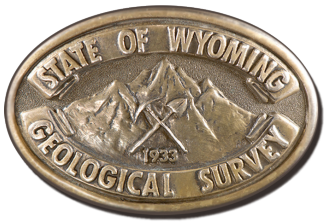

Interpreting the past, providing for the future

Data Release of Reprocessed Select National Uranium Resources Evaluation Program Samples in Wyoming

David W. Lucke, Steven M. Smith, Jaime S. Azain, and Andrew D. Ingraham

Open File Report 2020-7
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Wyoming State Geological Survey

Erin A. Campbell, Director and State Geologist

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Layout by Christina D. George

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This Wyoming State Geological Survey (WSGS) Open File Report is preliminary and may require additional compilation and analysis. Additional data and review may be provided in subsequent years. For more information about the WSGS, or to download a copy of this Open File Report, visit www.wsgs.wyo.gov. The WSGS welcomes any comments and suggestions on this research. Please contact the WSGS at 307-766-2286, or email wsgs-info@wyo.gov.

Lucke, D.W., Smith, S.M., Azain, J.S., and Ingraham, A.D., 2020, Data release of reprocessed select National Uranium Resources Evaluation program samples in Wyoming: Wyoming State Geological Survey Open File Report 2020-7, 9 p.

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INTRODUCTION

The U.S. Atomic Energy Commission established the National Uranium Resources Evaluation (NURE) program in 1973 to identify uranium resources throughout the United States. Part of this program focused on the collection of stream-sediment samples and subsequent geochemical analyses of these samples for uranium, in addition to 47 other elements. As part of the original program, 18,424 stream-sediment samples were collected from Wyoming and analyzed. All original samples are stored at the U.S. Geological Survey's (USGS) National Geochemical Sample Archive (NGSA). The Wyoming State Geological Survey (WSGS) recently selected 159 of the original Wyoming NURE stream samples to be reanalyzed using modern and standardized analytical equipment. The raw results of the reanalysis are provided with this report (see accompany Excel spreadsheet files MRP-18288_18289.xlsx, MRP-18290_18291.xlsx, and WSGS_2020NURE_DataRelease.xlsx).

SAMPLE SELECTION

Two NURE-based datasets were used for this project: 1) original NURE data (U.S. Geological Survey, 2014) and 2) data imputed (or calculated) by a WSGS computer model (Pisel and Samra, 2019). The WSGS model was necessary to fill in missing elements by statistically deriving possible values from an otherwise incomplete original dataset. Stream-sediment samples were selected from both the original and imputed NURE datasets with a focus on critical and economic elements.

The 159 samples were selected for anomalous values using the following criteria. 1) For each sample, the concentration of every critical and economic mineral was compared to five times the crustal abundance of that element (Taylor and McLennan, 1995). If the sample contained greater than five times the crustal abundance of an element, a count was added to that sample. After comparing all samples for all elements, the counts for each sample were totaled. Samples with higher total counts were considered anomalous, warranting reanalysis. 2) The selected samples were further constrained by removing samples that were inside wilderness areas, wilderness study areas, national parks, state parks, and within cities and towns. These areas were excluded because they are unlikely to ever see any critical and strategic mineral development. 3) The last constraint on sample selection included the amount of sample in the USGS's NGSA. If there was less than 1 to 2 grams of material available for a sample, that sample was excluded to preserve the original sample material. An additional 26 samples were selected as backup in the event the original selection was missing, exhausted, or otherwise unavailable. Of the 26 backup samples, seven were needed because six selected samples could not be found in the USGS sample archives and one sample determined to have insufficient material. Sample locations are shown in figure 1 of this report.

SAMPLE REPROCESSING

The reprocessing of 159 NURE stream-sediment samples archived with the USGS took place at the request of the WSGS under direction from the Wyoming Legislature. Many of the elements that were evaluated are deemed critical by the U.S. Department of the Interior, and many are known to occur in Wyoming, including uranium, vanadium, titanium, platinum group elements, and rare earth elements.

The selected samples were prepared at AGAT Laboratories, in Mississauga, Ontario. The samples were fused at 750°C with sodium peroxide, and the resulting fusion cake was then dissolved in diluted nitric acid. The solution was analyzed by inductively coupled plasma optical emission spectroscopy mass spectroscopy (ICP-OES-MS) for a suite of 60 elements which are listed in Table 1. Quality assurance and quality control was completed by the USGS by inserting four standard reference material samples and one duplicate sample per 50 samples. For the 159 selected samples, there were 16 quality assurance and quality control reference materials.

