U.S. Department of Energy
Office of Fossil Energy and Carbon Management
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**Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Assessment of San Juan
River-Raton Coal Basin**

Summary Progress Report
Reporting Period: October 1-March 31, 2023
Project Performance Period: 10/01/2021 – 09/30/2023

Submitted by:
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1. ACCOMPLISHMENTS

The objective of this project is to determine the rare earth elements (REE) and critical minerals (CM) resource potential in coal and related stratigraphic units in the San Juan and Raton basins, New Mexico. We will conduct the following tasks: (1) a basinal assessment for CM and REE potential, using state-of-the-art technologies to estimate basin-wide CM and REE resources in coal and related stratigraphic units; (2) identify, sample, and characterize coal waste stream products; (3) conduct bench tests to develop a basinal reuse of waste strategy; (4) illustrate the current status of the feedstock supply of REE and CM to understand the basinal REE industry's capital expenditures and obstacles to expanding REE-related business development; (5) develop a life-cycle analysis to establish pathways, process engineering, and design requirements to upgrade REE processing industry, (6) evaluate technology gaps, (7) establish a Center of Excellence and Training Center (COE) for coal ash beneficiation at San Juan County; and (8) create REE research-based activities that can be shared during the NMBGMR summer geology teacher workshop and assemble REE research-related articles for an REE-centered issue of Lite. This project will delineate favorable geologic terranes and priority areas containing potential REE and CM deposits for the DOE mandate, which is also a priority of the NMBGMR and state of NM.

A. <u>Major goals and objectives</u>
The following are the major goals of this project as described in the approved Statement of Project Objectives (SOPO):
1. Identify and quantify the distribution of critical minerals (CM), including rare earth elements (REE), in coal beds and related stratigraphic units in the San Juan and Raton basins in New Mexico (including coal, coal refuse, ash, coal seam, interstitial clays/shales, volcanic ash beds, acid mine drainage, associated sludge samples, mine dumps, other nonfuel carbon-based products, process waters, etc.).
2. Identify possible sources of CM and REE in the basins.
3. Identify the coal mine and nonfuel carbon-based waste products that could contain CM and REE.
4. Characterize the CM and REE in these materials.
5. Determine the economic viability of extracting CM and REE from these materials
6. Test and develop new technologies in identifying and quantifying CM and REE in high-fidelity geologic models.

Table 1 describes the tasks and subtasks that will be undertaken to accomplish these goals and Table 2 provides a listing of the revised project milestones, along with anticipated delivery dates.

TABLE 1. List of tasks and subtasks

Task 1.0 Project Management and Planning

Task 2.0 Basinal Assessment of CM and REE in the San Juan and Raton Basins
 Subtask 2.1 Identification of Sampling Sites
 Subtask 2.2 Collection and Review of Existing Data
 Subtask 2.3 Develop a Sampling Plan
 Subtask 2.4 Collect Samples
 Subtask 2.5 Sample Characterization
      Subtask 2.5.1 Bulk Rock Characterization
      Subtask 2.5.2 Micro-scale Characterization
      Subtask 2.5.3 3D Multiscale Petrography
      Subtask 2.5.4 In situ LIBS/RAMAN Analyses
 Subtask 2.6 Application of Machine Learning techniques for basin-wide resource assessment

Task 3.0 Basinal Strategies for Reuse of Waste Streams   Subtask 3.1 Waste Streams Sampling and Characterization   Subtask 3.2 Coal Ash   Subtask 3.3 Technology Development of Basinal Reuse Strategy
Task 4.0 Basinal Strategies for Infrastructure, Industries and Businesses   Subtask 4.1 Infrastructure Investigation   Subtask 4.2 Competitiveness and Challenge   Subtask 4.3 Life-Cycle Analysis
Task 5.0 Technology Assessment, Development and Field Testing   Subtask 5.1 Identify and Assess Existing and Novel Technologies Specific to the Resource   Subtask 5.2 Develop Plan for Field Testing
Task 6.0 Technology Innovation Centers   Subtask 6.1 SonoAsh Center of Excellence
Task 7.0 Stakeholder Outreach and Education   Subtask 7.1 New Mexico State and Regional Education   Subtask 7.2 Lessons Learned and Narratives Constructed   Subtask 7.3 Publications   Subtask 7.4 Training and Conferencing with SJC and Sonoash COE

