

**Supplemental Report  
Energy and Mineral Resources Assessment  
Plan Revision  
Nantahala and Pisgah National Forests**

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## **Introduction**

This energy and mineral resource assessment of the Nantahala and Pisgah NFs is based on information from several sources, including North Carolina Geological Survey (NCGS), U.S. Geological Survey (USGS), Bureau of Land Management (BLM), North Carolina Department of Environment and Natural Resources, Land Quality Section, and Mountain Resources Commission for Western North Carolina.

On June 3, 2013 the Nantahala and Pisgah NFs sent a letter to the State Director, BLM Eastern States Office requesting:

1. Coordination with BLM regarding energy and mineral resources in revising the Nantahala and Pisgah National Forests Land and Resource Management Plan.
2. BLM become a cooperating agency in the National Environmental Policy Act (NEPA) process for revising the Plan.

On December 10, 2013 the BLM accepted the invitation to be a cooperating agency.

Energy and mineral resources are part of the Western North Carolina Vitality Index developed and funded by the Mountain Resources Commission in partnership with the Blue Ridge National Heritage Area and the USDA Forest Service. The Mountain Resources Commission was established during the 2009 North Carolina General Assembly legislative session to encourage healthy and equitable development while preserving the natural resources, open spaces, and farmland of the mountain region of Western North Carolina (North Carolina Mountain Resources Commission, 2012a,b,c).

The Western North Carolina Vitality Index assesses components of the vitality of 27 counties in western North Carolina through the perspectives of their natural, social, built, and economic environments. The Vitality Index was developed to provide planners and decision makers the information necessary to inspire quality discussion and craft informed decisions on issues affecting western North Carolina's abundant natural resources and its potential for sustainable growth.

The 18 counties where the Nantahala and Pisgah NFs are located are part of the 27 counties covered by the Western North Carolina Vitality Index. The Index draws on information from various State agencies including the North Carolina Department of Environment and Natural Resources, North Carolina Geological Survey, and Land Quality Section.

**What are the current type, extent, and general location of energy and mineral activity and energy facilities on the Nantahala and Pisgah NFs?**

**Energy and Mineral Supply**

**Federal leasable minerals (FS & BLM administered)**

BLM is the federal agency with legal authority to lease minerals (43 CFR 3000). Forest Service consent is required before BLM can issue a lease on the Nantahala & Pisgah NFs. The Forest Service administers surface operations for mineral exploration and development under a BLM lease.

A Bureau of Land Management (BLM) hardrock mineral lease (NC-ES 13667) for olivine is in effect in the Buck Creek area of Clay County on the Tusquitee Ranger District in the Nantahala NF. The 158 acre BLM lease for olivine is in effect but mining operations under the lease are not active.

**Federal mineral materials (FS administered)**

The Forest Service has authority for managing and disposing of mineral materials (36 CFR 228C). A Forest Service mineral materials contract for crushed stone and riprap is in effect in the Massey Branch quarry near Robbinsville area of Graham County on the Cheoah Ranger District, Nantahala NF. Contract operations occur within 34.4 acres of the Massey Branch quarry, where mining operations have occurred for many years under a series of five year mineral material contracts. The most recent five year contract was issued in May 2012 and will expire May 31, 2017. This five year contract is for 1,250,000 tons, mined at a rate of 250,000 tons per year. Actual production for 2010-2012 is:

<b>Year</b>	<b>Production (short tons)</b>
2010	9,623
2011	9,248
2012	9,975

The Johns Knob quarry on the Cheoah Ranger District was a key source of mineral materials to build the Cherohala Skyway in Graham County. In 2013, the Ranger District was considering a request to use the quarry for a landslide repair on the Skyway.

Other quarries that have been active in the past include: 1) O.J. Wilson quarry (2 acres), a dimension stone quarry near Unicoi in Yancey County on the Toecane Ranger District (now part of the Appalachian Ranger District) in the Pisgah NF, 2) A. Taylor quarry (3 acres), a dimension stone quarry near Linville in Avery County on the Grandfather Ranger District in the Pisgah NF.

The Nantahala and Pisgah NFs uses mineral materials (crushed rock aggregate, rip rap, landscaping rock, etc.) for 1) FS administrative use such as constructing and maintaining roads, developed recreation sites, trailheads, and other facilities, 2) FS contracts, such as for timber sales, flood or landslide repairs, and recreation projects where mineral materials are needed for the project. The vast majority of mineral materials used by the Forest are purchased from private land. The Forest may use rocks pits on the Forest to supply some mineral materials.

The Forest Service Supervisor's Office (SO) in Asheville, N.C. is considering a stockpile of rock placed on the Appalachian Ranger District by NCDOT as a result of a rockslide removal on I-40. This stockpile of rock may contain on the order of 100,000 cubic yards of rock that could be processed into crushed rock for future use by the Forest.

In fiscal year 2012, the Tusquitee and Nantahala ranger districts each issued two mineral material permits for landscaping rock to the general public

### **Privately-owned minerals (non-federal minerals; reserved & outstanding rights)**

Hewitt Quarry, a mineral reservation located within the Nantahala National Forest in Swain County, occupies approximately 25 acres of the 300 acre private mineral estate. The quarry contains limestone or low grade marble.

## **Energy and Mineral Demand**

### **21<sup>st</sup> Century Demand**

The 1987 Forest Plan was developed more than a quarter of a century ago. Since then U.S. demand for minerals has grown to include not only traditional demands for minerals but also new and emerging demands for minerals essential for high technology, computers, Internet, fiber optics, cell phones, GPS, national defense, strategic and critical minerals, nanotechnology, renewable energy (wind, solar, biomass), clean car technology, greenhouse gas reduction and carbon capture infrastructure, and other climate change mitigation and adaptation infrastructures.

In response to increased demand, the U.S. Geological Survey initiated a Critical Mineral Resources for the 21st Century project, and noted that one of the principal causes of lag in meeting these demands is the limited amount of exploration done in the last few decades for new sources of these minerals:

“A broad range of existing and emerging technologies used by developed and rapidly-developing economies are generating unprecedented demand for less-common minerals such as lithium (Li), indium (In), tellurium (Te), gallium (Ga), antimony (Sb), beryllium (Be), high-purity quartz, and rare earth elements (REE). These technologies range from new alternative energy sources to seemingly mundane routine uses, such as fire-retardants. For a variety of reasons, supplies of these elements tend to lag significantly behind demand. One of the principal

causes of this lag is the limited amount of exploration done in the last few decades for new sources of these minerals. There are significant gaps in our knowledge of the geologic occurrence, resource availability, methods of extraction, and environmental behavior and management of these elements. Ensuring an adequate supply depends on learning how to discover and develop new sources of supply in an economic and environmentally sensitive fashion.” (USGS, 2014)

The North Carolina Geological Survey raised similar concerns and pointed out the potential for the Nantahala and Pisgah NFs to respond to these new and emerging demands for minerals (Reid, 2013).

