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Spatial Trends in Ash Yield, Sulfur, Selenium, and Other Selected Trace Element Concentrations in Coal Beds of the Appalachian Plateau Region, U.S.A.

by

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ABSTRACT

Land disturbances sometimes contribute to relative increases in deleterious substances in streams. Acid drainage in response to coal mining in certain regions of the Appalachian Plateau is one well known example. Apparent relative increases in selenium (Se) in some streams where land disturbance has occurred in the coal-producing region of the Appalachian Plateau may also be of concern. As a result of concerns regarding selenium, this report evaluates the spatial variation (both stratigraphic and regional) of selenium in coal beds in the Appalachian coal fields of Pennsylvania, Maryland, Ohio, West Virginia, Kentucky, Tennessee, and Virginia.

Analyses of selenium, ash yield, and sulfur concentrations in more than 3,000 coal samples were used to evaluate both the stratigraphic and regional variation of these parameters. The samples are from more than 70 coal beds in the Lower, Middle, and Upper Pennsylvanian Series, located in the Appalachian Plateau region of western Pennsylvania, western Maryland, eastern Ohio, throughout West Virginia, eastern Kentucky, northeastern Tennessee, and southwestern Virginia. Coal beds in the middle Middle Pennsylvanian series, from the Cedar Grove coal bed in West Virginia and the correlative Whitesburg coal bed in eastern Kentucky up through the Clarion coal bed in Pennsylvania and Ohio generally have an average selenium concentration greater than 3.9 ppm (remnant-moisture, whole-coal), an empirical observation. All coal samples from this stratigraphic interval have an average selenium concentration of 5.4 ppm. For the purposes of this report, this stratigraphic interval is referred to as "selenium greater than background" abbreviated SGB, in reference to average selenium concentrations in coal that are greater than the average for all northern and central Appalachian basin coal samples of 3.6 ppm Se.

Coal beds in the SGB stratigraphic interval generally have a median selenium concentration greater than 3.5 ppm. In contrast, coal beds that are from older strata that underlie the SGB interval (pre-SGB in this report) or from younger strata that overlie the SGB interval (post-SGB in this report) generally have median selenium concentrations that are less than 3.5 ppm. The median selenium concentrations for all coal samples from the pre-SGB, SGB, and post-SGB intervals are 2.7, 5.0, and 2.6 ppm selenium, respectively. This trend of lower-higher-lower selenium concentrations in the three stratigraphic intervals is different from the median ash yield that is 6.7, 11, and 11 percent ash on an as-received, whole-coal basis, respectively, or a

stratigraphic trend of lower-higher-higher. The stratigraphic trend in median sulfur concentration for all coal samples is lower-lower-higher with values of 0.9, 1.1, and 2.7 percent sulfur on an as-received, whole-coal basis, respectively, and is different from the trends in both selenium and ash yield. In the Appalachian Plateau region, the selenium concentrations in coal samples from the Cedar Grove/Whitesburg to Clarion (SGB) interval are almost twice those in coal samples from the older (pre-SGB) and younger (post-SGB) coal beds for thick (≥ 28 inch) as well as thin (< 28 inch) coal samples.

The different stratigraphic trends in selenium, ash yield, and sulfur concentration suggest that different processes control their concentrations in coal and that neither ash yield nor sulfur concentration can be used as a predictor for selenium concentration in coal. Whether the stratigraphic trend in selenium concentrations in eastern U.S. Pennsylvanian coal reflects a similar trend in selenium concentrations in overall Pennsylvanian strata remains unanswered.

INTRODUCTION

The practice of mountaintop coal mining (MTM) disturbs large volumes of rock. Elevated selenium concentrations reported from streams that drain areas impacted by MTM in southern West Virginia (Bryant and others, 2002; Ferreri and others, 2004; Vesper and others, 2004) and areas impacted by coal surface mining and reclamation in Ohio (Bonta and Dick, 2003) have drawn attention to the potential for increases in selenium concentrations in drainage from these Appalachian Plateau coal mining regions. The source of selenium in drainage water may be coal, although in surface mining all of the coal is removed, and the source of selenium is more likely to be the associated strata disturbed by mining operations. In underground room and pillar mining, an average of 50 percent (range 35 - 70 percent) of the coal is left in place (Wood and others, 1983). In underground longwall mining, approximately 30 percent of the coal remains. Selenium in coal left in underground mines could conceivably contribute to selenium in groundwater and streams in areas of both active and abandoned underground mines. Understanding levels and trends in selenium concentrations in coal beds and associated rocks would aid in predicting the potential for selenium mobilization as a result of coal mining and other major rock disturbance. Although study of the selenium concentrations in rocks is beyond the scope of this report, an assessment of the concentration range of selenium content in coal beds throughout the Appalachian basin is a first step toward determining whether there are any potential risks of selenium contamination from past, present, or future coal mining and utilization in the Appalachian basin.

Selenium concentration in coal varies among coal basins. The average and geometric mean concentrations of selenium in United States (U.S.) coal are reported as 2.8 and 1.8 ppm (whole-coal basis) respectively (Finkelman, 1993). Average selenium concentration in coal in the Appalachian basin, Interior province, and Powder River basin in the U.S. are reported as 3.5, 3.2, and 1.1 ppm (whole-coal basis), respectively (Finkelman and others, 1994). Gluskoter and

others (1977) calculated the enrichment factor for selenium in U.S. coal (the ratio of geometric mean selenium in coal / average selenium in crust) and showed that it is greater than the enrichment factor of all other elements. In eastern, interior, and western coal basins, selenium enrichment (whole-coal) is 68, 40, and 26, respectively (Gluskoter and others, 1977). Coal mining and utilization are major pathways that mobilize selenium into the environment (Lemly, 2004). For coal utilization purposes, selenium concentrations on a Btu basis are more meaningful than on a whole-coal basis. Se/Btu are more similar than Se/coal among the Appalachian, Interior, and Powder River basins due to a decrease in Btu values in conjunction with the decrease in selenium from the Appalachian to Interior to Powder River basin (Bragg and others, 1998). Elevated concentrations of selenium mobilized by coal mining disturbance in the Powder River basin have been observed by Dreher and Finkelman (1992).

The assumption that selenium in coal is primarily associated with pyrite (Coleman and others, 1993; Taylor and others, 1998; Diehl and others, 2004) is often made because selenium shows some chemical behavior similar to sulfur (McNeal and Balistrieri, 1989) and coal beds are reducing environments where sulfur and selenium would generally be in a reduced state and therefore less mobile. Various studies of selenium in coal and rocks associated with coal have shown that selenium substitutes for sulfur in pyrite, is associated with mineral matter, or is associated with organic matter (Kuhn and others, 1980; Cecil and others, 1981; Cahill and others, 1982; Oman and others, 1988; Naftz and Rice, 1989; Diessel, 1992; Dreher and Finkelman, 1992; Coleman and others, 1993; Taylor, 1998; Zhang and others, 2002; Hower and Robertson, 2003; Lussier and others, 2003; Diehl and others, 2004; Jenkins and Schaer, 2004). The fact that selenium may have more than one mode of occurrence in coal and coal-bearing strata and that selenium occurs in trace amounts may explain why it is difficult to demonstrate a correlation between selenium and other parameters.

The data used in this report are a subset of the U.S. Geological Survey COALQUAL database (Bragg and others, 1998; http://energy.er.usgs.gov/products/databases/CoalQual/intro.htm). Statistical data are presented herein for selenium, coal bed thickness, ash yield, sulfur (S), pyritic sulfur (Spyr), arsenic (As), mercury (Hg), and manganese (Mn). Arsenic and mercury data are included because they are trace elements in coal that are released to the environment via coal combustion and may have deleterious health effects (U.S. Environmental Protection Agency, websites: http://www.epa.gov/ttn/atw/hlthef/arsenic.html., http://www.epa.gov/safewater/arsenic.html., http://www.epa.gov/mercury/ , http://www.epa.gov/mercury/control_emissions/index.htm., http://www.epa.gov/OGWDW/dwh/t-ioc/mercury.html.). Manganese data are included in this report because manganese is released to the environment via coal mining and major rock disturbance. Manganese causes staining, an aesthetic problem, and is currently under study to determine whether there are health issues related to manganese exposure that warrant revision of manganese standards for drinking water (California Department of Health Services, 2005). In addition to selenium, only the thickness, ash yield, and sulfur data are discussed in detail in this

report.

This Open File Report focuses on selenium concentration in Pennsylvanian coal beds in the northern and central Appalachian basin coal region (fig. 1). Extensive data for selenium concentrations in coal beds, including those from the stratigraphic interval of MTM in the central Appalachian basin and the equivalent time interval in the northern Appalachian basin, are available at a regional scale (Appendix 1). Selenium, ash yield and sulfur data are examined for the average and median concentrations in each state, the distribution of concentrations in coal samples from three individual coal beds, stratigraphic trends in concentrations among coal beds, and comparison of concentrations in coal that is thicker or thinner than 28 inches. Stratigraphic trends in selenium concentration of coal beds are compared to stratigraphic trends in ash yield and sulfur concentration and are found to be dissimilar.

METHODS

Samples

Concentrations of selenium and other parameters in coal beds were obtained from the U.S. Geological Survey COALQUAL Database (Bragg and others, 1998; http://energy.er.usgs.gov/products/databases/CoalQual/intro.htm). Data from 3227 coal samples (Appendix 1) from 124 counties in western Pennsylvania, western Maryland, eastern Ohio, throughout West Virginia, eastern Kentucky, northeastern Tennessee, and southwestern Virginia in the northern and central Appalachian basin (Tully, 1996) are included in this report. Each coal sample represents the complete-bed thickness and was collected from working mines (2400 channel samples), drill cores (529 samples), or outcrops (298 weathered channel samples) in the 1970's and 1980's. The analytical methods used to determine selenium concentration were X-ray fluorescence spectroscopy (XRF) (184 samples) and instrumental neutron activation analysis (INAA) (3043 samples). Selenium concentration is reported to two significant figures on a remnant-moisture, whole-coal basis. Approximately 6 percent of the selenium values are qualified; that is, the value is greater than or less than the value reported (Bragg and others, 1998; http://energy.er.usgs.gov/products/databases/CoalQual/Docs/techinfo.pdf). In COALQUAL, selenium concentrations below the lower detection limit of the analytical method are reported as 0.7 times the detection limit. Selenium concentrations were not reported by Bragg and others (1998) for two samples, one channel and one drill core, analyzed by INAA. Additionally, selenium values for two channel samples analyzed by XRF were discarded in this report because of their exceptionally high selenium concentrations (150 ppm in the Lower Freeport coal bed in Ohio and 52 ppm in the Princess No. 9 coal bed in West Virginia), which are greater than two times the next highest value. The range of selenium concentrations of the remaining 3223 samples (fig. 1) is 0.07 to 21 ppm (Appendix 1). Ash yield and sulfur were determined by ASTM methods D3174 and D4239, respectively, and are reported to two decimal places on an as-received, whole-coal basis (ASTM, 1992). One manganese concentration, analyzed by INAA in a channel sample from the Little Raleigh coal bed in West Virginia, was discarded for this report

because of its exceptionally high value (1400 ppm) that was more than two times the next highest value (690 ppm).

Coal Bed Correlations

Coal bed samples from the COALQUAL database were correlated on an interstate basis in the northern and central Appalachian coal regions for this report (table 1). The chronostratigraphic position of each coal bed name, as used in this report, and the number of samples is given in table 2. The number of coal samples in each coal bed are listed by state (table 1) and by thickness (greater than or less than 28 inches) (table 2). Although the correlation of coal beds across county and state boundaries has uncertainty, the relative stratigraphic positions and correlations of this report are generally correct or never offset by more than one coal bed.

Correlation of coal beds from the lower Middle Pennsylvanian Pond Creek coal in eastern Kentucky and correlative coal beds in the central Appalachian basin up through the upper Middle Pennsylvanian No. 6 Block coal bed in the central Appalachian basin in southern West Virginia and the correlative Lower Kittanning coal bed in Pennsylvania in the northern Appalachian basin are summarized in Figure 2 (from Neuzil, 2001, fig. 1 and references therein).

The stratigraphic positions of the Quakertown coal bed and the Mercer coal beds in the Pottsville Formation of the northern Appalachian basin in relation to coal beds in the central Appalachian basin are uncertain because the coal beds are discontinuous and stratigraphic palynology does not resolve these coal bed correlations. Peppers (1996) places the Quakertown coal bed in Ohio in the upper Westphalian A series (western European terminology), the upper Morrowan series (midcontinent terminology), and in the lower Kanawha Formation (southern West Virginia terminology). However, the Pottsville Formation in the northern Appalachian basin does not include much of the strata in the Lower and lower Middle Pennsylvanian (Eble, 1994) and we have, therefore, placed the Quakertown coal bed in the Middle Pennsylvanian, Westphalian C, or Atokan (table 2), which is higher than Peppers' (1996) placement.

Peppers (1996) correlates the Upper Mercer coal bed in Ohio with the Upper No. 5 Block coal bed in southern West Virginia and the Lower Mercer coal bed in Ohio with the Stockton coal bed in southern West Virginia. Although the Upper and Lower Mercer coal beds may correlate with the No. 5 Block and Stockton coal beds, in this report we will consider these northern and central Appalachian basin coal beds separately because the stratigraphic correlations are uncertain (tables 1 and 2).

Correlation of the Brookville and Clarion coal beds in the upper Middle Pennsylvanian Allegheny Formation in the northern Appalachian basin to coal beds in the central Appalachian basin is uncertain (Neuzil, 2001). The Brookville and Clarion coal beds may correlate with the No. 5 Block coal zone (Rice, and others, 1994) or they may be above the No. 5 Block coal zone (Blake, 1992; Eble, 1994). In this report the northern Appalachian basin Brookville and Clarion

coal beds are placed stratigraphically above the No. 5 Block coal bed in the central Appalachian basin and are considered separately (tables 1 and 2).

Coal bed samples collected in the central Appalachian basin in counties in southern West Virginia and eastern Kentucky that were designated by northern Appalachian basin coal bed names (Appendix 1), such as Upper Kittanning and Lower Kittanning, have been correlated to central Appalachian basin coal bed names through discussions with Bascombe M. Blake Jr. (WVGES), Donald R. Chesnut Jr. (KGS retired), and Cortland F. Eble (KGS) (Neuzil, 2001, Appendix 2).

Statistical Analyses and Terminology

Statistical analyses were conducted as follows. First, the average, standard deviation, minimum, lower quartile, median, upper quartile, and maximum were calculated for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese for all coal bed samples within each state, treating the northern and southern West Virginia coal fields separately (table 3). Second, the distribution of selenium (fig. 3a), ash yield (fig. 3b), and sulfur (fig. 3c) concentration values were calculated for each of three coal beds (Pond Creek, Coalburg, and Pittsburgh) that have a large sample population, more than 100 samples. The Pond Creek, Coalburg, and Pittsburgh coal beds span the lower Middle to Upper Pennsylvanian stratigraphic interval (fig. 2 and table 2) and have been studied in detail (Neuzil, 2001; Ruppert and others, 2001; Tewalt and others, 2001). Third, the geometric mean, average, standard deviation, minimum, lower quartile, median, upper quartile, and maximum were calculated for selenium and other parameters for each coal bed with 5 or more samples in the Appalachian Plateau region (table 4a). Finally, the same statistical parameters were also calculated for coal bed samples greater than and less than 28 inches thick, if there were 5 or more samples in a coal bed in the thickness category (tables 4b and 4c).

The terms median, midspread, and lower and upper quartiles as used herein are clarified as follows. Consider the values of a given parameter (for example, the selenium concentration) of a sample population (for example, each sample in a coal bed) and sort these values into ascending order. The median is the value of the middle sample, which is at the 50th percentile of the sample population. The midspread is the range of values from the lower to the upper quartile, which is the range from the 25th to 75th percentile of the ascending order sample population. The values for half of the samples fall within the midspread. One quarter of the samples have a value less than the lower quartile, and one quarter of the samples have a value greater than the upper quartile. When a sample population has a normal distribution, the median and geometric mean will be equal to the average. If a sample population has a normal distribution, 30 random samples from that sample population are generally considered a large enough sample set to statistically represent the entire sample population (Drennan, 1996). A larger sample set, for example >100 samples, may appear more convincing. However, statistical values (average, median, geometric mean, lower quartile, and upper quartile) calculated from a larger sample population will not be

significantly different from those calculated from 30 random samples (Drennan, 1996).

RESULTS and DISCUSSION

Regional Distribution of Selenium

The latitude and longitude locations of 3223 coal samples with selenium data are shown in Figure 1. The sample locations reflect the general extent of coal resources in the northern and central Appalachian basin (Tully, 1996). The density of sample locations is not uniform throughout the basin because deep coal in the middle of the basin is under represented. The subset of 809 samples with elevated selenium concentrations that are greater than the upper quartile for the entire Appalachian basin (> 4.5 ppm Se) are shown in red in Figure 1. Samples with elevated selenium have a geographic distribution that is similar to the distribution of all coal samples (fig.1). To examine geographic variability, one can consider the selenium concentration in all coal samples within each state. All of the coal samples in Pennsylvania, Maryland, and Ohio are located within the northern Appalachian basin and all of the coal samples in Kentucky, Tennessee, and Virginia are within the central Appalachian basin. Therefore, we will consider the northern and southern West Virginia coal fields separately. The average and median selenium concentration in coal in each state ranges from a low of 2.5 and 1.7 ppm, respectively, in northern West Virginia, to a high of 4.2 and 3.8 ppm, respectively, in eastern Kentucky (table 3). The increase from low to high selenium values by state, for either average or median selenium concentration, is approximately a factor of two, and reflects the stratigraphic variability of selenium.

Selenium Concentrations in Coal Beds

The selenium concentration in coal beds with more than 30 samples ranges from a low average and median in the Pittsburgh coal bed of 1.7 and 1.4 ppm Se, respectively, to a high average and median in the No. 5 Block coal bed of 7.1 and 6.4 ppm Se, respectively (table 4a). The increase from low to high selenium values by coal bed, for either average or median selenium concentration, is approximately a factor of four.

Selenium Distribution Within Coal Beds

When a sample population has a normal distribution, the average will be close to the median value. If a sample population has a log normal distribution, the geometric mean will be close to the value of the median. Histograms illustrating the distribution of selenium concentrations in 3 coal beds, which each have a large sample population of more than 100 samples, appear to be close to normal with a tail of high values (fig. 3a). The average, median, and geometric mean selenium values are plotted for coal beds that each have more than 30 samples (fig. 4a), a sufficiently large random sample set if the sample population has a normal distribution. For most coal beds in the Appalachian basin the average, median, and geometric mean values for selenium concentration are quite close. This is consistent with each coal bed having a nearly normal distribution of selenium concentrations and indicates that these three

statistical parameters (average, median, and geometric mean) are all useful for understanding stratigraphic trends in selenium concentration in the Appalachian Plateau region coal beds. For coal beds with more than 30 samples, the average selenium concentration is greater than the median, except in the Waynesburg coal bed, and the average is slightly greater than the geometric mean in all cases. This confirms that each coal bed has no more than a few high values of selenium (Appendix 1). For example, only 6 of the 31 coal beds with more than 30 samples have a maximum selenium value that is more than 10 ppm greater than the upper quartile selenium value (table 4a). The median and midspread of selenium concentration in each coal bed with 30 or more samples are illustrated in Figure 5a. There is a considerable range in selenium concentrations in each coal bed throughout the Pennsylvanian (figs. 3a and 5a and tables 4a, 4b, and 4c).

Selenium in Thick and Thin Coal

The top and bottom layers of a coal bed often have higher ash yield or pyrite content compared to the rest of the coal bed (Gluskoter and others, 1977; Cecil and others, 1981; Taylor and others, 1998). If an element is enriched in the top and bottom layers of a coal bed, then thin areas of coal beds would have a greater overall concentration of the element than thick areas as a result of the greater proportion of "surface" coal and less dilution by the lower concentration in the middle of the coal bed. In order to determine whether the thickness of a coal bed has any influence on selenium distribution within a coal bed, the geometric mean of selenium is plotted for coal that is greater than or less than 28 inches thick, for each coal bed where there are more than 30 samples in the thickness category (fig. 6a). The geometric mean for selenium in thick coal is greater than in thin coal for 12 of the 14 coal beds that have more than 30 samples in each of the two thickness categories (tables 4b and 4c). This suggests that selenium is not concentrated in the top and bottom surfaces of each coal bed, but rather uniformly distributed. For comparison, higher concentrations of ash yield are found in thick coal compared to thin coal in 8 of 14 cases (fig. 6b; tables 4b and 4c). In contrast to selenium and ash yield, sulfur concentrations are higher in thin coal compared to thick coal in 12 of 14 cases (fig. 6c; tables 4b and 4c).

Stratigraphic Trends in Selenium

When the selenium concentrations in coal beds are considered in a stratigraphic context, selenium concentrations appear to be generally higher in coal beds in the upper Kanawha and lowermost Allegheny Formations and equivalent strata compared to coal beds in underlying and overlying stratigraphic intervals (figs. 4a, 5a, and 6a; table 2). Eight coal beds, each with more than 30 samples, from the Cedar Grove/Whitesburg up through the Clarion have an average, median, and geometric mean selenium concentration greater than 3.9, 3.5 and 3.6 ppm respectively and a lower quartile greater than 2.7 ppm (table 4a). This stratigraphic interval will be referred to in this report as "selenium greater than background" or SGB in reference to the elevated levels of selenium in the coal beds. Thirteen coal beds from the underlying interval and ten coal beds from the overlying interval, each with more than 30 samples, have lower average, median, and geometric mean selenium concentrations that are less than 3.9, 3.5, and 3.6,

respectively, with 3, 2, and 1 exceptions, respectively. These two stratigraphic intervals will be referred to as pre-SGB and post-SGB. This stratigraphic trend of lower-higher-lower selenium concentrations in coal beds in the (1) pre-SGB interval (Pocahontas No. 3 to Williamson/Amburgy), (2) SGB interval (Cedar Grove/Whitesburg to Clarion), and (3) post-SGB interval (Lower Kittanning to Waynesburg) is also apparent in thick (≥ 28 inch) and thin (< 28 inch) coal bed samples (fig. 6a; tables 4b and 4c). In thick coal beds, with more than 30 thick samples in a coal bed, the range for geometric mean values for selenium in the pre-SGB, SGB, and post-SGB intervals is 2.0 to 3.8 ppm, 3.5 to 7.0 ppm, and 1.4 to 4.5 ppm, respectively. In thin coal beds, with more than 30 thin samples in a coal bed, the geometric mean values for selenium have a range of 1.9 to 2.9 ppm, 3.8 to 4.6 ppm, and 2.6 to 3.4 ppm in the pre-SGB, SGB, and post-SGB intervals, respectively.

On the basis of data from the COALQUAL database (Bragg and others, 1998), selenium concentrations in coal beds in the Appalachian basin coal region have a distinctive stratigraphic trend. Selenium is relatively low in coal beds contained in Lower and lower Middle Pennsylvanian strata, the pre-SGB interval (fig. 2; table 2). These strata include the Lower Pennsylvanian, Pocahontas and New River Formations, and the lower Middle Pennsylvanian, lower division and lower part of the middle division of the Kanawha Formation in West Virginia and equivalent strata in other states in the northern and central Appalachian basin. There is a relative increase in selenium in the middle of the Middle Pennsylvanian, upper part of the middle division and the upper division of the Kanawha Formation and lowermost Allegheny Formation in West Virginia (and equivalent strata), the SGB interval. The upper Kanawha Formation and lower Allegheny Formation (and equivalent strata) coal beds in the northern and central Appalachian basin that have elevated levels of selenium, comprise the coal beds that are the predominant targets of MTM (table 2). After reaching a maximum selenium concentration in the lower Allegheny Formation No. 5 Block coal bed, selenium concentrations are relatively low in the coal beds in the overlying upper Middle Pennsylvanian Allegheny Formation and the Upper Pennsylvanian Conemaugh and Monongahela Formations, the post-SGB interval.

Statistical calculations were conducted for the pre-SGB, SGB, and post-SGB stratigraphic intervals that included all coal samples, regardless of the number of coal samples in each coal bed (table 5). The average and median selenium concentrations both show a trend of lower-higher-lower values from oldest to youngest for the three stratigraphic intervals whether all coal (table 5a), thick coal (table 5b), or thin coal (table 5c) samples are considered. This trend is apparent even though elevated concentrations of selenium (> 4.5 ppm) are present in coal samples in each of the three stratigraphic intervals (figs. 1 and 5a; tables 4a, 4b, and 4c). The trend in selenium contrasts to an average, median, geometric mean, and midspread ash yield trend that is lower-higher-higher (figs. 4b, 5b, and 6b) in the pre-SGB, SGB, and post-SGB intervals, respectively (tables 5a, 5b, and 5c). The average, median, geometric mean, and midspread sulfur concentration trend is lower-lower-higher (figs. 4c, 5c, and 6c) for the pre-SGB, SGB, and post-SGB intervals, respectively (tables 5a, 5b, and 5c), which is different from both the selenium concentration and

ash yield trends. The difference in the stratigraphic trends for selenium, ash yield, and sulfur are illustrated by histograms of their concentration distribution in each of the three stratigraphic intervals for all (fig. 7a), thick (fig. 7b), and thin (fig. 7c) coal samples.

CONCLUSIONS

1. Mountaintop mining practices remove most of the coal. Therefore, coal is unlikely to be the source of slightly elevated concentrations of selenium found in streams impacted by MTM. Underground coal mining practices leave a significant portion of the coal, which may be a source of selenium in abandoned and active underground coal mine drainage.
2. The spatial (regional and stratigraphic) distribution of elevated selenium concentration coal samples (defined as > 4.5 ppm Se in this report) includes both the northern and central Appalachian basin and is not restricted to the MTM region or the MTM stratigraphic interval of southern West Virginia and eastern Kentucky.
3. There is more variability in selenium concentration stratigraphically among coal beds than geographically among states.
4. Selenium concentrations within a coal bed have a normal distribution.
5. Selenium does not appear to be concentrated in the surfaces of coal beds and has slightly higher concentrations in thick (≥ 28 inch) than thin (< 28 inch) portions of coal beds.
6. Statistical results suggest that selenium concentrations are approximately two times higher in coal beds in the "selenium greater than background" interval of the middle Middle Pennsylvanian (equivalent to the uppermost Westphalian B, Westphalian C, and lowermost Westphalian D in western Europe terminology or the upper Atokan and lowest Desmoinesian in mid-continent time series terminology) than in older or younger coal beds in the Appalachian basin.
7. The stratigraphic trend in selenium concentration is the same for all thicknesses, thick (≥ 28 inch), or thin (< 28 inch) coal bed samples.
8. The stratigraphic trend in selenium concentrations does not correspond to the stratigraphic trends in either ash yield or sulfur concentration.
9. Understanding stratigraphic trends of selenium in coal is important to coal users to predict potential total selenium in fly ash and other byproducts that may be reintroduced to the environment at disposal sites.
10. Whether stratigraphic trends in selenium concentration in coal beds indicate trends in selenium concentration in associated strata needs to be confirmed with rock analyses.

FUTURE WORK

There is a critical need to evaluate selenium concentrations in the non-coal strata of the Appalachian Plateau region, especially where the rocks are subjected to significant surface and underground disturbance and could be a source of selenium, for example in land disturbance such as MTM. Extensive data are not currently available for the selenium concentrations in the overburden and interburden rocks of the SGB interval in the Appalachian Plateau region.

Preliminary data from three cores indicate that the concentration of selenium in rocks in the SGB stratigraphic interval, the interval most commonly subjected to current intensive MTM, may be higher than in rocks above and below this interval (work in progress by Cecil, Dulong, and Renton). Further sampling and analyses of the rocks in the SGB interval is needed to assess potential rates of weathering and leaching and the produced ionic species in leachates to better understand the potential sources of selenium to the environment from coal mining practices and other major rock disturbance throughout the Appalachian Plateau region.

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Figure 1. Coal bed sample locations (N = 3223).

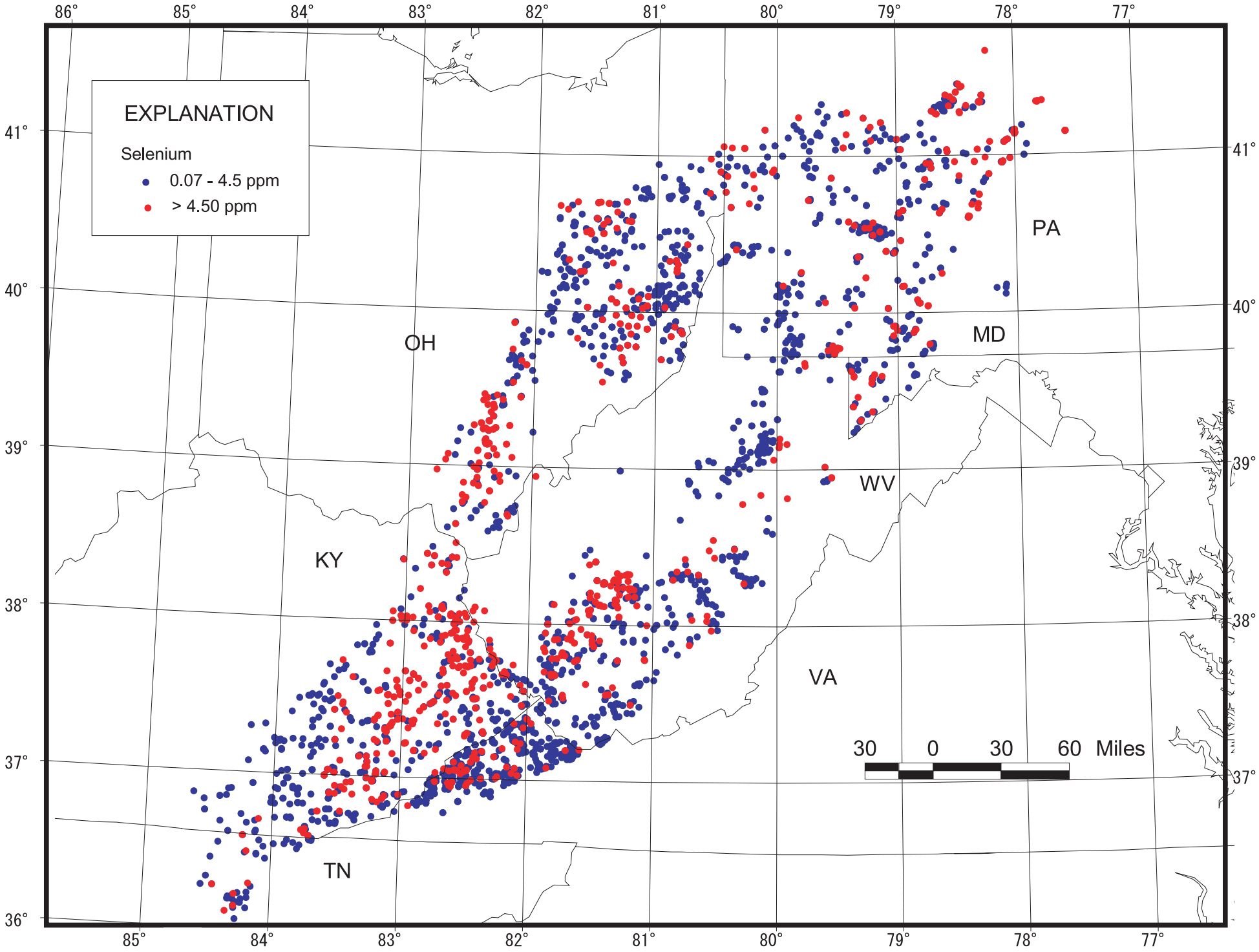
EXPLANATION
Selenium
0.07 - 4.5 ppm
> 4.50 ppm
PA
MD
OH
WV
KY
VA
TN
30 0 30 60 Miles
86°
85°
84°
83°
82°
81°
80°
79°
78°
77°
41°
40°
39°
38°
37°
36°

Figure 2. Stratigraphic correlation of coal beds and coal zones in part of the Middle Pennsylvanian Series in the northern and central Appalachian basin coal region, from the northeast to the southwest (modified from Neuzil, 2001, fig.1 http://pubs.usgs.gov/prof/p1625c/CHAPTER_I/CHAPTER_I.pdf.) Chart showing correlation of coal zones in part of the Middle Pennsylvanian Series in the northern and central Appalachian Basin coal regions, from the northeast to the southwest. Stratigraphic relationships and coal-zone correlations are indicated for southern West Virginia, eastern Kentucky, southwestern Virginia, and northern Tennessee. Beyond this explanation, the correlation chart is broken into four pages: ***Page 3*** = Upper left quadrant of chart; ***Page 4*** = Upper right quadrant of chart; ***Page 5*** = Lower left quadrant of chart; ***Page 6*** = Lower right quadrant of chart. Formal and informal unit names, stratigraphic relationships, and coal zone correlations are drawn from Rice and others (1994); also see references therein, except as noted: a, Kosanke (1988); b, Eble (1994); c, Blake (1992); d, Blake (1998); e, Donald R. Chesnut, Jr. and Cortland F. Eble (KGS, written commun., 1999); f, Blake and others (1994); g, Chesnut (1992); h. Chesnut (1997); i, Nolde (1994a); j, Nolde (1994b); k. Charles L. Rice (USGS retired, oral commun., 1999); and l, Rice (1984). This correlation chart is generalized and not all units are shown. 'Coal' indicates coal bed. Coal zones are noted. Query '?' indicates uncertain correlation of this unit. Empty formal or informal unit boxes indicate no significant unit present at this horizon. Unshaded units are coal. Shaded units are clastic and carbonate sedimentary units; many are marine in origin. Where two coal bed names appear in one block, they are both considered to be in the same coal zone in this study. 'Marine zone' indicates the presence of an unnamed marine zone. Boxes are not to scale and do not imply length of time, thickness of interval, or aerial extent of unit. 'Group (this report)' indicates stratigraphic group names used throughout the northern and central Appalachian Basin coal resource assessment reports for data entry purposes. 'Code (this report)' indicates code used in this chapter for data entry purposes. 'SGB' is selenium greater than background interval from table 2. Stratigraphic position and correlative coal beds are indicated for Pond Creek coal and Coalburg coal bed (see fig. 3). Pittsburgh coal bed (see fig. 3) is in the Upper Pennsylvanian Monongahela Formation, which is above the stratigraphic interval in this figure.

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						Pennsylvania		West Virginia				
										Kanawha Valley region	Tug Fork region	
							Bituminous coal field			Southern West Virginia coal field	Southern West Virginia coal field	Southern West Virginia coal field
										Boone, Clay, Fayette, Greenbrier, Kanawha, Nicholas, Raleigh, Wyoming Cos.	Boone, Lincoln, Logan, McDowell, Mingo, Wayne, Wyoming Cos.	
System	Series	Midcontinent Stage	Group (this report)	Code (this report)	Coal Zone Names (this report)	Formation	Formal or informal units	Formation	Divisions of Blake (1998)	Formal or informal units	Formal or informal units	Formal or informal units
		Desmoinesian (part)	Allegheny (part)			Allegheny (part)	Lower Kittanning coal	Charleston Sandstone (part)		No. 6 Block coal (a,b,c)	No. 6 Block coal (a,b,c)	No. 6 Block coal zone (a,b,c)
				13	No. 5 Block coal zone		Clarion coal (?)			No. 5 Block coal (a,b,c)	No. 5 Block coal (a,b,c)	No. 5 Block coal zone (a,b,c)
							Brookville coal (?)			Little No. 5 Block coal (c)	Little No. 5 Block coal (c)	Little No. 5 Block coal (c)
										Stockton "A" coal (c)	Stockton "A" coal (c)	Stockton "A" coal (c)
		Atokan					Homewood Sandstone Member		upper	Kanawha black flint of White (1891)	Kanawha black flint of White (1891)	Kanawha black flint of White (1891)
				14	Stockton and Coalburg coal zone		Lower Mercer coal (?)			Stockton coal	Stockton coal	Stockton coal zone (c,d)
				15						Coalburg coal	Coalburg coal	Coalburg coal zone (c,d)
										Arnett Member (d)	Arnett Member (d)	Arnett Member (d)
				16	Winifrede/Hazard coal zone					Winifrede coal (d,e)	Winifrede, Buffalo Creek coals (d,e)	Winifrede coal zone (c,d,f)
				17						Lower Winifrede coal (d,e)	Lower Winifrede, Lower Buffalo Creek coals (d,e)	
										Winifrede limestone of White (1908) (c,d,f)	Buffalo Creek limestone of Hennen and Reger (1914) (c,d,f)	Winifrede Shale Member (c,d,f)

Kentucky				Virginia			Tennessee				
			Harlan subdistrict								
		Hazard and Big Sandy reserve districts	Upper Cumberland River reserve district					Jellico area	Walnut Mountain area		
		Eastern Kentucky coal field	Eastern Kentucky coal field			Southwest Virginia coal field		west of Cumberland overthrust sheet	Cumberland overthrust sheet		
		Breathitt, Floyd, Harlan, Johnson, Knott, Leslie, Letcher, Martin, Perry, Pike Cos.	Bell, Harlan, Letcher Cos.			western Buchanan, Dickenson, Lee, Wise Cos.		Anderson, Campbell, Morgan, Scott Cos.	Campbell, Claiborne Cos.	SGB interval (from table 2)	Coal bed (from fig. 3)
Group as used by Chesnut (1992)	Formations of Chesnut (1992)	Formal or informal units	Formal or informal units	Formation	Informal division of Nolde (1994a)	Formal or informal units	Formation of Wilson and others (1956) as revised by Hardeman and others (1966)	Formal or informal units	Formal or informal units		
	Princess (part)	eroded	eroded			eroded		eroded	eroded	post-SGB interval (part) (from table 2)	
		Richardson, Skyline coal zones (g,h)								SGB interval (from table 2)	
				Harlan							
		Stoney Fork Member (?) (g)									
	Four Corners	Broas coal zone (e,g,h)	Black Mountain coal zone (h)			No. 13 coal					
		Peach Orchard coal zone (e,g,h)	High Splint coal zone (h)			High Splint coal (i)	Vowell Mountain (part)	Hazard No. 9 (?) (k)			Coalburg coal (from fig.3)
		Arnett Member (h)									
		Hazard coal zone (h)	Morris coal zone (h)			Morris, No. 11 coals (i,j)		Braden Mountain, Pewee coals (l)			
		Haddix coal zone (h)	Lower Highsplint coal (h)			Reynolds Sandstone Member (i,j)		Red Ash coal			
			Reynolds Sandstone Member (h)					Fodderstack Sandstone Member			
		Magoffin Member (g,h)	Magoffin Member (g,h)			Magoffin Member		Magoffin Member			

						Pennsylvania		West Virginia				
										Kanawha Valley region	Tug Fork region	
							Bituminous coal field			Southern West Virginia coal field	Southern West Virginia coal field	Southern West Virginia coal field
										Boone, Clay, Fayette, Greenbrier, Kanawha, Nicholas, Raleigh, Wyoming Cos.	Boone, Lincoln, Logan, McDowell, Mingo, Wayne, Wyoming Cos.	
System	Series	Midcontinent Stage	Group (this report)	Code (this report)	Coal Zone Names (this report)	Formation	Formal or informal units	Formation	Divisions of Blake (1998)	Formal or informal units	Formal or informal units	Formal or informal units
Pennsylvanian (part)	Middle (part)	Morrowan (part)	Pottsville (part)			Pottsville (part)	?	Kanawha Formation (part)	middle	Chilton coal (c,d,f)	Chilton "A" coal (c,d,f)	Chilton coal zone (c,d,f)
												marine zone (d)
										Hernshaw coal (?) (c,d,f)	Chilton coal (c,f)	Fire Clay coal zone (c,d,f)
										Seth limestone of Krebs and Teets (1915) (c,d,f)		marine zone (c,d,f)
										Cedar Grove coal (c,d,f)	Hernshaw coal (c,d,f)	Cedar Grove coal (d.f)
											Dingess limestone of Hennen and Reger (1914) (c,d,f)	Dingess Shale Member
				22	Williamson/Amburgy coal zone					Alma coal (c,d,f)	Williamson coal (c,d,f)	Williamson coal zone
										Campbell Creek limestone of White (1885) (c,d,f)	Seth limestone of Krebs and Teets (1915) (d)	Campbell Creek limestone of White (1885)
				24	Campbell Creek/Upper Elkhorn No. 3 coal zone					Peerless coal, Campbell Creek coal zone (c,d,f)	Cedar Grove coal (c,d,f)	Peerless, Campbell Creek coal zones (c,f)
										No. 2 Gas coal, Campbell Creek coal zone (c,d,f)	Lower Cedar Grove coal (c,d,f)	No. 2 Gas, Campbell Creek coal zones (c,d,f)
				25	Upper Elkhorn Nos. 1 and 2/Powellton coal zone					Powellton coal (c,d,f)	Alma coal (c,d,f)	Powellton coal zone (d)
										Cannelton limestone of White (1885) (c,d,f)	Campbell Creek limestone of White (1885) (c,d,f)	Crummies Member (d)
										Eagle coal (c,d,f)	Campbell Creek coal (c,f)	Eagle coal zone (c,d)
										Eagle limestone and shale of White (1891) (c,d,f)	Cannelton limestone of White (1885) (c,d,f)	Betsie Shale Member

modified from Neuzil (2001) U.S. Geological Survey Professional Paper 1625-C, Chapter I, Figure 1.

