SECTION 2

FIELD CLUES AND SAMPLING METHODS

2.1 WHAT TO LOOK FOR AND MEASURE IN THE FIELD

2.1.1 Summary

Procedures in this section aid the field observer. As one looks at an overburden column, prominent characteristics observed include changes in color, soil horizons, rock types and special features such as nodules, layers, faults and coatings. As seen in Figure 2, the sandstone unit at the surface is divided due to the degree of physical and chemical weathering. The high chroma (brown) shows where oxidation of iron has occurred. This upper zone will be lower in sulfur due to oxidation and leaching. It is generally more porous and less consolidated than the underlying low chroma (gray) unoxidized rock. Most of the carbonates that were present in the oxidized rock have been removed by leaching. Directly underlying the sandstone unit is a low chroma mudrock or shale, which may or may not contain carbonates. A layer of black carbolithic mudrock directly overlies the coal. The high carbon material, indicated by a color value of 3 or less, may be high in acid-producing sulfur.

The Pittsburgh-Redstone coal overburden, as seen in Figures 3 and 4, is high in calcareous materials. A bed of limestone, the light gray layer, occurs between the coal seams. This limestone is stained with yellowboy (iron oxides) where sulfate-rich waters have been neutralized and precipitated out. The yellowboy color varies depending on the form and amount of iron present. The yellowboy staining can be seen on the limestone between the coal seams in Figure 3 and also where the sulfate-rich waters are coming from the base of the Pittsburgh coal and draining over a calcareous mudstone in Figure 4. A rock type comparison can be made between the overburden in Figure 2 which is comprised mainly of sandstone with some mudrock or shale and the overburdens in Figures 3 and 4 which are predominantly limestones and calcareous mudstones, mudrocks, and shales with some sandstone.

The classification of soil horizons and rock type and the determination of color are given in the following procedures. To aid in the determiniation of soil horizons and rock types and to predict their useful properties, methods for rock hardness, detection of calcareous materials, and estimation of rock and soil textures are included. Special interest features (such as presence of pyrite, mica, gypsum, epsomite, Fe-Al sulfates and others) assist the observer in predicting potentially favorable or unfavorable materials in the overburden for selective placement and use during reclamation. At the

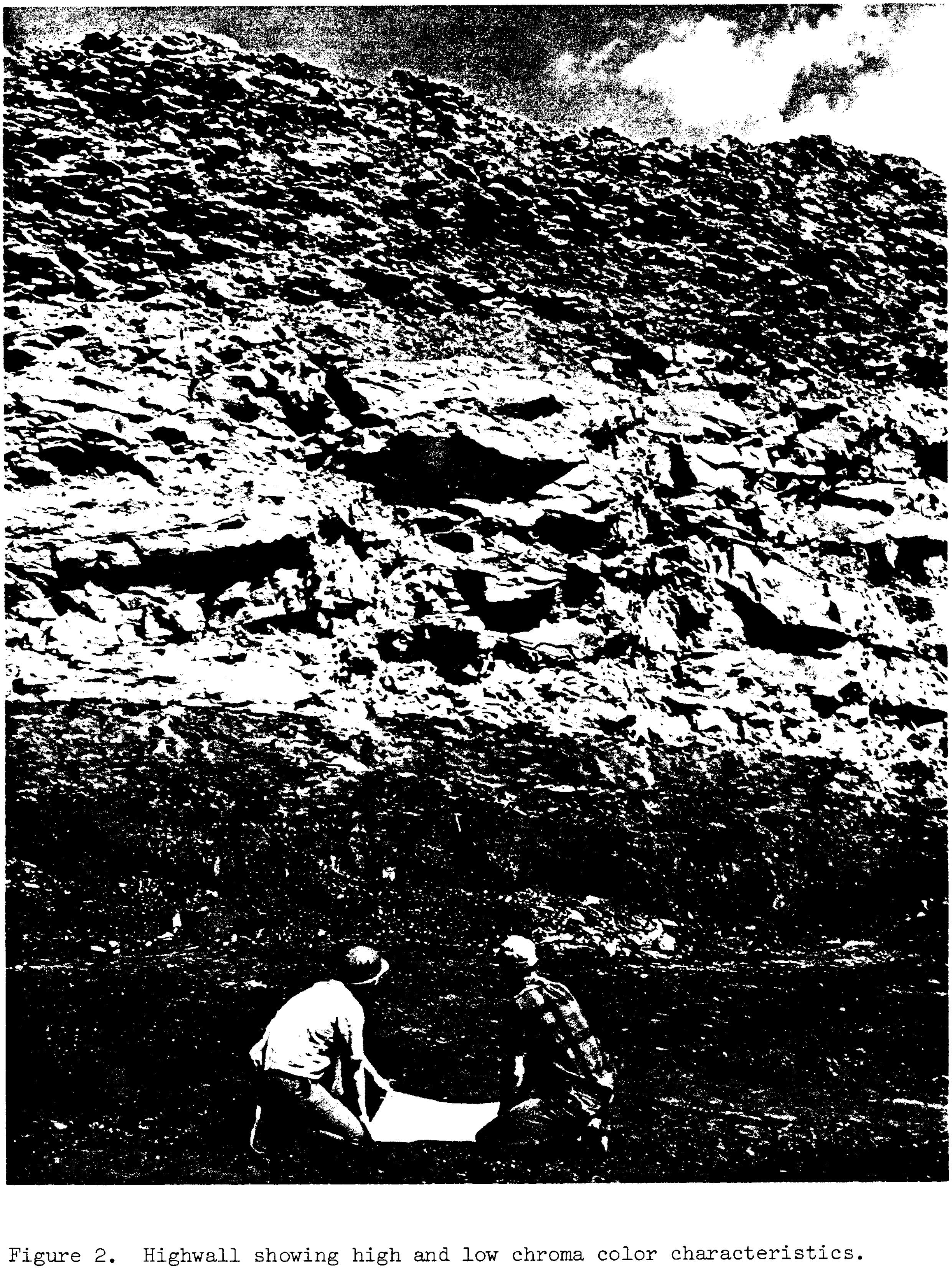

Figure 2. Highwall showing high and low chroma color characteristics.

Figure 3. Pittsburgh-Redstone overburden showing yellowboy staining on the limestone between the coal seams.

Figure 4. Pittsburgh-Redstone overburden showing extreme yellowboy staining on a calcareous mudstone below the Pittsburgh coal seam.

end of each procedure a meaning of the clue has been included. Through these meanings, generalized field predictions can be made or decisions can be reached regarding the need for laboratory analyses.

2.1.2 Soil Horizons and Rock Types

2.1.2.1 Principle--

Soil horizons and rock types will react differently when exposed on the surface or near-surface after reclamation. This procedure defines individual soil and rock units for field and/or laboratory identification.

2.1.2.2 Comments--

Both soils and rocks must be examined on a freshly exposed surface. The following characterizations of each soil and rock type will aid in their identification:

1. Soil Horizon 1 is the surface layer which is usually darkened by organic matter. It is the zone of maximum biological activity (i.e., it will have the most plant roots; the most earthworm activity) and the zone of maximum accumulation of organic matter.