TABLE 2. Revised List of Milestones **(bold=completed)**

Task/ Subtask	Milestone Title	Planned Completion	Verification method	Status
	Quarterly reports	Quarterly	Report every quarter	**1-6th quarters completed** (see https://geoinfo.nmt.edu/staff/mclemore/REEinCoalWeb.html)

	Year I interim report	Year 1	Submitted this report	**completed**
	Meeting with DOE manager	12/7/22	attend	**Presentation given**
1.0	**A: Project Kick-off meeting**	**10/15/21**	**Attend, report**	**Completed** (see https://geoinfo.nmt.edu/staff/mclemore/documents/CORE-CMprojectNMfinal.pdf)
2.1	B: Identification of Sampling Sites	Quarterly	Reports every quarter (quarterly reports), environmental questionnaire	**Ongoing**, planned in 2 phases Phase 1 (https://geoinfo.nmt.edu/staff/mclemore/SampleLocations1_23.xlsx), environmental questionnaire completed and revision submitted
2.2	C: Collection and Review of Existing Data	2nd quarter	Map, description	**Report completed** (https://geoinfo.nmt.edu/staff/mclemore/documents/legacychemistryrpt23.pdf), ongoing activity, **REE in produced waters** (https://geoinfo.nmt.edu/staff/mclemore/ree_produced_waters_for_GIS.xlsx) and **USGS coal chemistry** (https://geoinfo.nmt.edu/staff/mclemore/REEcoal.mpk) are on the project web site; summary of data and preliminary interpretations https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreGSA22Wed10-12-22.pdf
2.3	D: **Sampling Plan** Database	10/31/2021, progress report 2nd quarter. 3/31/2022	**Sampling plan** Database, web forms, reports.	**Sampling plan is completed** (https://geoinfo.nmt.edu/staff/mclemore/documents/samplingplan_v3.pdf). Database and data entry web pages are available and being updated.
2.4	E: Collect Samples	Quarterly	Report, database	Started sampling in April 2022 (see Table 3), permit to

				collect on Navajo Tribal Lands issued April 2023
2.5	F: Characterization	Quarterly	Progress report quarterly, database	**Ongoing** once samples are collected, **samples submitted to laboratories for chemical analyses, chemical analyses received (see Attachment 3)** Chemical analyses at https://geoinfo.nmt.edu/staff/mclemore/NMTcoalChem_000.xlsx, preliminary report by Sandia https://geoinfo.nmt.edu/staff/mclemore/documents/Coal9_Petrography.pdf
2.6	G: Application of Machine Learning techniques for Basin-wide Assessment	12/31/2022	Progress report quarterly, database	Due in March 2023 (revised)
3.0	H: Sampling and Characterization of Waste Streams	Quarterly	Progress report quarterly, database	**Ongoing**, see 2.5, future activity
4.0	I: Results of Basinal Infrastructure, Industries and Business Assessment	03/31/2023	Progress report quarterly, database, publications	Future activity; 4.3 **Life cycle analysis completed (see below),** Extraction techniques report completed https://geoinfo.nmt.edu/staff/mclemore/documents/January2023ExtractionTechnique.pdf

PERFORMERS INVOLVED IN THE REE IN COAL PROJECT
New Mexico Tech
Dr. Navid Mojtabai (PI) is a professor and department chair in the Mineral Engineering Department at New Mexico Tech - Tasks 1, 3, 5, and 7.
Dr. Virginia McLemore (Co-PI) is the Principal Senior Economic Geologist for the NMBGMR - Tasks 1, 2, 3, 5 and 7.
Dr. Robert Balch (PM) is the Project manager for this project and is the Director of the PRRC – Task 1, 2, 4 and 7.
Dr. William Ampomah (Co-PI) is a Research Engineer and Section Head at PRRC – Task 1, 4, 5 and 7.
Dr. Sai Wang is a Research Associate at PRRC - Tasks 4.