Kentucky				Virginia			Tennessee				
			Harlan subdistrict								
		Hazard and Big Sandy reserve districts	Upper Cumberland River reserve district					Jellico area	Walnut Mountain area		
		Eastern Kentucky coal field	Eastern Kentucky coal field			Southwest Virginia coal field		west of Cumberland overthrust sheet	Cumberland overthrust sheet		
		Breathitt, Floyd, Harlan, Johnson, Knott, Leslie, Letcher, Martin, Perry, Pike Cos.	Bell, Harlan, Letcher Cos.			western Buchanan, Dickenson, Lee, Wise Cos.		Anderson, Campbell, Morgan, Scott Cos.	Campbell, Claiborne Cos.	SGB interval (from table 2)	Coal bed (from fig. 3)
Group as used by Chesnut (1992)	Formations of Chesnut (1992)	Formal or informal units	Formal or informal units	Formation	Informal division of Nolde (1994a)	Formal or informal units	Formation of Wilson and others (1956) as revised by Hardeman and others (1966)	Formal or informal units	Formal or informal units		
Breathitt (part)	Hyden	Copland coal zone, Taylor coal	Limestone coal	Wise (part)	Wis	Pardee coal	Red	Sharp coal			
		marine zone (h)	marine zone (h)					Caryville Sandstone Member (?)			
		Fire Clay rider coal zone	Smith coal zone			Gin Creek coal		Big Mary coal			
		Fire Clay coal	Wallins Creek coal zone			Phillips coal	Graves Gap	Windrock coal	Walnut Mountain coal		
		member J (h)			unit 3			Roach Creek Sandstone Member (?)	Magoffin Member (l)		
		Whitesburg coal zone	Stray coal zone			House coal (?) (i,j)		Upper Pioneer coal			
		Kendrick Shale Member (g,h)	Kendrick Shale Member (g,h)			Kendrick Shale Member		Kendrick Shale Member		pre-SGB interval (part) (from table 2)	
	Pikeville	Williamson, Amburgy coal zones	Creech coal zone		unit 2	Low Splint coal		Lower Pioneer, Jordan coals	Windrock coal (l)		
		Elkins Fork shale of Morse (1931) (h)	Elkins Fork shale of Morse (1931) (h)			Marcum Hollow Sandstone Member	Indian Bluff	Pioneer Sandstone Member			
		Upper Elkhorn No. 3 coal zone	Taggart coal zone (h)			Taggart coal (i,j)		Elk Gap coal	Jordan coal (l)		
			Taggart Marker coal (h)			Taggart Marker coal (i,j)			Pioneer Sandstone Member (?) (l)		
		Upper Elkhorn No. 1, Upper Elkhorn No. 2 coals (h)	Harlan coal zone (h)			Wilson, Upper St. Charles coals (i,j)	Slatestone (part)	Jellico coal zone	Jellico coal zone (l)		
		Crummies Member (h)	Crummies Member (h)			marine zone (j)		Sand Gap Sandstone Member	Newcomb Sandstone Member		
		Pond Creek, Lower Elkhorn coals	Imboden coal, Path Fork coal zone (h)			Kelly coal, Imboden coal zone (i,j)		Blue Gem coal zone	Rich Mountain coal zone		Pond Creek coal (from fig.3)
		Betsie Shale Member (g,h)	Betsie Shale Member (g,h)			Betsie Shale Member (j)		Betsie Shale Member	Betsie Shale Member		

Figure 3a. Histograms of selenium concentration in three coal beds (Pond Creek, Coalburg, and Pittsburgh) that each have > 100 samples.

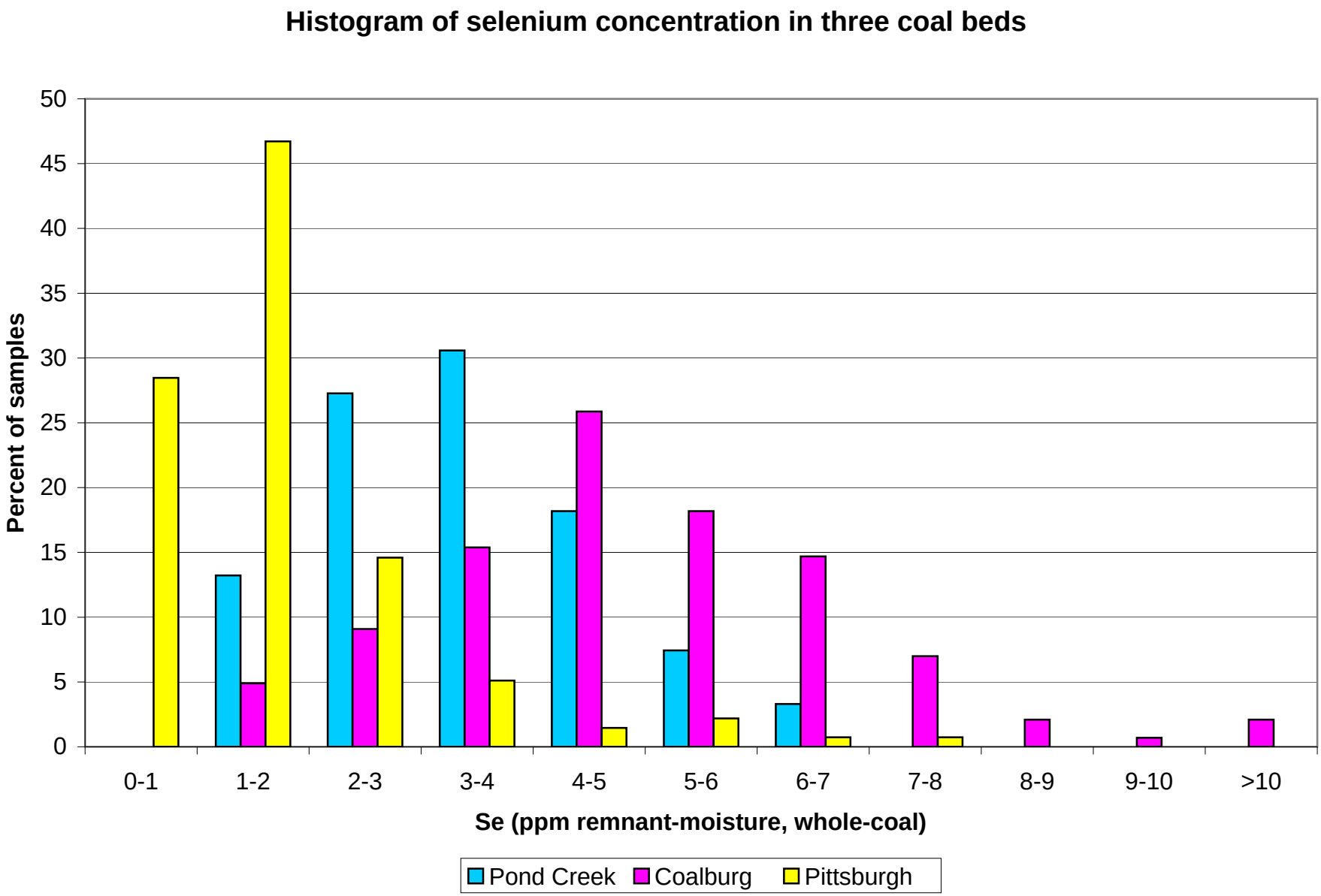

Histogram of selenium concentration in three coal beds
Percent of samples
50
45
40
35
30
25
20
15
10
5
0
0-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
>10
Se (ppm remnant-moisture, whole-coal)
Pond Creek
Coalburg
Pittsburgh

Figure3b. Histograms of ash yield concentration in three coal beds (Pond Creek, Coalburg, and Pittsburgh) that each have > 100 samples.

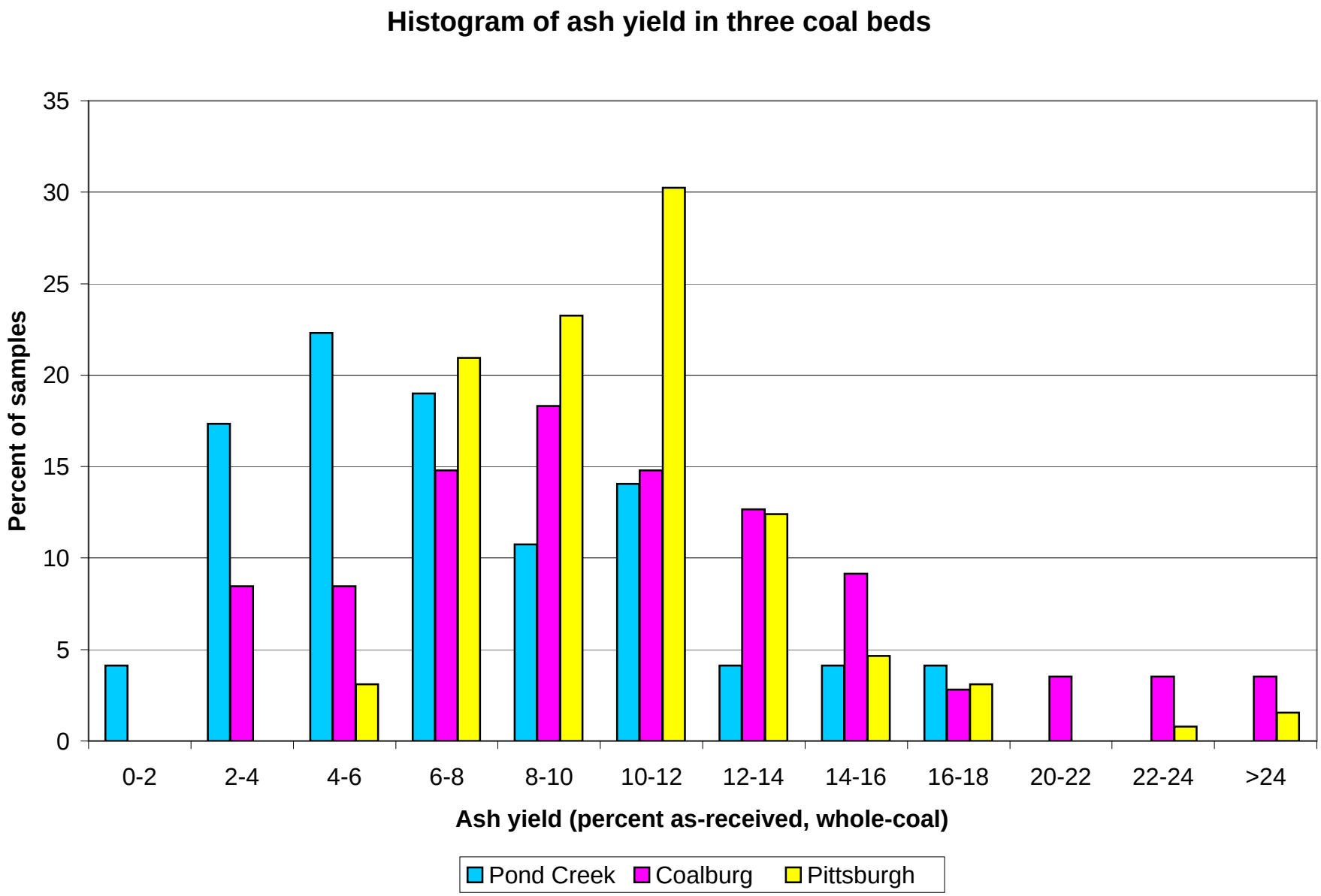

Histogram of ash yield in three coal beds
Percent of samples
35
30
25
20
15
10
5
0
0-2
2-4
4-6
6-8
8-10
10-12
12-14
14-16
16-18
20-22
22-24
>24
Ash yield (percent as-received, whole-coal)
Pond Creek
Coalburg
Pittsburgh

Figure 3c. Histograms of sulfur concentration in three coal beds (Pond Creek, Coalburg, and Pittsburgh) that each have > 100 samples.

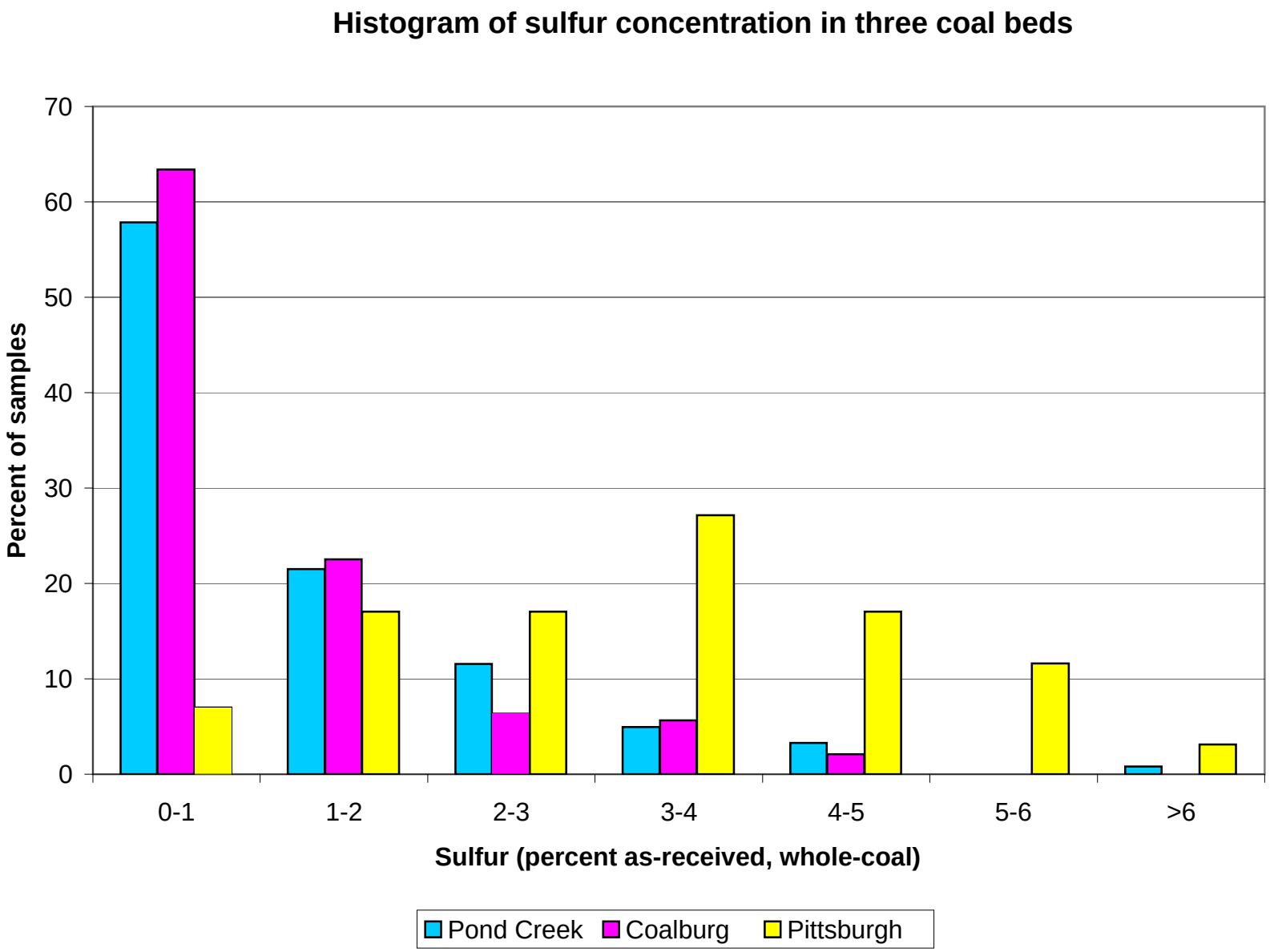

Histogram of sulfur concentration in three coal beds
Percent of samples
70
60
50
40
30
20
10
0
0-1
1-2
2-3
3-4
4-5
5-6
>6
Sulfur (percent as-received, whole-coal)
Pond Creek
Coalburg
Pittsburgh

Figure 4a. Chart of average, median, and geometric mean of selenium concentration in coal beds with $\geq$ 30 samples.

Se (ppm remnant-moisture, whole-coal)
0
1
2
3
4
5
6
7
8
Waynesburg
Sewickley
Redstone
Pittsburgh
Lower Bakerstown
Upper Freeport
Lower Freeport
Upper Kittanning
Middle Kittanning
Lower Kittanning
Clarion
Brookville
No 5 Block
Stockton
Coalburg
Winifrede/Hazard
Fire Clay
Cedar Grove/Whitesburg
Williamson/Amburgy
Campbell Creek/Upper Elkhorn No 3
Upper Elkhorn Nos. 1 and 2/Powellton
Pond Creek
Matewan/Clintwood
Little Eagle/Dorchester
Glenalum Tunnel/Splashdam
Gilbert A/Upper Banner
Douglas/Kennedy
Iaeger/Jawbone
Sewell/Lower Seaboard
Beckley/War Creek
Pocahontas No 3
coal bed (≥30 samples)
Geometric Mean
Median
Average

Figure 4b. Chart of average, median, and geometric mean of ash yield in coal beds with $\geq$ 30 samples.

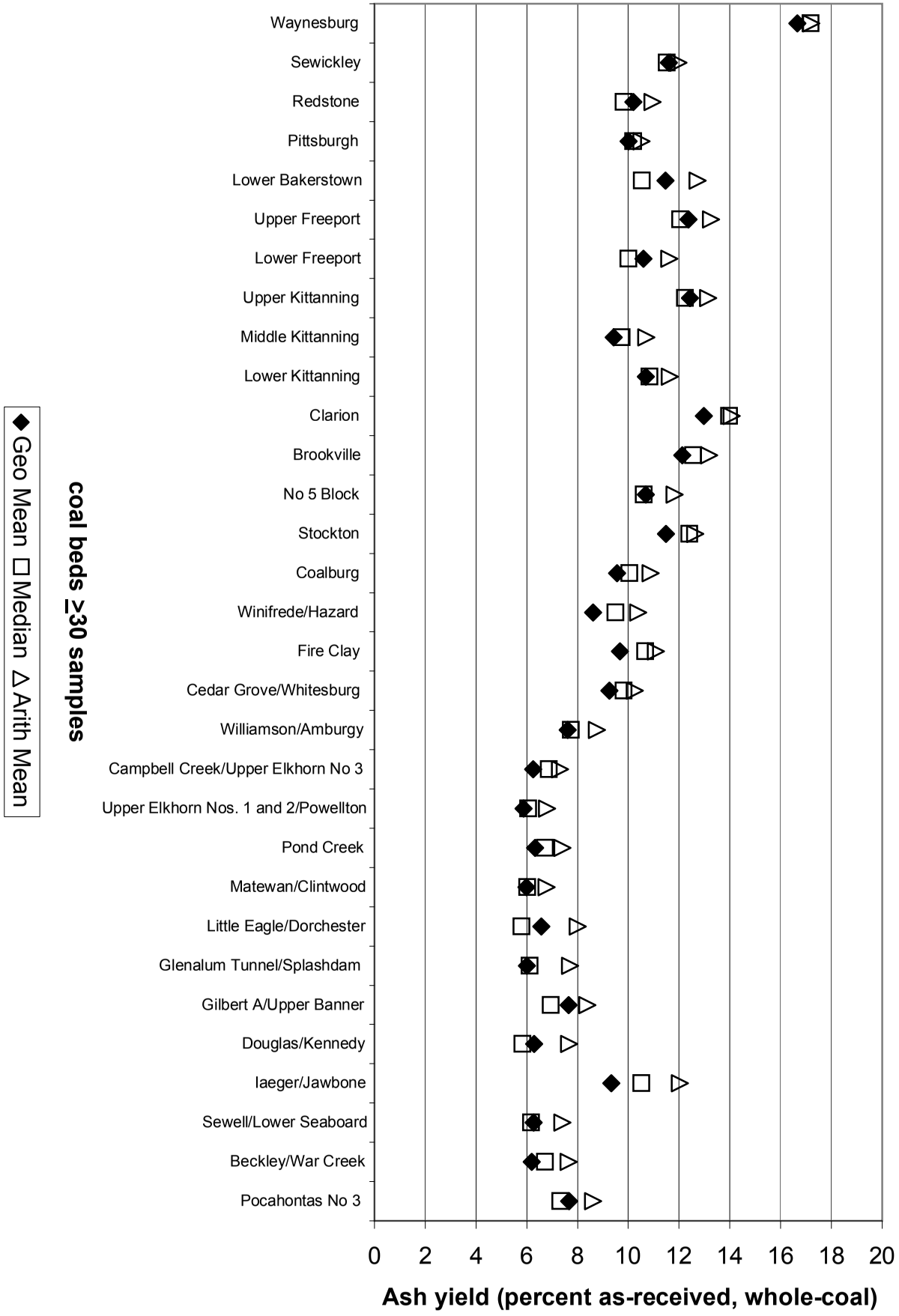

Waynesburg
Sewickley
Redstone
Pittsburgh
Lower Bakerstown
Upper Freeport
Lower Freeport
Upper Kittanning
Middle Kittanning
Lower Kittanning
Clarion
Brookville
No 5 Block
Stockton
Coalburg
Winifrede/Hazard
Fire Clay
Cedar Grove/Whitesburg
Williamson/Amburgy
Campbell Creek/Upper Elkhorn No 3
Upper Elkhorn Nos. 1 and 2/Powellton
Pond Creek
Matewan/Clintwood
Little Eagle/Dorchester
Glenalum Tunnel/Splashdam
Gilbert A/Upper Banner
Douglas/Kennedy
Iaeger/Jawbone
Sewell/Lower Seaboard
Beckley/War Creek
Pocahontas No 3
0
2
4
6
8
10
12
14
16
18
20
Ash yield (percent as-received, whole-coal)
coal beds ≥30 samples
◆ Geo Mean □ Median △ Arith Mean

Figure 4c. Chart of average, median, and geometric mean of sulfur concentration in coal beds with $\geq$ 30 samples.

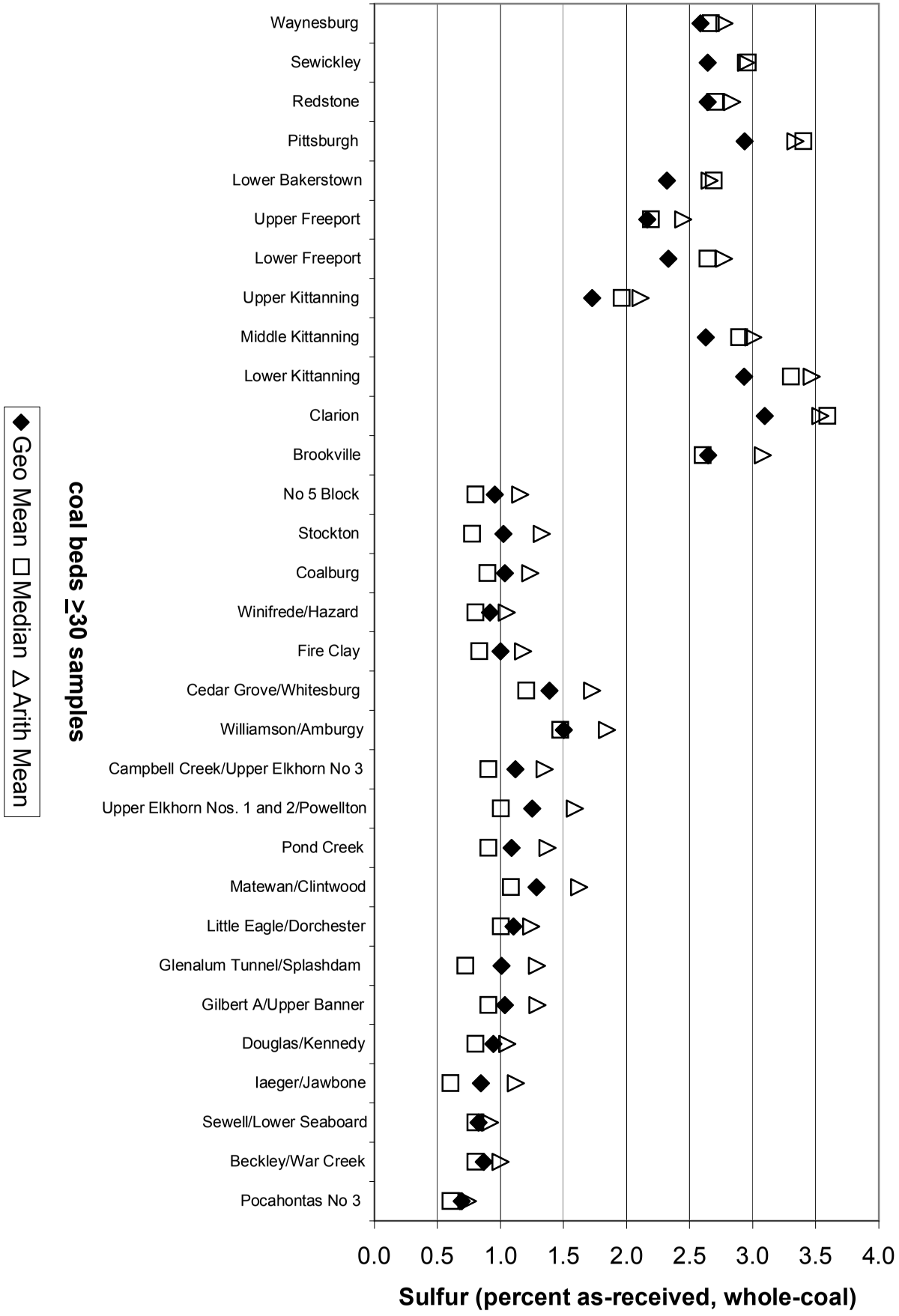

Geo Mean
Median
Arith Mean
coal beds ≥30 samples
Waynesburg
Sewickley
Redstone
Pittsburgh
Lower Bakerstown
Upper Freeport
Lower Freeport
Upper Kittanning
Middle Kittanning
Lower Kittanning
Clarion
Brookville
No 5 Block
Stockton
Coalburg
Winifrede/Hazard
Fire Clay
Cedar Grove/Whitesburg
Williamson/Amburgy
Campbell Creek/Upper Elkhorn No 3
Upper Elkhorn Nos. 1 and 2/Powellton
Pond Creek
Matewan/Clintwood
Little Eagle/Dorchester
Glenalum Tunnel/Splashdam
Gilbert A/Upper Banner
Douglas/Kennedy
Iaeger/Jawbone
Sewell/Lower Seaboard
Beckley/War Creek
Pocahontas No 3
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Sulfur (percent as-received, whole-coal)

Figure 5a. Chart of median and midspread of selenium concentration in coal beds with $\geq$ 30 samples.

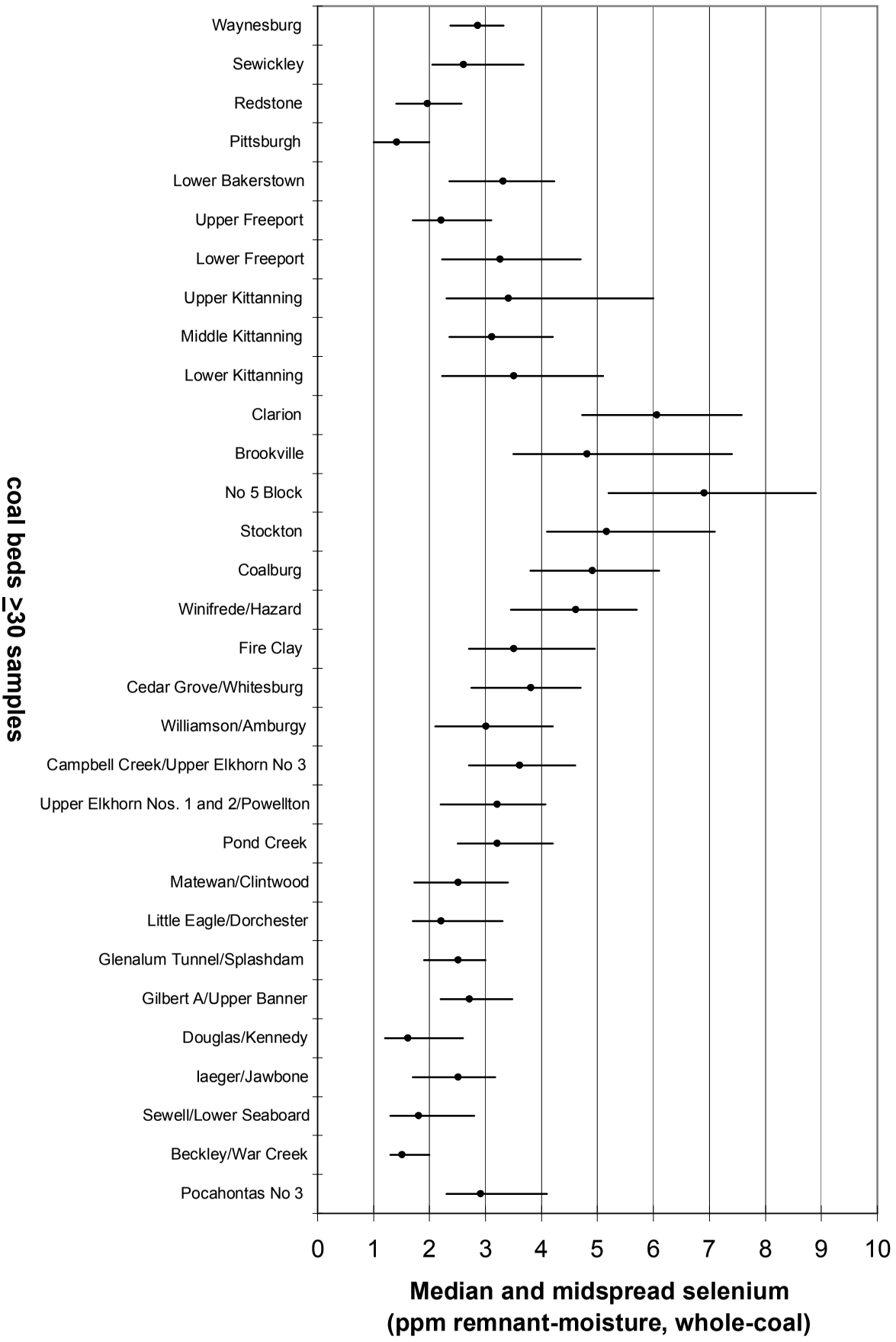

Waynesburg
Sewickley
Redstone
Pittsburgh
Lower Bakerstown
Upper Freeport
Lower Freeport
Upper Kittanning
Middle Kittanning
Lower Kittanning
Clarion
Brookville
No 5 Block
Stockton
Coalburg
Winifrede/Hazard
Fire Clay
Cedar Grove/Whitesburg
Williamson/Amburgy
Campbell Creek/Upper Elkhorn No 3
Upper Elkhorn Nos. 1 and 2/Powellton
Pond Creek
Matewan/Clintwood
Little Eagle/Dorchester
Glenalum Tunnel/Splashdam
Gilbert A/Upper Banner
Douglas/Kennedy
Iaeger/Jawbone
Sewell/Lower Seaboard
Beckley/War Creek
Pocahontas No 3
coal beds ≥30 samples
0
1
2
3
4
5
6
7
8
9
10
Median and midspread selenium
(ppm remnant-moisture, whole-coal)

Figure 5b. Chart of median and midspread of ash yield in coal beds with $\geq$ 30 samples.

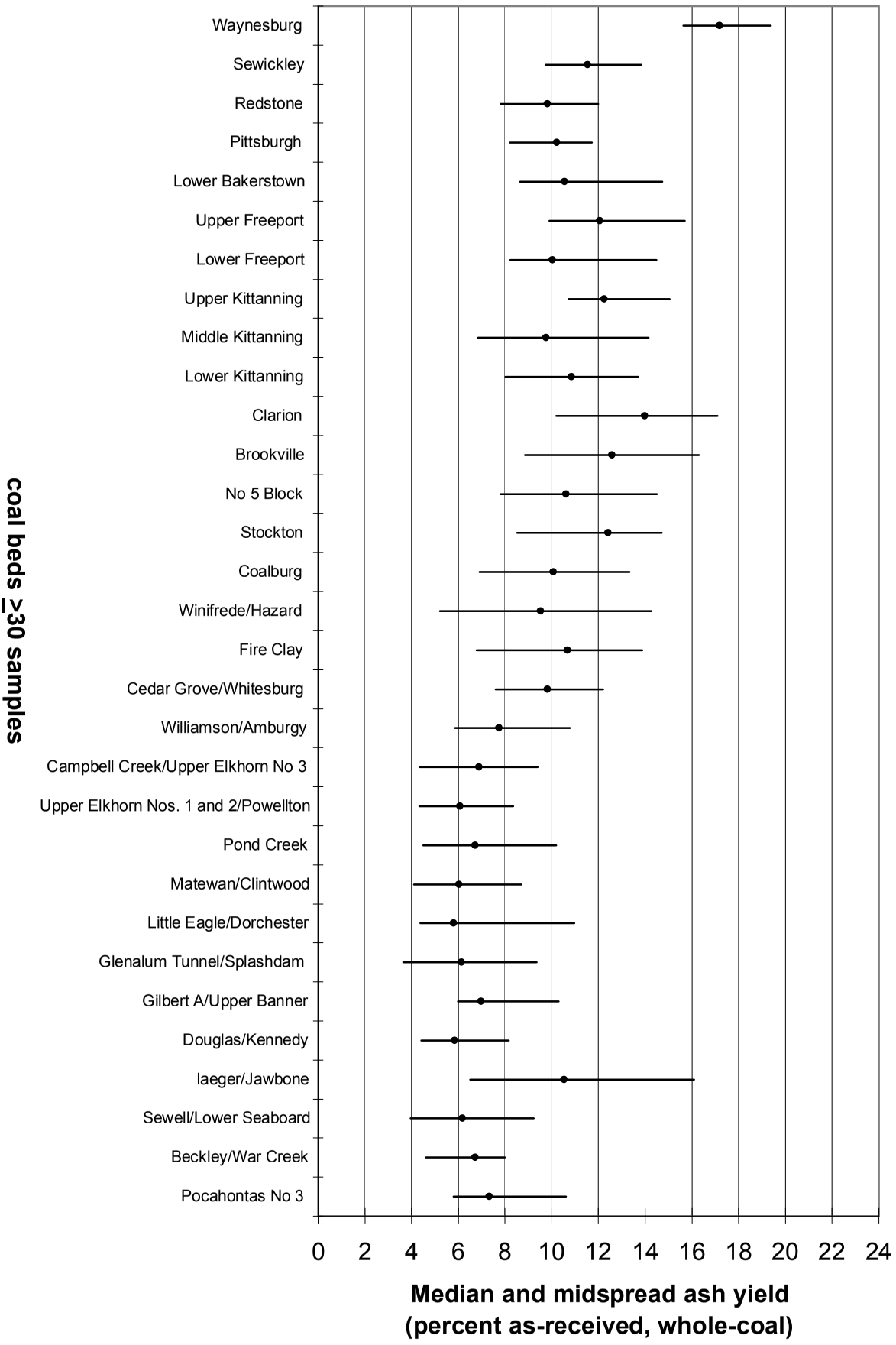

Waynesburg
Sewickley
Redstone
Pittsburgh
Lower Bakerstown
Upper Freeport
Lower Freeport
Upper Kittanning
Middle Kittanning
Lower Kittanning
Clarion
Brookville
No 5 Block
Stockton
Coalburg
Winifrede/Hazard
Fire Clay
Cedar Grove/Whitesburg
Williamson/Amburgy
Campbell Creek/Upper Elkhorn No 3
Upper Elkhorn Nos. 1 and 2/Powellton
Pond Creek
Matewan/Clintwood
Little Eagle/Dorchester
Glenalum Tunnel/Splashdam
Gilbert A/Upper Banner
Douglas/Kennedy
Iaeger/Jawbone
Sewell/Lower Seaboard
Beckley/War Creek
Pocahontas No 3
coal beds ≥30 samples
0
2
4
6
8
10
12
14
16
18
20
22
24
Median and midspread ash yield
(percent as-received, whole-coal)

Figure 5c. Chart of median and midspread of sulfur concentration in coal beds with $\geq$ 30 samples.

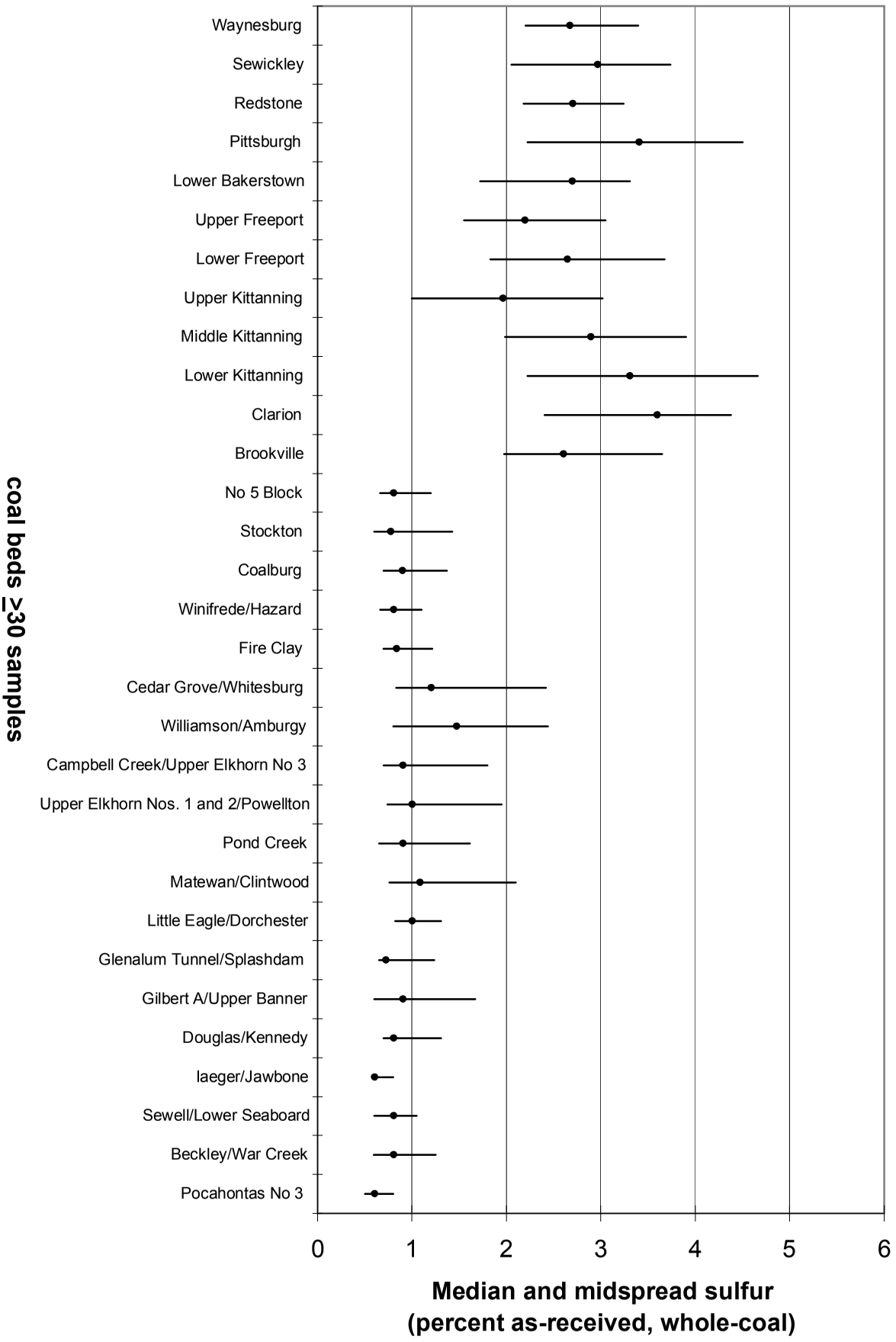

Waynesburg
Sewickley
Redstone
Pittsburgh
Lower Bakerstown
Upper Freeport
Lower Freeport
Upper Kittanning
Middle Kittanning
Lower Kittanning
Clarion
Brookville
No 5 Block
Stockton
Coalburg
Winifrede/Hazard
Fire Clay
Cedar Grove/Whitesburg
Williamson/Amburgy
Campbell Creek/Upper Elkhorn No 3
Upper Elkhorn Nos. 1 and 2/Powellton
Pond Creek
Matewan/Clintwood
Little Eagle/Dorchester
Glenalum Tunnel/Splashdam
Gilbert A/Upper Banner
Douglas/Kennedy
Iaeger/Jawbone
Sewell/Lower Seaboard
Beckley/War Creek
Pocahontas No 3
coal beds ≥30 samples
0
1
2
3
4
5
6
Median and midspread sulfur
(percent as-received, whole-coal)

Figure 6a. Chart of geometric mean of selenium concentration for all, thick ($\geq$ 28 inch), or thin (< 28 inch) coal samples in coal beds with $\geq$ 30 samples.

