The Jajur Coal Deposit, Northwestern Armenia

By Brenda S. Pierce, Gourgen Malkhasian, and Artur Martirosyan

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All data relating to the Jajur coal deposit — stratigraphic, coal quality, a nd resource information — are contained in this one comprehensive, interpretive report

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THE JAJUR COAL DEPOSIT, NORTHWESTERN ARMENIA

By Brenda S. Pierce,[1] Gourgen Malkhasian,[2] and Artur Martirosyan[2]

INTRODUCTION

There are six known coal fields in Armenia — Jajur, Ijevan, Antaramut, Shamut, Jermanis, and Nor Arevik (fig. 1) — as well as other minor coal deposits or occurrences. In addition, Armenia contains oil shale deposits at Dilijan, Aramus, Jajur, and Nor Arevik (fig. 1).

The Jajur coal deposit is located in northwestern Armenia in the Shirak Administrative District, about 15 km north of Gyumri, the second largest city in Armenia (fig. 1). The Jajur coal field is located in the valley of the Atskhajur River, which is a tributary of the Getik River. The Getik river valley is bordered by the Bazum mountain range on the north and the Shirak mountain range on the south.

SOURCE OF DATA

For the first time, all data relating to the Jajur coal deposit (stratigraphic, coal quality, and resource information) are contained in one comprehensive, interpretive report. This report, which is the result of a multiyear coal exploration and resource assessment study of Armenia, presents a synopsis of the previously inaccessible data contained either in the State Archives (Fund) of the former U.S.S.R. Ministry of Geology-Armenian Geology Department and the current Republic of Armenia's Ministry of Environment or the former Soviet and current Republic of Armenia Academy of Sciences. All reports within the State Archives and the Academy of Sciences related to coal and carbonaceous or combustible shale were obtained, translated, and analyzed. Contained here are all the basic data relating to the Jajur coal deposit, supplemented with some additional data from our earlier published works.

As part of our study of Armenian coals, we built stratigraphic data bases of all the coal information from the original archival reports. The stratigraphic data bases are reproduced here in tabular format; all data are credited to the original investigators. Additionally, all available coal-quality data and coal-resource estimates are reported here.

In addition, we used the created stratigraphic data bases to recalculate the coal-resource estimates on the basis of all the original data. For the first time, all previously existing data have been combined to determine the full resource of the Jajur coal field. Even Vardanian and Elbakian (1996) used only their own exploratory data in the latest attempt at resource calculations.

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Research and exploration of the Jajur coal field date back to the 1920's. The Jajur coal deposit has been one of the most extensively studied deposits in Armenia, at least locally. It was first explored in the late 1920's (Tarayan and others, 1929) and again from the 1930's until the mid-1940's (Gambarian, 1932; Tsamirian, 1935; Eremishian, 1938; Baicharov, 1939; Tarayan, 1942; Isaguliants and Azizyan, 1945). A small mine was operated in the Jajur coal deposit in the 1940's as a result of this exploratory work. As was the case with most of the coal deposits in Armenia, there was renewed interest in the Jajur deposit in the 1950's (Talanian and Azatian, 1953; Aslanian and Rudzyanski, 1954; Mesropian and Sarkissian, 1956) and again in the early 1990's (Vardanian and Elbakian, 1996) because of the energy crisis in Armenia.

STRATIGRAPHIC DATA

It is generally accepted that there are six coal beds in the Jajur deposit. However, because the strata in many parts of the coal field are repeated owing to faulting, early investigators recognized as many as fourteen coal beds in the Jajur deposit.

Baicharov (1939), in the 1930's, was the first to determine that there were thrusts in the area, but his interpretation was not taken seriously. According to Aslanian and Rudzyanski (1954), Demekhin and Gabashev made a detailed geologic study of the deposit in the mid-1940's and determined that there were six lignite seams in this deposit, two of which (No. 2 and No. 6) were potentially industrially important. Then, in 1954, Aslanian and Rudzyanski presented their 1953 exploration work, which revealed the structure of the deposit. The field and structural interpretations that the repetition of the strata was caused by faults in the area were reconfirmed petrographically by these same authors.

Of the six accepted coal beds, coal beds No. 2 and No. 6 are the thickest. According to Talanian and Azatian (1953), the composite thickness of the six coal beds and associated sedimentary units is 15.5 m. Specifically, the average thickness of each coal bed and the interburden are as follows:

Coal bed	Coal bed thickness (m)	Distance between coal beds (m)
No. 6	1.15	5.0
No. 5	0.3	1.5
No. 4	0.2	0.4
No. 3	0.45	4.0
No. 2	2.45	not reported
No. 1	0.35	not reported

The borehole, shaft, trench, and adit data included in this report are reproduced verbatim from the original reports (table 1) even though doing so sometimes meant including obvious errors. For example, in borehole 19 (Vardanian and Elbakian, 1996), intervals 22.60 to 26.10 m and 65.50 to 66.00 m are labeled “marl” in the lithologic columns of the report. Yet Vardanian and Elbakian’s data table shows the same intervals containing coal quality analyses. Obviously one must be incorrect, but we kept both in the data base table.

Also, the original bed numbers were used in the data base just as the original geologist had designated them. Many of the reports are old and, as mentioned above, subsequent regional and

local structural and stratigraphic interpretations have changed the conventional ordering and numbering of the coal beds at Jajur. Thus, old reports contain coal bed designations greater than bed No. 6 (for example borehole 25/32-33^{T32} and borehole 1/39^{B39} table 1).

More recent workers who recognized that the repetition in strata was fault related named the first occurrences of the coal beds as coal beds No. 1 through No. 6 and the repetitions as coal beds 1 bis through 6 bis (in Russian). We have renamed these repetitions No. 1' through No. 6', depending on which beds are present (see examples, table 1).

Although it appears in the data base (table 1) that workers sometimes designated a repeated stratum when no primary stratum was present (see, for example, many of the adit points in the data base), this is not actually the case. Workers based their coal-bed designations upon the whole of their exploratory work. Thus if the primary and secondary beds both appeared in one exploration work, such as a borehole, and only the secondary or repeated stratum's occurrence occurred updip in an adit or trench, this bed would be designated as the "bis" bed.

As mentioned above, some of the earlier workers in the Jajur coal field named the coal beds without taking into account the fact that faults in the area accounted for the repetition of strata. Thus, these authors have coal beds numbered greater than coal bed No. 6. For the purpose of resource calculations in this report, we have tried to rename the coal beds in the earlier reports and correlate them with those in the newer reports. We also felt that we should be able to correlate the latest study (Vardanian and Elbakian, 1996) with the reports of the 1940's and 1950's on the basis of our own extensive fieldwork in the region and an understanding of the coal beds. However, the correlations simply do not agree. The boreholes from the old reports are too different from the boreholes in the newer reports, even ones that are very close together. For example, compare boreholes 12 and 8/32 (fig. 2, table 1). These two boreholes are very close together and their elevations are close (2062 m and 2060.8 m), but borehole 12 was drilled in the 1990's and borehole 8/32 in the 1930's. Borehole 8/32 reached a depth of 30.2 m, and borehole 12 reached a depth of 100 m. Within 29 m of borehole 8/32, there are four coal beds; yet in borehole 12, there are only two coal beds – one at 19.5 to 21.1 m and the second one at 35.4 to 36.0 m.

There appear to be multiple reasons for the inability to correlate between boreholes, including (1) unreported core loss owing to poor coring equipment and a best estimate by the geologist as to what lithology was present; (2) no geophysical logging of the boreholes to help determine missing lithologies; (3) different lithologic descriptions based upon different geologic interpretations throughout time; (4) lack of anything definitive such as coal quality indicators to distinguish coal beds; (5) an individual author's interpretive biases for distinguishing coal beds; and (6) differences in the locality maps in each report. The location maps for each of the Jajur reports were very different in terms of coordinates and even topography. Thus, locating the different boreholes, trenches, adits, and so on, on a single map proved to be quite difficult. Archival maps made at different times and at different scales, once digitized, ended up with the same sampling point (borehole, adit, and so on) at different localities. Reports also had different elevations given for a specific point. Therefore, the locations of these sample localities cannot be considered exact, but must be considered approximate. These problems applied to the location of adits and trenches as well.

As explained earlier, we entered exactly what was contained in the original report for vertical boreholes, except for language translation. However, for horizontal exploratory works, such as adits and trenches, we could not enter straightforward vertical data. Because a great deal of exploration was carried out by adits and trenches in the former Soviet Union, we needed a way to represent these data. Therefore, we divided the adits and trenches into sections, depending upon

their length and number of lithologies. Similar lithologies were grouped together horizontally. This (horizontal) point then became a data point in a vertical data base, with the coordinate being directly above the midway point of the subsection of the adit or trench. The lithology entered into that vertical point represented the dominant lithology within the horizontal section of adit or trench, and the thickness entered was the average thickness of the dominant lithology of that section.

An internal system of coordinates was used on all working (nonmilitary) maps created in the Soviet Union. This internal coordinate system was a systematic *x-y* coordinate system. We converted the internal system of coordinates of the Jajur data into latitude and longitude. Both coordinate sets are presented in table 2.

The exploration data - boreholes, adits, shafts, and trenches - are also graphically represented in figure 2. The map is made from data from a variety of authors, including Tarayan and others (1929), Gambarian (1932), Tsamirian (1935), Baicharov (1939), Tarayan (1942), Aslanian and Rudzyanski (1954), and Vardanian and Elbakian (1996).

AGE OF THE JAJUR COAL DEPOSIT

Authors disagree about the age of the Jajur coal deposit and enclosing strata, but many workers accept an Eocene age (Talanian and Azatian, 1953; Georgadze, 1954). More recently, Kharazian (1990) gives a middle Eocene age for the Jajur coal deposit. Khatchatrian (1993), in a still more recent overview of coal deposits of Armenia, makes the following citations: V.V. Bogachev (1930's and 1940's) believed that the Jajur deposit was late Miocene-early Pliocene in age; A.T. Aslanian (1940's) interpreted the age as Oligocene; K.N. Paffenholts (1940's) believed that these deposits were Quaternary; and K.H. Mkrtchian and G.H. Chubarian (1990's) concluded that Jajur is late Miocene in age, nonconformably overlying Middle Eocene deposits.

Mesropian and Sarkissian (1956) cite Bogachev's interpretation of the Jajur deposit in the 1940's as Miocene in age on the basis of the fauna *Bythinia gregoria* and *Volvata rupensis*. Mesropian and Sarkissian also cite Aslanian's interpretation in the 1940's that the Jajur deposit is Oligocene in age on the basis of the general stratigraphy and tectonic information. According to Talanian and Azatian (1953), the Jajur coal field is composed of Cretaceous, Paleogene, and Quaternary sediments. Aslanian and Rudzyanski (1954) state that the upper Pliocene in the Shirak region is composed of shales, clays, siltstones, arenaceous clays, bituminous siltstones, and brown coal.

The composite geologic stratigraphic section of the Jajur coal field, according to Talanian and Azatian (1953), is as follows (base to top). The oldest rocks in the section are marls and limestones, late Turonian and Cenonian in age, having a thickness of about 1 km. This age was determined by microfaunal radiolaria (*Radiolaria* and *Globotrucana*). Talanian and Azatian (1953) cite Paffenholts who also found *Orbulina*, *Globigerina*, *Globotrucana*, *Tektulariidae*, *Nodosariidae*, and *Calcarina*, as well as fragments of *Bruozoa* [sic], *Echinodermata*, *Pelecypoda*, and *Lithothamnium*. These authors indicate that these fossils are characteristic of the Upper Cretaceous. The basal limestones are overlain by thick suites of Eocene tuffaceous (volcanic or sedimentary) rocks and porphyrites having a thickness of 2 km. The sediments of both the Cretaceous and the Eocene are intensively folded and subsequently transgressively covered by a thick (> 1.5 km) Quaternary volcanogenic suite. This suite is represented by doleritic basalts altering upward into andesite, dacite, and liparites. On the eroded surface of Upper Cretaceous limestones, basalts and tuff conglomerates 200 m thick are found overlain by normal marine Eocene

sediments, which are represented by clay-rich sandy facies. Within the Eocene sandstones were found fauna – in particular, *Nummulites atacicus* Leym, *N. subatatcius* Dam, *N. perforatus* Monh, *N. levigatus* Bray, *N. lucasi* Defr, and *Assilina* sp af expoens Sow. These nummulites, according to Talanian and Azatian (1953), are characteristic of the Eocene. All coal and carbonaceous shale occurrences in the Jajur section are connected with these clay-sand facies of Eocene age. The Quaternary sediments are represented by volcanogenic and sedimentary formations.

Vardanian and Elbakian (1996) report the coal-bearing section of the Jajur deposit as being Pliocene in age, according to faunal and floral control, citing work by Kh. K. Baicharov, S.A. Bubikian, and S. M. Grigorian. Vardanian and Elbakian (1996) state that they found many fossils in the coals of the Jajur deposit, including some age-diagnostic fossils such as the ostracodes *Cyprinotus speciosus* and *Llyocypris gibba*. These authors state that these two fossils have wide occurrences in the Pliocene-Quaternary deposits of Armenia, Georgia and Kazakhstan, but are also very characteristic of Pliocene deposits. However, the last sentence of their fossil description section says that the only fossils encountered were ostracodes and gastropods, which makes it difficult to determine the age.

Based upon recent extensive fieldwork and geologic mapping in the Shirak region and correlation of the units on a regional scale (Dallegge and others, 2000), we agree with the Eocene age designation for the Jajur coal deposit. Without better age controls on the lithologies - mineralogical dating or floral or faunal control - there is no way to determine whether the Jajur coal beds are upper, middle, or lower Eocene.

COAL QUALITY OF THE JAJUR DEPOSIT

MEGASCOPIC AND PETROGRAPHIC DESCRIPTION

Many of the earlier workers in the Jajur coal field have described the different coal in this deposit in some detail. Mesropian and Sarkissian (1956) describe the lithotypes of the Jajur deposit as predominantly semilustrous clarain with subordinate semidull durain. Talanian and Azatian (1953) state that clarain and vitrain were observed throughout the Jajur coals. Aslanian and Rudzyanski (1954) describe coal bed No. 2 as semibright coal with semidull striated partings. The same authors describe coal bed No. 6 as black, friable, coal characterized by a straight fracture tending toward conchoidal, homogenous in appearance and having poorly developed lenses, bands, and striations of vitrain.

Vardanian and Elbakian (1996) describe the Jajur coal beds No. 3, No. 4, and No. 5 as homogeneous, compact, resembling asphalt, and abundant in fossils. Furthermore, according to Vardanian and Elbakian (1996), coal beds No. 4 and No. 5 “are saturated with pure bitumen.” However, none of the previous authors have ever described these attributes nor have we ever seen these coals as they described them. The strata surrounding the coals are abundant in macrofossils, but not the coals themselves. Nor is bitumen evident in coal beds No. 4 or No. 5.

Talanian and Azatian (1953) conducted petrographic analyses on the Jajur coals. All samples microscopically analyzed were determined to be clarain, formed from lignite cellulose tissues. According to their petrographer, no sapropelic elements were discovered in the samples. Additional petrographic description of the coals have been give by Aslanian and Rudzyanski (1954). According to these authors, the Jajur coal bed No. 6 is microscopically a clarain, containing a vitrainlike matrix with considerable admixtures of bituminous bodies, yellow spore and pollen membranes, cuticles, resin, and algae. They describe the Jajur coal bed No. 2 as predominantly

clarain containing well developed vitrainlike masses and small admixtures of cuticles, resin, spore and pollen membranes, and sponge spicules.

According to the detailed petrographic description given by Aslanian and Rudzyanski (1954), Jajur coals are of two types - semibright, uniform/homogenous coal and semidull striated coal. The first type represents black, friable, semibright coal, which weathers to a mat surface. The fracture is straight and tends toward conchoidal. Within the thin sections, red-brown vitrainlike matrix representing the humified stems of plants predominated. The spore and pollen membranes were yellow, very thin, and although sparse in occurrence, distributed rather homogeneously in the main humic mass. Some samples contained considerable amounts of yellow cuticles and a single light-yellow algal body. Microfauna – sponge spicula and ostracodes – were also present, according to another worker in the same report. In horizontal thin sections, the sponge spicules represented thin needles; in vertical thin sections, they showed transparent or clear round points homogeneously distributed throughout the humic vitrainlike mass.

The second type of Jajur coal, according to Aslanian and Rudzyanski (1954), is represented by semidull striated dense and hard coal. The fracture is angular, and striated vitrain lenses are present. Abundant microfauna were observed on the horizontal surface in the form of very fine white formations, which were interpreted as ostracode remnants and sponge spicula. Microscopically, the semidull coal consists of brown matrix and an admixture of fine-grained clays. There is a considerable mixture of spore and pollen membranes. There are occurrences of yellow algae, cuticles, and a single vitrain lenses. In some samples are observed mineral grains of quartz, pyrite, and other unspecified minerals.

RANK OF JAJUR COALS

Vardanian and Elbakian (1996) call the Jajur coal bed both a bituminous coal and a “brown coal” in accordance with GOST (U.S.S.R. State Standard) classification. Brown coal is analogous to subbituminous coal or lignite. According to GOST (1988), brown coal has an average vitrinite reflectance (R_o) of less than 0.60 percent and a calorific value (moist, ash-free basis) of less than 24 MJ/kg. Most of the Jajur workers agree with this interpretation and call this coal a lignite. According to the petrographic work that Aslanian and Rudzyanski (1954) have done, Jajur coals are bituminous and display a high degree of coalification. Pierce and others (1994) have determined that the Jajur coal’s apparent rank indicates that it is on border between the lower end of the subbituminous and the upper end of the lignite groups.

COAL QUALITY

The Jajur coal deposit contains six coal beds. Average ash yield for the Jajur deposit, as reported by the Armenian government, is 21.8 percent, and sulfur content is 4.3 percent (both reporting bases are unknown, but probably as-determined) (Pierce and others, 1997). Georgadze (1954) reports overall quality values for the Jajur deposit (all bases unreported) as: moisture content ranging from 10 to 19 percent, ash yields ranging from 10 to 35 percent, volatile matter ranging from 20 to 45 percent, sulfur contents ranging from 2.3 to 7 percent, and calorific values from 5000 to 6000 cal/g.

However, because the quality of the Jajur coal beds is quite variable, it is difficult to make generalizations such as these for the entire deposit.