Dr. William Chavez is a professor in the Mineral Engineering department at New Mexico Tech – Task 2 and 3.
Mr. Mark Leo is the NMBGMR database specialist - Task 2 and 3. NEW
Mr. Mark Mansell: is the NMBGMR GIS specialist - Task 2. NO LONGER ON PROJECT
Ms. Cynthia Connolly is the Education Outreach Manager at the NMBGMR – Task 7.
Dr. Shari Kelley is a senior field geologist and geophysicist at the NMBGMR – Task 2 and 7.
Mr. Christopher Armijo is the NMBGMR computer specialist - Task 1 and 2.
Mr. Brian Wheeler is the NMBGMR fleet manager - Tasks 2 and 3.
Ms. Gretchen Hoffman is the NMBGMR emeritus coal geologist - Task 2 and 3. NO LONGER ON PROJECT
Mr. Evan Owen is the Economic Geologist at NMBGMR- Task 2 and 3. NEW

Sandia National Laboratories(SANL)
Dr. Jason Heath is a hydrogeologist at SANL. –Task 2 and 5.
Dr. Guangpring Xu is an experimental geochemist at SANL - Tasks 2, 3 and 5.

San Juan College
Dr. John Burris is a Professor of Geology and Department Chair at San Juan College - Tasks 7.
Craig Williams San Juan College - Tasks 7. NEW

Los Alamos National Laboratory (LANL)
Dr. Hakim Boukhalfa is a Senior Scientist at LANL – Task 5
Dr. Brent Goehring NEW

SonoAsh
Mr. Claudio Arato is the CTO of SonoAsh company - Task 3, 4, 5, 6 and 7.
Mr. Brad MacKenzie is the VP of SonoAsh company – Task 4 and 6

Change in support levels of key persons
Dr. Rajesh Pawar had shifted his responsibilities on this project to Dr. Kirsten Sauer.
Craig Williams and Summer Begay are now representing San Juan College.
Evan Owen added to project at NMBGMR to assist with Tasks

BACKGROUND

The San Juan and Raton basins are predominant Laramide structural basins in northern New Mexico and southern Colorado. They host important energy and mineral resources that have produced significant amounts of coal, uranium, petroleum, and gas (Fig. 1). Cretaceous coal units in the San Juan and Raton basins are listed in Table 3. These coal and associated stratigraphic units have the potential for many critical minerals (CM), especially REE (Finkelman et al., 2018). Coal deposits throughout the world are known to contain high concentrations of CM and REE (Dai and Finkelman, 2018). A basin-wide geochemical, mineralogical, and geochemical characterization study of New Mexico coals is needed to determine the potential for CM and REE in coals in the San Juan and Raton basins.