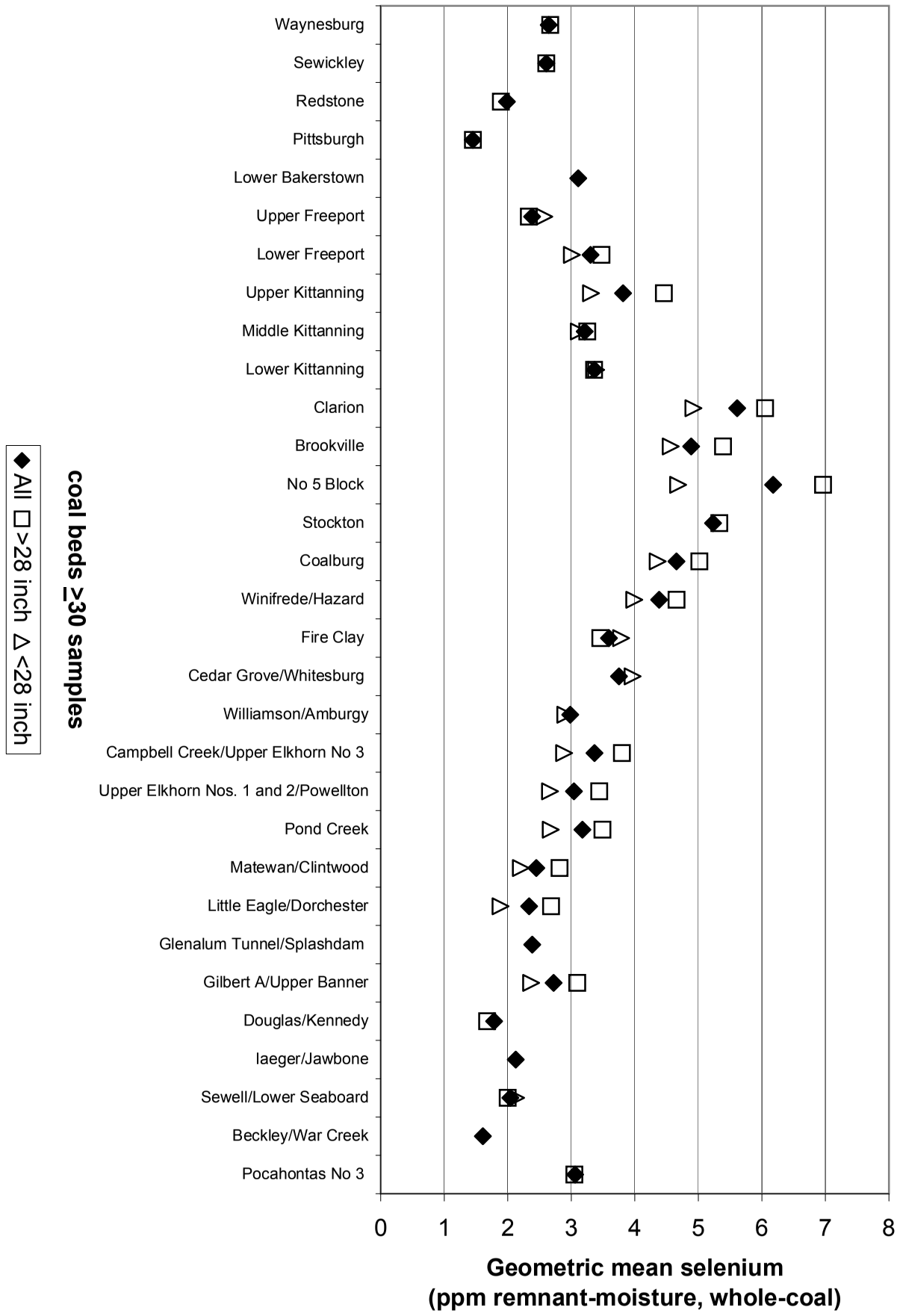

Waynesburg
Sewickley
Redstone
Pittsburgh
Lower Bakerstown
Upper Freeport
Lower Freeport
Upper Kittanning
Middle Kittanning
Lower Kittanning
Clarion
Brookville
No 5 Block
Stockton
Coalburg
Winifrede/Hazard
Fire Clay
Cedar Grove/Whitesburg
Williamson/Amburgy
Campbell Creek/Upper Elkhorn No 3
Upper Elkhorn Nos. 1 and 2/Powellton
Pond Creek
Matewan/Clintwood
Little Eagle/Dorchester
Glenalum Tunnel/Splashdam
Gilbert A/Upper Banner
Douglas/Kennedy
Iaeger/Jawbone
Sewell/Lower Seaboard
Beckley/War Creek
Pocahontas No 3
0
1
2
3
4
5
6
7
8
Geometric mean selenium
(ppm remnant-moisture, whole-coal)
coal beds ≥30 samples
◆ All □ >28 inch △ <28 inch

Figure 6b. Chart of geometric mean of ash yield for all, thick ($\geq$ 28 inch), or thin (< 28 inch) coal samples in coal beds with $\geq$ 30 samples.

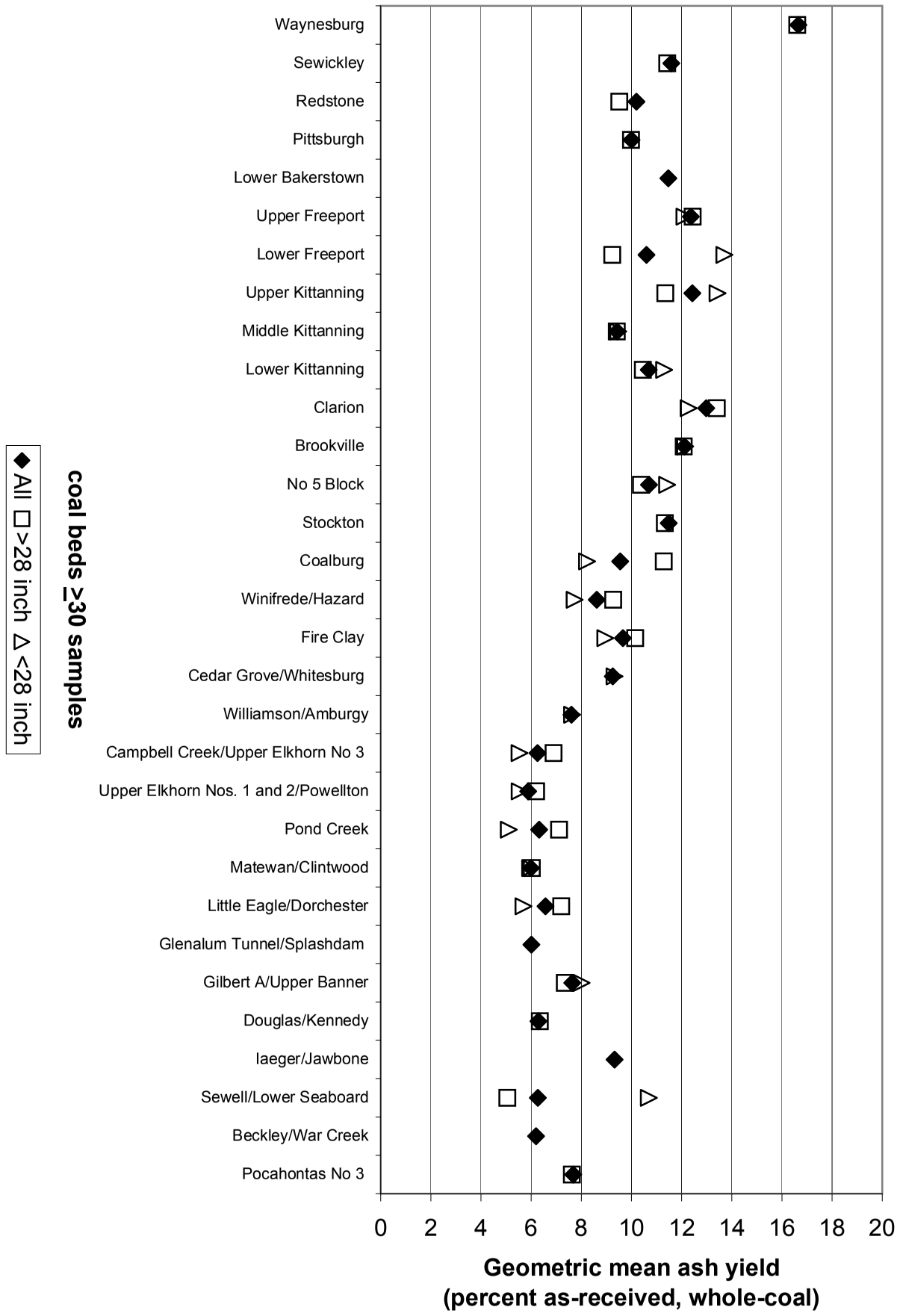

Waynesburg
Sewickley
Redstone
Pittsburgh
Lower Bakerstown
Upper Freeport
Lower Freeport
Upper Kittanning
Middle Kittanning
Lower Kittanning
Clarion
Brookville
No 5 Block
Stockton
Coalburg
Winifrede/Hazard
Fire Clay
Cedar Grove/Whitesburg
Williamson/Amburgy
Campbell Creek/Upper Elkhorn No 3
Upper Elkhorn Nos. 1 and 2/Powellton
Pond Creek
Matewan/Clintwood
Little Eagle/Dorchester
Glenalum Tunnel/Splashdam
Gilbert A/Upper Banner
Douglas/Kennedy
Iaeger/Jawbone
Sewell/Lower Seaboard
Beckley/War Creek
Pocahontas No 3
0
2
4
6
8
10
12
14
16
18
20
Geometric mean ash yield
(percent as-received, whole-coal)
coal beds ≥30 samples
◆ All □ >28 inch △ <28 inch

Figure 6c. Chart of geometric mean of sulfur concentration for all, thick ($\geq$ 28 inch), or thin (< 28 inch) coal samples in coal beds with $\geq$ 30 samples.

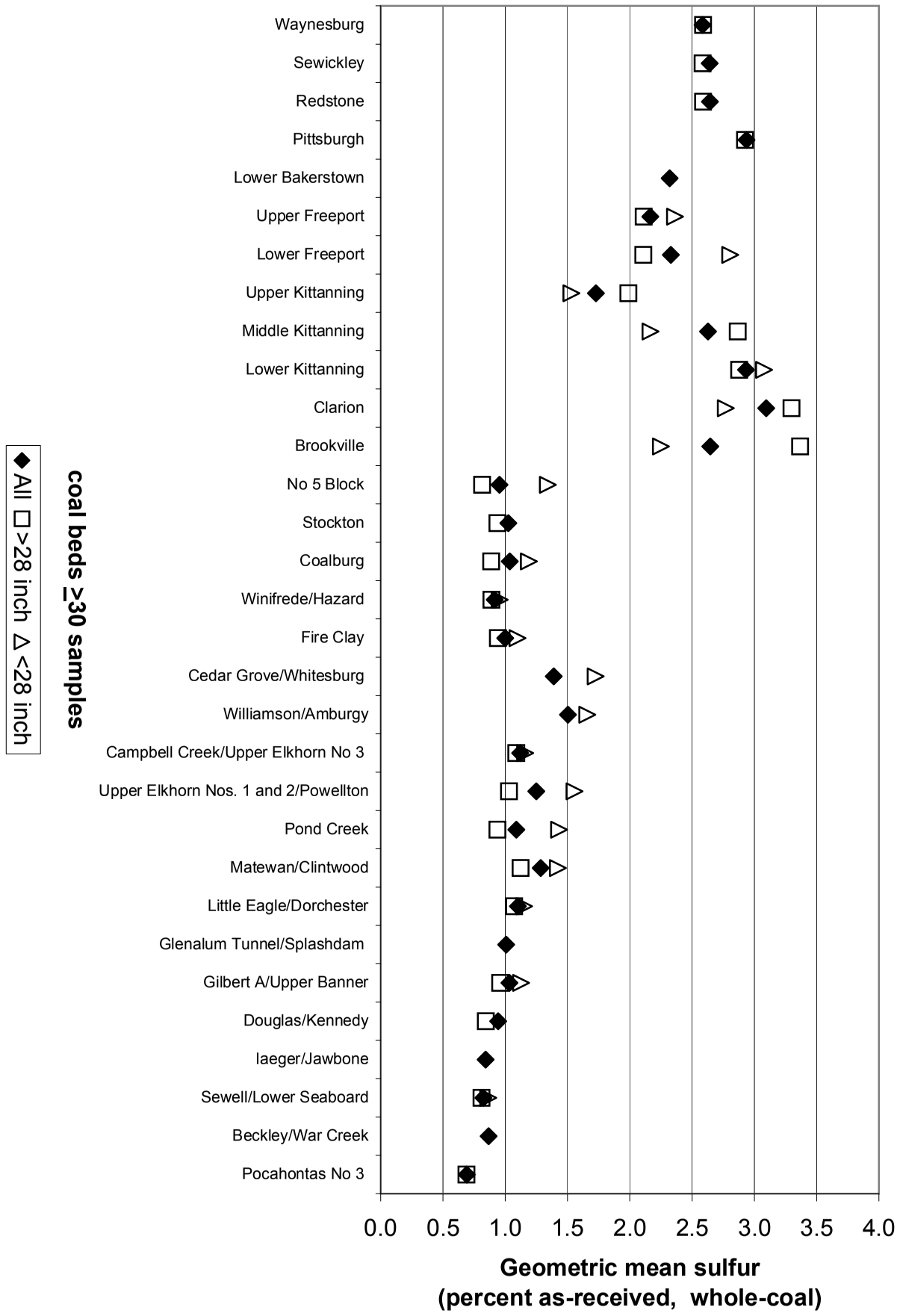
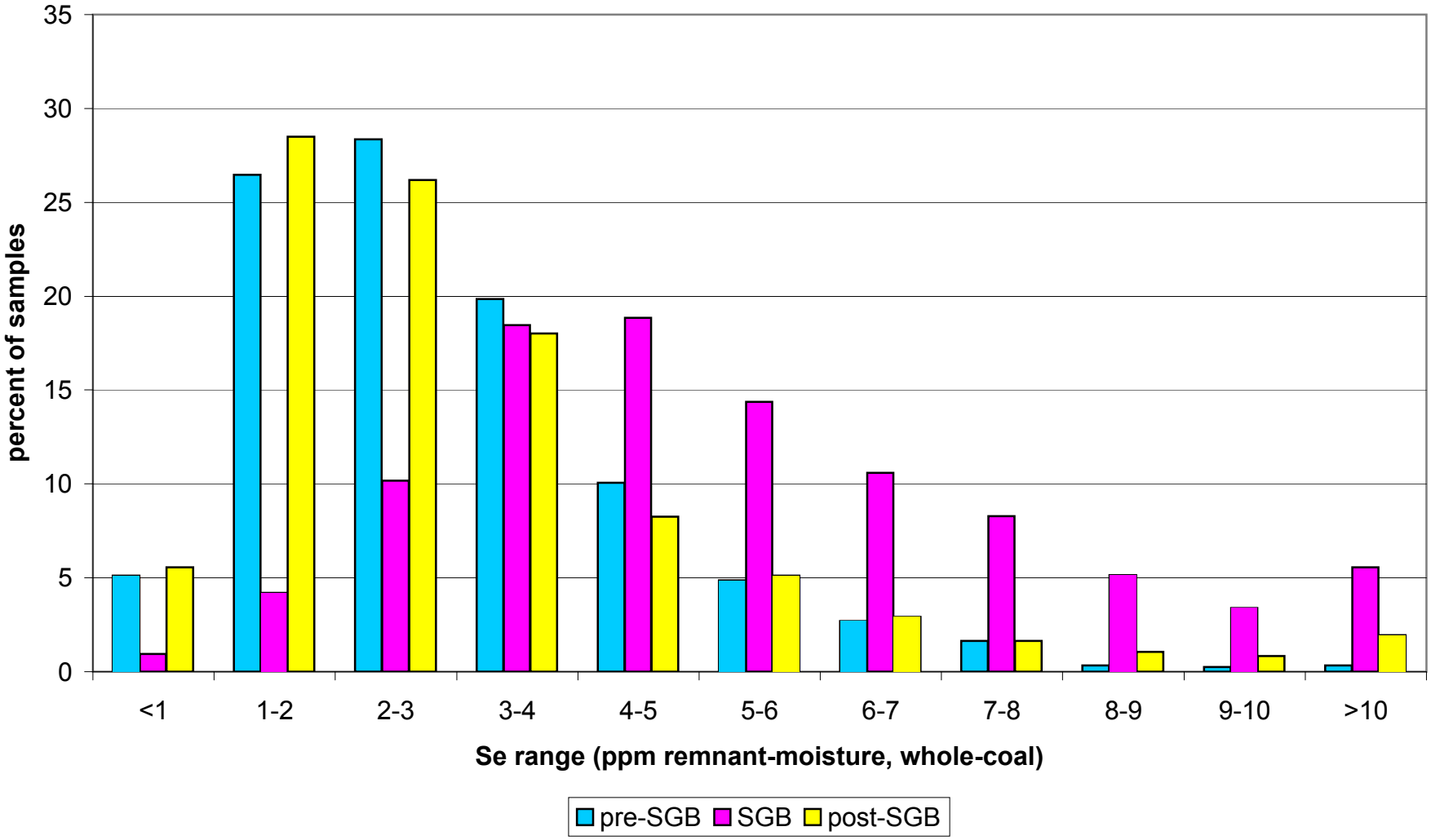
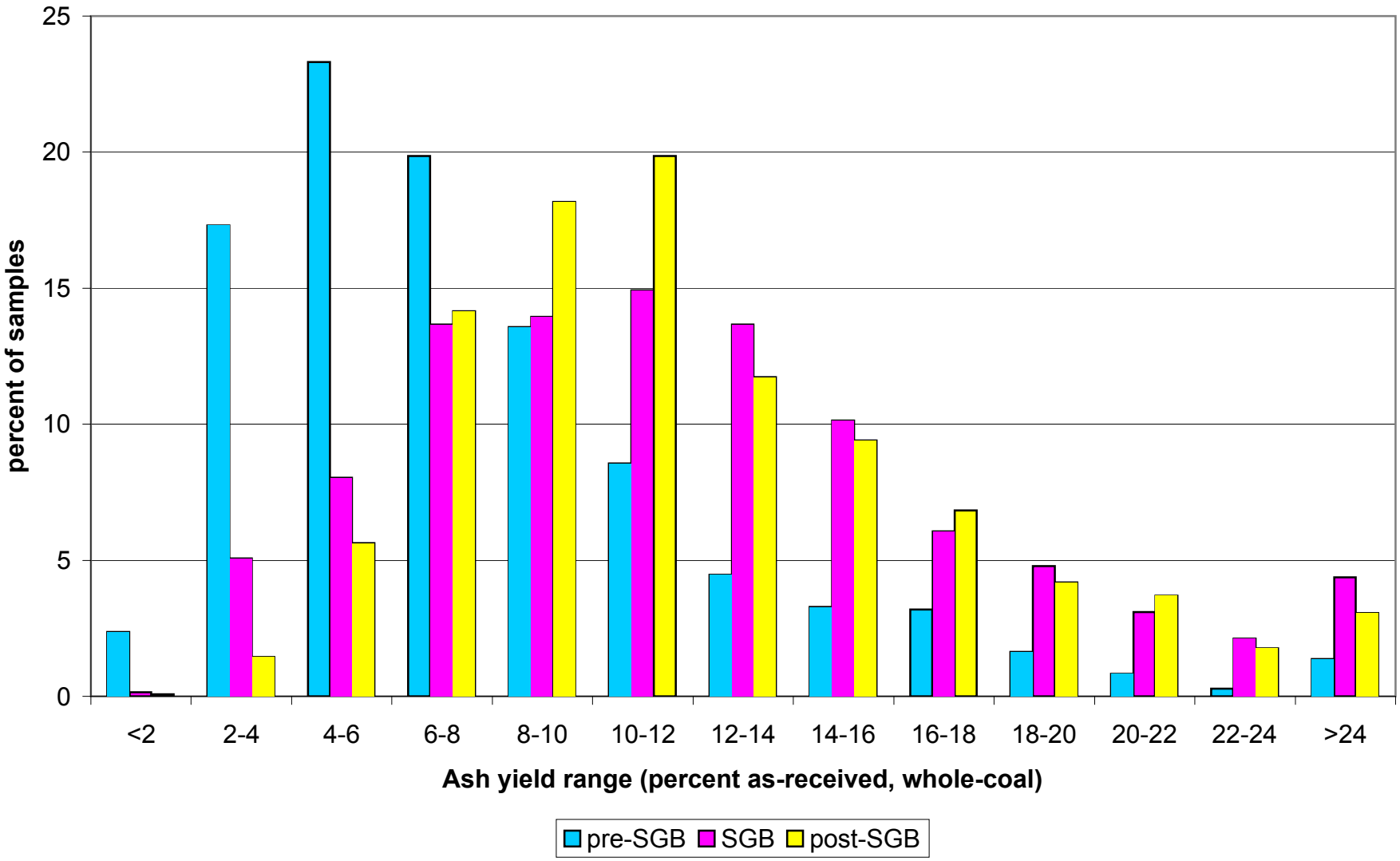

coal beds ≥30 samples
◆ All □ >28 inch △ <28 inch
Waynesburg
Sewickley
Redstone
Pittsburgh
Lower Bakerstown
Upper Freeport
Lower Freeport
Upper Kittanning
Middle Kittanning
Lower Kittanning
Clarion
Brookville
No 5 Block
Stockton
Coalburg
Winifrede/Hazard
Fire Clay
Cedar Grove/Whitesburg
Williamson/Amburgy
Campbell Creek/Upper Elkhorn No 3
Upper Elkhorn Nos. 1 and 2/Powellton
Pond Creek
Matewan/Clintwood
Little Eagle/Dorchester
Glenalum Tunnel/Splashdam
Gilbert A/Upper Banner
Douglas/Kennedy
Iaeger/Jawbone
Sewell/Lower Seaboard
Beckley/War Creek
Pocahontas No 3
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Geometric mean sulfur
(percent as-received, whole-coal)

Figure 7a. Histograms of selenium, ash yield and sulfur concentrations in three stratigraphic intervals (pre-SGB, SGB, and post-SGB) for all coal bed samples. [Number of samples listed in table 5a. Coal beds in stratigraphic intervals pre-SGB, SGB, and post-SGB listed in table 2.]

Histogram of selenium concentration in three stratigraphic intervals for all coal bed samples.



Histogram of ash yield in three stratigraphic intervals for all coal bed samples.



Histogram of total sulfur concentration in three stratigraphic intervals for all coal bed samples.

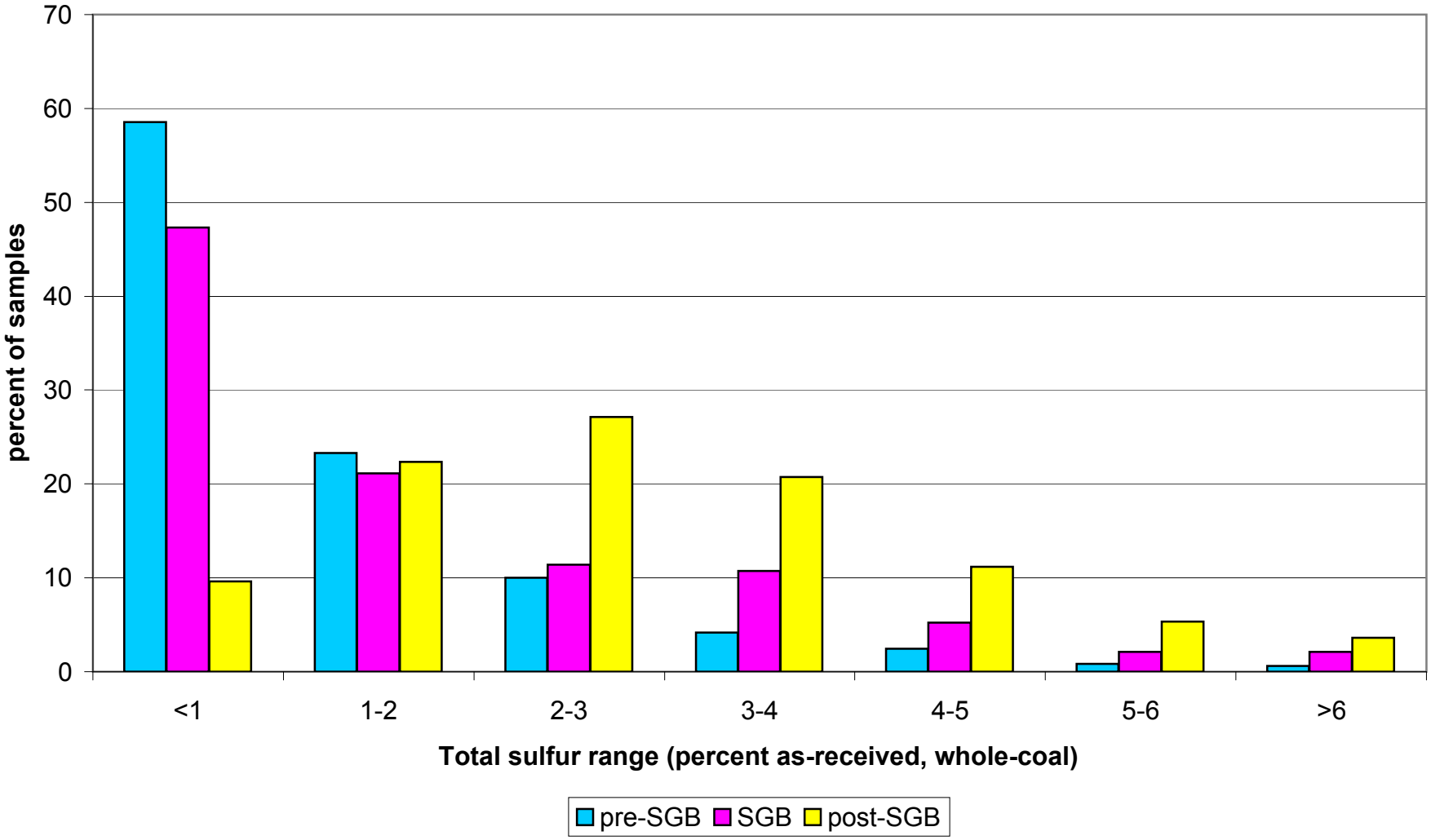
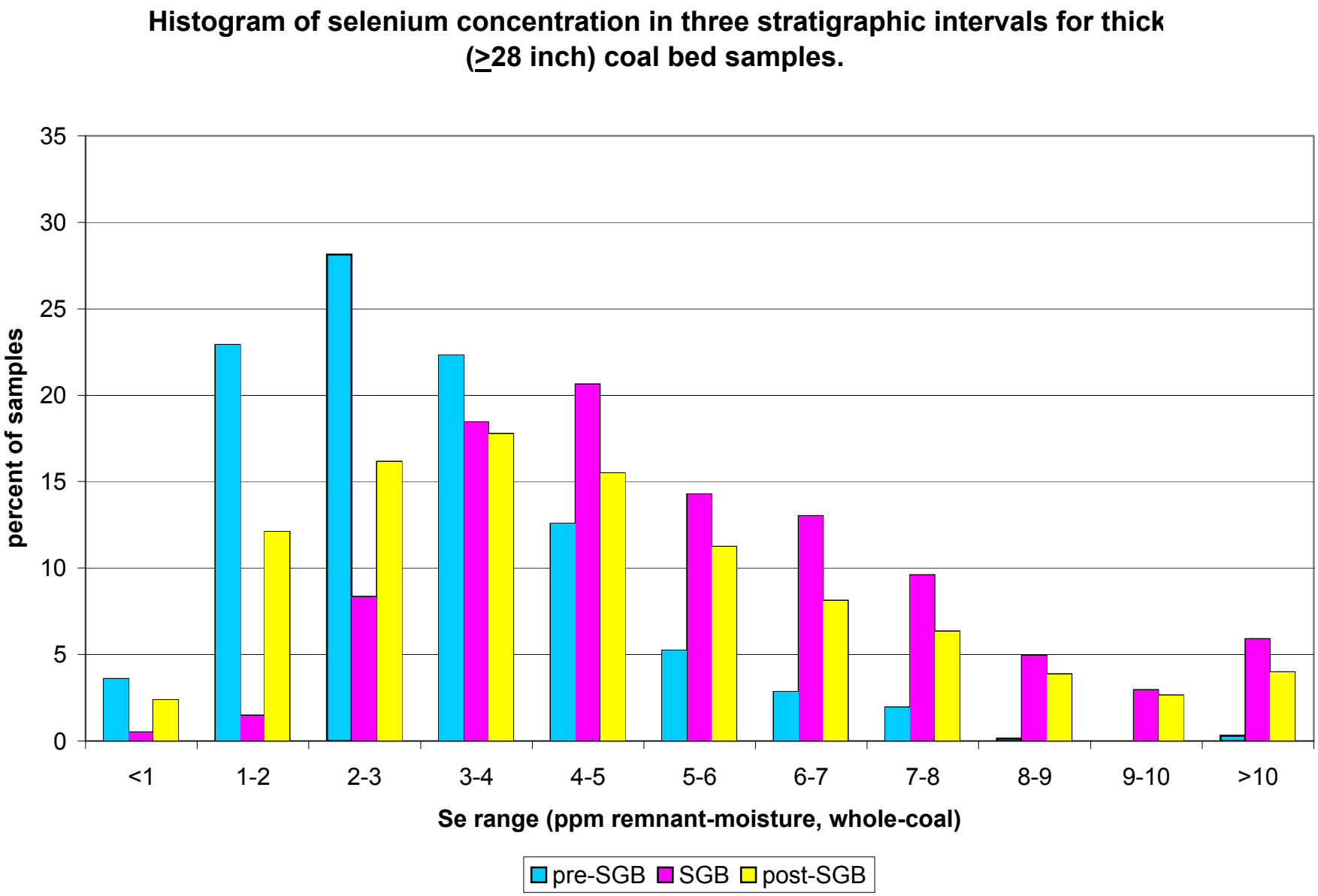
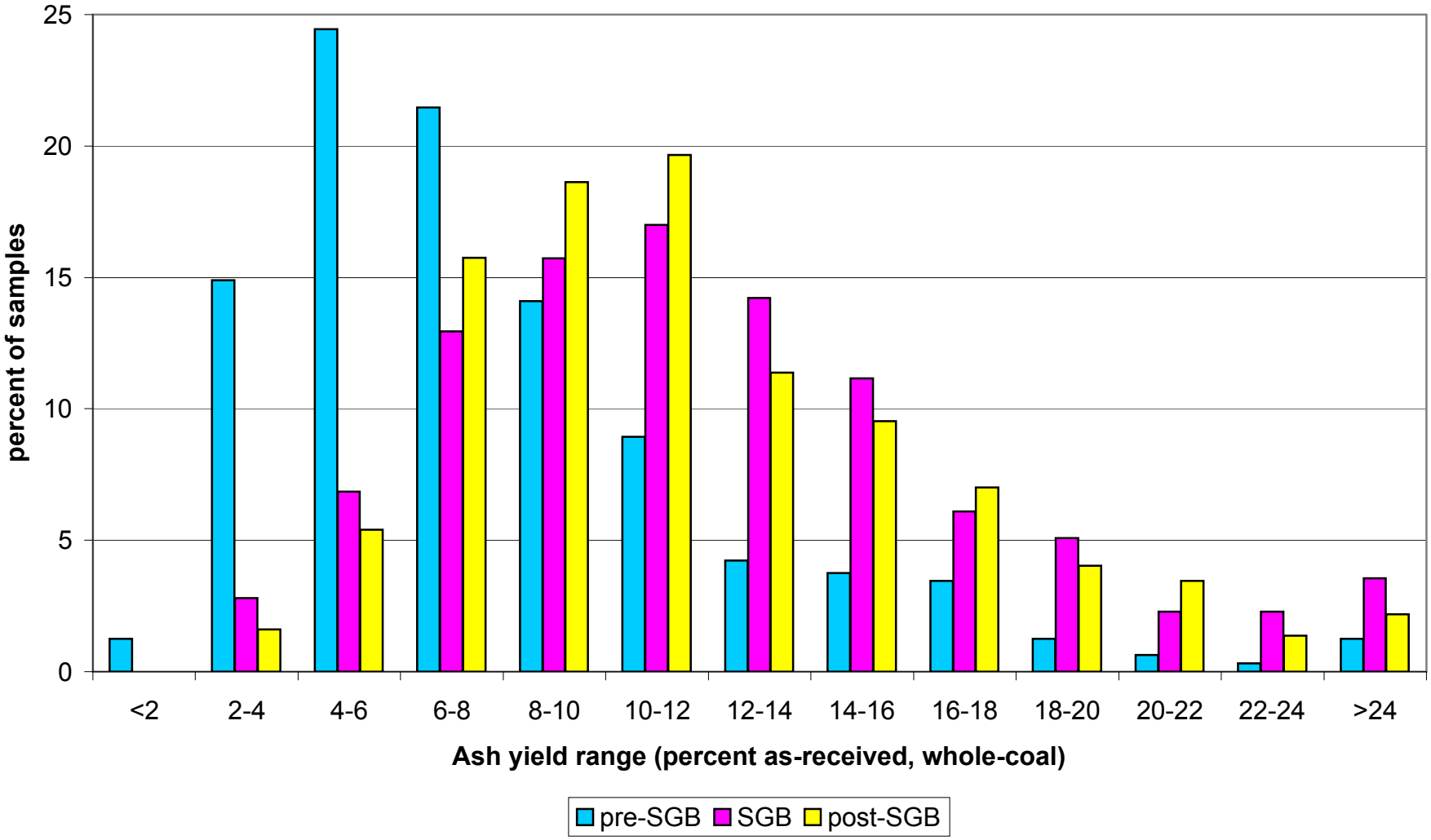


Figure 7b. Histograms of selenium, ash yield and sulfur concentrations in three stratigraphic intervals (pre-SGB, SGB, and post-SGB) for thick ($\geq$ 28 inch) coal bed samples. [Number of samples listed in table 5b. Coal beds in stratigraphic intervals pre-SGB, SGB, and post-SGB listed in table 2.]


Histogram of selenium concentration in three stratigraphic intervals for thick
(≥28 inch) coal bed samples.
percent of samples
35
30
25
20
15
10
5
0
<1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
>10
Se range (ppm remnant-moisture, whole-coal)
pre-SGB
SGB
post-SGB

Histogram of ash yield in three stratigraphic intervals for thick (≥28 inch) coal bed samples.



Histogram of total sulfur concentration in three stratigraphic intervals for thick (≥28 inch) coal bed samples.