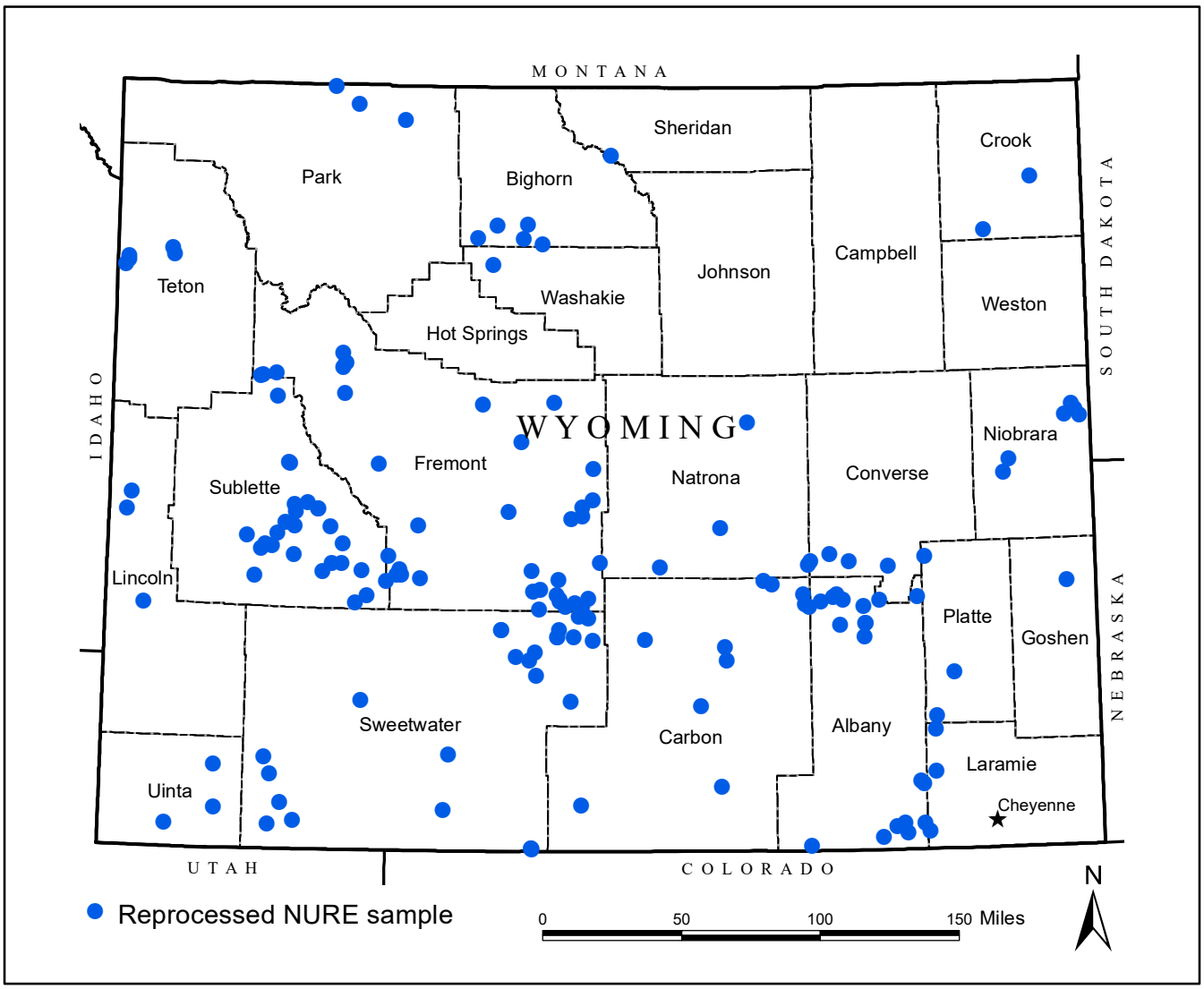

Figure 1. Map of Wyoming showing locations of 159 NURE samples that were reprocessed.

The new results, as received, are presented along with this report in the accompanying supplemental data as Excel spreadsheet files MRP-18288_18289.xlsx and MRP-18290_18291.xlsx. The analytical data were combined with information from the original NURE database (U.S. Geological Survey, 2004) to create a single Excel spreadsheet file (WSGS_2020NURE_DataRelease.xlsx). The contents of this combined file are described in NURE_Reanalysis_DataDictionary.xlsx. Future geologic investigations of regions with high elemental concentrations, both by the WSGS as well as private industry, will hinge on this publicly available dataset.

