Haoma Mining NL

June 15, 2021

Haoma Mining Shareholder Update

To all shareholders,

This shareholder report updates Haoma's:

- **2020 Annual Report:** **https://haoma.com.au/wp-content/uploads/2021/03/Haoma-Mining-NL-Annual-Report-June-30-2020.pdf**
- **Chairman's Address** shareholders on Monday March 29, 2021**:** **https://haoma.com.au/wp-content/uploads/2021/03/Haoma-Chairmans-Address-to-2020-AGM-by-Gary-Morgan-March-29-2021.pdf**

It includes updated information on Haoma's **Rare Earths and Other Elements including Strategic Minerals** measured in **Spear Hill Tailing Sands**, see Figures 1-6 below.

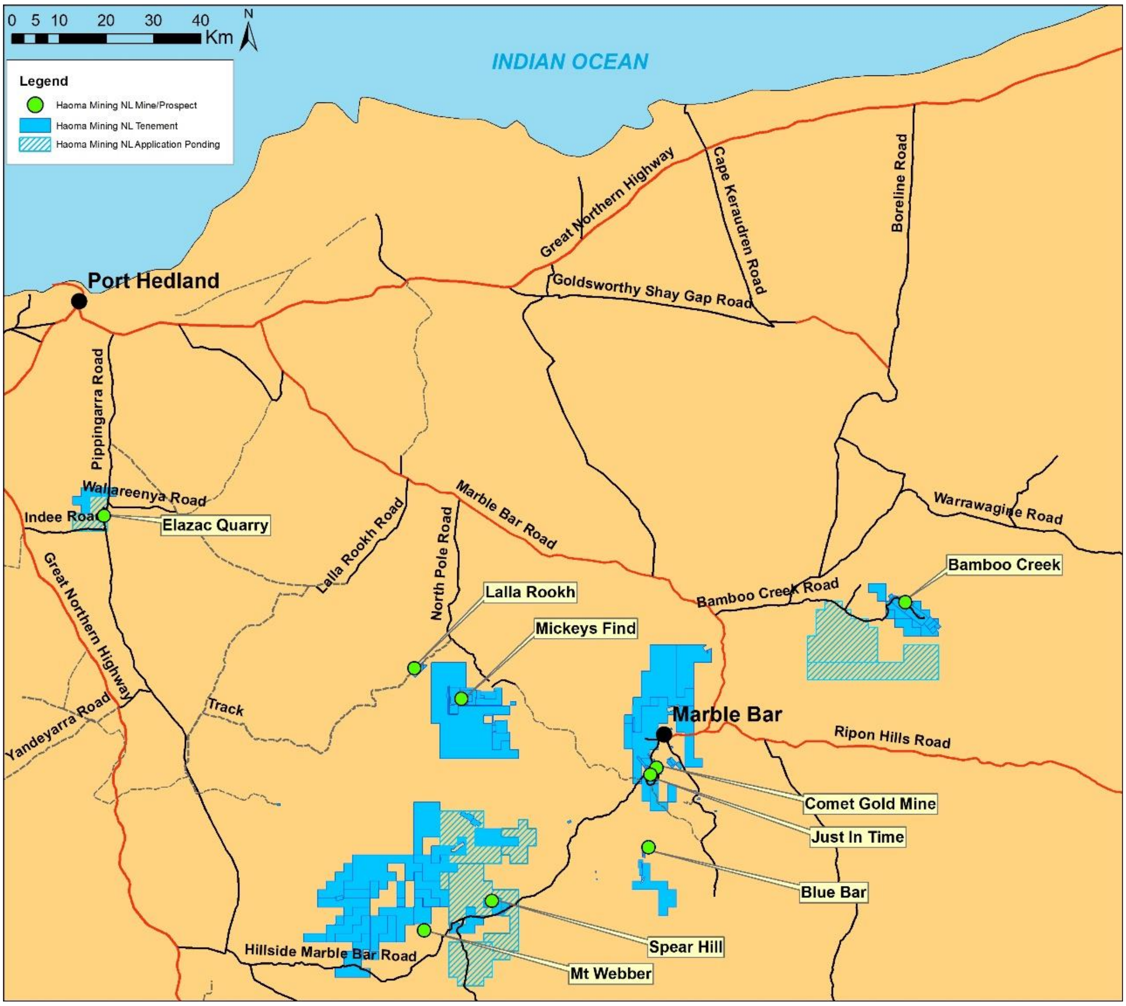

Figure 1: Location map of Haoma Mining Pilbara mining tenements.

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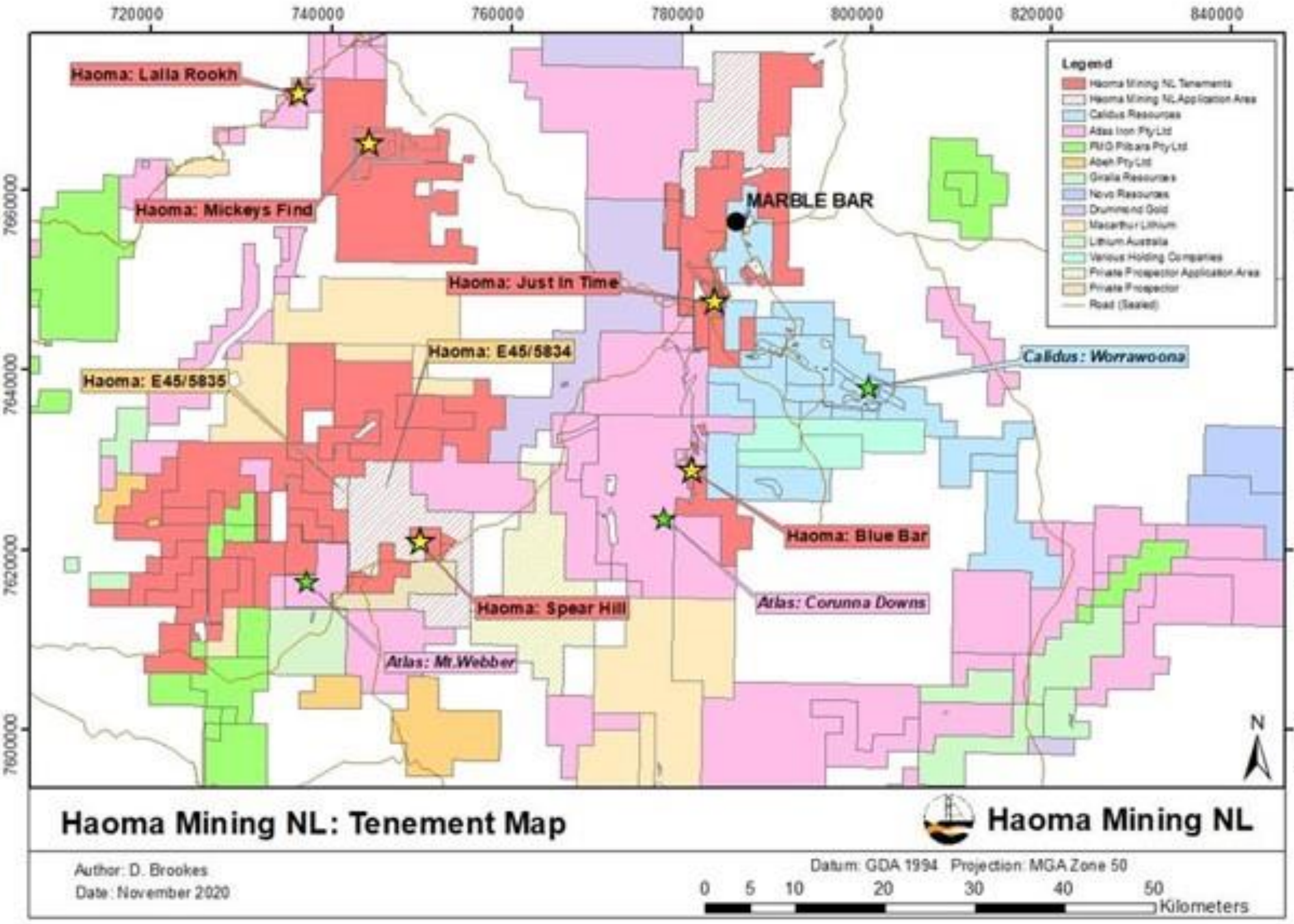
Extraction of Rare Earths and Other elements from Spear Hill Tailing Sands