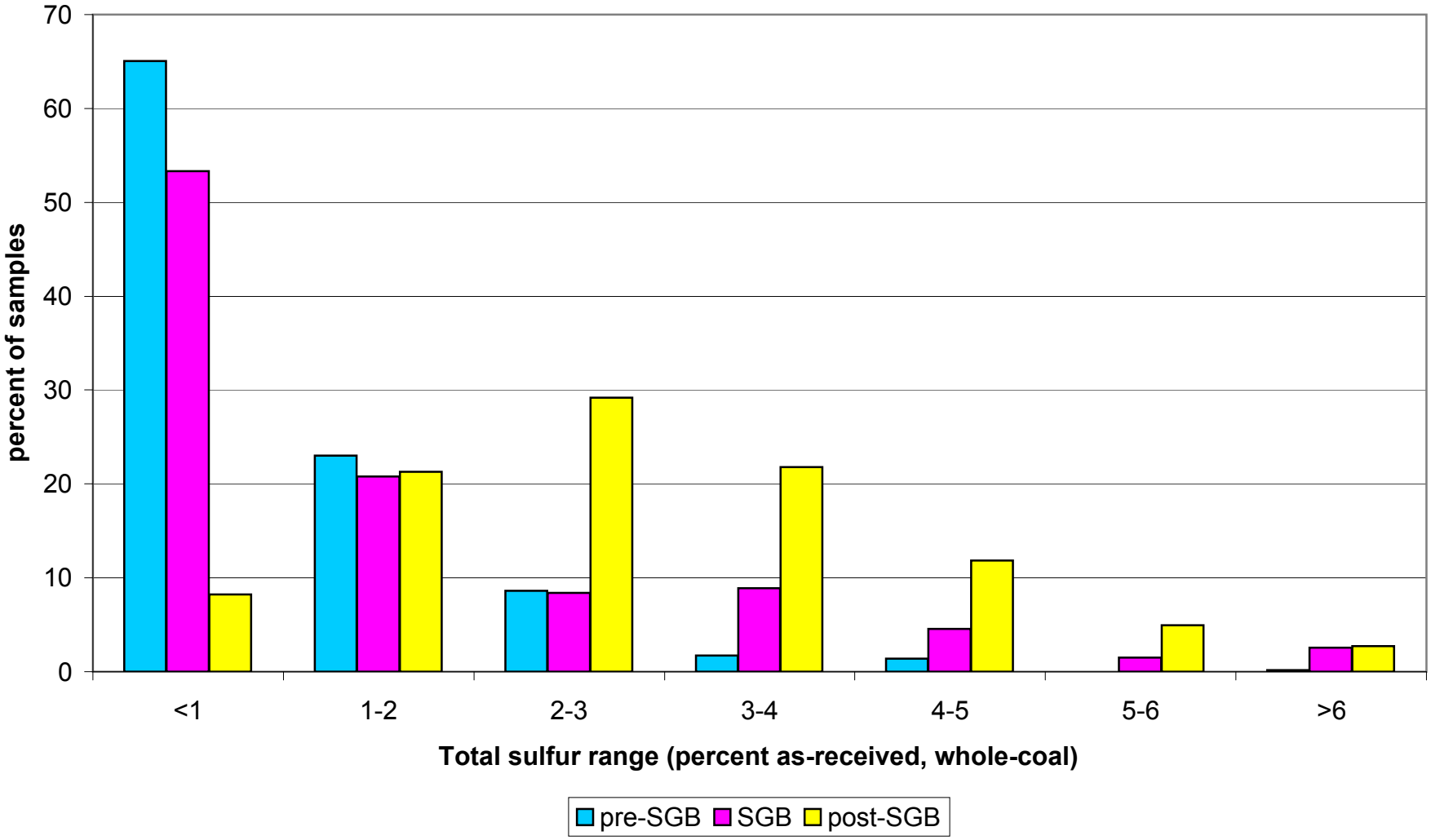
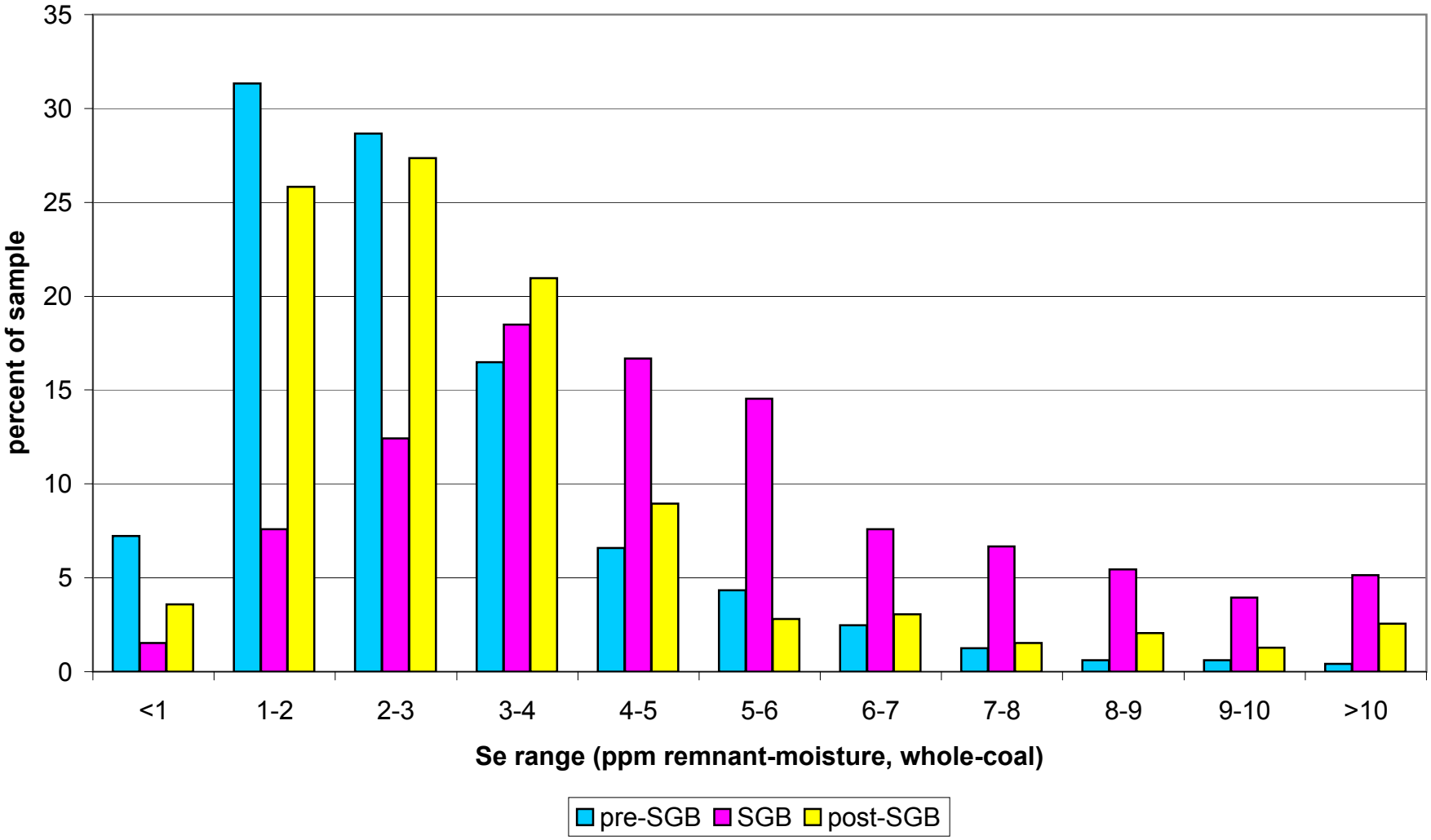
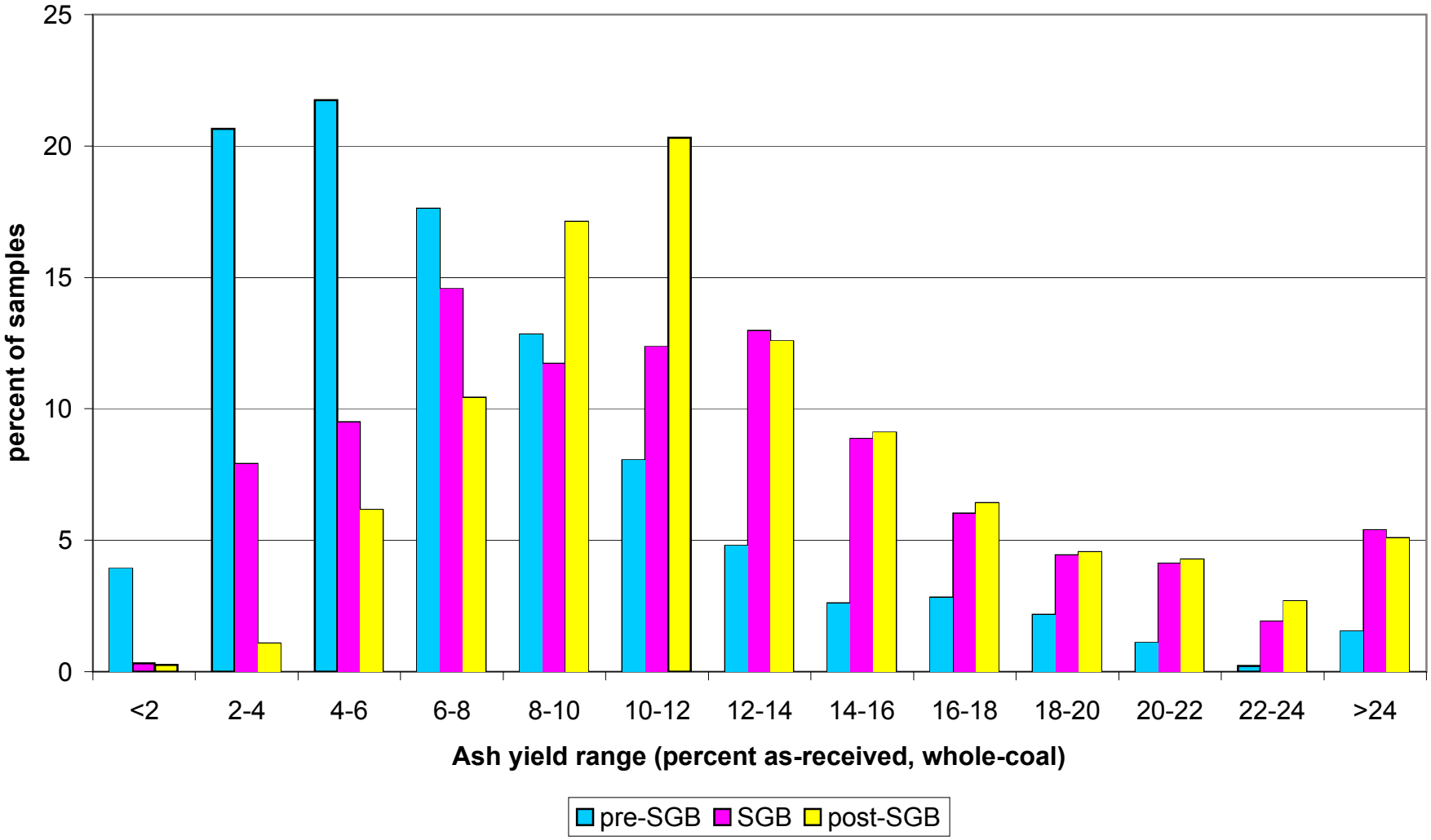


Figure 7c. Histograms of selenium, ash yield and sulfur concentrations in three stratigraphic intervals (pre-SGB, SGB, and post-SGB) for thin (< 28 inch) coal bed samples. [Number of samples listed in table 5c. Coal beds in stratigraphic intervals pre-SGB, SGB, and post-SGB listed in table 2.]

Histogram of selenium concentration in three stratigraphic intervals for thin (<28 inch) coal bed samples.



Histogram of ash yield in three stratigraphic intervals for thin (<28 inch) coal bed samples.



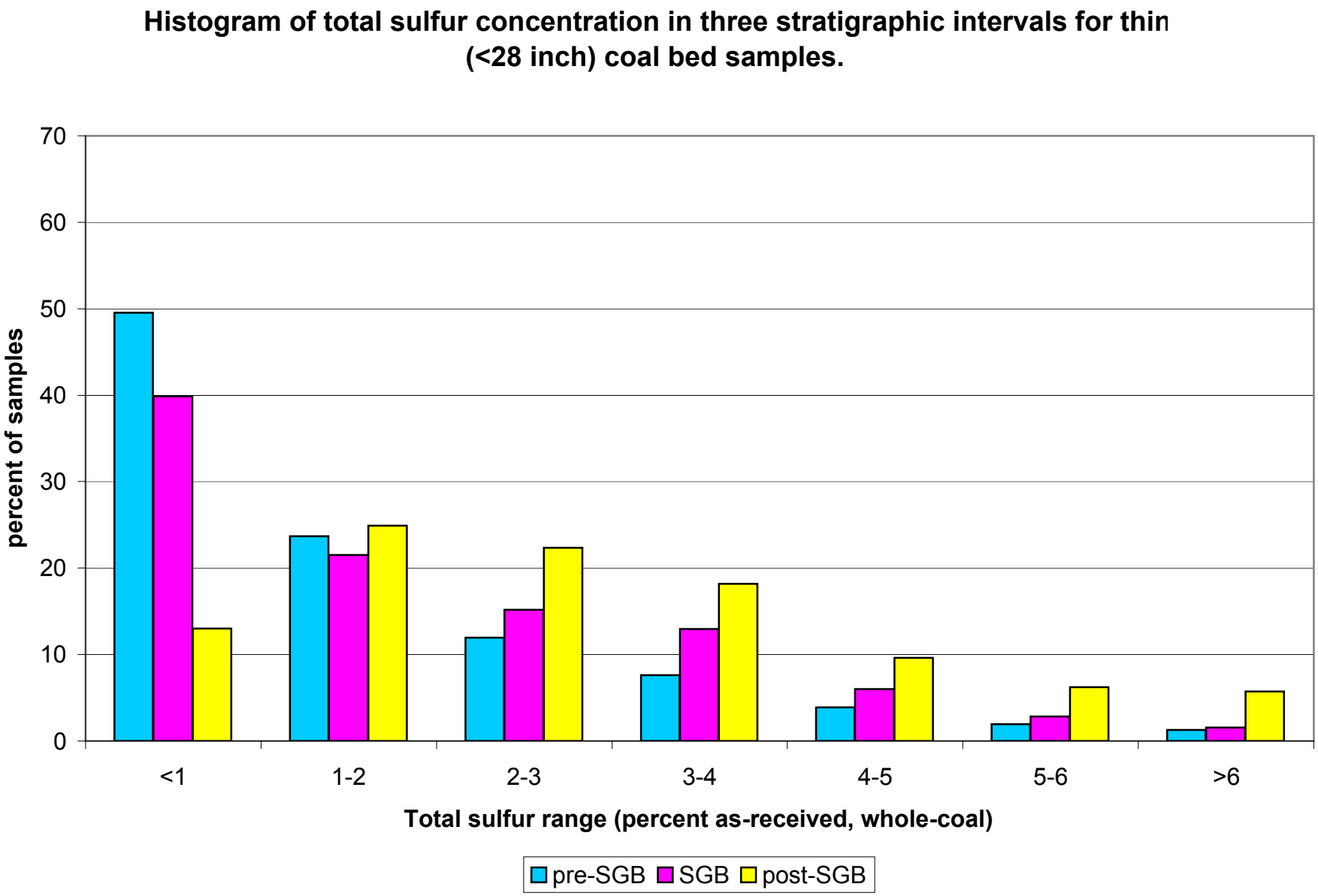

Histogram of total sulfur concentration in three stratigraphic intervals for thin
(<28 inch) coal bed samples.
percent of samples
70
60
50
40
30
20
10
0
<1
1-2
2-3
3-4
4-5
5-6
>6
Total sulfur range (percent as-received, whole-coal)
pre-SGB
SGB
post-SGB

Table 1. Coal bed names used in this report (names in bold), correlative alternate coal bed names used in COALQUAL database (see column CBED in Appendix 1), number of samples (N) from each state, and total number of samples for each coal bed (in bold). [nWV = northern West Virgina coal field; sWV = southern West Virginia coal field.]

COAL BED NAMES (COALQUAL database)	Number of Samples								
COAL BED NAMES (BOLD, THIS REPORT)	**PA**	**MD**	**OH**	**nWV**	**sWV**	**KY**	**TN**	**VA**	**Total**
WAYNESBURG	29	1		6					36
WAYNESBURG NO 11			24						24
WAYNESBURG	**29**	**1**	**24**	**6**					**60**
MEIGS CREEK NO 9			27						27
SEWICKLEY	11	2		2					15
SEWICKLEY	**11**	**2**	**27**	**2**					**42**
FISHPOT	**1**		**3**						**4**
REDSTONE	14	1		42					57
REDSTONE NO 8A			17						17
REDSTONE	**14**	**1**	**17**	**42**					**74**
PITTSBURGH ROOF	8								8
PITTSBURGH ROOSTER	2								2
PITTSBURGH ROOF	**10**								**10**
PITTSBURGH	29	1		40					70
PITTSBURGH NO 8			66						66
PITTSBURGH-PITTSBURGH ROOF	1								1
PITTSBURGH	**30**	**1**	**66**	**40**					**137**
ELK LICK				1					1
WELLERSBURG	2								2
ELK LICK	**2**			**1**					**3**
FEDERAL HILL	**3**								**3**
HARLEM	**1**	**3**	**5**						**9**
UPPER BAKERSTOWN	**4**								**4**
ANDERSON			11						11
BAKERSTOWN	1	3		1					5
BARTON	1								1
LOWER BAKERSTOWN	8	5							13
LOWER BAKERSTOWN	**10**	**8**	**11**	**1**					**30**
WILGUS			**4**						**4**
BRUSH CREEK	**9**	**2**							**11**
MAHONING	7		11						18
SPEER	2								2
MAHONING	**9**		**11**						**20**
KELLY RIDER	1								1
UPPER FREEPORT RIDER	5								5
UPPER FREEPORT RIDER	**6**								**6**
KELLY	1								1
PRINCESS NO 9				4		1			5
UPPER FREEPORT	192	20		3					215
UPPER FREEPORT NO 7			57						57
UPPER FREEPORT	**193**	**20**	**57**	**7**		**1**			**278**
LOWER FREEPORT	57								57
LOWER FREEPORT NO 6A			42						42
LOWER FREEPORT RIDER	1								1
MOSHANNON	2								2
PRINCESS NO 8						1			1
LOWER FREEPORT	**60**		**42**			**1**			**103**
UPPER KITTANNING 2 RIDER	1								1
UPPER KITTANNING RIDER	2								2
UPPER KITTANNING RIDER	**3**								**3**
UPPER KITTANNING	**64**	**2**		**1**					**67**

Table 1. Coal bed names used in this report (names in bold), correlative alternate coal bed names used in COALQUAL database (see column CBED in Appendix 1), number of samples (N) from each state, and total number of samples for each coal bed (in bold). [nWV = northern West Virgina coal field; sWV = southern West Virginia coal field.]

COAL BED NAMES (COALQUAL database)	Number of Samples								
COAL BED NAMES (BOLD, THIS REPORT)	**PA**	**MD**	**OH**	**nWV**	**sWV**	**KY**	**TN**	**VA**	**Total**
MIDDLE KITTANNING 1 RIDER	2								2
MIDDLE KITTANNING 2 RIDER	2								2
MIDDLE KITTANNING RIDER	4								4
MIDDLE KITTANNING RIDER	**8**								**8**
MIDDLE KITTANNING	78	2		3					83
MIDDLE KITTANNING A	1								1
MIDDLE KITTANNING NO 6			151						151
MIDDLE KITTANNING SPLIT	1								1
PRINCESS NO 7						7			7
MIDDLE KITTANNING	**80**	**2**	**151**	**3**		**7**			**243**
STRASBURG	1								1
STRASBURG NO 5A			10						10
STRASBURG	**1**		**10**						**11**
LOWER KITTANNING 1 RIDER	2								2
LOWER KITTANNING 2 RIDER	2								2
LOWER KITTANNING 3 RIDER	1								1
LOWER KITTANNING RIDER	2								2
LOWER KITTANNING RIDER	**7**								**7**
KITTANNING		2							2
LAWRENCE			1						1
LOWER KITTANNING	78	2		4					84
LOWER KITTANNING NO 5			103						103
NO 6 BLOCK				5					5
PRINCESS NO 6						2			2
UPPER KITTANNING				1					1
LOWER KITTANNINGNo. 6 BLOCK	**78**	**4**	**104**	**10**		**2**			**198**
CLARION	8								8
CLARION 4A-SCRUBGRASS			1						1
CLARION COAL ZONE			6						6
CLARION NO 1	2								2
CLARION NO 2	1								1
CLARION NO 4A			40						40
CLARION-BROOKVILLE	2								2
CLARION-BROOKVILLE RIDER	1								1
LAUREL						1			1
LAUREL RIDER						1			1
SCRUBGRASS	2		4						6
UPPER CLARION	5								5
CLARION	**21**		**51**			**2**			**74**
BROOKVILLE	30								30
BROOKVILLE NO 4			30						30
BROOKVILLE-CLARION	2								2
LOWER CLARION	7								7
OGAN			1						1
WINTERS			3						3
BROOKVILLE	**39**		**34**						**73**

Table 1. Coal bed names used in this report (names in bold), correlative alternate coal bed names used in COALQUAL database (see column CBED in Appendix 1), number of samples (N) from each state, and total number of samples for each coal bed (in bold). [nWV = northern West Virgina coal field; sWV = southern West Virginia coal field.]

COAL BED NAMES (COALQUAL database)	Number of Samples								
COAL BED NAMES (BOLD, THIS REPORT)	**PA**	**MD**	**OH**	**nWV**	**sWV**	**KY**	**TN**	**VA**	**Total**
KNOB						1			1
KNOB SPLIT 2						1			1
KNOB ZONE						5			5
LOWER KITTANNING					4				4
LOWER NO 5 BLOCK					6				6
LOWER RICHARDSON						1			1
NO 5 BLOCK					30				30
PRINCESS NO 5						5			5
RICHARDSON						19			19
RICHARDSON RIDER						1			1
SKYLINE						8			8
SKYLINE SPLIT 1						1			1
SKYLINE SPLIT 2						1			1
SKYLINE SPLIT 3						1			1
SKYLINE SPLIT 4						1			1
SKYLINE SPLIT 5						1			1
SKYLINE SPLIT 6						1			1
UPPER NO 5 BLOCK					3				3
UPPER RICHARDSON						1			1
UPPER SPLIT NO 5 BLOCK					2				2
NO 5 BLOCK					**45**	**48**			**93**
STOCKTON A					3				3
UPPER KITTANNING					1				1
STOCKTON A/LITTLE NO 5 BLOCK					**4**				**4**
TIONESTA			**5**						**5**
UPPER MERCER	6								6
UPPER MERCER NO 3A			2						2
UPPER MERCER	**6**		**2**						**8**
LOWER MERCER	3								3
LOWER MERCER A	1								1
LOWER MERCER B	1								1
LOWER MERCER NO 3			2						2
MERCER	17								17
LOWER MERCER	**22**		**2**						**24**
QUAKERTOWN	2								2
QUAKERTOWN NO 2			7						7
QUAKERTOWN	**2**		**7**						**9**
BROAS						14			14
BROAS, UPPER RIDER						1			1
HAZARD NO 9						4			4
HINDMAN						15			15
PRINCESS NO 4						2			2
STOCKTON					17				17
STOCKTON RIDER					1				1
STOCKTON-LEWISTON					1				1
TIPTOP						4			4
UPPER BROAS						3			3
STOCKTON					**19**	**43**			**62**

Table 1. Coal bed names used in this report (names in bold), correlative alternate coal bed names used in COALQUAL database (see column CBED in Appendix 1), number of samples (N) from each state, and total number of samples for each coal bed (in bold). [nWV = northern West Virgina coal field; sWV = southern West Virginia coal field.]

COAL BED NAMES (COALQUAL database)	Number of Samples								
COAL BED NAMES (BOLD, THIS REPORT)	**PA**	**MD**	**OH**	**nWV**	**sWV**	**KY**	**TN**	**VA**	**Total**
COALBURG					22				22
COALBURG A					1				1
FRANCIS						9			9
FRANCIS RIDER						4			4
HAZARD NO 7						19			19
HAZARD NO 8						9			9
HIGH SPLINT						1		1	2
LENOX						1			1
LOWER PEACH ORCHARD						9			9
MIDDLE PEACH ORCHARD						1			1
MUDSEAM						6			6
PEACH ORCHARD						33			33
PEACH ORCHARD RIDER						1			1
PRINCESS NO 3						6			6
PRINCESS NO 3 RIDER						1			1
SEBASTIAN						3			3
UPPER PEACH ORCHARD						16			16
COALBURG					**23**	**119**		**1**	**143**
HAZARD						38			38
HAZARD NO 5A						2			2
HAZARD RIDER						5			5
INDEX						1			1
MORRIS						3		3	6
PEWEE							5		5
PRATER						3			3
RED SPRINGS						1			1
WINIFREDE					17	1			18
WINIFREDE/HAZARD					**17**	**54**	**5**	**3**	**79**
LOWER WINIFREDE/HAZARD						**10**			**10**
CHILTON A					1				1
COPLAND						3			3
LIMESTONE						1			1
PARDEE								5	5
TAYLOR						5			5
CHILTON/TAYLOR					**1**	**9**		**5**	**15**
BIG MARY						2	7		9
FIRE CLAY RIDER						20			20
FIRE CLAY RIDER						**22**	**7**		**29**
CHILTON					2				2
FIRE CLAY						40			40
HERNSHAW					2				2
HIGNITE						2			2
LITTLE FIRE CLAY						6			6
PHILLIPS								1	1
STRAY						6			6
UPPER WHITESBURG						2			2
WALLINS CREEK						1			1
WALNUT MOUNTAIN							2		2
WHITESBURG						2			2
WINDROCK							4		4
FIRE CLAY					**4**	**59**	**6**	**1**	**70**

Table 1. Coal bed names used in this report (names in bold), correlative alternate coal bed names used in COALQUAL database (see column CBED in Appendix 1), number of samples (N) from each state, and total number of samples for each coal bed (in bold). [nWV = northern West Virgina coal field; sWV = southern West Virginia coal field.]

COAL BED NAMES (COALQUAL database)	Number of Samples								
COAL BED NAMES (BOLD, THIS REPORT)	**PA**	**MD**	**OH**	**nWV**	**sWV**	**KY**	**TN**	**VA**	**Total**
CEDAR GROVE					2				2
DINGESS					2				2
HERNSHAW					12				12
HOUSE								2	2
LOWER HIGNITE						2			2
LOWER WHITESBURG						3			3
UPPER WHITESBURG						3			3
WHITESBURG						11			11
WHITESBURG RIDER						2			2
CEDAR GROVE/WHITESBURG					**16**	**21**		**2**	**39**
ALMA					1				1
AMBURGY						7			7
CANNEL CITY						5			5
CREECH						3			3
GUN CREEK						1			1
JORDAN							1		1
LOW SPLINT						2	1	3	6
PEERLESS					1				1
PIONEER							1		1
POPLAR LICK						2	3		5
STERLING						1			1
WILLIAMSON						13			13
WILLIAMSON/AMBURGY					**2**	**34**	**6**	**3**	**45**
34 INCH								1	1
BUCKEYE SPRING						3			3
CAMPBELL CREEK					12				12
CEDAR GROVE					13				13
DARBY						3			3
KELLIOKA						4			4
LITTLE CANEY						7			7
LOWER CAMPBELL CREEK					4				4
LOWER CEDAR GROVE					6	2			8
NO 2 GAS					15				15
PEERLESS					12				12
TAGGART								9	9
TAGGART MARKER								3	3
TOM COOPER						1			1
UPPER CEDAR GROVE					7				7
UPPER ELKHORN 3 2ND RIDER						1			1
UPPER ELKHORN NO 3						29			29
UPPER ELKHORN NO 3 RIDER						1			1
UPPER ELKHORN NO 3.5						1			1
VAN LEAR						9			9
CAMPBELL CREEK/UPPER ELKHORN NO 3					**69**	**61**		**13**	**143**

Table 1. Coal bed names used in this report (names in bold), correlative alternate coal bed names used in COALQUAL database (see column CBED in Appendix 1), number of samples (N) from each state, and total number of samples for each coal bed (in bold). [nWV = northern West Virgina coal field; sWV = southern West Virginia coal field.]

COAL BED NAMES (COALQUAL database)	Number of Samples								
COAL BED NAMES (BOLD, THIS REPORT)	**PA**	**MD**	**OH**	**nWV**	**sWV**	**KY**	**TN**	**VA**	**Total**
ALMA					12	4			16
GRASSY						7			7
HARLAN						6			6
HUCKLEBERRY						4			4
JELLICO						26	3		29
JOYNER							1		1
MINGO						1			1
POWELLTON					10				10
POWELLTON A					1				1
RIM						2			2
UPPER ALMA						2			2
UPPER ELKHORN NO 1						8			8
UPPER ELKHORN NO 2						18			18
UPPER ELKHORN NO 2-1						2			2
UPPER ELKHORN NO 2-1 RIDER						1			1
UPPER ST CHARLES								1	1
WILSON								5	5
UPPER ELKHORN NOS. 1 AND 2/POWELLTON					**23**	**81**	**4**	**6**	**114**
KELLY								**3**	**3**
BLUE GEM						23	3		26
BLUE GEM RIDER						1			1
CAMPBELL CREEK					9			2	11
EAGLE					31				31
IMBODEN						1		9	10
IMBODEN MARKER								4	4
LITTLE BLUE GEM						1			1
LOWER CAMPBELL CREEK					1				1
LOWER ELKHORN						9			9
LOWER PATH FORK						1			1
NO 2 GAS					8				8
PATH FORK						3			3
POND CREEK						10			10
POND CREEK RIDER						2			2
STRAIGHT CREEK						2			2
VIRES						1			1
POND CREEK					**49**	**54**	**3**	**15**	**121**
BLAIR								17	17
BLAIR MARKER								3	3
CLINTWOOD						3		55	58
CLINTWOOD MARKER								2	2
CLINTWOOD RIDER								1	1
COAL CREEK							3		3
COLONY						2			2
COLONY RIDER						1			1
HANCE						4			4
HANCE SPLIT 1						1			1
HANCE SPLIT 2						1			1
HANCE SPLIT 3						1			1
HANCE SPLIT 4						1			1
LILY						9			9
MANCHESTER						15			15
MATEWAN					2				2
RIVER GEM						1			1
RIVER GEM RIDER						1			1
ZACHARIAH						3			3
MATEWAN/CLINTWOOD					**2**	**43**	**3**	**78**	**126**

Table 1. Coal bed names used in this report (names in bold), correlative alternate coal bed names used in COALQUAL database (see column CBED in Appendix 1), number of samples (N) from each state, and total number of samples for each coal bed (in bold). [nWV = northern West Virgina coal field; sWV = southern West Virginia coal field.]

COAL BED NAMES (COALQUAL database)	Number of Samples								
COAL BED NAMES (BOLD, THIS REPORT)	**PA**	**MD**	**OH**	**nWV**	**sWV**	**KY**	**TN**	**VA**	**Total**
EAGLE					5			1	6
LYONS								15	15
MILLARD						2			2
MIDDLE WAR EAGLE/EAGLE					**5**	**2**		**16**	**23**
BENS CREEK					5				5
GLAMORGAN						2			2
MASON						4	4		8
BENS CREEK/BLAIR					**5**	**6**	**4**		**15**
DORCHESTER								50	50
GLEN MARY							3		3
LITTLE EAGLE					3				3
LYONS								14	14
NORTON								16	16
POPLAR CREEK							1		1
POWELLTON					1				1
LITTLE EAGLE/DORCHESTER					**4**		**4**	**80**	**88**
GILBERT					2				2
HAGY						2		8	10
LOWER WAR EAGLE					1				1
LOWER WAR EAGLE/HAGY					**3**	**2**		**8**	**13**
GLENALUM TUNNEL					1				1
GRAY HAWK						7			7
REX							4		4
SPLASH DAM						1			1
SPLASHDAM								19	19
SPLITSEAM						3			3
GLENALUM TUNNEL/SPLASHDAM					**1**	**11**	**4**	**19**	**35**
BARREN FORK						5			5
BARREN FORK RIDER						1			1
BEATTYVILLE						3			3
CORLEY HOLLOW						1			1
HALSEY ROUGH						3			3
LEE								5	5
UPPER BANNER								28	28
GILBERT A/UPPER BANNER						**13**		**33**	**46**
GILBERT					3				3
LOWER BANNER								20	20
GILBERT/LOWER BANNER					**3**			**20**	**23**
BIG FORK								**3**	**3**
DOUGLAS					4				4
KENNEDY								28	28
LOWER DOUGLAS					1				1
RED ASH RIDER								2	2
WIDOW KENNEDY								2	2
DOUGLAS/KENNEDY					**5**			**32**	**37**
JEWELL								11	11
RAVEN								6	6
RAVEN NO 1								3	3
STEARNS NO 2						4			4
JEWELL/RAVEN						**4**		**20**	**24**

Table 1. Coal bed names used in this report (names in bold), correlative alternate coal bed names used in COALQUAL database (see column CBED in Appendix 1), number of samples (N) from each state, and total number of samples for each coal bed (in bold). [nWV = northern West Virgina coal field; sWV = southern West Virginia coal field.]

COAL BED NAMES (COALQUAL database)	Number of Samples								
COAL BED NAMES (BOLD, THIS REPORT)	**PA**	**MD**	**OH**	**nWV**	**sWV**	**KY**	**TN**	**VA**	**Total**
BEAVER CREEK						1			1
IAEGER					2				2
JAWBONE								22	22
JAWBONE RIDER								3	3
JAWBONE-TILLER								5	5
STEARNS NO 1.5						1			1
IAEGER/JAWBONE					**2**	**2**		**30**	**34**
STEARNS						8			8
STEARNS ZONE						1			1
TILLER								8	8
LOWER IAEGER/TILLER						**9**		**8**	**17**
CASTLE								4	4
CASTLE RIDER								1	1
SEWELL B					1				1
SEWELL B/GREASY CREEK					**1**			**5**	**6**
MIDDLE SEABOARD								1	1
SEWELL A					5			1	6
SEWELL A					**5**			**2**	**7**
DIRTY NO 6								1	1
DIRTY SIX					1			1	2
DIRTY SIX					**1**			**2**	**3**
LOWER SEABOARD								8	8
SEWELL				1	39			4	44
SEWELL RIDER					3				3
SHARON NO 1			6						6
SEWELL/LOWER SEABOARD			**6**	**1**	**42**			**12**	**61**
SMITH						3		2	5
UPPER HORSEPEN								7	7
WELCH					1			2	3
WELCH/UPPER HORSEPEN					**1**	**3**		**11**	**15**
LITTLE RALEIGH/MIDDLE HORSEPEN					**7**			**1**	**8**
BECKLEY					25			2	27
BECKLEY RIDER					1				1
WAR CREEK								2	2
BECKLEY/WAR CREEK					**26**			**4**	**30**
FIRE CREEK					19				19
FIRE CREEK RIDER								2	2
LOWER HORSEPEN								1	1
FIRE CREEK/LOWER HORSEPEN					**19**			**3**	**22**
POCAHONTAS NO. 10/LITTLE FIRE CREEK								**3**	**3**
COVE CREEK								7	7
POCAHONTAS NO 7					1				1
POCAHONTAS NO 7					**1**			**7**	**8**
POCAHONTAS NO 6					**13**				**13**
POCAHONTAS NO 4					**12**			**1**	**13**
POCAHONTAS NO 3					37			14	51
POCAHONTAS NO 3 RDR					2				2
POCAHONTAS NO 3					**39**			**14**	**53**
POCAHONTAS NO 1								**3**	**3**
Grand Total	**723**	**46**	**639**	**114**	**469**	**723**	**46**	**467**	**3227**

Table 2. Stratigraphic list of coal bed names used in this report and number (N) of samples, thick samples (≥28 inch), and thin samples (<28 inch).

Stratigraphic system, series, stage, and formation names have been debated and revised in the literature numerous times. We cite recent references for the stratigraphic intervals used in this table and report. ***** = some and ****** = significant mountaintop mining, target coal beds. Coal bed code letters indicate coal beds with N ≥30 samples. SGB (selenium greater than background) indicates the stratigrahic interval with coal beds' average selenium concentration greater than average selenium concentration in Appalachian basin coal. Stratigraphic intervals pre-SGB, SGB, and post-SGB, this report, used in fig. 7 and table 5.

Table 2. Stratigraphic list of coal bed names used in this report and number (N) of samples, thick samples (≥28 inch), and thin samples (<28 inch).

System	Peppers (1996) western European Series and Stage	Peppers (1996) Midcon-tinent System	Peppers (1996) Midcon-tinent Series	Peppers (1996), Blake (1998) West Virginia Formation	Chesnut (1996) eastern Kentucky Group and Formation	This report central and northern Appalachian basin Coal bed names	All samples N	All samples coal bed code, N ≥30	Thick samples ≥28 inch N	Thick samples ≥28 inch coal bed code, N ≥30	Thin samples <28 inch N	Thin samples <28 inch coal bed code, N ≥30	This report Se trend Interval
	Stephanian C	Upper Pennsylvaian	Virgilian	Monongahela	Monongahela	Waynesburg	60	**A**	56	**A**	4		post-SGB
						Sewickley	42	**B**	40	**B**	2		
						Fishpot	4		1		3		
						Redstone	74	**C**	56	**C**	18		
						Pittsburgh Roof	10		2		8		
						Pittsburgh	137	**D**	132	**D**	5		
	Stephanian B		Missourian	Conemaugh	Conemaugh	Elk Lick	3		2		1		
						Federal Hill	3		1		2		
	Stephanian A					Harlem	9		1		8		
						Upper Bakerstown	4		2		2		
						Lower Bakerstown	30	**E**	12		18		
						Wilgus	4		1		3		
						Brush Creek	11		3		8		
	Westphalian D		Desmoinsian			Mahoning	20		6		14		
				Allegheny/Charleston	Breathitt / Princess	Upper Freeport Rider	6		3		3		
						Upper Freeport	278	**F**	215	**F**	63	**F**	
						Lower Freeport	103	**G**	67	**G**	36	**G**	
						Upper Kittanning Rider	3				3		
						Upper Kittanning	67	**H**	32	**H**	35	**H**	
						Middle Kittanning Rider	8				8		
						Middle Kittanning	243	**I**	168	**I**	75	**I**	
						Strasburg	11		1		10		
						Lower Kittanning Rider	7		1		6		
						Lower Kittanning / ** No 6 block	198	**J**	141	**J**	57	**J**	
						Clarion	74	**K**	47	**K**	27		
						Brookville	73	**L**	30	**L**	43	**L**	
		ylvanian				** No 5 Block	93	**M**	65	**M**	28		
						* Stockton A / Little No 5 Block	4		2		2		
						Tionesta	5		4		1		
						Upper Mercer	8		2		6		

Pennsylvanian	Westphalian C	Middle Penns	Atokan	Kanawha upper division	Breathitt / Four Corners	Lower Mercer	24		7		17		SGB
						Quakertown	9		2		7		
						** Stockton	62	**N**	51	**N**	11		
						** Coalburg	143	**O**	67	**O**	76	**O**	
						* Winifrede / Hazard	79	**P**	48	**P**	31	**P**	
						* Lower Winifrede / Hazard	10		4		6		
				Kanawha middle division	Breathitt / Hyden	Chilton/Taylor	15		9		6		
						Fire Clay Rider	29		13		16		
						* Fire Clay	70	**Q**	40	**Q**	30	**Q**	
						* Cedar Grove / * Whitesburg	39	**R**	16		23		
	Westphalian B				Breathitt / Pikeville	* Williamson / * Amburgy	45	**S**	19		26		pre-SGB
						* Campbell Creek / * Upper Elkhorn No 3	143	**T**	80	**T**	63	**T**	
						Upper Elkhorn Nos 1 and 2 / Powellton	114	**U**	59	**U**	55	**U**	
						Kelly	3		3				
						Pond Creek	121	**V**	78	**V**	43	**V**	
				Kanawha lower division	Breathitt / Grundy	Matewan / Clintwood	126	**W**	54	**W**	72	**W**	
						Middle War Eagle / Eagle	23		12		11		
						Bens Creek / Blair	15		11		4		
						Little Eagle / Dorchester	88	**X**	54	**X**	34	**X**	
	Westphalian A	Lower Pennsylvanian	Morrowan			Lower War Eagle / Hagy	13		8		5		
						Glenalum Tunnel / Splashdam	35	**Y**	17		18		
						Gilbert A / Upper Banner	46	**Z**	24		22		
						Gilbert / Lower Banner	23		17		6		
						Big Fork	3		2		1		
						Douglas / Kennedy	37	**AA**	22		15		
				New River	Breathitt / Alvy Creek	Jewell / Raven	24		19		5		
						Iaeger / Jawbone	34	**BB**	17		17		
						Lower Iaeger / Tiller	17		7		10		
					Breathitt / Bottom Creek	Sewell B / Greasy Creek	6		2		4		
						Sewell A	7		3		4		
						Dirty Six	3		3				
						Sewell / Lower Seaboard	61	**CC**	41	**CC**	20		
						Welch / Upper Horsepen	15		10		5		
						Little Raleigh / Middle Horsepen	8		5		3		
	Namurian C					Beckley / War Creek	30	**DD**	18		12		
						Fire Creek / Lower Horsepen	22		14		8		
						Pocahontas No 10 / Little Fire Creek	3		1		2		
	Namurian B			Pocahontas	Breathitt / Pocahontas	Pocahontas No 7	8		3		5		
						Pocahontas No 6	13		10		3		
						Pocahontas No 4	13		13				
						Pocahontas No 3	53	**EE**	43	**EE**	10		
						Pocahontas No 1	3				3		
						Grand Total	**3227**	**31**	**2019**	**23**	**1208**	**14**	

Table 3. Coal quality statistics by state for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese. [N = number of samples; nWV = northern West Virginia coal field; sWV = southern West Virginia coal field.]

Parameter	State	N	Average	Standard Deviation	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
			ppm	ppm	ppm	ppm	ppm	ppm	ppm
Selenium	**PA**	723	3.6	2.6	0.41	1.9	2.8	4.2	21
Selenium	**MD**	46	3.4	2.8	0.63	1.7	2.3	4.2	14
Selenium	**OH**	638	3.7	2.4	0.60	2.1	3.1	4.7	17
Selenium	**nWV**	113	2.5	2.3	0.20	1.1	1.7	2.7	14
Selenium	**sWV**	469	3.8	2.3	0.76	2.1	3.5	4.6	16
Selenium	**KY**	723	4.2	2.3	0.07	2.6	3.8	5.5	18
Selenium	**TN**	46	3.1	1.6	0.50	1.9	2.9	4.1	8
Selenium	**VA**	465	2.7	1.4	0.07	1.7	2.5	3.4	8
			in	in	in	in	in	in	in
Thickness	**PA**	723	36	19	2	23	33	47	115
Thickness	**MD**	46	34	23	8	20	27	40	112
Thickness	**OH**	639	37	15	9	27	36	45	125
Thickness	**nWV**	114	57	21	8	42	58	72	108
Thickness	**sWV**	469	39	19	4	27	38	49	172
Thickness	**KY**	723	29	18	3	16	26	39	156
Thickness	**TN**	46	34	13	9	26	33	40	84
Thickness	**VA**	467	33	16	5	22	31	41	128
			percent	percent	percent	percent	percent	percent	percent
Ash y\ield	**PA**	665	12.87	5.24	1.70	8.98	11.82	15.90	31.20
Ash y\ield	**MD**	45	14.56	6.64	5.55	9.78	13.01	18.40	29.31
Ash y\ield	**OH**	625	11.94	5.20	2.20	8.60	10.91	14.32	32.40
Ash y\ield	**nWV**	94	9.95	3.64	5.60	7.23	9.05	11.40	20.90
Ash y\ield	**sWV**	449	8.68	5.13	0.90	5.10	7.40	10.70	31.50
Ash y\ield	**KY**	695	9.59	5.47	0.90	5.51	8.57	12.66	32.90
Ash y\ield	**TN**	46	7.48	5.59	1.60	3.20	5.10	10.80	22.00
Ash y\ield	**VA**	433	8.30	5.28	1.66	4.50	6.60	10.51	30.90
			percent	percent	percent	percent	percent	percent	percent
Sulfur	**PA**	717	2.48	1.45	0.39	1.44	2.20	3.21	9.34
Sulfur	**MD**	45	2.16	1.39	0.40	1.17	1.99	2.80	8.00
Sulfur	**OH**	625	3.53	1.53	0.50	2.50	3.40	4.50	10.60
Sulfur	**nWV**	95	2.55	1.16	0.40	1.75	2.60	3.20	6.80
Sulfur	**sWV**	449	0.97	0.62	0.40	0.60	0.80	1.10	6.30
Sulfur	**KY**	695	1.65	1.29	0.40	0.71	1.08	2.20	8.90
Sulfur	**TN**	46	1.71	1.31	0.50	0.80	1.20	2.18	5.20
Sulfur	**VA**	433	1.19	0.89	0.40	0.68	0.85	1.27	6.61

Table 3. Coal quality statistics by state for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese. [N = number of samples; nWV = northern West Virginia coal field; sWV = southern West Virginia coal field.]

