VHD GRAPHITE TECHNOLOGY - THERMAL PERFORMANCE *BREAKTHROUGH* FOR HEAT DISSIPATION

Exceptional results for thermal diffusivity positions VHD Graphite as one of the highest-performing thermal materials available in the market, validating exciting commercial scalability

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- **Thermal Diffusivity Breakthrough** – VHD Graphite achieves peak of **288 mm²/s**, significantly surpassing copper, aluminium, and conventional graphite for mass market thermal management materials, confirming **unmatched heat dissipation efficiency** for **Artificial Intelligence** (**AI**) **cooling and high-performance electronics**.

- **Ultra-Lightweight Heat Spreading** – At **14.3% weight efficiency**, heat diffuses through VHD Graphite **12x faster** per unit of weight than copper, providing next-generation solutions for lightweight heat sinks and AI thermal management.

- **High Degree of Anisotropy Validated** – Testing confirmed a **25x directional advantage**, ensuring precision heat dissipation in AI data centres, GPUs and high-performance computing applications.

- **Outperforms Traditional Heat Sink Materials** – VHD Graphite delivers **3x higher thermal diffusivity than aluminium and standard graphite and 2.6x higher than copper, making it the most effective mass high-tech cooling material**.

- **Commercial Scalability & Process Repeatability Proven** – High-density and anisotropy results match lab-scale performance, with thermal diffusivity results confirming exceptional thermal management properties – demonstrating successful replication at the pilot-plant scale.

- **AI, Data Centre & Semiconductor Cooling Market Alignment** – With ultra-fast heat spreading, lightweight structure, and targeted cooling, VHD Graphite is ideal for high-density server racks, high performance computing, and AI processor infrastructure.

- **Next-Generation Heat Sink Innovation** – VHD Graphite's properties enable more weight efficient cooling solutions, replacing heavier, bulkier copper and aluminium in high-performance laptops, gaming consoles, and industrial power systems.

- **Progression to Heat Sink Design –** With exceptional thermal properties confirmed, progression to heat sink design and computational modelling will now commence.

Green Critical Minerals Ltd (**ASX: GCM** or the "**Company**") is pleased to report a major breakthrough in the validation of VHD Graphite's commercial scalability, with exceptional results generated in thermal diffusivity and anisotropy.

As AI computing, data centres, and high-performance electronics demand better heat management, traditional materials like copper and aluminium are facing limitations. VHD Graphite is not only demonstrating the ability to replace these materials but also significantly outperform them, with results showing the potential to offer a lighter, more efficient and cost-effective alternative for next generation cooling solutions.

Managing Director, Clinton Booth, commented: *"These latest results mark a significant milestone in proving VHD Graphite's ability to revolutionise high-performance thermal management. VHD Graphite has not previously been tested for thermal diffusivity and these results represent a new and advanced property of VHD Graphite and importantly, confirm its thermal performance superiority for applications such as heat sinks.*

"GCM engaged the University of New South Wales to use the latest and most precise technology to determine the thermal diffusivity of VHD Graphite. The confirmation of exceptional thermal diffusivity, in conjunction with anisotropy and high-density repeatability, demonstrates its potential to outperform copper and aluminium in AI cooling, semiconductor applications and next-generation heat sinks. With the demand for advanced thermal solutions increasing, VHD Graphite is emerging as the logical successor to traditional materials and a disruptor to the heat sink market.

"These results provide GCM with a high-level of confidence in delivering on the commercial scalability of the VHD technology and we will now move straight into the heat sink design phase. We have made excellent progress toward our primary objective of commencing commercialisation by the end of 2025 and we remain focused on continuing to execute on our strategy at a rapid pace and unlock the significant potential of our VHD technology"

Head of R&D for VHD Technology, Professor Andrew Ruys commented: *"The results from our latest testing confirm that heat diffuses through VHD Graphite* ***nearly three times faster than it does through aluminium and 2.6 times faster than it does through copper****, a significant breakthrough for AI processors, semiconductor cooling, and next-gen heat sinks. The validation of high anisotropy and industry-leading density further demonstrates its ability to deliver targeted, efficient heat dissipation in high-power applications where traditional materials fall short.*

"The ability to manufacture VHD Graphite with high density, a high degree of anisotropy, and a high thermal diffusivity, enable the opportunity to unlock its potential as a commercially viable, next-generation material for AI cooling and advanced electronics. With the results we have achieved we are confident that VHD Graphite has the potential to redefine thermal performance

benchmarks across multiple industries and become the superior choice for next-generation AI cooling, heat sinks, and semiconductor thermal management."