In 2010, the U.S. Department of Energy (DOE) in its first Critical Materials Strategy, focused on materials used in four clean energy technologies: wind turbines, electric vehicles, solar cells and energy-efficient lighting. Several components of the clean energy technologies—including permanent magnets, batteries, photovoltaic (PV) thin films and phosphors—depend on materials at risk of supply disruptions (U.S. DOE, 2010)

### ***Olivine: New Discovery of Potential Uses in Clean Energy and Carbon Capture & Sequestration may Increase Demand for Olivine***

Currently, the Nantahala NF has a Bureau of Land Management (BLM) hardrock mineral lease for olivine in effect in the Buck Creek area of Clay County on the Tusquitee Ranger District. Recent research and discoveries on the use of olivine for clean energy and carbon capture & sequestration may increase demand to lease olivine on the Forest.

A new scientific discovery opens the potential for olivine to be the catalyst breakthrough to produce hydrogen for clean energy. Researchers from the University of Lyon announced the discovery at the 2013 fall meeting of the American Geophysical Union in San Francisco, and published the research in the October 2013 journal *American Mineralogist* (Muriel Andreani and other, 2013). The discovery sparked news reports of the potential dramatic and far-reaching effects that olivine may have on clean energy as well as on capturing and sequestering carbon on a global scale.

### **Nantahala and Pisgah NFs Demand**

The Nantahala and Pisgah NFs use energy and non-energy mineral resources for a wide range of resource programs. The overwhelming majority of the tools, equipment and energy used to manage the Forest and sustain ecosystems are made of minerals, not wood. Minerals are used in three forms, 1) the hardware made from minerals: tools, equipment, computers, GPS, cell phones, vehicles, culverts, bridges, water wells, fire trucks, aircraft, electrical grid, and other infrastructure, 2) highly processed mineral supplies needed to fuel, power, operate and maintain the hardware or to conduct operations (applying fertilizer, herbicides, fire retardant, etc.): gasoline, diesel, oil, chemicals, batteries, etc. 3) minerals used as construction materials or in a relatively raw form: aggregate, rip-rap, concrete, landscaping rock, building stone, etc.

## ***Forest Fossil Fuel Consumption***

### **Forest Fleet**

In fiscal year 2012, the Nantahala and Pisgah NFs consumed a total of 100,228 gallons of fossil fuels (gasoline and diesel), and travelled 1,981,419 miles.

The Forest also consumed fossil fuel through such activities as, 1) contractors performing road grading, road resurfacing, cutting up and hauling fallen trees that block roads and bridges, etc., 2) volunteers travelling back and forth to the Forest, 3) helicopters and fixed wing aircraft used in fire management, insects and disease surveillance, and monitoring, and flood and wind storm damage assessments, 4) airplane, bus and vehicle transportation of fire fighters from across the U.S. to fight forest fires on the Forest.

### **Forest Recreation**

The Forest provides and promotes public recreation requiring substantial travel that consumes fossil fuels (gasoline, diesel, oil). The number of Nantahala and Pisgah Forest visitors and distances travelled in FY2008 are reported in the Forest's Visitor Use Report as part of National Visitor Use Monitoring (USDA-Forest Service). Report data (Tables 2, 9 and 11) was used to estimate total round-trip miles travelled by Forest visitors. The draft estimate indicates that visitors travelled about 500 million miles in order to recreate on the Nantahala and Pisgah Forest in FY2008. Assuming 20 miles per gallon, recreation users of the Forest consumed on the order of 25 million gallons of gasoline/diesel in FY2008. This estimate includes only round trip mileage from the visitors' home to the Forest, and does not include any additional miles the visitor may have travelled on the Forest as part of the visit.

### **Forest Timber Harvest**

For FY 2010-2012, the Nantahala and Pisgah NFs used an estimated 120,647 gallons per year for fossil fuel consumption for timber harvest.

## ***Forest Mineral Materials Consumption***

The Forest uses mineral materials (crushed rock aggregate, rip rap, landscaping rock, etc.) to construct and maintain the roads, develop recreation sites, trailheads, and other facilities. The largest use of mineral materials is road aggregate on the Forest's approximately 1,613 miles of open roads. Every year the Forest resurfaces a few roads with several thousand tons of aggregate. For fiscal year 2010 to 2012, the Forest's average annual aggregate use was 4,000 tons per year. However, there is a backlog of roads in need of resurfacing, so the 4,000 tons per year is substantially less than the annual surface rock replacement needed to maintain 1,613 miles of open road.

Table 1 – Report aggregate use by Ranger District for FY 2010-2012.

	<b>FY10</b>	<b>FY11</b>	<b>FY12</b>
	<b>Aggregate (tons)</b>	<b>Aggregate (tons)</b>	<b>Aggregate (tons)</b>
<b>Appalachian</b>	None Reported	130	None Reported

<b>Cheoah</b>	None Reported	601	None Reported
<b>Grandfather</b>	None Reported	640	300
<b>Pisgah</b>	390	555	427
<b>Tusquitee</b>	94	1,082	None Reported
<b>Nantahala</b>	33	6,253	1,350
<b>Total</b>	517	9261	2077

In addition to regular maintenance, minerals materials in large quantities are needed to repair roads and stream crossings damaged or destroyed by storm events, floods, road slopes failures, etc. These episodic emergencies can increase the need for mineral materials far beyond the annual use for routine maintenance and surface rock replacement. The Forest uses rocks pits on the Forest to supply some mineral materials, however, the vast majority of mineral materials used by the Forest are purchased from quarries on private land off the Forest.

### **What is the potential for energy and mineral activity on the Nantahala and Pisgah NFs?**

The Nantahala and Pisgah NFs are endowed with a wide range of mineral resources. A wealth of mineral resource data relevant to the Forest is available from sources such as:

- North Carolina Geological Survey
- U.S. Geological Survey
- North Carolina State University's Mineral Resource Laboratory
- Tennessee Valley Authority

The vast mineral resource data available reflects the range and diversity of mineral resource potential on the Nantahala and Pisgah NFs. The North Carolina Geological Survey provides a summary and links to various mineral data sources relevant to assessing mineral resource potential on the Nantahala and Pisgah NFs (Reid, 2013).

Potential energy and mineral activity depends on many factors in addition to mineral potential, such as: 1) level of local, regional or national economic activity, 2) level of energy or mineral imports from foreign sources, 3) new geologic information and exploration models, 4) new technology for exploration and development, 5) advances in mineral processing, such as, processing lower grade ore, 6) new uses or changing demand for specific mineral or energy resources. Many of the above factors change with time, sometimes in unpredictable ways. For the National Forests, other factors that affect potential activity include acres of National Forest where energy and mineral activity is 1) legally prohibited or administratively unavailable, 2) restricted to the point the activity would be technically or economically unfeasible, 3) subject to high costs and long delays in approval of the activity. A compilation of the current Plan direction on mineral resources is in Appendix A.

The following sections provide an overview of existing information on energy and mineral potential on the Nantahala and Pisgah NFs. This overview scratches the surface of the immense mineral estate on the Forest. The existing information on mineral potential for various minerals is often two or three decades old. As a result, there is also a general lack of up-to-date information on the potential for mineral activity on the Nantahala and Pisgah NFs.

### **Federal leasable minerals (FS & BLM administered)**

Congress passed laws providing for the exploration and development of energy and mineral resources on federal lands administered by multiple use agencies: Forest Service (FS) and Bureau of Land Management (BLM). Under federal leasing laws applicable to all federal lands, federal leasable minerals include oil and gas, geothermal, coal, phosphate, and a few other minerals. However, on the Nantahala and Pisgah NFs and other eastern NFs with acquired land status, the minerals (such as gold, olivine, platinum group minerals, etc.) that would be locatable minerals on western NFs are classified as leasable hardrock minerals. BLM is the federal agency with legal authority to lease minerals (43 CFR 3000). Forest Service consent is required before BLM can issue a lease on the Nantahala and Pisgah NFs.

