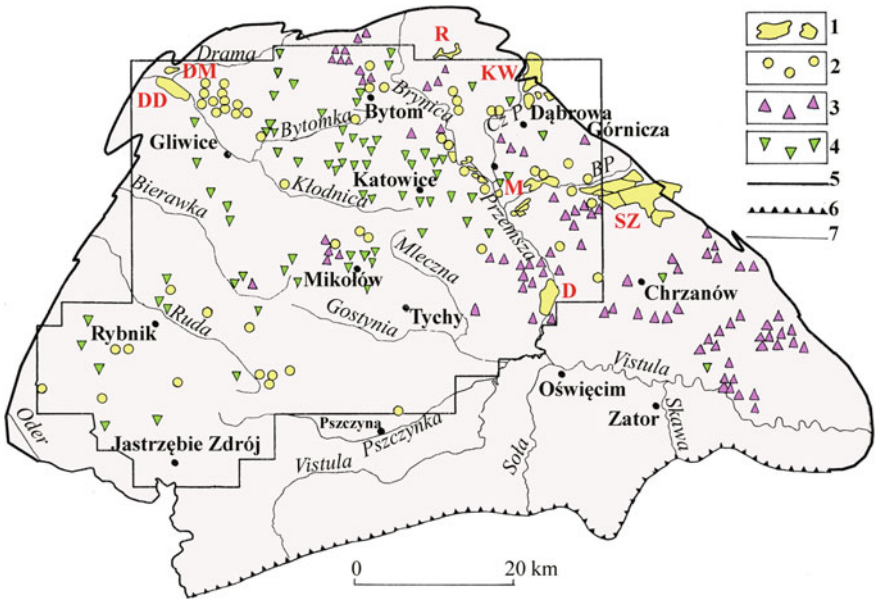

Fig. 2.3 Rocks resources mining in the Upper Silesian Coal Basin (based on Dulias 2013). (**1**) The largest sandpit of stowing sands: *D* Dziećkowice sandpit, *DD* Dzierżno Duże sandpit, *DM* Dzierżno Małe sandpit, *KW* Kuźnica Warężyńska sandpit, *M* Maczki-Bór sandpit, *R* Rogoźnik sandpit, *SZ* Szczakowa sandpit, (**2–4**) excavations of less than 0.6 km^2: (**2**) sandpits, (**3**) quarries (limestones, dolomites, porphyries, melaphyres, diabases), (**4**) clay-pits, (**5**) boundaries of the Upper Silesian Coal Basin after Doktorowicz-Hrebnicki 1968, (**6**) Carpathian thrust, (**7**) the Polish-Czech border; abbreviations: B P—the Biała Przemsza River, Cz P—the Czarna Przemsza River

1954–1980. Limestones and marls for the lime industry were exploited from the Sosnowiec Środula, Brynica-Czeladź and Mikołów-Mokre deposits.

The main areas of rock exploitation for construction purposes are now Imielin Hills (dolomite) and the Tenczynek Hummock (limestones, porphyries, diabases). In the two decades of 1990–2009, the Żelatowa quarry showed the largest output at 17 million tonnes, followed by the Zalas quarry with 14 million tonnes. In each of the remaining quarries, less than 3.8 million tonnes of deposits were extracted (Table 2.3). In addition to large quarries, there are a number of smaller quarries in the area of the USCB, especially in its south-eastern part, which have been used since the nineteenth century for local construction or lime industry needs.

Within the USCB, there are also deposits of gravel aggregates. Operation has been discontinued in 19 and is still carried out in 30. In 2009, a total of 4.776 million tonnes of aggregates were extracted there, which represents 3.4 % of national production. Most of the output came from large river valleys: the Oder (35 %), the Vistula, the Soła, and the Olza (41 %). The total output of gravel aggregates by 2009 was estimated at approximately 300 million tonnes.

Fig. 2.4 Gródek dolomite quarry in the Ciężkowice Hummock (Dulias 2011)

Stowing sands mining has more than a hundred years of history in the USCB (Dulias 2010). Initially, the exploitation of sands from fluvioglacial and partly aeolian deposits was carried out in the vicinity of mines in small, shallow (5–8 m) excavations, up to groundwater level only. Then, until the mid-twentieth century, mining was focused in the Dzierżno Duże, Dzierżno Małe, Pogoria I, Pogoria II, Czechowice, and Betoniarnia sandpits, as well as in the complex of sandpits of the Brynica Valley: Przezchlebie, Borowa Wieś, and Panewniki. Production volumes in the last 3 workings could not be determined because they were filled in with tailings. After World War II, stowing sands were mainly extracted from the Szczakowa, Kuźnica Warężyńska, Dziećkowice, Maczki-Bór Zachód, Maczki-Bór Wschód, Pogoria III, Jęzor Wysoki Brzeg, and Rogoźnik pits. Sandpits occur mainly in the eastern part of the USCB in the valleys of the Biała and Czarna Przemsza, as well as in the valleys of Brynica and Kłodnica.

