DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
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INTERPRETING GEOLOGIC MAPS
FOR
ENGINEERING PURPOSES

BY
MEMBERS OF THE ENGINEERING GEOLOGY
AND GROUND WATER BRANCHES
UNITED STATES GEOLOGICAL SURVEY

HOLLIDAYSBURG QUADRANGLE
PENNSYLVANIA

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INTRODUCTION

This set of maps has been prepared to show the kinds of information, useful to engineers, that can be derived from ordinary geologic maps. A few additional bits of information, drawn from other sources, are mentioned below. Some of the uses of such maps are well known; they are indispensable tools in the modern search for oil or ore deposits; they are the first essential step in unraveling the story of the earth we live on. Less well known, perhaps, is the fact that topographic and geologic maps contain many of the basic data needed for planning any engineering construction job, big or little. Any structure built by man must fit into the topographic and geologic environment shown on such maps. Moreover, most if not all construction jobs must be based on knowledge of the soils and water, which also are intimately related to this same environment. The topographic map shows the shape of the land—the hills and valleys, the stream courses, and towns. The geologic map shows the kinds and shapes of the rock bodies that form the land surface and that lie beneath it. These are the facts around which the engineer must build.

To be sure, ortho-drone geologic maps, prepared primarily for scientific purposes, do not show, as such, all the facts that are needed for engineering plans. Still, the facts that are on the maps or in the descriptive texts that accompany them are quite useful for preliminary studies, if properly interpreted. How these facts can be interpreted is demonstrated by maps in this set. They are published in the hope that they will aid in an appreciation of the value of geologic maps and that they may be useful in teaching the practical applications of geology.

The set has two parts—basic data and interpretations. The basic data consist of a standard topographic map and a general-purpose geologic map of the Hollidaysburg 15-minute quadrangle in south-central Pennsylvania. The topographic map of the Hollidaysburg quadrangle is a redrawn from the Hollidaysburg-Huntingdon folio of the USGS. The folio itself contains complete descriptions of the rocks shown on the map and of their relation to each other. These descriptions supplement the map and are considered part of the basic data. They must be consulted by any one who wishes a more complete understanding of the geologic relations shown on the map and of the exactitude and limitations of the interpretations. These descriptions also serve to pin-point the problem to show where and what other good geologic maps, of any part of the country and showing conditions to each other. These descriptions supplement the map, and are considered part of the basic data. They must be consulted by any one who wishes a more complete understanding of the geologic relations shown on the map and of the exactitude and limitations of the interpretations. These descriptions also serve to pin-point the problem to show where and what are the scenic view points, described below and shown on the topographic map, and the observed slopes and properties of the rocks were cut out of the foundation and excavation. Thus, the map is so excellent that any attempt at revision would quickly reach the point of diminishing returns.

The objective of the field check, then, was simply to check, on the spot, the validity of these conclusions. Some changes and corrections were necessary; virtually all of them were due to the single fact that the original descriptions were not as exact and definitive as was desirable. For example, the interpretations were often led astray because several formations had been described as shale, whereas only “clay” might be thin-layered and slippier when wet and another “clay” might consist of thick, massive layers and contain so much sand or limy material as to form an excellent road bed even in wet weather.

A different method would have been used, of course, had the geologist started from the beginning to prepare engineering maps of the Hollidaysburg quadrangle rather than to interpret an existing map. In this case, his first objective would have been exactly the same—to prepare as complete and detailed a map of the geologic relations as was permitted by the scale of his base map. In addition, however, he would have had available for his use the same amount of information as was available to the interpreter of the existing map. He would also have a complete understanding of the map and of the exactitude and limitations of the interpretations, and could tell which of the facts shown will help solve a particular problem. Few sources of help in interpreting geologic maps are as readily available as such maps are, and can tell which of the facts shown will help solve a particular problem. For example, the map showing the location of various types of soil and drainage conditions and find adequate source of fill material.