Western North Carolina is endowed with a variety of strategic mineral resources. For example, it is the Nation's leading producer of feldspar and mica; and 90% of the world's high purity quartz is mined and processed in western North Carolina for the world's electronic industry, including semi-conductor, solar photovoltaic, optic, and fiber-optic. This ultra-pure quartz from Spruce Pine Mining District is essential for building most of the world's silicon chips. Avery, Mitchell, and Yancey Counties, where Spruce Pine Mining District is located, also include portions of the Pisgah NF.

A comprehensive overview of the North Carolina's mineral resources and economic impact compiled by Jeffrey Reid, Senior Geologist, Energy and Minerals, titled "North Carolina's Mineral Storehouse and Emerging Resources", is available online at: <http://www.imcc.isa.us/North%20Carolina's%20Mineral%20Storehouse%20and%20Emerging%20Resources.pdf>.

According to this study, North Carolina and the U.S. have an emerging need for a variety of mineral resources (including special, unusual and rare minerals) to build and operate the infrastructures for National defense and renewable energy (wind, solar, biomass), clean car technology, greenhouse gas reduction and carbon capture infrastructure, high tech computer and internet infrastructure, and other climate change mitigation and adaptation infrastructures.

### **Solid Minerals Other Than Coal and Oil Shale**

Federal leasable mineral resources on the Nantahala and Pisgah NFs include more than 40 metallic and non-metallic minerals (USGS, Mineral Resources Data System) (Table 2). MRDS is a data base of mineral site records including present and past mines, prospects, and occurrences along with related geologic, commodity, and deposit

information (U.S. Geological Survey, 2013a). The MRDS has about 200 records of known mineral occurrences on the Nantahala and Pisgah NFs. Maps of mineral occurrences on the Forest's six Ranger Districts based on USGS MRDS data is displayed in Appendix B.

The MRDS mineral occurrences on the Forest are mainly leasable hardrock minerals (43 CFR 3500). The Nantahala and Pisgah National Forests is number one among National Forests east of the Mississippi in the diversity of non-fuel mineral commodities, as measured by reported mineral commodities occurrences in the Mineral Resources Data System (MRDS) of the U.S. Geological Survey (Table 3).

Table 2. Mineral resources on the Nantahala and Pisgah National Forests based on Mineral Resources Data System (MRDS) of the U.S. Geological Survey.

Arsenic	Gold	Nickel	Silver
Asbestos	Graphite	Niobium (Columbium)	Stone, Dimension
Barium-Barite	Iron	Olivine	Sulfur
Beryllium	Kaolin	Palladium	Talc-Soapstone
Chromium	Kyanite	Platinum	Tantalum
Cobalt	Lead	Pyrite	Thorium
Copper	Magnesite	Quartz	Tin
Corundum	Manganese	Rare Earth Elements	Titanium, Metal,
Feldspar	Marble	Rhodium	Vermiculite
Fluorine-Fluorite	Mica	Silica	Zinc
Garnet	Molybdenum		Zirconium

The North Carolina Geological Survey (NCGS) recognizes the mineral resource potential of the Nantahala and Pisgah NFs and notes:

“Large portions of the Nantahala and Pisgah National Forests are underlain by a Precambrian rift basin (Coleman and Cahan, 2012). Western North Carolina has been the focus of extensive mineral exploration since the early exploration and development of the State. Ore deposit models, summarized in Cox and Singer (1992), suggest the potential for further mineral discoveries including volcanogenic massive sulfides, and precious metal vein systems.”

“Diverse other mineral commodities in the two national forests include: monazite (source of rare earth elements – see Mertie, 1975) and important industrial minerals ‘alaskite’ (quartz, mica, and feldspar), olivine, gold, diamonds, industrial garnet, building- and dimension stones (river rock and flat mylonitized stone), marble, talc, and gemstones. Other minerals summarized from the studies of F.G. Lesure and his many co-authors (see the USGS’ National Geologic Map Database) and section below “Land that has been withdrawn – Wilderness, Roadless, and Adjacent regions” include”: kyanite-sillimanite-andalusite, gold, silver, rare-earth elements, thorium, titanium and uranium, pegmatite

minerals, mafic and ultramafic rock mineralization, mica along with supporting geologic and geochemical data. Talc and marble deposits occur nearby to USFS lands. Decorative stone, “river rock” and “flagstone” (mylonitized metamorphic rock) are present throughout Western North Carolina. Saprolite (weathered bedrock) is may provide local clay. Sand and gravel may be a local source of construction aggregate.” (Reid, 2013)

The US Geological Survey conducted a study of the bedrock geology and mineral resources of the Knoxville 1°x2° Quadrangle, Tennessee, North Carolina, and South Carolina, an area that includes most of the Forest (Robinson and others, 1992). This study also indicates the Forest has a potential for a vast array of metallic and non-metallic minerals important to society’s needs now and in the future.

North Carolina and the U.S. have an emerging need for variety of mineral resources to build and operate the infrastructure for National defense, high technology industries (computers, Internet, fiber optics, cell phones, GPS, nanotechnology, etc), and for renewable energy (wind, solar, biomass), clean car technology, greenhouse gas reduction and carbon capture and sequestration, and other climate change mitigation and adaptation infrastructures. For example, currently the Nantahala NF has a Bureau of Land Management (BLM) hardrock mineral lease for olivine in effect in the Buck Creek area of Clay County on the Tusquitee Ranger District. Recent research indicates olivine may be used 1) in carbon capture and sequestration, and 2) to produce hydrogen gas which could present several advantages compared to the current production via steam-methane reforming, which, besides relying on hydrocarbons, requires temperatures of over 5000C and releases carbon dioxide (CO<sub>2</sub>) (Muriel Andreani and other, 2013; Redfern, 2013). Rare earth elements (REE) are used in wind turbines, fiber optic cables, magnetic-refrigeration technology, and energy-efficient fluorescent lamps for institutional lighting which could potentially reduce U.S. carbon dioxide emissions equivalent to removing one-third of the automobiles currently on the road, according to USGS Fact Sheet 087-02 (Haxel and others, 2002).

Responding to climate change is a major emphasis of the Forest Service. The infrastructure for climate change mitigation is overwhelmingly based on minerals and advanced mineral technology. The U.S. is 50% to 100% dependent on foreign sources for many minerals essential for climate change mitigation. The National Academy of Sciences (2007) describes the National Research Council report “Minerals, Critical Minerals, and the U.S. Economy” as:

“This report investigates and highlights the importance of minerals in modern U.S. society, which minerals might be termed “critical” and why, the extent to which the availability of these minerals is subject to restriction, and the data, information, and research needed to aid decision makers in taking steps to avoid restrictions in mineral supply. The audience for the study includes not only federal agencies, industry, and research organizations, but also the general public and decision makers.”

On October 29, 2013 a bipartisan group of 17 Senators, including Senator Hagan from North Carolina, introduced the Critical Minerals Policy Act of 2013 to revitalize the United States’ critical minerals supply chain and help reduce the nation’s dependence on

foreign suppliers. The Critical Minerals Policy Act would update critical minerals policies for the 21st Century, by coordinating efforts across federal agencies. It also focuses on the broader supply chain for critical minerals. From resource assessments to recycling and alternatives, it takes a comprehensive approach to ensure the development of strong national mineral policies (U.S. Senate Energy and Natural Resources Committee, 2013).