2. Soil Horizon 2 lies between Horizons 1 and 3 and often is referred to as the "subsoil". It will have some plant roots and earthworm activity, but less than the overlying Horizon 1. Horizon 2 may contain a zone of clay accumulation, which should be favorable in a coarse textured soil and unfavorable in a fine textured soil.

3. Horizon 3 is a zone of weathered rock or earthy material. It is unconsolidated material with little or no biological activity. This horizon will often have individual rock fragments larger than 2 mm. Horizon 3 extends down to consolidated, intact bedrock or a depth of 1.5 m (5 ft) whichever is shallower. Horizon 3 may contain a fragipan.

4. A fragipan is a dense, firm layer of intermediate texture that impedes free movement of air and water down through the soil and restricts root growth. Plant roots cannot branch out in this layer and often grow laterally along its top. When crushed between thumb and finger, a dry piece of this layer shatters abruptly rather than crumbling gradually. The fragipan becomes extremely hard during the dry season and may be difficult or impossible to penetrate with a soil tube or to crush with thumb and forefinger.

5. Earthy material (EM) is a broad term for any unconsolidated material between a depth of 1.5 m (5 ft) and consolidated bedrock. It may be similar to horizon 3 in composition and appearance.

6. Drift is a broad term for glacial deposits.

7. Till is unstratified and unsorted drift deposited directly by glacial ice. Till consists of clay, silt, sand, gravel, and boulder-size particles of varied rock types which can be intermixed in any proportion.

8. Outwash (OW) was deposited by melt-water streams beyond active glacial ice. In contrast to till, outwash is stratified and sorted.

9. Loess is a homogeneous, unindurated deposit consisting predominantly of silt-size particles, with smaller amounts of very fine sand and/or clay-size particles. Loess may or may not be stratified.

10. Sandstone (SS) contains more than 50 percent sand-size (less than 2 mm and greater than 0.05 mm in diameter) particles. The particles are predominantly quartz and may be cemented with silica, iron oxide, carbonates, or clays. Qualitative modifiers such as calcareous, argillaceous, micaceous, and pyritic, for example, are used when they seem to add useful information.

11. Mudrock (MR) is a broad term for a sedimentary rock dominated by silt-size and/or clay-size particles. The term is used when a rock cannot be definitely distinguished as either a mudstone or shale. Mudrock can be further subdivided into hard mudrock (moist hardness greater than 2.5) or normal mudrock (moist hardness less than 2.5). Mudrock may contain as much as 50 percent sand-size particles if properties are judged to be dominated by silt and/or clay. Mudrocks may contain any proportion of carbonates so long as properties are dominantly silt and/or clay when rubbed in water.

12. Mudstone (MS) is a non-fissile mudrock dominated by silt-size and/or clay-size particles. Mudstones have a moist hardness of less than 2.5. They differ from shale because of their non-fissile nature. Mudstones may contain as much as 50 percent sand-size particles if properties are judged to be dominated by silt and/or clay.

13. Shale (SH) is a mudrock that appears predominantly fissile (having a tendency to split along parallel planes into thin layers). These layers must be less than 5 mm thick. Shales can be further subdivided into hard shale (moist hardness greater than 2.5) and normal shales (moist hardness less than 2.5). They differ from mudstones because of their fissile nature.

14. Limestone (LS) is a sedimentary rock consisting dominantly of calcium carbonate. On a freshly exposed surface, limestone will react with a noticeable "fizz" upon application of dilute hydrochloric acid. Limestones must have a moist hardness of greater than 2.5, thus distinguishing them from calcareous mudstones. When powdered, the powder will have a Munsell color value of 7 or greater. Some limestones are dolomitic due to substitution of magnesium for some of the calcium. Dolomitic limestones (or dolomite) will only react with cold dilute hydrochloric acid when applied to the rock powder.

15. Chert, Flint, and Jasper are rocks consisting dominantly of amorphous silica or extremely small (cryptocrystalline) quartz and hard (6.5 to 7.0 on Moh's scale) enough to scratch glass or an ordinary knife blade.

16. Carbolith (Carb) is a name that has been coined (Smith et al., 1974) to cover dark colored sedimentary rocks that will make a black or very dark (Munsell color value of 3 or less) streak or powder. Rocks under this name include coal not scheduled for mining, impure waste coal, bone coal, high-carbon shales, and high-carbon muds. In general, such rocks will contain at least 25 percent carbonaceous matter oxidizable at 350-400°C.

17. Intercalate (I) is a term coined for use in this manual to describe rocks which contain at least two different rock types that are so intimately interlayered or "intercalated" that they cannot conveniently be sampled separately. Intercalates have at least three or more layers within a 13 cm (5 in) measured section. This rock type can be defined in greater detail by listing in order of abundance some or all of the kinds of rocks included. Commonly only two or three types of rock will be listed to suggest the dominant properties of an Intercalate (e.g. I-SS/MS, I-SS/MR/Carb).

2.1.2.3 Chemicals--

Hydrocholoric acid (HCl), 1 part acid to 3 parts water: Dilute 250 ml of concentrated HCl to a volume of 1 liter with distilled water.

2.1.2.4 Materials--

1. Shovel.

2. Rock hammer.

3. Soil knives (any kind of knives, nails, knitting needles, pencils, or pointed objects can be substituted).

4. Dropper bottle (for holding the acid).

5. Wash bottle.

6. Munsell color book.

7. Record book.

8. Ruler or tape measure.

9. Hand lens, 10 power.

2.1.2.5 Procedure--

2.1.2.5.1 For Soils--These steps are used for the determination of soil horizons.

1. Examine freshly exposed soil profile. NOTE: If a freshly exposed profile is not available, a pit can be dug or a core taken of the profile. If a profile does exist, it can be cleaned off with a shovel to expose a fresh surface.

2. Examine profile for the point of separation of horizons 1 and 2 (see 2.1.2.2) and mark point with a soil knife.

3. Examine profile for the point of separation of horizons 2 and 3 (see 2.1.2.2) and mark point with a soil knife.

4. Beginning at the original land surface, record depth of each horizon.

5. Record depth to bedrock or 150 cm (5 ft) whichever comes first. NOTE: If depth to bedrock exceeds 150 cm (5 ft), record thickness of earthy material (see 2.1.2.2).

6. Examine profile for presence of a zone of clay accumulation (see 2.1.2.2). Record depth from surface and thickness if found to exist.

7. Examine profile for presence of a fragipan (see 2.1.2.2). Record depth from surface and thickness if found to exist.

8. Record color of each horizon (see 2.1.3).

9. Record texture of each horizon (see 2.1.8).

10. Record presence of any nodules, concretions, or any other features deemed necessary to detail the profile.

<u>2.1.2.5.2 For Rocks</u>--These steps are used for the determination of rock type.

1. Examine a fresh surface of the rock. NOTE: This can be accomplished by breaking the rock with a rock hammer.

2. Test rock for hardness (see 2.1.4).

3. Test for presence of carbonates with 1:3 HCl (see 2.1.5).

4. Using a knife, scrape the rock to form a powder. Determine powder color (see 2.1.3). NOTE: The powder color can be taken of some rocks by streaking the rock on a streak plate (unglazed porcelain plate) and determining the color of the streak.