In **Haoma's 2020 Annual Report** s**hareholders were advised Rare Earths** and **Other Elements** assay results from **Spear Hill Tailing Sands** samples, conducted by ALS (Australian Laboratory Services), See Table 1 below. (Also reported were XRF readings of the samples conducted at Haoma's Laboratory at Bamboo Creek.)

Samples from **Spear Hill Tailing Tailing Sands** (See Figures 4 to 6 below) were obtained by drilling approximately 12 meter holes to base rock. There are approximately **2 million tonnes of Spear Hill Tailing Sands** which were deposited in the 1970s by **Endeavour Resources Ltd** after recovering tin and tantalum.



<u>Figure 2:</u> Haoma's Marble Bar-Normay-Mt Webber-Spear Hill tenement groups showing E45/5834 (under application) and E45/5835 (under application).

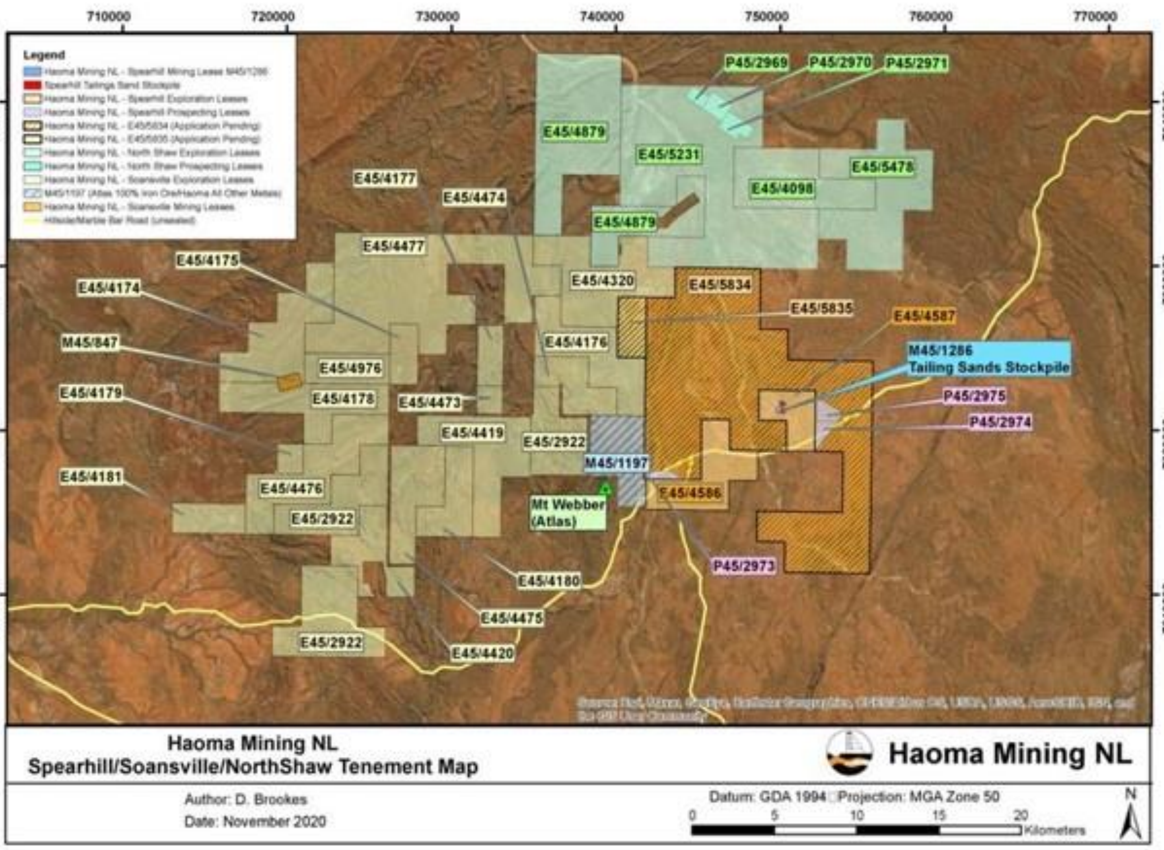


Figure 3: Haoma's Spear Hill Tenement Group C145/2016 comprising M45/1286 (under application), E45/4586, E45/4587, E45/5834 (under application) and E45/5835 (under application), adjoining Mt Webber M45/4586.