In the western U.S., the FS and the BLM are two federal surface management agencies with multiple use missions where mineral exploration and development can play a meaningful role. In onshore eastern U.S., the BLM administers subsurface federal mineral rights under non-federal surface (split estate) as well as under surface management agencies in the East. In eastern U.S., the Forest Service is the only surface management federal agency with the special combination of significant surface management acreage (millions of acres) and a multiple use mission where minerals can play a meaningful role in federal minerals management. And among NFs in eastern U.S., the Nantahala and Pisgah National Forests with an outstanding variety of mineral occurrences (USGS MRDS records for more than 40 metallic and non-metallic minerals) has a special opportunity to consider the potential for provisioning minerals for ecosystem services and climate change mitigation.

The Nantahala and Pisgah National Forests diversity of mineral occurrences based on USGS MRDS is not matched by any other National Forest in the eastern U.S., and probably not by any other unit of a federal surface management agency in the eastern U.S.

## **Oil and Gas**

During the oil crisis of the early 1980's, large areas of Nantahala and Pisgah NFs were leased for federal oil and gas. When oil prices dropped, interest waned because of the exploration costs and unfavorable risk/reward in an unproven province for oil & gas exploration and development.

The U.S. Geological Survey conducted a study of the bedrock geology and mineral resources of the Knoxville 1°x2° Quadrangle, Tennessee, North Carolina, and South Carolina, an area that includes most of the Forest (Robinson and others, 1992). In regard to oil and gas potential, the study found that the northwestern portion of the Knoxville quadrangle is a high-risk frontier area for natural gas exploration (Wallace deWitt, Jr., written commun., 1989).

In 2008 the Bureau of Land Management issued a report "North Carolina - Reasonable Foreseeable Development Scenario for Fluid Minerals" that assessed oil and gas occurrence potential and oil and gas development activity potential for federal lands in North Carolina, including the Forest. The BLM report concluded: "No oil and gas wells are forecast to be drilled in North Carolina in the next ten years...There are no estimates of the surface disturbances associated with the development of oil and gas on federal minerals within the State of North Carolina because no new wells are predicted to occur over the next ten years."

## Coal

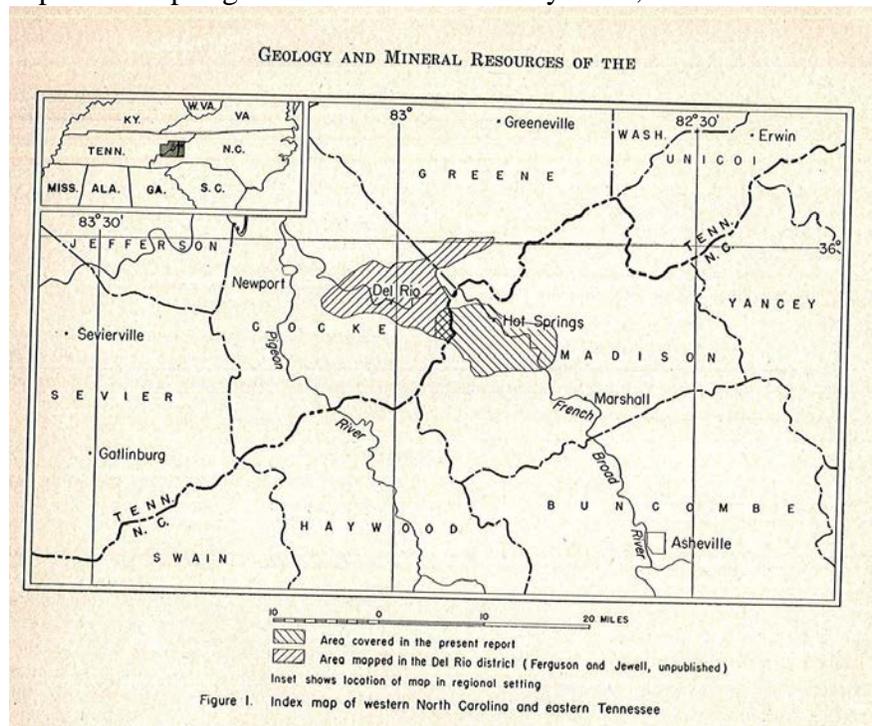
A 1992 US Geological Survey study of the bedrock geology and mineral resources of the Knoxville 1°x2° Quadrangle, Tennessee, North Carolina, and South Carolina, an area that includes most of the Forest (Robinson and others, 1992), concluded that rocks in the Knoxville quadrangle contain no coal.

## Geothermal

In 1950 the North Carolina Geological Survey issued a report on the geology and mineral resources of the Hot Springs window, Madison County (Oriel, 1950). The study area (Figure 1) included parts of the Pisgah NF. The reports states:

“The hot springs constitute the most valuable mineral resource in the area covered by the present report. Since their discovery, the springs have attracted visitors from many states and have been an important source of revenue for the town and county.”

Figure 1. Map of Hot Springs window area studied by Oriel, 1950



The US Geological Survey conducted a study of the major warm springs in the Appalachians extending from western Georgia to eastern New York (Hobba and others, 1979).

Based on these studies by the NCGS and USGS, the portion of the Pisgah NF in the vicinity of Hot Springs has potential for geothermal resources, including Enhanced Geothermal Systems (EGS) as defined by the U.S. Department of Energy.

## **Mineral Potential for Wilderness, Wilderness Study, and Roadless Areas**

### Historic mineral potential studies by US Geological Survey

In 1992 the US Geological Survey issued a report on the bedrock geology and mineral resources of the Knoxville 1°x2° Quadrangle, Tennessee, North Carolina, and South Carolina, an area that includes most of the Forest (Robinson and others, 1992). The study provides an overview of USGS studies conducted two to three decades ago for mineral potential information for Wilderness, Wilderness Study, and Roadless Areas, as follows:

“The Knoxville quadrangle contains all of two and parts of three wildernesses, three wilderness study areas, and 11 roadless areas in the National Forests plus the large proposed wilderness in the Great Smoky Mountains National Park (fig. 4). Wilderness resource assessments have been completed on some of these areas. The Shining Rock Wilderness, an area of 13,400 acres in the Pisgah National Forest near the center of the quadrangle in Haywood County, N.C. (Lesure and Dunn, 1982) was established as a wilderness in 1964. In 1984 the Shining Rock Additions of 5,100 acres were added to the north and southwest of the original wilderness, and the Middle Prong Wilderness of 7,900 acres was established a few miles to the west. These additional areas have not been studied by USGS. About 4,000 acres of the Ellicott Rock Wilderness lie in the Nantahala and Sumter National Forests along the southern border of the quadrangle where Georgia, North Carolina, and South Carolina meet (Luce and others, 1983). The northern part of the Southern Nantahala Wilderness, consisting of about 10,000 acres in the Nantahala National Forest, lies along the southern border of the quadrangle in Clay and Macon counties, N.C., 20 mi west of Ellicott Rock (Peper and others, 1991). The eastern three-fourths of the Joyce Kilmer-Slickrock Wilderness in the Nantahala and Cherokee National Forests straddles the North Carolina-Tennessee border in the southwestern part of the quadrangle (Lesure and others, 1977).