5. Using data obtained in steps 2-4, determine and record rock type (see 2.1.2.2).

6. Record presence of pyrite and/or mica (see 2.1.6) as well as any other rock features (see 2.1.7).

<u>2.1.2.6 Meaning of Clue</u>--

1. If horizon 1 is 25 cm (10 in) or more in thickness having a moist color value and chroma of 3.5 or less, it will be high in soil organic matter, can be high in plant nutrients, and generally have favorable properties with respect to tillage and water relationships.

2. Fragipans make unfavorable soil material.

3. Zone of clay accumulation could be unfavorable soil material, especially where clay content exceeds 35 percent.

4. Drift and till can contain members of any size fraction from boulders to clay. Individual characteristics will determine their use.

5. Outwash, if mixed with suitable "fines," may have good soil potentials.

6. Loess will have a favorable soil texture and usually is calcareous. Soils developed in loess that have been leached can be neutral to strongly acid.

7. Sandstone can have a textural range from very coarse to loamy and can be pervious. Proportions and porosity of coarse fragments are important variables that depend on strength of cementation and mineralogy.

8. Mudrock can have the properties of a mudstone and/or shale. Soils formed from mudrock will be of a medium to fine texture and, depending on hardness, may or may not produce coarse fragments. Calcareous mudrock should be considered for its neutralizing potential.

9. Mudstones will form soils having a medium to fine texture. In some cases, high-alumina clays are abundant, and resulting soils have relatively high anion-exchange but low cation-exchange capacity, even though clay percentages are high. Minesoil management difficulties may occur with either silty or clayey textures because of weak structures. Plant nutrient reserves may be adequate, and carbonates may be present at any level below that of a recognized limestone or dolomite.

10. Shales can form soils having a medium to fine texture with coarse fragments in the form of chips derived from their fissile nature. Any level of carbonates and plant nutrients may be present.

11. Limestones and dolomites will persist as coarse fragments, unless broken down during mining operations. As long as limestone or dolomite remain in coarse fragments, neutralization effects will be minimal.

12. Chert, flint, and jasper, if highly weathered, may contain considerable useful porosity.

13. Carboliths are a common source of pyritic sulfur. These rocks may contain carbonates or simple or complex sulfate salts. Carboliths may be high in phosphorus which can be used as a plant nutrient if the toxic acids can be neutralized. Since carboliths have a color value of 3 or less, they will absorb heat which can be detrimental in hot weather and favorable in cold weather until well vegetated.

14. Intercalates, by definition, are combinations of any of the above rock types and would have the characteristics of the incorporated rock types.

2.1.3 Color

2.1.3.1 Principle--

A standard color system is required for uniformity of description among field workers. The Munsell Soil Color Charts are standards which subdivide color into three measureable elements: hue, value and chroma.

In these color charts, hue is the dominant spectral color (red, yellow, green, blue, and purple) and is related to wavelength of light; value is the measure of lightness or darkness and is related to total reflected light; and chroma indicates purity or strength of color (or departure from neutral of the same lightness).

2.1.3.2 Comments--

The quality and intensity of light affects the visual impression of color from the standard color chips and the sample. When using the color standards in the field or laboratory, it is important that the quality of light be similar to the white light of mid-day and the amount of light be adequate to visually distinguish between the color chips. Color measurements made in the field during early morning or late evening and during a hazy overcast day will not be precise.

Color values are usually lower when samples are moistened as compared to air-dry. Color measurements are made on air-dry, powdered (less than 60 mesh) samples in the laboratory and on a freshly exposed surface in the field.

2.1.3.3 Chemicals--

None required.

2.1.3.4 Materials--

1. Munsell Soil Color Charts (available from Munsell Color Division, Killmorgan Corporation, Baltimore, Maryland 21218).

2. Spatula.

2.1.3.5 Procedure--

NOTE: If powdered (less than 60 mesh) sample is used instead of soil ped or rock fragments, place 0.5 g of sample on the tip of a spatula and omit steps 1 and 2.

1. Break soil ped or rock fragment in half.

2. Use a freshly exposed surface to determine color. NOTE: In the case of more than one color being present, select the dominant color for color determination. Record the secondary color(s) as "mottles."

3. Compare the sample to the 10YR chips. NOTE: If the sample is judged to be more red, compare sample to chips with a more red hue. If the sample is judged to be more yellow, compare sample to chips with a more yellow hue. If the sample is judged to have a chroma less than 1, compare sample to neutral chips.

4. After selecting the proper hue, match the sample to the chip to which it most closely corresponds.

5. Record the hue, value and chroma. NOTE: The color hue is the number found in the top right corner of the color page, the value is the number to the left of the row in which the color chip was selected, and the chroma is the number at the bottom of the color chip column. Color is recorded as hue then value then chroma (e.g. 10YR 6/4).

2.1.3.6 Meaning of Clue--

In rock material, hue can be used in a very general way as a clue to indicate rock quality. A striking example of a favorable minesoil material having a readily distinguished color hue and chroma is the dusky red shales and mudstones common in western and northwestern West Virginia.

Value can be used to readily distinguish highly carbonaceous black shales from true gray shales that appear black to the casual observer. Bonecoal, roof shales, and other dark or black appearing rocks frequently contain significant amounts of pyrite and may be a source of extreme sulfuric acid acidity unless neutralizers are present. The field clue to such material is a black (value of 3 or less on any Munsell hue) streak when rubbed on an unglazed porcelain plate or hard white rock such as chert or when the rock is powdered by scraping with a knife. Dark colored clay or silty shales that are low in carbon, on the other hand, are medium or light gray (Munsell color value of 4 or higher) when powdered.

Chroma is one of the most easily recognized color attributes, and can be used to recognize many soil and rock features. It is now well established that minesoil developing in overburden from the intensely weathered zone below the original land surface is safe from pyritic sulfur (pyrite, marcasite, and chalcopyrite) and extreme acidity. This zone commonly is 6 m (20 ft) deep or deeper in West Virginia, depending on lithology, degree of structural fracturing of the rock, and position of the water table. Brown and yellow rock colors (chroma 3 or higher on Munsell Soil Color Charts) as typified by materials from the weathered zone, provide useful clues to safe materials regardless of their position in the stratigraphic section. However, absence of high chromas in near-surface soils and rocks can result from intense leaching of iron oxides or (in soils) from impeded drainage which causes iron reduction. The low chroma imparted to the surface of highly leached materials in soils and near-surface rocks can be distinguished readily from low-chroma rocks below depth of iron oxidation. Low chromas (gray colors) caused by leaching or impeded soil drainage occur on rock or soil ped exteriors. In contrast, low chromas occur on the interiors of unoxidized sandstones or shales. Color chroma has proven reliable as a field clue particularly with many sandstones. Freshly broken rock surfaces with chromas of 3 or higher (hand specimen or pulverized sample) indicate negligible percentages of pyritic sulfur. Chromas of 2 or less often correspond with sufficient pyrite to cause pH below 4.0 and biotoxic reactions unless neutralizers are abundant.

Darker color values of undisturbed surface soils commonly indicate high organic matter content. A moist soil value and chroma of less than 3.5 indicates a mollic, umbric, or anthropic surface horizon.

