

Mining

High purity silica sand for solar panels

December 5, 2023

Highlighted companies

Diatreme Resources (DRX)

DRX reported A\$41.8M in cash after the second tranche payment by industrial minerals miner and trader Sibelco for a 26.8% interest in DRX's Northern Silica Project, having a dominant ground position with 550km² under Exploration Licence (see map on Page 2). A Feasibility Study into development of 3Mtpy of HPSS for export through existing marine infrastructure is in progress. Sibelco is a major customer of Cape Flattery Silica Mines, and a shareholder in both Diatreme (19.3%) and Metallica (16.4%).

Metallica Minerals (MLM)

MLM has completed a Feasibility Study to develop the Reserves at its Cape Flattery Silica project and export 3Mtpy of HPSS, intending to export from a stand-alone jetty and loadout facility, located adjacent to MLM's Mining Lease Application and within the Port of Cape Flattery limits, as is permitted under government guidelines. Australian resource industry investor Ilwella has interests in both MLM (24.1%) and DRX (21.0%).

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Analyst(s) own shares in the following stock(s) mentioned in this report:

– Metallica Minerals (ASX:MLM)

- High purity silica sand (HPSS) is the primary raw material to manufacture high-quality glass for solar panels. China produces ~90% of this glass and ~80% of the fabricated panels. Silica sand is now considered a *Critical Mineral* in the European Union, the USA, and in Australia.
- Cape Flattery Silica Mines (CFSM), now owned by Mitsubishi Corporation, has operated for 57 years at Cape Flattery, 220km north of Cairns, and is the world's largest HPSS mine, with current exports of 3 million tonnes of product per year.
- ASX-listed Diatreme Resources (ASX:DRX) and Metallica Minerals (ASX:MLM) have Mining Lease Applications (MLAs) and granted Exploration Permits, each with resources defined to JORC Code (2012) standards, on the Cape Flattery dunefield, currently exploited by CFSM. Both companies are progressing their projects to production in negotiations with the Traditional Owners.

Demand for HPSS for PVCs

- To produce 1MW of photovoltaic cells (PVCs) requires ~40t of HPSS for the glass and 13t of solar grade polysilicon feedstock (SGPF). From 2021 to 2022 solar panel production capacity grew by 55% to 379GW (source [Statista.com](https://www.statista.com)). We estimate demand for HPSS for the glass was 20-25Mt, and Asia-Pacific seaborne trade ~9Mt, of which CFSM shipped an estimated 3Mtpy in 2022.

Strategic investors in HPSS companies

- Major non-Chinese participants in the HPSS market include, amongst others, Mitsubishi's Cape Flattery Silica Mines and the Belgium-based SCR-Sibelco NV, which operates world-wide to mine, process and sell a range of industrial minerals including silica. Sibelco has a 16.4% interest in Metallica Minerals and 19.3% interest in Diatreme, as well as a direct 26.8% interest in Diatreme Resources' Northern Silica project. Successful resource investor Ilwella Pty Ltd holds a 21.0% interest in DRX and 24.1% in MLM. These holdings should ensure that any corporate consolidation at Cape Flattery should be on equitable terms for the two junior companies.

Metallica (ASX:MLM) and Diatreme (ASX:DRX)

- In November 2023 Metallica Minerals updated its definitive feasibility study (DFS) for development of Cape Flattery Silica (CFS). A capital cost of A\$237M was estimated to produce 3Mtpy of HPSS from the Ore Reserve to JORC Code (2012) standards of 47Mt @ 99.18% SiO₂. Metallica has its own export solution, in conjunction with Far North Queensland Ports Corporation (Ports North), the administrator of Port of Cape Flattery. MLM's development incorporates a jetty contiguous with MLA 100284, and transshipment vessel to load oceangoing vessels for export 3km from the jetty.
- Diatreme delivered a Feasibility Study for its Galalar Project, but focus shifted to its Northern Resource project where a scoping study evaluated mining a resource of 235Mt @ 99.29% SiO₂ to JORC Code (2012) standards. An initial capital cost of A\$356M was estimated to produce 3Mtpy of HPSS. The Port of Cape Flattery operates under a sublease structure, with CFSM owning the *above deck* infrastructure including the shiploader, and Ports North the owner of the *below deck* assets. Diatreme intends to build its own outloading facilities for product transshipment to a vessel moored at the existing wharf and then load by use of geared vessels from barge to ocean going vessels for product export.