There have been two in-depth studies of the Jajur coal deposit in which quite a number of samples were collected and analyzed from coal beds No. 2 and No. 6. The first of these studies was done by Aslanian and Rudzyanski (1954). They collected 116 samples from the two coal beds but unfortunately do not state specifically how many were analyzed from each bed. The second of these studies was conducted by Vardanian and Elbakian (1996), who collected and analyzed over 200 samples of coal beds No. 2 and No. 6. Unfortunately, the number of samples per bed and how they were collected (for example, complete channel, grab, excluding or including partings, and so on) is not enumerated. However, given the large number of samples, these studies are probably a good representation of the Jajur No. 2 and No. 6 coal beds. Below are the reported average values of analyses from those two studies:

	Coal bed No. 2		**Coal bed No. 6**	
	Aslanian and Rudzyanski (1954)	Vardanian and Elbakian (1996)	Aslanian and Rudzyanski (1954)	Vardanian and Elbakian (1996)
Natural moisture (%)	30.7	22.04	38.1	38.1
Air Dried Moisture (%)	18.41	13.94	16.58	13.26
Air Dried Ash (%)	24.46	26.95	12.5	16.4
Total Sulfur (%)	2.84	2.51	2.18	2.79
Calorific Value (cal/g)	3938	4186	5178	5244
Bitumen Yield (%)	1.26	9.29	1.75	1.75
Tar Yield (%)	3.29	3.29	3.68	1.75
Fixed Carbon (%)	40.1	40.1	52.1	62.5
Density (g/cm^3)	1.56	1.58	1.4	1.47

Because so many workers investigated the Jajur coal deposit over the years and conducted coal quality analyses, we have been able to compile coal-quality tables for Jajur coal beds No. 2 through No. 6 from all the archival coal-quality information. These data are contained in tables 3 through 7.

Many of the authors of the archival reports gave coal-bed designations for the quality that they reported; these designations are simply reproduced within the appropriate coal-bed table. However, because some authors did not designate which coal beds had been analyzed, these data obviously could not be assigned to a specific coal bed. To try and rectify this situation, we examined the raw data at the geochemical laboratory and many of the original orders to the laboratory, but usually these sources included only field numbers. Thus, we chose to reproduce the tables of averaged data that authors provided for a specific coal bed rather than reproduce original data that were not bed specific.

The geochemical table in Vardanian and Elbakian's (1996) report also contains no coal-bed identifiers. Rather, it contains borehole, trench, or adit numbers and sample intervals. Therefore, in order to identify the coal beds, we used the borehole descriptions and compared the borehole intervals with the geochemical table intervals. The ones having intervals that matched are included

in the appropriate bed-specific table in tables 3 through 7. However, many coal beds were not identified and therefore were included in the unidentified coals table (table 8). The interval depths for many coal beds in the geochemical table differed greatly from the interval depths given in the borehole descriptions. We chose to err on the side of the borehole descriptions. If we could identify the coal in the borehole and match it with a coal in the quality table, even if it had different sample intervals (because those sample intervals did not exist in the borehole description), we included the analyses in the table with the appropriate coal bed identified by the borehole. Such inclusion was possible for approximately half of the data. When we compared the coal sample intervals listed in the geochemical table, we found that sometimes the lithologies did not match. One such example occurred in borehole No. 4. The coal geochemical table lists a sample and analyses for the interval of 22.0 to 24.0 m. The borehole description for No. 4 shows sandstone at that interval. Although it is entirely unclear how to correct this disagreement, this lithology had a calorific value and volatile matter, and so is most likely coal or carbonaceous shale. It is therefore contained in the unidentified coals table (table 8). There are a number of samples that are included in table 8 for the same reason. Each case is discussed in the footnotes of that table.

Ash yield for the Jajur No. 2 coal bed ranges from as low as 7.5 to as high as 46 percent. However, it is probably better to discuss these coal quality parameters as averages because appropriate analytical base information was not always reported by the different authors. Some of the averages discussed below may not always agree precisely with what is contained in tables 3 through 7, because the following discussion was made after trying to determine the different authors' reporting bases. So sometimes an anomalously high or low value was not considered for the sake of this discussion.

All coal beds have a fairly high total moisture content, which corresponds to the low rank of the coal. Coal bed No. 2 has an average total moisture of 32 percent and average equilibrium moisture content of 32 (table 3). Coal beds No. 3, 4, and 5 have similar total moisture contents (31, 35, and 40 percent, respectively) and equilibrium moisture contents (42, 35, and 47 percent, respectively) (tables 4, 5, 6). As stated above, the ash yields of coal bed No. 2 are quite variable. Some of this variation is probably owing to the different reporting bases, but some is also owing to the fact the coal bed No. 2 is internally variable. One study (Pierce and others, 1994) subsampled coal bed No. 2 into five incremental channel samples. The results of those analyses (table 3, pt. A) show that internally the ash yield of the No. 2 coal bed is quite variable, ranging from 14 to 38 percent. Many early authors of the internal reports also broke the No. 2 coal bed into two benches for subsampling and found them different. Therefore, the great range of ash yields found in table 3 for coal bed No. 2 is probably the result of the type of samples taken and the natural range of ash yield within the No. 2 coal bed.

In comparison with coal bed No. 2, coal bed No. 3 is higher in quality, having ash yields (on a dry basis) mostly between 10 and 15 percent, volatile matter contents ranging from 42 to 60 percent, and calorific values mainly in the mid- to high-4000 cal/g. Coal bed No. 4 is also of relatively good quality, having fairly low ash yields (between 8 and 19 percent), fairly high calorific values (from mid-5000 to 7000 cal/g, on a dry basis), and sulfur values ranging between 2 and 3 percent. Coal bed No. 5 also has fairly low ash yields (mostly around 11 and 12 percent, with one sample up to 21 percent [dry basis]) and calorific values ranging from 4195 to 5588 cal/g (probably dry basis). For coal bed No. 6, most workers report fairly low ash yields of around 14 percent (although a few are as high as 38 percent), and calorific values from the mid-4000's to high-5000's cal/g.

Isaguliants and Azizyan (1945) report quite a number of coal-quality parameters in addition to the normal proximate and ultimate analyses. These authors determined the elemental analysis of

the organic fraction of the different coal beds of the Jajur deposit, which are also found in part B of each appropriate bed-specific table (tables 3 - 7). Isaguliants and Azizyan (1945) also determined oxide data on the different coal beds of the Jajur deposit, which are found in part C of each appropriate bed-specific table (tables 3 - 7).

In addition, Isaguliants and Azizyan (1945) determined the primary and secondary gases that were produced from Jajur coal beds No. 2, No. 4, and No. 6. The results of these tests are found in table 9.

Aslanian and Rudzyanski (1954) also performed a number of different coal-quality tests on the Jajur coal beds. They subjected the Jajur coals to physical and chemical treatment by KOH (potassium hydroxide) and weak nitric acid. According to the results of this test, the Jajur coals belong to the brown coal category. High hydroscopicity (water-absorbing capacity) equaled 16.6 to 18.4 percent, and the brown streak (on a streak plate) testified to the fact that these are brown coals, according to Aslanian and Rudzyanski (1954).

Aslanian and Rudzyanski (1954) also carried out tests to determine the tar yield and tar characteristics of the Jajur coals. During distillation, Jajur coal bed No. 2 produced a primary tar yield of 3.29 percent. Jajur coal bed No. 6 coal yielded 3.68 percent tar. During distillation of coal bed No. 4, the yield of primary tar was 77.2 percent. The tar from Jajur coal bed No. 4 is a harder substance in comparison to tars from coal beds No. 6 and No. 2. (A note should be made here. The Russian word used by Aslanian and Rudzyanski (1954) and described above is “smolla.” This word translates into English as both “tar” and “resin,” so it is not exactly clear which test these authors performed. From the description of the procedure and what was produced, we chose the word tar.)

COMBUSTIBLE SHALE QUALITY

The Jajur coal deposit also contains combustible shales. Combustible shales are shales that literally will burn. AGI (Bates and Jackson, 1980) gives a definition of combustible shale, or tasmanite, as an impure coal transitional between cannel coal and oil shale. Often the combustible shales at Jajur are called oil shales, but, to our knowledge, no definitive studies have been done on these shales to determine if they are true oil shales. However, these combustible shales are a potential resource. Quality analyses were conducted by Vardanian and Elbakian (1996); although these rocks are quite high in ash yield, they do burn, having calorific values between 472 and 1413 cal/g (basis unknown) and quite high volatile matters (table 10).

COAL RESOURCE CALCULATIONS OF JAJUR

RESOURCE TERMINOLOGY

The methods used in the United States and the former Soviet Union to calculate and report coal resource and reserve tonnage are very similar (Pierce and others, 1996). The system used in the United States was developed at the U.S. Geological Survey (USGS) (Wood and others, 1983) and the former U.S. Bureau of Mines. The system currently used in many countries of the Commonwealth of Independent States was developed by the Ministry of Geology of the former U.S.S.R. Both systems classify coal resources and reserves according to the degree of geologic control and economic feasibility of recovery. Both systems have mechanisms for exclusions based upon ash yield, depth, bed thickness, and parting thickness.

Both systems are based upon the distribution and spacing of known data. As a result, both systems have reporting categories based on degrees of confidence or uncertainty. In the USGS system, the resource reliability categories are termed “measured,” “indicated,” “inferred,” and “hypothetical”; in the former U.S.S.R. Ministry of Geology, the categories are termed "A" (which is sometimes broken down into “A_1” and "A_2"), “B,” “C_1," “C_2," and “P_1 and P_2.” The USGS “measured” equates to the Soviet “A” + “B,” “indicated” is the same as “C_1," “inferred” is correlative to “C_2," and “hypothetical” is equivalent to “P_1" and “P_2.” Each resource or reserve category is dependent upon the density of the exploration network and is directly dependent upon distance from known data points, either coal in boreholes or in outcrop. Moving from category to category increases the distance from known coal localities and correlatively decreases the certainty with which the tonnage estimate is given.

In addition to the categories referred to above, the Soviet system has an additional overall two-category system for classifying the economic viability of a coal deposit. These two categories are referred to as “in-balance” resources and “out-of-balance” resources. “In-balance” resources are deemed economically viable within a given set of technological parameters or market constraints. “Out-of-balance” resources are present but deemed not economically viable within the current economic parameters, although they may become economically viable should market forces or demand change.

ARCHIVAL RESOURCES

Many different sets of coal-resource estimates are available for the Jajur deposit. However, only one set of resource numbers has been officially approved by the State Committee on Reserves of the former U.S.S.R. and the current Republic of Armenia. These resource estimates, which were approved in 1943, are as follows (from Pierce and others, 1997) (no area is given for this resource estimate):

Category	**Original estimate (thousand metric tonnes)**	**Amount remaining at present (after mining) (thousand metric tonnes)**
A	62.1	0
B	90.8	64.7
A+B	152.9	64.7
C_1	241.4	151.2
C_2 (economical)	10.4	10.4
C_2 (non economical)	128.9	128.9

The first reported resource estimate for the Jajur coal deposit appears in the literature in the 1930's (table 11). Eremeshian (1938) reported a total resource of A_2 + B category coal of 149,560 metric tonnes from seven Jajur coal beds, because his work was done before the faults responsible for repeating the sections were recognized. The areas that were calculated in his study were very small, 500 x 100 m being the largest area (table 11). These small areas of calculation are reflected

in the reporting categories; categories A_2 and B indicate very closely spaced point localities and a high degree of confidence in the numbers. (A_2 is simply a refinement within the overall catetory of "A.")

A year later, a more thorough study and resource calculation was conducted by Baicharov (1939). Unfortunately, even though Baicharov recognized that there were thrust faults in the region, he did not recognize the repeated beds as such and interpreted them as separate beds. Baicharov therefore calculated tonnage for 13 coal beds in the Jajur deposit (table 12). Baicharov (1939) determined a total tonnage for the Jajur coal deposit of $A_2 + B + C_1$ category coal of 578,002 metric tonnes for areas ranging from 3700 m^2 to almost 60,000 m^2, depending upon the coal bed and its extent (table 12).

In 1940, a regional Committee of Reserves approved the Jajur coal resources by category $A_2 + B + C_1$. The informally approved resources were calculated at 565,100 metric tonnes. After their finding, impetus to explore for coal in the Jajur deposit increased. One major adit dug in the Jajur coal in 1940 (fig. 2) showed a number of thrust faults that were responsible for the repetition of the coals. The digging of this adit and the revelation of the thrust faults drastically changed ideas about the tectonic structure of the Jajur deposit and prompted the government to recalculate the coal reserves. But the recalculation, which was carried out by Tarayan (1942), would lessen the amount of the resources. Tarayan was entrusted with this work by the administration of Jajur Coal, and he used the new geologic data that was obtained during the mining.

Following the discovery of the faults in the Jajur coal field and the new interpretation of repetition of strata, the coal beds were henceforth labeled bed No. 1 through bed No. 6. Coal beds No. 2 and No. 6 were interpreted to be the thickest and most extensive and, as a result, coal resources were often calculated only for these two beds. Because mining practices dictate that repeated beds be considered separate beds, resource tonnage was calculated separately for the primary and repeated beds.

The coal resources recalculated by Tarayan (1942) (table 13) totaled 265,900 metric tonnes of $A_2 + B + C_1 + C_2$ category coal. However, the regional committee on reserves only approved 251,400 metric tonnes of $A_2 + B + C_1$ category coal in 1943. Tarayan (1942) also calculated an out-of-balance resource (coal beds No. 3, No. 4, No. 5 and "sooty" coals) of 128,900 metric tonnes.

In addition to the change in numbering of the Jajur coal beds, resource calculations often reflected a distinction between "in-balance" and "out-of-balance" starting in the 1940's. As mentioned earlier, some authors calculated the resources on Jajur coal beds No. 2 and No. 6 only, because they were the thickest and most extensive and represented the largest resource. However, because coal beds No. 3, No. 4, and No. 5 lay between coal beds No. 2 and No. 6, some authors also calculated the resource tonnage on these three beds. Most authors, including Tarayan (1942), considered coal beds No. 2 and No. 6 to be an in-balance resource; the thinner beds, 3, 4, and 5 were considered out-of-balance (table 13). The quality of Jajur coal beds No. 3, No. 4, and No. 5 is often quite good, so the "out-of-balance" distinction is probably based solely upon thickness exclusions.

Tarayan's (1942) Jajur resource estimates were accepted until the early 1990's, when mining of the Jajur deposit resumed owing to the energy crisis in Armenia. Recently, coal resources at Jajur have been reestimated by the Armenian government on five of the six coal beds. The new estimates include 260,113 metric tonnes of C_1 (indicated) resources, 336, 224 metric

tonnes of C_2 (inferred) resources, and 200,000 metric tonnes of P_1 (hypothetical) resources (Pierce and others, 1997).

Another recent exploratory study and resource assessment was conducted in the 1990's (Vardanian and Elbakian, 1996) (table 14). These authors also consider Jajur coal beds No. 2 and No. 6 to be in-balance and coal beds No. 3, No. 4, and No. 5 to be out-of-balance. Their total calculated resources for Jajur coal bed No. 2 in category $C_1 + C_2$ is 332,067 metric tonnes; Jajur coal bed No. 6, category $C_1 + C_2$, is 144,930 metric tonnes. Their total resource for the main Jajur coal beds is reported as 476,997 metric tonnes of original resource. However, two mines operating in the Jajur coal field in this century have produced approximately 84,263 metric tonnes. Thus, an estimated 392,734 metric tonnes of coal remain in the Jajur coal field for an area of approximately 110,000 m^2. The out-of-balance resources for coal beds No. 3, No. 4, and No. 5, reported by Vardanian and Elbakian (1996) in category $C_1 + C_2$ are 119,340 metric tonnes (table 14).

Vardanian and Elbakian (1996) exclude from their calculations coals less than 0.3 m thick and coals having ash yields greater than 50 percent (basis unknown). Because of the grid spacing on the known data points of the area calculated, these resources could be considered in the B (measured) category. However, the authors "downgrade" their category to C_1 because they believe that the qualitative and technological characteristics of the beds have not yet been sufficiently investigated. The resources were calculated by using the geological block method. Vardanian and Elbakian report a calculation of total original resources for Jajur of $C_1 + C_2$ category of 596,337 tonnes (260,113 tonnes of C_1 coal). However, they go on to say that 84,260 tonnes of coal were mined between 1940 and 1995; thus, the remaining Jajur resources total only 512,074 tonnes.

It is not really clear why many authors consider Jajur coal beds No. 3, No. 4, and No. 5 to be out-of-balance. These beds are not so thin that they are not strippable during mining; average thickness ranges from 0.45 to 0.38 m for bed No. 3, 0.2 to 0.29 m for bed No. 4, and 0.3 to 0.28 m for bed No. 5, according to Talanian and Azatian (1953) and Vardanian and Elbakian (1996), respectively. And, in fact, when a small strip mine was operated in the 1990's in the Jajur field, the Vardanian and Elbakian actually stripped coal beds No. 3, No. 4, and No. 5 when mining beds No. 2 and No. 6, a procedure that increased their resource considerably.

RESOURCE RECALCULATION

As mentioned above, for coal-resource recalculation purposes, we attempted to correlate the different coal beds from all of the available archival data. However, even boreholes close to each other were simply too different in character to permit correlation. Thus, we calculated the whole coal resource of the Jajur deposit. We summed all the coal beds in each of the boreholes to come up with a total Jajur resource, which is shown within the gray area in figure 3.

For an area of 13.32 hectares (133,150 m^2) using all available archival data, we calculated a total Jajur resource of 483,537 metric tonnes (table 15, pt. A). The area of calculation (fig. 3) was bounded by the extent of coal occurrence and a relatively large fault in the area. We used the same density as all other workers – 1.2 g/cm^3 – in our resource calculations. This resource figure is greatly expanded from that used by some earlier workers and is smaller than others, probably because the computer zeroed out areas where no coal was found within the area that we calculated (we included all boreholes as data points). Previous workers probably used only those boreholes that contained coal, an indication that the resource covered the entire area.

For comparison purposes, we also recalculated Jajur coal beds No. 2 and 6 (table 15, pt. B) using data only from the latest archival report (Vardanian and Elbakian, 1996). Although the areas that we calculated were slightly larger than theirs, we came out with very similar resource tonnage for those two coal beds. It is unfortunate that we could not correlate the old data with the data from this report and thereby increase our understanding of the specific beds in the Jajur coal deposit.

RELATED COAL DEPOSITS

There are several coal deposits in the region that may be related to the Jajur deposit – Maissian, Bandivan, and Lernut. The Maissian coal occurrence is located approximately 6.5 km north of Gyumri (fig. 1) and was first looked at in any detail by I.A. Tarayan in 1929 (Aslanian and Rudzyanski, 1954). Tarayan concluded that Maissian was of no interest and that the beds pinched out along strike.