THERMAL DIFFUSIVITY: A CRITICAL BREAKTHROUGH FOR AI AND DATA CENTRE COOLING & SEMICONDUCTOR HEAT SINKS

Thermal diffusivity measures how fast heat spreads through a material, making it a crucial property for AI, data centres, semiconductor cooling and high-power electronics.

Unlike thermal conductivity, which tells us how easily one atom or molecule of a material accepts or gives away heat, thermal diffusivity tells us how quickly heat moves (or spreads) through an object. Thermal diffusivity plays a critical role in thermal management, as it determines how fast heat is transferred through a material so it can be dissipated to the surrounding environment.

In a practical sense, materials with a higher thermal diffusivity have the potential to be more effective in thermal management situations, as they have a potentially greater capacity to reduce hotspots, reduce radiant heat and move the heat faster to the desired location, the convection zone – improving the overall efficiency of the cooling system.

WHY THERMAL DIFFUSIVITY MATTERS FOR GCM AND TARGET MARKET

1. Faster Heat Dissipation = Improved Performance

- ✓ High thermal diffusivity means heat diffuses through VHD Graphite significantly quicker than copper or aluminium, which enables the potential to reduce hotspots which may accumulate when the heat generated from items such as AI chips, HPC systems, etc are unable to be dissipated quickly enough.
- ✓ High thermal diffusivity means heat can be moved to the convection zone faster, reducing radiant heat.
- ✓ High thermal diffusivity is a critical consideration for data centres, AI processors, and HPC, as increased diffusion of heat can potentially avoid / reduce the likelihood of thermal throttling, premature degradation and reduced component life, and unnecessary (wasted) energy consumption.

2. Better Thermal Shock Resistance

- ✓ Materials with high diffusivity have the potential to experience less thermal stress, reducing the risk of cracking or failure due to rapid temperature changes.
- ✓ VHD Graphite has the necessary properties to outperform materials in extreme-temperature applications, making it ideal for aerospace and renewable energy storage.

3. Efficiency in Thin Layers and Compact Designs

- ✓ In applications like thin heat spreaders, high diffusivity can potentially ensure efficient heat distribution across a wide surface area with minimal material usage.
- ✓ AI processors and GPUs will benefit from lighter, more effective cooling solutions, improving overall system efficiency.

KEY RESULTS

VHD Graphite (in-plane) achieves a peak thermal diffusivity of 288 mm^2/s and an average thermal diffusivity of 285 mm^2/s, making it one of the highest-performing thermal materials available in the mass market. See Appendix A for results from the sample set.

- **Compared to conventional materials**:
  - 3x higher than conventional graphite (96 mm^2/s)
  - 3x higher than aluminium (97 mm^2/s)
  - 2.6x higher than copper (111 mm^2/s)
- **Weight-Efficient Heat Transfer:**
  - At 14.3% weight efficiency, heat diffuses through VHD Graphite 12x faster per unit weight than copper (1.2%), providing a next-generation lightweight solution for high-performance cooling applications.

Material	Density (kg/m³)[1]	Thermal Diffusivity (mm²/s)[2,3,4]	% Weight Efficiency[5]
VHD Graphite	**2000**	**285**	**14.3%**
Conventional Graphite	1700	96	5.6%
Aluminium	2600	97	3.7%
Silver	10500	166	1.6%
Copper	9000	111	1.2%

Table 1 *Comparison of Thermal Diffusivity (mm²/s)*

- VHD Graphite achieves the highest thermal diffusivity values for mass market thermal management materials (peak 288 mm²/s, average 285 mm²/s), surpassing silver, copper, and aluminium.
- Compared to copper (111 mm²/s), VHD Graphite diffuses heat more than 2.6x faster, making it a superior heat dissipation material.

These findings confirm that **VHD Graphite has the potential to be the superior choice for next-generation AI cooling, heat sinks, and semiconductor thermal management**.

BREAKING THE COST BARRIER FOR HIGH-PERFORMANCE THERMAL MANAGEMENT

For decades, thermal management materials have been constrained by a trade-off between performance and cost. While high-performance materials like pyrolytic graphite offer exceptional thermal performance, they have remained too expensive and impractical for large-scale adoption, forcing industries to rely on cheaper but less effective materials such as copper and aluminium.