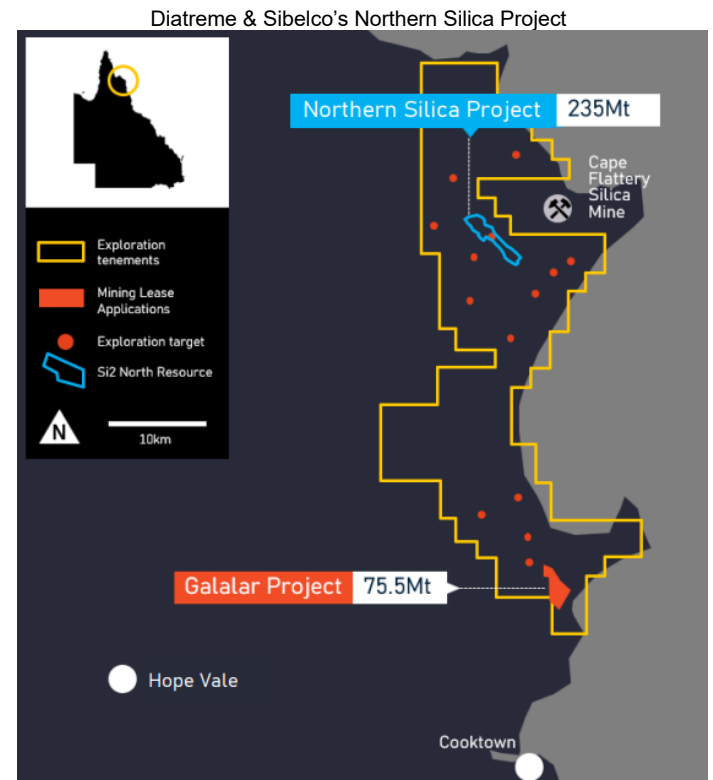
Engagement with Traditional Owners

- Resource companies must meet the regulatory standards for operational health and safety (OH & S) and for environmental, social and governance (ESG) at all levels of government to develop and operate resource projects. The informed consent and goodwill of the Traditional Owners and communities affected by the project and the associated logistics must be obtained and maintained. The Traditional Owners of the broader Cape Flattery area are the Dingaal, Nguurruumungu, Dharrpa, Gulaal, and Thanil clans of the Gammaay people. The Hopevale Congress Aboriginal Corporation is the Trustee Landowner for this area. The MLAs held by Metallica and Diatreme give them the right to negotiate with the Traditional Owners to develop the projects.

Key companies and projects

Diatreme – Northern Silica Project (73.2%)

The international silica miner and industrial minerals trader, Belgium-based Sibelco, has paid A\$35M for a 26.8% equity interest in Diatreme's Northern Silica Project (NSP), where a Scoping Study evaluated production from the resource of 235Mt at 99.29% SiO₂. The Galalar resource of 75.5Mt at 99.18% SiO₂ is located 40km to the south, and forms a part of the total project resource of 310Mt. Initially Diatreme's focus for development, Galalar has a Reserve of 32.5Mt at 99.20% SiO₂ to JORC Code (2012) standards. With development of shipping options restricted to the *Port of Cape Flattery* limits, imposed by the Queensland government, Diatreme has focussed on development of the Northern Silica resource. Diatreme held cash of A\$41.8M in late November 2023 after the early payment of the second tranche investment of A\$24M by Sibelco. This indicates a value of A\$160M for the NSP, and implies a value of A\$117M for DRX's interest. DRX's Market Capitalisation is A\$85.8M at A2.3cps, giving an EV for DRX's interest in the NSP of A\$31M, compared with the see-through valuation of A\$117M from the Sibelco investment. Sibelco also holds a 19.3% interest in DRX. Experienced Australian resource investor Ilwella Pty Ltd has a 21.0% interest in DRX (and 24.1% in MLM).