2.1.4 Determination of Rock Hardness

2.1.4.1 Principle--

Hardness is the resistance of a mineral or rock to scratching. The numerical value for hardness is based on Moh's hardness scale. Moh derived a scale where the softest mineral, talc, is number 1 and the hardest mineral, diamond, is number 10. All minerals (and rocks) fall within this range of 1 to 10 depending on hardness.

2.1.4.2 Comments--

Three ranges of hardness (less than 2.5; 2.5 to 5; greater than 5) based on Moh's scale are used in this procedure. These ranges are determined in the field by using the hardness of the fingernail as 2.5 and the steel of a pocket knife as a little over 5.

Care must be taken to insure that a powder, and not the breaking off of individual grains, is being formed when a hardness "standard" (fingernail or steel knife) is scratched against the rock fragment. This is especially true with sandstones. NOTE: Care must be taken to insure that the "standard" is not scraping off on to the rock. A visible groove should be evident in the rock surface if it is scratched.

2.1.4.3 Chemicals--

None required.

2.1.4.4 Materials--

Steel knife.

2.1.4.5 Procedure--

1. With the steel knife try to scratch the rock fragment. If no scratch occurs, record hardness as greater than 5. If a scratch occurs, continue to step 2.

2. With a fingernail try to scratch the rock fragment. If no scratch occurs, record hardness as 2.5 to 5. If a scratch occurs, record hardness as less than 2.5.

2.1.4.6 Meaning of Clue--

As a general rule: the harder a rock; the better it will withstand weathering and form coarse fragments.

2.1.5 Presence of Calcareous Material

2.1.5.1 Principle--

Calcium carbonate is the major constituent in limestone; however, soils and other rock types can also contain calcium carbonate. The addition of cold dilute hydrochloric acid to a sample containing calcium carbonate causes the following reactions to occur:

Calcium carbonate + hydrochloric acid forms calcium chloride + carbonic acid

$$CaCO_3 + 2HCl = CaCl_2 + H_2CO_3$$

Carbonic acid will further disassociate to water + carbon dioxide

$$H_2CO_3 = H_2O + CO_2$$

Since carbon dioxide gas is released, a noticeable effervescence (bubbling) and even an audible "fizz" occurs indicating the presence of carbonates.

2.1.5.2 Comments--

The particle size of the material is reduced by scraping the rock fragment with a knife or other tool to form a powder allowing more surface area to become available for reaction with the acid. Calcareous material, which may not have been detected previously, may now be detected.

Care must be taken to insure that the acid is reacting with the rock or soil and not with a calcium carbonate coating.

2.1.5.3 Chemicals--

Hydrochloric acid (HCl), 1 part acid to 3 parts water: Dilute 250 ml of concentrated HCl to a volume of 1 liter with distilled water.

2.1.5.4 Materials--

1. Dropper bottle.

2. Knife.

2.1.5.5 Procedure--

1. Add one or two drops of cold hydrochloric acid to a fresh surface of the sample. NOTE: Presence of calcium carbonate ($CaCO_3$) is indicated by a bubbling reaction or audible "fizz."

2. If no reaction occurs, scrape the surface with a knife or other tool to produce a powder.

3. Add a drop of cold hydrochloric acid to the powder and check for presence of carbonates as stated in step 1.

2.1.5.6 Meaning of Clue--

Our results indicate that at least 20 tons $CaCO_3$ equivalent per 1000 tons of material is present if a noticeable reaction occurs.

2.1.6 Determining Rock Texture and Presence of Pyritic and Micaceous Material Using Ten Power Hand Lens

2.1.6.1 Principle--

Pyrite and mica are common minerals in sedimentary rocks. Using a ten power hand lens for magnification, the presence of small pyrite grains, mica flakes, or inclusions may be detected or confirmed. Individual mineral grains may be seen for texture observations.

2.1.6.2 Comments--

Pyrite is commonly found in crystal clusters with many faces. It has a metallic look and is usually pale brass-yellow. However, it may appear to be black due to weathering or to extremely small particle size.

Mica may range in color from pale golden brown to black. It usually appears as flakes in a rock, sometimes along bedding planes. Pyrite can be distinguished from mica, since pyrite is opaque and will glisten on all surfaces of the crystal whereas mica will only glisten on one surface as the sample is tilted.

Individual mineral grains in the size range of coarse silt or coarser can be detected.

2.1.6.3 Chemicals--

None required.

2.1.6.4 Materials--

1. Hand lens, ten power.

2. Hammer.

2.1.6.5 Procedure--

1. View surface of sample with ten power hand lens.

2. Examine for presence of pyrite or mica (see 2.1.6.2).

3. Examine texture of sample to detect individual mineral grains in the size range of coarse silt or coarser.

4. Break the rock with a hammer to expose a fresh surface. Repeat steps 2 and 3.

2.1.6.6 Meaning of Clue--

Since pyrite may weather to sulfuric acid, rocks containing pyrite may indicate zones of potentially toxic materials in the overburdens. Laboratory analyses would be needed to verify this implication.

Micas affect the weathering potential of a rock. Rocks high in mica (especially if the mica is in layers within the rock) usually tend to weather rapidly.

Texture is important in sampling and identifying rock types, especially in classifying sandstones by texture.

2.1.7 Other Soil and Rock Features

2.1.7.1 Principle--

More detail can be added to the overburden material description by noting the taste, smell, and presence of lenses, minerals, fossils, concretions and nodules. Taste and smell can indicate the presence of Fe-Al sulfates and epsomite or gypsum. Lenses, which can be between rock types or within a rock type, show a change in mineralogy. By looking at concretions, nodules, and plant and animal fossils, zones of carbon or calcareous material may be detected.

If any of these features exist in an overburden, their presence should be recorded.

2.1.7.2 Comments--

Laboratory procedures may be required to determine the presence of gypsum, epsomite, the Fe-Al sulfates, as well as the mineralogy of the concretions and nodules. Lenses, which are not detected in the field, may be found to exist after drawing the stratigraphic cross-sections (see 1.3.2) of the area.

Definitions of terms used in this procedure can be found in the glossary.

2.1.7.3 Chemicals--

None required.

2.1.7.4 Materials--

None required.

2.1.7.5 Procedure--

1. Taste and smell - The presence of simple or complex Fe-Al sulfates (usually white, gray or reddish in color) can be detected by its metallic taste and smell. The smell is similar to that of a brass door knob. Epsomite (colorless to white, but may vary due to impurities) can be detected by its bitter, non-metallic taste.

2. Lenses - Lenses may occur between or within soil and rock types. Both lateral and vertical extent should be determined and recorded.

3. Minerals - Record the presence of minerals or crystals of minerals and their composition, especially gypsum (which is colorless to white, but may vary due to impurities, and can be scratched with a fingernail) and pyrite (see 2.1.6).

4. The presence of both plant and animal fossils and their mineral composition should be recorded.

5. Concretions and nodules - Concretions and nodules may occur within both soils and rock types. Determine and record their mineralogy, frequency of occurrence, and size.

2.1.7.6 Meaning of Clue--

1. Fe-Al sulfates, epsomite, and gypsum - Fe-Al sulfates are extremely acid. Epsomite and gypsum are neutral. Epsomite provides magnesium for plant growth. Neutralization potential (see 3.2.3) and non-HCl extractable sulfur (see 3.2.4) data should be used to determine acid producing material.