Parameter	State	N	Average	Standard Deviation	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
			percent	percent	percent	percent	percent	percent	percent
Pyritic sulfur	**PA**	688	1.61	1.25	0.01	0.71	1.38	2.17	7.31
Pyritic sulfur	**MD**	45	1.41	1.20	0.01	0.57	1.22	1.94	6.18
Pyritic sulfur	**OH**	625	2.10	1.24	0.03	1.22	1.90	2.78	8.97
Pyritic sulfur	**nWV**	22	1.31	0.85	0.13	0.74	1.22	1.69	3.18
Pyritic sulfur	**sWV**	84	0.30	0.41	0.02	0.07	0.17	0.32	2.14
Pyritic sulfur	**KY**	694	0.89	1.11	0.01	0.11	0.35	1.30	7.62
Pyritic sulfur	**TN**	46	0.79	0.98	0.03	0.10	0.39	1.01	3.65
Pyritic sulfur	**VA**	427	0.49	0.70	0.01	0.09	0.21	0.52	5.22
			ppm	ppm	ppm	ppm	ppm	ppm	ppm
Arsenic	**PA**	719	34	39	0.31	11.0	22	43	410
Arsenic	**MD**	46	25	21	0.80	9.9	18	31	79
Arsenic	**OH**	638	24	33	0.49	5.8	13	31	390
Arsenic	**nWV**	113	19	21	0.90	6.9	11	20	100
Arsenic	**sWV**	467	11	16	0.08	1.8	5	12	130
Arsenic	**KY**	718	29	52	0.50	3.8	11	34	680
Arsenic	**TN**	46	24	32	0.30	3.1	10	34	160
Arsenic	**VA**	466	20	31	0.45	3.4	8	21	330
			ppm	ppm	ppm	ppm	ppm	ppm	ppm
Mercury	**PA**	723	0.28	0.26	0.003	0.110	0.22	0.38	2.9
Mercury	**MD**	46	0.33	0.40	0.003	0.085	0.18	0.32	1.6
Mercury	**OH**	639	0.21	0.15	0.003	0.100	0.17	0.27	1.1
Mercury	**nWV**	114	0.25	0.20	0.007	0.120	0.20	0.30	1.0
Mercury	**sWV**	469	0.13	0.16	0.007	0.043	0.08	0.16	1.8
Mercury	**KY**	721	0.18	0.17	0.007	0.060	0.13	0.24	1.5
Mercury	**TN**	46	0.16	0.15	0.007	0.038	0.12	0.22	0.6
Mercury	**VA**	466	0.11	0.11	0.003	0.045	0.07	0.16	0.8
			ppm	ppm	ppm	ppm	ppm	ppm	ppm
Manganese	**PA**	720	25	40	0.9	8.5	15	25	470
Manganese	**MD**	46	18	18	1.1	6.7	12	22	90
Manganese	**OH**	639	31	47	2.5	13.0	20	33	690
Manganese	**nWV**	114	28	34	2.8	12.0	21	29	290
Manganese	**sWV**	468	20	44	0.7	4.3	8	17	540
Manganese	**KY**	721	18	43	1.2	5.4	9	17	660
Manganese	**TN**	46	15	14	2.8	5.7	11	18	70
Manganese	**VA**	466	21	27	0.8	6.2	12	23	260

Table 4. Coal quality statistics for coal beds with≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4a. Coal Samples, all thicknesses.

			Selenium								
Coal bed name, this report	Thickness range	Coal bed code N ≥ 30	N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Waynesburg	all	A	60	2.6	2.8	0.90	0.64	2.4	2.9	3.3	5.5
Sewickley	all	B	42	2.6	2.9	1.3	0.70	2.1	2.6	3.7	7.2
Redstone	all	C	74	2.0	2.2	1.2	0.50	1.4	2.0	2.6	7.0
Pittsburgh Roof	all		10	1.9	2.1	1.1	0.60	1.5	1.8	2.6	4.4
Pittsburgh	all	D	137	1.4	1.7	1.2	0.20	1.0	1.4	2.0	7.5
Harlem	all		9	1.1	1.2	0.32	0.68	0.90	1.2	1.4	1.6
Lower Bakerstown	all	E	30	3.1	3.5	1.9	1.5	2.4	3.3	4.2	11
Brush Creek	all		11	2.7	3.0	1.6	1.2	2.0	2.9	3.5	6.4
Mahoning	all		20	2.0	2.2	1.1	1.2	1.5	1.9	2.5	4.7
Upper Freeport Rider	all		6	2.8	3.2	1.5	1.4	1.8	3.5	4.2	5.1
Upper Freeport	all	F	277	2.4	2.8	2.0	0.43	1.7	2.2	3.1	14
Lower Freeport	all	G	102	3.3	3.9	2.6	0.90	2.2	3.3	4.7	15
Upper Kittanning	all	H	67	3.8	4.6	2.9	1.3	2.3	3.4	6.0	13
Middle Kittanning Rider	all		8	4.5	5.2	2.3	1.0	3.6	5.9	6.6	8.1
Middle Kittanning	all	I	243	3.2	3.6	2.1	1.0	2.4	3.1	4.2	17
Strasburg	all		11	3.6	3.9	1.6	1.5	3.6	3.9	4.1	7.7
Lower Kittanning Rider	all		7	3.4	3.9	2.5	1.6	2.4	3.1	4.4	8.9
Lower Kittanning/No 6 block	all	J	198	3.4	4.0	2.6	0.60	2.2	3.5	5.1	20
Clarion	all	K	74	5.6	6.2	2.5	1.2	4.7	6.1	7.6	14
Brookville	all	L	73	4.9	5.7	3.4	1.2	3.5	4.8	7.4	21
No 5 Block	all	M	93	6.2	7.1	3.1	0.10	5.2	6.9	8.9	18
Tionesta	all		5	7.7	8.1	2.9	5.8	6.2	7.1	8.2	13
Upper Mercer	all		8	7.7	8.6	4.3	3.1	5.8	7.2	12	16
Lower Mercer	all		24	6.2	7.1	3.1	0.84	5.6	6.6	8.8	13
Quakertown	all		9	5.9	7.2	4.2	1.2	4.5	5.7	12	12
Stockton	all	N	62	5.2	5.6	1.9	2.4	4.1	5.2	7.1	11
Coalburg	all	O	143	4.7	5.0	1.9	1.2	3.8	4.9	6.1	12
Winifrede/Hazard	all	P	79	4.4	4.7	1.8	0.50	3.5	4.6	5.7	11
Lower Winifrede/Hazard	all		10	2.8	4.0	2.0	0.07	3.4	4.0	5.0	7.4
Chilton/Taylor	all		15	3.1	3.7	2.2	0.73	2.4	3.4	4.4	8.7
Fire Clay Rider	all		29	4.0	4.5	2.6	1.7	3.2	4.1	4.9	13
Fire Clay	all	Q	70	3.6	3.9	1.6	1.3	2.7	3.5	5.0	9.0
Cedar Grove/Whitesburg	all	R	39	3.8	4.1	1.8	1.2	2.8	3.8	4.7	9.4
Williamson/Amburgy	all	S	45	3.0	3.3	1.6	0.90	2.1	3.0	4.2	7.5
Campbell Creek/Upper Elkhorn No 3	all	T	143	3.4	3.8	1.6	0.07	2.7	3.6	4.6	9.3
Upper Elkhorn Nos 1 and 2/Powellton	all	U	114	3.0	3.5	2.0	0.64	2.2	3.2	4.1	16
Pond Creek	all	V	121	3.2	3.4	1.2	1.2	2.5	3.2	4.2	6.7
Matewan/Clintwood	all	W	126	2.4	2.8	1.6	0.54	1.7	2.5	3.4	8.0
Middle War Eagle/Eagle	all		23	3.1	3.5	2.1	1.1	2.2	3.1	4.3	9.3
Bens Creek/Blair	all		15	2.0	2.2	0.88	0.80	1.8	2.0	2.5	4.2
Little Eagle/Dorchester	all	X	87	2.3	2.7	1.6	0.63	1.7	2.2	3.3	7.1
Lower War Eagle/Hagy	all		13	2.9	3.1	0.76	1.3	2.7	3.2	3.6	4.0
Glenalum Tunnel/Splashdam	all	Y	35	2.4	2.5	0.82	0.76	1.9	2.5	3.0	4.4
Gilbert A/Upper Banner	all	Z	46	2.7	3.0	1.3	1.2	2.2	2.7	3.5	6.7
Gilbert/Lower Banner	all		23	2.7	2.9	1.1	1.4	2.3	2.7	3.1	6.3
Douglas/Kennedy	all	AA	37	1.8	2.2	1.8	0.40	1.2	1.6	2.6	11
Jewell/Raven	all		24	1.9	2.2	1.2	0.20	1.5	2.1	2.7	5.9
Iaeger/Jawbone	all	BB	34	2.1	2.7	1.9	0.07	1.7	2.5	3.2	11
Lower Iaeger/Tiller	all		17	2.5	2.7	1.0	1.0	2.1	2.7	2.9	5.4
Sewell B/Greasy Creek	all		6	2.0	2.3	1.3	1.2	1.3	1.7	3.4	4.0
Sewell A	all		7	1.8	1.9	0.64	0.93	1.5	1.6	2.5	2.6
Sewell/Lower Seaboard	all	CC	61	2.0	2.6	2.2	0.76	1.3	1.8	2.8	14
Welch/Upper Horsepen	all		15	1.6	1.8	0.79	0.70	1.2	1.8	2.2	3.6
Little Raleigh/Middle Horsepen	all		8	2.1	2.2	0.63	1.1	1.9	2.1	2.6	3.1
Beckley/War Creek	all	DD	30	1.6	1.8	1.2	0.78	1.3	1.5	2.0	7.0
Fire Creek/Lower Horsepen	all		22	2.1	2.4	1.2	0.67	1.6	2.1	3.1	4.9
Pocahontas No 7	all		7	1.6	1.8	1.0	1.0	1.2	1.4	1.8	4.0
Pocahontas No 6	all		13	2.5	2.8	1.3	1.1	2.0	2.3	3.3	5.9
Pocahontas No 4	all		13	2.4	2.5	1.1	1.8	2.0	2.3	2.5	5.9
Pocahontas No 3	all	EE	53	3.1	3.4	1.7	1.1	2.3	2.9	4.1	8.2

Table 4. Coal quality statistics for coal beds with≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4a. Coal Samples, all thicknesses.

Coal Bed Name This Study	Thickness range	Coal bed code N ≥ 30	Thickness N	Geometric mean in	Average in	Standard Deviation in	Minimum in	Lower Quartile in	Median in	Upper Quartile in	Maximum in
Waynesburg	all	A	60	45.3	48.1	17.3	20.5	35.9	43.2	57.8	95.0
Sewickley	all	B	42	44.7	46.3	12.3	19.8	38.5	46.5	54.8	87.5
Redstone	all	C	74	40.4	45.5	20.3	12.0	28.1	47.3	61.8	88.0
Pittsburgh Roof	all		10	22.7	24.2	8.6	10.2	20.1	23.5	27.3	42.0
Pittsburgh	all	D	137	57.7	61.8	21.8	9.0	47.0	59.5	75.5	125.0
Harlem	all		9	23.9	24.3	4.7	17.5	20.0	25.8	27.0	32.0
Lower Bakerstown	all	E	30	27.4	28.7	8.9	13.2	23.3	27.0	32.9	56.0
Brush Creek	all		11	18.4	20.8	10.4	7.8	14.4	20.0	26.7	38.0
Mahoning	all		20	22.0	24.7	12.2	4.8	17.6	22.0	29.3	63.0
Upper Freeport Rider	all		6	24.0	25.4	8.7	15.0	18.0	27.5	30.6	36.0
Upper Freeport	all	F	278	36.7	41.3	18.0	2.0	29.3	42.0	49.2	105.5
Lower Freeport	all	G	103	31.0	34.8	16.0	5.4	25.1	32.6	42.5	74.0
Upper Kittanning	all	H	67	26.9	30.7	16.5	6.6	19.8	26.4	37.2	94.8
Middle Kittanning Rider	all		8	12.6	15.2	8.3	3.0	11.4	15.0	19.5	27.6
Middle Kittanning	all	I	243	31.3	34.1	13.2	2.5	26.0	34.0	41.4	95.5
Strasburg	all		11	18.8	19.8	6.8	12.8	14.3	17.5	23.9	33.0
Lower Kittanning Rider	all		7	13.7	17.3	15.6	6.6	9.9	12.0	15.6	51.6
Lower Kittanning/No 6 block	all	J	198	32.2	34.1	11.7	9.8	26.4	33.3	39.2	86.4
Clarion	all	K	74	29.6	33.7	17.2	9.0	20.1	31.6	42.6	96.0
Brookville	all	L	73	24.3	27.4	13.6	6.6	17.0	23.0	36.0	61.5
No 5 Block	all	M	93	37.7	47.0	32.5	7.4	24.0	40.0	55.0	171.8
Tionesta	all		5	31.9	36.0	15.1	10.5	36.6	39.5	44.3	49.3
Upper Mercer	all		8	21.7	23.8	10.8	11.4	15.9	21.9	29.3	40.5
Lower Mercer	all		24	24.6	26.8	12.2	10.8	21.9	24.3	30.2	69.6
Quakertown	all		9	24.1	24.7	6.1	18.5	19.8	24.0	26.0	38.4
Stockton	all	N	62	37.0	43.0	19.6	5.9	30.2	45.5	54.1	93.3
Coalburg	all	O	143	26.6	32.5	20.8	4.3	17.6	26.8	45.0	112.5
Winifrede/Hazard	all	P	79	27.6	31.9	15.8	4.3	20.3	31.0	40.0	73.2
Lower Winifrede/Hazard	all		10	20.7	22.7	8.9	6.7	17.7	24.2	29.1	35.8
Chilton/Taylor	all		15	24.5	32.1	22.1	5.5	14.4	31.1	41.4	85.2
Fire Clay Rider	all		29	21.6	27.9	19.5	6.0	10.2	27.2	38.0	91.3
Fire Clay	all	Q	70	28.5	33.4	17.5	6.0	20.0	32.0	44.0	80.5
Cedar Grove/Whitesburg	all	R	39	21.6	25.9	13.6	3.1	15.3	23.5	34.7	52.0
Williamson/Amburgy	all	S	45	23.0	27.4	16.5	5.5	14.6	24.0	38.9	84.0
Campbell Creek/Upper Elkhorn No 3	all	T	143	27.5	30.6	13.8	7.0	20.8	29.7	38.2	85.5
Upper Elkhorn Nos 1 and 2/Powellton	all	U	114	24.7	28.5	14.2	7.1	16.0	28.3	39.0	69.3
Pond Creek	all	V	121	30.8	35.2	16.5	4.0	23.6	34.0	44.1	85.4
Matewan/Clintwood	all	W	126	23.6	26.4	12.7	7.7	17.7	25.0	33.5	87.2
Middle War Eagle/Eagle	all		23	27.5	30.0	13.0	12.6	20.1	28.8	37.8	64.8
Bens Creek/Blair	all		15	27.4	30.2	11.6	7.0	25.3	31.0	35.7	50.0
Little Eagle/Dorchester	all	X	88	28.9	31.2	11.8	10.2	22.0	32.4	37.2	66.0
Lower War Eagle/Hagy	all		13	26.0	28.2	9.0	6.0	22.8	28.8	33.6	39.0
Glenalum Tunnel/Splashdam	all	Y	35	27.4	30.7	14.7	11.0	17.3	27.6	40.8	69.0
Gilbert A/Upper Banner	all	Z	46	25.5	30.0	18.1	6.3	17.4	29.4	37.1	110.2
Gilbert/Lower Banner	all		23	36.6	40.1	16.0	12.8	29.3	41.0	45.7	71.0
Douglas/Kennedy	all	AA	37	30.9	32.2	9.7	18.0	26.5	30.5	36.0	62.0
Jewell/Raven	all		24	30.9	35.6	15.6	6.0	29.5	37.0	43.3	68.4
Iaeger/Jawbone	all	BB	34	29.1	33.4	17.2	8.4	24.6	28.6	41.0	77.8
Lower Iaeger/Tiller	all		17	18.4	23.9	17.7	5.4	9.0	18.0	35.9	68.4
Sewell B/Greasy Creek	all		6	21.4	23.2	10.2	13.0	16.7	18.8	32.0	36.0
Sewell A	all		7	26.7	28.8	11.3	12.0	23.3	27.8	34.5	46.0
Sewell/Lower Seaboard	all	CC	61	33.0	35.9	14.6	12.5	24.0	35.9	44.0	70.6
Welch/Upper Horsepen	all		15	33.1	40.5	30.3	11.0	24.0	31.0	43.0	128.0
Little Raleigh/Middle Horsepen	all		8	32.2	34.8	13.0	17.0	22.5	42.0	42.0	51.0
Beckley/War Creek	all	DD	30	28.8	33.2	17.6	8.0	23.3	29.0	40.1	87.0
Fire Creek/Lower Horsepen	all		22	31.5	34.7	15.9	14.0	21.3	31.9	40.5	70.0
Pocahontas No 7	all		8	21.8	24.2	11.7	10.5	16.3	20.1	34.8	42.5
Pocahontas No 6	all		13	32.5	33.2	6.6	23.0	30.1	33.3	38.0	43.5
Pocahontas No 4	all		13	64.8	65.9	12.6	49.0	60.1	62.6	76.0	91.0
Pocahontas No 3	all	EE	53	41.7	45.9	18.3	11.1	34.0	47.4	55.8	94.0

Table 4. Coal quality statistics for coal beds with≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4a. Coal Samples, all thicknesses.

			Ash Yield								
Coal Bed Name This Study	Thickness range	Coal bed code N ≥ 30	N	Geometric mean percent	Average percent	Standard Deviation percent	Minimum percent	Lower Quartile percent	Median percent	Upper Quartile percent	Maximum percent
Waynesburg	all	A	57	16.65	17.20	3.71	3.16	15.63	17.16	19.37	29.70
Sewickley	all	B	40	11.59	11.98	3.10	5.70	9.72	11.50	13.83	20.20
Redstone	all	C	71	10.20	10.96	4.69	5.60	7.80	9.80	12.00	27.20
Pittsburgh Roof	all		10	14.63	15.30	4.39	6.80	12.95	15.62	17.25	22.30
Pittsburgh	all	D	129	10.00	10.51	3.83	4.40	8.20	10.18	11.72	32.03
Harlem	all		9	9.83	10.05	2.23	7.30	7.79	9.80	11.60	13.02
Lower Bakerstown	all	E *	29	11.47	12.74	6.22	5.55	8.65	10.52	14.74	29.30
Brush Creek	all		11	11.80	12.49	4.92	7.17	9.90	11.28	13.92	25.50
Mahoning	all		17	11.09	11.59	3.83	7.00	9.02	10.27	13.05	20.23
Upper Freeport Rider	all		6	12.61	14.05	8.09	8.10	8.89	11.81	14.19	29.70
Upper Freeport	all	F	218	12.36	13.26	5.08	3.60	9.90	12.03	15.69	29.31
Lower Freeport	all	G	103	10.60	11.61	5.38	3.90	8.23	10.00	14.48	31.20
Upper Kittanning	all	H	65	12.43	13.14	4.48	4.54	10.71	12.21	15.05	30.21
Middle Kittanning Rider	all		8	9.03	10.13	5.68	4.50	7.50	8.80	10.65	22.70
Middle Kittanning	all	I	239	9.43	10.71	5.33	1.70	6.85	9.73	14.16	28.66
Strasburg	all		11	11.32	11.73	3.15	6.30	9.80	11.80	13.57	16.80
Lower Kittanning Rider	all		7	11.43	13.08	7.50	5.70	7.49	12.90	15.29	27.44
Lower Kittanning/No 6 block	all	J	193	10.69	11.64	5.01	2.80	8.02	10.82	13.70	31.50
Clarion	all	K	74	12.98	14.07	5.43	4.20	10.19	13.95	17.09	28.38
Brookville	all	L	72	12.12	13.19	5.60	5.30	8.86	12.55	16.30	29.45
No 5 Block	all	M	85	10.70	11.83	5.52	2.70	7.80	10.59	14.50	31.50
Tionesta	all		5	13.58	15.26	9.64	9.82	10.62	10.75	12.70	32.40
Upper Mercer	all		8	18.07	18.61	4.48	10.40	16.57	19.08	21.11	24.52
Lower Mercer	all		23	15.22	16.18	5.32	4.80	12.78	15.07	19.73	27.09
Quakertown	all		9	11.09	12.10	4.35	3.30	10.33	12.81	14.42	17.40
Stockton	all	N	60	11.48	12.64	5.61	4.22	8.53	12.39	14.72	29.60
Coalburg	all	O	142	9.55	10.87	5.56	2.70	6.91	10.04	13.33	30.70
Winifrede/Hazard	all	P	77	8.62	10.39	6.13	2.00	5.20	9.49	14.27	28.50
Lower Winifrede/Hazard	all		10	7.43	8.26	3.81	3.50	5.66	7.43	10.82	15.10
Chilton/Taylor	all		15	11.56	12.53	5.75	5.70	8.95	12.70	13.54	30.00
Fire Clay Rider	all		23	11.38	12.88	6.96	3.65	8.75	11.12	16.05	32.90
Fire Clay	all	Q	66	9.66	11.08	5.85	2.50	6.79	10.66	13.88	31.80
Cedar Grove/Whitesburg	all	R	37	9.25	10.26	4.58	2.47	7.60	9.80	12.20	23.30
Williamson/Amburgy	all	S	44	7.61	8.76	4.99	2.30	5.86	7.72	10.77	26.10
Campbell Creek/Upper Elkhorn No 3	all	T	142	6.25	7.30	3.87	0.90	4.35	6.86	9.40	21.60
Upper Elkhorn Nos 1 and 2/Powellton	all	U	111	5.88	6.81	3.91	1.60	4.33	6.04	8.35	22.37
Pond Creek	all	V	121	6.32	7.40	3.95	1.22	4.50	6.70	10.20	16.80
Matewan/Clintwood	all	W	125	5.99	6.78	3.54	1.73	4.10	6.00	8.70	21.60
Middle War Eagle/Eagle	all		21	5.16	5.88	3.17	1.66	3.79	5.50	6.70	14.01
Bens Creek/Blair	all		15	5.08	7.20	6.26	1.60	2.65	4.34	10.40	18.30
Little Eagle/Dorchester	all	X	88	6.57	8.01	5.31	1.93	4.38	5.77	10.97	28.20
Lower War Eagle/Hagy	all		12	9.63	10.70	5.16	4.30	8.14	9.99	12.30	22.80
Glenalum Tunnel/Splashdam	all	Y	35	6.01	7.70	5.87	1.74	3.65	6.10	9.35	25.30
Gilbert A/Upper Banner	all	Z	41	7.64	8.38	3.92	3.60	5.99	6.94	10.30	20.67
Gilbert/Lower Banner	all		20	9.08	10.20	4.87	3.40	6.46	10.12	12.83	19.63
Douglas/Kennedy	all	AA	32	6.29	7.67	6.07	2.75	4.41	5.82	8.15	29.55
Jewell/Raven	all		19	6.41	7.95	5.75	2.40	3.95	5.90	9.83	24.59
Iaeger/Jawbone	all	BB	33	9.33	12.03	8.06	2.00	6.50	10.50	16.10	30.90
Lower Iaeger/Tiller	all		17	8.48	9.64	4.84	2.90	6.10	8.81	12.20	19.40
Sewell B/Greasy Creek	all		5	10.02	10.88	5.12	5.90	7.46	10.31	11.64	19.09
Sewell A	all		5	5.66	6.80	5.38	3.70	3.90	4.20	5.90	16.30
Sewell/Lower Seaboard	all	CC	52	6.27	7.39	4.59	2.30	3.95	6.15	9.23	21.60
Welch/Upper Horsepen	all		9	6.83	7.42	3.09	3.40	5.20	8.00	8.30	13.19
Little Raleigh/Middle Horsepen	all		6	8.75	10.59	8.62	5.10	5.98	7.80	9.18	27.85
Beckley/War Creek	all	DD *	27	6.19	7.64	5.61	0.90	4.60	6.70	8.00	29.30
Fire Creek/Lower Horsepen	all		22	6.23	6.91	3.31	2.60	5.03	6.50	8.63	17.20
Pocahontas No 7	all		8	9.40	11.23	8.09	4.60	7.44	8.74	10.96	29.25
Pocahontas No 6	all		13	7.33	7.98	3.78	4.30	5.60	6.90	9.60	17.90
Pocahontas No 4	all		13	6.14	6.35	1.84	4.20	5.60	5.93	6.60	11.40
Pocahontas No 3	all	EE	49	7.68	8.61	4.45	2.90	5.80	7.30	10.60	26.00

Table 4. Coal quality statistics for coal beds with≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4a. Coal Samples, all thicknesses.

Coal Bed Name This Study	Thickness range	Coal bed code N ≥ 30	Sulfur N	Geometric mean percent	Average percent	Standard Deviation percent	Minimum percent	Lower Quartile percent	Median percent	Upper Quartile percent	Maximum percent
Waynesburg	all	A	58	2.58	2.77	0.98	0.70	2.20	2.67	3.40	5.20
Sewickley	all	B	40	2.64	2.95	1.28	0.70	2.05	2.96	3.74	5.90
Redstone	all	C	71	2.64	2.84	1.05	0.80	2.18	2.70	3.24	5.90
Pittsburgh Roof	all		10	2.23	2.88	1.99	0.60	1.26	2.30	4.38	6.50
Pittsburgh	all	D	129	2.94	3.34	1.48	0.40	2.22	3.40	4.50	6.70
Harlem	all		9	1.38	1.70	1.12	0.50	0.80	1.26	2.70	3.66
Lower Bakerstown	all	E *	29	2.32	2.66	1.22	0.40	1.72	2.69	3.31	5.41
Brush Creek	all		11	2.46	3.01	1.88	0.39	2.05	2.39	3.36	7.50
Mahoning	all		17	2.08	2.41	1.27	0.63	1.43	1.93	3.22	5.10
Upper Freeport Rider	all		6	1.97	2.72	2.08	0.50	1.10	2.27	4.46	5.40
Upper Freeport	all	F	270	2.16	2.45	1.29	0.59	1.55	2.19	3.05	8.00
Lower Freeport	all	G	103	2.33	2.77	1.48	0.50	1.83	2.64	3.68	7.22
Upper Kittanning	all	H	65	1.73	2.11	1.25	0.40	1.00	1.96	3.02	5.72
Middle Kittanning Rider	all		8	1.25	1.79	1.47	0.50	0.50	1.55	2.63	4.40
Middle Kittanning	all	I	239	2.63	3.01	1.45	0.50	1.99	2.89	3.90	8.11
Strasburg	all		11	4.28	4.88	1.98	1.10	4.41	5.59	6.14	7.20
Lower Kittanning Rider	all		7	1.33	1.49	0.80	0.82	0.91	1.00	1.95	2.93
Lower Kittanning/No 6 block	all	J	193	2.93	3.47	1.81	0.40	2.22	3.30	4.66	10.40
Clarion	all	K	74	3.09	3.53	1.61	0.50	2.41	3.59	4.38	9.34
Brookville	all	L	72	2.65	3.08	1.81	0.70	1.98	2.60	3.65	10.40
No 5 Block	all	M	85	0.95	1.15	0.89	0.40	0.66	0.80	1.20	4.87
Tionesta	all		5	3.99	4.92	3.49	1.38	2.97	4.80	4.83	10.60
Upper Mercer	all		8	3.53	3.73	1.31	2.19	2.77	3.70	4.45	5.96
Lower Mercer	all		23	2.13	2.58	1.58	0.51	1.47	1.91	3.75	6.15
Quakertown	all		9	1.70	2.35	2.19	0.55	0.90	1.71	2.40	7.21
Stockton	all	N	60	1.02	1.33	1.19	0.50	0.60	0.77	1.43	5.50
Coalburg	all	O	142	1.04	1.24	0.88	0.40	0.70	0.90	1.37	4.70
Winifrede/Hazard	all	P	77	0.91	1.05	0.71	0.41	0.66	0.80	1.10	4.70
Lower Winifrede/Hazard	all		10	0.91	0.99	0.48	0.60	0.69	0.77	1.21	2.14
Chilton/Taylor	all		15	1.45	1.78	1.27	0.60	0.90	1.20	2.77	4.90
Fire Clay Rider	all		23	2.24	2.70	1.52	0.69	1.32	2.80	3.60	5.20
Fire Clay	all	Q	66	1.00	1.18	0.91	0.50	0.70	0.83	1.22	5.95
Cedar Grove/Whitesburg	all	R	37	1.39	1.73	1.22	0.60	0.83	1.20	2.42	4.53
Williamson/Amburgy	all	S	44	1.50	1.84	1.25	0.59	0.80	1.47	2.44	5.80
Campbell Creek/Upper Elkhorn No 3	all	T	142	1.12	1.35	0.95	0.46	0.70	0.90	1.80	5.10
Upper Elkhorn Nos 1 and 2/Powellton	all	U	111	1.25	1.59	1.28	0.50	0.74	1.00	1.95	6.60
Pond Creek	all	V	121	1.09	1.37	1.09	0.41	0.65	0.90	1.61	6.30
Matewan/Clintwood	all	W	125	1.28	1.62	1.28	0.50	0.76	1.08	2.10	6.61
Middle War Eagle/Eagle	all		21	1.33	1.58	0.89	0.46	0.90	1.40	2.40	3.10
Bens Creek/Blair	all		15	1.17	1.38	0.89	0.50	0.80	1.00	1.88	3.56
Little Eagle/Dorchester	all	X	88	1.10	1.24	0.79	0.50	0.82	1.00	1.31	5.00
Lower War Eagle/Hagy	all		12	1.56	1.80	0.99	0.60	1.13	1.41	2.61	3.60
Glenalum Tunnel/Splashdam	all	Y	35	1.01	1.29	1.16	0.60	0.65	0.72	1.24	5.20
Gilbert A/Upper Banner	all	Z	41	1.03	1.29	1.03	0.40	0.60	0.90	1.67	5.80
Gilbert/Lower Banner	all		20	0.92	1.01	0.50	0.56	0.60	0.80	1.13	2.19
Douglas/Kennedy	all	AA	32	0.94	1.05	0.58	0.50	0.70	0.80	1.31	2.93
Jewell/Raven	all		19	0.96	1.29	1.27	0.50	0.60	0.75	1.14	4.20
Iaeger/Jawbone	all	BB	33	0.84	1.12	1.15	0.50	0.60	0.60	0.80	4.90
Lower Iaeger/Tiller	all		17	1.67	2.77	2.63	0.50	0.60	1.59	4.20	8.90
Sewell B/Greasy Creek	all		5	1.36	1.52	0.75	0.60	1.13	1.39	1.96	2.54
Sewell A	all		5	0.65	0.66	0.13	0.50	0.60	0.60	0.80	0.80
Sewell/Lower Seaboard	all	CC	52	0.82	0.91	0.48	0.40	0.60	0.80	1.05	2.58
Welch/Upper Horsepen	all		9	0.81	0.86	0.32	0.50	0.72	0.80	1.00	1.40
Little Raleigh/Middle Horsepen	all		6	0.72	0.75	0.21	0.50	0.58	0.80	0.88	1.00
Beckley/War Creek	all	DD *	27	0.87	1.00	0.61	0.40	0.60	0.80	1.25	3.20
Fire Creek/Lower Horsepen	all		22	0.86	0.90	0.28	0.40	0.70	0.85	1.10	1.50
Pocahontas No 7	all		8	0.76	0.81	0.33	0.50	0.56	0.63	1.15	1.27
Pocahontas No 6	all		13	1.00	1.06	0.43	0.50	0.80	0.90	1.20	2.30
Pocahontas No 4	all		13	0.64	0.65	0.12	0.50	0.60	0.65	0.70	0.88
Pocahontas No 3	all	EE	49	0.69	0.74	0.33	0.40	0.50	0.60	0.80	1.80

Table 4. Coal quality statistics for coal beds with≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4a. Coal Samples, all thicknesses.

			Pyritic Sulfur								
Coal Bed Name This Study	Thickness range	Coal bed code N ≥ 30	N	Geometric mean percent	Average percent	Standard Deviation percent	Minimum percent	Lower Quartile percent	Median percent	Upper Quartile percent	Maximum percent
Waynesburg	all	A	50	1.49	1.83	0.95	0.05	1.11	1.77	2.33	4.00
Sewickley	all	B	38	1.09	1.45	0.78	0.02	0.96	1.35	1.94	2.87
Redstone	all	C	35	1.63	1.90	1.00	0.19	1.24	1.75	2.41	4.93
Pittsburgh Roof	all		10	1.01	1.99	1.84	0.03	0.55	1.31	3.23	5.74
Pittsburgh	all	D	99	1.66	2.09	1.07	0.05	1.39	2.02	2.89	5.16
Harlem	all		9	0.60	0.94	0.81	0.07	0.26	0.62	1.22	2.44
Lower Bakerstown	all	E *	29	1.12	1.61	0.90	0.01	0.74	1.69	2.25	3.46
Brush Creek	all		11	1.45	2.18	1.75	0.05	1.31	1.52	2.38	6.45
Mahoning	all		16	0.90	1.44	0.98	0.02	0.70	1.36	2.08	3.34
Upper Freeport Rider	all		6	0.50	1.90	1.95	0.01	0.26	1.42	3.57	4.39
Upper Freeport	all	F	264	1.22	1.58	1.10	0.05	0.81	1.35	1.89	6.18
Lower Freeport	all	G	102	1.15	1.77	1.15	0.01	0.95	1.64	2.50	5.43
Upper Kittanning	all	H	63	0.72	1.40	1.17	0.01	0.37	1.41	2.15	5.41
Middle Kittanning Rider	all		8	0.30	1.06	1.10	0.02	0.04	0.99	1.73	2.89
Middle Kittanning	all	I	234	1.33	1.78	1.18	0.01	0.99	1.63	2.39	6.85
Strasburg	all		11	2.53	3.12	1.54	0.38	2.74	3.11	3.95	5.48
Lower Kittanning Rider	all		7	0.39	0.68	0.71	0.07	0.16	0.49	1.06	1.78
Lower Kittanning/No 6 block	all	J	186	1.62	2.24	1.43	0.02	1.21	2.02	3.02	8.08
Clarion	all	K	74	1.58	2.15	1.33	0.03	1.39	1.98	2.68	7.31
Brookville	all	L	71	1.36	1.85	1.60	0.07	0.91	1.38	2.03	8.97
No 5 Block	all	M	55	0.23	0.69	0.93	0.01	0.05	0.33	0.84	3.46
Tionesta	all		5	3.00	3.77	2.92	1.13	2.02	3.39	3.65	8.67
Upper Mercer	all		8	2.63	2.89	1.28	1.31	2.20	2.59	4.00	4.66
Lower Mercer	all		22	1.00	1.64	1.30	0.02	0.80	1.01	2.58	4.75
Quakertown	all		9	0.93	1.80	2.18	0.14	0.44	1.11	1.52	6.81
Stockton	all	N	43	0.26	0.75	1.11	0.01	0.08	0.30	0.76	4.85
Coalburg	all	O	120	0.28	0.61	0.79	0.01	0.11	0.28	0.82	3.99
Winifrede/Hazard	all	P	63	0.19	0.45	0.68	0.01	0.07	0.20	0.58	3.66
Lower Winifrede/Hazard	all		10	0.16	0.30	0.38	0.04	0.07	0.15	0.33	1.16
Chilton/Taylor	all		14	0.50	1.01	1.08	0.07	0.19	0.37	2.17	2.86
Fire Clay Rider	all		23	0.92	1.58	1.27	0.03	0.57	1.30	2.31	4.21
Fire Clay	all	Q	62	0.24	0.49	0.66	0.02	0.10	0.22	0.56	3.33
Cedar Grove/Whitesburg	all	R *	22	0.76	1.39	1.11	0.02	0.38	1.08	2.37	3.54
Williamson/Amburgy	all	S	42	0.48	0.97	0.97	0.02	0.18	0.66	1.38	4.18
Campbell Creek/Upper Elkhorn No 3	all	T	80	0.30	0.76	0.94	0.03	0.09	0.24	1.22	3.50
Upper Elkhorn Nos 1 and 2/Powellton	all	U	90	0.36	0.93	1.17	0.01	0.12	0.30	1.46	5.17
Pond Creek	all	V	73	0.27	0.70	0.88	0.02	0.07	0.23	1.11	3.78
Matewan/Clintwood	all	W	123	0.36	0.85	1.06	0.01	0.14	0.32	1.23	5.22
Middle War Eagle/Eagle	all		17	0.43	0.83	0.71	0.02	0.18	0.68	1.35	2.06
Bens Creek/Blair	all		10	0.34	0.84	1.00	0.06	0.08	0.33	1.47	2.90
Little Eagle/Dorchester	all	X	85	0.28	0.47	0.56	0.01	0.15	0.31	0.51	3.27
Lower War Eagle/Hagy	all		9	0.51	0.91	0.94	0.06	0.23	0.59	1.13	2.80
Glenalum Tunnel/Splashdam	all	Y	34	0.18	0.66	1.07	0.01	0.04	0.18	0.61	4.20
Gilbert A/Upper Banner	all	Z	41	0.23	0.61	0.99	0.01	0.10	0.19	0.78	5.72
Gilbert/Lower Banner	all		17	0.18	0.29	0.34	0.03	0.09	0.17	0.30	1.36
Douglas/Kennedy	all	AA *	27	0.23	0.37	0.46	0.05	0.13	0.19	0.42	2.07
Jewell/Raven	all		19	0.20	0.56	0.98	0.03	0.07	0.18	0.37	3.61
Iaeger/Jawbone	all	BB *	29	0.17	0.55	0.94	0.02	0.07	0.10	0.29	3.23
Lower Iaeger/Tiller	all		16	0.60	2.16	2.40	0.03	0.07	1.27	3.72	7.62
Sewell B/Greasy Creek	all		4	0.78	0.86	0.46	0.48	0.55	0.74	1.06	1.49
Sewell A	all		0								
Sewell/Lower Seaboard	all	CC *	22	0.28	0.46	0.46	0.04	0.09	0.39	0.59	1.79
Welch/Upper Horsepen	all		8	0.13	0.21	0.18	0.01	0.09	0.14	0.37	0.46
Little Raleigh/Middle Horsepen	all		6	0.13	0.17	0.10	0.02	0.11	0.19	0.22	0.30
Beckley/War Creek	all	DD *	19	0.18	0.37	0.54	0.03	0.10	0.13	0.29	2.14
Fire Creek/Lower Horsepen	all		13	0.18	0.27	0.25	0.02	0.16	0.18	0.26	0.96
Pocahontas No 7	all		7	0.14	0.24	0.22	0.02	0.08	0.19	0.36	0.62
Pocahontas No 6	all		4	0.32	0.38	0.21	0.12	0.27	0.41	0.52	0.59
Pocahontas No 4	all		4	0.09	0.11	0.07	0.04	0.05	0.11	0.16	0.17
Pocahontas No 3	all	EE *	19	0.13	0.18	0.11	0.02	0.08	0.19	0.25	0.38

Table 4. Coal quality statistics for coal beds with≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4a. Coal Samples, all thicknesses.