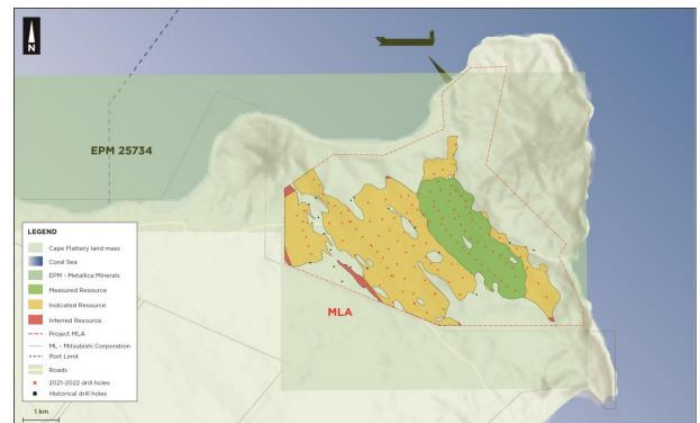


Source: Diatreme Resources - ASX Release, November 2023

Metallica's Cape Flattery Silica (CFS) project

The updated DFS modelled a product above 99.9% SiO₂, containing less than 100ppm Fe₂O₃ (the major deleterious element), produced from the Reserves with a yield of 86%. The modelled Free on Board (FOB) production cost is sub-\$30/t, and the sales price above A\$80/t, generating a strong margin. Metallica's proposed CFS jetty lies within the limits of the *Port of Cape Flattery* and is therefore not subject to the Sustainable Ports Act 2015, enabling Metallica to develop an export facility, subject to meeting the standards of Ports North. MLM has engaged with providers of transshipping services, which remain subject to the approval or the relevant marine authorities, but, as noted above, would represent less than 1% of tonnage shipped through the Marine Park. Successful Australia-based resource industry investor Ilwella Pty Ltd has a 24.1% interest in MLM (and 21.0% in DRX).

Metallica's CFS project – MLA, reserve & proposed jetty



Source: Metallica Minerals – ASX Release & Presentation, August 2022

Mitsubishi's CFSM

CFSM recovers silica sand by front-end loader, the sand then transported by conveyor belt or by slurry pipeline for washing and filtering, where rocks, vegetation and contaminants are removed. Graded product is then sent to CFSM's shiploader and wharf, with exports now estimated at ~3 Mtpy. The wharf deck is 220 metres long and there is a minimum water depth of 24 metres. Little information is available in the public domain about the resource tonnage and grade. In 1993 Cooper reported "reserves of 200Mt under mining lease", with the potential in the area "much greater" (Queensland Government Mining Journal 94).