Talanian and Azatian (1953) analyzed quite a number of samples from adits and shafts dug into the Maissian coal deposit. Their data (table 16) indicate a fairly high ash yield (average 47 percent, as-determined basis), volatile matter (55 percent, dry basis), a moderate sulfur range (average 1.2 percent), and moderate calorific values (average 2366 cal/g, probably as-determined basis). The coal quality of the Maissian coal deposit, as reported by Mesropian and Sarkissian (1956), is as follows (reporting bases not given): ash yield varies between 45 and 77 percent, calorific value ranges from 1412 to 2824 cal/g, specific weight ranges from 1.67 to 1.90, sulfur values range from 1.68 to 2.01 percent, and volatile matter is between 43.02 and 57.38 percent. Mesropian and Sarkissian (1956) report a coal resource estimate from 1939 on the Maissian deposit that does not exceed 10,000 metric tonnes.

There are several outcrops of coal near the village of Sariar, which is approximately 4 km south-southwest of Jajur and may also be related to the Jajur deposit. Mesropian and Sarkissian (1956) cite an earlier worker who described one of these deposits as sapropelic coal. The coal-bearing sequence of the Sariar deposit consists of interbedded clays, coaly shales, sandstones, shales, and coals. Mesropian and Sarkissian (1956) state that the quality of the Sariar coals is similar to that of the Maissian coals, except it has a higher ash yield, but they give no specific numbers in their report. Vardanian and Elbakian (1996) analyzed one sample of the Mets Sariar coal and report the following: an analytical moisture of 10.1 percent, ash yield of 44.2 percent (basis not given), total sulfur of 0.80 percent, and volatile matter (dry ash-free basis) of 58.9 percent. Calorific value was not analyzed on the Mets Sariar sample.

The Bandivan deposit, which is located in the Amassia region approximately 20 km northwest of Jajur, has long been thought to be related to the Jajur coal deposit. However, just as most authors disagree about the age of the Jajur deposit, there is disagreement on the age of the Bandivan strata. Khatchatrian (1993) gives an age of late Oligocene-early Miocene for the Bandivan coal deposit (and an age of late Miocene-early Pliocene for the Jajur deposit). If he is correct, then these two deposits cannot be related. The Bandivan coal deposit, however, has been correlated to the Jajur coal field through extensive mapping (Kharazian, 1990), although the coal beds are not continuous across the entire extent. Proximate analyses for Bandivan samples are as follows (basis unreported): moisture, 6.97 percent; ash yield, 45 percent; volatile matter, 19.39 percent; sulfur, 3.12 percent (Mesropian and Sarkissian, 1956).

A reported coal occurrence approximately 10 km southeast of the Jajur deposit (near the villages with the old names of Chiharlu and Hamzaly) has the following quality characteristics:

moisture, 3.68 percent; ash yield, 54.86 percent; sulfur, 0.94 percent (Mesropian and Sarkissian, 1956).

CONCLUSIONS

The Jajur coal deposit is one of the most thoroughly studied deposits in Armenia. Studies began in the 1920's, continued through the 1930's, 40's, and 50's, and resumed in the 1990's. The Jajur coal deposit has been mined twice. Current resource estimates of the Jajur deposit are approximately 483,000 metric tonnes (although this is for a relatively small area, 133,150 m^2).

The Jajur resource estimates may be slightly larger than this estimate, because the density used in the resource calculations was lower than the actual density of the coal. However, this difference will not increase the resources significantly.

Although there are related coal and carbonaceous shale deposits in the Shirak region, the resource tonnage given above may be the entire extent of the Jajur resources, most likely owing to the fact that, although the Jajur coals correlate to the other deposits in the area (Bandivan, Maissian, Sariar), the coal beds are not laterally continuous across the area. And although all of these deposits most likely formed at the same time and in the same type of environment, they all formed most probably as small, isolated, organic, lacustrine deposits.

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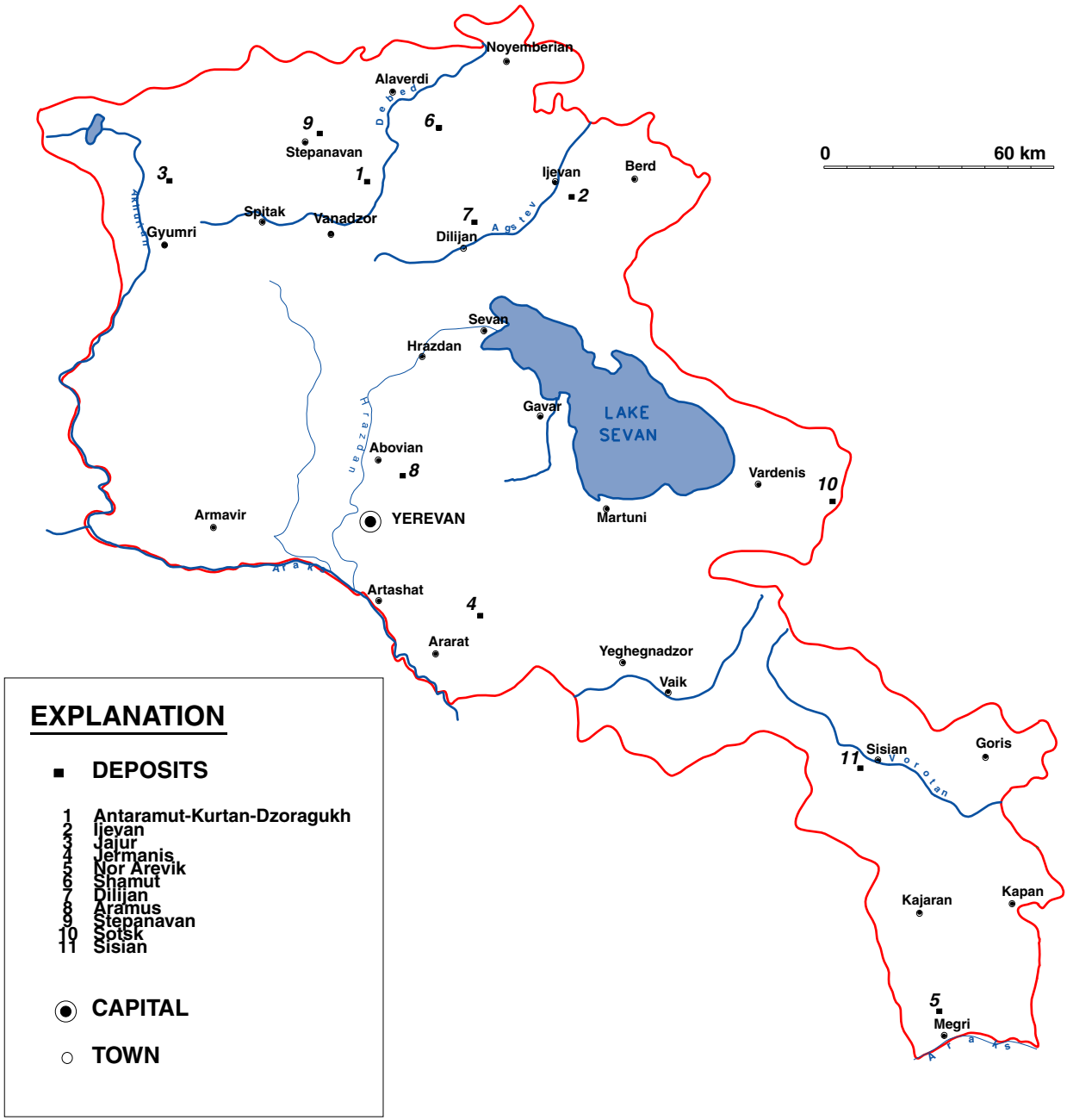
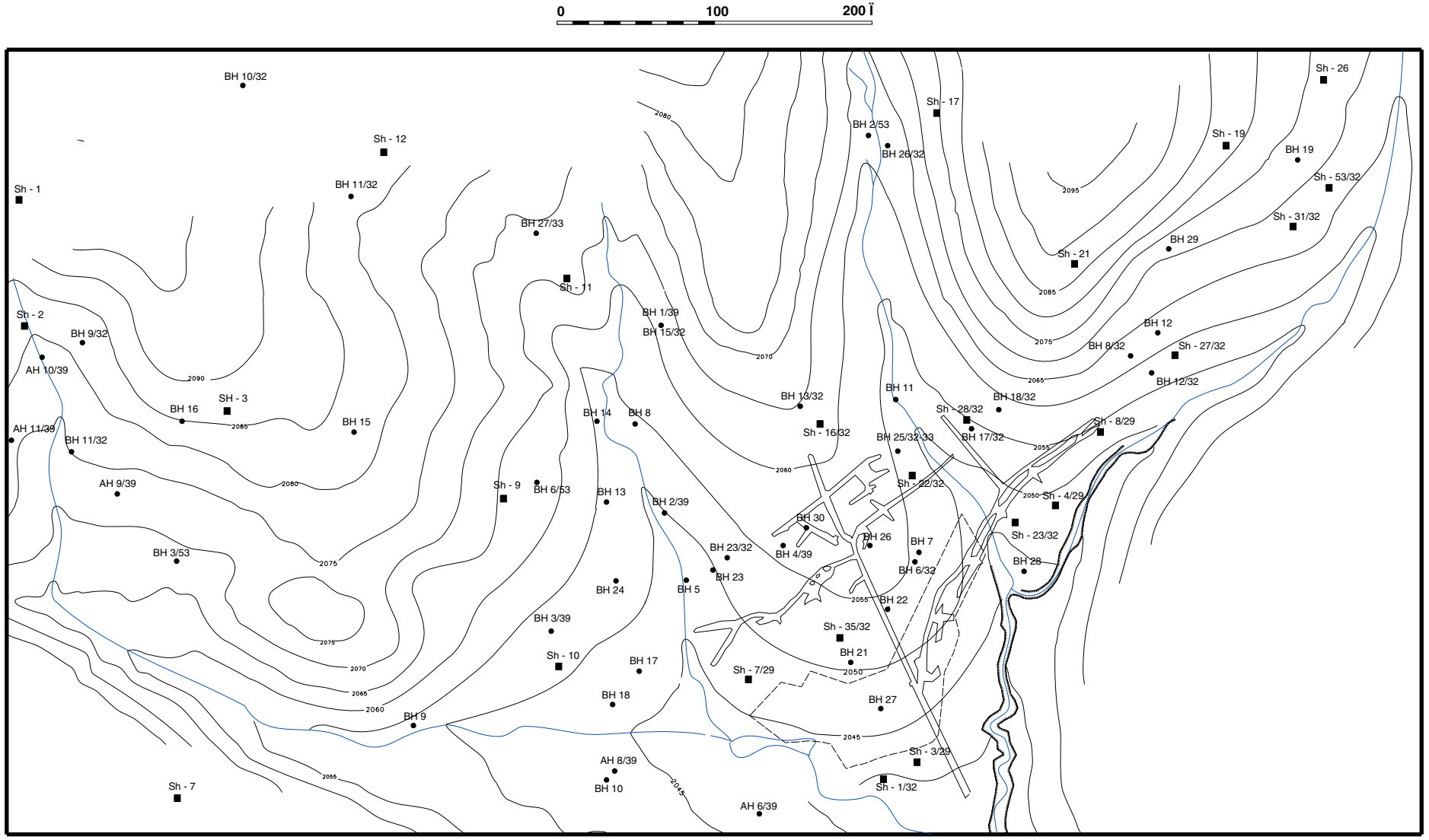


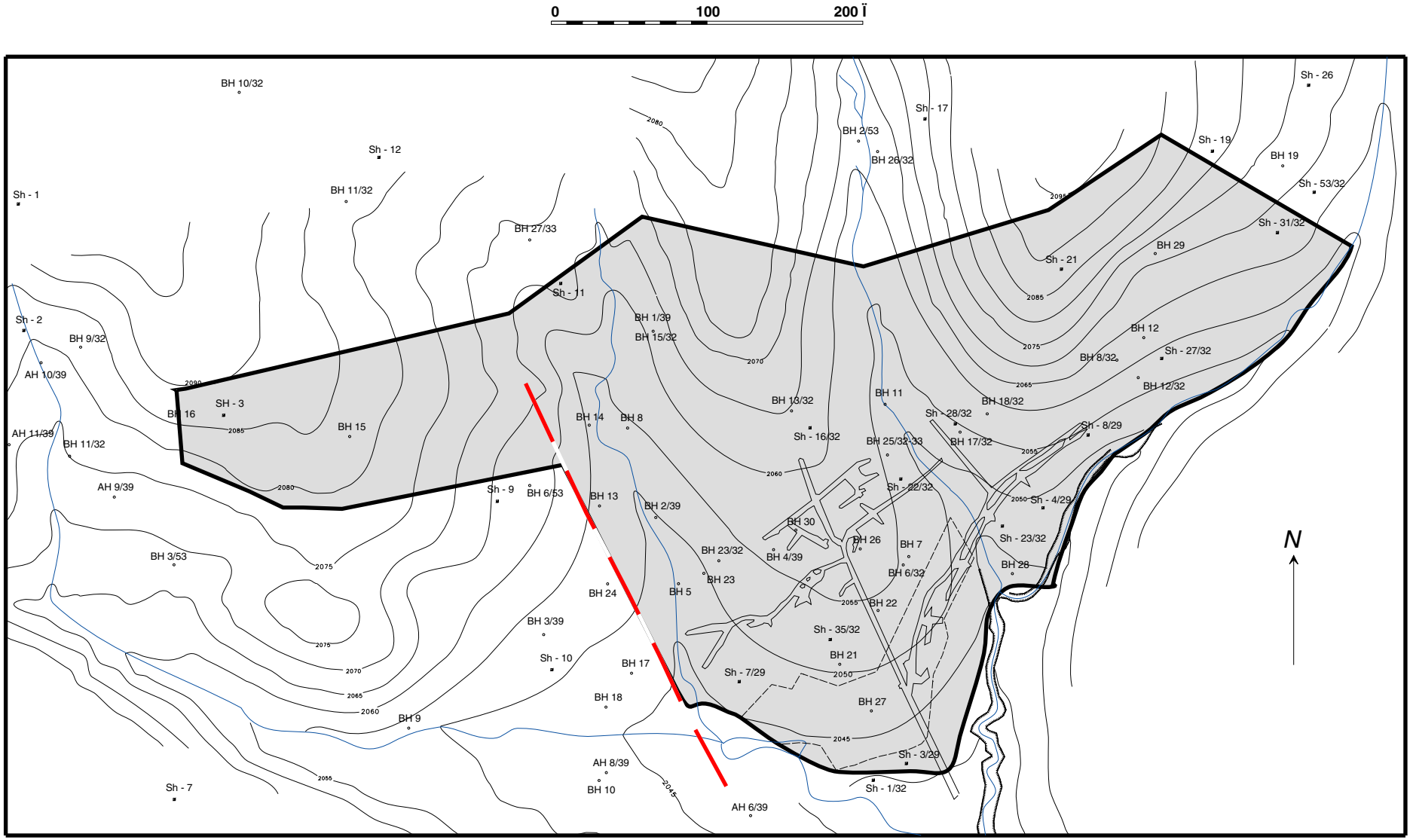
Figure 1. Location of coal, carbonaceous shale, and oil shale deposits in Armenia.



Explanation

- BH 9 = borehole locality
- AH 8/39 = hand-augered hole locality
- Sh - 7/53 = shaft locality

Figure 2. Exploratory works in the Jajur coal field. Data and sources are found in table 1. Placed on the map are boreholes (BH), hand-augered holes (AH), shafts (SH), exploratory adits/underground mine (outline), and surface mine (dashed line).



Explanation

- BH 9 = borehole locality
- AH 8/39 = hand-augered hole locality
- Sh - 7/53 = shaft locality

Figure 3. Area of resource recalculation for the Jajur coal deposit (gray shaded area). Area is bounded by the extent of the coal occurrence (heavy black outline) and fault (red dashed line).

Table 1. Lithologic columns and coal quality data from exploratory adits, boreholes, shafts, and trenches of the Jajur coal field.

[Data contained in this table represent data within the stratigraphic data base created to calculate coal resources. PNTID ^{SRC} = Point Identifier and Source of Data; BTM = bottom interval; M = moisture; Ash = ash yield, dry basis; S = sulfur, basis unknown; VM = volatile matter, basis unknown; CV = calorific value, basis unknown; d = density; BH = borehole; NA = not available; BH ^{unp} = unpublished stratigraphic data, no locations are available for these three boreholes; AH = (hand) augered hole; Trench (B) and Trench (E) = beginning and ending intervals of trench samples, in order to represent them in a vertical database. Sources of data: T29 = Tarayan and others (1929); G32 = Gambarian (1932); T35 = Tsamirian (1935); B39 = Baicharov (1939); T42 = Tarayan (1942); AR54 = Aslanian and Rudzyanski (1954); VE96 = Vardanian and Elbakian (1996)]

