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Metallurgical tests at Halleck Creek indicate low mining, processing costs

Key US Rare Earths project shows viable pathway using conventional technology

American Rare Earths (ASX: ARR | OTCQB: ARRNF | FSE:1BHA) is able to report that at its Halleck Creek rare earths elements project in Albany County, Wyoming, USA, metallurgical tests have paved the way for a potentially low-cost mining and processing operation using conventional technology.

The company, which is also progressing the La Paz REE project in Arizona, is positioning itself to be a key player in the North American supply chain for the renewable future. US Government policy now supports the revival of the American rare earths industry in order to decrease dependence on Chinese supply.

Highlights

The metallurgical tests, conducted by Wood Australia, show that Halleck Creek has favourable characteristics on a number of counts. These are:

- **Low ore strength: the ore can be liberated easily, with the ore strength ranking in the lowest 14th percentile of more than 1,300 deposits globally. This requires minimal energy use.**
- **Ore abrasiveness is below average.**
- **The ore will require less coarse grinding at the processing plant, meaning another level of energy expenditure and the opportunity to increase capacity.**
- **These factors will make possible a simplified flow sheet reflecting lower capital cost outlays.**

The recently completed comminution testing (which reduces the ore to minute particles) on core material from the Halleck Creek project provides the opportunity to optimise and simplify the grinding and crushing flow sheet. This further demonstrates the capability to reduce operating and capital cost using conventional technology.

Managing Director Chris Gibbs said that one of the major costs in any processing plant is within the crushing and grinding circuit. “These test results indicate there could be significant energy savings due to the ore softness. Simply put, the easier the ore is to crush and grind, the lower our operating costs will be. It will also enable higher throughput rates and efficiencies as the comminution circuit is so often the limiting factor for plant capacity. And, apart from energy savings, the less abrasive ore will lead to reduced wear and tear”

Under the guidance of Wood Australia, Nagrom Laboratories concluded the Feed Characterisation/Comminution module of the test work program. This included SMC Testing Pty Ltd (SMC) that produces data used for the sizing of SAG mills and was originally designed to support Mine-to-Mill studies.

The SMC test work results indicate low ore competency which would translate to low specific energy consumption in a SAG mill. Compared to SMCs global database of over 1300 deposits, Halleck Creek was rated in the 14th percentile for ore competency. The Bond abrasion index test returned a value of 0.24, which is below the average of Wood Australia’s database. The Bond ball mill work index test result of 15.6 kWh/t is close to average hardness relative to Wood’s database.

The combination of values suggest that Halleck Creek ore should be suitable for processing in a SAG-Ball mill configuration without the need for pebble crushing and could also be processed in a single stage SAG mill. Other modes of grinding, such as high-pressure grinding mills and vertical roller mills may also be considered down track when sufficient sample mass is available for testing.

Next Steps

With oversight from Wood Australia, test work is currently underway on additional steps in the process flow sheet. This includes magnetic separation test work currently underway at Nagrom Laboratories in Perth, Western Australia. We will then transition to flotation testing of WHIMS magnetics at Auralia Metallurgy, to assess the potential for further upgrading. Testing will then commence on the leach process using Watts & Fisher’s proprietary leach technology.

The Company will continue to provide updates on metallurgical test work as results come to hand.

Together with mineralogy tests results announced earlier this month ([ASX release 2.12.2022](#)) the economic and technical benefits from these new test results could be significant. Previously the company has advised that mineralogy tests have shown that rare earths host mineral at Halleck Creek can easily be liberated, while the host mineral Allanite contains approximately 90% of total rare earths present. American Rare Earths noted that Halleck Creek has the potential to be a key strategic project with the US, helping to bring supply of critical rare earths onshore.

This market announcement has been authorised for release to the market by the Board of American Rare Earths Limited.

Chris Gibbs
CEO & Managing Director

Competent Persons Statement:

The information in this document is based on information compiled by Mr Greg Henderson. Mr Henderson is a Senior Process Consultant at Wood Australia. Mr Henderson is a Fellow of the Australian Institute of Mining and Metallurgy (AUSIMM), number 109007, and has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the 2012 JORC Code. Mr Henderson consents to the inclusion in the report of the matters based upon the information in the form and context in which it appears.

About American Rare Earths:

One of the only ASX listed companies with exposure to the rapidly expanding US market, American Rare Earths is developing its 100% owned magnet metals projects, La Paz in Arizona, and Halleck Creek in Wyoming. Both have potential to be among the largest, rare earths deposits in North America. The company is concurrently evaluating other exploration opportunities while collaborating with US Government supported R&D to develop a sustainable domestic supply chain for the renewable future.