CFSM's shiploader and Ports North's wharf at the Port of Cape Flattery



Source: Cape Flattery Silica Mines - <https://www.cfsm.com.au/ship-berthing>

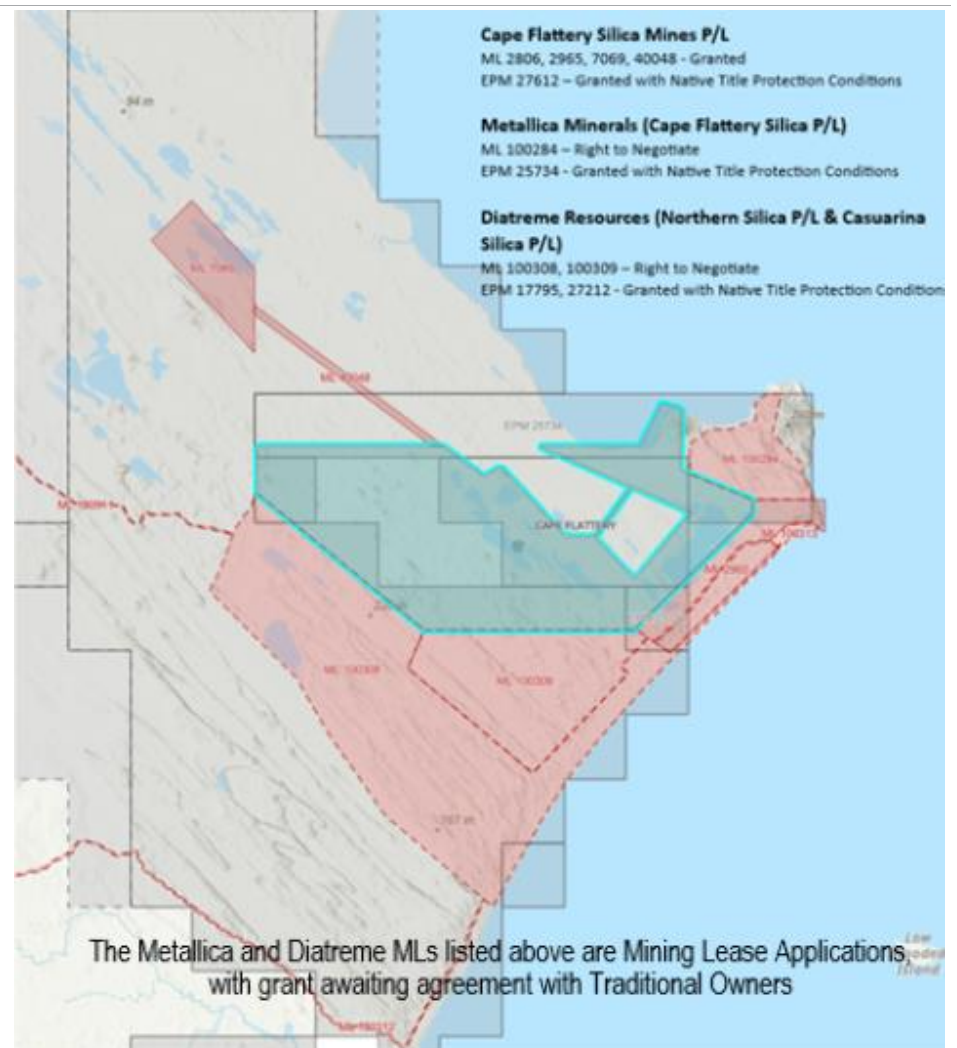
High purity silica sand dunefield

Cape Flattery – an established mine and two developers

Cape Flattery lies on the east coast of Cape York Peninsula, approximately 220km north of Cairns, and 35km from the Hope Vale township of 1,300 people. It abuts the World Heritage listed Great Barrier Reef Marine Park. The dunefield extends over 55km in a low-lying coastal plain up to 22km wide, commonly between 5m and 10m above sea level, with mounds rising to 90m. Older sand masses have been heavily leached, forming a deep white *A2 horizon* of pure silica sand. The optimum source of HPSS lies on bare apical mounds of the elongate parabolic dunes (p178, capeyorknrm.com.au).

Cape Flattery Silica Mines (CFSM) is the World's largest producer of HPSS with an estimated 30% of seaborne trade. Mining is by front end loader, the sand then transported by conveyor belt or by slurry pipeline for washing and filtering to remove rocks, vegetation and contaminants. Graded product is then sent to CFSM's shiploader and wharf, with exports now estimated at ~3 Mtpy. The shipping of this clean, pure silica sand represents less than 1% of tonnage shipped through the Marine Park.

Figure 1: Cape Flattery tenements – CFSM ML 2806 (Blue)



Source: <https://minserve.com.au/tenement-maps/>, Morgans

The Traditional Owners of the Cape Flattery area include the Dingaal, Nguurruumungu, Dharrpa, Gulaal, and Thanil clans, five of the 13 clans which constitute the *Hopevale Congress of Clans*. The Walmbaar Aboriginal Corporation is Trustee Landowner for the Dingaal clan.