PNTID ^{SRC}	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
ADIT 2 ^{AR54}	0.00	11.65	CLAY						
	11.65	12.30	TUFF						
	12.30	18.20	CLAY						
	18.20	18.80	TUFF						
	18.80	26.20	CLAY						
	26.20	26.80	TUFF						
	26.80	30.00	CLAY						
ADIT 3 ^{AR54}	0.00	9.60	CLAY						
	9.60	10.80	TUFF						
	10.80	18.20	CLAY						
	18.20	20.35	TUFF						
	20.35	23.50	CLAY						
	23.50	24.00	TUFF						
	24.00	27.00	CLAY						
ADIT 4 ^{AR54}	0.00	1.50	COAL W/ CLAY						
	1.50	2.40	CLAYSHALE						
	2.40	2.70	COAL						
	2.70	3.50	CLAYSHALE						
	3.50	4.50	COAL						
	4.50	11.00	CLAYSHALE						
	11.00	11.80	COAL						
	11.80	41.20	CLAYSHALE						
	41.20	46.60	COAL W/ CLAY						
ADIT 5 ^{AR54}	0.00	14.00	GABBRO DIORITE						
ADIT 6 ^{AR54}	0.00	4.60	CLAY						
	4.60	5.30	SOOTY COAL						
	5.30	14.30	CLAY						
	14.30	16.75	TUFF						
	16.75	17.60	CLAYSHALE						
	17.60	17.80	TUFF						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
		17.80	20.30	CLAYSHALE						
		20.30	22.40	CLAY						
		22.40	22.60	COAL						
		22.60	26.60	CLAY						
		26.60	28.40	COAL						
		28.40	28.80	COQUINA						
		28.80	29.60	CLAY						
		29.60	29.80	TUFF						
		29.80	46.00	CLAY						
		46.00	46.50	TUFF						
		46.50	53.00	CLAY						
Adit Pt 1	T42	0.00	5.30	UNKNOWN						
		5.30	7.74	COAL BED 2						
		7.74	7.75	UNKNOWN						
Adit Pt 10	T42	0.00	11.10	UNKNOWN						
		11.10	13.50	COAL BED 2'						
		13.50	13.51	UNKNOWN						
Adit Pt 11	T42	0.00	7.00	UNKNOWN						
		7.00	8.60	COAL BED 2'						
		8.60	8.65	UNKNOWN						
Adit Pt 12	T42	0.00	7.87	UNKNOWN						
		7.87	9.14	COAL BED 2'						
		9.14	9.15	UNKNOWN						
Adit Pt 13	T42	0.00	15.35	UNKNOWN						
		15.35	16.50	COAL BED 6						
		16.50	16.51	UNKNOWN						
Adit Pt 14	T42	0.00	14.98	UNKNOWN						
		14.98	16.30	COAL BED 6						
		16.30	16.31	UNKNOWN						
Adit Pt 15	T42	0.00	18.10	UNKNOWN						
		18.10	19.45	COAL BED 6'						
		19.45	19.46	UNKNOWN						
Adit Pt 16	T42	0.00	16.34	UNKNOWN						
		16.34	17.75	COAL BED 6'						
		17.75	17.76	UNKNOWN						
Adit Pt 17	T42	0.00	13.95	UNKNOWN						
		13.95	15.25	COAL BED 6'						
		15.25	15.26	UNKNOWN						
Adit Pt 18	T42	0.00	18.40	UNKNOWN						
		18.40	19.75	COAL BED 6'						
		19.75	19.76	UNKNOWN						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
Adit Pt 19	T42	0.00	17.52	UNKNOWN						
		17.52	18.75	COAL BED 6'						
		18.75	18.76	UNKNOWN						
Adit Pt 2	T42	0.00	3.50	UNKNOWN						
		3.50	5.78	COAL BED 2						
		5.78	5.85	UNKNOWN						
Adit Pt 20	T42	0.00	14.28	UNKNOWN						
		14.28	15.52	COAL BED 6'						
		15.52	15.53	UNKNOWN						
Adit Pt 21	T42	0.00	11.83	UNKNOWN						
		11.83	12.25	COAL BED 3						
		12.25	12.26	UNKNOWN						
Adit Pt 22	T42	0.00	11.80	UNKNOWN						
		11.80	12.25	COAL BED 3						
		12.25	12.26	UNKNOWN						
Adit Pt 23	T42	0.00	11.50	UNKNOWN						
		11.50	11.95	COAL BED 3						
		11.95	11.96	UNKNOWN						
Adit Pt 24	T42	0.00	12.60	UNKNOWN						
		12.60	12.75	COAL BED 4						
		12.75	12.76	UNKNOWN						
Adit Pt 25	T42	0.00	12.31	UNKNOWN						
		12.31	12.45	COAL BED 4						
		12.45	12.46	UNKNOWN						
Adit Pt 26	T42	0.00	8.75	UNKNOWN						
		8.75	8.90	COAL BED 4						
		8.90	8.91	UNKNOWN						
Adit Pt 27	T42	0.00	13.45	UNKNOWN						
		13.45	13.75	COAL BED 5						
		13.75	13.76	UNKNOWN						
Adit Pt 28	T42	0.00	9.98	UNKNOWN						
		9.98	10.30	COAL BED 5						
		10.30	10.31	UNKNOWN						
Adit Pt 29	T42	0.00	11.03	UNKNOWN						
		11.03	11.40	COAL BED 3'						
		11.40	11.41	UNKNOWN						
Adit Pt 3	T42	0.00	3.74	UNKNOWN						
		3.74	5.24	COAL BED 2						
		5.24	5.25	UNKNOWN						
Adit Pt 30	T42	0.00	11.35	UNKNOWN						
		11.35	11.70	COAL BED 4'						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
		11.70	11.71	UNKNOWN						
Adit Pt 31	T42	0.00	11.94	UNKNOWN						
		11.94	12.02	COAL 6'						
		12.02	12.03	UNKNOWN						
Adit Pt 4	T42	0.00	6.68	UNKNOWN						
		6.68	9.13	COAL BED 2						
		9.13	9.14	UNKNOWN						
Adit Pt 5	T42	0.00	9.53	UNKNOWN						
		9.53	12.14	COAL BED 2						
		12.14	12.15	UNKNOWN						
Adit Pt 6	T42	0.00	6.44	UNKNOWN						
		6.44	8.89	COAL BED 2						
		8.89	8.90	UNKNOWN						
Adit Pt 7	T42	0.00	12.19	UNKNOWN						
		12.19	13.74	COAL BED 2						
		13.74	13.75	UNKNOWN						
Adit Pt 8	T42	0.00	14.14	UNKNOWN						
		14.14	15.84	COAL BED 2'						
		15.84	15.85	UNKNOWN						
Adit Pt 9	T42	0.00	11.80	UNKNOWN						
		11.80	14.15	COAL BED 2'						
		14.15	14.16	UNKNOWN						
BH 1/39	B39	0.00	1.00	DELUVIUM						
		1.00	9.45	GRAVEL W/ CLAY						
		9.45	10.00	CLAY						
		10.00	12.35	GRAVEL W/ CLAY						
		12.35	13.60	SAND PEBBLE						
		13.60	16.70	GRAVEL W/ CLAY						
		16.70	17.20	CLAY						
		17.20	20.50	GRAVEL W/ CLAY						
		20.50	21.70	SAND PEBBLE						
		21.70	23.60	GRAVEL W/ CLAY						
		23.60	23.90	CLAY						
		23.90	24.10	COALY SHALE						
		24.10	24.45	SOOTY COAL	9.8	67.8	3.1	12	NA	2
		24.45	30.50	CLAY						
		30.50	32.50	SOOTY COAL	18.4	23.6	5.1	20.3	NA	1.3
		32.50	39.91	CLAY						
		39.91	40.31	SOOTY COAL	11.0	35.3	5.1	22.6	NA	1.9
		40.31	41.61	CLAY						
		41.61	42.35	SOOTY COAL BED 11	13.0	36.7	5.9	18.4	NA	1.7

PNTID SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
	42.35	42.70	CLAY						
	42.70	43.96	SOOTY COAL BED 11	12.8	55.8	3.5	24.0	NA	1.8
	43.96	44.51	CLAY W/ COAL, BED NO. 11						
	44.51	46.21	SOOTY COAL BED 11	13.5	49.8	4.8	15.1	NA	1.8
	46.21	48.83	CLAY						
	48.83	51.00	PORPHYRITE						
	51.00	52.63	SOOTY COAL BED 10	9.9	73.0	2.6	14.3	NA	2.2
	52.63	60.70	CLAY						
	60.70	61.20	COAL BED 9	9.6	58.4	3.5	29.8	NA	1.4
	61.20	67.92	CLAY						
	67.92	68.27	COALY SHALE						
	68.27	70.77	CLAY						
	70.77	71.82	COAL BED 2	14.4	49.2	3.4	2.5	NA	1.9
	71.82	96.30	CLAY, BED 2						
	96.30	98.10	PORPHYRITE						
	98.10	99.42	SAND PEBBLE						
	99.42	100.00	COAL BED 2	9.1	68.3	3.9	18.1	NA	2.2
	100.00	101.30	COAL BED 2	8.7	71.3	4.3	24.6	NA	2.2
	101.30	102.70	CLAY						
	102.70	103.10	COAL BED 2	13.9	37.4	3.0	45.1	NA	1.6
	103.10	103.50	COAL BED 5	11.9	74.4	2.3	7.4	NA	2.2
	103.50	104.25	CLAY						
	104.25	152.30	PORPHYRITE						
BH 1/53 AR54	0.00	4.00	DELUVIUM						
	4.00	85.40	GABBRO						
	85.40	91.05	TUFFSTONE						
	91.05	96.65	TUFF						
	96.65	102.95	GABBRO						
	102.95	108.80	TUFFSTONE						
	108.80	112.30	GABBRO						
	112.30	176.70	TUFF						
BH 10 VE96	0.00	0.60	SOIL						
	0.60	36.00	CLAY						
	36.00	36.30	TUFF BRECCIA						
	36.30	48.00	CLAY						
BH 10/32 G32	0.00	0.50	SOIL						
	0.50	11.00	ALLUVIUM						
	11.00	21.00	PORPHYRITE						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
BH 11	VE96	0.00	0.70	SOIL						
		0.70	12.50	ALLUVIUM						
		12.50	21.20	CLAY						
		21.20	33.00	CLAYSHALE						
		33.00	34.20	MARL						
		34.20	35.40	COAL BED 6						
		35.40	38.70	CLAY						
		38.70	39.00	CLAYSHALE						
		39.00	39.20	CLAY						
		39.20	41.20	CLAYSHALE						
		41.20	41.40	COAL BED 5						
		41.40	42.60	CLAY						
		42.60	42.80	COAL BED 4						
		42.80	43.30	CLAYSHALE						
		43.30	43.70	COAL BED 3						
		43.70	45.00	CLAY						
		45.00	46.80	CLAYSHALE						
		46.80	47.10	CLAY						
		47.10	49.70	COAL BED 2						
		49.70	50.30	CLAY						
		50.30	53.50	CLAYSHALE						
		53.50	81.00	MARL						
		81.00	100.00	PORPHYRITE						
BH 11/32	G32	0.00	0.50	SOIL						
		0.50	20.00	ALLUVIUM						
		20.00	21.00	PORPHYRITE						
BH 12	VE96	0.00	0.70	SOIL						
		0.70	5.00	CLAY						
		5.00	7.00	CLAYSHALE						
		7.00	14.00	CLAY						
		14.00	18.50	MARL						
		18.50	19.50	CLAY						
		19.50	21.10	COAL BED 6						
		21.10	26.00	CLAY						
		26.00	26.50	SAND						
		26.50	28.00	CLAY SANDSTONE						
		28.00	32.00	MARL						
		32.00	35.40	CLAY						
		35.40	36.00	COALBED 5						

PNTID SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
	36.00	59.00	CLAY						
	59.00	72.00	CLAY SANDSTONE						
	72.00	100.00	PORPHYRITE						
BH 12/32 T35	0.00	1.00	SOIL						
	1.00	14.17	CLAY						
	14.17	15.10	COAL						
	15.10	18.05	CLAY						
	18.05	18.20	TUFF						
	18.20	20.40	CLAY						
BH 13 VE96	0.00	0.90	SOIL						
	0.90	2.10	TUFF BRECCIA						
	2.10	3.80	CLAYSHALE						
	3.80	5.60	MARL						
	5.60	6.00	COQUINA						
	6.00	7.50	COAL BED 6						
	7.50	14.30	MARL						
	14.30	15.00	COAL BED 5						
	15.00	17.00	MARL						
	17.00	18.80	COAL BED 2						
	18.80	26.20	CLAY						
	26.20	38.40	CLAYSHALE						
	38.40	46.00	BENTONITE W/ LENSES OF COAL						
	46.00	52.00	CLAYSHALE						
	52.00	55.00	CLAY						
BH 13/32 T35	0.00	1.00	SOIL						
	1.00	9.60	CLAY						
	9.60	9.90	SOOTY COAL						
	9.90	10.09	COAL						
	10.09	10.20	CLAY						
	10.20	10.60	COAL						
	10.60	12.73	CLAY						
BH 14 VE96	0.00	0.70	SOIL						
	0.70	1.50	TUFF BRECCIA						
	1.50	5.20	COQUINA						
	5.20	14.30	MARL						
	14.30	14.90	COAL BED 3						
	14.90	17.30	MARL						
	17.30	18.00	SANDSTONE						
	18.00	22.00	MARL						
	22.00	24.20	COAL BED 2						

PNTID SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
	24.20	29.00	CLAY						
	29.00	33.00	CLAYSHALE						
	33.00	42.00	MARL						
	42.00	42.50	COAL BED 5						
	42.50	47.00	MARL						
	47.00	60.00	CLAY						
BH 15 VE96	0.00	0.80	SOIL						
	0.80	5.70	ALLUVIUM						
	5.70	31.30	CLAY						
	31.30	32.50	PORPHYRITE						
	32.50	34.00	CLAY SANDSTONE						
	34.00	35.20	COAL BED 6						
	35.20	38.20	CLAYSHALE						
	38.20	40.00	CLAY SANDSTONE						
	40.00	40.30	COAL BED 5						
	40.30	41.10	MARL						
	41.10	41.40	COAL BED 4						
	41.40	41.80	MARL						
	41.80	42.20	COAL BED 3						
	42.20	43.00	MARL						
	43.00	44.90	CLAYSHALE						
	44.90	47.30	COAL BED 2	1.6	55.9	1.9	60.8	NA	NA
	47.30	60.00	MARL						
BH 15/32 T35	0.00	1.00	SOIL						
	1.00	2.00	CLAY						
	2.00	2.50	SOOTY COAL						
	2.50	23.57	CLAY						
	23.57	26.13	SOOTY COAL						
	26.13	29.25	CLAY						
	29.25	31.05	SOOTY COAL						
	31.05	38.46	CLAY						
	38.46	41.62	SOOTY COAL						
	41.62	50.25	CLAY						
	50.25	51.85	SOOTY COAL						
	51.85	52.26	CLAY						
BH 16 VE96	0.00	6.10	CLAY						
	6.10	6.80	CLAYSHALE						
	6.80	7.30	CLAY						
	7.30	8.90	CLAYSHALE						
	8.90	15.90	CLAY						
	15.90	16.00	CLAYSHALE						

PNTID SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
	16.00	17.20	COAL BED 6	3.3	38.5	2.7	60.6	NA	1.7
	17.20	21.80	CLAYSHALE						
	21.80	22.00	COAL BED 5						
	22.00	23.10	MARL						
	23.10	23.40	COAL BED 4						
	23.40	23.80	MARL						
	23.80	24.10	COAL BED 3						
	24.10	24.90	MARL						
	24.90	25.00	CLAY SANDSTONE						
	25.00	26.90	CLAYSHALE						
	26.90	29.30	COAL BED 2	3.9	47.7	2.1	57.3	NA	1.8
	29.30	46.80	CLAY						
	46.80	60.00	TUFF						
BH 17 VE96	0.00	1.10	CLAYSHALE						
	1.10	3.30	CLAY SANDSTONE						
	3.30	4.60	MARL						
	4.60	4.90	COAL BED 5						
	4.90	6.30	MARL						
	6.30	6.50	COAL BED 4						
	6.50	7.00	SHALE						
	7.00	7.40	COAL BED 3						
	7.40	8.60	MARL						
	8.60	8.70	SANDSTONE						
	8.70	11.80	MARL						
	11.80	14.40	COAL BED 2	4.8	37.2	2.9	74.2	NA	1.5
	14.40	27.00	MARL						
	27.00	35.40	CLAY						
	35.40	45.00	PORPHYRITE						
BH 17/32 T35	0.00	1.00	SOIL						
	1.00	10.14	CLAY						
	10.14	11.62	COAL						
	11.62	14.00	CLAY						
BH 18 VE96	0.00	0.40	SOIL						
	0.40	4.40	CLAY						
	4.40	8.30	MARL						
	8.30	8.70	COAL BED 6						
	8.70	12.10	MARL						
	12.10	12.25	COAL BED 5						
	12.25	12.80	MARL						
	12.80	13.10	COAL BED 4						
	13.10	13.60	COMBUSTIBLE SHALE						

PNTID SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
	13.60	13.90	COAL BED 3						
	13.90	22.00	CLAY						
	22.00	24.50	COAL BED 2						
	24.50	26.50	CLAY						
	26.50	44.40	CLAY SANDSTONE						
	44.40	60.00	PORPHYRITE						
BH 18/32 T35	0.00	1.00	SOIL						
	1.00	20.51	CLAY						
	20.51	21.88	COAL						
	21.88	23.00	CLAY						
BH 19 VE96	0.00	0.50	SOIL						
	0.50	7.90	CLAY						
	7.90	9.40	COAL	2.3	24.7	4.4	58.6	NA	1.6
	9.40	19.50	SHALE						
	19.50	19.80	CLAY FAULT						
	19.80	21.80	MARL						
	21.80	22.60	CLAY						
	22.60	26.10	MARL	3.4	30.0	2.0	67.9	NA	1.7
	26.10	31.60	CLAY SANDSTONE						
	31.60	34.50	MARL						
	34.50	35.20	COAL BED 4						
	35.20	36.40	COAL	3.5	75.0	NA	78.0	NA	2.1
	36.40	37.10	COAL	7.1	8.2	NA	56.3	NA	1.4
	37.10	39.70	MARL						
	39.70	39.90	CLAY SANDSTONE						
	39.90	54.20	MARL						
	54.20	55.70	COAL BED 6	8.4	26.0	NA	50.0	NA	1.7
	55.70	62.90	MARL						
	62.90	63.40	COAL BED 5	9.4	11.7	NA	47.0	NA	1.4
	63.40	64.30	MARL						
	64.30	65.50	COAL BED 4	2.5	65.4	NA	75.1	NA	2.1
	65.50	66.00	MARL	10.5	13.4	NA	43.6	NA	1.5
	66.00	71.30	SANDSTONE W/ COAL						
	71.30	75.40	CLAY						
	75.40	75.70	PORPHYRITE						
	75.70	80.00	SAND						
BH 2/39 B39	0.00	0.50	DELUVIUM						
	0.50	2.80	CLAY						
	2.80	7.70	TUFF						
	7.70	10.50	COAL	5.4	80.0	4.4	13.6	NA	NA
	10.50	16.60	CLAYSHALE						