Coal Bed Name This Study	Thickness range	Coal bed code N ≥ 30	Arsenic N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Waynesburg	all	A	60	16	19	14	0.80	10	15	25	74
Sewickley	all	B	42	5.4	6.7	4.1	0.80	3.7	6.1	8.5	19
Redstone	all	C	74	16	28	41	1.5	8.0	14	32	290
Pittsburgh Roof	all		9	11	17	12	0.85	9.3	14	25	41
Pittsburgh	all	D	136	11	17	18	0.70	5.5	11	22	87
Harlem	all		9	8.8	15	16	1.5	5.9	9.3	19	53
Lower Bakerstown	all	E	30	30	47	69	3.4	14	34	50	390
Brush Creek	all		11	21	32	23	0.76	16	30	40	77
Mahoning	all		20	71	96	87	9.3	46	73	110	410
Upper Freeport Rider	all		6	35	62	60	2.7	25	49	78	170
Upper Freeport	all	F	278	30	40	32	2.4	19	31	50	200
Lower Freeport	all	G	102	24	37	34	0.88	14	30	51	190
Upper Kittanning	all	H	67	24	41	41	1.0	12	29	53	230
Middle Kittanning Rider	all		8	22	43	39	1.4	16	38	61	120
Middle Kittanning	all	I	240	11	22	29	0.70	4.6	10	28	180
Strasburg	all		11	15	28	30	2.7	5.4	15	35	100
Lower Kittanning Rider	all		7	11	15	13	3.0	5.6	9.6	22	38
Lower Kittanning/No 6 block	all	J	197	15	27	40	0.31	8.3	15	32	320
Clarion	all	K	74	10	17	17	1.4	3.9	9.8	27	73
Brookville	all	L	73	10	20	31	0.49	4.9	10	18	180
No 5 Block	all	M	92	5.8	14	24	0.75	1.9	4.9	13	150
Tionesta	all		5	33	49	44	9.1	17	30	80	110
Upper Mercer	all		8	27	37	39	11	17	21	38	130
Lower Mercer	all		24	14	26	36	1.6	7.8	14	28	160
Quakertown	all		9	22	28	24	9.5	12	17	41	81
Stockton	all	N	62	5.2	12	16	0.60	1.7	4.3	20	79
Coalburg	all	O	142	6.8	15	25	0.40	2.6	6.2	16	170
Winifrede/Hazard	all	P	79	5.4	15	39	0.50	2.1	4.8	11	270
Lower Winifrede/Hazard	all		9	6.0	12	16	1.2	2.6	5.6	13	52
Chilton/Taylor	all		15	8.5	17	19	1.2	2.5	7.7	30	58
Fire Clay Rider	all		29	23	45	61	1.2	9.2	30	46	300
Fire Clay	all	Q	70	6.7	14	21	0.70	2.8	5.1	17	120
Cedar Grove/Whitesburg	all	R	39	10	24	46	0.75	3.6	10	34	280
Williamson/Amburgy	all	S	45	13	29	35	0.61	5.0	16	33	170
Campbell Creek/Upper Elkhorn No 3	all	T	142	7.2	17	26	0.85	2.3	7.0	19	170
Upper Elkhorn Nos 1 and 2/Powellton	all	U	114	13	42	90	0.80	4.3	11	34	680
Pond Creek	all	V	120	5.9	16	25	0.08	1.7	5.5	17	120
Matewan/Clintwood	all	W	126	10	26	37	0.50	3.4	9.9	32	180
Middle War Eagle/Eagle	all		23	17	38	37	1.1	3.8	29	66	110
Bens Creek/Blair	all		15	9.7	29	37	0.30	3.2	6.2	42	110
Little Eagle/Dorchester	all	X	88	12	23	28	1.1	3.9	14	29	130
Lower War Eagle/Hagy	all		13	23	75	110	1.0	4.2	48	59	330
Glenalum Tunnel/Splashdam	all	Y	35	7.7	21	31	0.87	2.8	5.7	22	120
Gilbert A/Upper Banner	all	Z	46	9.2	20	26	0.76	3.5	6.4	32	99
Gilbert/Lower Banner	all		23	11	23	34	1.6	4.0	8.4	22	120
Douglas/Kennedy	all	AA	37	14	23	25	1.6	7.7	11	30	100
Jewell/Raven	all		24	6.5	8.3	6.8	2.0	4.5	6.9	10	30
Iaeger/Jawbone	all	BB	34	5.9	14	20	0.45	2.4	6.0	15	80
Lower Iaeger/Tiller	all		17	15	50	81	1.6	4.7	14	56	310
Sewell B/Greasy Creek	all		6	23	39	32	1.5	20	29	66	79
Sewell A	all		7	3.8	5.3	6.1	2.0	2.4	3.1	4.3	19
Sewell/Lower Seaboard	all	CC	61	6.4	13	17	0.40	2.9	6.4	16	78
Welch/Upper Horsepen	all		15	12	22	22	1.4	4.5	11	40	64
Little Raleigh/Middle Horsepen	all		8	5.0	5.8	3.7	2.2	3.8	4.9	6.2	14
Beckley/War Creek	all	DD	30	8.8	18	22	0.25	4.2	12	19	89
Fire Creek/Lower Horsepen	all		22	7.9	12	11	1.3	3.1	12	16	40
Pocahontas No 7	all		7	12	26	31	2.7	4.6	7.6	44	75
Pocahontas No 6	all		12	11	18	22	1.4	6.4	11	19	85
Pocahontas No 4	all		13	6.6	12	13	1.2	3.5	5.0	16	39
Pocahontas No 3	all	EE	53	5.3	12	16	0.30	1.7	5.1	12	73

Table 4. Coal quality statistics for coal beds with≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4a. Coal Samples, all thicknesses.

			Mercury								
Coal Bed Name This Study	Thickness range	Coal bed code N ≥ 30	N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Waynesburg	all	A	60	0.15	0.17	0.082	0.010	0.13	0.15	0.20	0.53
Sewickley	all	B	42	0.10	0.12	0.066	0.021	0.080	0.10	0.14	0.29
Redstone	all	C	74	0.15	0.22	0.17	0.007	0.10	0.17	0.29	0.93
Pittsburgh Roof	all		10	0.24	0.31	0.21	0.068	0.15	0.28	0.43	0.69
Pittsburgh	all	D	137	0.13	0.17	0.15	0.003	0.081	0.13	0.21	1.0
Harlem	all		9	0.076	0.14	0.11	0.007	0.030	0.18	0.23	0.31
Lower Bakerstown	all	E	30	0.16	0.23	0.24	0.003	0.12	0.18	0.25	1.3
Brush Creek	all		11	0.17	0.27	0.22	0.010	0.11	0.20	0.35	0.70
Mahoning	all		20	0.32	0.40	0.27	0.068	0.26	0.30	0.45	1.0
Upper Freeport Rider	all		6	0.76	0.84	0.44	0.490	0.57	0.73	0.83	1.7
Upper Freeport	all	F	278	0.25	0.33	0.25	0.003	0.20	0.29	0.38	2.9
Lower Freeport	all	G	103	0.20	0.30	0.24	0.003	0.14	0.27	0.41	1.6
Upper Kittanning	all	H	67	0.18	0.31	0.29	0.003	0.080	0.27	0.48	1.4
Middle Kittanning Rider	all		8	0.42	0.53	0.37	0.140	0.25	0.48	0.65	1.3
Middle Kittanning	all	I	243	0.15	0.23	0.21	0.003	0.11	0.17	0.28	1.6
Strasburg	all		11	0.23	0.27	0.13	0.076	0.17	0.27	0.38	0.45
Lower Kittanning Rider	all		7	0.048	0.12	0.12	0.003	0.037	0.090	0.18	0.33
Lower Kittanning/No 6 block	all	J	198	0.15	0.24	0.21	0.003	0.10	0.19	0.33	1.6
Clarion	all	K	74	0.14	0.18	0.14	0.010	0.086	0.13	0.24	0.76
Brookville	all	L	73	0.16	0.22	0.21	0.018	0.10	0.20	0.27	1.5
No 5 Block	all	M	93	0.13	0.18	0.18	0.023	0.082	0.14	0.23	1.5
Tionesta	all		5	0.11	0.16	0.16	0.054	0.055	0.057	0.18	0.43
Upper Mercer	all		8	0.16	0.21	0.14	0.040	0.11	0.20	0.29	0.42
Lower Mercer	all		24	0.13	0.23	0.17	0.003	0.088	0.20	0.39	0.51
Quakertown	all		9	0.12	0.16	0.13	0.033	0.073	0.12	0.26	0.42
Stockton	all	N	62	0.11	0.16	0.15	0.007	0.061	0.12	0.20	0.67
Coalburg	all	O	143	0.10	0.15	0.12	0.007	0.060	0.10	0.21	0.59
Winifrede/Hazard	all	P	79	0.090	0.16	0.17	0.007	0.042	0.084	0.22	1.0
Lower Winifrede/Hazard	all		9	0.044	0.079	0.093	0.007	0.020	0.049	0.055	0.26
Chilton/Taylor	all		15	0.15	0.20	0.17	0.043	0.090	0.16	0.26	0.74
Fire Clay Rider	all		29	0.19	0.23	0.16	0.055	0.12	0.18	0.26	0.72
Fire Clay	all	Q	70	0.082	0.12	0.099	0.007	0.050	0.080	0.22	0.43
Cedar Grove/Whitesburg	all	R	39	0.099	0.18	0.22	0.003	0.038	0.12	0.25	1.1
Williamson/Amburgy	all	S	45	0.092	0.14	0.11	0.010	0.045	0.091	0.22	0.49
Campbell Creek/Upper Elkhorn No 3	all	T	142	0.085	0.13	0.12	0.007	0.051	0.091	0.17	0.72
Upper Elkhorn Nos 1 and 2/Powellton	all	U	114	0.11	0.16	0.14	0.007	0.059	0.12	0.24	0.81
Pond Creek	all	V	121	0.078	0.12	0.12	0.003	0.049	0.080	0.16	0.57
Matewan/Clintwood	all	W	126	0.077	0.14	0.12	0.003	0.035	0.11	0.21	0.56
Middle War Eagle/Eagle	all		23	0.080	0.12	0.11	0.007	0.040	0.10	0.17	0.45
Bens Creek/Blair	all		15	0.052	0.10	0.11	0.007	0.025	0.039	0.18	0.29
Little Eagle/Dorchester	all	X	88	0.076	0.12	0.11	0.003	0.050	0.070	0.16	0.51
Lower War Eagle/Hagy	all		13	0.11	0.18	0.15	0.003	0.10	0.16	0.27	0.55
Glenalum Tunnel/Splashdam	all	Y	35	0.13	0.19	0.15	0.003	0.068	0.13	0.28	0.55
Gilbert A/Upper Banner	all	Z	46	0.058	0.099	0.11	0.003	0.050	0.070	0.12	0.51
Gilbert/Lower Banner	all		23	0.061	0.11	0.11	0.003	0.045	0.070	0.15	0.37
Douglas/Kennedy	all	AA	37	0.080	0.14	0.15	0.007	0.050	0.080	0.19	0.62
Jewell/Raven	all		24	0.080	0.10	0.083	0.015	0.050	0.075	0.13	0.37
Iaeger/Jawbone	all	BB	34	0.086	0.13	0.11	0.007	0.051	0.090	0.19	0.42
Lower Iaeger/Tiller	all		17	0.096	0.27	0.30	0.007	0.034	0.13	0.52	1.0
Sewell B/Greasy Creek	all		6	0.12	0.23	0.29	0.014	0.080	0.16	0.20	0.80
Sewell A	all		7	0.11	0.20	0.21	0.020	0.055	0.070	0.36	0.51
Sewell/Lower Seaboard	all	CC	61	0.13	0.20	0.21	0.017	0.060	0.14	0.26	0.97
Welch/Upper Horsepen	all		15	0.10	0.17	0.21	0.030	0.060	0.077	0.20	0.81
Little Raleigh/Middle Horsepen	all		8	0.083	0.11	0.080	0.014	0.064	0.091	0.13	0.27
Beckley/War Creek	all	DD	30	0.074	0.15	0.32	0.007	0.050	0.075	0.11	1.8
Fire Creek/Lower Horsepen	all		22	0.076	0.092	0.058	0.025	0.050	0.071	0.13	0.23
Pocahontas No 7	all		7	0.026	0.044	0.030	0.003	0.024	0.060	0.065	0.070
Pocahontas No 6	all		13	0.089	0.20	0.24	0.015	0.030	0.080	0.32	0.66
Pocahontas No 4	all		13	0.042	0.054	0.031	0.007	0.039	0.050	0.080	0.095
Pocahontas No 3	all	EE	53	0.068	0.11	0.12	0.007	0.050	0.072	0.11	0.66

Table 4. Coal quality statistics for coal beds with≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4a. Coal Samples, all thicknesses.

Coal Bed Name This Study	Thickness range	Coal bed code N ≥ 30	Manganese N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Waynesburg	all	A	60	26	32	27	10	20	25	35	180
Sewickley	all	B	42	20	33	53	6.4	11	16	24	260
Redstone	all	C	74	28	45	65	5	17	25	39	460
Pittsburgh Roof	all		10	14	15	5.9	6.1	13	14	17	27
Pittsburgh	all	D	137	21	29	33	1.4	14	20	35	300
Harlem	all		9	16	25	27	6.2	7.3	15	28	90
Lower Bakerstown	all	E	30	24	43	71	6.5	12	16	52	390
Brush Creek	all		11	13	27	46	3.4	5.6	8.6	25	160
Mahoning	all		20	12	16	13	3.3	6.4	13	25	59
Upper Freeport Rider	all		6	15	20	16	5.8	8.7	15	28	47
Upper Freeport	all	F	276	16	22	21	1.1	9.3	16	27	140
Lower Freeport	all	G	103	17	34	75	0.92	9.2	16	30	690
Upper Kittanning	all	H	67	13	18	22	3.3	8.2	12	21	170
Middle Kittanning Rider	all		8	24	26	12	14	16	24	32	46
Middle Kittanning	all	I	242	18	25	29	1.7	10	17	28	310
Strasburg	all		11	25	35	32	6.3	17	28	42	120
Lower Kittanning Rider	all		7	8.5	9.6	6.4	5.8	6.4	7.9	8.5	24
Lower Kittanning/No 6 block	all	J	198	16	26	47	1.6	9.7	15	26	430
Clarion	all	K	74	20	27	29	3.6	12	22	33	220
Brookville	all	L	73	17	29	57	2.1	10	17	26	470
No 5 Block	all	M	93	7.8	13	24	1.4	4.4	6.8	12	200
Tionesta	all		5	35	99	180	13	21	21	21	420
Upper Mercer	all		8	32	52	63	8.8	15	32	55	200
Lower Mercer	all		24	15	26	39	4.1	6.9	15	25	190
Quakertown	all		9	11	22	34	2.6	5.1	11	15	110
Stockton	all	N	62	7.6	11	18	1.2	5.3	7.1	12	140
Coalburg	all	O	143	9.4	13	13	1.1	5.9	9.0	16	120
Winifrede/Hazard	all	P	79	9.4	14	14	1.2	5.8	8.0	16	83
Lower Winifrede/Hazard	all		9	6.2	8.0	6.3	1.6	4.6	4.8	12	21
Chilton/Taylor	all		15	12	21	28	3	7.0	9.6	22	89
Fire Clay Rider	all		29	22	44	71	3.6	11	17	48	350
Fire Clay	all	Q	70	9.4	15	17	1.9	5.0	7.7	20	86
Cedar Grove/Whitesburg	all	R	39	11	41	130	0.73	5.1	9.4	15	660
Williamson/Amburgy	all	S	45	11	21	44	2.2	5.8	9.9	17	250
Campbell Creek/Upper Elkhorn No 3	all	T	142	7.8	11	11	1.2	3.9	7.4	15	63
Upper Elkhorn Nos 1 and 2/Powellton	all	U	114	7.7	12	15	0.96	4.2	7.1	12	110
Pond Creek	all	V	121	13	27	59	2.1	6.6	12	22	540
Matewan/Clintwood	all	W	126	8.0	15	38	1.1	4.4	7.1	14	390
Middle War Eagle/Eagle	all		23	9.6	21	28	0.75	4.7	8.0	19	100
Bens Creek/Blair	all		15	8.1	15	21	3	4.1	4.9	16	68
Little Eagle/Dorchester	all	X	88	9.0	17	28	1.1	3.8	8.3	15	170
Lower War Eagle/Hagy	all		13	13	22	31	2.4	6.3	12	24	120
Glenalum Tunnel/Splashdam	all	Y	35	7.8	14	18	1.2	4.0	6.0	18	84
Gilbert A/Upper Banner	all	Z	46	12	16	13	1.5	7.3	12	21	70
Gilbert/Lower Banner	all		23	20	25	17	4.5	14	17	29	60
Douglas/Kennedy	all	AA	37	18	32	39	2.8	9.0	20	33	190
Jewell/Raven	all		24	23	27	17	7.8	16	21	35	74
Iaeger/Jawbone	all	BB	34	15	26	32	1.1	7.5	16	31	160
Lower Iaeger/Tiller	all		17	24	29	18	7.3	15	29	37	74
Sewell B/Greasy Creek	all		6	14	22	29	5.4	7.9	12	16	81
Sewell A	all		7	16	27	30	2.4	11	17	28	91
Sewell/Lower Seaboard	all	CC	61	12	27	49	1.5	4.9	9.3	29	320
Welch/Upper Horsepen	all		15	9.4	11	6.7	3.8	6.1	9.4	15	27
Little Raleigh/Middle Horsepen	all		7	32	65	97	8.3	14	22	60	280
Beckley/War Creek	all	DD	30	11	36	77	1.4	4.8	7.2	27	320
Fire Creek/Lower Horsepen	all		22	6.7	11	15	1.0	3.1	7.5	13	75
Pocahontas No 7	all		7	15	27	29	1.3	8.8	18	37	79
Pocahontas No 6	all		13	8.3	19	37	1.5	2.9	8.0	15	140
Pocahontas No 4	all		13	18	37	68	3.4	8.5	21	30	260
Pocahontas No 3	all	EE	53	16	24	28	1.7	10	19	27	200

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4b. Thick Coal Samples, ≥28 inch thick.

			Selenium								
Coal bed name, this study	Thickness range	Coal bed code N≥30	N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Waynesburg	≥ 28 in	A	56	2.7	2.8	0.89	0.64	2.4	2.9	3.3	5.5
Sewickley	≥ 28 in	B	40	2.6	2.9	1.3	0.70	2.2	2.6	3.6	7.2
Redstone	≥ 28 in	C	56	1.9	2.1	1.1	0.50	1.4	1.9	2.4	6.9
Pittsburgh	≥ 28 in	D	132	1.4	1.7	1.2	0.20	1.0	1.4	2.0	7.5
Lower Bakerstown	≥ 28 in		12	3.5	3.7	1.5	1.6	2.8	3.4	4.8	6.6
Mahoning	≥ 28 in		6	2.5	2.8	1.2	1.5	1.9	2.3	3.7	4.5
Upper Freeport	≥ 28 in	F	215	2.3	2.7	1.8	0.72	1.7	2.2	3.0	14
Lower Freeport	≥ 28 in	G	66	3.5	4.2	2.9	1.1	2.3	3.2	4.9	15
Upper Kittanning	≥ 28 in	H	32	4.5	5.2	3.1	1.4	2.8	4.1	6.4	13
Middle Kittanning	≥ 28 in	I	168	3.3	3.6	2.0	0.99	2.3	3.2	4.5	17
Lower Kittanning/No 6 block	≥ 28 in	J	141	3.4	4.0	2.6	0.60	2.2	3.7	5.4	20
Clarion	≥ 28 in	K	47	6.0	6.5	2.5	2.3	5.0	6.2	7.5	14
Brookville	≥ 28 in	L	30	5.4	6.1	3.0	1.8	3.9	5.3	7.7	14
No 5 Block	≥ 28 in	M	65	7.0	7.4	2.6	3.1	5.7	7.0	8.9	17
Lower Mercer	≥ 28 in		7	7.7	8.3	3.3	4.0	5.9	8.3	10	13
Stockton	≥ 28 in	N	51	5.3	5.6	1.9	2.7	4.1	5.5	7.1	11
Coalburg	≥ 28 in	O	67	5.0	5.2	1.5	1.8	4.3	4.9	6.3	8.7
Winifrede/Hazard	≥ 28 in	P	48	4.7	4.9	1.7	2.4	3.8	4.8	5.6	11
Chilton/Taylor	≥ 28 in		9	2.5	3.0	1.7	0.73	2.0	3.0	3.8	5.8
Fire Clay Rider	≥ 28 in		13	4.0	4.1	1.3	2.4	3.5	3.6	4.4	7.8
Fire Clay	≥ 28 in	Q	40	3.5	3.7	1.2	1.3	2.8	3.4	4.5	6.3
Cedar Grove/Whitesburg	≥ 28 in		16	3.5	3.6	1.1	2.2	2.5	3.7	4.5	5.5
Williamson/Amburgy	≥ 28 in		19	3.1	3.5	1.7	0.90	2.5	3.5	4.1	7.5
Campbell Creek/Upper Elkhorn No 3	≥ 28 in	T	80	3.8	4.0	1.3	1.7	3.0	3.9	4.7	7.8
Upper Elkhorn Nos 1 and 2/Powellton	≥ 28 in	U	59	3.4	3.7	1.5	0.93	2.9	3.6	4.4	7.7
Pond Creek	≥ 28 in	V	78	3.5	3.7	1.2	1.6	2.7	3.7	4.5	6.7
Matewan/Clintwood	≥ 28 in	W	54	2.8	3.2	1.6	0.54	2.1	2.9	3.8	7.4
Middle War Eagle/Eagle	≥ 28 in		12	3.4	3.7	1.4	1.7	3.0	3.4	4.3	6.0
Bens Creek/Blair	≥ 28 in		11	2.1	2.1	0.55	1.1	1.9	2.0	2.4	3.3
Little Eagle/Dorchester	≥ 28 in	X	53	2.7	3.0	1.6	1.2	1.8	2.5	3.5	7.1
Lower War Eagle/Hagy	≥ 28 in		8	2.9	3.0	0.86	1.3	2.7	3.1	3.7	4.0
Glenalum Tunnel/Splashdam	≥ 28 in		17	2.6	2.8	0.93	0.76	2.2	2.8	3.2	4.4
Gilbert A/Upper Banner	≥ 28 in		24	3.1	3.3	1.1	1.2	2.5	3.0	3.6	5.6
Gilbert/Lower Banner	≥ 28 in		17	2.7	2.9	1.1	1.7	2.2	2.7	3.0	6.3
Douglas/Kennedy	≥ 28 in		22	1.7	2.2	2.2	0.40	1.1	1.3	2.3	11
Jewell/Raven	≥ 28 in		19	1.7	2.0	0.88	0.20	1.5	2.0	2.7	3.8
Iaeger/Jawbone	≥ 28 in		17	1.9	2.5	1.3	0.07	1.7	2.7	3.1	4.8
Lower Iaeger/Tiller	≥ 28 in		7	2.6	2.8	0.97	1.0	2.8	2.9	3.0	4.3
Sewell/Lower Seaboard	≥ 28 in	CC	41	2.0	2.5	2.3	0.76	1.3	1.8	2.5	14
Welch/Upper Horsepen	≥ 28 in		10	1.6	1.8	0.91	0.70	1.1	1.7	2.2	3.6
Little Raleigh/Middle Horsepen	≥ 28 in		5	2.2	2.2	0.44	1.7	1.9	2.1	2.6	2.7
Beckley/War Creek	≥ 28 in		18	1.5	1.6	0.44	0.78	1.3	1.5	1.8	2.4
Fire Creek/Lower Horsepen	≥ 28 in		14	2.5	2.7	1.1	1.1	1.8	2.8	3.3	4.9
Pocahontas No 6	≥ 28 in		10	2.7	2.9	1.4	1.4	2.1	2.5	3.8	5.9
Pocahontas No 4	≥ 28 in		13	2.4	2.5	1.1	1.8	2.0	2.3	2.5	5.9
Pocahontas No 3	≥ 28 in	EE	43	3.0	3.4	1.7	1.1	2.3	3.0	4.1	8.2

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4b. Thick Coal Samples, ≥28 inch thick.

Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Thickness Geometric mean in	Average in	Standard Deviation in	Minimum in	Lower Quartile in	Median in	Upper Quartile in	Maximum in
Waynesburg	≥ 28 in	A	56	47.3	49.8	16.7	28.3	37.3	46.1	58.4	95.0
Sewickley	≥ 28 in	B	40	46.4	47.5	11.2	32.0	39.0	47.8	55.1	87.5
Redstone	≥ 28 in	C	56	51.6	54.0	15.7	28.0	38.1	55.1	67.2	88.0
Pittsburgh	≥ 28 in	D	132	60.0	63.3	20.7	28.0	49.9	60.5	75.5	125.0
Lower Bakerstown	≥ 28 in		12	36.1	36.8	8.0	28.0	32.1	35.9	36.9	56.0
Mahoning	≥ 28 in		6	37.2	38.5	12.4	28.0	33.2	34.8	37.1	63.0
Upper Freeport	≥ 28 in	F	215	46.2	48.1	14.4	28.0	39.0	46.5	50.5	105.5
Lower Freeport	≥ 28 in	G	67	41.3	43.0	13.2	28.5	33.6	38.0	50.2	74.0
Upper Kittanning	≥ 28 in	H	32	41.0	43.2	15.5	28.4	31.4	37.2	51.8	94.8
Middle Kittanning	≥ 28 in	I	168	39.4	40.4	10.3	28.0	33.5	38.7	45.0	95.5
Lower Kittanning/No 6 block	≥ 28 in	J	141	37.9	38.9	10.2	28.0	32.4	36.0	41.5	86.4
Clarion	≥ 28 in	K	47	41.1	43.0	14.5	28.8	31.9	39.3	48.8	96.0
Brookville	≥ 28 in	L	30	39.7	40.9	10.4	28.4	32.3	37.8	49.4	61.5
No 5 Block	≥ 28 in	M	65	53.8	59.7	30.9	28.0	40.0	49.6	70.5	171.8
Lower Mercer	≥ 28 in		7	38.9	40.5	13.8	29.4	33.6	35.1	41.1	69.6
Stockton	≥ 28 in	N	51	47.7	49.7	14.5	28.5	40.0	48.0	58.7	93.3
Coalburg	≥ 28 in	O	67	47.0	49.7	18.1	28.0	37.0	45.5	55.6	112.5
Winifrede/Hazard	≥ 28 in	P	48	40.0	41.5	12.1	28.0	32.8	37.9	45.9	73.2
Chilton/Taylor	≥ 28 in		9	43.1	45.6	17.8	29.6	35.0	40.9	46.1	85.2
Fire Clay Rider	≥ 28 in		13	42.6	44.6	16.3	33.0	35.0	38.0	46.0	91.3
Fire Clay	≥ 28 in	Q	40	43.7	45.3	13.0	28.0	34.7	43.0	51.3	80.5
Cedar Grove/Whitesburg	≥ 28 in		16	38.6	39.4	8.1	28.3	31.8	40.4	45.3	52.0
Williamson/Amburgy	≥ 28 in		19	41.3	42.9	13.4	28.8	35.2	39.4	46.6	84.0
Campbell Creek/Upper Elkhorn No 3	≥ 28 in	T	80	38.4	39.7	11.2	28.0	31.3	37.6	44.8	85.5
Upper Elkhorn Nos 1 and 2/Powellton	≥ 28 in	U	59	39.0	40.0	9.2	28.0	32.6	39.0	43.9	69.3
Pond Creek	≥ 28 in	V	78	42.7	44.3	12.8	28.0	35.1	42.1	47.4	85.4
Matewan/Clintwood	≥ 28 in	W	54	36.9	37.9	10.2	28.0	31.2	35.5	43.2	87.2
Middle War Eagle/Eagle	≥ 28 in		12	38.6	39.7	10.3	28.8	34.2	37.8	39.0	64.8
Bens Creek/Blair	≥ 28 in		11	35.2	35.8	7.1	28.5	30.9	32.0	39.4	50.0
Little Eagle/Dorchester	≥ 28 in	X	54	37.7	38.5	8.6	28.7	33.1	36.5	41.9	66.0
Lower War Eagle/Hagy	≥ 28 in		8	33.4	33.6	3.7	28.4	32.0	33.5	36.1	39.0
Glenalum Tunnel/Splashdam	≥ 28 in		17	41.5	42.8	11.1	28.8	32.0	41.4	49.6	69.0
Gilbert A/Upper Banner	≥ 28 in		24	39.5	41.7	17.4	29.4	32.1	36.8	42.5	110.2
Gilbert/Lower Banner	≥ 28 in		17	46.3	47.4	11.2	32.8	39.6	44.4	56.4	71.0
Douglas/Kennedy	≥ 28 in		22	36.8	37.7	8.8	28.0	32.3	35.0	40.4	62.0
Jewell/Raven	≥ 28 in		19	40.5	41.7	10.8	28.0	32.8	41.0	47.2	68.4
Iaeger/Jawbone	≥ 28 in		17	44.2	46.2	14.5	29.5	35.0	41.2	59.9	77.8
Lower Iaeger/Tiller	≥ 28 in		7	40.0	41.5	13.6	29.8	34.3	36.0	44.0	68.4
Sewell/Lower Seaboard	≥ 28 in	CC	41	42.4	43.7	11.2	28.6	35.9	42.8	52.0	70.6
Welch/Upper Horsepen	≥ 28 in		10	45.1	51.4	31.8	28.0	31.3	38.0	57.8	128.0
Little Raleigh/Middle Horsepen	≥ 28 in		5	43.7	43.8	4.0	42.0	42.0	42.0	42.0	51.0
Beckley/War Creek	≥ 28 in		18	40.5	42.8	16.0	28.0	30.5	39.3	51.0	87.0
Fire Creek/Lower Horsepen	≥ 28 in		14	41.4	43.2	13.6	29.5	32.3	36.8	56.3	70.0
Pocahontas No 6	≥ 28 in		10	35.5	35.8	4.8	30.1	31.1	35.8	39.9	43.5
Pocahontas No 4	≥ 28 in		13	64.8	65.9	12.6	49.0	60.1	62.6	76.0	91.0
Pocahontas No 3	≥ 28 in	EE	43	50.5	52.1	14.0	31.0	43.3	51.8	57.6	94.0

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4b. Thick Coal Samples, ≥28 inch thick.

			Ash Yield								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean percent	Average percent	Standard Deviation percent	Minimum percent	Lower Quartile percent	Median percent	Upper Quartile percent	Maximum percent
Waynesburg	≥ 28 in	A	53	16.61	17.12	3.34	3.16	15.66	17.16	19.37	22.96
Sewickley	≥ 28 in	B	38	11.42	11.81	3.06	5.70	9.71	11.31	13.23	20.20
Redstone	≥ 28 in	C	53	9.51	10.20	4.39	5.60	7.60	9.02	11.10	25.70
Pittsburgh	≥ 28 in	D	124	9.98	10.51	3.88	4.40	8.03	10.10	11.74	32.03
Lower Bakerstown	≥ 28 in		11	11.84	13.25	6.49	5.55	8.07	11.83	17.37	24.90
Mahoning	≥ 28 in		4	11.31	11.45	2.09	9.51	10.08	11.02	12.39	14.25
Upper Freeport	≥ 28 in	F	169	12.44	13.22	4.79	3.60	10.30	12.00	15.60	29.10
Lower Freeport	≥ 28 in	G	67	9.23	9.94	4.12	3.90	7.67	8.46	11.41	26.43
Upper Kittanning	≥ 28 in	H	30	11.35	11.82	3.56	5.69	10.22	11.20	12.98	24.00
Middle Kittanning	≥ 28 in	I	165	9.41	10.59	5.07	2.20	6.80	9.20	14.32	23.80
Lower Kittanning/No 6 block	≥ 28 in	J	138	10.45	11.44	5.13	2.80	7.70	10.55	13.49	31.50
Clarion	≥ 28 in	K	47	13.40	14.37	5.40	4.80	10.81	13.58	17.25	28.38
Brookville	≥ 28 in	L *	29	12.08	13.10	5.83	6.22	8.90	11.33	14.62	29.45
No 5 Block	≥ 28 in	M	58	10.37	11.31	4.70	2.70	7.90	10.36	14.09	27.50
Lower Mercer	≥ 28 in		7	15.02	15.68	5.49	10.82	12.78	13.42	16.43	27.09
Stockton	≥ 28 in	N	49	11.33	12.57	5.62	4.22	8.00	12.65	15.43	28.20
Coalburg	≥ 28 in	O	67	11.28	12.35	5.36	3.42	8.70	11.40	14.32	30.70
Winifrede/Hazard	≥ 28 in	P	46	9.27	10.72	5.65	2.44	6.91	9.75	14.35	28.50
Chilton/Taylor	≥ 28 in		9	11.19	11.49	2.59	6.80	9.20	12.70	13.28	14.00
Fire Clay Rider	≥ 28 in		13	11.58	12.24	4.35	6.51	9.00	11.12	15.90	22.00
Fire Clay	≥ 28 in	Q	40	10.15	11.45	5.83	3.34	7.06	10.50	14.62	31.80
Cedar Grove/Whitesburg	≥ 28 in		15	9.15	10.50	5.60	2.47	7.45	9.80	11.90	23.30
Williamson/Amburgy	≥ 28 in		19	7.57	8.92	5.43	2.30	6.26	7.63	11.09	26.10
Campbell Creek/Upper Elkhorn No 3	≥ 28 in	T	79	6.89	7.60	3.43	2.30	4.88	7.17	9.30	21.60
Upper Elkhorn Nos 1 and 2/Powellton	≥ 28 in	U	59	6.20	6.97	3.55	1.65	4.56	6.24	8.89	19.10
Pond Creek	≥ 28 in	V	78	7.11	8.00	3.73	1.66	5.48	7.24	10.27	16.80
Matewan/Clintwood	≥ 28 in	W	54	6.02	6.68	3.46	2.57	4.51	6.05	7.45	21.60
Middle War Eagle/Eagle	≥ 28 in		10	4.85	5.55	3.23	2.10	3.67	3.80	7.25	12.54
Bens Creek/Blair	≥ 28 in		11	4.23	6.07	6.13	1.60	2.65	3.22	5.90	18.30
Little Eagle/Dorchester	≥ 28 in	X	54	7.19	8.75	5.82	1.93	4.75	6.53	12.05	28.20
Lower War Eagle/Hagy	≥ 28 in		8	9.68	11.03	6.01	4.30	8.52	9.99	11.89	22.80
Glenalum Tunnel/Splashdam	≥ 28 in		17	8.98	10.50	6.29	3.40	6.10	9.10	13.90	25.30
Gilbert A/Upper Banner	≥ 28 in		22	7.34	7.94	3.50	3.60	5.99	6.72	9.38	18.19
Gilbert/Lower Banner	≥ 28 in		14	10.95	11.86	4.68	4.68	7.75	11.85	14.70	19.63
Douglas/Kennedy	≥ 28 in		18	6.34	7.40	4.95	3.08	4.57	6.25	8.25	22.57
Jewell/Raven	≥ 28 in		16	6.20	7.81	5.95	2.40	3.75	5.86	9.35	24.59
Iaeger/Jawbone	≥ 28 in		16	11.51	13.83	8.38	2.44	7.88	12.80	16.46	30.90
Lower Iaeger/Tiller	≥ 28 in		7	7.77	8.63	4.34	3.68	6.05	7.20	10.51	16.40
Sewell/Lower Seaboard	≥ 28 in	CC	37	5.05	5.57	2.62	2.30	3.60	4.44	7.00	12.36
Welch/Upper Horsepen	≥ 28 in		7	6.71	7.45	3.54	3.40	4.55	8.00	9.22	13.19
Little Raleigh/Middle Horsepen	≥ 28 in		5	6.94	7.14	1.90	5.10	5.80	6.50	9.10	9.20
Beckley/War Creek	≥ 28 in		16	5.78	6.62	3.01	0.90	5.05	6.30	7.53	12.00
Fire Creek/Lower Horsepen	≥ 28 in		14	6.92	7.54	3.53	3.60	5.43	6.50	8.90	17.20
Pocahontas No 6	≥ 28 in		10	7.71	8.46	4.14	4.60	5.60	6.95	10.58	17.90
Pocahontas No 4	≥ 28 in		13	6.14	6.35	1.84	4.20	5.60	5.93	6.60	11.40
Pocahontas No 3	≥ 28 in	EE	41	7.62	8.44	3.85	2.90	5.80	7.30	10.60	16.09

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4b. Thick Coal Samples, ≥28 inch thick.

			Sulfur								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean percent	Average percent	Standard Deviation percent	Minimum percent	Lower Quartile percent	Median percent	Upper Quartile percent	Maximum percent
Waynesburg	≥ 28 in	A	54	2.59	2.75	0.93	0.70	2.20	2.65	3.34	5.20
Sewickley	≥ 28 in	B	38	2.58	2.89	1.29	0.70	1.95	2.92	3.58	5.90
Redstone	≥ 28 in	C	53	2.59	2.76	0.99	0.90	2.10	2.60	3.20	5.66
Pittsburgh	≥ 28 in	D	124	2.92	3.34	1.50	0.40	2.08	3.35	4.50	6.70
Lower Bakerstown	≥ 28 in		11	1.91	2.23	1.11	0.40	1.55	2.40	2.91	4.39
Mahoning	≥ 28 in		4	2.22	2.73	1.50	0.63	2.26	3.06	3.53	4.15
Upper Freeport	≥ 28 in	F	210	2.11	2.35	1.12	0.59	1.60	2.13	2.80	6.30
Lower Freeport	≥ 28 in	G	67	2.11	2.49	1.25	0.50	1.68	2.56	3.23	5.75
Upper Kittanning	≥ 28 in	H	30	1.99	2.35	1.22	0.40	1.36	2.25	3.30	5.60
Middle Kittanning	≥ 28 in	I	165	2.87	3.18	1.32	0.50	2.30	3.05	3.91	7.50
Lower Kittanning/No 6 block	≥ 28 in	J	138	2.88	3.42	1.78	0.40	2.11	3.30	4.55	8.43
Clarion	≥ 28 in	K	47	3.30	3.71	1.66	0.66	2.70	3.70	4.46	9.34
Brookville	≥ 28 in	L *	29	3.37	3.76	1.96	1.31	2.30	3.12	4.56	10.40
No 5 Block	≥ 28 in	M	58	0.81	0.92	0.66	0.40	0.60	0.73	0.97	4.87
Lower Mercer	≥ 28 in		7	2.37	2.89	2.07	1.36	1.47	1.60	4.08	6.15
Stockton	≥ 28 in	N	49	0.94	1.17	1.01	0.50	0.60	0.70	1.30	5.40
Coalburg	≥ 28 in	O	67	0.89	0.99	0.54	0.40	0.67	0.80	1.10	3.12
Winifrede/Hazard	≥ 28 in	P	46	0.89	0.99	0.55	0.50	0.65	0.80	1.08	3.50
Chilton/Taylor	≥ 28 in		9	1.15	1.28	0.72	0.60	0.90	1.11	1.32	3.10
Fire Clay Rider	≥ 28 in		13	2.19	2.63	1.45	0.69	1.44	2.80	3.50	5.20
Fire Clay	≥ 28 in	Q	40	0.94	1.02	0.48	0.50	0.74	0.86	1.11	2.57
Cedar Grove/Whitesburg	≥ 28 in		15	1.01	1.19	0.97	0.60	0.77	0.90	1.15	4.53
Williamson/Amburgy	≥ 28 in		19	1.32	1.61	1.05	0.59	0.78	1.16	2.45	4.00
Campbell Creek/Upper Elkhorn No 3	≥ 28 in	T	79	1.09	1.28	0.82	0.46	0.70	0.90	1.65	4.00
Upper Elkhorn Nos 1 and 2/Powellton	≥ 28 in	U	59	1.03	1.21	0.86	0.51	0.70	0.80	1.39	4.50
Pond Creek	≥ 28 in	V	78	0.94	1.11	0.78	0.41	0.60	0.80	1.32	4.50
Matewan/Clintwood	≥ 28 in	W	54	1.12	1.33	0.90	0.50	0.71	0.92	1.72	4.40
Middle War Eagle/Eagle	≥ 28 in		10	1.13	1.38	0.88	0.46	0.62	1.20	2.13	2.80
Bens Creek/Blair	≥ 28 in		11	1.15	1.31	0.73	0.50	0.80	1.00	1.88	2.60
Little Eagle/Dorchester	≥ 28 in	X	54	1.07	1.16	0.55	0.60	0.81	1.00	1.28	3.38
Lower War Eagle/Hagy	≥ 28 in		8	1.38	1.58	0.86	0.60	0.87	1.41	2.17	3.00
Glenalum Tunnel/Splashdam	≥ 28 in		17	1.01	1.28	1.16	0.60	0.66	0.75	1.16	4.40
Gilbert A/Upper Banner	≥ 28 in		22	0.96	1.17	0.81	0.40	0.60	0.82	1.79	3.17
Gilbert/Lower Banner	≥ 28 in		14	0.85	0.93	0.45	0.56	0.60	0.80	1.04	2.10
Douglas/Kennedy	≥ 28 in		18	0.84	0.91	0.40	0.50	0.60	0.77	0.93	1.70
Jewell/Raven	≥ 28 in		16	0.87	1.16	1.20	0.50	0.58	0.72	0.95	4.20
Iaeger/Jawbone	≥ 28 in		16	0.61	0.62	0.11	0.50	0.54	0.60	0.64	0.90
Lower Iaeger/Tiller	≥ 28 in		7	1.03	1.82	2.36	0.50	0.53	0.60	1.93	6.70
Sewell/Lower Seaboard	≥ 28 in	CC	37	0.81	0.87	0.36	0.40	0.60	0.80	1.00	2.20
Welch/Upper Horsepen	≥ 28 in		7	0.77	0.82	0.31	0.50	0.61	0.80	0.90	1.40
Little Raleigh/Middle Horsepen	≥ 28 in		5	0.78	0.80	0.19	0.50	0.80	0.80	0.90	1.00
Beckley/War Creek	≥ 28 in		16	0.95	1.06	0.49	0.40	0.60	1.15	1.43	1.90
Fire Creek/Lower Horsepen	≥ 28 in		14	0.89	0.94	0.31	0.40	0.73	0.85	1.18	1.50
Pocahontas No 6	≥ 28 in		10	0.97	0.99	0.19	0.80	0.82	0.90	1.18	1.30
Pocahontas No 4	≥ 28 in		13	0.64	0.65	0.12	0.50	0.60	0.65	0.70	0.88
Pocahontas No 3	≥ 28 in	EE	41	0.69	0.73	0.28	0.40	0.52	0.65	0.80	1.80

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4b. Thick Coal Samples, ≥28 inch thick.