ASX-listed companies, Diatreme Resources (ASX:DRM) and Metallica Minerals (ASX:MLM) have reported Resources to JORC Code (2012) standards and Metallica has delivered a Definitive Feasibility Study.

HPSS Specifications

Metallica reported projected product specifications from its CFS reserve on 18 September 2023 (Bulk metallurgical tests confirm High Purity Silica Sand at Cape Flattery), with a “spiral product”, an “attrition product”, and “WHIMS non-magnetic product”, as well as a “Hot Acid Leach” product. We show the specifications for the WHIMS product below.

Diatreme reported the specifications from its Galalar reserve in the south of its tenements on 22 April 2021 (Positive initial testwork results received for Galalar DFS), and they’re shown in the table below. Diatreme has yet to report for its Northern Silica project, now the focus for the company.

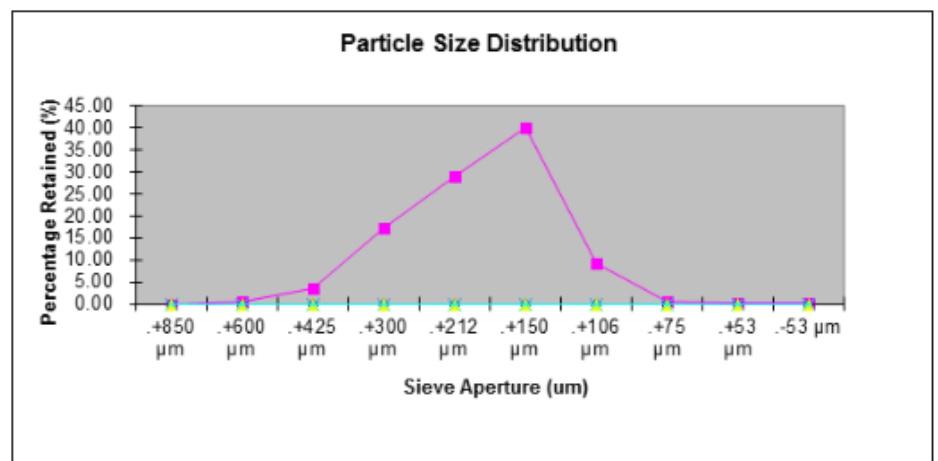
Figure 2: HPSS product specifications

CFSM Product		1990	2022	CFS	Galalar
SiO2	%	99.82	99.93	99.9	>99.7
Al2O3	ppm	500	300	340	500
Fe2O3	ppm	100	100	100	110
TiO2	ppm	200	200	200	140

Source: Cape Flattery Silica Mines - <https://www.c fsm.com.au/product>, Metallica Minerals -- September 2023, Cooper & Sawers (1990) in capeyorknrm.com.au, Diatreme Resources – April 2021.

The size distribution of CFSM’s product is shown below. Both the Metallica study of their CFS reserve and Diatreme’s Galalar study evaluated the grain size distribution of their respective projects, without identifying any fatal issues. These studies confirm the broad homogeneity of the formation of the dunefield, with higher purity silica sand formed by heavy leaching of parts of the dunes.

Figure 3: CFSM's HPSS particle size distribution



Source: Cape Flattery Silica Mines - <https://www.c fsm.com.au/product>

Development risks

Mining Lease Applications give the applicant the right to negotiate the terms of access with the each of the Traditional Owners. This is in train for both Metallica and Diatreme. Metallica appears to have a shipping solution, while Diatreme is yet to ink an agreement with Ports North and CFSM. China produces 90% of the glass for solar panels and dominates the HPSS market, which is opaque, and this dominance carries a risk to offtake tonnage and product pricing. Securing a market for product may be an issue for debt funding. All resource developments carry construction, commissioning and ramp-up risk, and ongoing operational risk, together with the obligation to maintain community goodwill.

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