4. Prepare and illustrate with maps and sections a geologic report on the feasibility of a proposed dam, 100 feet high, across Fracktown Branch just below mouth of South Poplar Run (near Clayshurban). Include comments on the geologic foundations, the water-tightness of the reservoir and spillway, and available construction materials for earth-fill and concrete. Outline necessary geologic studies and experiment needed for decisions as to whether concrete or earth-fill dam is preferable.

7. Prepare geologic section along a proposed highway tunnel, at 1,500-foot altitude, connecting East Shaparshurg with head of Otsown Run Valley. Describe excavation and support problems to be encountered.

8. Lay out highway from Hollidaysburg up Otsown Run to portal of tunnel proposed in problem 7. Describe and illustrate construction, maintenance, and building problems to be encountered and tell what further geologic data are needed.

9. Find a site for an underground factory, 100,000 square feet in area, near existing transportation and water supply. Minimum thickness of solid rock above factory must be 150 feet except within 200 feet of entrance. Rock should be easily excavate by usual underground mining methods but should stand without artificial support. Heavy flow of underground water must be avoided.

10. Locate a water well within 2 miles of Altoona, estimate depth to water, and state whether or not it should flow under arduous pressure.

CALL THE SPECIALIST!

A good geologic map is packed with facts that can be applied to the solution of practical, everyday problems. Because geologists understand the geologic history that has gone into making a part of the earth's surface as we see it today, the geologist can help solve problems as from the scenic viewpoint to the engineering problem. The geologist can help the specialist deal with water-supply problems. The specialist can help the geologist solve the problem of making a soil survey. The geologist can help the specialist deal with the geologic conditions in planning construction projects. The specialist can help the geologist deal with the problems of water-supply problems.
CONSTRUCTION MATERIALS
HOLLIDAYSBURG QUADRANGLE, PENNSYLVANIA

EXPLANATION
Material to be excavated and moved to construction jobs to be used with or without treatment.

Quartzite (granite)
Very hard, tough, deeply-foliated granite, becomes in places to gneiss. Generally consisting of mica and quartz. Good for hard, durable building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Sandstone
Coarse to fine-grained sandstone, mostly in massive beds more than foot thick. Contains large quartz crystals, and fossil shells and brachiopods. Good for hard, durable building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Silt
By far the least common sand, fine-grained, and varies in hardness and color. Good for use as aggregate material. Requires hand tools for removal.

Gravel, cobbles, sand, and silt
Fluvial deposits, mostly in massive beds more than foot thick. Contains gravel, cobbles, sand, and silt. Good for riprap, ballast, and construction material. Requires blasting and power equipment for removal.

Slate
Bladed, foliated metamorphic rocks, mostly in massive beds more than foot thick. Contains slate, shale, and schist. Good for building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Cherty limestone and dolomite
Soft, flexible, and durable limestone and dolomite with chert nodules. Good for building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Dolomite
Hard, durable limestone and dolomite in beds of varying thickness. Good for building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Mudstone and siltstone
Massive and lacks any definite structure. Good for building stone and concrete aggregate. Requires blasting and power equipment for removal.

Basalt
Fine-grained igneous rock, mostly in massive beds more than foot thick. Contains basalt and andesite. Good for building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Gravel and cobbles
Gravel, cobbles, sand, and silt. Good for riprap, ballast, and construction material. Requires blasting and power equipment for removal.

Sand and silt
Fine-grained sandstone, mostly in massive beds more than foot thick. Contains sand and silt. Good for building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Coarse sandstone
Coarse-grained sandstone, mostly in massive beds more than foot thick. Contains coarse sandstone. Good for building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Siltstone
Fine-grained sediments, mostly in massive beds more than foot thick. Contains siltstone. Good for building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Limestone
Pure limestone and dolomite
Limestone and dolomite in beds of varying thickness. Good for building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Dolomite
Hard, durable limestone and dolomite in beds of varying thickness. Good for building stone, brick, and concrete aggregate. Requires blasting and power equipment for removal.