PNTID SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
	16.60	17.30	PORPHYRITE						
	17.30	19.90	CLAYSHALE						
	19.90	21.40	COAL BED 6	15.0	10.4	4.6	45.2	5112	NA
	21.40	22.70	CLAYSHALE						
	22.70	24.30	LIMESTONE						
	24.30	27.40	CLAYSHALE						
	27.40	27.70	COAL BED 6	13.5	12.0	6.8	38.4	5375	NA
	27.70	29.00	CLAYSHALE						
	29.00	30.20	COAL BED 5	11.7	17.0	7.1	43.1	4960	NA
	30.20	35.18	CLAYSHALE						
	35.18	36.28	COAL BED 4	2.1	68.7	4.4	11.4	NA	NA
	36.28	37.90	CLAYSHALE						
	37.90	38.73	COAL BED 3	10.4	26.2	7.1	33.2	6032	NA
	38.73	45.05	CLAY						
	45.05	50.42	CLAYSHALE						
	50.42	51.22	SOOTY COAL BED 2	9.5	49.8	2.5	10.3	NA	1.9
	51.22	52.78	CLAY W/ COAL						
	52.78	52.88	SOOTY COAL BED 1						
	52.88	56.42	CLAY W/ COAL						
	56.42	58.00	CLAY						
	58.00	63.00	CLAYSHALE						
	63.00	66.51	CLAY						
	66.51	90.12	PORPHYRITE						
BH 2/53 AR54	0.00	58.10	GABBRO						
	58.10	97.00	TUFF SILTSTONE						
	97.00	99.60	CLAY						
	99.60	102.80	CLAYSHALE						
	102.80	129.40	TUFF SILTSTONE						
	129.40	160.50	CLAY						
	160.50	188.70	CLAY SANDSTONE						
	188.70	189.00	GABBRO						
	189.00	216.40	CLAY						
	216.40	245.30	TUFF						
	245.30	249.10	TUFFSTONE						
	249.10	291.50	GABBRO						
	291.50	294.90	TUFFSTONE						
	294.90	338.90	TUFF						
BH 21 VE96	0.00	0.60	SOIL						
	0.60	2.60	CLAY						
	2.60	4.50	CLAYSHALE						
	4.50	6.10	COAL BED 6						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
		6.10	6.30	SHALE						
		6.30	8.50	CLAYSHALE						
		8.50	10.70	MARL						
		10.70	10.90	COAL BED 5						
		10.90	12.00	MARL						
		12.00	12.30	COAL BED 4						
		12.30	12.70	MARL						
		12.70	13.00	COAL BED 3						
		13.00	19.40	MARL						
		19.40	22.00	COAL BED 2						
		22.00	23.00	CLAY						
BH 22	VE96	0.00	0.40	SOIL						
		0.40	5.80	CLAY						
		5.80	6.60	CLAYSHALE						
		6.60	8.20	COAL BED 6						
		8.20	14.30	CLAYSHALE						
		14.30	14.60	COAL BED 5						
		14.60	15.40	MARL						
		15.40	15.70	COAL BED 4						
		15.70	16.10	MARL						
		16.10	16.50	COAL BED 3						
		16.50	17.30	MARL						
		17.30	20.60	CLAYSHALE						
		20.60	23.60	COAL BED 2						
		23.60	24.20	CLAYSHALE						
BH 23	VE96	0.00	0.60	SOIL						
		0.60	2.30	CLAY						
		2.30	3.60	MARL						
		3.60	7.10	CLAYSHALE						
		7.10	8.50	MARL						
		8.50	8.65	COAL						
		8.65	9.40	MARL						
		9.40	10.60	COAL BED 6						
		10.60	13.50	SHALE						
		13.50	13.95	COAL BED 5						
		13.95	17.10	MARL						
		17.10	17.70	BROWN COAL BED 4						
		17.70	19.30	MARL						
		19.30	19.70	CLAYSHALE						
		19.70	20.10	MARL						
		20.10	20.40	CLAY SANDSTONE						

PNTID SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
	20.40	20.70	COMBUSTIBLE SHALE						
	20.70	21.40	CLAY						
	21.40	22.00	SAND						
	22.00	25.10	COAL BED 2						
	25.10	34.00	CLAY						
	34.00	35.20	CLAYSHALE						
	35.20	55.00	CLAY						
BH 24 VE96	0.00	0.50	SOIL						
	0.50	4.00	CLAY						
	4.00	4.50	BROWN COAL BED 5						
	4.50	5.50	CLAYSHALE						
	5.50	5.70	COAL						
	5.70	11.20	MARL						
	11.20	14.80	COAL BED 2						
	14.80	23.00	CLAY						
	23.00	36.00	CLAYSHALE						
	36.00	43.00	CLAY						
BH 25 VE96	0.00	0.40	SOIL						
	0.40	5.20	CLAY						
	5.20	6.80	CLAYSHALE						
	6.80	8.10	COAL BED 6						
	8.10	13.40	CLAYSHALE						
	13.40	13.60	COAL BED 5						
	13.60	14.70	CLAY SANDSTONE						
	14.70	14.90	COAL BED 4						
	14.90	15.30	MARL						
	15.30	15.60	COAL BED 3						
	15.60	16.50	MARL						
	16.50	16.60	SANDSTONE						
	16.60	21.10	CLAYSHALE						
	21.10	23.50	COAL BED 2						
	23.50	28.00	CLAYSHALE						
BH 25/32-33 T35	0.00	0.50	SOIL						
	0.50	17.10	CLAY						
	17.10	18.58	COAL BED 7						
	18.58	25.37	CLAY						
	25.37	25.96	COAL BED 6						
	25.96	27.55	CLAY						
	27.55	28.57	COAL BED 5						
	28.57	34.15	CLAY						
	34.15	34.95	COAL BED 4						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
		34.95	36.62	CLAY						
		36.62	37.48	COAL BED 3						
		37.48	49.08	CLAY						
		49.08	50.51	COAL BED 2						
		50.51	53.17	CLAY						
		53.17	54.79	COAL BED 1						
		54.79	65.20	CLAY						
		65.20	66.00	CLAY						
		66.00	78.62	CLAYSHALE						
		78.62	85.78	CLAY						
		85.78	164.05	PORPHYRITE						
BH 26	VE96	0.00	0.40	SOIL						
		0.40	2.80	CLAY						
		2.80	6.40	CLAYSHALE						
		6.40	7.50	COAL BED 6						
		7.50	11.00	CLAYSHALE						
		11.00	13.70	MARL						
		13.70	13.90	COAL BED 5						
		13.90	14.20	COAL BED 4						
		14.20	14.60	MARL						
		14.60	15.00	COAL BED 3						
		15.00	15.90	MARL						
		15.90	16.00	CLAY						
		16.00	18.50	MARL						
		18.50	21.00	COAL BED 2						
		21.00	22.50	CLAY						
BH 26/33	T35	0.00	20.50	ALLUVIUM						
		20.50	63.85	TUFF						
		63.85	84.31	PORPHYRITE						
		84.31	184.00	TUFF						
BH 27	VE96	0.00	0.30	SOIL						
		0.30	1.60	CLAY						
		1.60	2.30	COAL BED 6						
		2.30	3.10	CLAY						
		3.10	4.00	CLAYSHALE						
		4.00	5.60	MARL						
		5.60	5.80	COAL BED 5						
		5.80	7.00	MARL						
		7.00	7.35	COAL BED 4						
		7.35	7.80	MARL						
		7.80	8.25	COAL BED 3						

PNTID SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm3)
	8.25	9.50	MARL						
	9.50	10.90	CLAY						
	10.90	13.30	COAL BED 2						
	13.30	25.00	CLAY						
BH 27/33 T35	0.00	1.50	CLAY						
	1.50	72.71	PORPHYRITE						
BH 28 VE96	0.00	1.20	SOIL						
	1.20	4.00	CLAY						
	4.00	5.00	CLAY SANDSTONE						
	5.00	7.80	COAL BED 2						
	7.80	13.50	CLAY						
	13.50	14.20	MARL						
	14.20	25.00	CLAY						
BH 29 VE96	0.00	0.70	SOIL						
	0.70	22.80	CLAY						
	22.80	25.70	TUFF BRECCIA						
	25.70	29.20	MARL						
	29.20	39.20	CLAY						
	39.20	40.70	COAL BED 6						
	40.70	43.00	CLAY						
BH 3/39 B39	0.00	0.80	DELUVIUM						
	0.80	2.35	CLAY						
	2.35	2.73	SOOTY COAL	13.8	28.7	2.8	35.4	NA	1.6
	2.73	3.81	CLAYSHALE						
	3.81	4.85	LIMESTONE						
	4.85	13.50	CLAYSHALE						
	13.50	14.60	CLAY						
	14.60	14.95	SOOTY COAL	8.4	82.5	3.7	25.8	NA	1.4
	14.95	60.13	PORPHYRITE						
BH 3/53 AR54	0.00	3.00	DELUVIUM						
	3.00	4.00	CLAY W/ COAL						
	4.00	5.60	CLAY						
	5.60	6.50	CLAY W/ COAL						
	6.50	9.00	CLAY						
	9.00	10.00	CLAY W/ COAL						
	10.00	14.30	CLAY						
	14.30	17.60	CLAYSHALE						
	17.60	18.40	SANDSTONE						
	18.40	28.30	CLAYSHALE						
	28.30	41.00	TUFF						
	41.00	69.40	TUFF & GABBRO						

PNTID SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
	69.40	155.70	GABBRO						
BH 30 VE96	0.00	6.40	CLAY SHALE						
	6.40	7.90	MARL						
	7.90	9.40	COAL BED 6						
	9.40	11.00	CLAYSHALE						
	11.00	14.60	MARL						
	14.60	14.90	COAL BED 5						
	14.90	16.20	MARL						
	16.20	16.40	COAL BED 4						
	16.40	16.90	MARL						
	16.90	17.30	COAL BED 3						
	17.30	21.70	MARL						
	21.70	24.50	COAL BED 2						
	24.50	25.50	CLAY						
BH 4/39 B39	0.00	1.00	DELUVIUM						
	1.00	9.81	CLAYSHALE						
	9.81	11.36	COAL BED 7	21.8	16.1	3.1	23.9	NA	1.1
	11.36	17.80	CLAYSHALE						
	17.80	18.43	COAL BED 6	11.2	16.6	4.4	26.6	NA	2.3
	18.43	19.63	CLAYSHALE						
	19.63	19.88	COAL	11.1	38.4	6.5	26.9	NA	1.9
	19.88	20.38	CLAYSHALE						
	20.38	20.90	COAL BED 5	13.3	21.9	6.3	28.4	NA	1.2
	20.90	25.38	CLAYSHALE						
	25.38	27.78	SOOTY COAL BED 4	21.0	50.5	2.2	31.6	NA	1.6
	27.78	28.02	CLAY						
	28.02	29.05	SOOTY COAL BED 4						
	29.05	29.30	CLAY						
	29.30	29.74	SOOTY COAL BED 4						
	29.74	30.25	CLAY						
	30.25	31.32	COALY SHALE						
	31.32	31.42	COAL BED 3						
	31.42	31.52	COALY SHALE						
	31.52	32.32	COAL BED 3	10.4	69.8	2.9	20.9	NA	2.2
	32.32	33.25	COALY SHALE						
	33.25	33.70	COAL BED 3	15.9	41.5	3.7	6.6	NA	2.0
	33.70	44.86	CLAYSHALE						
	44.86	45.44	TUFF						
	45.44	45.89	CLAYSHALE						
	45.89	47.97	COAL BED 2	15.7	36.6	3.5	34.2	NA	1.6
	47.97	48.93	COAL BED 2	15.3	35.7	2.3	9.9	NA	1.6

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
		48.93	49.77	PORPHYRITE						
		49.77	50.77	CLAYSHALE						
		50.77	50.92	COAL						
		50.92	59.53	CLAYSHALE						
		59.53	61.03	PORPHYRITE						
BH 4/53	AR54	0.00	5.20	SOIL						
		5.20	10.30	TUFF BRECCIA						
		10.30	151.70	GABBRO						
BH 41	unp	0.00	10.00	CLAY						
		10.00	25.00	LANDSLIDE						
		25.00	46.50	CLAY						
		46.50	49.80	MARL W/ COAL						
		49.80	51.40	COAL						
		51.40	53.00	COMBUSTIBLE SHALE						
		53.00	54.40	BRECCIA W/ COAL						
		54.40	55.10	SAND						
		55.10	64.90	MARL						
		64.90	66.10	COAL						
		66.10	80.00	CLAY						
BH 42	unp	0.00	1.00	SOIL						
		1.00	6.50	CLAY SANDSTONE						
		6.50	24.00	PORPHYRITE						
		24.00	46.20	PORPHYRITE						
		46.20	50.60	TUFF						
		50.60	52.00	COAL						
		52.00	76.80	CLAY						
		76.80	77.00	COAL						
		77.00	81.90	CLAY						
		81.90	82.50	COMBUSTIBLE SHALE						
		82.50	83.00	CLAY						
		83.00	102.00	PORPHYRITE						
BH 44	unp	0.00	25.40	CLAY						
		25.40	26.40	COAL						
		26.40	33.20	PORPHYRITE						
		33.20	40.80	UNKNOWN						
		40.80	42.30	BITUMINOUS COAL						
		42.30	46.70	COMBUSTIBLE SHALE						
		46.70	80.00	PORPHYRITE						
BH 5	VE96	0.00	0.60	SOIL						
		0.60	4.30	CLAY						
		4.30	5.10	COAL BED 6						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
		7.00	9.20	MARL						
		9.20	9.80	CLAY SANDSTONE						
		9.80	10.00	COAL BED 5						
		10.00	11.20	CLAYSHALE						
		11.20	11.70	SHALE						
		11.70	12.00	COAL BED 4						
		12.00	14.50	CLAYSHALE						
		14.50	14.80	COAL BED 3						
		14.80	16.40	CLAYSHALE						
		16.40	17.30	MARL						
		17.30	20.10	COAL BED 2						
		20.10	33.00	CLAY						
		33.00	37.00	CLAY SANDSTONE						
		37.00	42.50	CLAY						
		42.50	47.00	MARL						
		47.00	54.20	CLAY						
		54.20	58.00	SHALE						
		58.00	59.00	CLAY						
BH 5/53	AR54	0.00	9.50	DELUVIUM						
		9.50	123.70	GABBRO						
		123.70	125.15	CLAY						
		125.15	127.80	SANDSTONE						
		127.80	128.95	CLAY W/ COAL						
		128.95	131.80	CLAY						
		131.80	137.90	GABBRO						
		137.90	139.90	CLAY						
		139.90	149.50	GABBRO						
		149.50	162.70	CLAY						
		162.70	202.15	GABBRO						
BH 6/53	AR54	0.00	1.00	DELUVIUM						
		1.00	4.85	CLAY						
		4.85	10.85	CLAY W/ COAL	13.1	60.5	0.9	15.4	589	1.9
		10.85	12.05	CLAY						
		12.05	13.58	BROWN COAL	16.4	13.4	1.7	30.1	4475	1.5
		13.58	22.25	CLAY						
BH 7	VE96	0.00	0.70	SOIL						
		0.70	2.20	ALLUVIUM						
		2.20	3.00	CLAYSHALE						
		3.00	4.20	CLAY						
		4.20	5.10	COMBUSTIBLE SHALE BED 6						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
		5.10	8.20	MARL						
		8.20	8.60	COAL BED 5						
		8.60	9.60	CLAYSHALE						
		9.60	10.00	MARL						
		10.00	11.00	CLAYSHALE						
		11.00	11.50	SANDSTONE						
		11.50	13.00	MARL						
		13.00	14.00	CLAY						
		14.00	14.60	COAL BED 3						
		14.60	16.90	SHALE						
		16.90	22.00	MARL						
		22.00	24.70	COAL BED 2						
		24.70	28.20	CLAY						
		28.20	31.50	SHALE						
		31.50	39.30	CLAY						
		39.30	45.00	MARL						
		45.00	50.00	CLAYSHALE						
BH 8	VE96	0.00	0.80	SOIL						
		0.80	1.90	TUFF BRECCIA						
		1.90	3.20	CLAY						
		3.20	4.00	COAL BED 3						
		4.00	5.50	CLAY						
		5.50	10.60	COAL BED 2						
		10.60	10.80	CLAYSHALE						
		10.80	15.00	MARL						
		15.00	21.20	CLAY						
		21.20	25.70	MARL						
		25.70	31.00	CLAYSHALE						
		31.00	38.00	CLAY						
		38.00	39.00	COAL BED 6						
		39.00	42.10	CLAY						
		42.10	43.00	COAL BED 5						
		43.00	46.00	CLAY						
BH 8/32	T35	0.00	1.00	SOIL						
		1.00	16.93	CLAY						
		16.93	17.18	COAL						
		17.18	20.37	CLAY						
		20.37	20.60	COAL						
		20.60	21.30	CLAY						
		21.30	22.74	SOOTY COAL						
		22.74	28.23	CLAY						

PNTID SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
	28.23	29.21	SOOTY COAL						
	29.21	30.20	CLAY						
BH 9 VE96	0.00	0.80	SOIL						
	0.80	25.00	CLAY						
AH 9 B39	0.00	0.90	DELUVIUM						
	0.90	2.10	GRAVEL W/ CLAY						
	2.10	5.45	CLAY						
AH 11/39 B39	0.00	0.70	DELUVIUM						
	0.70	8.00	CLAY						
AH 5/39 B39	0.00	0.50	DELUVIUM						
	0.50	12.00	CLAY						
AH 6/39 B39	0.00	0.50	DELUVIUM						
	0.50	7.00	CLAY						
AH 7/39 B39	0.00	1.00	DELUVIUM						
	1.00	7.00	CLAY						
AH 8/39 B39	0.00	1.00	DELUVIUM						
	1.00	10.12	CLAY						
AH 9/39 B39	0.00	0.80	DELUVIUM						
	0.80	1.35	CLAY W/ COAL						
	1.35	4.20	CLAYSHALE						
	4.20	7.35	CLAY						
	7.35	8.00	TUFF						
Shaft 1/32 T35	0.00	1.00	SOIL						
	1.00	3.75	CLAY						
	3.75	5.95	COAL						
	5.95	6.70	CLAY						
Shaft 1/53 AR54	0.00	1.80	DELUVIUM						
	1.80	2.70	GABBRO-DIORITE						
Shaft 10/53 AR54	0.00	0.80	CLAY						
Shaft 11/53 AR54	0.00	3.00	DELUVIUM						
Shaft 12/53 AR54	0.00	4.60	DELUVIUM						
Shaft 13/53 AR54	0.00	1.30	DELUVIUM						
	1.30	2.20	TUFF						
Shaft 14/53 AR54	0.00	0.80	DELUVIUM						
	0.80	2.50	GABBRO-DIORITE						
Shaft 15/53 AR54	0.00	2.40	DELUVIUM						
	2.40	4.00	GABBRO-DIORITE						
Shaft 16/32 T35	0.00	0.70	SOIL						
	0.70	2.30	CLAY						
	2.30	3.38	SOOTY COAL						
	3.38	8.10	CLAY						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
Shaft 16/53	AR54	0.00	1.30	DELUVIUM						
		1.30	7.00	TUFF						
Shaft 17/53	AR54	0.00	4.00	DELUVIUM						
		4.00	10.00	TUFF						
Shaft 18/53	AR54	0.00	6.00	DELUVIUM						
		6.00	7.00	TUFF						
Shaft 19/53	AR54	0.00	3.00	DELUVIUM						
		3.00	10.00	CLAYSHALE						
Shaft 2/53	AR54	0.00	2.00	DELUVIUM						
		2.00	3.00	GABBRO-DIORITE						
Shaft 20/53	AR54	0.00	0.60	DELUVIUM						
		0.60	4.00	CLAYSHALE						
Shaft 21/53	AR54	0.00	0.30	DELUVIUM						
		0.30	1.00	TUFF						
Shaft 22/32	T35	0.00	0.70	SOIL						
		0.70	7.00	CLAY						
		7.00	8.40	COAL						
		8.40	10.00	CLAY						
Shaft 22/53	AR54	0.00	2.00	DELUVIUM						
		2.00	3.50	TUFF						
Shaft 23/32	T35	0.00	1.00	SOIL						
		1.00	2.40	CLAY						
		2.40	4.40	COAL						
		4.40	5.40	CLAY						
Shaft 23/53	AR54	0.00	1.50	DELUVIUM						
		1.50	3.80	TUFF						
Shaft 24/53	AR54	0.00	4.50	DELUVIUM						
		4.50	7.80	TUFFSTONE						
Shaft 25/53	AR54	0.00	0.30	DELUVIUM						
		0.30	1.50	TUFFSTONE						
Shaft 26/32	T35	0.00	1.00	SOIL						
		1.00	4.05	CLAY						
		4.05	5.60	COAL						
		5.60	5.80	CLAY						
Shaft 27/32	T35	0.00	1.00	SOIL						
		1.00	6.40	CLAY						
		6.40	7.10	COAL						
		7.10	10.60	CLAY						
Shaft 28/53	AR54	0.00	0.50	DELUVIUM						
		0.50	1.50	TUFFSTONE						
Shaft 3/29	T29	0.00	1.00	SOIL						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
		1.00	3.30	ALLUVIUM						
		3.30	4.10	SOOTY COAL						
		4.10	5.90	COAL	13.4	27.1	NA	52.9	3862	NA
		5.90	9.00	CLAY						
		9.00	9.50	COAL						
		9.50	17.90	CLAY						
		17.90	19.00	COAL						
Shaft 3/53	AR54	0.00	4.35	DELUVIUM						
		4.35	6.80	CLAY						
Shaft 31/32	T35	0.00	0.50	SOIL						
		0.50	6.90	CLAY						
		6.90	8.80	COAL						
		8.80	10.60	CLAY						
Shaft 35/32	T35	0.00	0.80	SOIL						
		0.80	9.95	CLAY						
		9.95	11.45	COAL						
		11.45	11.50	CLAY						
Shaft 4/29	T29	0.00	0.90	SOIL						
		0.90	2.00	MARL						
		2.00	5.20	SAND						
		5.20	5.50	COAL						
		5.50	6.00	COAL	17.6	16.4	NA	50.5	3835	NA
		6.00	7.50	CLAYSHALE						
		7.50	10.00	COQUINA						
		10.00	12.25	CLAYSHALE						
Shaft 4/53	AR54	0.00	6.40	DELUVIUM						
		6.40	7.80	GABBRO-DIORITE						
Shaft 5/53	AR54	0.00	1.50	DELUVIUM						
Shaft 53/32	T35	0.00	1.00	SOIL						
		1.00	5.20	CLAY						
		5.20	6.50	COAL						
		6.50	10.70	CLAY						
Shaft 6/53	AR54	0.00	2.60	DELUVIUM						
Shaft 7/29	T29	0.00	0.50	SOIL						
		0.50	12.00	PORPHYRITE						
Shaft 7/53	AR54	0.00	5.00	DELUVIUM						
Shaft 8/29	T29	0.00	1.00	SOIL						
		1.00	3.00	MARL						
Shaft 8/53	AR54	0.00	4.00	DELUVIUM						
Shaft 9/53	AR54	0.00	1.20	DELUVIUM						
		1.20	4.40	CLAY						