Appendix A – JORC Table 1

JORC Code, 2012 Edition – Table 1 Halleck Creek Exploration Area		
Section 1 Sampling Techniques and Data		
(Criteria in this section apply to all succeeding sections.)		
Criteria	JORC Code explanation	Commentary
Sampling techniques	<p><i>Nature and quality of sampling (e.g. cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as downhole gamma sondes, handheld XRF instruments, etc.). These examples should not be taken as limiting the broad meaning of sampling.</i></p>	<p>In March and April 2022, WRE drilled nine HQ-sized core holes across the Halleck Creek Resource claim area. All holes were approximately 350 ft with the exception of one hole which was terminated at 194 ft. Total drilled length of 3,008 ft (917 m). Rock core was divided into sample lengths of 5 ft (1.52 m) long and at key lithological breaks.</p> <p>An additional 71 surface rock samples were collected on claim areas east of the Overton Mountain study area.</p> <p>A total of 513 surface rock samples exist at the Halleck Creek. Surface rock samples collected by ARR are logged, photographed and located using handheld GPS units.</p> <p>As part of reverse circulation (RC) exploration drilling at Halleck Creek. ARR collected XRF readings on RC chip samples. Elements included in XRF measurements include: Lanthanum, Cerium, Neodymium, and Praseodymium. ARR collected three XRF readings on each sample, then averaged the readings. Readings are performed at 25-meter intervals down each drill hole. These values are considered to be qualitative in nature and provide only rough indications of grade.</p>
	<p><i>Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.</i></p>	<p>Core recoveries and RQDs were calculated by WRE field geologists.</p>
	<p><i>Aspects of the determination of mineralisation that are Material to the Public Report.</i></p>	

	<i>In cases where 'industry standard' work has been done, this would be relatively simple (e.g. 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases, more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (e.g. submarine nodules) may warrant disclosure of detailed information.</i>	Rock core samples 5 ft (1.52 m) long are being fillet cut. The fillet cuts are being pulverised and sampled for 60 elements including rare earth elements using ICP-MS and industry standards. A select number of samples are additionally being assayed for whole rock geochemistry. American Assay Labs in Sparks, NV is performed the analyses.
		The rock samples pulverised and analysed for 48 elements, including rare earth elements using ICP-MS. American Assay Labs in Sparks, NV is performed the analyses.
<i>Drilling techniques</i>	<i>Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc.) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or another type, whether the core is oriented and if so, by what method, etc.).</i>	Core: HQ, diamond tip, 5-ft runs, unoriented. Total drilled depth of 3,008 ft (917 m).
<i>Drill sample recovery</i>	<i>Method of recording and assessing core and chip sample recoveries and results assessed.</i>	All drill core was visually logged, measured, and photographed by WRE geologists. Drill core was collected in lengths (runs) of 5 ft (1.52 m). Recoveries were calculated for each core run. Each rock sample was described, photographed with its location determined using handheld GPS.
	<i>Measures are taken to maximise sample recovery and ensure the representative nature of the samples.</i>	All core and associated samples were immediately placed in core boxes.
	<i>Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.</i>	Recoveries were very high in competent rock. No loss or gain of grade or grade bias related to recovery

Logging	<i>Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.</i>	All drill core was visually logged, measured, and photographed by WRE geologists. Drill core was collected in lengths (runs) of 5 feet (1.52m). WRE geologists calculated recoveries for each core run. WRE geologists logged lithology, various types of alteration and mineralisation, fractures, fracture conditions, and RQD.
	<i>Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc.) photography.</i>	Core logging is quantitative in nature. All core was photographed.
	<i>The total length and percentage of the relevant intersections logged.</i>	All drill core was visually logged, measured, and photographed by WRE geologists. Drill core was collected in lengths (runs) of 5 feet (1.52m). WRE geologists calculated recoveries for each core run. WRE geologists logged lithology, various types of alteration and mineralisation, fractures, fracture conditions, and RQD.
Sub-sampling techniques and sample preparation	<i>If core, whether cut or sawn and whether quarter, half or all core taken.</i>	Drill core was fillet cut by American Assay Labs, with approximately 1/3 of the core used for assay. The remaining core material will be kept in reserve by WRE in a secure location.
	<i>If non-core, whether riffled, tube sampled, rotary split, etc. and whether sampled wet or dry.</i>	
	<i>For all sample types, the nature, quality and appropriateness of the sample preparation technique.</i>	All samples were dry. Sample preparation: 1kg samples split to 250g for pulverising to -75 microns. Sample analysis: 0.5g charge assayed by ICP-MS technique.
	<i>Quality control procedures adopted for all sub-sampling stages to maximise the representivity of samples.</i>	WRE submitted CRM sample blanks, CRM standard REE samples from CND Labs and duplicate samples for analysis. Blank samples were added one for every 10 core samples, REE samples were added one for every 25 core samples, and Duplicate samples were added one per every 25 core samples.