1 San Juan-Public Service Co. of NM plant and San Juan underground mine (Westmoreland)
2 Four Corners-Arizona Public Service Co. plant and Navajo mine (Bisti Fuels Co., LLC)
3 Escalante-TriState plant
4 El Segundo mine (Lee Ranch Coal)
5 Lee Ranch mine (Lee Ranch Coal)
6 La Plata (reclamation)
7 York Canyon and Ancho mines (reclamation)
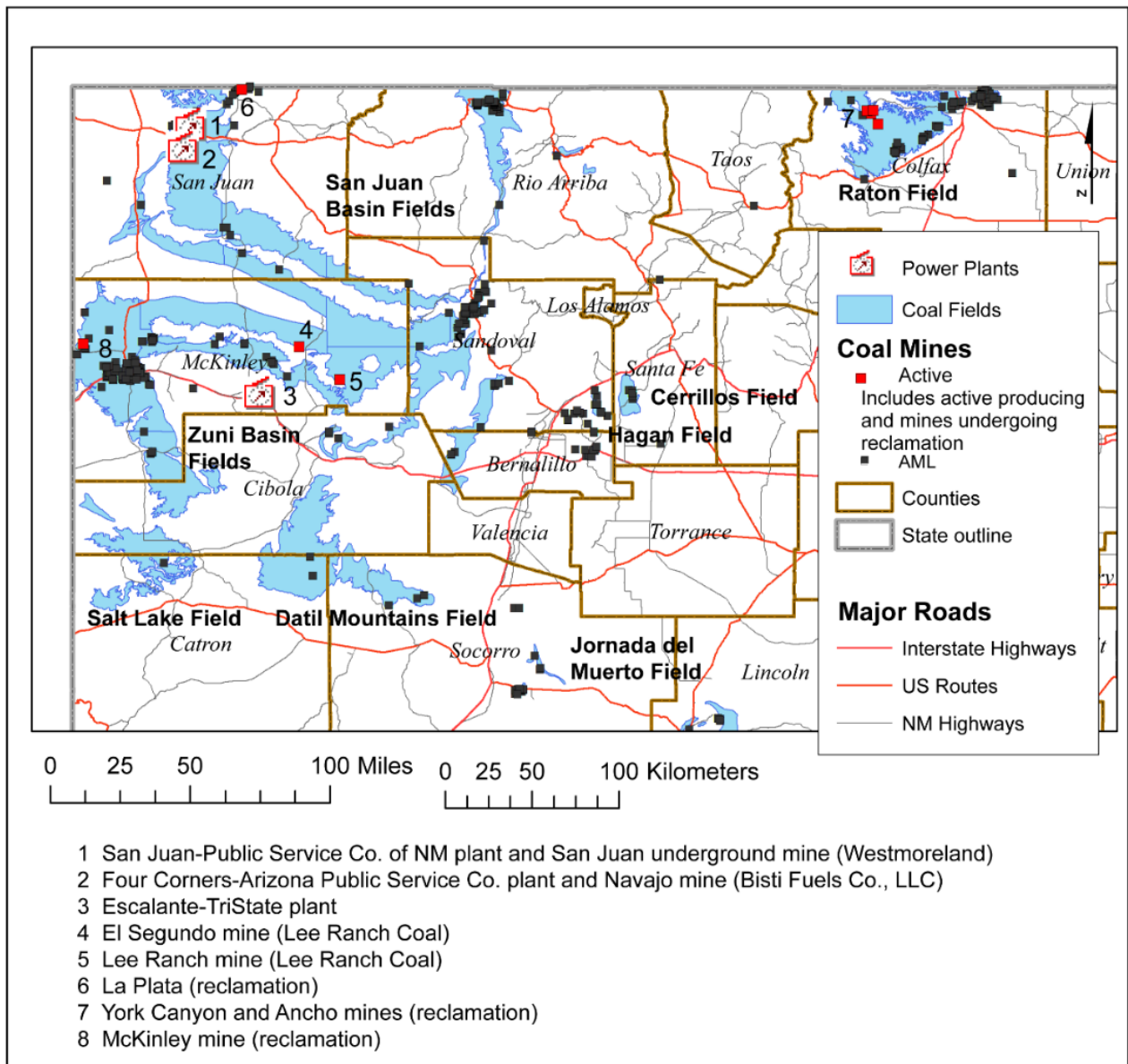8 McKinley mine (reclamation)

FIGURE 1. Location map of coal fields, active mines, AML (abandoned mine lands) sites, and power plants in the San Juan and Raton basins, New Mexico (from Hoffman, 2017). Coal mines

are surface operations except for the underground mine at the San Juan mine. Lee Ranch mine suspended operations in 2016. Coal fields are listed in Table 2. Note that the San Juan mine and generating plant closed in September 2022.

TABLE 3. Coal fields in the San Juan and Raton basins, studied in this project, delineated by Hoffman (1996, 2017). District Id is from the New Mexico Mines Database (McLemore, 2010a, 2017). Representative samples will be collected from each coal field. Each drill core sample will be identified by the hole number and depth. At least 3 samples will be collected from each coal field. Approximately 130 samples will be collected. Red=no analyses at this time