PNTID	SRC	TOP (m)	BTM (m)	LITHOLOGY	M (%)	Ash (%)	S (%)	VM (%)	CV (cal/g)	d (g/cm^3)
Trench 1(B)	AR54	0.00	1.20	DELUVIUM						
		1.20	2.00	GABBRO-DIORITE						
Trench 1(E)		0.00	0.50	DELUVIUM						
		0.50	2.00	GABBRO-DIORITE						
Trench 2(B)	AR54	0.00	0.60	DELUVIUM						
		0.60	2.00	GABBRO-DIORITE						
Trench 2(E)		0.00	1.30	DELUVIUM						
		1.30	2.00	GABBRO-DIORITE						
Trench 3(B)	AR54	0.00	0.50	DELUVIUM						
		0.50	2.00	CLAY						
Trench 3(E)		0.00	1.00	DELUVIUM						
		1.00	2.00	CLAY						
Trench 4(B)	AR54	0.00	1.20	DELUVIUM						
		1.20	2.00	TUFF						
Trench 4(E)		0.00	0.60	DELUVIUM						
		0.60	2.00	TUFF						

Table 2. Adit, adit point, borehole, hand-augered hole, shaft, and trench elevation, location, and depth information.

[Sources of data are found in table 1. The internal coordinate system is explained in the text. ID = identifier; Adit Pt = adit point]

Point ID	Elevation (m)	North coordinate		East coordinate		Point ID total depth (m)
		Internal system	Latitude	Internal system	Longitude	
Adit 2	2040.00	865.00	40.92737	1013.00	43.88616	30.00
Adit 3	2044.00	911.00	40.92778	983.00	43.88580	27.00
Adit 4	2044.00	910.00	40.92777	930.00	43.88517	46.60
Adit 5	2058.50	950.00	40.92813	590.00	43.88113	14.00
Adit 6	2060.00	1216.00	40.93049	1305.00	43.88964	53.00
Adit Pt 1	2046.00	927.00	40.92792	1032.00	43.88639	7.75
Adit Pt 10	2053.50	1001.00	40.92858	950.00	43.88541	13.51
Adit Pt 11	2048.80	982.00	40.92841	905.00	43.88488	8.65
Adit Pt 12	2049.00	1078.00	40.92926	1046.00	43.88655	9.15
Adit Pt 13	2055.40	1010.00	40.92866	992.00	43.88591	16.51
Adit Pt 14	2055.20	1001.00	40.92858	935.00	43.88523	16.31
Adit Pt 15	2058.70	1060.00	40.92910	968.00	43.88563	19.46
Adit Pt 16	2057.00	1046.00	40.92898	952.00	43.88543	17.76
Adit Pt 17	2055.50	1034.00	40.92887	938.00	43.88527	15.26
Adit Pt 18	2059.00	1062.00	40.92912	971.00	43.88566	19.76
Adit Pt 19	2058.00	1081.00	40.92929	992.00	43.88591	18.76
Adit Pt 2	2044.50	910.00	40.92777	997.00	43.88597	5.85
Adit Pt 20	2056.00	1088.00	40.92935	1004.00	43.88605	15.53
Adit Pt 21	2051.50	971.00	40.92831	1014.00	43.88617	12.26
Adit Pt 22	2051.50	972.00	40.92832	1012.00	43.88615	12.26
Adit Pt 23	2051.20	964.00	40.92825	1004.00	43.88605	11.96
Adit Pt 24	2052.00	979.00	40.92838	1010.00	43.88613	12.76
Adit Pt 25	2051.70	965.00	40.92826	1004.00	43.88605	12.46
Adit Pt 26	2049.00	1072.00	40.92921	1078.00	43.88693	8.91
Adit Pt 27	2053.00	983.00	40.92842	1008.00	43.88610	13.76
Adit Pt 28	2050.40	1074.00	40.92923	1076.00	43.88691	10.31
Adit Pt 29	2051.50	1102.00	40.92948	1054.00	43.88665	11.41
Adit Pt 3	2044.00	904.00	40.92772	985.00	43.88583	5.25
Adit Pt 30	2051.80	1103.00	40.92949	1052.50	43.88663	11.71
Adit Pt 31	2052.30	1105.00	40.92950	1051.50	43.88662	12.03
Adit Pt 4	2047.50	939.00	40.92803	1030.00	43.88636	9.14
Adit Pt 5	2051.50	1005.00	40.92861	1047.00	43.88657	12.15
Adit Pt 6	2049.00	1062.00	40.92912	1082.00	43.88698	8.90

Adit Pt 7	2054.30	1101.00	40.92947	1130.00	43.88755	13.75
Adit Pt 8	2055.50	1058.00	40.92909	1014.00	43.88617	
Adit Pt 9	2056.00	1019.00	40.92874	972.00	43.88567	14.16
Borehole 1/39	2061.00	1175.00	40.93013	868.00	43.88444	
Borehole 1/53	2093.37	725.00	40.92612	1158.00	43.88789	176.70
Borehole 10/96	2047.40	885.70	40.92755	831.50	43.88400	48.00
Borehole 10/32	2095.50	1328.00	40.93149	600.00	43.88125	21.00
Borehole 11/96	2052.20	1128.50	40.92971	1016.70	43.88620	100.00
Borehole 11/32	2081.50	1258.00	40.93087	670.00	43.88208	21.00
Borehole 12/96	2062.00	1170.60	40.93009	1183.20	43.88819	100.00
Borehole 12/32	2057.60	1145.00	40.92986	1179.00	43.88814	20.40
Borehole 13/96	2053.80	1062.00	40.92912	854.40	43.88427	55.00
Borehole 13/32	2063.80	1123.00	40.92967	956.00	43.88548	12.73
Borehole 14/96	2054.50	1114.10	40.92959	825.20	43.88393	60.00
Borehole 15/96	2081.40	1106.20	40.92952	671.00	43.88209	60.00
Borehole 15/32	2061.00	1175.00	40.93013	868.00	43.88444	52.26
Borehole 16/96	2085.30	1113.00	40.92958	561.80	43.88079	60.00
Borehole 17/96	2047.80	956.30	40.92818	853.20	43.88426	45.00
Borehole 17/32	2054.00	1110.00	40.92955	1065.00	43.88678	14.00
Borehole 18/96	2047.50	932.30	40.92797	836.60	43.88406	60.00
Borehole 18/32	2059.00	1122.00	40.92966	1082.00	43.88698	23.00
Borehole 19/96	2072.80	1281.80	40.93108	1272.80	43.88925	80.00
Borehole 2/39	2049.70	1054.50	40.92906	869.00	43.88445	90.12
Borehole 2/53	2119.34	1297.00	40.93121	1010.00	43.88613	338.90
Borehole 21/96	2051.20	961.60	40.92823	987.20	43.88585	23.00
Borehole 22/96	2054.20	995.10	40.92853	1012.00	43.88615	24.20
Borehole 23/96	2049.80	1019.00	40.92874	900.20	43.88482	55.00
Borehole 24/96	2051.90	1012.10	40.92868	837.80	43.88408	43.00
Borehole 25/96	2058.92	1076.50	40.92925	990.00	43.88589	28.00
Borehole 25/32-33	2111.50	1095.00	40.92942	1018.00	43.88622	164.05
Borehole 26/96	2056.90	1034.40	40.92888	1001.10	43.88602	22.50
Borehole 26/33	2062.00	1290.00	40.93115	1012.00	43.88615	184.00
Borehole 27/96	2047.70	930.40	40.92795	1007.90	43.88610	25.00
Borehole 27/33	2068.80	1233.00	40.93064	778.00	43.88336	72.71
Borehole 28/96	2044.80	1018.80	40.92874	1100.00	43.88720	25.00
Borehole 29/96	2071.30	1225.00	40.93057	1190.00	43.88827	43.00
Borehole 3/39	2053.00	979.00	40.92838	798.00	43.88360	60.13
Borehole 3/53	2125.87	1023.00	40.92878	558.00	43.88075	155.70
Borehole 30/96	2057.40	1046.80	40.92899	959.90	43.88553	25.50
Borehole 4/39	2056.00	1034.50	40.92888	946.00	43.88536	61.03
Borehole 4/53	2145.00	1495.00	40.93298	572.00	43.88091	151.70
Borehole 5/96	2047.50	1012.10	40.92868	883.00	43.88461	59.00

Borehole 5/53	2139.72	1421.00	40.93232	1224.00	43.88867	202.15
Borehole 6/53	2119.94	1075.00	40.92924	788.00	43.88348	22.25
Borehole 7/96	2053.70	1029.50	40.92883	1032.40	43.88639	50.00
Borehole 8/96	2053.80	1111.70	40.92956	850.20	43.88422	46.00
Borehole 8/32	2060.80	1157.00	40.92997	1166.00	43.88798	30.20
Borehole 9/96	2052.65	919.10	40.92785	708.30	43.88253	25.00
Auger hole 10/39	2078.00	1152.00	40.92992	472.00	43.87972	5.45
Auger hole 11/39	2076.00	1100.00	40.92946	451.50	43.87949	8.00
Auger hole 5/39	2045.50	835.00	40.92710	913.00	43.88497	12.00
Auger hole 6/39	2043.50	863.00	40.92735	929.00	43.88516	7.00
Auger hole 7/39	2048.50	846.00	40.92720	862.00	43.88436	7.00
Auger hole 8/39	2046.50	890.00	40.92759	837.50	43.88407	10.12
Auger hole 9/39	2072.50	1067.00	40.92917	520.00	43.88029	8.00
Shaft 1/32	2039.50	886.00	40.92756	1008.00	43.88610	6.70
Shaft 1/53	2168.26	1255.00	40.93084	458.00	43.87956	2.70
Shaft 10/53	2108.72	957.00	40.92819	802.00	43.88365	0.80
Shaft 11/53	2124.11	1205.00	40.93039	808.00	43.88372	3.00
Shaft 12/53	2141.12	1287.50	40.93113	690.20	43.88232	4.60
Shaft 13/53	2121.90	1604.50	40.93395	1152.80	43.88782	2.20
Shaft 14/53	2142.59	1470.50	40.93276	646.50	43.88180	2.50
Shaft 15/53	2150.53	1453.00	40.93260	750.80	43.88304	4.00
Shaft 16/32	2061.50	1112.00	40.92957	968.00	43.88563	8.10
Shaft 16/53	2133.85	1351.50	40.93170	941.30	43.88531	7.00
Shaft 17/53	2180.22	1312.00	40.93135	1043.00	43.88652	10.00
Shaft 17/96	2068.00	1017.00	40.92872	707.00	43.88252	2.00
Shaft 18/53	2152.73	1354.50	40.93173	1128.66	43.88754	7.00
Shaft 19/53	2137.78	1292.50	40.93117	1229.82	43.88874	10.00
Shaft 2/53	2143.13	1175.10	40.93013	461.50	43.87960	3.00
Shaft 20/53	2136.16	1340.60	40.93160	400.80	43.87888	4.00
Shaft 21/53	2155.13	1215.40	40.93049	1130.50	43.88756	1.00
Shaft 22/32	2052.00	1080.00	40.92928	1027.00	43.88633	10.00
Shaft 22/53	2132.52	1287.50	40.93113	1395.00	43.89071	3.50
Shaft 23/32	2048.00	1050.00	40.92902	1093.00	43.88711	5.40
Shaft 23/53	2145.13	1411.40	40.93223	1446.30	43.89132	3.80
Shaft 24/53	2145.73	1496.37	40.93299	1252.00	43.88900	7.80
Shaft 25/53	2168.26	1768.00	40.93541	1242.00	43.88889	1.50
Shaft 26/32	2053.00	1116.00	40.92960	1041.00	43.88649	5.80
Shaft 27/32	2059.50	1157.00	40.92997	1190.00	43.88827	10.60
Shaft 28/53	2179.00	1620.00	40.93409	10.83	43.87423	1.50
Shaft 3/29	2042.00	897.00	40.92765	1030.00	43.88636	19.00
Shaft 3/53	2146.26	1119.00	40.92963	590.50	43.88113	6.80
Shaft 31/32	2068.00	1240.00	40.93071	1270.00	43.88922	10.60
Shaft 35/32	2053.00	978.00	40.92837	982.00	43.88579	11.50

Shaft 4/29	2048.50	1062.00	40.92912	1118.00	43.88741	12.25
Shaft 4/53	2160.43	1357.00	40.93175	618.00	43.88146	7.80
Shaft 5/53	2147.06	1486.00	40.93290	1387.00	43.89061	1.50
Shaft 53/32	2067.70	1265.00	40.93093	1293.00	43.88949	10.70
Shaft 54/39	2073.00	994.00	40.92852	678.00	43.88217	5.00
Shaft 55/39	2058.00	985.00	40.92844	758.00	43.88313	5.00
Shaft 6/53	2160.05	1120.00	40.92964	309.00	43.87778	2.60
Shaft 7/29	2047.50	949.00	40.92812	922.00	43.88508	0.00
Shaft 7/53	2131.30	873.00	40.92744	558.00	43.88075	
Shaft 8/29	2051.00	1100.00	40.92946	1148.00	43.88777	3.00
Shaft 8/53	2160.84	823.00	40.92700	524.00	43.88034	4.00
Shaft 9/53	2122.10	1066.00	40.92916	767.00	43.88323	4.40
Trench 1(BEG)	2113.94	1134.00	40.92976	816.00	43.88382	2.00
Trench 1(END)	2124.65	1126.00	40.92969	771.00	43.88328	2.00
Trench 2(BEG)	2169.72	1468.00	40.93274	807.00	43.88371	2.00
Trench 2(END)	2152.72	1373.48	40.93189	853.00	43.88426	2.00
Trench 3(BEG)	2128.43	1263.00	40.93091	1266.00	43.88917	2.00
Trench 3(END)	2121.40	1225.00	40.93057	1287.00	43.88942	2.00
Trench 4(BEG)	2197.69	1387.00	40.93201	1612.00	43.89329	2.00
Trench 4(END)	2203.00	1486.00	40.93290	1592.00	43.89305	2.00

Table 3. Coal quality characteristics of the Jajur coal bed No. 2.

[Reporting basis listed when known. No. Samples = number of samples; NM = natural moisture; ADM = air dried moisture; ADA = air dried ash yield; TS = total sulfur; CV = calorific value; TY = tar yield; BY = bitumen yield; FC = fixed carbon; d = density; VM_{daf} =volatile matter, dry ash-free basis; [u] = reporting bases are unknown or not given for these authors; NR = not reported; H = hydrogen; C = carbon; N = nitrogen; O = oxygen; SS = sulfate sulfur; PS = pyritic sulfur; OS = organic sulfur; VM = volatile matter; EM = equilibrium moisture; bh = borehole; sn = sample number. Oxides are on an ash basis. Data qualifiers are explained in footnotes at end of tables.]

