Mineral Report for Forest Plan Revisions
Green Mountain National Forest and Finger Lakes National Forest

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Introduction

This report has been prepared by the Bureau of Land Management's Solid Minerals Team, Rolla, Missouri to assist the U.S. Forest Service with their Forest Plan Revision process. It is a short description of the geology and mineral potential of those lands that fall with the forest boundaries of the Green Mountain and Finger Lakes National Forests of Vermont and New York, respectively. Additionally, an attempt has been made to predict what would be a reasonable and foreseeable development scenario (RFDS) regarding commercial mineral interest and development within the two subject National Forests.

In the preparation of this paper, books, reports and other publicly available data sources were consulted. No field work was conducted. It needs to be stated at the outset that RFDS's are subject to change as new geologic research, exploration and technologies present themselves. Also, political and economic changes can profoundly affect a mineral resource's availability and profitability.

Green Mountain National Forest, Vermont

Location

The Green Mountain National Forest (GMNF) occupies about 360,000 acres in roughly the central and south-central part of Vermont. It is divided into two units: a northern section and a southern section. The southern section of the forest abuts the states of New York and Massachusetts to the west and south, respectively. Rutland, Vermont lies about midway between the two units and is the location of the Forest Supervisor's Office.

Physiography

The Green Mountain National Forest falls within the New England sub-province of the Appalachian Highland physiographic province. This is a mountainous area consisting of a series of more-or-less northwest-trending ridges and valleys. Topographic relief of the area is moderate to high with peaks rising as much as 1500 feet above the floors of their adjacent valleys. In the general area of GMNF, the Green Mountains attain heights of around 4000 feet above sea level.

Topographic expression reflects, in large measure, the structure and composition of the regional underlying bedrock. Consequently, valleys and lowland areas tend to be underlain by comparatively soft carbonate strata while ridges and uplands are composed of harder more resistant rock types such as quartzites and schists.

General Geology

Bedrock Geology - The GMNF falls within a region of complexly folded geology. The principal geologic structure here is the Green Mountain anticlinorium. Structurally, an anticlinorium is a series of synclines and anticlines so grouped that an arch is formed. The Green Mountain anticlinorium extends roughly from the Vermont-Massachusetts states line northeasterly for about 200 miles. The northern unit of the Green Mountain National Forest essentially sits astride the axis of the Green Mountain anticlinorium. The southern unit straddles three distinct physiographic provinces: the Taconic Mountains, on the forest unit's western side, the Green Mountains on the eastern edge and the narrow, synclinal Vermont Valley between them. Superimposed upon the Green Mountain anticlinorium is a series of smaller anticlines, synclines and domes all of which are the result of compressional and vertical movements of the underlying bedrock.

The Green Mountain National Forest is underlain by a variety of Precambrian and lower Paleozoic rocks, which in total, form a stratigraphic column of about 20,000 feet in thickness. The majority of these strata are metamorphosed rocks of sedimentary and volcanic origin. The oldest rocks in this sequence belong to Mount Holly Complex of early Precambrian age. Rocks of the Mount Holly Complex consist principally of fine-to-medium grained biotitic gneiss, amphibolite and hornblende gneiss and beds of mica schist, quartzite and small bodies of pegmatite granitic rock. Above the Mount Holly Complex lie various schists, quartzites and marbles of the late Precambrian. Rocks underlying the Taconic Mountains (on the western side of the southern forest unit) are somewhat less folded and faulted and so display a lower grade of metamorphism than formations on the eastern side of the Forest.

Surficial Geology - As with the rest of the New England area, Vermont's topography and surficial geology has been heavily influenced by the great ice sheets that advanced and retreated during the Pleistocene. Within the study area, past glacial action is evident by the striation marks on exposed hillside bedrock left by the passing ice sheets and the deposits of glacial till that are widespread throughout the region. Till is a material composed of pebbles, sand, clay and other types of unsorted sediment that was carried and deposited by the glaciers. As a general matter, it occurs as a relatively thin surficial cover on the upland areas of Vermont and thickens in the lowlands and valleys. Also, these till deposits tend to be unsorted, but in some of the larger valleys, stream action has sorted and stratified the material.

Economic Geology - The vast majority of mineral commodities currently produced in Vermont is industrial minerals, that is to say, stone products produced for the stone itself and not the metals or other mineral materials they may host. Examples are: crushed and dimension stone (of various geologic origins) and sand and gravel. This statement applies also to the Green Mountain National Forest and the region surrounding it. While records indicate that there has been a wide variety of minerals explored for and produced in the past (metallics, such as lead, copper and molybdenum), the commodities that possess the greatest potential for production in the future appear to be industrial minerals.