2. Lenses - Lenses show a change in soil or rock characteristics which could change the net acid-base account of a mine site.

3. Fossils - A potential carbonate and/or pyrite source may be detected in animal fossils. A potential carbon and/or pyrite source may be detected in plant fossils.

4. Concretions and nodules - A change in the net acid-base account may occur depending on the mineralogy of the concretions and nodules.

2.1.8 Soil and Minesoil Texture by Feel

2.1.8.1 Principle--

Soil texture refers to the percentages of sand, silt and clay present in a sample or layer of soil. All textures can be designated as belonging to one of three families: the clayey family (includes clay loams), the loamy family (includes silt loam), and sandy family.

2.1.8.2 Comments (adapted from USDA, 1975)--

Sand particles feel gritty when rubbed between the fingers and are not sticky or plastic when wet. Silt particles feel smooth and powdery much like flour when rubbed between the fingers and are only slightly plastic or sticky when moist. Clay particles feel smooth and are sticky and plastic when moist.

A sample of the clayey family will have 35 percent or more clay content with the remaining fraction composed of silt and sand. The feel may be smooth or slightly gritty depending on the relative proportions of sand and silt present. The moist sample will feel plastic or stiff and sticky, and form a long flexible ribbon that is durable when handled, especially when the clay content exceeds 40 percent. If allowed to dry, the sample will form hard clods that are difficult to break apart with the fingers, especially with higher clay contents.

A sample of the loamy family will contain less then 35 percent clay and less than 15 percent fine sand or coarser. The moist sample may or may not be sticky and plastic or form a ribbon that breaks easily depending on silt content. The feel will be somewhat gritty if the sand fraction dominates and smooth (flourly) if silt dominates. Firm clods that can readily be crushed with the fingers will form upon drying.

In areas where soils are high in silt, the loamy family can be subdivided into a silty family and loamy family. The silty family will contain less than 15 percent sand and greater than 65 percent silt with the remaining material being clay. A moist sample will feel smooth when kneaded and will not feel gritty nor form a very good ribbon.

A sample of the sandy family will contain sands and loamy sands, exclusive of loamy very fine sand and very fine sand textures. When the moist sample is rubbed between the fingers, it will feel abrasive and no ribbon will be formed.

The adjectives skeletal or fragmental can be added to the above textural families. If particles having an equivalent diameter coarser than 2 mm make up at least 35 percent by volume of the layer being studied and contain enough fine earth to fill the larger than 1 mm interstices, the term skeletal is used. Soils dominated by stones, cobbles, gravel, and very coarse sand particles with not enough fine earth to fill the larger than 1 mm interstices are termed fragmental.

Texture by feel can be confirmed by laboratory analysis, either by the hydrometer method or the pipette method. See sections 3.4.2 and 3.4.3 for discussion of these procedures.

2.1.8.3 Chemicals--

Water (H_2O).

2.1.8.4 Materials--

Wash bottle.

2.1.8.5 Procedure--

1. Take about a teaspoon of soil in the palm of the hand.

2. Add water slowly from the wash bottle, constantly kneading the soil. Knead to the consistency of a moist workable putty. NOTE: Working the soil to the proper consistency is critical since moist soil feels different to the fingers than dry soil.

3. When the soil is at the proper consistency, rub it between the thumb and fingers. Try to press the soil into a thin ribbon.

4. Determine the soil or minesoil texture using section 2.1.8.2.

2.1.8.6 Meaning of Clue--

By taking soil and minesoil textures, the relation of particle sizes with each other can be determined. If a sample is high in clay, compaction problems can exist. Samples high in sand content can be a problem during periods of extensive drought due to low water holding capacities. Samples high in silt are more favorable.

2.2 OVERBURDEN SAMPLING AND LABELING

2.2.1 Summary

Before useful laboratory analyses can be performed, consistent sampling and labeling procedures must be utilized. Exploration cores can provide excellent samples. Since rock cores remain intact, accurate rock type depths from the surface, and thicknesses can be measured. Any vertical variation within a rock unit can be seen and noted.

If exploration cores are not available, samples at 30 cm (12 in) increments can be obtained using a blast hole drilling rig. The rock chips blown from the drill are collected on a shovel. Exact rock type, depths from the surface, and some vertical variations within rock units are lost.

Hand samples can be taken from a freshly exposed high wall if neither exploration cores nor blast hole drillings are available. Accurate depths from the surface and variations in rock units can be determined; however, the procedure of working vertical faces with ropes and ladders may be time consuming.

Materials of special interest can also be selectively sampled. Selective samples, as the term implies, are taken by hand. They are especially useful for checking variation within rocks that appear similar and for determining properties of peculiar or extreme specimens.

Once a sample is collected, it must be properly labeled to include all data about the site. Information such as site location, depth taken, rock type, and date sampled are necessary, not only to keep from confusing samples, but to locate sampled areas if the need should arise.

Since variations can exist within an overburden, the laboratory data can only reflect what exists within that particular exploration core, blast hole, hand sampled high wall column, or selective sample. The more information acquired about a site, the better an overall picture can be made of the overburden material.

2.2.2 Rock Chip Sampling From Blast Hole Operations

2.2.2.1 Principle--

Rotary drilling gives a vertical column of the overburden material. The drilling breaks the material into rock chips and compressed air brings the chips to the surface.

2.2.2.2 Comments--

Samples should be taken where overburden material is the thickest, e.g. top of a hill or farthest strip cut into a slope, to obtain the most information. The lateral distance and direction between sampled blast holes should be recorded where more than one column of rock chip samples is collected on a job. Indication of upslope or downslope from a previous sample should be recorded.

The geographical location of the sample site should be located on a U.S.G.S. 7 1/2 minute topographic map. Latitude and longitude coordinates are determined to four decimal places by using a ruler.

Blast hole drilling offers a speedy and easy method of collecting rock chip samples. Exact depth of a rock type break is lost, but relative depths can be obtained.

This procedure will not work with some center-platform types of drills. Samples from the drill bench to the surface must be taken by hand sampling (see 2.2.3.1) for a complete vertical column of the overburden material.

2.2.2.3 Chemicals--

None required.

2.2.2.4 Materials--

1. Long handled shovel (common round pointed garden shovel is adequate).

2. Container with lid, round, one pint or one quart. NOTE: One container for each foot drilled or each sample obtained is required.

3. Felt-tip pen or other marker for legibly labeling sample container.

4. Wooden crate or heavy corrugated paper carton to transport rock filled containers.

5. Drill rig, rotary bit, compressed air type (Robbins Rotary Drill Model RR-T or similar type).

6. Record book.

<u>2.2.2.5 Procedure</u> (revised and updated from Smith et al., 1974)--

1. Determine the number of links per foot of the drive mechanism suspension chain on the drill rig.

2. Depth increment is approximated by marking successive link pins that occur about 30 cm (12 in) apart. Use a dab of grease or other mark that will be visible through the dust. NOTE: Every sixth pin is 34 cm (13.5 in) on the commonly used Robbins drill rig. This is close enough to the suggested 30 cm depth increment, but total depths recorded should count the full 34 cm in each successive increment.