District id	District (coal field)	Year of Initial Production	Year of Last Production	Estimated Cumulative Production	Formation	Number of samples analyzed	Number of coal analyzed	Number of samples analyzed from legacy data	Number of samples to be analyzed
DIS257	Barker Creek		1905		Menefee				
DIS150	Bisti	1980	1988	40,075,148	Fruitland	6	3		11
DIS208	Carthage	1861	1963		Crevasse Canyon, Tres Hermanos				
DIS259	Chaco Canyon	1905			Menefee				
DIS260	Chacra Mesa		1945		Menefee	3	2		
DIS118	Crownpoint	1914	1951	20,758	Crevasse Canyon				4
DIS262	Datil	1917	1940	66,980	Crevasse Canyon, Tres Hermanos				
DIS155	Fruitland	1889	2001	3,137,957,050	Fruitland	1	1	63	4
DIS119	Gallup	1882	2001	121,522,629,885	Crevasse Canyon				13
DIS156	Hogback	1907	1971	301,237	Menefee				
DIS264	Jornada del Muerto		1927		Crevasse Canyon				
DIS174	La Ventana	1904	1983		Menefee	4	4		
DIS146	Monero	1882	1970	5,277,552	Menefee	7	7		
DIS016	Mount Taylor	1952	1953	69,948	Crevasse Canyon	6	5		1
DIS157	Navajo	1963	9999	4,714,689,147	Fruitland	8	8	1	
DIS258	Newcomb				Menefee				
DIS021	Raton	1898	2002	954,470,032	Vermejo, Raton	22	10	40	10
DIS003	Rio Puerco	1937	1944	139,555	Crevasse Canyon				
DIS009	Salt Lake	1987	1987	100,000	Moreno Hill	7	3	13	1
DIS121	San Mateo	1983	2001	954,470,032	Menefee	1	1	170	
DIS261	Standing Rock	1952	1958		Menefee				3
DIS158	Star Lake				Fruitland	27	17		4

District id	District (coal field)	Year of Initial Production	Year of Last Production	Estimated Cumulative Production	Formation	Number of samples analyzed	Number of coal analyzed	Number of samples analyzed from legacy data	Number of samples to be analyzed
DIS263	Tierra Amarilla	1955	1955		Menefee				
DIS159	Toadlena				Menefee				
DIS124	Zuni	1908	1926	16,010	Crevasse Canyon, Tres Hermanos			3	2
	coal ash					2		2	
	beach placer sandstone					2		103	
	uranium sandstone							22	
	Other samples					6		1	
	total samples					102	61	418	53

Impact

Not only are proposed data collection required in order to delineate favorable geologic terranes and priority areas containing potential CM and REE deposits for the DOE and USGS mandates, but identification and examination of CM and REE is a high priority of the NMBGMR. This project is important to the state of New Mexico because CM and REE resources must be identified before land exchanges, withdrawals, or other land-use decisions are made by government officials. Potential cleanup of hazardous contaminated AML sites could be funded by the production of CM and REE from coal and other mine wastes, including AML sites. Future mining of potential economic CM and REE deposits will directly benefit the economy of New Mexico. Furthermore, it is crucial to re-establish a domestic CM and REE production industry in the U.S. to help secure the nation's clean energy future, reduce the vulnerability of the U.S. to material shortages related to national defense, and to maintain our global technical and economic competitiveness. Potential CM and REE deposits in New Mexico, especially coal, could contribute to the resource base in the U.S. Most CM and REE are imported into the U.S. and have specific, critical uses in our economy. Disruptions of imports may occur because of natural disasters, labor strife, trade disputes, resource nationalism, armed conflict, and so on, which requires knowledge of CM and REE deposits in the U.S. that could provide the required raw materials. Another aspect of this project is the training of the future workforce because students at the New Mexico Institute of Mining and Technology and San Juan College will be hired to work on this project. Many of the PIs (McLemore, Mojtabai, Kelley, Chavez) have a strong history of mentoring minority (BIPOC) students, thereby contributing to diversity in the geoscience workforce. We will present information at meetings, project workshops, journal papers, and final project reports (will be a NMBGMR open file report and available to the public). A Center of Excellence is being established in the Farmington area to assist with education and stakeholder activities.

Current Status

Task 1.0 Project Management and Planning

Project management activities during this quarter included the implementation of regular procedures including regular management and biweekly working group meetings. The team also has regular meetings of the New Mexico Bureau of Geology and Mineral Resources (NMBGMR) database group to develop the project database. Meetings with the DOE coordinator have been held.

