Resource Overview for the Original 1996 Grand Staircase–Escalante National Monument Designation and Vicinity

Utah Geological Survey March 2021 doi.org/10.34191/PI-103

According to data compiled by the Utah Geological Survey, the area within the original 1996 designation of Grand Staircase–Escalante National Monument (GSENM) holds low to moderate potential for oil and gas development, high potential for coal, and low potential for most other commodities. The one active oil field on the boundary of the monument has produced over 29 million barrels of oil since 1964, but all other drilling within the monument and vicinity has resulted in only dry holes. The coal resource within the Kaiparowits Plateau coal field is high quality, extensive, and conducive to underground mining. However, the area is remote, lacks infrastructure, and general questions remain about the future viability of the coal industry. Metal and industrial mineral resources are present within the monument, but development potential is considered low overall.

Oil and Gas

Five oil and gas plays are recognized within GSENM: (1) Late Proterozoic/Cambrian, (2) Paleozoic Devonian-Mississippian, (3) Permo-Triassic unconformity, (4) Cretaceous sandstone, and (5) Coalbed methane. The only significant oil production within/adjacent to GSENM is from the Upper Valley field in the Permo-Triassic unconformity play, which targets the Permian-age Kaibab Limestone and Triassic-age Moenkopi Formation. Upper Valley field was discovered in 1964 and has produced over 29.4 million barrels of oil and minimal gas. The field currently has 14 producing wells, 5 shut-in wells, and 8 water injection wells (both within and outside the monument boundary). Because of production at Upper Valley and the possibility of other undiscovered Upper Valley-like fields, the Permo-Triassic unconformity play has a moderate potential for new oil discoveries. The other four plays are rated low to moderate, having no established production, most likely due to the lack of one or more basic criteria required for hydrocarbons to be present.

Given the high exploration risk, remoteness of the region, lack of pipelines and infrastructure, depressed prices, and other factors, drilling activity is unlikely to take place in or near GSENM. Most companies exploring in Utah will continue to focus their efforts on the Uinta and Paradox Basins where there are high rates of drilling success, well-established infrastructure, and major exploitable oil and gas reserves.

- Only 57 wells have been drilled within the 1996 boundary of GSENM and an additional 15 planned wells were abandoned before drilling (location abandoned).
    - 50 wells scattered around the monument were all dry holes and were plugged and abandoned.
    - Five wells in the Upper Valley field, within the monument boundary, are currently producing.
    - Two wells in the Upper Valley field, within the monument boundary, are currently used as water injection wells, one of these wells has historical production.
- No APDs (applications for permit to drill) currently exist within GSENM or vicinity.

Renewable Resources

Renewable resources have never been examined within the original 1996 GSENM boundary since all renewable energy studies have taken place after the initial designation and excluded these lands from consideration. Significant solar resources are available throughout the monument, in association with large tracts of flat land. In addition, two sets of power lines cross the area, which could provide grid access. However, vast tracts of land are also available outside the monument boundary.

Coal

Beds of coal thick enough to be mined commercially occur in the Cretaceous-age Dakota (more recently called the Naturita) Formation and Straight Cliffs Formation within GSENM. The Dakota coal beds occur in the Alton coalfield, where only the far eastern side overlaps with GSENM, whereas the Straight Cliffs coal beds occur in the Kaiparowits Plateau coalfield, located in the central area of GSENM. Substantial past coal exploration drilling in both the Alton and Kaiparowits Plateau coalfields has been sufficient to meet BLM requirements to delineate Known Recoverable Coal Resource Areas (KRCRA).

The Alton coalfield within GSENM contains coal beds that are greater than 4 feet thick and are under less than 3000 feet of cover, including a small area under less than 200 feet of cover potentially suitable for surface mining. However, despite the presence of several exploratory drill holes, no historical coal mining has occurred in the Alton coalfield within GSENM (there is one currently active surface mine, Coal Hollow, located west of GSENM). In addition, the area of the Alton coalfield in GSENM has been declared by the BLM as unsuitable for surface mining (and surface disturbance related to underground mining) due to its proximity to Bryce

Canyon National Park. These declarations can change, but due to the mostly thin nature of the coal beds, development potential in this area is thought to be low.