3. Begin sampling with the first 30 cm (12 in) increment drilled from the leveled bench on which the rig is parked.

4. Hold shovel under dust apron almost touching the rotary drill extension. Air-expelled rock chips are allowed to collect on the shovel as the bit lowers 30 cm (6 link pins). NOTE: If an obvious change in rock type occurs within the 30 cm (12 in) interval, the rock types should be sampled separately and depth of change recorded.

5. Place shovel-full of sample in a container. Discard any material overflowing the container.

6. Samples are marked for each depth increment in the order 1, 2, 3, etc., collected from the surface downward.

7. Containers are marked occasionally with the location's abbreviation to aid in organization.

8. Place filled containers in a crate or heavy carton. Include a page of accompanying field notes which contain location, surface elevation, total depth drilled, unusual drilling conditions encountered, changes in rock type (see 2.1.2), depth encountered, depth of drill bench with respect to original land surface, thickness of coal seam(s) scheduled for mining, and date sampled. Transport to laboratory.

2.2.3 Sampling From Exploration Cores

2.2.3.1 Principle--

Exploration cores give a vertical column of overburden material. The cores, usually 5 cm (2 in) in diameter, leave intact rock samples. From these cores detailed geologic logging can be accomplished.

2.2.3.2 Comments--

Cores are logged and sampled from the top to the bottom of the core. Hand samples from the drill bench to the surface must be taken by hand if an intact soil core was not obtained.

The geographical location of the core should be located on a U.S.G.S 7 1/2 minute topographic map. Latitude and longitude coordinates are determined to four decimal places using a ruler.

Sample intervals cited are a general rule to follow. Special characteristics of the core will ultimately determine sample interval and number of samples required.

2.2.3.3 Chemicals--

Hydrochloric acid (HCl), 1 part acid to 3 parts water: Dilute 250 ml of concentrated HCl to 1 liter with distilled water.

2.2.3.4 Materials--

1. Rock hammer.

2. Containers with lids, one-quart. NOTE: One-pint containers may be substituted for smaller samples.

3. Felt-tip pen or other marker for legibly labeling sample containers.

4. Crate or heavy corrugated carton for transporting containers to laboratory.

5. Record book.

6. Hand lens, 10 power.

7. Dropper bottle for acid.

2.2.3.5 Procedure (revised and updated from Smith et al., 1974)--

1. Record the following: (a) site location, (b) depth from land surface to top of core, (c) total length of core, (d) elevation of land surface, (e) coal seams scheduled for mining with elevations and thickness, and (f) date sampled.

2. Samples 12 cm (5 in) long are taken from near the center of the represented sample interval.

3. Locate coal seams scheduled for mining.

4. Take a sample representing the total 30 cm (12 in) of material overlying a coal seam scheduled for mining.

5. Take a sample representing the total 30 cm (12 in) of material underlying a coal seam scheduled for mining. NOTE: Samples are not taken of the coal seam scheduled for mining.

6. Determine soil horizons and rock types (see 2.1.2). NOTE: In cores, if the soil horizons are absent, a pit will have to be dug to obtain soil horizon information (see 2.2.4).

7. Take samples. NOTE: Samples are taken from near the center of the represented sample interval. The sample interval is usually 30 cm (12 in) unless one of the following criteria can be met:

a. Rock members less than 13 cm (5 in) thick are considered transition zones, with the upper half incorporated with the overlying rock member and the lower half incorporated with the underlying rock member. Existence of transition zones should be recorded.

b. When an obvious change in chroma or texture (e.g. high (greater than 3) versus low (less than 2) chroma or coarse versus fine grained sandstone) occurs within a rock type, the two zones are sampled separately.

c. Zones of special interest should be sampled separately regardless of thickness.

d. If a sandstone is determined by an experienced person to have the same characteristics throughout, one sample can represent up to 1.5 meters (5 ft) of a thick-bedded or highly weathered (chroma 3 or higher) sandstone.

e. If the rock type has the same characteristics throughout, as determined by an experienced person, one sample can represent up to 1 meter (3 ft) of carbolith, mudrock, mudstone, shale, limestone, or other rock type.

8. Record sample number, soil horizon or rock type, and sample interval represented by the sample.

9. Record any items of special interest contained in the sample.

10. Place sample in container and label (see 2.2.6).

11. In the laboratory, recheck soil horizons and rock types. Determine soil horizon and rock type color. CAUTION: Above all, use intelligence guided by experience when sampling.

2.2.4 Hand Sampling A Highwall

2.2.4.1 Principle--

A vertical column of samples is needed to represent the different materials contained in the overburden of a coal seam. Samples are taken with a rock hammer from freshly exposed surfaces of the material.

2.2.4.2 Comments--

This procedure should be used only when an exploration core or a blast hole drill is not available or when mining operations expose different strata from those represented by earlier investigations.

Samples must be taken of freshly exposed surfaces. Contact with weathering elements over a long period of time will change the characteristics of exposed surfaces. Samples are taken by hand sampling the highwall at prescribed intervals from the coal to the land surface. One should work along access roads, use an extension ladder, or ropes and cliff climbing techniques to acquire samples. When working near a highwall, remember the presence of loose rock and use care. Hard hats, steel-toed shoes, and other safety equipment are necessities.

If the vertical column of overburden material is inaccessible or incomplete, one can sample the total column by combining lateral movement with vertical sampling, thus establishing a step-like sampling pattern across the highwall.

The geographical location of the sample site should be located on a U.S.G.S. 7 1/2 minute topographic map. Latitude and longitude coordinates are determined to four decimal places by using a ruler.

Sample intervals cited are a general rule to follow. Special characteristics of the highwall will ultimately determine sample interval and number of samples required.

2.2.4.3 Chemicals--

Hydrochloric acid (HCl), 1 part acid to 3 parts water: Dilute 250 ml of concentrated HCl to a volume of 1 liter with distilled water.

2.2.4.4 Materials--

1. Rock hammer and chisel.

2. Extension ladder (if required).

3. Climbing gear (if required).

4. Containers with lids, one-quart capacity, plastic coated cardboard. NOTE: One-pint containers may be substituted depending on sample size.

5. Felt-tip pen or other marker for legibly labeling sample containers.

6. Crate or heavy corrugated carton.

7. Record book.

8. Hand lens, 10 power.

9. Dropper bottle for acid.

2.2.4.5 Procedure--

1. Record the following: (a) site location, (b) coal seams scheduled for mining with elevations and thicknesses, (c) elevation of original land surface, and (d) date sampled.

2. Samples are taken from near the center of a freshly exposed surface of the sampling interval.

3. Locate coal seams scheduled for mining.

4. Take a sample representing the total 30 cm (12 in) of material overlying a coal seam scheduled for mining.

5. Take a sample representing the total 30 cm (12 in) of material underlying a coal seam scheduled for mining. NOTE: Samples are not taken of the coal seam scheduled for mining.