[1] Rounded to the nearest hundred
[2] VHD Graphite determined from test work performed by the University of New South Wales, using the laser flash process
[3] Determined from research conducted by GCM Management, http://www.tainstruments.com/pdf/literature/TPP028.pdf and https://www.engineersedge.com/heat_transfer/thermal_diffusivity_table_13953.htm
[4] Results present performance at room temperature
[5] Weight efficiency = 100×(Thermal Diffusivity)/(Density), a metric for lightweight thermal performance.

VHD Graphite changes this equation - By leveraging an innovative, scalable manufacturing process, GCM has successfully developed a material that delivers the superior thermal performance of premium-grade graphite at a fraction of the cost.

GAME-CHANGER FOR HEAT SINKS AND, HIGH TECH COMPUTING AND AI COOLING SYSTEMS

- **Lightweight and High-Performance** – 80% lighter than copper, with 3x higher thermal diffusivity than aluminium, enabling the potential for ultra-efficient cooling in AI data centres, high-performance laptops and next-gen semiconductor devices.
- **Scalable, Cost-Effective Production** – VHD Graphite is manufactured using a highly efficient, repeatable, and scalable process, eliminating the cost barriers that have historically prevented the widespread use of high-performance thermal materials.
- **Maximising Space Efficiency in Electronics** – Unlike traditional materials, VHD Technology has the potential for net shape forming, allowing the capability for custom-engineered heat dissipation components that optimise real estate in compact electronic devices. In smartphones, gaming consoles, and AI processors, every millimetre of space is valuable, making VHD Graphite potentially an ideal next generation cooling solution.
- **A Logical Replacement for Copper and Aluminium Heat Sinks** – Current AI cooling systems rely on copper and aluminium based heat sinks, which are heavy, have increasing supply challenges and are increasingly costly. VHD Graphite solves these issues by offering superior heat dissipation with favourable weight, cost, and design constraints.
- **Eliminating the Cost Barrier to Premium Thermal Materials** – The biggest hurdle to adopting high-performance materials in mainstream industries has been cost and scalability. The simple and scalable VHD Technology process, with its reduced energy consumption and incubation time removes this limitation, making it potentially a new viable high-performance alternative to copper and aluminium in heat sinks, power electronics, and energy storage.

With these thermal performance results and commercialisation efforts ramping up, VHD Graphite is poised to transform high-tech cooling systems, solving thermal challenges in AI-driven applications and unlocking new efficiency gains across multiple industries.

DEGREE OF ANISOTROPY: CONFIRMING UNMATCHED ALIGNMENT AND PERFORMANCE

One of the defining advantages of VHD Thermal Blocks is their anisotropic properties, which provide the foundation for the superior properties exhibited by VHD Graphite.

Testing confirmed a peak degree of anisotropy (alignment) of 24.9, matching the previous peak lab-recorded result of 25.7. See Appendix A for results from the sample set.

This exceptional alignment enables VHD Blocks to outperform traditional materials like copper and aluminium in targeted thermal applications, particularly in heat sinks and high-performance cooling systems.

The successful replication of alignment at pilot scale demonstrates that VHD Technology can reliably produce high-performance graphite at a commercial level.

PROGRESSING TO HEAT SINK DESIGN

The results received to date on anisotropy, density and thermal diffusivity provide GCM with the necessary data to progress to the heat sink design phase. GCM will now use this data to design VHD graphite heat sinks and to progress computational modelling to predict the behaviour of GCM heat sinks in an operating environment.

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Authorisation

The provision of this announcement to the ASX has been authorised by the Board of Directors of Green Critical Minerals Limited.

Forward Looking Statements

This announcement contains general information about GCM's activities current as at the date of the announcement. The information is provided in summary form and does not purport to be complete.

This release contains estimates and information that is based on projections, assumptions and estimates of our future performance and the future performance of the industry in which we operate and is necessarily subject to a high degree of uncertainty and risk due to a variety of factors, which could cause results to differ materially from those expressed in these publications and reports.

Appendix A – Table of Results[6,7]

Test #	Thermal Diffusivity (In-plane) mm^2/s	Degree of Anisotropy[8]
1	288.352	24.327
2	288.034	24.938
3	279.491	24.568
Average	**285.292**	**24.611**

[6] Testing performed by the University of New South Wales, using laser flash methodology
[7] Results presented for tests performed at room temperature
[8] Degree of anisotropy determined from the out of plane / in plane results from the laser flash thermal tests