Task 2.0 Basinal Assessment of CM and REE in the San Juan and Raton Basins

<u>*Subtask 2.1 Identification of Sampling Sites*</u> (COMPLETED)

Sample sites include the coal fields and mines in the San Juan and Raton basins, shown in Figure 1. Samples from each coal field (Table 3) are being collected. Sampling began in April 2022.

2. Potential sample sites listed
    https://geoinfo.nmt.edu/staff/mclemore/SampleLocations1_23.xlsx.
3. Received permit from Navajo Tribe to sample on Tribal lands April-July 2023

<u>*Subtask 2.2 Collection and Review of Existing Data*</u> (COMPLETED)

Legacy chemistry data have been collected. See preliminary results in Geological Society of America presentation by McLemore (https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreGSA22Wed10-12-22.pdf), DOE workshop presentation (https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreDOE22Tues10-25-22.pdf), group presentation on geochemistry (11/15.22), and report (https://geoinfo.nmt.edu/staff/mclemore/documents/legacychemistryrpt23.pdf).

<u>*Subtask 2.3 Develop a Sampling Plan*</u> (COMPLETED)

The field sampling plan is completed and revised (https://geoinfo.nmt.edu/staff/mclemore/documents/samplingplan_v5.pdf). Figure 1 shows the coal fields and mines in the area. Table 3 is a list of the coal fields.

The Environmental Questionnaire (EQ) was submitted with the proposal and approved. A revised EQ was submitted to DOE upon their request in January 2023 and approved. A permit request has been submitted to the Navajo Tribe with sampling on Tribal lands to start April 1, 2023.

Health and safety plan (COMPLETED)

HASP is complete (https://geoinfo.nmt.edu/staff/mclemore/documents/HASP_10.pdf). NMT requires all projects to have a **Safe and Inclusive Working Environment Plan for Off-Campus or Off-Site Research**, which has been added to the HASP.

<u>*Subtask 2.4 Collect Samples*</u>

Sampling was delayed due to poor weather, vacation schedules, closures of Federal land because of fire danger, and students not available because of school schedule. We started sampling in April. Additional delays were encountered in selecting laboratories and getting purchase orders in place for chemical analyses. Therefore, the project is approximately 6-8 months behind schedule.

We have logged 3162 ft of core (33 holes). Some of the drill holes have had all of the coal removed, whereas other holes contain only cuttings and no core. Photographs of drill core are at https://photoarchive.nmt.edu/ (you need to search by "coal" and sample or drill hole number)

We have collected 155 samples and have been submitted for geochemistry (Table 3; Attachment 3, https://geoinfo.nmt.edu/staff/mclemore/NMTcoalChem_000.xlsx).
Additional samples will be collected.

Subtask 2.5 Sample Characterization
Attended the DOE CORE-CM Characterization Working Group - Planning Meetings on April 11, 19, May 9, June 13, 2022 and October 24, 2022. Chemical analyses have been delayed due to obtaining quotes and proper paperwork required by NM Tech (completed August 2022). Samples have been analyzed for major and trace elements (see Attachment 3, https://geoinfo.nmt.edu/staff/mclemore/NMTcoalChem_000.xlsx)

Subtask 2.6 Application of Machine Learning techniques for basin-wide resource assessment
There is no update on this subtask. Report pending in next week or so.

Task 3.0 Basinal Strategies for Reuse of Waste Streams
Subtask 3.1 Waste Streams Sampling and Characterization
There is no update on this subtask.

Subtask 3.2 Coal Ash
We have collected 2 coal ash samples from San Juan Generating Plant prior to closure.

Subtask 3.3 Technology Development of Basinal Reuse Strategy
There is no update on this subtask.

Task 4.0 Basinal Strategies for Infrastructure, Industries and Businesses
Subtask 4.1 Infrastructure Investigation
There is no update on this subtask.

Subtask 4.2 Competitiveness and Challenge
There is no update on this subtask.