			Pyritic Sulfur								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean percent	Average percent	Standard Deviation percent	Minimum percent	Lower Quartile percent	Median percent	Upper Quartile percent	Maximum percent
Waynesburg	≥ 28 in	A	47	1.57	1.83	0.89	0.14	1.12	1.78	2.33	4.00
Sewickley	≥ 28 in	B	36	1.05	1.40	0.76	0.02	0.91	1.30	1.93	2.87
Redstone	≥ 28 in	C *	19	1.76	1.97	1.03	0.67	1.30	1.75	2.31	4.93
Pittsburgh	≥ 28 in	D	94	1.64	2.08	1.09	0.05	1.33	2.00	2.89	5.16
Lower Bakerstown	≥ 28 in		11	0.84	1.37	0.84	0.01	0.65	1.65	1.76	2.73
Mahoning	≥ 28 in		4	0.64	1.58	1.14	0.02	1.18	1.79	2.18	2.72
Upper Freeport	≥ 28 in	F	208	1.19	1.52	1.00	0.05	0.86	1.33	1.81	5.57
Lower Freeport	≥ 28 in	G	66	0.97	1.58	1.04	0.01	0.73	1.59	2.31	3.92
Upper Kittanning	≥ 28 in	H *	29	0.94	1.57	1.20	0.02	0.66	1.43	2.15	5.41
Middle Kittanning	≥ 28 in	I	161	1.46	1.80	1.03	0.04	1.07	1.69	2.27	6.49
Lower Kittanning/No 6 block	≥ 28 in	J	134	1.54	2.19	1.42	0.02	1.16	2.01	3.00	6.07
Clarion	≥ 28 in	K	47	1.76	2.19	1.38	0.18	1.34	1.99	2.66	7.31
Brookville	≥ 28 in	L *	29	1.99	2.44	1.82	0.63	1.32	1.75	3.10	8.97
No 5 Block	≥ 28 in	M	31	0.13	0.38	0.66	0.02	0.03	0.10	0.39	3.07
Lower Mercer	≥ 28 in		6	1.18	1.59	1.59	0.58	0.75	0.92	1.47	4.75
Stockton	≥ 28 in	N	35	0.23	0.60	0.88	0.01	0.09	0.30	0.68	4.02
Coalburg	≥ 28 in	O	51	0.24	0.42	0.45	0.03	0.11	0.27	0.53	1.79
Winifrede/Hazard	≥ 28 in	P	34	0.20	0.41	0.56	0.01	0.07	0.24	0.54	2.95
Chilton/Taylor	≥ 28 in		9	0.31	0.46	0.58	0.13	0.18	0.33	0.38	1.97
Fire Clay Rider	≥ 28 in		13	0.81	1.35	1.00	0.03	0.62	1.19	1.96	3.41
Fire Clay	≥ 28 in	Q	36	0.23	0.39	0.44	0.03	0.12	0.21	0.47	1.85
Cedar Grove/Whitesburg	≥ 28 in		6	0.24	0.77	1.15	0.02	0.07	0.34	0.79	3.02
Williamson/Amburgy	≥ 28 in		19	0.39	0.85	0.93	0.04	0.12	0.35	1.27	3.34
Campbell Creek/Upper Elkhorn No 3	≥ 28 in	T	43	0.29	0.68	0.84	0.03	0.10	0.22	1.14	2.92
Upper Elkhorn Nos 1 and 2/Powellton	≥ 28 in	U	42	0.23	0.52	0.74	0.02	0.09	0.19	0.76	3.65
Pond Creek	≥ 28 in	V	40	0.19	0.36	0.40	0.02	0.06	0.17	0.56	1.39
Matewan/Clintwood	≥ 28 in	W	53	0.29	0.59	0.72	0.03	0.12	0.26	0.84	3.30
Middle War Eagle/Eagle	≥ 28 in		7	0.23	0.61	0.69	0.02	0.08	0.18	1.13	1.65
Bens Creek/Blair	≥ 28 in		7	0.32	0.73	0.79	0.06	0.07	0.42	1.30	1.93
Little Eagle/Dorchester	≥ 28 in	X	51	0.25	0.40	0.38	0.01	0.14	0.33	0.50	2.12
Lower War Eagle/Hagy	≥ 28 in		5	0.31	0.50	0.43	0.06	0.12	0.59	0.60	1.13
Glenalum Tunnel/Splashdam	≥ 28 in		16	0.16	0.66	1.17	0.01	0.03	0.20	0.59	4.20
Gilbert A/Upper Banner	≥ 28 in		22	0.21	0.47	0.60	0.02	0.09	0.15	0.76	1.91
Gilbert/Lower Banner	≥ 28 in		12	0.14	0.18	0.16	0.03	0.09	0.14	0.21	0.65
Douglas/Kennedy	≥ 28 in		15	0.19	0.26	0.26	0.06	0.12	0.19	0.27	1.08
Jewell/Raven	≥ 28 in		16	0.17	0.42	0.70	0.03	0.06	0.14	0.36	2.20
Iaeger/Jawbone	≥ 28 in		14	0.10	0.13	0.10	0.02	0.06	0.10	0.14	0.36
Lower Iaeger/Tiller	≥ 28 in		6	0.17	1.21	2.17	0.03	0.04	0.05	1.27	5.43
Sewell/Lower Seaboard	≥ 28 in	CC *	10	0.19	0.30	0.30	0.04	0.08	0.18	0.46	1.00
Welch/Upper Horsepen	≥ 28 in		6	0.16	0.21	0.16	0.08	0.09	0.14	0.30	0.45
Little Raleigh/Middle Horsepen	≥ 28 in		5	0.18	0.20	0.08	0.08	0.19	0.19	0.23	0.30
Beckley/War Creek	≥ 28 in		10	0.20	0.39	0.43	0.04	0.09	0.18	0.72	1.12
Fire Creek/Lower Horsepen	≥ 28 in		7	0.22	0.32	0.31	0.04	0.18	0.19	0.35	0.96
Pocahontas No 6	≥ 28 in		2	0.40	0.41	0.12	0.32	na	na	na	0.49
Pocahontas No 4	≥ 28 in		4	0.09	0.11	0.07	0.04	0.05	0.11	0.16	0.17
Pocahontas No 3	≥ 28 in	EE *	18	0.13	0.17	0.11	0.02	0.08	0.18	0.26	0.38

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4b. Thick Coal Samples, ≥28 inch thick.

			Arsenic								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Waynesburg	≥ 28 in	A	56	16	19	12	5.8	11	15	23	74
Sewickley	≥ 28 in	B	40	5.2	6.4	4.0	0.80	3.6	5.6	7.6	19
Redstone	≥ 28 in	C	56	14	23	25	2.7	7.9	12	26	120
Pittsburgh	≥ 28 in	D	131	11	17	17	0.70	5.3	11	22	87
Lower Bakerstown	≥ 28 in		12	20	28	23	3.4	13	17	43	73
Mahoning	≥ 28 in		6	55	76	53	9.3	44	75	95	160
Upper Freeport	≥ 28 in	F	215	28	36	29	2.4	18	29	44	200
Lower Freeport	≥ 28 in	G	67	22	33	33	0.88	12	28	38	190
Upper Kittanning	≥ 28 in	H	32	23	34	29	2.4	14	27	44	130
Middle Kittanning	≥ 28 in	I	168	9.3	17	23	0.90	4.3	8.3	20	180
Lower Kittanning/No 6 block	≥ 28 in	J	140	13	21	32	0.31	7.8	14	26	320
Clarion	≥ 28 in	K	47	8.9	15	17	2.1	3.9	6.3	21	61
Brookville	≥ 28 in	L	30	10	19	33	2.3	6.7	8.1	18	180
No 5 Block	≥ 28 in	M	65	4.5	8.6	11	0.75	1.8	4.3	10	49
Lower Mercer	≥ 28 in		7	18	25	27	5.7	13	14	23	84
Stockton	≥ 28 in	N	51	4.6	10	14	0.60	1.7	3.7	14	79
Coalburg	≥ 28 in	O	67	5.7	11	20	0.60	2.2	5.8	14	150
Winifrede/Hazard	≥ 28 in	P	48	5.6	11	18	0.70	2.5	4.7	12	100
Chilton/Taylor	≥ 28 in		9	7.2	12	12	1.5	2.6	7.7	15	31
Fire Clay Rider	≥ 28 in		13	14	20	15	1.2	9.1	18	30	47
Fire Clay	≥ 28 in	Q	40	6.3	12	20	0.70	3.0	5.1	15	120
Cedar Grove/Whitesburg	≥ 28 in		16	5.9	11	14	0.75	1.7	7.8	9.8	42
Williamson/Amburgy	≥ 28 in		19	9.3	24	35	0.80	3.6	10	23	120
Campbell Creek/Upper Elkhorn No 3	≥ 28 in	T	80	6.7	13	18	0.85	2.3	7.1	14	85
Upper Elkhorn Nos 1 and 2/Powellton	≥ 28 in	U	59	7.4	16	26	0.80	3.5	7.7	16	160
Pond Creek	≥ 28 in	V	77	3.6	7.7	11	0.08	1.4	3.2	8.5	48
Matewan/Clintwood	≥ 28 in	W	54	8.3	19	32	0.90	3.4	7.2	24	160
Middle War Eagle/Eagle	≥ 28 in		12	10	28	35	1.1	2.8	9.4	49	110
Bens Creek/Blair	≥ 28 in		11	8.0	24	33	0.30	3.2	6.2	31	97
Little Eagle/Dorchester	≥ 28 in	X	54	12	22	25	1.1	4.1	15	29	120
Lower War Eagle/Hagy	≥ 28 in		8	19	66	98	1.0	3.5	51	59	300
Glenalum Tunnel/Splashdam	≥ 28 in		17	7.1	20	35	1.3	2.8	5.7	12	120
Gilbert A/Upper Banner	≥ 28 in		24	6.6	12	15	1.6	3.1	4.8	14	59
Gilbert/Lower Banner	≥ 28 in		17	7.8	14	17	1.6	3.8	5.0	16	57
Douglas/Kennedy	≥ 28 in		22	10	15	16	1.6	7.0	10	16	70
Jewell/Raven	≥ 28 in		19	5.8	7.5	6.5	2.0	3.7	5.0	9.2	30
Iaeger/Jawbone	≥ 28 in		17	4.7	7.8	8.0	0.45	2.4	4.0	11	30
Lower Iaeger/Tiller	≥ 28 in		7	6.0	13	20	1.7	2.3	4.7	12	56
Sewell/Lower Seaboard	≥ 28 in	CC	41	5.1	11	15	0.40	2.6	4.2	9.9	56
Welch/Upper Horsepen	≥ 28 in		10	9.1	16	20	2.0	4.2	9.4	16	64
Little Raleigh/Middle Horsepen	≥ 28 in		5	6.1	7.0	4.2	2.9	5.0	5.8	7.3	14
Beckley/War Creek	≥ 28 in		18	9.3	19	22	0.25	4.3	13	25	89
Fire Creek/Lower Horsepen	≥ 28 in		14	9.8	14	12	2.2	5.3	12	16	40
Pocahontas No 6	≥ 28 in		9	9.3	13	8.1	1.4	6.3	12	19	25
Pocahontas No 4	≥ 28 in		13	6.6	12	13	1.2	3.5	5.0	16	39
Pocahontas No 3	≥ 28 in	EE	43	5.4	10	14	0.30	2.3	5.2	12	73

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4b. Thick Coal Samples, ≥28 inch thick.

			Mercury								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Waynesburg	≥ 28 in	A	56	0.15	0.16	0.074	0.060	0.13	0.15	0.19	0.53
Sewickley	≥ 28 in	B	40	0.099	0.12	0.067	0.021	0.079	0.098	0.15	0.29
Redstone	≥ 28 in	C	56	0.17	0.23	0.18	0.007	0.10	0.18	0.31	0.93
Pittsburgh	≥ 28 in	D	132	0.13	0.17	0.15	0.003	0.082	0.14	0.21	1.0
Lower Bakerstown	≥ 28 in		12	0.18	0.21	0.16	0.080	0.12	0.15	0.23	0.57
Mahoning	≥ 28 in		6	0.30	0.31	0.065	0.26	0.27	0.28	0.31	0.43
Upper Freeport	≥ 28 in	F	215	0.24	0.31	0.20	0.003	0.20	0.28	0.37	1.7
Lower Freeport	≥ 28 in	G	67	0.23	0.33	0.26	0.003	0.20	0.30	0.43	1.6
Upper Kittanning	≥ 28 in	H	32	0.25	0.37	0.30	0.030	0.11	0.35	0.52	1.4
Middle Kittanning	≥ 28 in	I	168	0.16	0.22	0.19	0.003	0.12	0.18	0.27	1.6
Lower Kittanning/No 6 block	≥ 28 in	J	141	0.14	0.23	0.22	0.003	0.10	0.18	0.32	1.6
Clarion	≥ 28 in	K	47	0.14	0.18	0.15	0.022	0.079	0.13	0.24	0.76
Brookville	≥ 28 in	L	30	0.19	0.25	0.26	0.048	0.12	0.21	0.29	1.5
No 5 Block	≥ 28 in	M	65	0.13	0.17	0.12	0.024	0.083	0.14	0.25	0.52
Lower Mercer	≥ 28 in		7	0.24	0.29	0.15	0.040	0.23	0.26	0.40	0.48
Stockton	≥ 28 in	N	51	0.10	0.15	0.14	0.007	0.059	0.11	0.19	0.62
Coalburg	≥ 28 in	O	67	0.089	0.12	0.11	0.007	0.060	0.082	0.16	0.52
Winifrede/Hazard	≥ 28 in	P	48	0.084	0.14	0.18	0.007	0.042	0.078	0.17	1.0
Chilton/Taylor	≥ 28 in		9	0.14	0.17	0.085	0.043	0.12	0.16	0.18	0.30
Fire Clay Rider	≥ 28 in		13	0.16	0.18	0.13	0.083	0.12	0.12	0.18	0.58
Fire Clay	≥ 28 in	Q	40	0.085	0.13	0.10	0.007	0.050	0.087	0.19	0.43
Cedar Grove/Whitesburg	≥ 28 in		16	0.051	0.089	0.086	0.003	0.030	0.050	0.13	0.26
Williamson/Amburgy	≥ 28 in		19	0.081	0.13	0.10	0.010	0.039	0.085	0.22	0.35
Campbell Creek/Upper Elkhorn No 3	≥ 28 in	T	80	0.085	0.12	0.096	0.007	0.055	0.091	0.15	0.52
Upper Elkhorn Nos 1 and 2/Powellton	≥ 28 in	U	59	0.10	0.14	0.13	0.014	0.060	0.095	0.18	0.81
Pond Creek	≥ 28 in	V	78	0.068	0.097	0.090	0.003	0.044	0.070	0.12	0.46
Matewan/Clintwood	≥ 28 in	W	54	0.058	0.10	0.088	0.003	0.035	0.083	0.14	0.36
Middle War Eagle/Eagle	≥ 28 in		12	0.082	0.13	0.12	0.007	0.035	0.14	0.18	0.45
Bens Creek/Blair	≥ 28 in		11	0.045	0.088	0.10	0.007	0.025	0.039	0.11	0.28
Little Eagle/Dorchester	≥ 28 in	X	54	0.095	0.13	0.10	0.010	0.055	0.087	0.20	0.40
Lower War Eagle/Hagy	≥ 28 in		8	0.11	0.18	0.11	0.003	0.090	0.20	0.28	0.29
Glenalum Tunnel/Splashdam	≥ 28 in		17	0.12	0.17	0.14	0.045	0.065	0.12	0.25	0.55
Gilbert A/Upper Banner	≥ 28 in		24	0.071	0.11	0.12	0.003	0.050	0.075	0.13	0.51
Gilbert/Lower Banner	≥ 28 in		17	0.046	0.092	0.10	0.003	0.021	0.050	0.082	0.35
Douglas/Kennedy	≥ 28 in		22	0.067	0.11	0.11	0.007	0.050	0.068	0.14	0.50
Jewell/Raven	≥ 28 in		19	0.074	0.10	0.091	0.015	0.050	0.060	0.13	0.37
Iaeger/Jawbone	≥ 28 in		17	0.077	0.12	0.10	0.007	0.050	0.10	0.17	0.41
Lower Iaeger/Tiller	≥ 28 in		7	0.051	0.19	0.36	0.007	0.021	0.052	0.11	1.0
Sewell/Lower Seaboard	≥ 28 in	CC	41	0.12	0.21	0.24	0.017	0.059	0.13	0.25	0.97
Welch/Upper Horsepen	≥ 28 in		10	0.073	0.093	0.075	0.030	0.053	0.069	0.082	0.25
Little Raleigh/Middle Horsepen	≥ 28 in		5	0.13	0.14	0.082	0.068	0.082	0.12	0.17	0.27
Beckley/War Creek	≥ 28 in		18	0.067	0.18	0.41	0.007	0.046	0.078	0.11	1.8
Fire Creek/Lower Horsepen	≥ 28 in		14	0.074	0.090	0.058	0.025	0.042	0.070	0.13	0.19
Pocahontas No 6	≥ 28 in		10	0.084	0.21	0.26	0.015	0.022	0.074	0.36	0.66
Pocahontas No 4	≥ 28 in		13	0.042	0.054	0.031	0.007	0.039	0.050	0.080	0.095
Pocahontas No 3	≥ 28 in	EE	43	0.056	0.081	0.079	0.007	0.046	0.065	0.10	0.47

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4b. Thick Coal Samples, ≥28 inch thick.

			Manganese								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Waynesburg	≥ 28 in	A	56	27	32	28	11	20	25	37	180
Sewickley	≥ 28 in	B	40	18	27	42	6.4	11	15	23	260
Redstone	≥ 28 in	C	56	25	35	31	5.0	17	24	36	140
Pittsburgh	≥ 28 in	D	132	21	29	33	1.4	14	20	36	300
Lower Bakerstown	≥ 28 in		12	18	26	25	6.6	12	15	25	75
Mahoning	≥ 28 in		6	13	16	10	4.9	9.1	14	23	30
Upper Freeport	≥ 28 in	F	215	16	22	20	2.5	10	16	27	140
Lower Freeport	≥ 28 in	G	67	14	31	87	0.92	8.2	13	21	690
Upper Kittanning	≥ 28 in	H	32	14	22	31	3.3	8.3	12	24	170
Middle Kittanning	≥ 28 in	I	167	20	27	32	3.7	12	19	32	310
Lower Kittanning/No 6 block	≥ 28 in	J	141	16	26	48	1.6	9.8	14	26	430
Clarion	≥ 28 in	K	47	20	27	32	3.6	13	21	28	220
Brookville	≥ 28 in	L	30	15	19	12	2.3	10	14	25	52
No 5 Block	≥ 28 in	M	65	8.1	15	27	1.4	4.1	7.5	12	200
Lower Mercer	≥ 28 in		7	11	14	11	4.1	5.6	12	19	35
Stockton	≥ 28 in	N	51	6.8	8.7	5.9	1.2	5.3	6.9	11	25
Coalburg	≥ 28 in	O	67	8.7	11	8.2	1.1	5.7	9.1	13	54
Winifrede/Hazard	≥ 28 in	P	48	11	15	17	1.9	6.2	9.5	16	83
Chilton/Taylor	≥ 28 in		9	12	20	27	3.0	8.8	9.6	13	89
Fire Clay Rider	≥ 28 in		13	16	20	15	3.6	11	15	24	56
Fire Clay	≥ 28 in	Q	40	9.2	14	18	1.9	5.0	8.2	16	86
Cedar Grove/Whitesburg	≥ 28 in		16	13	46	130	2.6	6.0	9.1	19	530
Williamson/Amburgy	≥ 28 in		19	13	27	55	2.8	7.5	11	19	250
Campbell Creek/Upper Elkhorn No 3	≥ 28 in	T	80	9.4	13	12	1.2	5.5	8.8	16	63
Upper Elkhorn Nos 1 and 2/Powellton	≥ 28 in	U	59	8.9	14	17	0.96	4.6	9.2	17	110
Pond Creek	≥ 28 in	V	78	13	29	67	2.2	6.6	12	23	540
Matewan/Clintwood	≥ 28 in	W	54	7.9	14	23	1.1	3.9	7.3	14	150
Middle War Eagle/Eagle	≥ 28 in		12	9.0	21	32	1.7	3.7	7.7	16	100
Bens Creek/Blair	≥ 28 in		11	7.0	15	24	3.0	3.8	4.9	5.7	68
Little Eagle/Dorchester	≥ 28 in	X	54	10	21	35	1.1	4.7	8.9	16	170
Lower War Eagle/Hagy	≥ 28 in		8	13	27	39	2.4	5.6	17	25	120
Glenalum Tunnel/Splashdam	≥ 28 in		17	12	20	23	2.1	4.6	11	29	84
Gilbert A/Upper Banner	≥ 28 in		24	13	17	12	3.9	7.3	15	22	53
Gilbert/Lower Banner	≥ 28 in		17	23	29	18	4.5	16	23	50	60
Douglas/Kennedy	≥ 28 in		22	20	35	45	2.9	11	24	32	190
Jewell/Raven	≥ 28 in		19	24	29	18	7.8	16	23	36	74
Iaeger/Jawbone	≥ 28 in		17	18	35	43	1.2	8.7	15	37	160
Lower Iaeger/Tiller	≥ 28 in		7	21	24	13	10	16	17	33	45
Sewell/Lower Seaboard	≥ 28 in	CC	41	9.3	17	21	1.5	4.4	8.2	21	100
Welch/Upper Horsepen	≥ 28 in		10	10	12	7.3	5.2	6.4	9.7	16	27
Little Raleigh/Middle Horsepen	≥ 28 in		4	39	91	130	8.3	16	38	110	280
Beckley/War Creek	≥ 28 in		18	9.6	30	70	1.4	4.8	6.3	22	300
Fire Creek/Lower Horsepen	≥ 28 in		14	6.6	8.1	5.1	2.7	3.5	7.5	12	19
Pocahontas No 6	≥ 28 in		10	8.4	22	42	1.5	2.8	11	15	140
Pocahontas No 4	≥ 28 in		13	18	37	68	3.4	8.5	21	30	260
Pocahontas No 3	≥ 28 in	EE	43	17	25	31	1.7	9.4	20	27	200

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4c. Thin Coal Smples, <28 inch thick.

			Selenium								
Coal bed name, this study	Thickness range	Coal bed code N≥30	N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Redstone	< 28 in		18	2.3	2.6	1.5	1.1	1.7	2.3	3.0	7.0
Pittsburgh Roof	< 28 in		8	2.1	2.3	1.1	1.4	1.5	1.8	2.7	4.4
Pittsburgh	< 28 in		5	1.5	1.7	1.0	0.70	1.3	1.4	1.5	3.4
Harlem	< 28 in		8	1.1	1.2	0.32	0.68	0.95	1.3	1.4	1.6
Lower Bakerstown	< 28 in		18	2.9	3.3	2.2	1.5	2.1	2.8	3.8	11
Brush Creek	< 28 in		8	2.7	3.1	1.7	1.2	2.0	2.6	3.6	6.4
Mahoning	< 28 in		14	1.8	2.0	0.91	1.2	1.4	1.6	2.3	4.7
Upper Freeport	< 28 in	F	62	2.6	3.2	2.6	0.43	1.8	2.3	3.7	14
Lower Freeport	< 28 in	G	36	3.0	3.4	1.8	0.90	2.2	3.3	4.3	9.1
Upper Kittanning	< 28 in	H	35	3.3	3.9	2.6	1.3	2.3	2.9	4.7	11
Middle Kittanning Rider	< 28 in		8	4.5	5.2	2.3	1.0	3.6	5.9	6.6	8.1
Middle Kittanning	< 28 in	I	75	3.1	3.6	2.3	0.99	2.4	3.0	3.9	14
Strasburg	< 28 in		10	3.8	4.1	1.5	1.5	3.7	4.0	4.1	7.7
Lower Kittanning Rider	< 28 in		6	2.9	3.1	1.2	1.6	2.3	2.9	3.8	4.8
Lower Kittanning/No 6 block	< 28 in	J	57	3.4	4.1	2.7	0.98	2.3	3.2	4.5	14
Clarion	< 28 in		27	4.9	5.6	2.5	1.2	3.3	5.4	8.0	9.5
Brookville	< 28 in	L	43	4.6	5.4	3.6	1.2	3.3	4.4	6.4	21
No 5 Block	< 28 in		28	4.7	6.4	4.0	0.10	3.6	5.9	8.5	18
Upper Mercer	< 28 in		6	6.3	6.8	3.0	3.1	5.5	6.6	7.2	12
Lower Mercer	< 28 in		17	5.6	6.6	3.0	0.84	5.6	6.5	8.2	13
Quakertown	< 28 in		7	5.5	6.9	4.2	1.2	4.1	5.7	11	12
Stockton	< 28 in		11	4.8	5.2	2.2	2.4	3.9	4.6	6.3	8.7
Coalburg	< 28 in	O	76	4.4	4.9	2.2	1.2	3.3	4.7	5.7	12
Winifrede/Hazard	< 28 in	P	31	4.0	4.5	2.0	0.50	3.2	3.9	5.8	9.2
Lower Winifrede/Hazard	< 28 in		6	2.2	3.7	1.9	0.07	3.8	4.0	4.3	5.9
Chilton/Taylor	< 28 in		6	4.2	4.8	2.7	2.0	3.2	3.6	6.6	8.7
Fire Clay Rider	< 28 in		16	4.1	4.9	3.3	1.7	2.7	4.1	4.9	13
Fire Clay	< 28 in	Q	30	3.8	4.2	2.0	1.7	2.6	3.8	5.5	9.0
Cedar Grove/Whitesburg	< 28 in		23	4.0	4.4	2.1	1.2	2.8	4.3	5.1	9.4
Williamson/Amburgy	< 28 in		26	2.9	3.2	1.6	1.0	2.1	2.8	4.3	7.4
Campbell Creek/Upper Elkhorn No 3	< 28 in	T	63	2.9	3.5	2.0	0.07	2.0	2.9	4.3	9.3
Upper Elkhorn Nos 1 and 2/Powellton	< 28 in	U	55	2.7	3.2	2.5	0.64	1.9	2.6	3.4	16
Pond Creek	< 28 in	V	43	2.7	2.9	1.2	1.2	2.1	3.0	3.4	6.6
Matewan/Clintwood	< 28 in	W	72	2.2	2.6	1.6	0.62	1.5	2.2	3.0	8.0
Middle War Eagle/Eagle	< 28 in		11	2.7	3.4	2.7	1.1	2.0	2.4	3.5	9.3
Little Eagle/Dorchester	< 28 in	X	34	1.9	2.2	1.3	0.63	1.4	1.8	2.7	7.0
Lower War Eagle/Hagy	< 28 in		5	3.1	3.1	0.65	2.0	3.2	3.3	3.5	3.6
Glenalum Tunnel/Splashdam	< 28 in		18	2.2	2.3	0.66	1.4	1.7	2.3	2.8	3.8
Gilbert A/Upper Banner	< 28 in		22	2.4	2.7	1.4	1.2	1.6	2.3	3.3	6.7
Gilbert/Lower Banner	< 28 in		6	2.8	3.0	1.2	1.4	2.3	2.8	3.9	4.7
Douglas/Kennedy	< 28 in		15	2.0	2.2	1.1	0.90	1.5	1.8	2.7	4.6
Jewell/Raven	< 28 in		5	2.4	2.9	2.0	0.88	1.7	2.4	3.7	5.9
Iaeger/Jawbone	< 28 in		17	2.3	2.9	2.4	0.70	1.7	2.5	3.2	11
Lower Iaeger/Tiller	< 28 in		10	2.4	2.6	1.1	1.5	2.0	2.4	2.8	5.4
Sewell/Lower Seaboard	< 28 in		20	2.1	2.7	2.1	0.79	1.1	1.9	4.1	7.0
Welch/Upper Horsepen	< 28 in		5	1.8	1.9	0.56	1.0	1.8	1.8	2.2	2.5
Beckley/War Creek	< 28 in		12	1.8	2.2	1.8	0.80	1.2	1.6	2.3	7.0
Fire Creek/Lower Horsepen	< 28 in		8	1.5	1.8	1.1	0.67	0.96	1.9	2.0	4.0
Pocahontas No 7	< 28 in		4	1.7	2.0	1.4	1.0	1.2	1.6	2.4	4.0
Pocahontas No 3	< 28 in		10	3.1	3.5	1.7	1.9	2.1	2.6	5.2	6.0

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4c. Thin Coal Smples, <28 inch thick.

			Thickness								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean in	Average in	Standard Deviation in	Minimum in	Lower Quartile in	Median in	Upper Quartile in	Maximum in
Redstone	< 28 in		18	19.0	19.3	3.5	12.0	17.0	18.0	21.6	25.3
Pittsburgh Roof	< 28 in		8	20.3	21.1	5.8	10.2	18.4	23.2	24.2	27.6
Pittsburgh	< 28 in		5	20.6	22.1	7.5	9.0	23.8	24.5	25.8	27.5
Harlem	< 28 in		8	23.0	23.3	4.0	17.5	19.6	25.4	26.3	27.0
Lower Bakerstown	< 28 in		18	22.8	23.2	4.1	13.2	20.9	24.3	26.4	27.6
Brush Creek	< 28 in		8	14.5	15.6	5.8	7.8	12.9	14.7	20.0	24.6
Mahoning	< 28 in		14	17.6	18.8	5.7	4.8	16.1	19.1	22.4	27.0
Upper Freeport	< 28 in	F	63	16.6	18.3	6.6	2.0	13.0	19.0	24.0	27.0
Lower Freeport	< 28 in	G	36	18.1	19.3	6.3	5.4	14.9	19.5	25.6	27.6
Upper Kittanning	< 28 in	H	35	18.3	19.3	5.6	6.6	15.3	20.4	23.7	27.6
Middle Kittanning Rider	< 28 in		8	12.6	15.2	8.3	3.0	11.4	15.0	19.5	27.6
Middle Kittanning	< 28 in	I	75	18.7	20.1	6.1	2.5	16.7	21.3	25.2	27.8
Strasburg	< 28 in		10	17.8	18.5	5.5	12.8	14.1	16.3	22.2	27.9
Lower Kittanning Rider	< 28 in		6	11.0	11.6	4.2	6.6	9.8	11.1	12.0	19.2
Lower Kittanning/No 6 block	< 28 in	J	57	21.6	22.1	4.3	9.8	20.4	23.0	25.2	27.8
Clarion	< 28 in		27	16.7	17.6	5.4	9.0	13.8	18.0	20.6	26.4
Brookville	< 28 in	L	43	17.3	18.0	4.9	6.6	15.6	18.3	21.2	27.6
No 5 Block	< 28 in		28	16.4	17.5	5.9	7.4	12.8	17.8	21.7	27.6
Upper Mercer	< 28 in		6	17.8	18.6	5.9	11.4	14.1	18.3	23.0	26.4
Lower Mercer	< 28 in		17	20.4	21.1	5.2	10.8	18.0	24.0	24.6	27.0
Quakertown	< 28 in		7	22.0	22.2	2.8	18.5	19.8	22.8	24.3	26.0
Stockton	< 28 in		11	11.3	12.3	5.3	5.9	7.9	12.5	15.2	23.6
Coalburg	< 28 in	O	76	16.1	17.3	5.9	4.3	13.3	18.0	21.1	27.8
Winifrede/Hazard	< 28 in	P	31	15.6	17.0	6.4	4.3	11.4	19.0	22.0	26.8
Lower Winifrede/Hazard	< 28 in		6	15.9	17.3	6.8	6.7	14.2	17.8	21.3	26.0
Chilton/Taylor	< 28 in		6	10.5	12.0	6.9	5.5	6.6	10.9	15.0	23.5
Fire Clay Rider	< 28 in		16	12.4	14.4	7.8	6.0	7.6	13.2	18.8	27.2
Fire Clay	< 28 in	Q	30	16.1	17.5	6.6	6.0	12.2	18.5	22.6	27.6
Cedar Grove/Whitesburg	< 28 in		23	14.5	16.5	7.2	3.1	11.7	16.1	22.6	26.8
Williamson/Amburgy	< 28 in		26	15.0	16.1	6.0	5.5	11.2	15.4	21.1	27.2
Campbell Creek/Upper Elkhorn No 3	< 28 in	T	63	18.0	19.0	5.8	7.0	15.2	20.0	23.2	27.6
Upper Elkhorn Nos 1 and 2/Powellton	< 28 in	U	55	15.1	16.2	5.7	7.1	12.3	15.4	20.7	27.2
Pond Creek	< 28 in	V	43	17.1	18.8	6.7	4.0	13.9	20.0	24.2	27.8
Matewan/Clintwood	< 28 in	W	72	16.9	17.8	5.6	7.7	13.2	18.0	22.8	27.6
Middle War Eagle/Eagle	< 28 in		11	19.0	19.5	4.8	12.6	16.7	18.5	22.6	28.0
Little Eagle/Dorchester	< 28 in	X	34	18.9	19.7	5.2	10.2	17.0	20.8	23.9	27.0
Lower War Eagle/Hagy	< 28 in		5	17.4	19.6	8.2	6.0	19.2	22.2	22.8	27.6
Glenalum Tunnel/Splashdam	< 28 in		18	18.6	19.4	5.8	11.0	14.9	17.3	25.4	27.6
Gilbert A/Upper Banner	< 28 in		22	15.8	17.2	6.6	6.3	12.3	17.0	23.5	27.0
Gilbert/Lower Banner	< 28 in		6	18.7	19.3	4.9	12.8	15.6	19.9	22.4	25.8
Douglas/Kennedy	< 28 in		15	23.9	24.1	3.1	18.0	22.0	24.0	27.0	27.6
Jewell/Raven	< 28 in		5	11.2	12.5	6.4	6.0	7.5	10.8	17.0	21.0
Iaeger/Jawbone	< 28 in		17	19.1	20.6	7.1	8.4	15.1	24.5	26.6	27.6
Lower Iaeger/Tiller	< 28 in		10	10.7	11.6	5.1	5.4	8.3	10.5	13.2	21.6
Sewell/Lower Seaboard	< 28 in		20	19.7	20.1	4.0	12.5	18.0	20.5	23.5	25.5
Welch/Upper Horsepen	< 28 in		5	17.8	18.6	5.7	11.0	16.0	18.0	22.0	26.0
Beckley/War Creek	< 28 in		12	17.3	18.7	7.0	8.0	12.8	19.0	24.5	27.8
Fire Creek/Lower Horsepen	< 28 in		8	19.5	19.9	4.3	14.0	17.8	19.0	21.3	26.9
Pocahontas No 7	< 28 in		5	15.8	16.3	4.6	10.5	14.0	17.0	17.2	23.0
Pocahontas No 3	< 28 in		10	18.3	19.2	6.0	11.1	13.3	20.8	24.3	27.0

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4c. Thin Coal Smples, <28 inch thick.

			Ash Yield								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean percent	Average percent	Standard Deviation percent	Minimum percent	Lower Quartile percent	Median percent	Upper Quartile percent	Maximum percent
Redstone	< 28 in		18	12.50	13.18	4.97	9.10	10.08	10.95	14.09	27.20
Pittsburgh Roof	< 28 in		8	15.94	16.29	3.65	11.90	13.25	16.22	18.04	22.30
Pittsburgh	< 28 in		5	10.55	10.72	2.24	8.30	10.20	10.20	10.49	14.40
Harlem	< 28 in		8	10.12	10.34	2.20	7.30	9.19	10.25	11.95	13.02
Lower Bakerstown	< 28 in		18	11.25	12.42	6.22	5.66	8.98	10.39	14.04	29.30
Brush Creek	< 28 in		8	11.64	12.55	5.78	7.17	8.78	11.28	13.76	25.50
Mahoning	< 28 in		13	11.02	11.63	4.30	7.00	8.90	9.77	13.05	20.23
Upper Freeport	< 28 in	F	49	12.11	13.37	6.03	5.50	8.20	12.10	16.36	29.31
Lower Freeport	< 28 in	G	36	13.71	14.72	6.09	8.43	9.71	12.02	17.79	31.20
Upper Kittanning	< 28 in	H	35	13.43	14.27	4.92	4.54	11.72	13.44	17.18	30.21
Middle Kittanning Rider	< 28 in		8	9.03	10.13	5.68	4.50	7.50	8.80	10.65	22.70
Middle Kittanning	< 28 in	I	74	9.47	10.98	5.91	1.70	7.04	10.21	13.58	28.66
Strasburg	< 28 in		10	11.33	11.78	3.31	6.30	9.35	11.90	13.65	16.80
Lower Kittanning Rider	< 28 in		6	11.20	13.12	8.22	5.70	6.80	11.78	15.59	27.44
Lower Kittanning/No 6 block	< 28 in	J	55	11.30	12.14	4.70	5.00	8.79	11.07	14.15	23.70
Clarion	< 28 in		27	12.28	13.55	5.55	4.20	8.80	14.70	17.04	25.57
Brookville	< 28 in	L	43	12.14	13.24	5.51	5.30	8.75	13.30	16.75	27.75
No 5 Block	< 28 in		27	11.42	12.94	6.94	4.20	7.65	11.58	15.39	31.50
Upper Mercer	< 28 in		6	18.82	18.99	2.72	15.22	17.47	19.08	20.18	23.07
Lower Mercer	< 28 in		16	15.31	16.40	5.41	4.80	13.54	16.76	20.85	24.34
Quakertown	< 28 in		7	10.50	11.60	4.44	3.30	10.11	12.81	13.81	17.23
Stockton	< 28 in		11	12.19	12.97	5.79	8.11	10.72	11.80	12.99	29.60
Coalburg	< 28 in	O	75	8.23	9.56	5.43	2.70	5.79	8.78	12.35	29.10
Winifrede/Hazard	< 28 in	P	31	7.74	9.90	6.85	2.00	3.61	9.30	13.30	26.40
Lower Winifrede/Hazard	< 28 in		6	7.98	8.99	4.43	3.50	5.70	9.06	11.73	15.10
Chilton/Taylor	< 28 in		6	12.13	14.09	8.76	5.70	8.32	12.58	15.75	30.00
Fire Clay Rider	< 28 in		10	11.13	13.72	9.57	3.65	7.99	10.42	16.31	32.90
Fire Clay	< 28 in	Q *	26	8.96	10.52	5.94	2.50	6.21	10.75	12.88	24.80
Cedar Grove/Whitesburg	< 28 in		22	9.33	10.09	3.86	3.32	7.63	9.83	12.83	18.09
Williamson/Amburgy	< 28 in		25	7.63	8.64	4.73	2.76	5.94	7.80	10.64	24.40
Campbell Creek/Upper Elkhorn No 3	< 28 in	T	63	5.54	6.92	4.36	0.90	3.41	5.40	9.44	19.10
Upper Elkhorn Nos 1 and 2/Powellton	< 28 in	U	52	5.54	6.62	4.32	1.60	4.24	5.85	8.09	22.37
Pond Creek	< 28 in	V	43	5.11	6.31	4.14	1.22	3.29	5.00	8.80	16.40
Matewan/Clintwood	< 28 in	W	71	5.96	6.85	3.63	1.73	3.85	6.00	9.01	19.70
Middle War Eagle/Eagle	< 28 in		11	5.46	6.18	3.23	1.66	4.19	6.30	6.55	14.01
Little Eagle/Dorchester	< 28 in	X	34	5.69	6.84	4.20	2.20	3.73	5.60	10.19	17.00
Lower War Eagle/Hagy	< 28 in		4	9.53	10.05	3.53	5.66	8.14	10.39	12.30	13.78
Glenalum Tunnel/Splashdam	< 28 in		18	4.11	5.05	4.07	1.74	2.53	4.11	6.05	19.10
Gilbert A/Upper Banner	< 28 in		19	8.01	8.90	4.41	3.65	6.10	7.05	11.46	20.67
Gilbert/Lower Banner	< 28 in		6	5.88	6.35	2.79	3.40	4.57	6.28	6.69	11.30
Douglas/Kennedy	< 28 in		14	6.22	8.03	7.46	2.75	4.38	4.69	7.80	29.55
Jewell/Raven	< 28 in		3	7.70	8.71	5.55	5.13	na	5.90	na	15.10
Iaeger/Jawbone	< 28 in		17	7.65	10.34	7.61	2.00	3.80	9.80	15.40	29.30
Lower Iaeger/Tiller	< 28 in		10	9.02	10.35	5.27	2.90	7.40	9.70	12.88	19.40
Sewell/Lower Seaboard	< 28 in		15	10.69	11.90	5.34	3.10	9.00	11.49	13.40	21.60
Welch/Upper Horsepen	< 28 in		2	7.28	7.32	0.97	6.63	na	na	na	8.00
Beckley/War Creek	< 28 in		11	6.85	9.13	8.00	2.00	4.25	7.30	10.15	29.30
Fire Creek/Lower Horsepen	< 28 in		8	5.19	5.82	2.74	2.60	3.07	6.34	7.65	10.00
Pocahontas No 7	< 28 in		5	11.09	13.48	9.72	4.81	8.32	8.92	16.10	29.25
Pocahontas No 3	< 28 in		8	7.97	9.49	7.07	3.80	6.23	7.15	10.08	26.00

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4c. Thin Coal Smples, <28 inch thick.