	<i>Measures are taken to ensure that the sampling is representative of the in situ material collected, including, for instance, results for field duplicate/second-half sampling.</i>	Fillet cuts along the entire length of all core are representative of the in-situ material.
	<i>Whether sample sizes are appropriate to the grain size of the material being sampled.</i>	Allanite is generally well distributed across the core and the sample sizes are representative of the fine grain size of the Allanite.
Quality of assay data and laboratory tests	<i>The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.</i>	AAL Labs uses 5-acid digestion and 48 element analysis including REE reported in ppm using method REE-5AO48 and whole-rock geochemical XRF analysis using method X-LIB15.
	<i>For geophysical tools, spectrometers, handheld XRF instruments, etc., the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.</i>	No geophysical tools used in the drilling program.
	<i>Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established.</i>	WRE submitted CRM sample blanks, CRM standard REE samples from CND Labs and duplicate samples for analysis. Blank samples were added one for every 10 core samples, REE samples were added one for every 25 core samples, and Duplicate samples were added one per every 25 core samples. Internal laboratory blanks and standards will additionally be inserted during analysis.
Verification of sampling and assaying	<i>The verification of significant intersections by either independent or alternative company personnel.</i>	Consulting company personnel have observed the assayed samples. Company personnel sampled the entire length of each hole.
	<i>The use of twinned holes.</i>	No twinned holes were used.,
	<i>Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.</i>	Data entry was performed by WRE personnel and checked by WRE geologists. All field logs were scanned and uploaded to company file servers. All photographs of the core were also uploaded to the file server daily. Drilling data will be imported into the DHDB drill

		<p>hole database. All scanned documents are cross-referenced and directly available from the database.</p> <p>Assay data was received electronically from AAL labs. These raw data as elements reported ppm were imported into the database with no adjustments.</p>
	<i>Discuss any adjustment to assay data.</i>	Oxide values are calculated in the database using the molar mass of the element and the oxide
<i>Location of data points</i>	<i>Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.</i>	<p>Down hole surveyed were not used.</p> <p>Drill hole location is based on GPS coordinates +/- 10 ft (3 m) accuracy.</p>
	<i>Specification of the grid system used.</i>	The grid system used to compile data was NAD83 Zone 13N.
	<i>Quality and adequacy of topographic control.</i>	Topography control is +/- 10 ft (3 m).
<i>Data spacing and distribution</i>	<i>Data spacing for reporting of Exploration Results.</i>	Both randomly spaced and localised clustering of drillholes.
	<i>Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.</i>	The data is not at a sufficient spacing to determine a mineral resource or reserve. No resources or reserves are being reported for the Halleck creek area.
	<i>Whether sample compositing has been applied.</i>	Each sample is the result of assaying a 5 ft interval of core. Composite assay values have not been calculated or applied.
<i>Orientation of data in relation to geological structure</i>	<i>Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.</i>	6 holes were vertical, and three were angled at 65° in various directions depending on drill hole location.
	<i>If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material.</i>	

Sample security	<i>The measures are taken to ensure sample security.</i>	<p>All core was collected from the drill rig daily and stored in a secure, locked facility until the core was dispatched by bonded courier to American Assay Labs. Chains of custody were maintained at all times.</p> <p>All rock samples were in the direct control of company geologists until dispatched to American Assay Labs.</p>
Audits or reviews	<i>The results of any audits or reviews of sampling techniques and data.</i>	No external audits or reviews have been conducted to date. However, sampling techniques are consistent with industry standards.

Section 2 Reporting of Exploration Results		
(Criteria listed in the preceding section also apply to this section.)		
Criteria	JORC Code explanation	Commentary
Mineral tenement and land tenure status	<i>Type, reference name/number, location and ownership, including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.</i>	<p>Wyoming Rare Earths Project Acquisition – 5 Unpatented mining claims on BLM US Federal Land totalling 71.6 acres (29 has) were acquired from Zenith Minerals Ltd.</p> <p>Sixty seven (67) additional unpatented mining claims were staked by ARR that totalled 1193.3 acres (482 ha). Overall, the ARR subsidiary controls 3101 acres (1255 ha) of mining claims and Wyoming State Leases.</p> <p>ARR staked an additional 182 federal claims in March 2022 covering an area of approximately 3,088 acres (1,250 ha).</p>
	<i>The security of the tenure held at the time of reporting and any known impediments to obtaining a licence to operate in the area.</i>	No impediments to holding the claims exist. To maintain the claims an annual holding fee of \$165/claim (\$11,880.00) is payable to the BLM. To maintain the State leases minimum rental payments of \$1/acre for 1-5 years; \$2/acre for 6-10 years; and \$3/acre if held for 10 years or longer.