Subtask 4.3 Life-Cycle Analysis (UPDATED AND COMPLETED)
Report in 4th Quarterly report.

Task 5.0 Technology Assessment, Development and Field Testing
Subtask 5.1 Identify and Assess Existing and Novel Technologies Specific to the Resource
There is no update on this subtask.

Subtask 5.2 Develop Plan for Field Testing
There is no update on this subtask.

Task 6.0 Technology Innovation Centers
Subtask 6.1 SonoAsh Center of Excellence
Memo written describing meetings with parties to establish COE.

Task 7.0 Stakeholder Outreach and Education
Subtask 7.1 New Mexico State and Regional Education
A short summary of the project was written for Gold Pan
(https://nmt.edu/advancement/goldpan_archives/2022_Summer_GoldPan_Digital2.pdf),
NMIMT Alumni Newsletter. Another short summary of the project written for Lite Geology
(pending).
The NMBGMR Rockin' Around New Mexico was in Farmington, NM July 6-8, 2022
(https://geoinfo.nmt.edu/education/rockin/home.html). Lectures on critical minerals and a tour of
the Navajo coal mine were included (https://geoinfo.nmt.edu/staff/mclemore/home.html) .
Attended CORE-CM Environmental Justice and Social Responsibility Working Group
meeting July 12, 2022. Presented short radio spot on critical minerals during Earth Science
Week (https://geoinfo.nmt.edu/events/esweek/2022/scripts/ESW_2022_McLemore.pdf).
We plan to participate in the NM Teachers Conference in Farmington in Oct 2023 as well as
Rockin' Around NM in July 2023.

Subtask 7.2 Lessons Learned and Narratives Constructed
There is no update on this subtask.

Subtask 7.3 Publications and presentations
See Section 2 below

Subtask 7.4 Training and Conferencing with SJC and Sonoash COE
SJC and Sonoash have attended biweekly meetings and plans for the COE are underway.

A. Publications, conference papers, and presentations
1st quarter
Kickoff presentation October 15, 2021
(https://geoinfo.nmt.edu/staff/mclemore/documents/CORE-CMprojectNMfinal.pdf)
DOE Division of Critical Minerals Program Plan Rollout on December 8, 2021
(https://geoinfo.nmt.edu/staff/mclemore/documents/CORE-
CMprojectNMDOEsummary12_21.pdf)

2nd quarter
New Mexico Geological Society abstract: Badonie, M.N. and McLemore, V.T., 2022, REE in
coalbeds in the San Juan-Raton coal basins (abstr.): New Mexico Geological Society,
Spring Meeting, https://nmgs.nmt.edu/meeting/abstracts/view.cfm?aid=2838. Poster at
https://geoinfo.nmt.edu/staff/mclemore/documents/NMSG.Poster2022COPY2.pdf.

3rd quarter
Rockin' 22 Critical Minerals presentation
(https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreRockinCM22.pdf)

Rockin' 22 Critical Minerals activities
(https://geoinfo.nmt.edu/staff/mclemore/documents/Rockin22.pdf)

4th quarter

New Mexico Mining Association abstract and presentation: REE in the coal and associated strata in the San Juan and Raton Basins, New Mexico, 2022, Megan Badonie, Jakob Newcomer, Devlon Shaver Advised by: Dr. Virginia T. McLemore, https://geoinfo.nmt.edu/staff/mclemore/documents/NMAAPresentationNMMAFINAL2022.pdf

McLemore, V.T., 2022, Rare Earth Elements (REE) in Late Cretaceous coal and beach-placer sandstone deposits in the San Juan Basin, New Mexico: Preliminary Observations (abstr.): Geological Society of America, Annual Conference, October, https://gsa.confex.com/gsa/2022AM/meetingapp.cgi/Paper/378264, presentation https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreGSA22Wed10-12-22.pdf

5th quarter

McLemore, V.T., 2022, Rare earth elements (REE) in Late Cretaceous coal and beach-placer sandstone deposits in the San Juan Basin, New Mexico: Preliminary results: presentation at the DOE National Energy Technology Laboratory Resource Sustainability Project Review Meeting, Oct. 25-27, 2022