“The three wilderness study areas—Craggy Mountain, Overflow, and Snowbird—are in North Carolina and were so designated by the North Carolina Wilderness Act of 1984. These areas were recommended as further planning areas in 1979 by the Second Roadless Area Review and Evaluation (RARE II) and have been studied by USGS. The Craggy Mountain Wilderness Study Area of about 2,300 acres is 10 mi northeast of Asheville in the Pisgah National Forest (Lesure and others, 1982). The Snowbird Wilderness Study Area of 8,490 acres is in the Nantahala National Forest along the western edge of the quadrangle about 5 mi south of the Joyce Kilmer-Slickrock Wilderness (Lesure and Chatman, 1983), and the north half of the Overflow Wilderness Study Area of 3,200 acres is in the Nantahala National Forest 5 mi west of Ellicott Rock Wilderness (Koeppen and others, 1983).

“The remaining roadless areas defined in RARE II were recommended for multiple use and have not been studied by USGS (fig. 4). These include the following in the Pisgah National Forest: Balsam Cone, 13,529 acres; Middle Prong, 2,265 acres; Wildcat, 7,120 acres; and Shining Rock Extension, 4,876 acres. In the Nantahala National Forest there are Fishhawk Mountain, 5,430 acres; Southern Nantahala, 11,412 acres; Chunky Gal, 12,445 acres; Tusquitee Mountains, 16,860 acres; Cheoah Bald, 21,434 acres; and Joyce

Kilmer-Slickrock Addition, 1,179 acres. In the Cherokee National Forest there is Devil's Backbone, 4,100 acres.” (Robinson and others, 1992)

Lack of recurrent survey of mineral values required by Wilderness Act

The Wilderness Act of 1964 requires that Wilderness areas be surveyed on a "planned, recurring basis" for mineral values by the Department of Interior, as stated in Sec. 4.

(d)(2)

“(2) Nothing in this Act shall prevent within national forest wilderness areas any activity, including prospecting, for the purpose of gathering information about mineral or other resources, if such activity is carried on in a manner compatible with the preservation of the wilderness environment. Furthermore, in accordance with such program as the Secretary of the Interior shall develop and conduct in consultation with the Secretary of Agriculture, such areas shall be surveyed on a planned, recurring basis consistent with the concept of wilderness preservation by the Geological Survey and the Bureau of Mines to determine the mineral values, if any, that may be present; and the results of such surveys shall be made available to the public and submitted to the President and Congress.”

In the event of new information, the appropriate Secretary can recommend to Congress a modification or adjustment to the Wilderness boundary, as provided for in Sec. 3. (e) of the Act:

“(e) Any modification or adjustment of boundaries of any wilderness area shall be recommended by the appropriate Secretary after public notice of such proposal and public hearing or hearings as provided on subsection (d) of this section. The proposed modification or adjustment shall then be recommended with map and description thereof to the President. The President shall advise the United States Senate and the House of Representatives of his recommendations with respect to such modification or adjustment and such recommendations shall become effective only on the same manner as provided for in subsections (b) and (c) of this section.”

The Nantahala and Pisgah NFs have 70,369 acres of designated Wilderness. The US Geological Survey studies of mineral potential for these Wilderness areas are from two to three decades ago. No updated surveys of mineral values by the Department of Interior pursuant to the Wilderness Act of 1964 are available. Congress recognized the importance of mineral resources on federal lands by requiring that Wilderness areas be surveyed on a "planned, recurring basis" for mineral values by the Department of Interior. Such up-to-date mineral surveys would provide mineral resource information applicable not only to Wilderness but to areas outside Wilderness that have a similar geologic setting.

North Carolina Geological Survey recognizes the need for an updated, modern assessment of mineral potential for all the Forest lands, including Wilderness and other lands withdrawn from mineral leasing, in order to “reflect the changed national demand

for minerals that have to be imported because the mineral is not mined in the United States, new sustained mineral use technologies, and new technology not envisioned when lands were initially withdrawn. Again, the North Carolina Geological Survey and the U.S. Geological Survey are the primary agencies with appropriate expertise to undertake these studies.” (Reid, 2013).

#### Lack of up-to-date mineral potential studies for Wilderness Study Areas

The Nantahala and Pisgah NFs has five Wilderness Study Areas with a total of +26,000 acres. The US Geological Survey studies of mineral potential for these Wilderness Study Areas were completed in 1984. These studies are three decades old.

Maps of mineral occurrences (USGS MRDS) and Wilderness, Wilderness Study Areas, and Inventoried Roadless Areas on the six Ranger Districts are displayed in Appendix B. The maps are based on US Forest Service GIS analysis of mineral commodities occurrences in the Mineral Resources Data System (MRDS) of the U.S. Geological Survey.

#### **Status of federal management of mineral estate on the Nantahala & Pisgah NFs**

Congress passed many laws providing for the exploration and development of energy and mineral resources on federal lands administered by multiple use agencies: Forest Service (FS) and Bureau of Land Management (BLM). On National Forests in the western U.S., most of the minerals are locatable minerals subject to mining claims under the Mining Law of 1872. Some minerals on western NFs are federal leasable minerals (such as oil & gas, coal and geothermal). However, on the Nantahala & Pisgah NFs and other eastern NFs with acquired land status, the Mining Law of 1872 does not apply. All of the minerals (such as gold, olivine, platinum group minerals, etc.) that would be locatable minerals on western NFs are classified as leasable hardrock minerals on the Nantahala & Pisgah NFs and other eastern NFs with acquired land status. These hardrock minerals are administered under applicable leasing laws (Mineral Resources on Weeks Act Lands of 1917, as amended by the President’s Reorganization Plan No. 3 of 1946; 43 CFR 3500).

BLM is the federal agency with legal authority to lease minerals. Because of the addition of hardrock minerals to leasable minerals on acquired lands, the scope of the mineral estate that BLM has the authority to lease is far greater on the Nantahala and Pisgah NFs than on western NFs. As a result, the scope of current and revised Forest Plan effects on availability and access to federal mineral resources is greater on the Nantahala & Pisgah NFs than on western NFs where locatable minerals are available by statute. In 2001 a prime example occurred illustrating the difference in impact of Forest Service decisions on locatable vs leasable minerals on acquired lands. The Forest Service issued the Roadless Area Conservation Rule, a discretionary rule that prohibited road construction and reconstruction in Inventoried Roadless Areas. Because access to locatable minerals is based on statutory rights, the prohibition does not apply to locatable minerals on western NFs. But the prohibition does apply to leasable minerals on acquired lands in the eastern U.S. like the Nantahala and Pisgah NFs.

***De facto role of Forest in management of leasable minerals***

While BLM has the authority to issue prospecting permits and leases for leasable minerals, BLM cannot issue prospecting permits and leases on the Nantahala & Pisgah NFs unless the Forest Service consents. As a result, de facto management of the federal mineral estate on the Nantahala & Pisgah NFs is divided among federal agencies in the Department of Interior and the Department of Agriculture. While it is sometimes said that the BLM manages minerals and the Forest Service manages the surface, this is a misleading oversimplification that hides the critical roles the Forest Service has in de facto management of federal minerals.