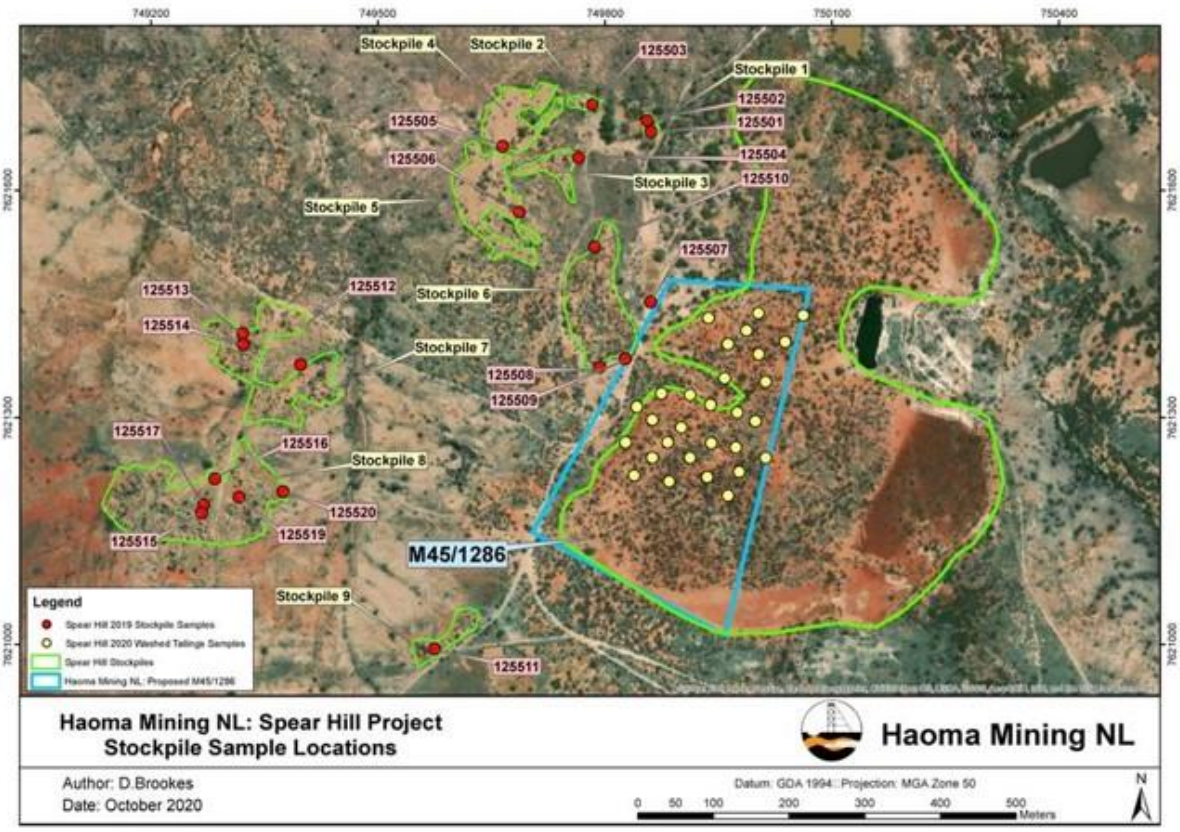
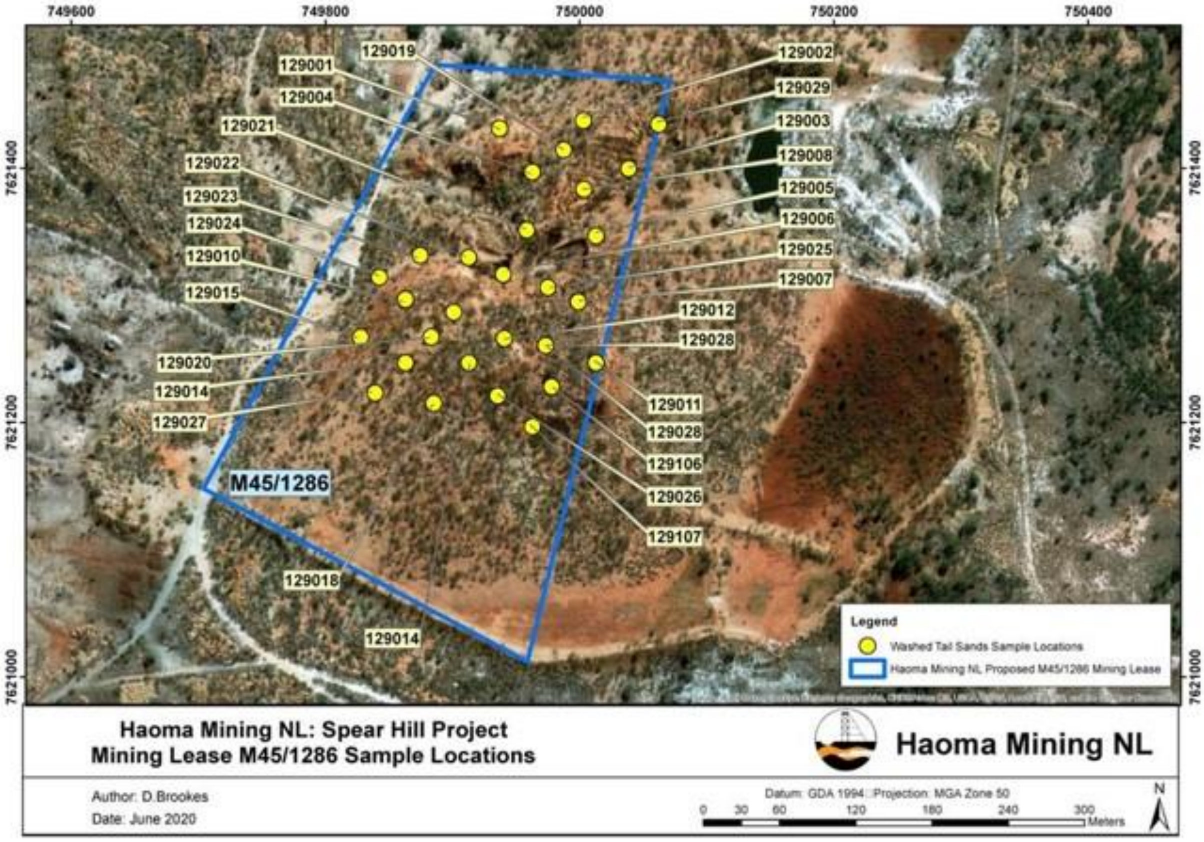
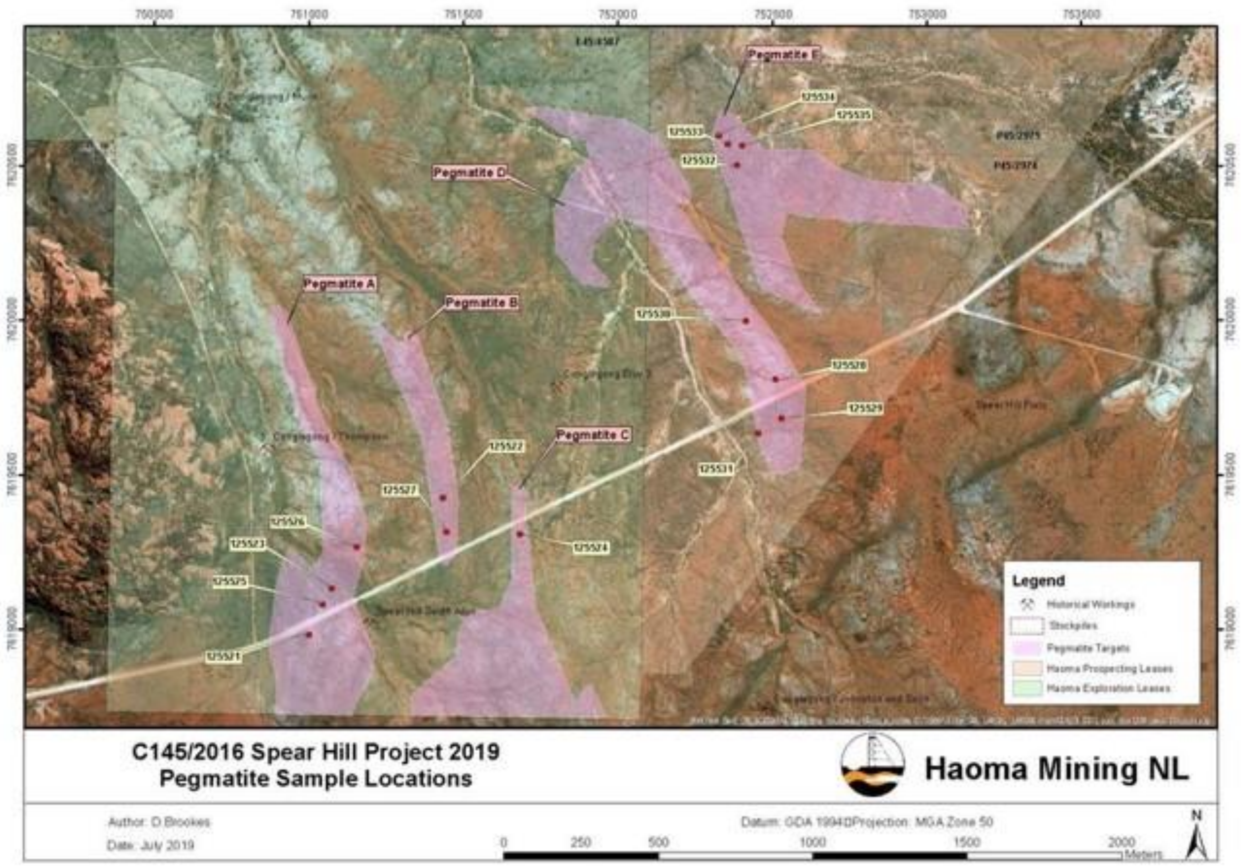


Figure 4: Spear Hill Stockpiles A&B sample locations (July 2019) with Spear Hill M45/1286 (under application) Tailing Sands sample locations (October 2020) shown inside blue mining lease boundary.