6th quarter

Badonie, M., Newcomer, J., Shaver, S., and McLemore, V.T., 2023, REE in coal and associated strata in the San Juan and Raton Basins, New Mexico: Minexchange, 2023 SME Annual Conference Technical Program, preprint 23-055, 5 p., https://geoinfo.nmt.edu/staff/mclemore/documents/23-055.pdf

B. Website(s) or other Internet site(s)
See project web page at https://geoinfo.nmt.edu/staff/mclemore/REEinCoalWeb.html

C. Technologies or techniques
No update

D. Inventions, patent applications, and/or licenses
No update

E. Other products
Sampling plan (https://geoinfo.nmt.edu/staff/mclemore/documents/samplingplan_v3.pdf)
Health and safety plan (https://geoinfo.nmt.edu/staff/mclemore/documents/HASP_v2.pdf)
SOP17 Drillhole logging
(https://geoinfo.nmt.edu/staff/mclemore/documents/SOP17DrillholeLoggingupdated.pdf)
Revised sampling plan
(https://geoinfo.nmt.edu/staff/mclemore/documents/samplingplan_v5.pdf)

REE in produced waters
(https://geoinfo.nmt.edu/staff/mclemore/ree_produced_waters_for_GIS.xlsx) and USGS
coal chemistry (https://geoinfo.nmt.edu/staff/mclemore/REEcoal.mpk)
Kickoff presentation October 15, 2021
(https://geoinfo.nmt.edu/staff/mclemore/documents/CORE-CMprojectNMfinal.pdf)
DOE Division of Critical Minerals Program Plan Rollout on December 8, 2021
(https://geoinfo.nmt.edu/staff/mclemore/documents/CORE-
CMprojectNMDOEsummary12_21.pdf)
New Mexico Geological Society abstract: Badonie, M.N. and McLemore, V.T., 2022, REE in
coalbeds in the San Juan-Raton coal basins (abstr.): New Mexico Geological Society,
Spring Meeting, https://nmgs.nmt.edu/meeting/abstracts/view.cfm?aid=2838. Poster at
https://geoinfo.nmt.edu/staff/mclemore/documents/NMSG.Poster2022COPY2.pdf.
Papers and posters planned for SME annual conference in February.

Project Start October 2021
Project End October 2023 (We have requested an extension)

Budget information

Spend Plan by Fiscal Year Format						
	FY 2022		FY 2023		Total	
	DOE funds	Cost Share	DOE funds	Cost Share	DOE	Cost Share
NMIMT	564,432	101,114	544,856	104,147	1,109,287	205,261
Los Alamos National Laboratory	93,750	-	93,750	-	187,500	-
Sandia National Laboratories	99,946	-	87,054	-	187,000	-
SonoAsh LLC	-	115,000	-	115,000	-	230,000
Total ($)	758,128	216,114	725,660	219,147	1,483,787	435,261
Total Cost Share %		22.2%		23.2%		22.7%

Contact Information
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References
Finkelman, R.B., Dai, S., and French, 2019, The importance of minerals in coal as the hosts of
chemical elements: A review: International Journal of Coal Geology, v. 212, 17 p.
McLemore, V.T., 2010, Distribution, Origin, and Mineral Resource Potential of Late Cretaceous
Heavy Mineral, Beach-Placer Sandstone Deposits, San Juan Basin, New Mexico: New
Mexico Geological Society Guidebook 61, p. 197-212.
McLemore, V.T., 2017a, Mining districts and prospect areas of New Mexico: New Mexico
Bureau of Geology and Mineral Resources, Resource Map 24, 65 p., scale 1:1,000,000.

Hoffman, G. K., 1996, Coal resources of New Mexico, New Mexico Bureau of Mines and Mineral Resources, Resource Map, v. 20, 22 p., 1 sheet, scale 1:1,000,000.

Hoffman, G.K., 2016, Coal, *in* McLemore, V.T., Timmons, S., and Wilks, M., eds., Energy and mineral resources of New Mexico: New Mexico Bureau of Geology and Mineral Resources Memoir 50B, and New Mexico Geological Society Special Publication 13B, 80 p.