<i>Exploration done by other parties</i>	<i>Acknowledgment and appraisal of exploration by other parties.</i>	Prior to sampling by WIM on behalf of Blackfire Minerals and Zenith Minerals there was no previous sampling by any other groups within the ARR claim and Wyoming State Lease blocks.
<i>Geology</i>	<i>Deposit type, geological setting and style of mineralisation.</i>	The REE's occur within Allanite which occurs as a variable constituent of the Red Mountain Pluton. The occurrence can be characterised as a disseminated type rare earth deposit.
<i>Drill hole Information</i>	<i>A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes:</i>	Authentic Drilling from Kiowa, Colorado used both a track mounted and ATV mounted core rig to drill nine HQ diameter core holes. From March to April 2022, WRE drilled nine core holes across the Halleck Creek claim area. Drill holes ranged in depth from 194 to 352.5 ft with a total drilled length of 3,008 ft (917 m).
	<i>easting and northing of the drill hole collar</i>	All relevant information for this section can be found in Table 1 of the report entitled "Summary of Maiden Exploration Drilling at the Halleck Creek Project Area", May 2022.
	<i>elevation or RL (Reduced Level – elevation above sea level in metres) of the drill hole collar</i>	
	<i>dip and azimuth of the hole</i>	
	<i>downhole length and interception depth</i>	
	<i>Hole length.</i>	No Drilling data has been excluded
	<i>If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case.</i>	
<i>Data aggregation methods</i>	<i>In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (e.g. cutting of high grades) and cut-off grades are usually Material and should be stated.</i>	Average Grade values were cut at minimum of TREO 1,500 ppm.
	<i>Where aggregate intercepts incorporate short lengths of high-grade results and longer lengths of low-grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.</i>	Assays are representative of each 5 ft (1.52 m) sample interval.
	<i>The assumptions used for any reporting of metal equivalent values should be clearly stated.</i>	No metal equivalents used.

Relationship between mineralisation widths and intercept lengths	<p><i>These relationships are particularly important in the reporting of Exploration Results.</i></p> <p><i>If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.</i></p> <p><i>If it is unknown and only the downhole lengths are reported, there should be a clear statement to this effect (e.g. 'down hole length, true width not known').</i></p>	<p>The geometry of the mineralisation with respect to drill hole angle is not yet known. Vertical holes represent true depth and angled holes represent down-hole length.</p>
Diagrams	<p><i>Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported. These should include, but not be limited to, a plan view of drill hole collar locations and appropriate sectional views.</i></p>	<p>See Figures in ASX Release "Halleck Creek Drilling Update" dated 24 November 2022.</p>
Balanced reporting	<p><i>Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practised to avoid misleading reporting of Exploration Results.</i></p>	<p>The latest exploration results reported in "Mapping and Surface Sampling Summary at the Halleck Creek Project Area: April 2022""</p> <p>All relevant information for this section can be found in Table 1 of the report entitled "Summary" of Maiden Exploration Drilling at the Halleck Creek Project Area", "May 2022.</p>
Other substantive exploration data	<p><i>Other exploration data, if meaningful and material, should be reported, including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.</i></p>	<p>In hand specimen this rock is a red colored, hard and dense granite with areas of localised fracturing. The rock shows significant iron staining and deep weathering.</p> <p>Microscopic description: In hand specimen the samples represent light colored, fairly coarse-grained granitic rock composed of visible secondary iron oxide, amphibole, opaques, clear quartz and pink to white colored feldspar. All of the specimens show moderate to strong weathering and fracturing. Allanite content is variable from trace to 2%. Rare Earths are found within the Allanite.</p> <p>Historical metallurgical testing consisted of concentrating the Allanite by both gravity and magnetic separation. The current program employs sequential high gradient magnetic separation and flotation to produce a concentrate suitable for downstream rare earth elements extraction. .</p>

Further work	<i>The nature and scale of planned further work (e.g. tests for lateral extensions or depth extensions or large-scale step-out drilling).</i>	Further drilling, mapping and sampling is planned.
	<i>Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.</i>	Locations of additional drillholes will be based on assay results when received.