<u>Figure 5</u>: Spear Hill M45/1286 (under application) Tailing Sands sample locations (May 2020).



<u>Figure 6:</u> Spear Hill Pegmatite sample locations (July 2019).

Mineralogical and Metallurgical assessment of Spear Hill Tailing Sands Rare Earths and Other Elements

Consultants MinAssist Pty Ltd with Prof Peter Scales (University Melbourne) has now completed mineralogical and metallurgical assessment of **Rare Earths** and **Other Elements** contained in **Spear Hill Tailings Sands** - See Table 1 below.

Table 1: Elements in 50kg Spear Hill sample

Sample Elements	Unit	Feed mass 4,973g
SiO_2	wt %	75.50
Al_2O_3	wt %	12.35
Fe_2O_3	wt %	2.01
CaO	wt %	1.26
MgO	wt %	0.34
Na_2O	wt %	2.94
K_2O	wt %	3.45
S	wt %	0.01

In addition valuable Rare Earths and Other Elements were measured – Rubidium (Rb) 221ppm, Cesium (Cs) 5.68ppm, Lutetium (Lu) 0.95ppm. See Table 2 and Appendix 1 below.

Table 2: Rare Earths and Other Elements in 50kg sample of Spear Hill Tailing Sands.

Sample Rare Earth and Other Elements		Grades (ppm)
Cerium	Ce	39.10
Dysprosium	Dy	2.99
Erbium	Er	3.24
Europium	Eu	0.48
Gadolinium	Gd	1.71
Holmium	Ho	0.78
Lanthanum	La	11.90
Lutetium	Lu	0.95
Praseodymium	Pr	2.57
Neodymium	Nd	9.60
Samarium	Sm	1.95
Scandium	Sc	3.00
Terbium	Tb	0.40
Thulium	Tm	0.66
Ytterbium	Yb	5.48
Yttrium	Y	27.40
Cesium	Cs	5.68
Rubidium	Rb	221
Thorium	Th	8.69
Uranium	U	2.07

Test work involving a program of **physical separation** was initiated to investigate potential to liberate Rb, Cs, Lu and other elements from host minerals in a: 1) **Concentrate fraction**, and 2) **Tailings fraction**. (See Table 3 below)

Table 3: Rare Earths and Other Elements in 1) Concentrate fraction, and 2) Tailings fraction

Rare Earths and Other Elements in fractions	Concentrate fraction	Tailings fraction
Sample Mass	6.1%	93.1%
Fe	11.73%	
Rb	148 ppm	248 ppm
Cs	7.62 ppm	6.19 ppm
Lu	12.45 ppm	0.36 ppm
Y	297 ppm	15.2 ppm
Tb	3.32 ppm	0.27 ppm
Er	35.8 ppm	1.52 ppm
Yb	72.5 ppm	2.2 ppm
Dy	29.5 ppm	1.86 ppm

A series of extraction tests under increasingly aggressive conditions was undertaken. The solubility of target elements in acid solution (aqua regia) was also investigated for each test.

In total **83% of the Rubidium** and **81% of the Cesium** was recoverable. Washing of the treated sample recovered 68% of the Rubidium and 40% of the Cesium, with an additional 15% of the Rubidium and 41% of the Cesium recovered by acid into a 'solution' using traditional extraction procedures.

The elements can be recovered by a traditional method using resins.

Also produced was a **Concentrate fraction** which contained **upgraded Rare Earths such as Lutetium and Yttrium** which are of considerable value.

As previously advised in Haoma's Shareholder Update of November 26, 2020 the data shows that the Spear Hill resource represents a low radiation hazard.

Application for New Tenements near Bamboo Creek and Coppins Gap (E45/5938 and E45/5944)

Haoma has recently renewed its exploration focus on **Rare Earths and Other Elements including Strategic Minerals**. A regional study and literature review highlighted **Granites within the Pilbara Craton** as an excellent exploration target. Previous **Sayona Lithium** assays in E45/5938 indicated significant high readings of **Rare Earths and Other Elements including Strategic Minerals,** such as Rubidium, Cesium and Lutetium.

In addition, the tenement areas **E45/5938 and E45/5944** contain several older tin mineral claims as part of the 1970's **Endeavour Resources Ltd** Mooryella tin mining operation confirming mineralisation exists within the exploration area.

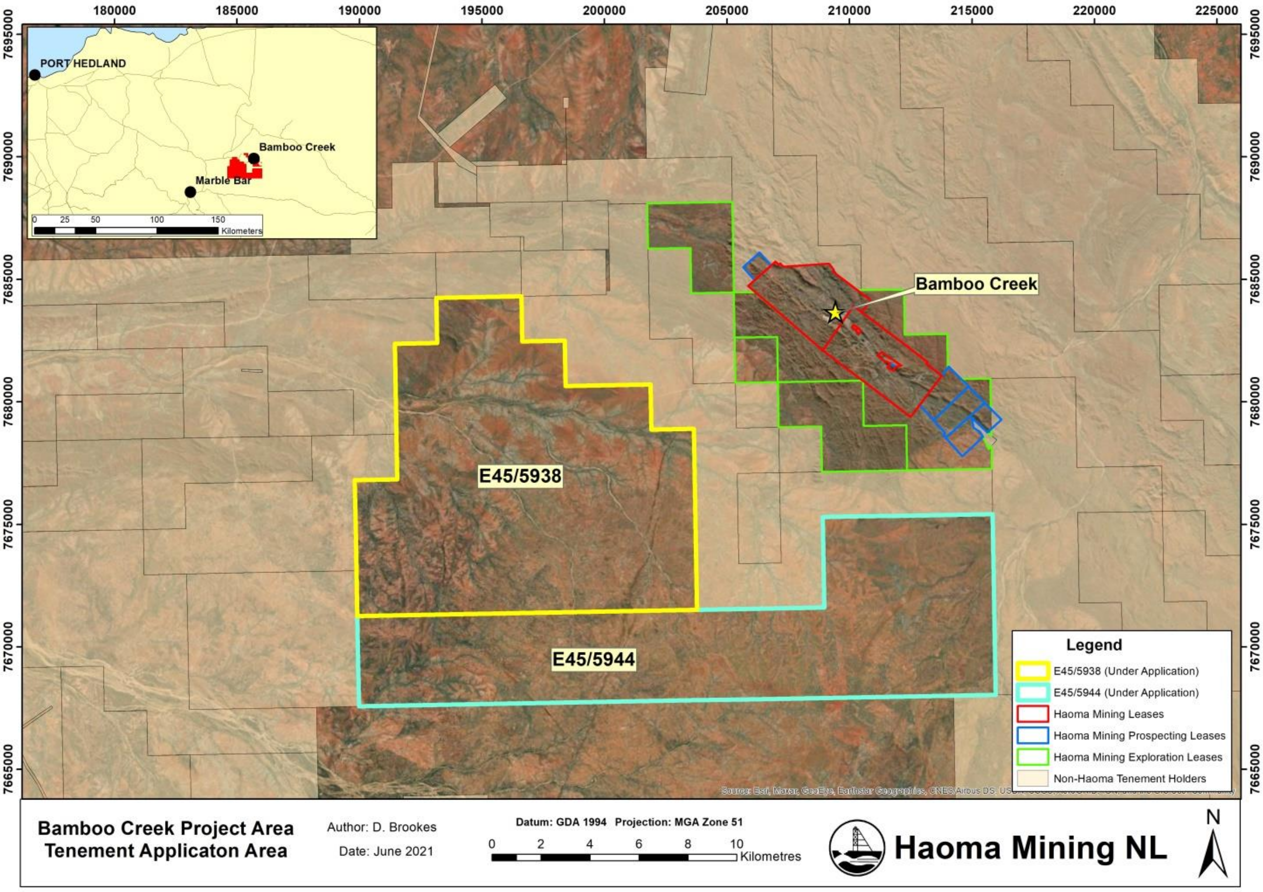
Haoma Mining is pleased to report it has applied for two tenements within the Bamboo Creek and Coppins Gap area (**Coppins Gap Granites within the Pilbara Craton**) with the primary focus of exploring for **Rare Earths and Other Elements including Strategic Minerals**.