6. Determine soil horizons and rock types (see 2.1.2).

7. Take samples. NOTE: Samples are taken from near the center of the represented sample interval. The sample interval is usually 30 cm (12 in) unless one of the following criteria can be met:

a. Rock members less than 13 cm (5 in) thick are considered transition zones, with the upper half incorporated with the overlying rock member and the lower half incorporated with the underlying rock member. Existence of transition zones should be recorded.

b. When an obvious change in chroma or texture (e.g. high (greater than 3) versus low (less than 2) chroma or coarse versus fine grained sandstone) occurs within rock type, the two zones are sampled separately.

c. Zones of special interest should be sampled separately regardless of thickness.

d. If a sandstone is determined by an experienced person to have the same characteristics throughout, one sample can represent up to 1.5 meters (5 ft) of a thick bedded or highly weathered (chroma 3 or higher) sandstone.

e. If the rock type has the same characteristics throughout, as determined by an experienced person, one sample can represent up to 1 meter (3 ft) of carbolith, mudrock, mudstone, shale, limestone, or other rock type.

8. For each sample record sample number, soil horizon or rock type, and thickness of material represented by the sample.

9. Record any items of special interest contained in the sample.

10. Place sample in container and label (see 2.2.6).

11. Recalculate depth so that soil horizons and rock types are recorded as depth from land surface.

12. In the laboratory, recheck soil horizons and rock types. Determine soil horizon and rock type color. CAUTION: Above all, use intelligence guided by experience when sampling.

2.2.5 Selective Samples

2.2.5.1 Principle--

Selective samples are taken by hand. They are usually selected from a sampling site on materials of special interest (such as a high pyrite zone, vegetated versus unvegetated area, etc.). These areas of special interest are taken into account in the total site overburden interpretation.

2.2.5.2 Comments--

The type and amount of selective samples acquired depends upon the analyses being performed. Description and sample size varies with the individual sampler and his specific needs or interest.

2.2.5.3 Chemicals--

None required.

2.2.5.4 Materials--

1. Rock hammer.

2. Shovel.

3. Containers with lids, one-quart capacity. NOTE: One-pint containers may be substituted for smaller samples.

4. Felt-tip pen or other marker for legibly labeling sample containers.

5. Record book.

2.2.5.5 Procedure--

1. Use the rock hammer or shovel to acquire sample.

2. Place sample in one-quart container and cover.

3. Label sample (see 2.2.6).

4. Record sample number, site location, surface elevation, date sampled, and reasons for taking sample in the record book.

5. Transport samples to laboratory for analysis.

2.2.6 Labeling Samples

2.2.6.1 Principle--

Samples are labeled to separate one location from another or one sample from another. Four main items are required on each sample label: site location, sample number, depth from original land surface or sample increment, and date sampled.

2.2.6.2 Comments--

Complete information about the site location is necessary. Site location should include mine name (also pit number where available), sample column number (e.g. if more than one column is sampled from the same site) or exploration core number, longitude and latitude, surface elevation, date sampled, and any additional information necessary to locate the sample site.

Sample numbers should be in consecutive order from the top to the bottom of the column. Any samples taken between existing samples should be followed by a letter in alphabetical order or a decimal point and number in numerical order. EXAMPLE: Four samples taken between sample 2 and 3 would be 2A, 2B, 2C, 2D or 2.1, 2.2, 2.3, 2.4.

Depth should be recorded from the original land surface. When original land surface cannot be determined, sample increments (e.g. 30 cm (1 ft), length of rock hammer, etc.) should be recorded. Any change in sample increments should also be recorded.

Any special interest information (such as noticeable gypsum, pyritic zone, etc.) can be added.

2.2.6.3 Chemicals--

None required.

2.2.6.4 Materials--

1. Shovel and/or rock hammer for acquiring samples.

2. Containers with lids, one-quart for holding samples. NOTE: One-pint containers may be substituted depending on sample size.

3. Felt-tip pen or other marker for legibly labeling sample containers.

4. Record book.

2.2.6.5 Procedure--

1. Acquire sample using the sampling procedures (2.2.2, 2.2.3, 2.2.4, or 2.2.5).

2. Place sample in container.

3. Label container with site location, sample number, sample depth or sampling increment, and date sampled.

4. Record data in step 3 in record book if not previously completed during sampling.

2.3 DESCRIBING AND SAMPLING MINESOILS

2.3.1 Describing Minesoil Profiles

2.3.1.1 Principle--

In the new classification system, Soil Taxonomy (USDA, 1975), soils are classified on the basis of characteristics which can be observed or measured in the field and in the laboratory. Such a study requires a vertical cross-section extending from the surface down through 100 cm (40 in) below the surface. Properties of minesoils that often are lacking or different in undisturbed soils include the following:

1. Disordered coarse fragments. If coarse fragments constitute at least 10% of the volume of the control section, they are disordered such that more than 50% will have their long axis at an angle of at least 10% relative to any plane in the profile.

2. Color mottling without regard to depth or spacing in the profile. The mottling involves color differences of at least 2 color chips in the standard Munsell Color Charts. This mottling occurs among fines as well as within coarse fragments or between fines and coarse fragments.

3. Splintery edges on fissile coarse fragments. If coarse fragments are fissile, the edges are frayed or splintery rather than smooth.

4. Bridging voids. Coarse fragments bridging across voids as a result of placement of materials leave discontinuous irregular pores. These pores are larger than those from textural porosity.

5. Thin surface horizon higher in fines. A thin "near-surface horizon" often immediately below a surface pavement of coarse fragments, contains a higher percentage of fines (material less than 2 mm in effective diameter) than any other horizon in the profile to the bottom of the control section.

6. Local pockets of dissimilar material. Local pockets of dissimilar materials, excluding single coarse fragments, may range from 7.6 to 100 cm

in horizontal diameter. These pockets have no lateral continuity and are the result of the original placement of material and not of post-depositional processes.

7. Artifacts. Artifacts (plastics, glass, paper, metal, tires, logs, etc.) may appear in the profile.

8. Carbolithic coarse fragments. Carbolithic coarse fragments are frequently found in non-carbolithic classes of minesoils. These coarse fragments, which are usually associated with a coal horizon, are found in the profile because of moving and mixing of overburden materials.

9. Irregular distribution of oxidizable organic carbon. The irregular distribution of oxidizable carbon with depth in the profile is due to the mixing of overburden materials. Both recent and geologically old carbon compounds are involved.

2.3.1.2 Comments--

It is necessary to sample and describe fresh exposures in soils. Many minesoils present a problem because of a high proportion of coarse fragments. This causes hand digging to be difficult and time consuming. In some cases profile descriptions can be taken from road cuts, gullies, slips, etc. if the exposed surface is scraped or cleaned to remove effects of surface weathering or overwash.

Walk over the area, examining the surface and selecting a site representative of the area in general. Once a site has been selected, an excavation should be made to a depth of at least 100 cm and preferably deeper. The profile should be described to the 100 cm depth. An experienced soil scientist would probably prefer to describe the profile in more detail than will be put in this method. He can do this by following the profile description outlined in the Soil Survey Manual (USDA, 1951, p. 137-141). However, in addition to the information as outlined in the Soil Survey Manual, the properties of Spolents as described in 2.3.1.1 should be noted and recorded.

The following list of morphological features should be noted when describing a minesoil profile:

1. Layers. Minesoils may have different layers which result from placement of materials.

2. Depth. Depth is given in centimeters and is measured from the surface downward (e.g. 0-10 cm).

3. Color of the matrix. See procedure 2.1.3.

4. Mottling. Describe abundance, contrast, size, and color. Since mottling is one of the dominant properties of minesoils, extra care should be taken in describing the mottled patterns. See procedure 2.1.3 for color determination of the mottling.