By 2009, 1.75 billion tonnes of stowing sands were extracted, with more than 93 % from the 6 largest sandpits: Szczakowa, Dzierżno Duże, Kuźnica Warężyńska, Dziećkowice, and Maczki-Bór (Western and Eastern) (Fig. 2.5, Table 2.4).

In the Upper Silesian Coal Basin, there are many excavations that remained after the exploitation of raw clay for construction ceramics. The development of mining of this material was a result of the widespread clay rock—glacial in the west, Miocene in the south, Carboniferous in the central part of the USCB, and Permian

Table 2.3 The main quarries of solid rocks in the Upper Silesian Coal Basin (after Dulias 2013)

Quarry	Location	Type of solid rocks	Period	Output 1990–2009 (mln tonnes)
Dolomites for metallurgical industry				
Bobrowniki-Blachówka	Tarnowice Plateau	Dolomites	Triassic	–
Gródek	Ciężkowice Hummock	Dolomites	Triassic	1.2
Żelatowa	Jaworzno Hummock	Dolomites	Triassic	16.8
Limestones and marls for cement industry				
Sadowa Góra	Jaworzno Hummock	Limestones	Triassic	–
Żychcice	Twardowice Plateau	Limestones	Triassic	–
Rogoźnik	Twardowice Plateau	Limestones	Triassic	–
Płaza	Tenczynek Hummock	Limestones	Triassic	2.48
Dimension and crushed stones				
Libiąż	Libiąż Hills	Dolomites	Triassic	3.2
Imielin North	Imielin Hills	Dolomites	Triassic	2.5
Imielin Rek	Imielin Hills	Dolomites	Triassic	2.6
Imielin	Imielin Hills	Dolomites	Triassic	2.7
Rybna (Balaton)	Myślachowice Hills	Limestones	Jurrasic	–
Pogorzyce	Tenczynek Hummock	Limestones	Triassic	–
Zalas	Tenczynek Hummock	Limestones	Jurrasic	–
Kamień-Odwozy	Tenczynek Hummock	Limestones	Jurrasic	–
Regulice (Czarna Mountain)	Tenczynek Hummock	Melaphyres	Permian	–
Poręba-Żegoty	Tenczynek Hummock	Melaphyres	Permian	–
Rudno-Wymiarki	Tenczynek Hummock	Melaphyres	Permian	–
Zalas	Tenczynek Hummock	Porhyries	Permian	14.5
Orlej in Głuchówki	Tenczynek Hummock	Porhyries	Permian	–

(continued)

Table 2.3 (continued)

Quarry	Location	Type of solid rocks	Period	Output 1990–2009 (mln tonnes)
Miękinia	Myślachowice Hills	Porhyries	Permian	–
Kowalska Mountain	Myślachowice Hills	Porphyritic tuff	Permian	–
Niedźwiedzia Mountain	Tenczynek Hummock	Diabases	Permian	3.8

Fig. 2.5 Maczki Bór sandpit in the Biskupi Bór Basin (Dulias 2008)

in the east. The exploitation, especially in the nineteenth and the first half of the twentieth century, was carried out for numerous brickyards, predominantly of local importance. The output of these clay pits has not been included in official statistics. Of the 46 deposits of clay raw materials, currently only two are in operation. Given the volume of excavations and density of the extracted raw materials, it was estimated that throughout the USCB, about 13 million tonnes of raw clay were extracted.

Table 2.4 Output of stowing sands in the Upper Silesian Coal Basin to 2009 (from Dulias 2013)

Sandpit	Output		% of total output
	(mln tonnes)	(mln m^3)	
Szczakowa	1107.7	651.6	63.13
Dzierżno Duże	188.7	111.0	10.75
Kuźnica Warężyńska	139.6	82.1	7.95
Dziećkowice	109.8	64.6	6.26
Maczki Bór (Western and Eastern)	88.9	52.3	5.07
Pogoria III	30.1	17.7	1.71
Dzierżno Małe	23.8	14.0	1.36
Rogoźnik	12.9	7.6	0.74
Pogoria I	10.5	6.2	0.60
Pogoria II	6.6	3.9	0.38
Milowice	4.4	2.6	0.25
Morawa	3.7	2.2	0.21
Hubertus I–IV	3.1	1.8	0.17
Betoniarnia	2.9	1.7	0.16
Jęzor–Wysoki Brzeg	2.7	1.6	0.16
Rozkówka	1.9	1.1	0.11
Stary Czekaj	1.5	0.9	0.09
Borki Duże	1.2	0.7	0.07
Other sandpits	14.6	8.6	0.83
Total	1754.7	1032.2	100.00

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