			Sulfur								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean percent	Average percent	Standard Deviation percent	Minimum percent	Lower Quartile percent	Median percent	Upper Quartile percent	Maximum percent
Redstone	< 28 in		18	2.81	3.08	1.22	0.80	2.24	3.19	3.55	5.90
Pittsburgh Roof	< 28 in		8	2.52	3.22	2.08	0.60	1.58	3.10	4.71	6.50
Pittsburgh	< 28 in		5	3.26	3.35	0.91	2.56	2.60	3.40	3.40	4.80
Harlem	< 28 in		8	1.40	1.75	1.18	0.50	0.78	1.38	2.75	3.66
Lower Bakerstown	< 28 in		18	2.61	2.92	1.23	0.77	2.39	3.00	3.63	5.41
Brush Creek	< 28 in		8	2.59	2.73	1.04	1.84	2.08	2.32	3.01	5.00
Mahoning	< 28 in		13	2.04	2.31	1.25	0.90	1.43	1.84	3.22	5.10
Upper Freeport	< 28 in	F	60	2.36	2.80	1.73	0.80	1.44	2.44	3.56	8.00
Lower Freeport	< 28 in	G	36	2.81	3.30	1.73	0.60	1.97	3.03	4.53	7.22
Upper Kittanning	< 28 in	H	35	1.53	1.90	1.25	0.47	0.87	1.59	2.78	5.72
Middle Kittanning Rider	< 28 in		8	1.25	1.79	1.47	0.50	0.50	1.55	2.63	4.40
Middle Kittanning	< 28 in	I	74	2.17	2.62	1.65	0.50	1.42	2.06	3.49	8.11
Strasburg	< 28 in		10	4.17	4.81	2.07	1.10	4.25	5.31	6.22	7.20
Lower Kittanning Rider	< 28 in		6	1.25	1.41	0.85	0.82	0.90	0.96	1.68	2.93
Lower Kittanning/No 6 block	< 28 in	J	55	3.08	3.59	1.91	0.43	2.39	3.30	4.79	10.40
Clarion	< 28 in		27	2.77	3.24	1.52	0.50	2.30	3.30	3.95	6.40
Brookville	< 28 in	L	43	2.25	2.62	1.57	0.70	1.67	2.40	2.92	7.85
No 5 Block	< 28 in		27	1.34	1.65	1.11	0.50	0.80	1.02	2.15	4.30
Upper Mercer	< 28 in		6	3.82	4.02	1.35	2.19	3.18	4.07	4.72	5.96
Lower Mercer	< 28 in		16	2.03	2.45	1.37	0.51	1.49	1.99	3.74	4.69
Quakertown	< 28 in		7	1.99	2.70	2.37	0.80	1.09	1.71	3.49	7.21
Stockton	< 28 in		11	1.53	2.06	1.64	0.50	0.75	1.60	3.26	5.50
Coalburg	< 28 in	O	75	1.19	1.46	1.05	0.50	0.73	1.00	1.90	4.70
Winifrede/Hazard	< 28 in	P	31	0.96	1.15	0.89	0.41	0.67	0.80	1.27	4.70
Lower Winifrede/Hazard	< 28 in		6	0.77	0.80	0.26	0.60	0.68	0.70	0.81	1.30
Chilton/Taylor	< 28 in		6	2.03	2.54	1.60	0.70	1.25	2.77	3.21	4.90
Fire Clay Rider	< 28 in		10	2.29	2.79	1.68	0.80	1.30	2.70	3.93	5.20
Fire Clay	< 28 in	Q *	26	1.10	1.43	1.31	0.56	0.68	0.81	1.36	5.95
Cedar Grove/Whitesburg	< 28 in		22	1.73	2.09	1.25	0.70	0.93	1.88	3.06	4.30
Williamson/Amburgy	< 28 in		25	1.66	2.02	1.38	0.60	0.90	1.71	2.40	5.80
Campbell Creek/Upper Elkhorn No 3	< 28 in	T	63	1.16	1.44	1.09	0.50	0.70	0.90	1.87	5.10
Upper Elkhorn Nos 1 and 2/Powellton	< 28 in	U	52	1.56	2.02	1.53	0.50	0.82	1.31	2.78	6.60
Pond Creek	< 28 in	V	43	1.43	1.84	1.38	0.50	0.80	1.20	2.59	6.30
Matewan/Clintwood	< 28 in	W	71	1.42	1.85	1.47	0.54	0.80	1.12	2.60	6.61
Middle War Eagle/Eagle	< 28 in		11	1.55	1.76	0.90	0.60	1.08	1.50	2.62	3.10
Little Eagle/Dorchester	< 28 in	X	34	1.15	1.37	1.05	0.50	0.88	1.00	1.35	5.00
Lower War Eagle/Hagy	< 28 in		4	1.99	2.25	1.21	1.20	1.23	2.09	3.11	3.60
Glenalum Tunnel/Splashdam	< 28 in		18	1.01	1.30	1.19	0.60	0.64	0.70	1.49	5.20
Gilbert A/Upper Banner	< 28 in		19	1.13	1.43	1.24	0.50	0.66	1.08	1.60	5.80
Gilbert/Lower Banner	< 28 in		6	1.10	1.22	0.60	0.60	0.78	1.11	1.50	2.19
Douglas/Kennedy	< 28 in		14	1.09	1.24	0.74	0.68	0.80	0.85	1.42	2.93
Jewell/Raven	< 28 in		3	1.54	1.96	1.69	0.80	na	1.17	na	3.90
Iaeger/Jawbone	< 28 in		17	1.14	1.60	1.46	0.50	0.60	0.80	2.00	4.90
Lower Iaeger/Tiller	< 28 in		10	2.33	3.44	2.71	0.60	0.85	3.65	4.43	8.90
Sewell/Lower Seaboard	< 28 in		15	0.86	1.03	0.69	0.40	0.55	0.80	1.21	2.58
Welch/Upper Horsepen	< 28 in		2	0.97	1.02	0.42	0.72	na	na	na	1.31
Beckley/War Creek	< 28 in		11	0.76	0.91	0.78	0.40	0.55	0.70	0.80	3.20
Fire Creek/Lower Horsepen	< 28 in		8	0.81	0.84	0.23	0.57	0.68	0.83	0.95	1.20
Pocahontas No 7	< 28 in		5	0.89	0.95	0.36	0.56	0.56	1.12	1.23	1.27
Pocahontas No 3	< 28 in		8	0.71	0.83	0.55	0.40	0.50	0.60	0.85	1.80

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4c. Thin Coal Smples, <28 inch thick.

			Pyritic Sulfur								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean percent	Average percent	Standard Deviation percent	Minimum percent	Lower Quartile percent	Median percent	Upper Quartile percent	Maximum percent
Redstone	< 28 in		16	1.49	1.82	0.99	0.19	1.12	1.79	2.37	3.51
Pittsburgh Roof	< 28 in		8	1.09	2.26	1.96	0.03	0.82	2.09	3.38	5.74
Pittsburgh	< 28 in		5	2.15	2.24	0.73	1.45	1.84	2.02	2.55	3.33
Harlem	< 28 in		8	0.60	0.98	0.85	0.07	0.25	0.89	1.38	2.44
Lower Bakerstown	< 28 in		18	1.33	1.76	0.92	0.09	1.24	1.86	2.39	3.46
Brush Creek	< 28 in		8	1.70	1.86	0.99	1.12	1.38	1.49	1.94	4.17
Mahoning	< 28 in		12	1.01	1.40	0.98	0.08	0.70	1.24	2.08	3.34
Upper Freeport	< 28 in	F	56	1.36	1.80	1.37	0.14	0.76	1.47	2.43	6.18
Lower Freeport	< 28 in	G	36	1.58	2.12	1.26	0.05	1.15	1.88	3.03	5.43
Upper Kittanning	< 28 in	H	34	0.58	1.25	1.13	0.01	0.28	1.00	2.12	4.21
Middle Kittanning Rider	< 28 in		8	0.30	1.06	1.10	0.02	0.04	0.99	1.73	2.89
Middle Kittanning	< 28 in	I	73	1.07	1.75	1.47	0.01	0.94	1.28	2.52	6.85
Strasburg	< 28 in		10	2.48	3.13	1.63	0.38	2.71	3.29	4.18	5.48
Lower Kittanning Rider	< 28 in		6	0.31	0.53	0.64	0.07	0.16	0.33	0.51	1.78
Lower Kittanning/No 6 block	< 28 in	J	52	1.83	2.38	1.46	0.02	1.40	2.08	3.13	8.08
Clarion	< 28 in		27	1.31	2.08	1.26	0.03	1.58	1.97	2.89	4.73
Brookville	< 28 in	L	42	1.04	1.45	1.30	0.07	0.60	1.14	1.78	7.10
No 5 Block	< 28 in		24	0.51	1.10	1.08	0.01	0.26	0.72	1.63	3.46
Upper Mercer	< 28 in		6	2.96	3.22	1.28	1.31	2.53	3.29	4.19	4.66
Lower Mercer	< 28 in		16	0.94	1.66	1.23	0.02	0.83	1.26	2.62	3.69
Quakertown	< 28 in		7	1.19	2.14	2.37	0.15	0.76	1.19	2.66	6.81
Stockton	< 28 in		8	0.43	1.43	1.71	0.04	0.08	1.02	2.18	4.85
Coalburg	< 28 in	O	69	0.32	0.76	0.95	0.01	0.10	0.29	1.05	3.99
Winifrede/Hazard	< 28 in	P *	29	0.18	0.50	0.80	0.01	0.08	0.15	0.74	3.66
Lower Winifrede/Hazard	< 28 in		6	0.13	0.22	0.29	0.04	0.07	0.12	0.15	0.80
Chilton/Taylor	< 28 in		5	1.21	1.99	1.11	0.07	2.24	2.25	2.55	2.86
Fire Clay Rider	< 28 in		10	1.07	1.87	1.56	0.06	0.61	1.49	2.94	4.21
Fire Clay	< 28 in	Q *	26	0.25	0.63	0.88	0.02	0.09	0.26	0.62	3.33
Cedar Grove/Whitesburg	< 28 in		16	1.17	1.62	1.03	0.09	0.91	1.54	2.41	3.54
Williamson/Amburgy	< 28 in		23	0.57	1.07	1.01	0.02	0.34	0.70	1.54	4.18
Campbell Creek/Upper Elkhorn No 3	< 28 in	T	37	0.31	0.85	1.05	0.03	0.09	0.25	1.41	3.50
Upper Elkhorn Nos 1 and 2/Powellton	< 28 in	U	48	0.52	1.28	1.36	0.01	0.19	0.88	1.86	5.17
Pond Creek	< 28 in	V	33	0.41	1.10	1.12	0.02	0.10	0.62	1.88	3.78
Matewan/Clintwood	< 28 in	W	70	0.42	1.04	1.22	0.01	0.15	0.42	1.85	5.22
Middle War Eagle/Eagle	< 28 in		10	0.68	0.98	0.72	0.06	0.54	0.74	1.62	2.06
Little Eagle/Dorchester	< 28 in	X	34	0.33	0.59	0.74	0.03	0.19	0.31	0.55	3.27
Lower War Eagle/Hagy	< 28 in		4	0.94	1.42	1.22	0.23	0.49	1.33	2.25	2.80
Glenalum Tunnel/Splashdam	< 28 in		18	0.19	0.66	1.01	0.01	0.06	0.17	0.82	3.65
Gilbert A/Upper Banner	< 28 in		19	0.27	0.77	1.31	0.01	0.10	0.43	0.71	5.72
Gilbert/Lower Banner	< 28 in		5	0.37	0.57	0.50	0.06	0.30	0.40	0.71	1.36
Douglas/Kennedy	< 28 in		12	0.29	0.52	0.62	0.05	0.15	0.27	0.54	2.07
Jewell/Raven	< 28 in		3	0.52	1.34	1.97	0.18	na	0.22	na	3.61
Iaeger/Jawbone	< 28 in		15	0.28	0.94	1.18	0.03	0.07	0.17	1.71	3.23
Lower Iaeger/Tiller	< 28 in		10	1.30	2.74	2.45	0.08	0.55	2.83	4.10	7.62
Sewell/Lower Seaboard	< 28 in		12	0.38	0.60	0.53	0.05	0.27	0.42	0.80	1.79
Welch/Upper Horsepen	< 28 in		2	0.07	0.24	0.32	0.01	na	na	na	0.46
Beckley/War Creek	< 28 in		9	0.15	0.36	0.67	0.03	0.10	0.13	0.22	2.14
Fire Creek/Lower Horsepen	< 28 in		6	0.14	0.21	0.17	0.02	0.15	0.17	0.21	0.52
Pocahontas No 7	< 28 in		5	0.14	0.28	0.25	0.02	0.03	0.32	0.39	0.62
Pocahontas No 3	< 28 in		1	na	na	na	na	na	0.22	na	na

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4c. Thin Coal Smples, <28 inch thick.

			Arsenic								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Redstone	< 28 in		18	21	44	68	1.5	9.5	20	45	290
Pittsburgh Roof	< 28 in		7	12	17	13	0.85	12	14	22	41
Pittsburgh	< 28 in		5	24	34	27	5.8	13	32	44	75
Harlem	< 28 in		8	7.8	14	17	1.5	4.8	9.3	14	53
Lower Bakerstown	< 28 in		18	39	60	86	9.9	23	43	53	390
Brush Creek	< 28 in		8	28	36	24	10	18	30	50	77
Mahoning	< 28 in		14	79	100	99	28	49	73	120	410
Upper Freeport	< 28 in	F	63	38	51	41	4.3	24	42	66	200
Lower Freeport	< 28 in	G	35	30	45	34	2.3	21	35	75	120
Upper Kittanning	< 28 in	H	35	26	47	49	1.0	10	35	67	230
Middle Kittanning Rider	< 28 in		8	22	43	39	1.4	16	38	61	120
Middle Kittanning	< 28 in	I	72	17	34	38	0.70	7.2	21	43	160
Strasburg	< 28 in		10	18	31	31	2.9	8.1	24	35	100
Lower Kittanning Rider	< 28 in		6	9.5	14	13	3.0	5.5	7.8	18	38
Lower Kittanning/No 6 block	< 28 in	J	57	24	42	52	2.0	11	21	48	270
Clarion	< 28 in		27	12	20	18	1.4	4.2	18	27	73
Brookville	< 28 in	L	43	11	21	29	0.49	4.7	12	20	150
No 5 Block	< 28 in		27	11	28	39	0.90	3.7	12	38	150
Upper Mercer	< 28 in		6	33	44	43	16	20	30	40	130
Lower Mercer	< 28 in		17	13	26	40	1.6	6.4	12	29	160
Quakertown	< 28 in		7	20	28	27	9.5	12	13	36	81
Stockton	< 28 in		11	9.2	20	22	0.70	3.6	7.3	29	61
Coalburg	< 28 in	O	75	8.0	18	28	0.40	3.0	6.6	19	170
Winifrede/Hazard	< 28 in	P	31	5.1	22	59	0.50	1.6	5.0	9.8	270
Lower Winifrede/Hazard	< 28 in		5	6.0	8.1	6.5	2.5	2.6	5.6	13	17
Chilton/Taylor	< 28 in		6	11	25	26	1.2	3.4	17	47	58
Fire Clay Rider	< 28 in		16	35	65	77	1.7	22	38	75	300
Fire Clay	< 28 in	Q	30	7.2	17	23	0.90	2.3	6.2	27	100
Cedar Grove/Whitesburg	< 28 in		23	15	33	57	1.8	5.8	17	38	280
Williamson/Amburgy	< 28 in		26	16	32	36	0.61	8.6	27	36	170
Campbell Creek/Upper Elkhorn No 3	< 28 in	T	62	7.7	21	33	0.90	2.3	5.7	30	170
Upper Elkhorn Nos 1 and 2/Powellton	< 28 in	U	55	23	70	120	1.1	9.5	23	53	680
Pond Creek	< 28 in	V	43	14	32	34	0.40	5.4	15	53	120
Matewan/Clintwood	< 28 in	W	72	11	30	40	0.50	3.6	12	40	180
Middle War Eagle/Eagle	< 28 in		11	28	48	39	1.9	14	34	84	100
Little Eagle/Dorchester	< 28 in	X	34	11	24	32	1.1	3.9	13	32	130
Lower War Eagle/Hagy	< 28 in		5	32	89	140	3.5	13	48	50	330
Glenalum Tunnel/Splashdam	< 28 in		18	8.2	22	28	0.87	3.2	6.1	44	79
Gilbert A/Upper Banner	< 28 in		22	13	29	33	0.76	5.2	12	46	99
Gilbert/Lower Banner	< 28 in		6	25	49	55	5.3	10	20	96	120
Douglas/Kennedy	< 28 in		15	23	35	32	2.8	11	24	54	100
Jewell/Raven	< 28 in		5	9.9	12	7.9	5.0	7.0	10	11	25
Iaeger/Jawbone	< 28 in		17	7.5	21	26	0.51	1.5	10	23	80
Lower Iaeger/Tiller	< 28 in		10	29	76	99	1.6	9.7	35	100	310
Sewell/Lower Seaboard	< 28 in		20	10	17	19	1.2	5.5	10	20	78
Welch/Upper Horsepen	< 28 in		5	19	32	23	1.4	18	39	45	59
Beckley/War Creek	< 28 in		12	8.1	15	23	1.5	4.1	11	15	87
Fire Creek/Lower Horsepen	< 28 in		8	5.5	9.1	8.3	1.3	2.1	7.1	15	21
Pocahontas No 7	< 28 in		4	23	41	35	2.7	16	44	69	75
Pocahontas No 3	< 28 in		10	5.2	17	25	0.90	1.6	2.6	32	70

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4c. Thin Coal Smples, <28 inch thick.

			Mercury								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Redstone	< 28 in		18	0.11	0.16	0.12	0.007	0.084	0.15	0.18	0.52
Pittsburgh Roof	< 28 in		8	0.26	0.32	0.21	0.085	0.17	0.28	0.43	0.69
Pittsburgh	< 28 in		5	0.14	0.21	0.21	0.058	0.077	0.10	0.22	0.57
Harlem	< 28 in		8	0.066	0.12	0.12	0.007	0.028	0.11	0.19	0.31
Lower Bakerstown	< 28 in		18	0.14	0.24	0.29	0.003	0.093	0.19	0.25	1.3
Brush Creek	< 28 in		8	0.13	0.19	0.13	0.010	0.12	0.19	0.27	0.40
Mahoning	< 28 in		14	0.33	0.44	0.32	0.068	0.21	0.35	0.63	1.0
Upper Freeport	< 28 in	F	63	0.29	0.38	0.37	0.030	0.20	0.32	0.46	2.9
Lower Freeport	< 28 in	G	36	0.15	0.25	0.20	0.003	0.10	0.17	0.35	0.87
Upper Kittanning	< 28 in	H	35	0.14	0.27	0.27	0.003	0.060	0.24	0.38	1.3
Middle Kittanning Rider	< 28 in		8	0.42	0.53	0.37	0.14	0.25	0.48	0.65	1.3
Middle Kittanning	< 28 in	I	75	0.12	0.24	0.26	0.003	0.060	0.14	0.32	1.0
Strasburg	< 28 in		10	0.24	0.27	0.14	0.076	0.15	0.29	0.39	0.45
Lower Kittanning Rider	< 28 in		6	0.035	0.088	0.080	0.003	0.020	0.080	0.16	0.18
Lower Kittanning/No 6 block	< 28 in	J	57	0.18	0.27	0.20	0.003	0.14	0.22	0.36	0.87
Clarion	< 28 in		27	0.14	0.18	0.12	0.010	0.10	0.13	0.26	0.45
Brookville	< 28 in	L	43	0.14	0.20	0.16	0.018	0.086	0.19	0.26	0.87
No 5 Block	< 28 in		28	0.13	0.21	0.28	0.023	0.056	0.14	0.23	1.5
Upper Mercer	< 28 in		6	0.15	0.19	0.14	0.040	0.090	0.20	0.24	0.41
Lower Mercer	< 28 in		17	0.11	0.20	0.17	0.003	0.080	0.17	0.38	0.51
Quakertown	< 28 in		7	0.13	0.18	0.14	0.033	0.062	0.18	0.26	0.42
Stockton	< 28 in		11	0.15	0.21	0.18	0.020	0.11	0.18	0.21	0.67
Coalburg	< 28 in	O	76	0.12	0.17	0.12	0.010	0.074	0.15	0.23	0.59
Winifrede/Hazard	< 28 in	P	31	0.099	0.17	0.16	0.007	0.045	0.10	0.29	0.55
Lower Winifrede/Hazard	< 28 in		5	0.052	0.075	0.082	0.020	0.030	0.050	0.055	0.22
Chilton/Taylor	< 28 in		6	0.17	0.25	0.26	0.060	0.090	0.17	0.28	0.74
Fire Clay Rider	< 28 in		16	0.22	0.26	0.17	0.055	0.15	0.21	0.35	0.72
Fire Clay	< 28 in	Q	30	0.079	0.11	0.096	0.007	0.050	0.070	0.22	0.32
Cedar Grove/Whitesburg	< 28 in		23	0.16	0.25	0.26	0.020	0.12	0.21	0.27	1.1
Williamson/Amburgy	< 28 in		26	0.10	0.14	0.12	0.020	0.050	0.11	0.22	0.49
Campbell Creek/Upper Elkhorn No 3	< 28 in	T	62	0.086	0.14	0.14	0.007	0.048	0.088	0.21	0.72
Upper Elkhorn Nos 1 and 2/Powellton	< 28 in	U	55	0.12	0.19	0.15	0.007	0.055	0.17	0.26	0.65
Pond Creek	< 28 in	V	43	0.10	0.17	0.15	0.007	0.062	0.11	0.24	0.57
Matewan/Clintwood	< 28 in	W	72	0.095	0.16	0.13	0.003	0.058	0.13	0.24	0.56
Middle War Eagle/Eagle	< 28 in		11	0.077	0.11	0.090	0.010	0.048	0.093	0.16	0.29
Little Eagle/Dorchester	< 28 in	X	34	0.053	0.094	0.11	0.003	0.032	0.062	0.11	0.51
Lower War Eagle/Hagy	< 28 in		5	0.11	0.20	0.21	0.010	0.13	0.13	0.16	0.55
Glenalum Tunnel/Splashdam	< 28 in		18	0.13	0.21	0.16	0.003	0.073	0.21	0.36	0.48
Gilbert A/Upper Banner	< 28 in		22	0.046	0.082	0.090	0.003	0.030	0.060	0.11	0.40
Gilbert/Lower Banner	< 28 in		6	0.14	0.17	0.12	0.070	0.080	0.12	0.22	0.37
Douglas/Kennedy	< 28 in		15	0.10	0.18	0.19	0.007	0.055	0.10	0.23	0.62
Jewell/Raven	< 28 in		5	0.11	0.11	0.044	0.070	0.080	0.11	0.13	0.18
Iaeger/Jawbone	< 28 in		17	0.096	0.14	0.11	0.010	0.060	0.080	0.19	0.42
Lower Iaeger/Tiller	< 28 in		10	0.15	0.32	0.25	0.007	0.085	0.39	0.54	0.60
Sewell/Lower Seaboard	< 28 in		20	0.15	0.20	0.16	0.045	0.067	0.16	0.26	0.58
Welch/Upper Horsepen	< 28 in		5	0.20	0.32	0.32	0.070	0.070	0.19	0.45	0.81
Beckley/War Creek	< 28 in		12	0.086	0.11	0.10	0.030	0.058	0.073	0.10	0.38
Fire Creek/Lower Horsepen	< 28 in		8	0.081	0.094	0.062	0.050	0.050	0.071	0.11	0.23
Pocahontas No 7	< 28 in		4	0.065	0.065	0.006	0.060	0.060	0.065	0.070	0.070
Pocahontas No 3	< 28 in		10	0.16	0.21	0.19	0.050	0.095	0.14	0.28	0.66

Table 4. Coal quality statistics for coal beds with ≥ 5 samples for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese: a. all, b. thcik (≥ 28 inch), and c. thin (< 28 inch) coal bed samples. [Coal bed code from table 2 if N ≥ 30; * if N < 30 for a specific parameter; N = number of samples.]

Table 4c. Thin Coal Smples, <28 inch thick.

			Manganese								
Coal Bed Name This Study	Thickness range	Coal bed code N≥30	N	Geometric mean ppm	Average ppm	Standard Deviation ppm	Minimum ppm	Lower Quartile ppm	Median ppm	Upper Quartile ppm	Maximum ppm
Redstone	< 28 in		18	41	75	120	15	20	33	59	460
Pittsburgh Roof	< 28 in		8	15	16	6.0	6.1	14	16	18	27
Pittsburgh	< 28 in		5	12	14	6.4	3.8	11	17	18	19
Harlem	< 28 in		8	18	27	28	6.2	7.7	21	29	90
Lower Bakerstown	< 28 in		18	29	55	89	6.5	13	23	65	390
Brush Creek	< 28 in		8	15	33	53	5.2	6.3	9.3	30	160
Mahoning	< 28 in		14	12	16	15	3.3	5.7	13	24	59
Upper Freeport	< 28 in	F	61	14	21	24	1.1	7.4	12	26	140
Lower Freeport	< 28 in	G	36	24	39	42	1.2	15	23	42	170
Upper Kittanning	< 28 in	H	35	12	14	7.8	3.4	8.0	12	19	33
Middle Kittanning Rider	< 28 in		8	24	26	12	14	16	24	32	46
Middle Kittanning	< 28 in	I	75	14	20	22	1.7	8.5	15	24	140
Strasburg	< 28 in		10	27	37	32	6.3	20	31	45	120
Lower Kittanning Rider	< 28 in		6	8.5	9.9	7.0	5.8	6.4	7.2	8.4	24
Lower Kittanning/No 6 block	< 28 in	J	57	15	25	44	1.6	8.4	15	23	280
Clarion	< 28 in		27	21	28	23	5.0	12	24	41	110
Brookville	< 28 in	L	43	18	36	74	2.1	9.8	18	27	470
No 5 Block	< 28 in		28	7.1	9.6	13	3.1	4.6	6.4	9.7	71
Upper Mercer	< 28 in		6	40	63	70	11	21	44	62	200
Lower Mercer	< 28 in		17	17	30	46	4.6	8.1	15	26	190
Quakertown	< 28 in		7	12	24	38	2.6	7.4	11	15	110
Stockton	< 28 in		11	12	24	40	4.3	6.8	8.1	20	140
Coalburg	< 28 in	O	76	10	14	16	1.6	6.0	9.0	16	120
Winifrede/Hazard	< 28 in	P	31	7.7	11	9.0	1.2	3.9	6.8	17	33
Lower Winifrede/Hazard	< 28 in		5	9.2	11	7.1	3.9	4.7	12	14	21
Chilton/Taylor	< 28 in		6	13	24	31	3.3	5.9	11	24	85
Fire Clay Rider	< 28 in		16	30	64	91	4.3	10	32	68	350
Fire Clay	< 28 in	Q	30	9.7	15	17	1.9	5.0	7.1	23	83
Cedar Grove/Whitesburg	< 28 in		23	9.4	39	140	0.73	4.6	11	14	660
Williamson/Amburgy	< 28 in		26	9.8	17	34	2.2	5.6	8.4	14	180
Campbell Creek/Upper Elkhorn No 3	< 28 in	T	62	6.2	8.7	8.0	1.2	3.5	4.6	13	32
Upper Elkhorn Nos 1 and 2/Powellton	< 28 in	U	55	6.6	9.5	12	1.1	4.1	6.2	8.4	75
Pond Creek	< 28 in	V	43	13	24	40	2.1	6.6	12	21	210
Matewan/Clintwood	< 28 in	W	72	8.1	16	46	1.4	4.7	6.8	13	390
Middle War Eagle/Eagle	< 28 in		11	10	20	24	0.75	6.2	11	20	78
Little Eagle/Dorchester	< 28 in	X	34	7.7	11	9.8	2.0	3.6	6.7	14	42
Lower War Eagle/Hagy	< 28 in		5	11	13	8.0	4.1	11	12	14	26
Glenalum Tunnel/Splashdam	< 28 in		18	5.4	7.4	6.6	1.2	3.5	4.9	6.7	22
Gilbert A/Upper Banner	< 28 in		22	11	15	15	1.5	7.5	12	17	70
Gilbert/Lower Banner	< 28 in		6	14	14	2.7	11	13	14	16	18
Douglas/Kennedy	< 28 in		15	16	27	30	2.8	8.5	16	31	110
Jewell/Raven	< 28 in		5	19	19	4.3	12	20	21	21	23
Iaeger/Jawbone	< 28 in		17	12	18	13	1.1	7.4	16	24	48
Lower Iaeger/Tiller	< 28 in		10	25	32	21	7.3	15	34	43	74
Sewell/Lower Seaboard	< 28 in		20	20	47	78	2.1	8.0	20	36	320
Welch/Upper Horsepen	< 28 in		5	7.5	8.8	5.3	3.8	4.9	6.2	14	15
Beckley/War Creek	< 28 in		12	14	44	89	2.0	5.1	14	32	320
Fire Creek/Lower Horsepen	< 28 in		8	6.8	16	25	1.0	2.6	8.1	17	75
Pocahontas No 7	< 28 in		4	6.4	9.2	7.1	1.3	5.2	8.8	13	18
Pocahontas No 3	< 28 in		10	15	16	5.8	6.3	13	16	18	28

Table 5. Coal quality statistics for coal samples in three stratigraphic intervals (pre-SGB, SGB, post-SGB) for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese; a. all, b. thick (≥ 28 inch), and c. thin (<28 inch) coal bed samples. [N = number of samples. Coal beds in stratigraphic intervals pre-SGB, SGB, and post-SGB are listed in table 2.]

Table 5a. Coal Samples, all thicknesses.

Stratigraphic interval	Parameter	Units	N	Average	Standard Deviation	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
post-SGB	Selenium	ppm	1,333	3.2	2.2	0.20	1.8	2.6	3.8	20
SGB	Selenium	ppm	737	5.4	2.7	0.07	3.6	5.0	6.7	21
pre-SGB	Selenium	ppm	1,153	3.0	1.6	0.07	1.8	2.7	3.7	16
post-SGB	Thickness	inch	1,335	39	19	2.0	26	36	49	125
SGB	Thickness	inch	737	34	21	3.1	19	30	45	172
pre-SGB	Thickness	inch	1,155	32	16	4.0	20	31	41	128
post-SGB	Ash Yield	percent	1,244	12.06	5.15	1.70	8.44	11.00	14.70	32.03
SGB	Ash Yield	percent	710	12.01	5.83	2.00	7.70	11.13	14.80	32.90
pre-SGB	Ash Yield	percent	1,098	7.82	4.78	0.90	4.43	6.70	9.62	30.90
post-SGB	Sulfur	percent	1,297	2.88	1.51	0.39	1.80	2.69	3.73	10.40
SGB	Sulfur	percent	710	1.83	1.54	0.40	0.70	1.10	2.57	10.60
pre-SGB	Sulfur	percent	1,098	1.34	1.08	0.40	0.70	0.90	1.54	8.90
post-SGB	Pyritic Sulfur	percent	1,198	1.79	1.21	0.01	0.94	1.61	2.48	8.08
SGB	Pyritic Sulfur	percent	602	1.12	1.31	0.01	0.14	0.60	1.73	8.97
pre-SGB	Pyritic Sulfur	percent	831	0.70	0.97	0.01	0.10	0.25	0.94	7.62
post-SGB	Arsenic	ppm	1,328	30	37	0.3	8.5	19	36	410
SGB	Arsenic	ppm	734	18	30	0.4	2.9	7.5	20	300
pre-SGB	Arsenic	ppm	1,151	23	43	0.1	3.1	8.3	25	680
post-SGB	Mercury	ppm	1,335	0.26	0.23	0.003	0.11	0.20	0.33	2.9
SGB	Mercury	ppm	736	0.17	0.16	0.003	0.060	0.12	0.24	1.5
pre-SGB	Mercury	ppm	1,153	0.14	0.15	0.003	0.050	0.085	0.18	1.8
post-SGB	Manganese	ppm	1,332	27	41	0.92	10	17	29	690
SGB	Manganese	ppm	736	20	46	0.73	5.9	11	21	660
pre-SGB	Manganese	ppm	1,152	20	37	0.75	5.2	10	20	540

Table 5. Coal quality statistics for coal samples in three stratigraphic intervals (pre-SGB, SGB, post-SGB) for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese; a. all, b. thick (≥ 28 inch), and c. thin (<28 inch) coal bed samples. [N = number of samples. Coal beds in stratigraphic intervals pre-SGB, SGB, and post-SGB are listed in table 2.]

Table 5b. Thick Coal Samples, ≥28 inch thick.

Stratigraphic interval	Parameter	Units	N	Average	Standard Deviation	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
post-SGB	Selenium	ppm	942	3.1	2.1	0.20	1.8	2.6	3.7	20
SGB	Selenium	ppm	407	5.6	2.5	0.73	3.9	5.1	6.9	17
pre-SGB	Selenium	ppm	668	3.1	1.6	0.07	2.0	2.9	4.0	14
post-SGB	Thickness	inch	943	47	16	28	35	43	53	125
SGB	Thickness	inch	407	47	19	28	35	43	53	172
pre-SGB	Thickness	inch	669	42	13	28	33	39	47	128
post-SGB	Ash Yield	percent	870	11.77	4.92	2.20	8.25	10.80	14.50	32.03
SGB	Ash Yield	percent	394	12.14	5.43	2.44	8.42	11.20	14.50	31.80
pre-SGB	Ash Yield	percent	638	7.93	4.55	0.90	4.80	6.80	9.62	30.90
post-SGB	Sulfur	percent	912	2.88	1.41	0.39	1.90	2.70	3.71	8.43
SGB	Sulfur	percent	394	1.67	1.52	0.40	0.70	0.98	2.13	10.40
pre-SGB	Sulfur	percent	638	1.12	0.78	0.40	0.66	0.80	1.27	6.70
post-SGB	Pyritic Sulfur	percent	826	1.78	1.13	0.01	1.00	1.62	2.43	6.49
SGB	Pyritic Sulfur	percent	309	1.00	1.27	0.01	0.14	0.46	1.48	8.97
pre-SGB	Pyritic Sulfur	percent	440	0.47	0.67	0.01	0.09	0.19	0.55	5.43
post-SGB	Arsenic	ppm	941	24	27	0.3	7.8	15	32	320
SGB	Arsenic	ppm	407	13	19	0.6	2.5	6.2	15	180
pre-SGB	Arsenic	ppm	667	15	24	0.1	2.7	6.6	16	300
post-SGB	Mercury	ppm	943	0.25	0.21	0.003	0.11	0.20	0.32	1.7
SGB	Mercury	ppm	407	0.16	0.15	0.003	0.060	0.12	0.22	1.5
pre-SGB	Mercury	ppm	669	0.12	0.14	0.003	0.047	0.080	0.16	1.8
post-SGB	Manganese	ppm	942	27	40	0.92	11	18	29	690
SGB	Manganese	ppm	407	16	32	1.1	5.8	10	18	530
pre-SGB	Manganese	ppm	668	22	38	0.96	5.6	11	23	540

Table 5. Coal quality statistics for coal samples in three stratigraphic intervals (pre-SGB, SGB, post-SGB) for selenium, thickness, ash yield, sulfur, pyritic sulfur, arsenic, mercury, and manganese; a. all, b. thick (≥ 28 inch), and c. thin (<28 inch) coal bed samples. [N = number of samples. Coal beds in stratigraphic intervals pre-SGB, SGB, and post-SGB are listed in table 2.]

Table 5c. Thin Coal Smples, <28 inch thick.

Stratigraphic interval	Parameter	Units	N	Average	Standard Deviation	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
post-SGB	Selenium	ppm	391	3.3	2.3	0.43	1.9	2.8	3.9	14
SGB	Selenium	ppm	330	5.2	2.8	0.07	3.2	4.6	6.4	21
pre-SGB	Selenium	ppm	485	2.8	1.7	0.07	1.7	2.4	3.4	16
post-SGB	Thickness	inch	392	20	5.9	2.0	16	21	25	28
SGB	Thickness	inch	330	17	6.1	3.1	12	18	22	28
pre-SGB	Thickness	inch	486	18	6.0	4.0	13	19	24	28
post-SGB	Ash Yield	percent	374	12.74	5.59	1.70	9.01	11.44	15.68	31.20
SGB	Ash Yield	percent	316	11.85	6.29	2.00	7.11	11.00	15.23	32.90
pre-SGB	Ash Yield	percent	460	7.66	5.09	0.90	4.12	6.40	9.61	29.55
post-SGB	Sulfur	percent	385	2.86	1.72	0.40	1.50	2.60	3.79	10.40
SGB	Sulfur	percent	316	2.02	1.55	0.41	0.80	1.50	2.91	10.60
pre-SGB	Sulfur	percent	460	1.64	1.34	0.40	0.71	1.03	2.18	8.90
post-SGB	Pyritic Sulfur	percent	372	1.81	1.37	0.01	0.76	1.58	2.58	8.08
SGB	Pyritic Sulfur	percent	293	1.24	1.35	0.01	0.15	0.82	2.00	8.67
pre-SGB	Pyritic Sulfur	percent	391	0.95	1.18	0.01	0.12	0.41	1.53	7.62
post-SGB	Arsenic	ppm	387	44	50	0.7	12	30	55	410
SGB	Arsenic	ppm	327	24	39	0.4	3.6	11	28	300
pre-SGB	Arsenic	ppm	484	34	57	0.4	4.0	13	42	680
post-SGB	Mercury	ppm	392	0.28	0.28	0.003	0.095	0.21	0.37	2.9
SGB	Mercury	ppm	329	0.19	0.17	0.003	0.070	0.15	0.26	1.5
pre-SGB	Mercury	ppm	484	0.16	0.15	0.003	0.050	0.10	0.23	0.81
post-SGB	Manganese	ppm	390	29	46	1.1	8.5	16	28	460
SGB	Manganese	ppm	329	25	58	0.73	6.1	11	22	660
pre-SGB	Manganese	ppm	484	17	34	0.75	4.7	8.7	18	390