The **Tenements E45/5938 and E45/5944** are located approximately 5km south-west of Haoma's current Bamboo Creek tenement holdings and cover a substantial area within the Pilbara Craton (See Figure 7).

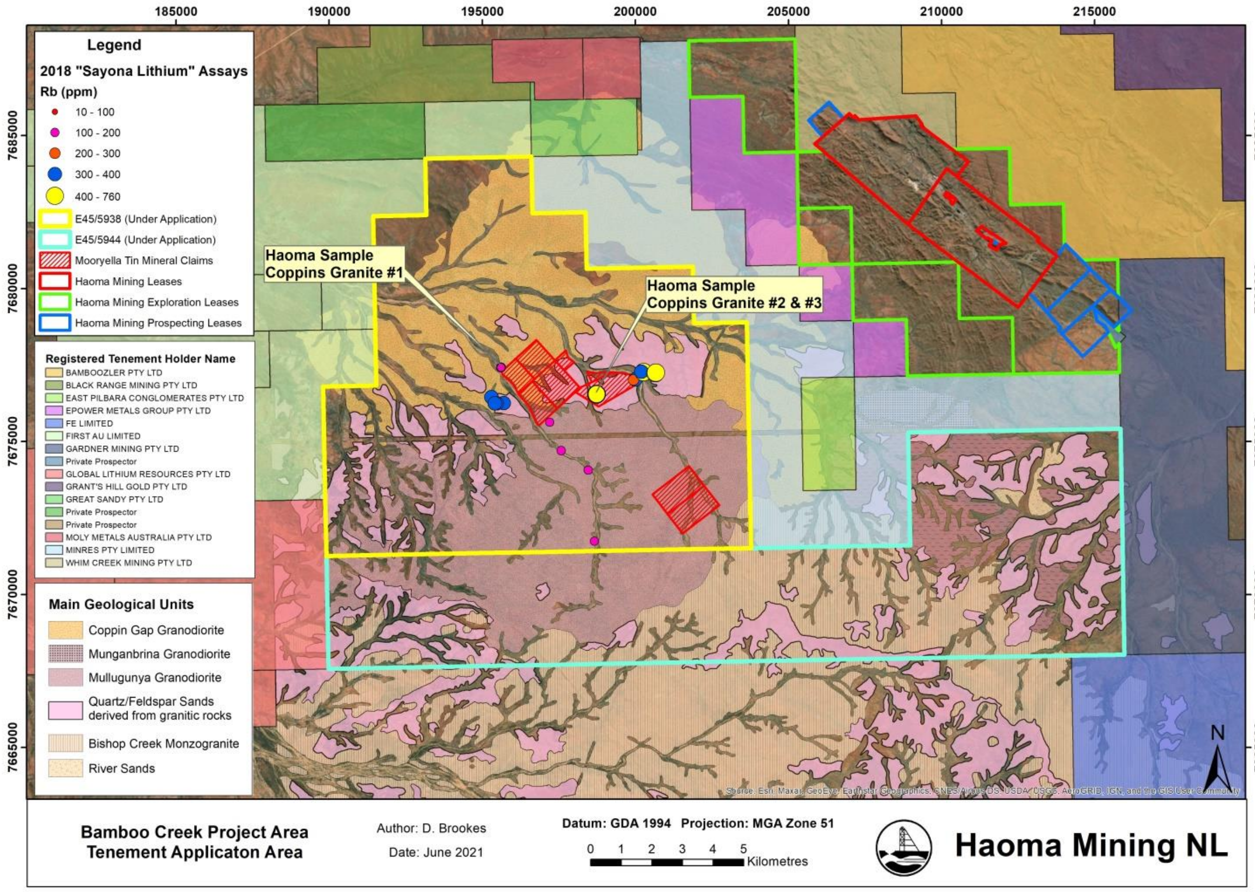
Haoma believes there is significant exploration potential in the areas as only limited exploration was conducted to date by **Sayona Lithium** in an area around E45/5938 (See Figure 8).

Sayona's primary focus was to identify a potential resource of Lithium within Tenement E45/5938 in the Coppins Gap Granitic including to the north of Tenement E45/5938. Although Lithium was measured from Sayona's initial assay results a potential resource was deemed unlikely and the tenement surrendered.

Once the tenements are granted Haoma will conduct regional exploration to identify targets for follow-up drilling.



<u>Figure 7:</u> Haoma Mining's tenement applications E45/5938 and E45/5944



<u>Figure 8:</u> Haoma 'surface grab' sample locations from Coppins Gap Granites, and Sayona Lithium (E45/5938) 2018 'surface grab' sample Rubidium assays

Three grab samples from the same area were recently collected by Haoma. They indicate similar assay readings of Rare Earths and Other Elements including Strategic Minerals, shown in the Table 3 below.