For example, a key part of managing any resource is to conduct an inventory. In the case of mineral resources, an inventory requires exploration, including subsurface exploration such as trenching, shallow drilling and deep drilling. Without Forest Service consent, BLM cannot issue prospecting permits to inventory the immense subsurface mineral estate on the Nantahala & Pisgah NFs.

Conversely, the Forest Service can take actions that have significant adverse effects on availability and access to federal mineral resources without obtaining consent from BLM or even consulting with BLM. Such FS actions may include 1) designating areas that create de facto or quasi wilderness, or 2) adopting Land and Resource Management Plan components that, intentionally or unintentionally, have various degrees of significant adverse effects on federal minerals management, up to and including making mineral exploration and development technically or economically unfeasible.

**Federal mineral materials (FS administered)**

The Forest Service has authority for managing and disposing of mineral materials (36 CFR 228C). The Forest has a high potential for the occurrence of mineral materials (aggregate, rip rap, building stone, landscaping rock, etc.) that can be used to meet the Forest's needs as well as local or regional needs for mineral materials. The potential for development of mineral materials will be based on Forest Plan direction.

**What portion of the Nantahala and Pisgah NF is the subsurface ownership not FS, and where is that located?**

Most of the minerals underlying the federal lands that make up the Nantahala & Pisgah NFs are federally owned. However, some tracts acquired by the USDA Forest Service either had the mineral rights reserved (reserved rights) or already had the mineral rights severed (outstanding rights). The land status in which owner of the mineral rights on a tract is different than the surface owner of the tract is referred to by various names: split estate; private subsurface ownership; reserved or outstanding mineral rights (ROR abbreviation); nonfederal mineral ownership; nonfederal minerals rights; private mineral rights.

GIS data for the Nantahala and Pisgah NFs lists 205 tracts with outstanding or reserved mineral rights in which there is less than 100% federal mineral ownership. Total acreage of outstanding mineral rights on these tracts is anywhere from 102,523 acres to 125,714 acres depending on which tracts or portions of tracts, had mineral claims extinguished per the N.C. Ancient Minerals Act (N.C. Gen. Stat. § 1- 42.1 through § 1- 42.9). Existing information is insufficient to provide an exact acreage of current subsurface ownership. It likely would be time-consuming and costly, particularly if attorney's opinion is sought, to remedy the insufficient information.

**Are there any abandoned mines or mining related hazards in need of reclamation or restoration?**

Recent Abandoned Mine Lands (AML) closures to abate mine hazards for public safety have been accomplished at Ray Mine on the Appalachian District, e Pisgah NF. More closures are planned.

The Tusquitee Ranger District has identified several mine shafts and is considering shaft closure in the Buck Creek area of Clay County on the in the Nantahala NF.

No systematic inventory. But can use existing MRDS.

The Mineral Resources Data System (MRDS) of the U.S. Geological Survey can be as to develop an AML inventory. MRDS is a data base of mineral site records including present and past mines, prospects, and occurrences along with related geologic, commodity, and deposit information. The MRDS has about 200 records for Nantahala and Pisgah National Forests, but only some of these records would lead to an AML site needing a safety closure.

**What are the current policies for rockhounding and gold panning on the forests (noncommercial mineral collecting)?**

The Forest-wide Direction for recreational collection of minerals (rockhounding, gold panning, etc.) in the current Forest Plan is to:

- Allow recreational collection of minerals where minerals are loose and free on the surface, in federal ownership, and not restricted by permit.
- Restrict mineral collection to nonmechanical equipment with no significant ground and stream disturbance.

Consistent with the Plan, the Forest's current policy on the Forest's public website is at <http://www.fs.usda.gov/detail/nfsnc/recreation/?cid=stelprdb5420144>

The public collecting of mineral specimens for non-commercial purposes on the Forest is based on authorities from two federal agencies: the Bureau of Land Management (BLM) and the Forest Service. BLM provides the mineral authority for disposal of mineral specimens (gold, etc.) to the public, while the Forest Service provides the surface management authority determining what areas and under what conditions the public may

collect minerals specimens. For more information regarding recreational rockhounding, see the recreation section of this assessment report.

### **Fossil Collecting (Paleontological Resources)**

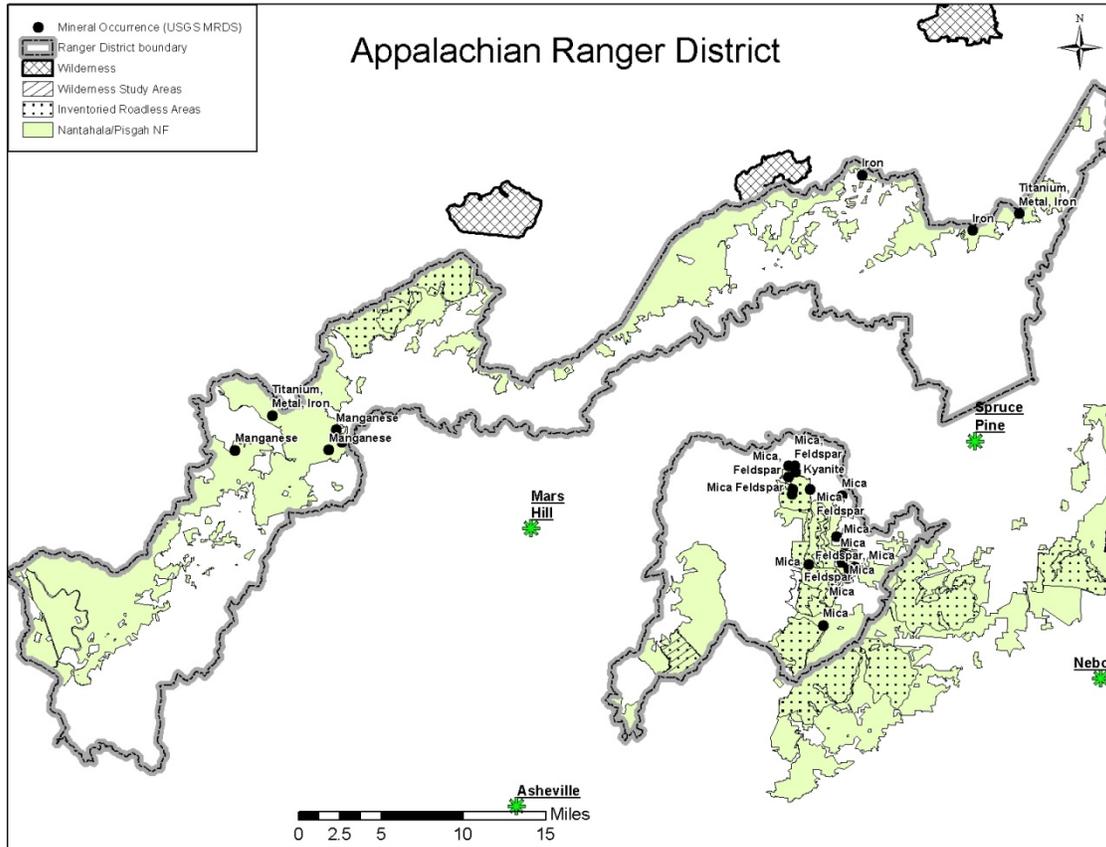
North Carolina Geological Survey Bulletin 89 “Fossil Collecting in North Carolina” provides information on where to find fossils and how to collect and identify fossils in North Carolina (Carter and others, 1988). Bulletin 89 notes:

“Fossil collecting is enjoyed by a large number of amateur and professional paleontologists in North Carolina. The popularity of this pursuit reflects the aesthetic and scientific value of fossils, plus the fact that eastern North Carolina has some of the richest fossil localities in eastern North America...The selected fossil localities are restricted to eastern North America (see back cover). The rocks comprising the mountains of western North Carolina generally lack fossils, or their fossils are poorly preserved and difficult to collect.”