The Kaiparowits Plateau coalfield contains up to 9 billion tons of potentially recoverable coal in beds thicker than 4 feet and under less than 3000 feet of cover. Nearly 1000 exploratory holes have been drilled to define the resource. In addition, several small historical mines produced minor amounts of coal in the early 1900s, and a large underground mine (Smoky Hollow) was in the planning/permitting stages when the monument was declared in 1996. Therefore, the coal resources of the Kaiparowits Plateau within GSENM are rated high for development potential.

Oil Sands

The oil/tar sand deposits in the Circle Cliffs area of GSENM have been designated as a Special Tar Sand Area (STSA) by the BLM. The occurrence potential for the deposit is high (meaning it is well defined), but development of the oil sands within GSENM is unlikely given minimal past development of Utah oil sands in general, lack of infrastructure in the area, and lack of specific past interest in the Circle Cliffs deposit.

Uranium and Vanadium

The GSENM area hosts minor known occurrences of sediment-hosted uranium and vanadium mineralization. Past production from the area represents about 0.1% of Utah's total uranium output and about 0.2% of Utah's total vanadium output, and most of this production is from the Circle Cliffs mining district. Uranium-vanadium deposits throughout GSENM are hosted primarily in the basal Shinarump Member of the Triassic-age Chinle Formation, though minor occurrences are known in the Jurassic-age Morrison Formation. Uranium-vanadium deposits are generally small, irregular, and low grade, and the potential for finding undiscovered larger, higher-grade deposits in GSENM is unlikely.

Other Metals

Copper is a common accessory metal in the sediment-hosted uranium-vanadium deposits of GSENM, though generally low grade. Copper, like uranium and vanadium, is hosted primarily in the Shinarump Member of the Triassic-age Chinle Formation. Cobalt occurs in several deposits, notably the historic Colt Mesa uranium-copper mine in the Circle Cliffs area, which was briefly leased for cobalt exploration in 2019 before the claims were dropped the same year. Minor lead deposits have been identified in the Jurassic-age Navajo Sandstone in the western part of GSENM, and minor manganese deposits are known in the Shinarump Member, Navajo Sandstone, and Jurassic-age Carmel Formation. Molybdenum and zinc mineralization is known to occur in trace amounts, typically associated with copper. The potential for discovery of major copper and/or cobalt deposits in GSENM is low given low grades and lack of infrastructure, and the potential for any other metals is unlikely.

Titanium and Zirconium

Known and defined Ti-Zr paleoplacer deposits exist within GSENM in the Kaiparowits mining district. These paleoplacer deposits occur within the John Henry Member of the Late Cretaceous-age Straight Cliffs Formation and have been investigated in the past during times of high Ti-Zr prices. Although the deposits have a reasonable grade, they are only a fraction of the size of typical economic paleoplacer deposits. Given their remoteness and small relative size, development of these deposits is unlikely.

Gypsum

Gypsum resources are present in multiple geologic units in GSENM and limited amounts have been produced at a few quarries within the monument boundary in the past. Resources occur within the Jurassic-age Carmel Formation as well as the Triassic Moenkopi Formation and Permian Toroweap Formation. Available information and past production suggest that the quality and quantity of gypsum in the Carmel Formation are likely superior to the Moenkopi and Toroweap Formations. Notably, some of the gypsum in the Carmel Formation in GSENM is high-quality sculpting alabaster and has been quarried for that purpose. Future development and production of gypsum in GSENM would likely be limited to alabaster as it has been in the past. Development of gypsum for more common construction purposes is unlikely given the remoteness of the area and lack of infrastructure. Utah has abundant, more-developed gypsum resources elsewhere.

Silica and Industrial Sand

Jurassic-age Navajo Sandstone and Quaternary-age eolian dune and sand deposits represent potential silica and industrial sand resources in GSENM. Any substantial development of silica resources in GSENM is unlikely given lack of past interest or development, remoteness of the area, and lack of infrastructure. In addition, the geologic units having potential are abundant and widespread outside GSENM.

Sand and Gravel

Several unconsolidated surficial geologic units in GSENM have sand and gravel resource potential and past extraction has occurred within GSENM. Deposits having the most potential include stream alluvium, pediment deposits, terrace deposits, and alluvial gravel. Any future development would likely be limited to local use and is most likely to occur at favorable locations within a short distance of major roads.