Sample Number	Description	Easting	Northing	Ce	Cs	Dy	Er	Eu	Ga	Gd	Hf	Ho	La
131203	Coppins Granite #1	195615	7677426	25.7	1.6	1.7	0.9	0.6	18.8	2.1	3.9	0.3	26.9
131204	Coppins Granite #2	198732	7676550	4.5	4.8	12.4	13.8	0.0	29.3	4.6	2.0	3.4	2.9
131205	Coppins Granite #3	198737	7676555	2.2	3.8	10.2	12.0	0.0	24.3	3.9	1.8	2.8	1.3
Sample Number	**Description**	**Easting**	**Northing**	**Lu**	**Nb**	**Nd**	**Pr**	**Rb**	**Sm**	**Sr**	**Tb**	**Th**	**Tm**
131203	Coppins Granite #1	195615	7677426	0.1	7.2	17.1	4.9	106.3	2.7	208.5	0.3	9.5	0.1
131204	Coppins Granite #2	198732	7676550	5.3	57.1	3.8	0.9	755.5	2.2	4.9	1.3	12.3	3.2
131205	Coppins Granite #3	198737	7676555	5.1	61.3	1.8	0.4	530.0	1.7	7.8	1.2	13.5	2.7
Sample Number	**Description**	**Easting**	**Northing**	**U**	**Y**	**Yb**	**La**	**Li**	**Pb**	**Rb**	**Sc**		
131203	Coppins Granite #1	195615	7677426	1.7	8.9	0.7	28.1	25.3	30.3	106.3	3.3		
131204	Coppins Granite #2	198732	7676550	4.3	113.2	29.1	2.6	8.3	41.0	755.5	6.1		
131205	Coppins Granite #3	198737	7676555	9.9	84.8	25.6	1.2	7.7	50.6	530.0	3.9		

Note: Assay readings in ppm

<u>Table 3:</u> Haoma 'surface grab' sample assays from Coppins Gap Granites within the Pilbara Craton

Yours sincerely

Gary C. Morgan
Chairman

<u>Appendix 1:</u> U.S. Geological Survey, Mineral Commodity Summaries, January 2020: https://pubs.usgs.gov/periodicals/mcs2021/mcs2021.pdf (6 pages total)

RUBIDIUM

(Data in metric tons of rubidium oxide unless otherwise noted)

Domestic Production and Use: In 2020, no rubidium was mined in the United States; however, occurrences of rubidium-bearing minerals are known in Alaska, Arizona, Idaho, Maine, South Dakota, and Utah. Rubidium is also associated with some evaporate mineral occurrences in other States. Rubidium is not a major constituent of any mineral. Rubidium concentrate is produced as a byproduct of pollucite (cesium) and lepidolite (lithium) mining and is imported from other countries for processing in the United States.

Applications for rubidium and its compounds include biomedical research, electronics, specialty glass, and pyrotechnics. Specialty glasses are the leading market for rubidium; rubidium carbonate is used to reduce electrical conductivity, which improves stability and durability in fiber optic telecommunications networks. Biomedical applications include rubidium salts used in antishock agents and the treatment of epilepsy and thyroid disorder; rubidium-82, a radioactive isotope used as a blood-flow tracer in positron emission tomographic imaging; and rubidium chloride, used as an antidepressant. Rubidium atoms are used in academic research, including the development of quantum-mechanics-based computing devices, a future application with potential for relatively high consumption of rubidium. Quantum computing research uses ultracold rubidium atoms in a variety of applications. Quantum computers, which have the ability to perform more complex computational tasks than traditional computers by calculating in two quantum states simultaneously, were expected to be in prototype phase within 10 years.

Rubidium's photoemissive properties make it useful for electrical-signal generators in motion-sensor devices, night-vision devices, photoelectric cells (solar panels), and photomultiplier tubes. Rubidium is used as an atomic resonance-frequency-reference oscillator for telecommunications network synchronization, playing a vital role in global positioning systems. Rubidium-rich feldspars are used in ceramic applications for spark plugs and electrical insulators because of their high dielectric constant. Rubidium hydroxide is used in fireworks to oxidize mixtures of other elements and produce violet hues. The U.S. military frequency standard, the United States Naval Observatory (USNO) timescale, is based on 48 weighted atomic clocks, including 4 USNO rubidium fountain clocks.

Salient Statistics—United States: Consumption, export, and import data are not available. Some concentrate was imported to the United States for further processing. Industry information during the past decade suggests a domestic consumption rate of approximately 2,000 kilograms per year. The United States was 100% import reliant for rubidium minerals.

In 2020, one company offered 1-gram ampoules of 99.75%-grade rubidium (metal basis) for $89.00, a slight increase from $87.80 in 2019, and 100-gram ampoules of the same material for $1,608.00, a slight increase from $1,592.00 in 2019. The price for 1-gram ampoules of 99.8% rubidium formate hydrate (metal basis) was $34.70, unchanged from 2019.

In 2020, the prices for 10 grams of 99.8% (metal basis) rubidium acetate, rubidium bromide, rubidium carbonate, rubidium chloride, and rubidium nitrate were $50.60, $67.00, $56.80, $61.30, and $47.20, respectively. The price for a rubidium-plasma standard solution (10,000 micrograms per milliliter) was $49.50 for 50 milliliters and $80.80 for 100 milliliters, a 5% decrease, each, from those of 2019.

Recycling: None.

Import Sources (2016–19): No reliable data have been available to determine the source of rubidium ore imported by the United States since 1988. Prior to 2016, Canada was thought to be the primary supplier of rubidium ore.

Prepared by **Christopher Candice Tuck [(703) 648–4912, ctuck@usgs.gov]**

RUBIDIUM

Tariff: Item	Number	Normal Trade Relations 12–31–20
Alkali metals, other	2805.19.9000	5.5% ad val.
Chlorides, other	2827.39.9000	3.7% ad val.
Bromides, other	2827.59.5100	3.6% ad val.
Iodides, other	2827.60.5100	4.2% ad val.
Sulfates, other	2833.29.5100	3.7% ad val.
Nitrates, other	2834.29.5100	3.5% ad val.
Carbonates, other	2836.99.5000	3.7% ad val.

Depletion Allowance: 14% (domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Domestic rubidium occurrences will remain uneconomic unless market conditions change, such as the development of new end uses or increased consumption for existing end uses, which in turn could lead to increased prices. No known human health issues are associated with exposure to naturally occurring rubidium, and its use has minimal environmental impact.

During 2020, no rubidium production was reported globally. Production of rubidium from all countries, excluding China, ceased within the past two decades. Production in Namibia ceased in the early 2000s, followed by the Tanco Mine in Canada shutting down and later being sold after a mine collapse in 2015. The Bikita Mine in Zimbabwe was depleted of pollucite ore reserves in 2018, and the Sinclair Mine in Australia completed the mining and shipments of all economically recoverable pollucite ore in 2019. Recent reports indicate that with current processing rates, the world's stockpiles of rubidium ore, excluding those in China, will be depleted by 2022.

The primary processing plant of rubidium compounds globally, located in Germany, has reportedly operated far below capacity for the past few years. A company completed an updated mineral resource estimate for the Karibib project in Namibia, reporting 8.9 million metric tons of measured and indicated resources containing 0.23% rubidium and 302 parts per million cesium. Located in the Karibib Pegmatite Belt, lithium would be the primary product, with cesium, potassium, and rubidium as potential byproducts.

World Mine Production and Reserves:[1] There were no official sources for rubidium production data in 2020. Lepidolite and pollucite, the principal rubidium-containing minerals in global rubidium reserves, can contain up to 3.5% and 1.5% rubidium oxide, respectively. Rubidium-bearing mineral resources are found in zoned pegmatites. Mineral resources exist globally, but extraction and concentration are mostly cost prohibitive. No reliable data are available to determine reserves for specific countries; however, Australia, Canada, China, Namibia, and Zimbabwe were thought to have reserves totaling less than 200,000 tons.