Marble, Limestone, Dolomite

The majority of Vermont's marble, limestone and dolomite resources occur within the Vermont Valley. These beds form part of what is referred to as the *Vermont Limestone-Marble belt* and extend from roughly mid-Bennington County directly north for almost one hundred miles. This belt averages perhaps ten miles in width.

Marble is formed by the metamorphism of limestone and dolomite. It represents an advanced stage in the crystallization of calcareous sediments produced by the heat and pressure brought to bear by intense folding of the original formations. These marble beds vary in thickness from fifty to over 300 feet, depending upon its location within the folded structure. It is produced from a variety of different formations ranging in age from early to middle Ordovician. Most of Vermont's marble production comes from Bennington and Rutland Counties. The principal uses for this stone are as a building material, or dimension stone, and as a source of calcium carbonate for filler in paint, plastic and paper.

Limestone is a sedimentary deposit principally made up of calcium carbonate. It is quarried regionally for both dimension and crushed stone applications. Available references indicate that there are crushed limestone operations in the vicinity of the Green Mountain National Forest in Addison County.

Dolomite is a sedimentary carbonate rock similar to limestone but is developed when a substantial portion of the calcium in the limestone is replaced by magnesium. Dolomite resources within the region carry essentially the same applications as limestone.

Those portions of the Green Mountain National Forest that are underlain by carbonate formations of these types must be considered prospective for economic development.

Ultramafics

Ultramafics are a variety of igneous rocks that chemically contain virtually no quartz or feldspar. They are composed almost entirely of ferromagnesium elements. Ultramafic rocks usually are coarse-grained and have one mineral species that dominates its composition. Within Vermont there is a narrow belt of ultramafic rocks that extends the length of the state north to south. Dated as Ordovician in age, this belt consists of a series of scattered ultramafic bodies that crop out along the entire length of the Vermont Appalachians. Perhaps the best known is the East Dover body in Windham County in southern Vermont. The East Dover body is composed chiefly of serpentine and olivine. Chrome, magnetite and pyroxene are accessory minerals.

The ultramafic rocks of Vermont possess commercial value and have yielded a number of merchantable products. These include: talc, verde antique (a marbled serpentine) and asbestos. Some ultramafics host nickel and chromium. Ultramafic bodies do not occur on the Green Mountain National Forest in abundance, but those areas of the forest that do host them should be considered prospective for commercial development.

Sand and Gravel

Stream and glacial deposits of sand and gravel occur on the Green Mountain National Forest. The best potential for development of these deposits is probably along stream valleys and lowland areas. However, given that there are no known large deposits on the forest and that the sand and gravel industry is not a major presence on the forest, future production will probably continue to be small-scale or for local uses only.

Gold

Gold deposits in Vermont have been known since the 1850's. However, they have always been relatively small, erratically occurring and economically marginal deposits. Some small amounts of gold-bearing quartz have been found, but the majority of Vermont's gold deposits are placer, deposited by glaciers and usually found in the gravel beds along stream bottoms.

While the Green Mountain National Forest will probably play host to recreational gold panning and weekend prospecting, the likelihood for any commercial interest in such deposits is tiny.

Natural Gas

The northern section of the Eastern Overthrust belt extends up into Vermont running the length of the state northward into Canada. Geologically, an overthrust belt describes a type of fault structure whereby the angle of dip is shallow (usually less than 30 degrees) and the hanging-wall block overrides the foot-wall block, often for many miles. Natural gas has been recovered from within the southern section of The Eastern Overthrust belt and there has been some speculation over the prospects of natural gas occurrence from the section in Vermont. However, because of the depth to potential gas-bearing horizons and thermal maturity of those beds, it is unlikely that economic deposits will in the found in the overthrust areas of the Green Mountain National Forest.

Other Minerals

Uranium and thorium, present in the forms of uraninite and thorianite, respectively, are constituents of the pegmatitic rocks of the Precambrian Mount Holly complex. The pegmatitic occurrences of uranium and thorium are common and widespread but seldom possess any commercial value. In the past there has been some interest displayed toward these deposits but no exploration or extraction has occurred. While it believed that commercial extraction of pegmatite-hosted uranium and thorium deposits on the GMNF is highly unlikely, this entire belt of rocks is considered speculative for the occurrence of these minerals.

Concluding Statement

There are a number of mineral commodities that occur, or have a history of occurrence on the Green Mountain National Forest. However, when assessing an area's mineral potential the distinction has to be made between a mineral "occurrence" and economic deposits. The setting of the GMNF within the highly metamorphosed Green Mountains is interesting geologically and is highly mineralized, but many of the mineral commodities described do not occur or have not occurred in commercial quantities. That is not to say

that they are not present in merchantable amounts, and it is likely that certain of these commodities will remain speculative, or even attract exploration interest in the future. However, large-scale commercial extraction is not foreseen as occurring on the forest in the near future.