Coal Bed No. 2 - Part A

No. samples	Description	NM (%)	ADM (%)	ADA (%)	TS (%)	CV (cal/g)	TY (%)	BY (%)	FC (%)	d (g/cm^3)	VM_{daf} (%)
Isaguliants and Azizyan (1945)											
2	Upper part of 2 Lower part of 2	23.77 NR	18.63 16.50	30.26 29.46	1.85 3.31	3500 3912				1.56[1]	
Talanian and Azatian (1953)											
NR		23.60[2]		22.18	3.92	3472-3835					
Aslanian and Rudzyanski (1954)											
116 [3]	Brown,foliated mainly durain	30.7	18.41	24.46	2.84	3938	3.29	1.26	40.1	1.56	
Mesropian and Sarkissian (1956)[u]											
NR	1.15-1.25 m thick			12.84-14.82 & 20.94-22.18		3472-3880					

Pierce and others (1994)[4]											
1	0.22 m thick		30.98[5]	23.27[6]	4.34[6]	5218[7]	(9392[7])		39.21[6]		
1	0.65 m thick		33.27[5]	21.42[6]	4.10[6]	5347[7]	(9624[7])		38.89[6]		
1	0.47 m thick		31.21[5]	35.29[6]	2.57[6]	4255[7]	(7659[7])		29.81[6]		
1	0.44 m thick		35.30[5]	14.64[6]	1.36[6]	5830[7]	(10494[7])		18.26[6]		
1	0.26 m thick		30.86[5]	38.00[6]	3.79[6]	3962[7]	(7131[7])		29.74[6]		
Vardanian and Elbakian (1996)[u]											
200[8]		22.04	13.94	26.95	2.51	4185. 5	3.29	9.29	40.1[9]	1.58	
1	bh no. 7 22.0 - 24.3 m	6.94[1]	14.48[11]	44.00		3200					55.14
1	bh no. 5 17.3 - 20.1	8.65[10]	14. 4811	44.34	2.01	2991					60.49
1	bh no. 24 11.2 - 13.0 13.0 - 14.8	 11.65[10] 11.20[10]	 17.46[11] 17.17[11]	 26.22 45.14	 2.24 1.51						 52.57 61.68
1 each	bh no. 8 5.5 - 7.0 7.0 - 10.0	 8.81[10] 7.18[10]	 9.28[11] 11.27[11]	 12.05 7.47	 NR 2.36	 5703 5216					 43.26 49.00
1	bh no. 11 47.1 - 49.5	16.0[10]		14.5							47.9
1	bh no. 16 26.9 - 29.3	3.9[10]		45.8	2.06						57.3
1	bh no. 17 11.8 - 14.4	4.8[10]		35.4	2.88						74.2
1	bh no. 13 17.0 - 18.8	7.4[10]		14.3	2.58	4984					50.6

1	bh no. 14 22.0 - 24.2	6.9[10]		29.2	4.08	5289					56.2
1	bh no. 21 19.4 - 22.0	9.4[10]		11.5	0.39	4974					
1	bh no. 25 21.1-23.5	24.59[10]		29.43		5850					
1	bh no. 23 21.7 - 24.5	7.6[10]		14.4		4912					
1	bh no. 28 5.0 - 7.8	39.8[10]		12.6							
1	bh no. 104/27 10.3 - 13.3 sn=104; bh=27	36.4[10]		12.6							

Coal Bed No. 2 - Part B

No. samples	Description	H[6] (%)	C[6] (%)	N[6] (%)	O[6] (%)	SS[6] (%)	PS[6] (%)	OS[6] (%)	VM[6] (%)	EM (%)	Ash (%)
Isaguliants and Azizyan (1945)											
2	"Upper part" of bed no. 2	3.16 3.15	40.11 10.19						58.47		37.40 37.28
2	"Lower part" of bed no. 2	3.58 3.51	12.31 42.22						49.04		33.83 33.92
Pierce and others (1994)[4]											
1	0.22 m thick	3.63	54.73	1.84	12.19	0.43	1.64	2.27	37.52	32.6	
1	0.65 m thick	4.03	55.8	1.99	12.66	0.22	2.14	1.74	39.69	32.66	
1	0.47 m thick	3.48	44.96	1.72	11.98	0.08	1.15	1.34	34.9	30.79	
1	0.44 m thick	4.28	62.01	2.27	15.44	0.23	0.31	0.82	67.1	35.06	

1	0.26 m thick	3.16	42.16	1.57	11.32	0.04	2.15	1.6	32.26	30.15	

Coal Bed No. 2 - Part C

No. samples	Description	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	SO_3 (%)
Isaguliants and Azizyan (1945)								
1	Upper part	40.02	15.1	16.73	0.64	13.88	3.6	1.2
1	Lower part	46.32	15.1	22.58	0.62	5.8	2.78	NR

1 Isaguliants and Azizyan (1945) subsampled the Djadjur No. 2 coal bed, as upper and lower benches. However, they combined the samples for density analyses.

2 This moisture is labeled simply "moisture," it is not clear what kind it is, perhaps total moisture.

3 116 total samples are reported for both the No. 2 and No. 6 coal beds. The authors do not make clear how many of the 116 were from the No. 2 and how many were from the No. 6 coal beds.

4 These five samples are incremental channel samples of the No. 2 coal bed, top to bottom.

5 This is total moisture, according to ASTM D3172.

6 These results are reported on a dry basis.

7 The first column is calculated cal/g from Btu/lb, which is in the next (TY) column. Cal/g and Btu/lb are dry basis.

8 200 total samples are reported for both the No. 2 and No. 6 coal beds. The authors do not make clear how many of the 200 were from the No. 2 and how many were from the No. 6 coal beds. It is also not clear from their report whether the samples are from boreholes, channel samples, grab samples, and so on, or a combination of all.

9 This value of 40.1 percent is reported only as "carbon," but is probably fixed carbon.

10 This moisture is labeled "Total Moisture" in the original table, but is really Analytical Moisture.

11 This moisture is labeled "Analytical Moisture" in the original table, but is really Total Moisture. The volatile matters in Vardanian and Elbakian (1996) are mislabeled as well, the first volatile matter column in their table is as-determined and the second is dry ash-free.

Table 4. Coal quality characteristics of the Jajur coal bed No. 3.

[Reporting basis listed when known. No. Samples = number of samples; NM = natural moisture; ADM = air dried moisture; ADA = air dried ash yield; TS = total sulfur; CV = calorific value; TY = tar yield; BY = bitumen yield; d = density; VM_{daf} = volatile matter, dry ash-free basis; [u] = reporting bases are unknown or not given for these authors; NR = not reported; H = hydrogen; C = carbon; N = nitrogen; O = oxygen; SS = sulfate sulfur; PS = pyritic sulfur; OS = organic sulfur; EM = equilibrium moisture. Oxides on an ash basis. Data qualifiers are explained in footnotes at end of tables.]

Coal Bed 3 - Part A

No. samples	Description	NM (%)	ADM (%)	ADA (%)	TS (%)	CV (cal/g)	TY (%)	BY (%)	FC (%)	d (g/cm^3)	VM_{daf} (%)
Isaguliants and Azizyan (1945)											
2			19.47 17.28	13.46 14.48	3.60 3.89	4048 6552				1.44	
Talanian and Azatian, 1953[u]											
NR		24.90[1]		12.63	3.56	4060- 4426					
Mesropian and Sarkissian (1956)[u]											
NR	0.45 m thick			10.37		4492					
Pierce and others (1994)											
1			31.04[2]	15.00[3]	4.13[3]	5837[4]	(10506[4])		43.19[3]		
Vardanian and Elbakian (1996)[u]											
1	bh no. 24 5.5 - 5.7 m	7.98[5]	15.54[6]	43.25		2498					60.57
1	bh no. 11 43.3 - 43.75	16.6[5]		11.7							44.5
1	bh no. 14 14.3 - 14.9	7.1[5,7]		10.6	1.14	5310					48.4[7]

Coal Bed No. 3 - Part B

No. samples	Description	H[3] (%)	C[3] (%)	N[3] (%)	O[3] (%)	SS[3] (%)	PS[3] (%)	OS[3] (%)	VM[3] (%)	EM (%)	Ash (%)
Isaguliants and Azizyan (1945)											
2		4.31 4.19	58.30 58.29						58.77 60.21		16.55 16.82
Pierce and others (1994)											
1		4.52	59.81	2.25	14.29	0.1	1.62	2.41	41.81	32.37	

Coal Bed No. 3 - Part C

No. samples	Description	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	SO_3 (%)
Isaguliants and Azizyan (1945)								
2		22.28 23.28	27.69 26.07	7.27 9.18	0.44 0.48	16.18 14.38	5.81 2.90	NR NR

[1] This moisture is simply labeled “moisture,” it is not clear what kind it is, perhaps total moisture.

[2] This is total moisture, according to ASTM D3172.

[3] These results are reported on a dry basis.

[4] The first column is calculated cal/g from Btu/lb, which is in the next (TY) column. Cal/g and Btu/lb are dry basis.

[5] This moisture is labeled “Total Moisture” in the original table.

[6] This moisture is labeled “Analytical Moisture” in the original table. The volatile matters in Vardanian and Elbakian (1996) are mislabeled as well, the first volatile matter column in their table is as determined and the second is dry ash-free.

[7] In Vardanian and Elbakian’s (1996) geochemical table, the moisture value is listed as 7.7 percent, but the original data sheets from the geochemical laboratory list this value as 7.1 percent; and the value for VM_{daf} in the archival report lists 48.7 percent, but the chemical laboratory’s original data sheet reports this value as 48.4 percent.

Table 5. Coal quality characteristics of the Jajur coal bed No. 4.

[Reporting basis listed when known. [No. Samples = number of samples; NM = natural moisture; ADM = air dried moisture; ADA = air dried ash yield; TS = total sulfur; CV = calorific value; TY = tar yield; BY = bitumen yield; FC = fixed carbon; d = density; VM_{daf} = volatile matter, dry ash-free basis; [u] = reporting bases are unknown or not given for these authors; NR = not reported; bh = borehole; H = hydrogen; C = carbon; N = nitrogen; O = oxygen; SS = sulfate sulfur; PS = pyritic sulfur; OS = organic sulfur; EM = equilibrium moisture. Oxides are on an ash basis. Data qualifiers are explained in footnotes at end of tables.]

Coal Bed No. 4 - Part A

No. samples	Description	NM (%)	ADM (%)	ADA (%)	TS (%)	CV (cal/g)	TY (%)	BY (%)	FC (%)	d (g/cm^3)	VM_{daf} (%)
Isaguliants and Azizyan (1945)											
2		24.19 NR	17.90 17.65	11.14 18.72	2.33 3.00	7033 5301				1.39	
Talanian and Azatian (1953)[u]											
NR		16.12[1]		39.12		3007- 3325					
Mesropian and Sarkissian (1956)[u]											
NR	0.4 m avg thick					3325					
Pierce and others (1994)											
1			35.39[2]	8.63[3]	2.98[3]	6423[4]	(11561[4])		44.12[3]		
Vardanian and Elbakian (1996)[u]											
1	bh no. 24 4.0 - 4.5 m	13.33[5]	13.79[6]	32.22	2	3701					67.55
1	bh no. 11 42.6 - 42.85	16.8[5]		8.3							50.1

Coal Bed No. 4 - Part B

No. samples	Description	H[3] (%)	C[3] (%)	N[3] (%)	O[3] (%)	SS[3] (%)	PS[3] (%)	OS[3] (%)	VM[3] (%)	EM (%)	Ash (%)
Isaguliants and Azizyan (1945)											
2		4.85 4.71	61.21 61.34						58.78 56.01		13.35 13.31
Pierce and others (1994)											
1		4.8	65.72	2.28	15.59	0.04	0.68	2.26	47.25	34.9	

Coal Bed No. 4 - Part C

No. samples	Description	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	SO_3 (%)
Isaguliants and Azizyan (1945)								
2		32.24 29.98	20.77 11.33	4.33 12.95	0.60 0.46	16.64 20.32	4.91 4.36	17.6 NR

[1] This moisture is simply labeled “moisture,” it is not clear what kind it is, perhaps total moisture.
[2] This is total moisture, according to ASTM D3172.
[3] These results are reported on a dry basis.
[4] The first column is calculated cal/g from Btu/lb, which is in the next (TY) column. Cal/g and Btu/lb are dry basis.
[5] This moisture is labeled “Total Moisture” in the original table.
[6] This moisture is labeled “Analytical Moisture” in the original table. The volatile matters in Vardanian and Elbakian (1996) are mislabeled as well, the first volatile matter column in their table is as-determined and the second is dry ash-free.

Table 6. Coal quality characteristics of the Jajur coal bed No. 5.

[Reporting basis listed when known. No. Samples = number of samples; NM = natural moisture; ADM = air dried moisture; ADA = air dried ash yield; TS = total sulfur; CV = calorific value; TY = tar yield; BY = bitumen yield; d = density; VM_{daf} = volatile matter, dry ash-free basis; [u] = reporting bases are unknown or not given for these authors; NR = not reported; bh = borehole; H = hydrogen; C = carbon; N = nitrogen; O = oxygen; SS = sulfate sulfur; PS = pyritic sulfur; OS = organic sulfur; EM = equilibrium moisture. Oxides are on an ash basis. Data qualifiers are explained in footnotes at end of tables.]

Coal Bed No. 5 - Part A

No. samples	Description	NM (%)	ADM (%)	ADA (%)	TS (%)	CV (cal/g)	TY (%)	BY (%)	FC (%)	d (g/cm^3)	VM_{daf} (%)
Isaguliants and Azizyan (1945)											
2			22.31 18.11	10.67 11.30	3.18 3.50	5524 5588				1.35	
Talanian and Azatian (1954)[u]											
NR		25.40[1]		12.12	3.67	4195- 4568					
Mesropian and Sarkissian (1956)[u]											
NR	0.3 m thick			12.12		4195- 4568					
Pierce and others (1994)											
1			40.06[2]	20.98[3]	3.33[3]	5254[4]	(9457[4])		32.35[3]		
Vardanian and Elbakian (1996)[u]											
1	bh no. 11 41.2 - 41.4	15.0[5]		12.3							51.6
1	bh no. 13 14.3 - 15.0	9.3[5]		13.2		5186					

Coal Bed No. 5 - Part B

No. samples	Description	H[3] (%)	C[3] (%)	N[3] (%)	O[3] (%)	SS[3] (%)	PS[3] (%)	OS[3] (%)	VM[3] (%)	EM (%)	Ash (%)
Isaguliants and Azizyan (1945)											
2		4.69 4.63	59.98 60.08						59.40 62.57		13.19 13.34
Pierce and others (1994)											
1		3.89	55.84	1.92	14.04	0.05	0.27	3.01	46.67	36.5	

Coal Bed No. 5 - Part C

No. samples	Description	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	SO_3 (%)
Isaguliants and Azizyan (1945)								
2		28.48 31.22	15.10 15.20	9.83 10.31	3.44 0.46	17.61 19.08	3.70 4.01	NR NR

[1] This moisture is simply labeled “moisture,” it is not clear what kind it is, perhaps total moisture.

[2] This is total moisture, according to ASTM D3172.

[3] These results are reported on a dry basis.

[4] The first column is calculated cal/g from Btu/lb, which is in the next (TY) column. Cal/g and Btu/lb are dry basis.

[5] This moisture was reported as “Total Moisture” in its original table. The volatile matters in Vardanian and Elbakian (1996) are mislabeled as well, the first volatile matter column in their table is as-determined and the second is dry ash-free.

Table 7. Coal quality characteristics of the Jajur coal bed No. 6.

[Reporting basis listed when known. No. Samples = number of samples; NM = natural moisture; ADM = air dried moisture; ADA = air dried ash yield; TS = total sulfur; CV = calorific value; TY = tar yield; BY = bitumen yield; FC = fixed carbon; d = density; VM_{daf} = volatile matter, dry ash-free basis; [u] = reporting bases are unknown or not given for these authors; NR = not reported; bh = borehole; H = hydrogen; C = carbon; N = nitrogen; O = oxygen; SS = sulfate sulfur; PS = pyritic sulfur; OS = organic sulfur. Oxides on an ash basis. Data qualifiers are explained in footnotes at end of tables.]

Coal Bed No. 6 - Part A

No. samples	Description	NM (%)	ADM (%)	ADA (%)	TS (%)	CV (cal/g)	TY (%)	BY (%)	FC (%)	d (g/cm^3)	VM_{daf} (%)
Isaguliants and Azizyan (1945)											
2		NR 24.92	20.86 23.57	9.22 9.23	1.73 2.07	5725 5962				1.4	
Talanian and Azatian (1954)[u]											
		24.5[1]		10.37	3.87	4492- 4862					
Aslanian and Rudzyanski (1954)											
116[2]	Brown, laminated mainly vitrain	38.1	16.58	12.5	2.18	5178	3.68	1.75	52.5	1.4	
Mesropian and Sarkissian (1956)[u]											
	1.15-1.25 m avg thick			19.98- 27.36		4492- 4862					
Vardanian and Elbakian (1996)[u]											
200[3]		38.1	13.26	16.4	2.79	5244	1.75	1.75	62.5[4]	1.47	
1	bh no. 11 34.2 - 35.4	14.8[5]		18.4							48.5
1	bh no. 12 19.5 - 21.0	19.5[5]		8.3		5450					47.7

1	bh no. 15 34.0 - 35.2	3.5[5]		38	2.04						59.7
1	bh no. 16 16.0 - 17.2	3.3[5]		37.2	2.7						60.6
1	bh no. 19 54.2 - 55.7	8.4[5]		23.8	4.49						51
1	bh no. 13 6.0 - 7.5	7.2[5]		11.9		5171					52.1
1	bh no. 21 4.5 - 6.1	10.1[5]		10.4		5340					
1	bh no. 25 6.8 - 8.1	50.29[5]		44.04	0.9	2661					
1	bh no. 23 7.9 - 9.4	7.2[5]		11.4		5220					

Coal Bed No. 6 - Part B

No. samples	Description	H[6] (%)	C[6] (%)	N (%)	O (%)	SS (%)	PS (%)	OS (%)	VM[6] (%)
Isaguliants and Azizyan (1945)									
2		4.19 4.33	52.51 62.56						57.57 58.24

Coal Bed No. 6 - Part C

No. samples	Description	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	SO_3 (%)
Isaguliants and Azizyan (1945)								
2		33.52 28.44	15.43 16.99	10.73 13.00	0.49 0.44	16.81 16.58	3.45 4.83	NR NR

[1] This moisture is simply labeled “moisture,” it is not clear what kind it is, perhaps total moisture.

[2] 116 total samples are reported for both the No. 2 and No. 6 coal beds. The authors do not make clear how many of the 116 are from the No. 2 and how many are from the No. 6 coal beds.

[3] 200 total samples are reported for both the No. 2and No. 6 coal beds. The authors do not make clear how many of the 200 are from the No. 2 and how many are from the No. 6 coal beds. It is also not clear from their report whether the samples are from boreholes, channel samples, grab samples, and so on, or a combination of all.

[4] This value of 62.5 percent is reported only as “carbon,” but is probably fixed carbon.

[5] This moisture was labeled “Total Moisture” in its original table.

[6] Values are on a dry basis.

Table 8. Coal quality characteristics of the unknown or unspecified coal beds of the Jajur deposit.
[Reporting basis listed when known. No. Samples = number of samples; Thk = sample thickness; AM = analytical moisture; TM = total moisture; Ash = ash yield; TS = total sulfur; CV = calorific value; C = carbon; H = hydrogen; N = nitrogen; O = oxygen; VM = volatile matter, dry ash-free basis; d = density; u = reporting bases are unknown or not given for these authors; NR = not reported; bh = borehole. Data qualifiers are explained in footnotes at end of tables.]