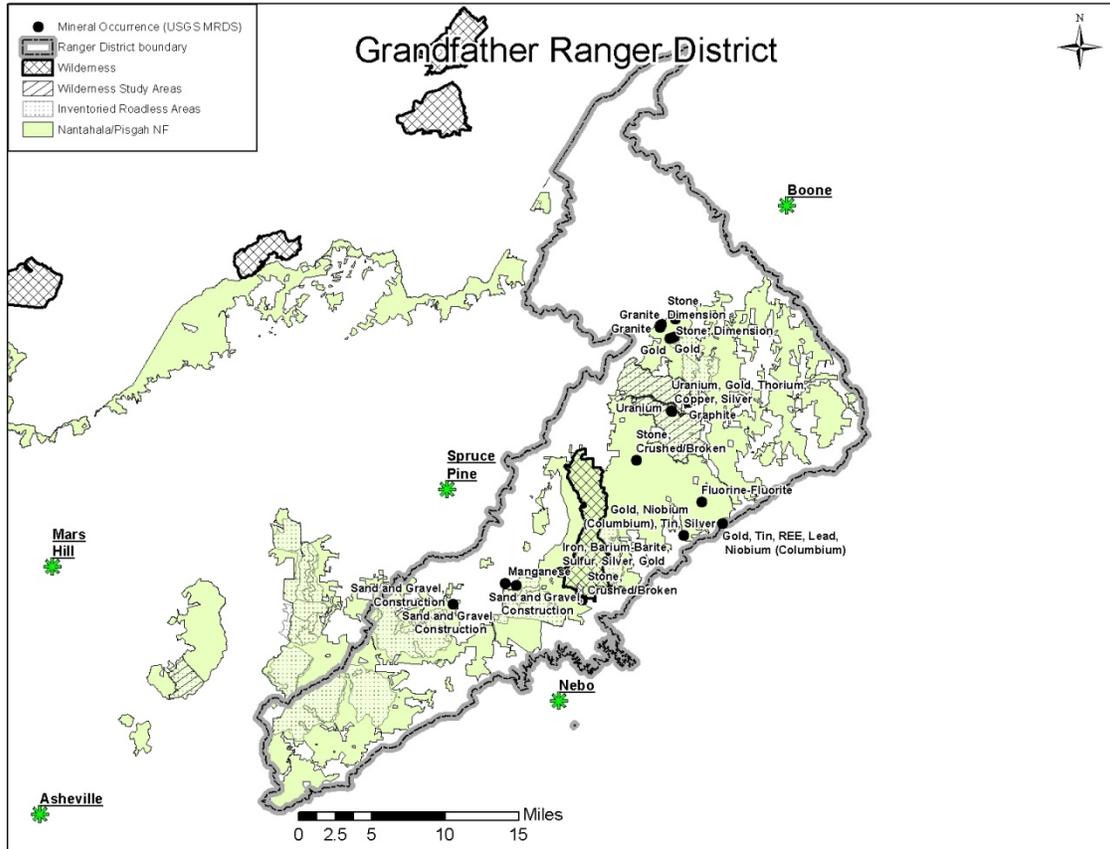
The Nantahala and Pisgah NFs are located in western North Carolina, and so, fit into the assessment of “generally lack fossils, or their fossils are poorly preserved and difficult to collect”. Congress passed the Paleontological Resources Preservation Act of 2009 (Public Law 111-11) which establishes a framework for management and protection of paleontological resources on federal lands. The Act states that the Secretary of Agriculture shall allow casual collecting without a permit on NFS lands where such collection is consistent with the laws governing the management of those lands and consistent with the Act. In 2013 the Forest Service issued for public comment a proposed rule to implement the Act (USDA-Forest Service, 2013). The Forest Service is analyzing the public comments on the proposed rule, and is expecting to issue a final rule in the last half of 2014.

**Appendix A– Mineral occurrences (USGS MRDS) by Ranger District**

Maps of mineral occurrences (USGS MRDS) on six Ranger Districts of Nantahala and Pisgah NFs. Based on US Forest Service GIS analysis of mineral commodity occurrences in the Mineral Resources Data System (MRDS) of the U.S. Geological Survey.