Finger Lakes National Forest, New York

Location

Finger Lakes National Forest (FLNF) encompasses approximately 16,000 acres in the Finger Lakes region of west-central New York State. The forest straddles the Seneca and Schuyler Counties line and is almost centrally positioned between Seneca Lake to the west and Cayuga Lake on the forest's east side. The region is largely rural with Ithaca, New York (population approximately 30,000) being the closest sizable city to the forest. Ithaca lies approximately fifteen miles to the east.

Physiography

Finger Lakes National Forest falls within the Allegheny Plateau section of the Appalachian Highland physiographic province. This section of the Appalachian Highlands was originally a level plateau region but the down-cutting action of the local rivers and streams has created the hilly upland area present today. The area's watercourses display a dendritic drainage pattern that is typical of the down-cutting action of water through relatively horizontal strata. Regional drainage is provided principally by the Allegheny and Delaware Rivers and their tributaries.

Topographic relief here is comparatively high and rugged with the highest peaks and elevations occurring in the Catskills on the eastern end of the Allegheny province.

As with the rest of New England, glacial ice played a principal role in sculpting the topography of the Finger Lakes region of New York. The Finger Lakes themselves are the vestiges of glacially scoured drainage valleys which were subsequently dammed by debris carried by the ice.

General Geology

Bedrock Geology - The Finger Lakes National Forest is underlain with Paleozoic rocks of the Devonian period. These formations consist predominantly of shale, sandstone and limestone and attain a thickness, within the study area, of about 3000 feet. Geologic structure here is relatively simple: essentially flat-lying strata. The small formational dip that does occur is to the southwest. Surficial material is composed of glacial drift which attains thicknesses of a few feet in the uplands areas to several hundred feet in the valleys.

Economic Geology – Records consulted for this report indicate that sand and gravel and natural gas are produced from Seneca and Schuyler Counties in the vicinity of the FLNF. While there is no history of production or exploration of these commodities within the forest boundaries, the proximity of such operations to the FLNF must be taken into

account when assessing a reasonable and foreseeable development scenario for the forest.

Sand and Gravel

It is conceivable that commercial sand and gravel operations could be developed in the glacial drift which is present on the forest. However, this type of development would be contingent upon such variables as the size and quality of the deposit, market demand and accessibility to the deposit. Available information indicates that the majority of the sand and gravel operations proximate to the forest are small pits servicing local markets and applications. Additionally, these are common-variety minerals. Deposits occurring on the forest would possess no special quality imparting to them a value above those deposits available throughout the region. Small amounts of gravel have been extracted by the Forest Service and the Town of Hector under a cooperative road maintenance agreement. The Town of Lodi has expressed interest in extracting gravel from unconfirmed locations on the northern part of the Forest.

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Natural Gas

The Finger Lakes National Forest is underlain by stratigraphic units belonging to the Ordovician Trenton-Black River Formations. First drilled and put into production in the 1880's, the Trenton-Black River Formations still produce and represent extremely important reservoirs for natural gas in the Northeast. Producing horizons occur at depths ranging from 6,000 to10, 000 feet below the surface.

The Finger Lakes National Forest sits astride an important fracture zone of the Trenton-Black River Formations and a significant amount of natural gas production, and leasing, is occurring in the areas surrounding the forest. As a theoretical matter, the FLNF is highly prospective for the occurrence of natural gas because of favorable geologic conditions and the probably presence of hosting formations, at depth. However, for the purposes of predicting a reasonable and foreseeable development scenario for natural gas production here, factors independent of geology take control.

For many years the oil and gas industry has expressed great interest in leasing FLNF lands for natural gas exploration. In response to an industry proposal to lease several thousand acres of forest land in 1998, the U.S. Forest Service issued a Record of Decision in which they chose a "No Action" alternative to the leasing proposal. Simply put, this means that the Forest Service will not consent to any natural gas leasing on the forest at this time, and this decision appears to be open-ended. During the interim, New York State Senators Schumer and Clinton introduced legislation (S.1046, December 18, 2001) which proposes to permanently ban all drilling for oil and gas deposits within the Finger Lakes National Forest. This bill currently is making its way through Congress and appears to be on its way to becoming law.

Concluding Statement

Under the regulatory controls currently in force, natural gas exploration, leasing and production all are prohibited on the Finger Lakes National Forest. Consequently, no natural gas development is anticipated on the Finger Lakes National Forest in the future.