Unspecified or Unknown Bed

No. samples	Description	Thk (m)	AM[2] (%)	TM[2] (%)	Ash (%)	TS (%)	CV (cal/g)	C (%)	H (%)	N (%)	O (%)	VM[3] (%)	d (g/cm³)
Talanian and Azatian (1953)[1]													
						4.35		78.43	5.64	2.25	13.68		
						4		79.86	5.45	2.38	12.31		
						3.99		80.76	5.53	1.98	11.73		
Vardanian and Elbakian (1996)[u]													
1	bh no. 7	0.4	11.4	13	28.07	1.91						61.29	2.17
1	bh no. 7	0.6	8	8.4	35.3							55.25	
1	bh no. 4[xx]	0.4	8.23	8.3	32.43	2.61	3896					54.23	2.06
1	bh no. 4[xx]	1.6	11.28	12.69	15.04	3.71	5100					53.78	
1	bh no. 4[xx]	2	10.79	10.8	29.4	2.91	3902					52.4	
1	bh no. 4[xx]	2.2	8.84	17.32	41.56	1.38	3077					53	1.82
1	bh no. 8	0.8	9.3	9.5	45.92		2724					59.18	
1	bh no. 25[xx]	0.4	16.7		16.9							50.4	1.53
1	bh no. 28[xx]	2.4	15.2		12.6							50.4	1.45
1	bh no. 29[xx]	1.5 0.7	16.1 16.1		12.6 15.0		5400 NR					55.8 49.6	1.47 1.49
1	bh no. 30[xx]	1.5	15.4	NR	9.2	NR	NR					50.8	1.46

1 each	bh no. 31[xx]	1.2 1.5 1.0 0.4	14.8 17.7 16.1 17.6	NR NR NR NR	45.6 36.9 45.6 8.4	NR NR NR NR	NR NR NR NR					54.5 70.0 62.6 46.2	1.88 1.72 1.81 1.41
1 each	bh no. 33[xx]	2.5 1.5 0.6 2.9	15.2 19.9 17.3 20.0	NR NR NR NR	11.8 12.5 8.3 9.7	NR NR NR NR	NR NR 5600 5500					53.6 54.1 46.0 53.2	1.48 1.50 1.41 1.41
1	bh no. 12	0.6	15.8	NR	10.6	NR	NR					53.3	1.48
1 each	bh no. 19[xx]	1.5 3.5	2.4 2.3	NR NR	29.0 24.1	2.03 4.38	NR NR					66.9 58.6	1.70 1.60
1 each	bh no. 15[xx]	1.4 3.2	8.8 10.4	NR NR	10.4 11.8	NR NR	52104 789					NR NR	NR NR
1 each	bh no. 18[xx]	0.8 2.7	8.2 8.8	NR NR	8.9 13.6	NR NR	54205 010					NR NR	NR NR
1	bh no. 101	0.15	NR	33.3	16.9	NR	NR					NR	NR
1 each	bh no. 110	2.5 2.6	NR NR	8.9 10.1	11.2 12.3	NR NR	53465 010					NR NR	NR NR

1	trench	2.0	6.82	NR	62.40	0.26	NR					NR	NR
each	samples	4.0	10.05	14.07	21.70	NR	NR					64.72	NR
		2.0	5.82	8.80	68.64	NR	NR					93.50	NR
		5.0	9.98	10.50	34.98	0.26	1743					78.28	NR
		NR	16.70	31.21	22.88	1.16	4322					78.06	NR
		NR	11.19	11.30	7.87	NR	5107					46.37	NR
		NR	14.9	NR	10.4	NR	5200					47.5	NR
		NR	14.5	NR	14.2	NR	5550					42.8	NR
		NR	15.8	NR	11.3	NR	NR					50.6	NR
		NR	5.8	NR	52.4	3.62	NR					73.7	1.86
		NR	8.2	NR	12.7	3.05	NR					53.1	1.44
		NR	12.6	NR	8.9	3.08	NR					46.1	1.43
		NR	NR	NR	NR	NR	NR					NR	NR
		NR	8.8	NR	10.5	3.64	5420					47.4	1.45
		NR	NR	NR	NR	NR	NR					NR	NR
		NR	8.1	NR	13.6	5.56	NR					54.7	1.48
		NR	8.8	NR	20.4	0.62	5210					52.8	1.52
		NR	0.1	NR	76.8	0.62	NR					85.3	2.25

[1] These analyses are reported on an ash-free and moisture-free basis.

[2] In Vardanian and Elbakian's (1996) geochemical table, the Analytical and Total Moisture columns were interchanged. We discovered this by checking the original chemical tables at the geochemical laboratory.

[3] The volatile matter results were also interchanged in Vardanian and Elbakian's (1996) geochemical table. They were labeled "Total Volatile Matter" for the first column and "Conventional Combustible Mass" for the second column. But after examining the geochemical tables, it is clear that the first column is Volatile Matter, as-determined basis, and the second column is Volatile Matter, dry ash-free basis.

[xx] These samples from Vardanian and Elbakian's (1996) boreholes were particularly difficult to rectify. The problems are described here:

Borehole No. 4 — These are obviously coal samples and therefore included in this table, but the interval of 15.5 to 15.9 m in the borehole description is listed as shale, 17.7 to 19.3 m is listed as shale, 22.0 to 24.0 m is listed as sandstone, and 24.8 to 26.2 m is listed as carbonaceous shale. This Borehole No. 4 may be a reiteration of samples from a previous report, although Vardanian and Elbakian (1996) do not give credit to that report.

Borehole No. 25 — There are two coal beds (No. 2 and No. 6) listed as occurring in bh 25, but the intervals do not match to the ones listed in the geochemical table. In the borehole description, Bed No. 6 is from 6.8 to 8.1 m and bed No. 2 is 21.1 to 23.5 m, but the "coal" interval listed in the report's table for bh 25 is 10.5 to 10.9 m.

Borehole No. 28 — The coal interval listed in the report's geochemical table (10.9 to 13.3 m) is different from coal bed No. 2 listed in the borehole description, which is from 7.8 to 9.0 m.

Borehole No. 29 — There is only one coal bed listed in the borehole description for borehole 29, yet two analyses appear in the geochemical

table at intervals 6.3 to 7.8 m and 13.5 to 14.2 m. The coal bed in the borehole description is coal bed No. 6 from 39.2 to 40.7 m.

Borehole No. 30 The interval listed in the geochemical table (39.2 to 40.7 m) is different than that listed in the borehole description, which is 21.7 to 24.5 m for coal bed No. 2 and is unreadable for coal bed No. 6. The total depth for this borehole is listed as 25.5 m, but the "coal" in the goechemical table is listed as occuring below this.

Borehole No. 31 There is no borehole 31 in the figures of the report, so these intervals could not be checked. The intervals occurring in the report's geochemical table are as follows: 13.0 to 14.2 m, 14.7 to 16.2 m, 18.0 to 19.0 m, and 34.7 to 37.3 m.

Borehole No. 33 There is no borehole 33 in the figures of the report, so these intervals could not be checked. The intervals occurring in the report's geochemical table are as follows: 8.5 to 11.0 m, 18.5 to 20.0 m, 31.6 to 32.1 m, and 34.7 to 37.3 m.

Borehole No. 19 The intervals listed in the geochemical table (7.9 to 9.4 m and 22.6 to 26.1 m) are not listed as coal in the borehole descriptions.

Borehole No. 15 There are no coals listed in borehole no. 15 in the borehole descriptions. Thus, this is probably not bh 15, but the analyses are included in this table because they are real coal data.

Borehole No. 18 The intervals in the table and the borehole descriptions differ. In the coal quality table, the coal intervals are listed as 3.8 to 4.6 m and 18.2 to 20.9 m. In the borehole descriptions, coal bed No. 6 is from 8.3 to 8.7 m and coal bed No. 2 is from 22 to 24.5 m.

Table 9. Primary and secondary gas analyses from the Jajur coal beds.
[All data from Isaguliants and Azizyan, 1945. All analyses in percent.]

Jajur coal bed number	Primary gases				Secondary gases			
	CO_2	O_2	CO	$NH_4 + H_2$	CO_2	O	CO	NH_4+H_2
2	14.6	8.2	0	8.8	13.4	8.9	0	10.6
6	18.2	5.8	0	9.7	--	--	--	-----
4	22	6	0	10.6	18	6.8	0	12.4

Table 10. Geochemical data from seven combustible shale and bituminous claystone samples from the Jajur strip mine.
[All data from Vardanian and Elbakian, 1996. SN = sample number; Moisture, in percent = working moisture (M_{work}) and analytical moisture ($M_{analytical}$); Ash, in percent = working ash (A_{work}) and analytical ash ($A_{analytical}$); Volatile Matter, in percent = working (VM_{work}) and combined (VM_{comb}); S=sulfur, in percent; Bitumen, in percent; CV=calorific value, in cal/g. It is unclear what is meant by "working" values. "Analytical" probably means as-determined, but this interpretation poses a problem for the A_{work} because it is a smaller value than the $A_{analytical}$. "Combined" volatile matter is also unclear, but may mean dry, ash-free basis.]

SN	Moisture		Ash		Volatile Matter		S	Bitumen	CV
	M_{work}	$M_{analytical}$	A_{work}	$A_{analytical}$	VM_{work}	VM_{comb}			
1	11.54	5.46	70.84	75.71	16.75	88.95	2.16	8.29	472.6
2	6.73	2.48	66.57	69.6	24.01	85.99			790.8
3	9.11	4.28	73.43	77.33	16.44	89.4		7.22	1024
4	11.81	6.99	68.19	71.92	19.2	91.04			948
5	8.36	4.71	67.3	69.98	20.63	81.51	1.53	7	1288
6	11.52	4.66	62.81	67.68	22.14	80.04		5.87	1413
7	10.97	3.73	68.65	74.23	19.97	90.61		5.93	834

Table 11. Coal resource calculation of the Jajur coal deposit by Eremeshian (1938).
[All densities used in the resource calculations are 1.2 g/cm^3. See the text for a discussion of the resource categories. CB = coal bed number; Thick = average thickness of coal bed; Length = length of the area used in resource calculation; Width = width of the area used in resource calculation; Resource 1 = coal bed resource, in m^3; Resource 2 = coal bed resource, in metric tonnes]

CB	Thick (m)	Length (m)	Width (m)	Resource 1 (m^3)	Resource 2 (m tonnes)	Category
1	1.2	200	100	24000	28000	A_2
2	1.1	500	100	55500	66600	A_2
3	0.78	200	75	11700	14040	B
4	0.72	200	70	10080	12096	B
5	0.74	200	55	8140	9768	B
6	0.54	200	50	5400	6480	B
7	1.31	200	40	10480	12576	B
Total resource of seven beds in categories A_2 + B: 149,560 metric tonnes						

Table 12. Resource calculations for the Jajur coal deposit by Baicharov (1939).
[All tonnage are in metric tonnes. Density used for all calculations was 1.2 g/cm^3. See text for a discussion of resource reporting categories. CB = coal bed; Proj Area = surface projection of coal bed; True Area = true area of coal bed; Avg bed thick = average coal bed thickness used for resource calculation]

CB	Proj area (m^2)	True area (m^2)	Avg bed thick (m)	Tonnage calculation by category		
				A_2	B	C_1
13	3420	3741.8	1.35			6062
12	4125	4513	1.73			9369
11	5610	6137.8	3.32			24453
10	8430	9223	1.47			16269
9	10295	11263.7	0.46			6218
8	13465	14731.7	0.96			16971
7	48655	53233	1.31	83682		
7	5305	8250.3	1.31			12969
6	54730	59879.6	0.46		33054	
6	6445	10023	0.46			5533
5	54650	59792	0.7		50225	
5	4750	7387	0.7			6205
4	54315	59425.6	1.73		123367	
3	49575	54239.6	0.73		47514	
2	51605	56460.6	1.22	66600	16058	
1	52875	57850	0.77	28000	25453	
Total of A_2 + B + C_1 = 578,002				178282	295671	104049

Table 13. Coal resource calculations of the Jajur deposit by Tarayan (1942).
[All resource tonnage in metric tonnes. No additional information given by Tarayan (1942), such as density, average bed thickness, ash yield, and so on. It is also not clear what the "sooty" coal is nor how it differs from coal beds No. 3, No. 4, or No. 5. For a discussion of the reporting categories, see text.]

Category of resource	Coal bed number	Calculated resources	Approved resources
In-balance resources			
A_2 A_2 A_2	Bed 2 Bed 2' Bed 6'	51,600 18,700 5,900	
Total of category A_2		76200	62,100
B B B B	Bed 2 Bed 2' Bed 6 Bed 6'	32,200 28,000 20,500 10,100	
Total of category B		90,800	90,800
C_1 C_1 C_1 C_1	Bed 2 Bed 2' Bed 6 Bed 6'	25,700 23,200 13,600 26,000	
Total of category C_1		88,500	88,500
C_2 C_2	Bed 2' Bed 6'	5,500 4,900	
Total of category C_2		10,400	10,400
Total resource of all categories $A_2 + B + C_1 + C_2$: 265,900			
Out-of-balance resources			
Beds 3 and 3' Beds 4 and 4' Beds 5 and 5'		31,400 16,300 25,000	
"Sooty" coal		56,200	
Total out-of-balance resources: 128,900			

Table 14. Resource calculations of coal beds of the Jajur deposit by Vardanian and Elbakian (1996).

[For a discussion of the reporting categories, see the text. Avg = average; Ash yield basis is unknown; CV = calorific value, basis unknown; Resource, m tons = tonnage in metric tonnes; NA = not available]

In-balance resources

Block no. - category	Area of block (m^2)	Avg. bed thickness (m)	Density (g/cm^3)	Avg. ash yield (%)	Avg. CV (cal/g)	Resource (m tonnes)
Jajur coal bed No. 2						
B1 - C_1	52260	2.47	1.2	26.08	3739	154899
B2 - C_2	30723	2.8	1.2	39.65	5101	103229
B3 - C_2	35823	1.72	1.2	18.35	NA	73939
	Total resources of Jajur coal bed No. 2 = 332,067					
Jajur coal bed No. 6						
B4 - C_1	40149	1.1	1.2	26.02	4524	52997
B5 - C_2	23199	0.96	1.2	35.46	NA	26725
B6 - C_2	43472	1.25	1.2	13.63	NA	65208
	Total resources of Jajur coal bed No. 2 = 144,930					
Jajur coal beds No. 2 + No. 6						
Total (original resources): 476,997 (C_1 of 207,896 and C_2 of 269,101)						
Resources extracted from 1939 to 1995: 84,263						
Total remaining resources $C_1 + C_2$: 392,734						

Out-of-balance resources

Block no. - category	Area of block (m^2)	Avg. bed thickness (m)	Density (g/cm^3)	Avg. ash yield (%)	Avg. CV (cal/g)	Resource (m tonnes)
Jajur coal bed No. 3						
B7 - C_1	40291	0.43	1.2	29.66	4805	20790
B8 - C_2	67402	0.33	1.2	24.6	4805	26692
Jajur coal bed No. 4						
B7 - C_1	40291	0.35	1.2	25.5	4805	16922

B8 - C_2	67402	0.23	1.2	39	4805	186001
Jajur coal bed No. 5						
B7 - C_1	40291	0.3	1.2	23.7	4805	14504
B8 - C_2	67402	0.27	1.2	31.82	4805	21831
Total resources $C_1 + C_2$: 119,340						

Table 15. Recalculation of total resources of the Jajur coal deposit - Part A. Calculation of total resources of the Jajur coal beds No. 2 and No. 6 - Part B.

[In Part A, total resources were calculated using all existing archival data (found in table 1). In Part B, the recalculation of coal beds No. 2 and No. 6 were based only on data from Vardanian and Elbakian (1996). Numbers in parentheses are their calculations for comparison purposes (also found in table 14) and the "blocks" are subdivisions of the total areas used in their report. Total area of calculation is shown in gray on figure 3. For all beds the density used was 1.2 g/cm^3. Avg. = average; min thk = minimum thickness exclusion]

Total Jajur Coal Deposit Resource - Part A

Area (m^2)	Resource (metric tonnes)
Total resource of the Jajur coal deposit using all archival data	
133150	483537

Resources for the Jajur Coal Beds No. 2 and No. 6 - Part B

Area (m^2)	Resource (metric tonnes)
Coal Bed No. 2	
Total area = 133,150 (188,806)	Total = 329,700 (332,067) min thk of 0.2 m = 329,637
Block 1 = 54,244 (52,260)	
Block 2 + 3 = 78,570 (66,543)	
Coal Bed No. 6	
Total area = 108,502 (106,820)	Total = 141,606 (144,930) min thk of 0.2m = 141,534
Block 1 = 40,366 (40,149)	
Block 2 + 3 = 67,809 (66,671)	

Table 16. Coal quality characteristics of the Maissian coal deposit.

[All data from Talanian and Azatian (1953). NS = number of samples; SI = sample interval; M^L = laboratory moisture; A^L = laboratory ash yield, probably as-determined basis; A^C = ash yield, dry basis; VM^L = laboratory volatile matter, probably as-determined basis; VM^C = volatile matter, dry basis; TS = total sulfur, basis unknown; CV = calorific value, basis unknown; d = density]

NS	Description	SI (m)	M^L (%)	A^L (%)	A^C (%)	VM^L (%)	VM^C (%)	TS (%)	CV (cal/g)	d (g/cm^3)
1	from adit 11	at 4.7	12.1	50.66	57.63	19.88	53.38	2.01	2151	1.82
1	from adit 11	at 5.1	12.86	52.04	59.72	20.18	57.49	0.88	1870	1.83
1	from adit 11	at 5.5	11.38	63.14	71.24	16.06	63.03	1.29	1412	1.9
1	from adit 11	at 10.3	12.3	43.22	49.28	29.3	65.87	0.7	2824	1.67
1	from adit 11	at 11.5	13.58	44.08	51	22.1	52.19	1.33	2623	1.7
1	from shaft 10	at 1.4	13.84	39.2	45.49	25.86	55.06	0.68	2868	1.68
1	from shaft 8	at 2.0	14.1	42.56	49.54	24.8	57.22	1.03	2537	1.69
1	from adit 6	at 2.2	14.16	39.34	45.82	24.28	52.21	1.58	2835	1.67
1	from adit 3	at 5.0	13.34	52.6	60.69	19.22	56.42	0.78	1660	1.85
1	from adit 4	at 6.0	12.17	55.2	62.92	16.36	50.13	0.54	1632	1.79
1	from shaft 16	at 0.6	13.38	35.4	40.86	25.52	49.82	2.77	3300	1.65
1	from adit 1	at 4.0	12.94	49.9	57.31	18.48	49.73	1.09	2200	1.68
1	from adit 8	at 5.0	13.02	42.32	48.65	22.14	49.57	0.87	2846	1.68