World Resources:[1] Significant rubidium-bearing pegmatite occurrences have been identified in Afghanistan, Australia, Canada, China, Denmark, Germany, Japan, Kazakhstan, Namibia, Peru, Russia, the United Kingdom, the United States, and Zambia. Minor quantities of rubidium are reported in brines in northern Chile and China and in evaporites in the United States (New Mexico and Utah), France, and Germany.

Substitutes: Rubidium and cesium can be used interchangeably in many applications because they have similar physical properties and atomic radii. Cesium, however, is more electropositive than rubidium, making it a preferred material for some applications.

[1]See Appendix C for resource and reserve definitions and information concerning data sources.

CESIUM

(Data in metric tons of cesium oxide unless otherwise noted)

Domestic Production and Use: In 2020, no cesium was mined domestically, and the United States was 100% import reliant for cesium minerals. Pollucite, mainly found in association with lithium-rich, lepidolite-bearing or petalite-bearing zoned granite pegmatites, is the principal cesium ore mineral. Cesium minerals are used as feedstocks to produce a variety of cesium compounds and cesium metal. The primary application for cesium, by gross weight, is in cesium formate brines used for high-pressure, high-temperature well drilling for oil and gas production and exploration. With the exception of cesium formate, cesium is used in relatively small-scale applications, using only a few grams for most applications. Owing to the lack of global availability of cesium, many applications have used mineral substitutes and the use in any particular application may no longer be viable.

Cesium metal is used in the production of cesium compounds and potentially in photoelectric cells. Cesium bromide is used in infrared detectors, optics, photoelectric cells, scintillation counters, and spectrophotometers. Cesium carbonate is used in the alkylation of organic compounds and in energy conversion devices, such as fuel cells, magneto-hydrodynamic generators, and polymer solar cells. Cesium chloride is used in analytical chemistry applications as a reagent, in high-temperature solders, as an intermediate in cesium metal production, in isopycnic centrifugation, as a radioisotope in nuclear medicine, as an insect repellent in agricultural applications, and in specialty glasses. Cesium hydroxide is used as an electrolyte in alkaline storage batteries. Cesium iodide is used in fluoroscopy equipment—Fourier-transform infrared spectrometers—as the input phosphor of x-ray image intensifier tubes, and in scintillators. Cesium nitrate is used as a colorant and oxidizer in the pyrotechnic industry, in petroleum cracking, in scintillation counters, and in x-ray phosphors. Cesium sulfates are soluble in water and are thought to be used primarily in water treatment, fuel cells, and to improve optical quality for scientific instruments.

Cesium isotopes, which are obtained as a byproduct in nuclear fission or formed from other isotopes, such as barium-131, are used in electronic, medical, metallurgical, and research applications. Cesium isotopes are used as an atomic resonance frequency standard in atomic clocks, playing a vital role in aircraft guidance systems, global positioning satellites, and internet and cellular telephone transmissions. Cesium clocks monitor the cycles of microwave radiation emitted by cesium's electrons and use these cycles as a time reference. Owing to the high accuracy of the cesium atomic clock, the international definition of 1 second is based on the cesium atom. The U.S. civilian time and frequency standard is based on a cesium fountain clock at the National Institute of Standards and Technology in Boulder, CO. The U.S. military frequency standard, the United States Naval Observatory timescale, is based on 48 weighted atomic clocks, including 25 cesium fountain clocks.

A company in Richland, WA, produced a range of cesium-131 medical products for treatment of various cancers. Cesium-137 may be used in industrial gauges, in mining and geophysical instruments, and for sterilization of food, sewage, and surgical equipment. Because of the danger posed by the radiological properties of cesium-137, efforts to find substitutes in its applications continued.

Salient Statistics—United States: Consumption, import, and export data for cesium have not been available since the late 1980s. Because cesium metal is not traded in commercial quantities, a market price is unavailable. Only a few thousand kilograms of cesium chemicals are thought to be consumed in the United States every year. The United States was 100% import reliant for its cesium needs.

In 2020, one company offered 1-gram ampoules of 99.8% (metal basis) cesium for $65.20, a 3.5% increase from $63.00 in 2019, and 99.98% (metal basis) cesium for $84.70, a 4.4% increase from $81.10 in 2019.

In 2020, the prices for 50 grams of 99.9% (metal basis) cesium acetate, cesium bromide, cesium carbonate, cesium chloride, and cesium iodide were $120.00, $72.90, $104.40, $107.20, and $121.20, respectively, with increases ranging from 1.4% to 3.6% from prices in 2019. The price for a cesium-plasma standard solution (10,000 micrograms per milliliter) was $77.80 for 50 milliliters and $119.00 for 100 milliliters, and the price for 25 grams of cesium formate, 98% (metal basis), was $41.40.

Recycling: Cesium formate brines are typically rented by oil and gas exploration clients. After completion of the well, the used cesium formate brine is returned and reprocessed for subsequent drilling operations. Cesium formate brines are recycled, recovering nearly 85% of the brines for recycling to be reprocessed for further use.

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CESIUM

Import Sources (2016–19): No reliable data have been available to determine the source of cesium ore imported by the United States since 1988. Prior to 2016, Canada was thought to be the primary supplier of cesium ore.

Tariff: Item	Number	Normal Trade Relations 12–31–20
Alkali metals, other	2805.19.9000	5.5% ad val.
Chlorides, other	2827.39.9000	3.7% ad val.
Bromides, other	2827.59.5100	3.6% ad val.
Iodides, other	2827.60.5100	4.2% ad val.
Sulfates, other	2833.29.5100	3.7% ad val.
Nitrates, other	2834.29.5100	3.5% ad val.
Carbonates, other	2836.99.5000	3.7% ad val.
Cesium-137, other	2844.40.0021	Free

Depletion Allowance: 14% (domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Domestic cesium occurrences will likely remain uneconomic unless market conditions change. No known human health issues are associated with naturally occurring cesium, and its use has minimal environmental impact. Manufactured radioactive isotopes of cesium have been known to cause adverse health effects. Certain cesium compounds may be toxic if consumed. Food that has been irradiated using the radioisotope cesium-137 has been found to be safe by the U.S. Food and Drug Administration.

During 2020, no primary cesium mine production was reported globally. Mine production of cesium from all countries, excluding China, ceased within the past two decades. Production in Namibia ceased in the early 2000s, followed by the Tanco Mine in Canada shutting down and later being sold after a mine collapse in 2015. The Bikita Mine in Zimbabwe was depleted of pollucite ore reserves in 2018, and the Sinclair Mine in Australia completed the mining and shipments of all economically recoverable pollucite ore in 2019.

A company completed an updated mineral resource estimate for the Karibib project in Namibia, reporting 8.9 million metric tons of measured and indicated resources containing 0.23% rubidium and 302 parts per million cesium. Located in the Karibib Pegmatite Belt, lithium would be the primary product, with cesium, potassium, and rubidium as potential byproducts.

World Mine Production and Reserves:[1] There were no official sources for cesium production data in 2020. Cesium reserves are, therefore, estimated based on the occurrence of pollucite, a primary lithium-cesium-rubidium mineral. Most pollucite contains 5% to 32% cesium oxide. No reliable data are available to determine reserves for specific countries; however, Australia, Canada, China, Namibia, and Zimbabwe were thought to have reserves totaling less than 200,000 tons.