Shale

CONSTRUCTION MATERIAlS...
INTRODUCTION

A knowledge of the geology is an essential element in understanding the water supply of an area, but it is only one of the fundamental factors involved. To an extent, the water supply is controlled by the characteristics of the rocks, but the water-bearing properties of the rocks may be greatly modified by alteration of the rock materials, as by solution, weathering, and chemical changes. Furthermore, the water supply is influenced to a limited extent by the distribution of the water, and by the distribution of the water-holding characteristics of the rocks. Therefore, the water supply is controlled to a large extent by the distribution of the water-holding characteristics of the rocks. Therefore, the water supply is controlled to a large extent by the distribution of the water-holding characteristics of the rocks.

EXPLANATION

A
Excellent water-producers
Limestones, dolomite

to
Field to scale to determine solution channels. Water supplying surface and ground water may be derived from these solution channels. These water supplies are generally good, and the water is generally of excellent quality.

B
Good small producers
Sandstones

Fair producers
Shale with some sandstones and limestones

Poor producers
Alternations of sandstones, conglomerates, clay, limestones, and coal

Capable of unknowns
Alluvial sand, gravel, silt, and clay

Surcharge recharging
Rocks underlie broad valleys except in the steep ridges. Unrecharge areas where water is forced.

Recharge areas

WATER SUPPLY

HOLOLLADYBURG QUADRANGLE, PENNSYLVANIA

Geology mapped in 1958 by Charles Buffs

Contour interval 50 feet
Below is more on foot
1953
SITE SELECTION FOR ENGINEERING WORKS
HOLLIDAYSBURG QUADRANGLE, PENNSYLVANIA
By Members of the Engineering Geology Branch

PROBLEM I
Problem: Route a tunnel between Hollidaysburg and Dry Gap. It will pass through the Juniata River Valley, which is 3,750 feet wide. The tunnel will be 7,400 feet long, connecting points A and B.

Recommendation:
1. Plan impermeable cut-off wall to bedrock across entire drainage basin.
2. Internal drainage of limestones and sandstones, in area between sites A and B.
3. Rock footings are near surface at all stream crossings. Plan rock footings at all sites.
4. Shale that will erode rapidly if unprotected. Recommendations:
- Adequate support of shale beneath a dam.
- Moreover, when reservoir is filled, water will now be necessary.
- Landslides are to be expected on east abutment as rocks undermine and rock falls occur along this fault on upstream side of site C. The fault passes through proposed dam. Large springs can probably yield much water.
- Drainage should be provided, as sandstone is porous and will drain sands into solution caverns.

Solution:
1. Heavy rock excavation anticipated in the following areas:
   - About 3/4 mile south of Hollidaysburg. Limestone will probably be necessary.
   - Dry Gap area, where sandstone will be encountered.

PROBLEM II
Problem: Compare advantages of alternative sites C and D for power dam on Juniata River. The Juniata River Dam will be 20 feet above the Juniata River.

Recommendation:
1. Prepare a summary of advantages and disadvantages of both sites C and D.
2. Determine whether limestone beds beneath dam contain solution caverns.

Solution:
1. Both sites are similar - alternating shale, sandstone, and limestone beds that are steeply inclined to the dip.
2. Sandstone, and limestone beds that are steeply inclined to the dip.
3. Solution caverns can probably be reached by piles; detailed investigations needed.
4. Shale that will erode rapidly if unprotected.
5. Heavy lining required for permanent lining.

PROBLEM III
Problem: Compare feasibility of short-radius (hairpin) curves to an alternate alignment of Juniata River with Martinsburg line.

Recommendation:
1. Prepare a summary of advantages and disadvantages of both alignments.

Solution:
1. Short-radius (hairpin) curves to attain a 6-percent grade.
2. Plan impermeable cut-off wall to bedrock across entire drainage basin.
3. Rock footings are near surface at all stream crossings. Plan rock footings at all sites.
4. Shale that will erode rapidly if unprotected.
5. Heavy lining required for permanent lining.
6. Landslides are to be expected on east abutment as rocks undermine and rock falls occur along this fault on upstream side of site C. The fault passes through proposed dam. Large springs can probably yield much water.
7. Drainage should be provided, as sandstone is porous and will drain sands into solution caverns.

The general purpose geologic map can be used in site selection for engineering works. Several hypothetical problems are given below. The answers will vary, depending upon the nature of the site selected.