5. Texture. See procedure 2.1.8.

6. Reaction (pH). If possible, pH should be determined in the field with a pH meter (see procedure 3.2.2). The reaction classes of Spolents are as follows: (a) extremely acid, pH is 4.0 or less, except for carbolithic classes (high-carbon mine waste) which are extremely acid at pH 3.0 or lower; (b) acid, pH is 4.0 to 5.5, except for carbolithic classes which have an acid range from pH 3.0 to 5.5; (c) neutral, pH is 5.5 to 8.0; (d) alkaline, pH is greater than 8.0.

7. Coarse fragments. Total percent by volume of each layer should be estimated in increments of 5% and recorded. Also record percent of each type of coarse fragment, such as shale, sandstone, mudstone, etc. NOTE: It may become necessary to break open the coarse fragments when in doubt.

8. Roots. Record the amount of roots in each layer.

9. Bridging voids. Abundance and size distribution for each layer should be recorded.

10. Artifacts. Record the amount and depth of all artifacts found in the profile. These artifacts can also include buried tree stumps and branches.

11. Pockets. Any pockets of dissimilar material should be described by size, texture, color, and percent abundance.

Anything else that may seem significant or will provide additional information about the profile should be recorded in the field notebook. Some of the miscellaneous things that would be noted are: coatings on coarse fragments, earthworm channels and excretions, concretions, etc.

<u>2.3.1.3 Chemicals--</u>

1. Hydrochloric acid (HCl), 1 part acid to 3 parts water: Dilute 250 ml of concentrated HCl to a volume of 1 liter with distilled water.

2. Water (H_2O).

<u>2.3.1.4 Materials--</u>

1. Spud bar.

2. Long handled shovel.

3. Marking knives.

4. Diapers or cloth towel.

5. Field notebook.

6. Portable pH meter or pH kit.

7. Munsell Soil Color Charts.

8. Tile spade.

9. Plastic sample bags, 20 pound capacity.

10. Felt-tip pen or other marker for legibly labeling sample bags.

2.3.1.5 Procedure--

1. Select the area on the minesoil to be described. Record location, surface elevation, and description of area where pit is to be dug in the field notebook.

2. Dig a pit vertically downward from the surface through a depth of at least 100 cm.

3. After the pit has been dug, clean the loose material from the face of the pit with a knife.

4. Study the features of the freshly exposed face of the pit.

5. Put a marking knife at the bottom of layer one. NOTE: This is the surface layer which will be higher in fines than the rest of the profile.

6. After layer one has been marked, study the rest of the exposed profile to see if any noticeable changes in material occur (e.g. a layer of carbolithic material sandwiched between layers of high chroma sandstone). In other words, there must be something which visually separates the material below layer one into different layers.

7. If there are no visual differences in the material from the bottom of layer one to the 100 cm depth, then place a knife at 25 cm intervals from the knife that marks the bottom of layer one.

8. Number the layers going downward: 1, 2, 3, etc.

9. Describe all the properties that have been put forth in 2.3.1.1 and 2.3.1.2 for each layer.

10. Record all descriptive material for each layer in the field notebook.

11. Sample each layer of the profile according to procedure 2.3.2.

12. Label all samples as to layer number, area, location (longitude, latitude, surface elevation), and transport back to laboratory (see 2.2.6).

2.3.2 Sampling Minesoils for Classification and Fertility

2.3.2.1 Principle--

An important source of error when investigating a soil body is taking samples for detailed laboratory measurements. Laboratory analyses only measure parameters that are contained in a particular soil sample. If the soil sample is taken haphazardly and is not representative of the soil body from which it was taken, then laboratory measurements are meaningless.

Sampling of minesoils should be done for a particular purpose. In minesoils (very young soils in pedogenic development) a measure of the variability within the soil body is extremely useful. Therefore, subdivisions of the minesoil, based on visual differences, are sampled and analyzed.

2.3.2.2 Comments--

The size of the sample depends on the purposes for sampling. For example, several small samples should be taken if only pH is to be measured. On the other hand, large samples are needed for doing all the measurements in section 3.

It is extremely important to label all samples correctly. Also, all sample numbers and descriptive information for each sample should be recorded in the record book along with a sketched map of the minesoil showing sampling subdivisions.

2.3.2.3 Chemicals--

None required.

2.3.2.4 Materials--

1. Record book.
2. Felt-tip pen or other marker for legibly labeling sample bags.
3. Spud bar.
4. Long handled shovel.
5. Tile spade.
6. Paddy shovel (D-handled dirt shovel).
7. Plastic bags, 20 lb capacity.
8. Plastic bags, sandwich size.
9. Rock hammer, flat nosed.
10. Knife, or large spatula.
11. Sieve, 7.6 cm (3 in) openings.

2.3.2.5 Procedure--

1. Walk or ride over the minesoil and note all visual differences such as color, texture, surface elevation, erosion, volunteer vegetation, and wet spots.

2. Draw a map of the minesoil dividing the surface area into different sampling units. NOTE: These subdivisions are made on the basis of visual differences as noted in step 1.

3. After the map of the area has been drawn and all sampling subdivisions have been made, examine the area once more to be sure that everything has been taken into account. Record longitude, latitude, and surface elevation of sampling area.

4. Do either 2.3.2.5.1 or 2.3.2.5.2.

2.3.2.5.1 Profile Sampling--

1. After deciding where the profile will be placed, take the spud bar and long handled shovel and dig a pit vertically from the surface to a depth of 100 cm.

2. After the pit has been dug so that a vertical cross section of the minesoil is exposed, describe the minesoil according to method 2.3.1.

3. Take a sample from each layer that has been described according to 2.3.1. Also, any major variations within a layer, such as pockets of dissimilar material that are of special interest, should be sampled.

4. All samples should be labeled as to pit number, layer number, depth, etc. NOTE: The more information gathered about a particular sample, the more useful the sample.

5. Pass all samples for a particular layer through a sieve with 7.6 cm openings and into a large plastic bag. Discard all material caught on the sieve after visually estimating the percentage of the total sample retained on the sieve. This information should be recorded and included in the final interpretation.

6. After sample has been put into labeled plastic bag, tie bag with twine and transport to laboratory.

2.3.2.5.2 Surface Sampling--

1. After the area has been subdivided into different units, determine the number of samples required per subdivision. NOTE: At least one sample per subdivision should be taken; however, depending on what analyses and what variability may be contained in one subdivision, more samples can be taken. Three samples per subdivision are preferred. If only pH is to be tested, take as many small samples (sandwich baggies full of material) as possible per each subdivision.

2. In each subdivision take representative samples of the 0 to 7.6 cm depth with a paddy shovel. NOTE: If a minesoil has been "topsoiled" with material that can be worked with farm implements, the samples are taken from the surface to a depth of 16 cm.

3. Pour sample from paddy shovel into a plastic ice bag through a sieve with 7.6 cm openings until bag is three-fourths full. NOTE: A visual estimate of the percentage of total sample retained on the sieve should be recorded and included in the ultimate interpretation. The material retained on the sieve is then discarded.

4. Label the sample bag carefully recording as much information about the site as possible and date sampled. Also record this information in the record book.

5. Transport samples back to laboratory.