World Resources:[1] Cesium is associated with lithium-bearing pegmatites worldwide, and cesium resources have been identified in Australia, Canada, Namibia, the United States, and Zimbabwe. In the United States, pollucite occurs in pegmatites in Alaska, Maine, and South Dakota. Lower concentrations occur in brines in Chile and China and in geothermal systems in Germany, India, and Tibet. China was thought to have cesium-rich deposits of geyserite, lepidolite, and pollucite, with concentrations highest in Yichun, Jiangxi Province, although no resource, reserve, or production estimates were available.

Substitutes: Cesium and rubidium can be used interchangeably in many applications because they have similar physical properties and atomic radii. Cesium, however, is more electropositive than rubidium, making it a preferred material for some applications. However, rubidium is mined from similar deposits, in relatively smaller quantities, as a byproduct of cesium production in pegmatites and as a byproduct of lithium production from lepidolite (hard-rock) mining and processing, making it no more readily available than cesium.

[1]See Appendix C for resource and reserve definitions and information concerning data sources.

RARE EARTHS[1]

[Data in metric tons of rare-earth-oxide (REO) equivalent content unless otherwise noted]

Domestic Production and Use: Rare earths were mined domestically in 2020. Bastnaesite (or bastnäsite), a rare-earth fluorocarbonate mineral, was mined as a primary product at a mine in Mountain Pass, CA. Monazite, a phosphate mineral, was produced as a separated concentrate or included as an accessory mineral in heavy-mineral concentrates. The estimated value of rare-earth compounds and metals imported by the United States in 2020 was $110 million, a significant decrease from $160 million in 2019. The estimated distribution of rare earths by end use was as follows: catalysts, 75%; ceramics and glass, 6%; polishing, 5%; metallurgical applications and alloys, 4%; and other, 10%.

Salient Statistics—United States:	2016	2017	2018	2019	2020[e]
Production, bastnaesite and monazite concentrates[e]	—	—	14,000	28,000	38,000
Imports:[e, 2]					
Compounds	11,800	11,000	10,800	12,300	6,700
Metals:					
Ferrocerium, alloys	268	309	298	332	260
Rare-earth metals, scandium, and yttrium	404	524	526	627	380
Exports:[e, 2]					
Ores and compounds	590	1,740	17,900	28,200	38,000
Metals:					
Ferrocerium, alloys	943	982	1,250	1,290	630
Rare-earth metals, scandium, and yttrium	103	55	28	83	27
Consumption, apparent[3]	10,500	9,060	6,520	11,700	7,800
Price, average, dollars per kilogram:[4]					
Cerium oxide, 99.5% minimum	2	2	2	2	2
Dysprosium oxide, 99.5% minimum	198	187	179	239	258
Europium oxide, 99.99% minimum	74	77	53	35	31
Lanthanum oxide, 99.5% minimum	2	2	2	2	2
Mischmetal, 65% cerium, 35% lanthanum	5	6	6	6	5
Neodymium oxide, 99.5% minimum	40	50	50	45	47
Terbium oxide, 99.99% minimum	415	501	455	507	628
Employment, mine and mill, annual average, number	—	24	190	202	180
Net import reliance[5] as a percentage of apparent consumption:[6]					
Compounds and metals	100	100	100	100	100
Mineral concentrates	XX	XX	E	E	E

Recycling: Limited quantities of rare earths are recovered from batteries, permanent magnets, and fluorescent lamps.

Import Sources (2016–19): Rare-earth compounds and metals: China, 80%; Estonia, 5%; Japan and Malaysia, 4% each; and other, 7%. Compounds and metals imported from Estonia, Japan, and Malaysia were derived from mineral concentrates and chemical intermediates produced in Australia, China, and elsewhere.

Tariff: Item	Number	Normal Trade Relations 12–31–20
Rare-earth metals	2805.30.0000	5.0% ad val.
Cerium compounds	2846.10.0000	5.5% ad val.
Other rare-earth compounds:		
Oxides or chlorides	2846.90.2000	Free.
Carbonates	2846.90.8000	3.7% ad val.
Ferrocerium and other pyrophoric alloys	3606.90.3000	5.9% ad val.

Depletion Allowance: Monazite, 22% on thorium content and 14% on rare-earth content (domestic), 14% (foreign); bastnäsite and xenotime, 14% (domestic and foreign).

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RARE EARTHS

Government Stockpile:[7] In the addition to the materials listed below, the FY 2021 potential acquisitions include neodymium, 600 tons; praseodymium, 70 tons; and samarium-cobalt alloy, 50 tons.

Material	Inventory as of 9–30–20	FY 2020 Potential acquisitions	FY 2020 Potential disposals	FY 2021 Potential acquisitions	FY 2021 Potential disposals
Cerium	—	900	—	500	—
Dysprosium	0.2	—	—	20	—
Europium	20.9	—	—	—	—
Ferrodysprosium	0.5	—	—	—	—
Lanthanum	—	4,100	—	1,300	—
Rare-earth-magnet feedstock	—	100	—	100	—
Yttrium	25	—	—	600	—

Events, Trends, and Issues: Global mine production was estimated to have increased to 240,000 tons of rare-earth-oxide equivalent. According to China's Ministry of Industry and Information Technology, the mine production quota for 2020 was 140,000 tons with 120,850 tons allocated to light rare earths and 19,150 tons allocated to ion-adsorption clays.

World Mine Production and Reserves: Reserves for Brazil and the United States were revised based on information from Government and industry reports.

	Mine production 2019	Mine production 2020[e]	Reserves[8]
United States	28,000	38,000	1,500,000
Australia	20,000	17,000	[9]4,100,000
Brazil	710	1,000	21,000,000
Burma	25,000	30,000	NA
Burundi	200	500	NA
Canada	—	—	830,000
China	[10]132,000	[10]140,000	44,000,000
Greenland	—	—	1,500,000
India	2,900	3,000	6,900,000
Madagascar	4,000	8,000	NA
Russia	2,700	2,700	12,000,000
South Africa	—	—	790,000
Tanzania	—	—	890,000
Thailand	1,900	2,000	NA
Vietnam	1,300	1,000	22,000,000
Other countries	66	100	310,000
World total (rounded)	220,000	240,000	120,000,000

World Resources:[8] Rare earths are relatively abundant in the Earth's crust, but minable concentrations are less common than for most other mineral commodities. In North America, measured and indicated resources of rare earths were estimated to include 2.7 million tons in the United States and more than 15 million tons in Canada.

Substitutes: Substitutes are available for many applications but generally are less effective.

[e]Estimated. E Net exporter. NA Not available. XX Not applicable. — Zero.
[1]Data include lanthanides and yttrium but exclude most scandium. See also Scandium and Yttrium.
[2]REO equivalent or content of various materials were estimated. Source: U.S. Census Bureau.
[3]Defined as production + imports – exports.
[4]Source: Argus Media group—Argus Metals International.
[5]Defined as imports – exports.
[6]In 2018–2020, all domestic production of mineral concentrates was exported, and all compounds and metals consumed were assumed to be imported material.
[7]Gross weight. See Appendix B for definitions.
[8]See Appendix C for resource and reserve definitions and information concerning data sources.
[9]For Australia, Joint Ore Reserves Committee-compliant reserves were 2.8 million tons.
[10]Production quota; does not include undocumented production.