SUMMARY

As requested by the Wyoming Legislature, the WSGS identified archived NURE stream-sediment samples with above-background concentrations of critical and economic elements. In cooperation with the USGS, 159 of the original NURE stream-sediment samples were reanalyzed using modern geochemical analytical techniques performed by AGAT Laboratories. Resultant data are available with this report and available through the WSGS's website at www.wsgs.wyo.gov. Results provide baseline geochemical data for future studies and exploration of mineral systems and deposits across Wyoming.

Table 1. Elements analyzed in NURE samples. Elements highlighted in yellow were evaluated in legacy data sets but are not included in the reanalysis 60-element suite.

Element Symbol	Element	Lower Detection Limit Concentration Legacy Data (ppm)	Maximum Detected Concentration Legacy Data (ppm)	Lower Detection Limit Concentration (ppm)	Upper Detection Limit Concentration (ppm)
Ag	Silver	2 to 5	194	1	1,000
Al	Aluminium	2,700	134,300	100	250,000
As	Arsenic	0.1 to 5	10,713	5	100,000
Au	Gold	0.01 to 0.72	7		
B	Boron	10	150	10	10,000
Ba	Barium	47 to 1,180	11,740	0.5	10,000
Be	Beryllium	1	53	5	2,500
Bi	Bismuth	5	25	0.1	1,000
Ca	Calcium	1.3	387,100	100	350,000
Cd	Cadmium	0.01 to 5	23	0.2	10,000
Ce	Cerium	3 to 22	6,579	0.1	10,000
Cl	Chlorine	13 to 691	33,550		
Co	Cobalt	0.1 to 4.5	84	0.5	10,000
Cr	Chromium	3 to 88	3,217	10	100,000
Cs	Cesium	0.3 to 7.4	406	0.1	10,000
Cu	Copper	10	14,452	5	50,000
Dy	Dyprosium	1 to 6	167	0.05	1,000
Er	Erbium			0.05	1,000
Eu	Europium	0.1 to 1.2	8	0.05	1,000
Fe	Iron	490 to 1,800	507,504	100	300,000
Ga	Gallium			0.01	1,000
Gd	Gadolinium			0.05	1,000
Ge	Germanium			1	1,000
Hf	Hafnium	0.4 to 15	425	1	10,000
Ho	Holmium			0.05	1,000
In	Indium			0.2	1,000
K	Potassium	500 to 28,030	56,090	100	250,000
La	Lanthanum	2 to 159	4,317	0.1	10,000
Li	Lithium	1	263	10	50,000
Lu	Lutetium	0.1 to 0.6	8	0.05	1,000
Mg	Magnesium	721 to 27,160	189,800	100	300,000
Mn	Manganese	9	21,333	10	100,000
Mo	Molybdenum	4	64	2	10,000
Na	Sodium	0.05	152,300		
Nb	Niobium	4 to 20	1,413	1	10,000
Nd	Neodymium			0.1	10,000

Element Symbol	Element	Lower Detection Limit Concentration Legacy Data (ppm)	Maximum Detected Concentration Legacy Data (ppm)	Lower Detection Limit Concentration (ppm)	Upper Detection Limit Concentration (ppm)
Ni	Nickel	2 to 159	8,144	5	10,000
P	Phosphorus	5	9,943	100	250,000
Pb	Lead	5 to 10	1,949	5	50,000
Pr	Praseodymium			0.05	1,000
Rb	Rubidium	6 to 972	198	0.2	10,000
S	Sulfur			1,000	400,000
Sb	Antimony	1 to 36	92	0.1	10,000
Sc	Scandium	0.1 to 1	58	5	50,000
Se	Selenium	0.1 to 5	13	5	1,000
Si	Silicon			100	400,000
Sm	Samarium	0.2 to 9.9	398	0.1	1,000
Sn	Tin	0.3 to 10	569	1	10,000
Sr	Strontium	41 to 892	4,072	0.1	10,000
Ta	Tantalum	1 to 6	10	0.5	10,000
Tb	Terbium	1 to 36	22	0.05	1,000
Te	Tellurium			0.5	1,000
Th	Thorium	0.2 to 11.8	1,000	0.1	1,000*
Ti	Titanium	142 to 6,472	51,476	100	250,000
Tl	Thallium			0.5	1,000
Tm	Thulium			0.05	1,000
U	Uranium	0.25	249	0.05	1,000
V	Vanadium	5 to 59	4,102	5	10,000
W	Tungsten	15	343	1	10,000
Y	Yttrium	1	868	0.5	10,000
Yb	Ytterbium	0.5 to 9.5	69	0.1	1,000
Zn	Zinc	1 to 205	3,083	5	50,000
Zr	Zirconium	2	2,514	0.5	10,000

*Samples with concentrations above the upper detection limit were diluted and reanalyzed to provide a quantitative number.

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