Crushed Stone and High-Calcium Limestone

Limestone-bearing geologic units in GSENM offer some resource potential for both crushed stone and high-calcium limestone, but potential for these commodities varies by geologic unit. The Permian-age Kaibab and Toroweap Formations include massive, cherty beds of limestone suggesting some potential for crushed stone, but chert content would negatively affect quality. Although the Jurassic-age Carmel Formation and Triassic-age Moenkopi Formation possess some limestone, the varied lithologies within the units, as implied by descriptions, do not suggest ideal conditions for uniform, high-quality crushed stone deposits. In the early 1970s, limestone in the Moenkopi Formation was evaluated for use at the Kaiparowits Power Plant in Arizona but was ultimately not selected. Available analytical data from that evaluation indicate marginal potential for high-calcium limestone. Given lack of past production of either commodity, future development will probably be minimal.

Building Stone

Based on production elsewhere, a few geologic units within GSENM have potential for building stone (e.g., flagstone, dimension stone, decorative stone), particularly the Triassic-age Moenkopi Formation. Although limited future development of building stone in GSENM is possible, we consider it unlikely given the absence of past production.

Clay

Several geologic units in GSENM have clay resource potential and minor amounts were produced in the past. Past producing units include the Cretaceous-age Dakota Formation and possibly the Cretaceous-age Tropic Shale, but a few other formations have potential including the Triassic-age Chinle, Jurassic Morrison, and Cretaceous Straight Cliffs Formations. Production from the Dakota Formation in GSENM was from 1960 and earlier for use in the Glen Canyon Dam project. Significant future development of clay resources in GSENM is unlikely given the remoteness of the area, lack of infrastructure, and availability of clay-bearing units elsewhere. Limited extraction could potentially occur for local purposes.

Humate

Potential humate resources exist in the Cretaceous-age Dakota and Straight Cliffs Formations within GSENM. However, development of humate deposits in the area is unlikely because better deposits with closer access to transport and market are available elsewhere in Utah. Thus, no exploration and development activities for humate are expected in GSENM.

For questions or additional information, contact:

Michael Vanden Berg, Energy and Minerals Program Manager, 801-538-5419, michaelvandenberg@utah.gov

Andrew Rupke, Industrial Minerals Geologist, 801-537-3366, andrewrupke@utah.gov

Stephanie Mills, Metals Geologist, 801-537-3308, smills@utah.gov

Select references:

Allison, M.L., 1997, A preliminary assessment of energy and mineral resources within the Grand Staircase-Escalante National Monument: UGS Circular 93, 36 p., https://doi.org/10.34191/C-93.

Chidsey, T.C., 2016, Major oil plays in Utah and vicinity: UGS Bulletin 137, 294 p., https://doi.org/10.34191/B-137.

Hettinger, R.D., Roberts, L.N., Biewick, L.R., and Kirschbaum, M.A., 1996, Preliminary investigations of the distribution and resources of coal in the Kaiparowits Plateau, southern Utah: U.S. Geological Survey Open-File Report 95-539, 72 p., https://pubs.usgs.gov/of/1996/OF96-539/.