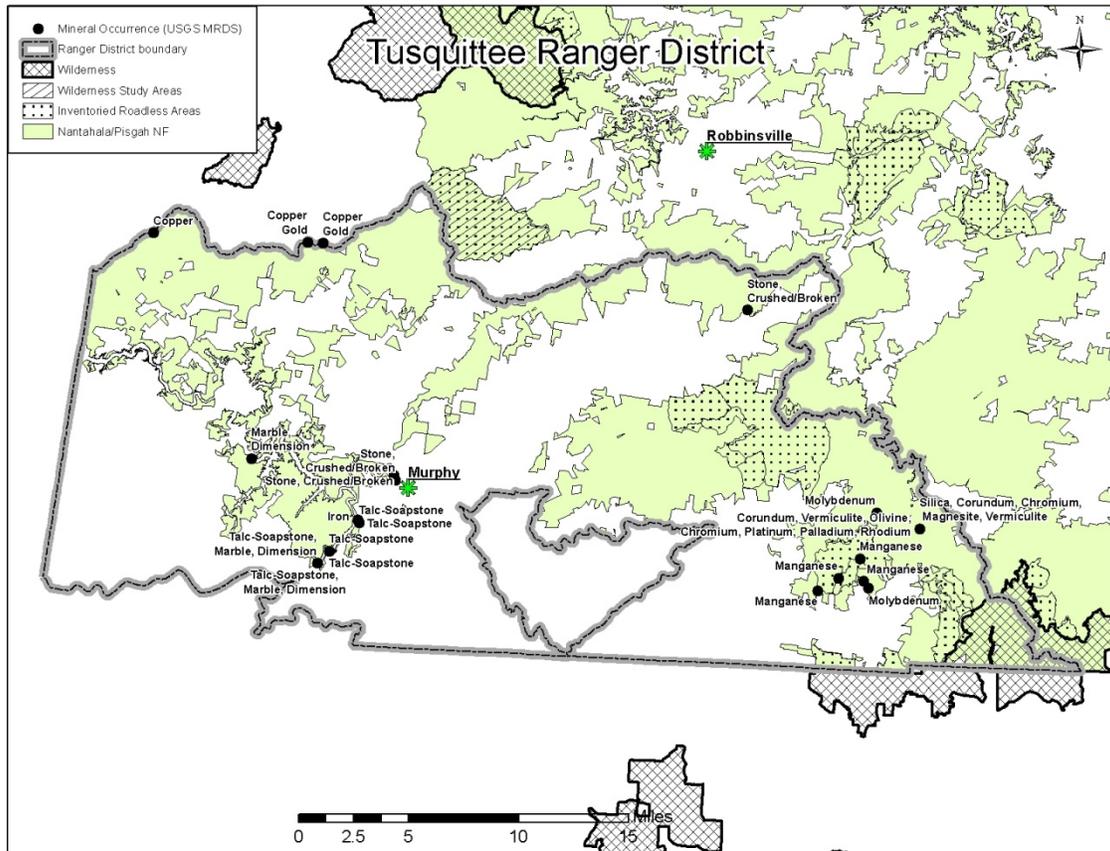












## References

- Bureau of Land Management, 2008, North Carolina - Reasonable Foreseeable Development Scenario for Fluid Minerals. U.S. Department of Interior.  
[http://www.blm.gov/pgdata/etc/medialib/blm/es/jackson\\_field\\_office/planning/planning\\_pdf\\_nc\\_rfds.Par.49259.File.dat/N\\_Carolina\\_RFDS\\_R1.pdf](http://www.blm.gov/pgdata/etc/medialib/blm/es/jackson_field_office/planning/planning_pdf_nc_rfds.Par.49259.File.dat/N_Carolina_RFDS_R1.pdf).
- Haxel, Gordon B., Hedrick, James B., and Orris, Greta J., 2002, Rare Earth Elements – Critical Resources for High Technology. U.S. Geological Survey, Fact Sheet 087-02. Online.  
<http://pubs.usgs.gov/fs/2002/fs087-02>.
- Hobba, W. A., Jr., Fisher, D. W., Pearson, F. J. Jr., Chemerys, J. C., 1979, Hydrology and geochemistry of thermal springs of the Appalachians, USGS Professional Paper: 1044-E.  
<http://pubs.usgs.gov/pp/1044e/report.pdf>.
- Merschat, C.E. 1993. Geologic Maps of Cherokee, Graham, and Swain Counties, North Carolina. Unpublished North Carolina Geological Survey report to the USDA Forest Service, 9 p.
- Muriel Andreani, Daniel Isabelle, and Marion Pollet-Villard, 2013, Aluminum speeds up the hydrothermal alteration of olivine. Abstract. American Mineralogist, October 2013, v. 98, p. 1738-1744 <http://ammin.geoscienceworld.org/content/98/10/1738.abstract>.
- National Academy of Sciences, 2007, Minerals, Critical Minerals, and the U.S. Economy. (online report):  
[http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/critical\\_minerals\\_final.pdf](http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/critical_minerals_final.pdf).
- North Carolina Mountain Resources Commission, 2012a, Western North Carolina Vitality Index. Online at:  
<http://www.wncvitalityindex.org>.  
<http://www.wncvitalityindex.org/overview/about>.  
<http://www.wncvitalityindex.org/overview/executive-summary>.
- North Carolina Mountain Resources Commission, 2012b, Western North Carolina Vitality Index: Mineral Resources. Data from North Carolina Geological Survey and U.S. Geological Survey.  
<http://www.wncvitalityindex.org/geology/mineral-resources>.
- North Carolina Mountain Resources Commission, 2012c, Western North Carolina Vitality Index: Energy Resources.  
<http://www.wncvitalityindex.org/energy/energy-resources>.
- North Carolina Statutes, 2013, North Carolina Gen. Stat. Certain ancient mineral claims extinguished in certain counties. North Carolina § 1- 42.1 through § 1- 42.9.

[http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter\\_1/GS\\_1-42.1.html](http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter_1/GS_1-42.1.html).

<http://www.ncga.state.nc.us/gascripts/statutes/StatutesTOC.pl?Chapter=0001>.

- Oriel, S. S., 1950, Geology and mineral resources of the Hot Springs window, Madison County, North Carolina: North Carolina Geological Survey Bulletin 60.
- Reid, J.C., 2012, North Carolina's Mineral Storehouse and Emerging Resources. North Carolina Geological Survey presentation at Interstate Mining Compact Commission workshop in December 2012 in Charlotte, N.C.  
<http://www.imcc.isa.us/North%20Carolina's%20Mineral%20Storehouse%20and%20Emerging%20Resources.pdf>.
- Reid, J.C., 2013, Summary, Geologic Maps, Oil and Gas, and Mineral comments. In Response to the U.S. Forest Service (USFS) draft assessment for the Pisgah and Nantahala National Forests, North Carolina. North Carolina Geological Survey, December 16, 2013.p. 22.
- Redfern, Simon, 2013, Hydrogen squeezed from stone could be new energy source. BBC News Science & Environment, December 12, 2013. Online article. (accessed 1/21/2014)  
<http://www.bbc.co.uk/news/science-environment-25349983>.
- Robinson, G.R. Jr. and others, 1992, Bedrock Geology and Mineral Resources of the Knoxville 1°x2° Quadrangle, Tennessee, North Carolina, and South Carolina, U.S. Geological Survey Bulletin 1979. [http://pubs.usgs.gov/of/2004/1075/user\\_files/Pub\\_text.pdf](http://pubs.usgs.gov/of/2004/1075/user_files/Pub_text.pdf).
- U.S. DOE, 2010, 2010 Critical Materials Strategy Summary, U.S. Department of Energy.  
[http://energy.gov/sites/prod/files/10\\_Critical\\_Materials\\_Strategy\\_Exec\\_Summary\\_final.pdf](http://energy.gov/sites/prod/files/10_Critical_Materials_Strategy_Exec_Summary_final.pdf).
- USDA Forest Service, 2013, Visitor Use Report, Nantahala and Pisgah NFs, National Visitor Use Monitoring, Survey data collected FY2008.  
<http://www.fs.fed.us/recreation/programs/nvum>.
- USDA OIG, 2013, Management of Oil and Gas Resources on National Forest System Land. Office of Inspector General Audit Report 08601-0001-21, March 2013.
- U.S. Department of Interior, Bureau of Land Management, 2008, North Carolina - Reasonable Foreseeable Development Scenario for Fluid Minerals, BLM Eastern States, Jackson Field Office, Jackson, MS, May 2008.  
[http://www.blm.gov/pgdata/etc/medialib/blm/es/jackson\\_field\\_office/planning/planning\\_pdf\\_nc\\_rfds.Par.49259.File.dat/N\\_Carolina\\_RFDS\\_R1.pdf](http://www.blm.gov/pgdata/etc/medialib/blm/es/jackson_field_office/planning/planning_pdf_nc_rfds.Par.49259.File.dat/N_Carolina_RFDS_R1.pdf).
- U.S. Geological Survey, 2013a, Mineral Resources Data System (MRDS), On-Line Spatial Data.  
<http://tin.er.usgs.gov/mrds>.
- U.S. Geological Survey, 2013b, Mineral commodity summaries 2013: U.S. Geological Survey, 198 p.

U.S. Geological Survey, 2014, Critical Mineral Resources for the 21st Century. (online, accessed 1/20/2014) <http://minerals.usgs.gov/east/critical/index.html>,  
<http://minerals.usgs.gov/east/critical/activities.html>.

U.S. Government Accountability Office, 1984, Private Mineral Rights Complicate the Management of Eastern Wilderness Areas. RCED-84-101, Jul 26, 1984.  
<http://www.gao.gov/products/RCED-84-101>.

U.S. Senate Energy and Natural Resources Committee, 2013, Senators Introduce Bipartisan Critical Minerals Legislation. Feature Items, Oct 29, 2013.  
<http://www.energy.senate.gov/public/index.cfm/2013/10/senators-introduce-bipartisan-critical-minerals-legislation>.