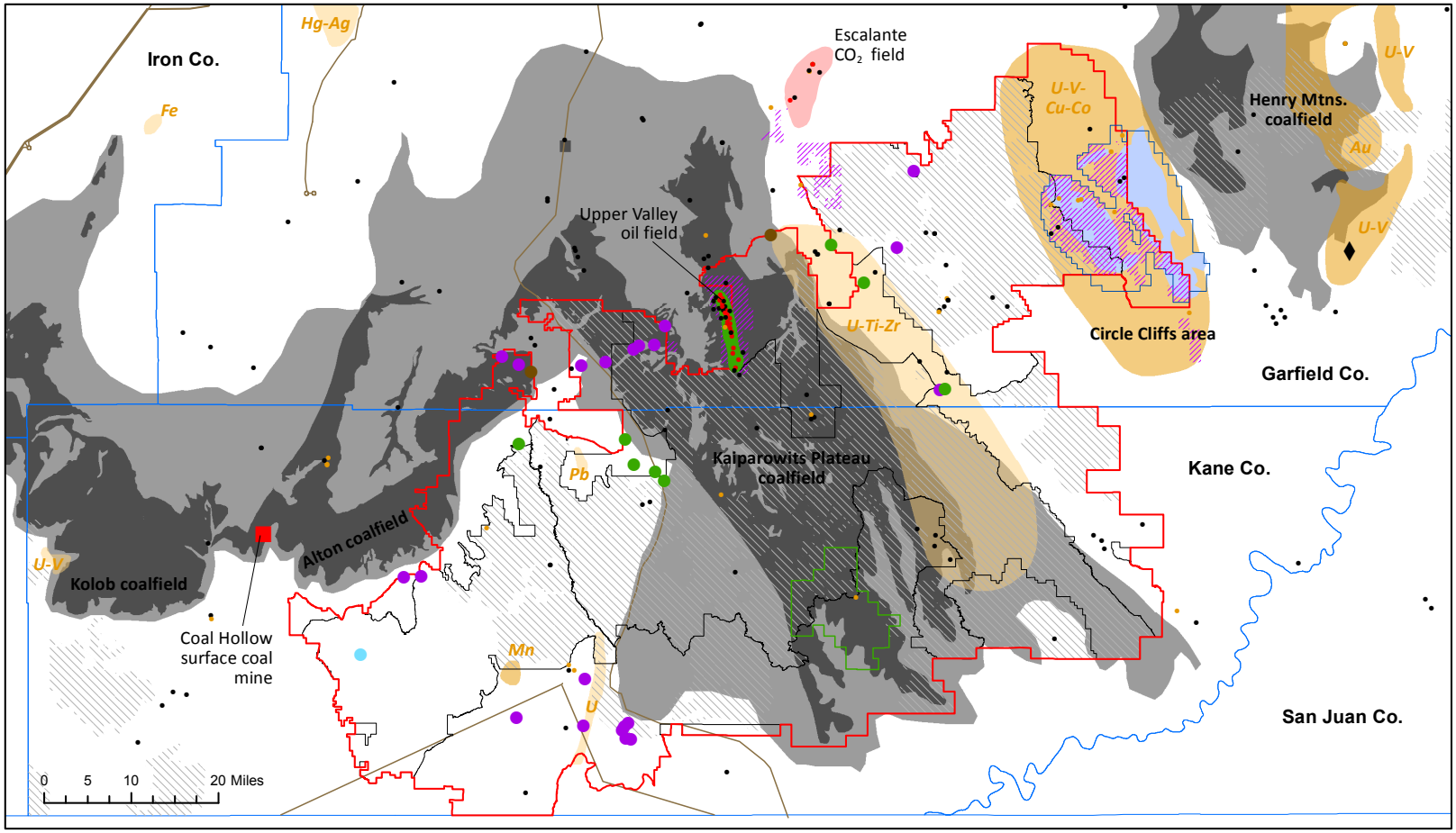
Krahulec, K., 2018, Utah mining districts: UGS Open-File Report 695, 191 p., https://doi.org/10.34191/OFR-695.

Mills, S.E., and Rupke, A., 2020, Critical minerals of Utah: UGS Circular 129, 49 p., https://doi.org/10.34191/C-129.

Vanden Berg, M.D., and others, 2018, Mineral potential report for the lands now excluded from the Grand Staircase-Escalante National Monument: report prepared by UGS for the U.S. Bureau of Land Management, 69 p., https://eplanning.blm.gov/public_projects/lup/94706/154275/188892/GSKRMP_Mineral_Potential_Report_508.pdf.

Public Information Series 103
UTAH GEOLOGICAL SURVEY
a division of
Utah Department of Natural Resources
2021

Resource Overview Map, Grand Staircase-Escalante National Monument and Vicinity

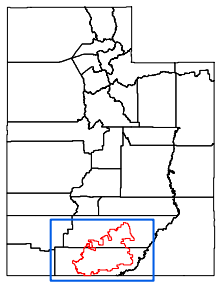


Original 1996 GSENM boundary
Revised 2018 GSENM boundary
County boundary
Transmission lines
Oil field
CO_2 field

Oil/gas well status
Producing or shut-in
Abandoned well (dry hole)
Well proposed but never drilled (location abandoned)
Gypsum quarry, prospect, or occurrence
Sand and gravel quarry or occurrence
Clay quarry, prospect, or occurrence
Silica quarry or occurrence

Coalfield
Coal seam >4 ft thick, under <3000 ft cover
Former Smokey Hollow coal mine lease area
Oil sands
Special tar sands area

Mining district with significant historical production
Mining district with minor or no historical production
Recently active uranium mine
Current federal oil/gas leases
Wilderness Study Area



Simplified resource map for Grand Staircase-Escalante National Monument and vicinity. This map was created by the Utah Geological Survey from published data. Nearly all possible commodities are represented on this map, but more specific data can be found in several topical reports (see select references). Oil and gas well data are from the Utah Division of Oil, Gas and Mining.