REPORT

ON THE FIRST PHASE OF LIMESTONE EXPLORATION

IN MANJI AREA, DHOFAR REGION,

SULTANATE OF OMAN

APRIL, 2011

SUBMITTED BY:

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TO THE MINISTRY OF COMMERCE AND INDUSTRY,

SULTANATE OF OMAN

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1. INTRODUCTION:

1-1. Background and Objectives:

This first phase of exploration was carried out based on the scope of works described in the proposal submitted to the Ministry of Commerce and Industry in the month of February of 2011. The objective of this study was to assess the economic potential of the Manji Limestone, and also to decide whether to go for further exploration of phase second or not for further detailed study. This report includes the survey results of the preliminary study.

1-2. Accessibility to the prospect area:

The area under study is located about 386 km, north east of Salalah. The access to the area of study is gained through Shaleem Township. A distance of 45 km from Shaleem in north eastern direction is covered by the paved metelled road and about 11 km through unpaved mule tracks in almost horizontal and even ground. The given area is about 11km away from the main road and about 3 km from the seashore. There is no human activity of any worth or any human settlement in and around the given area. Also, very low vegetation is seen around. The prospect area having a total area of 4 sq km is enclosed by the UTM coordinates shown in table 1.

Table-1.

Point	Easting	Northing
1.	392000	1987000
2.	394000	1987000
3.	394000	1985000
4	392000	1985000

The location map of the prospect area is given in figure-1.

Figure-1

1.3 Team of the geological survey:

The members of team of the geological survey included Mr. Naushad Ahmad Ansari, Senior Geologist, Mr Majid Al Abri, Junior Geologist, Mr. Salim Ali Salim Ba Omar, a local representative and Mr. Imran Khan, field coolie.

1.4 Survey Period:

The preliminary fieldwork in the given area of study was conducted from 08.02.2011 to 11.04.2011, a total period of 60 days.

2. GEOLOGY:

2.1 REGIONAL GEOLOGY:

The sedimentary cover is the most extensive litho-stratigraphic unit outcropping in Oman. It covers about two thirds of the country. Exposures in Interior Oman and Dhofar are almost continuous. They are made up of sedimentary rocks that are typically marine at the base, deposited from the end-cretaceous to earliest miocene, represented by the Aruma, Hadhramaut and Dhofar Groups. These are overlain by shallow-marine to continental deposits from miocene-pliocene, represented by the Fars Group. Despite the diversity of sedimentary environments and facies in the sedimentary cover, carbonate rocks in general, particularly fossiliferous shelf limestone predominate. These rocks represent a further, long period of flooding of the Arabian continental slope and shelf. In addition,

presence of marl and chalk, with other deeper marine deposits such as turbiditic calcarenite and calcirudite, indicate pronounced subsidence of intra-shelf basins or narrow troughs within the shallow-marine carbonate shelf environment.

A thick sequence of tertiary rocks ranging in age from Paleocene to Pliocene is present in Southern Oman. At the base, the Umm Er Radhuma Formation is comprised of massive, hard, compact and partly recrystallized limestone which includes the Hasik Member in which the limestone deposits occur. A total thickness of 450 m for the limestone deposits present in the souther Oman is reported. The lowest unit of limestone is comprised of bedded nodular limestone, whereas the upper unit is said to be recrystallized massive white limestone.

The geological map of the concession area is given in figure-2.

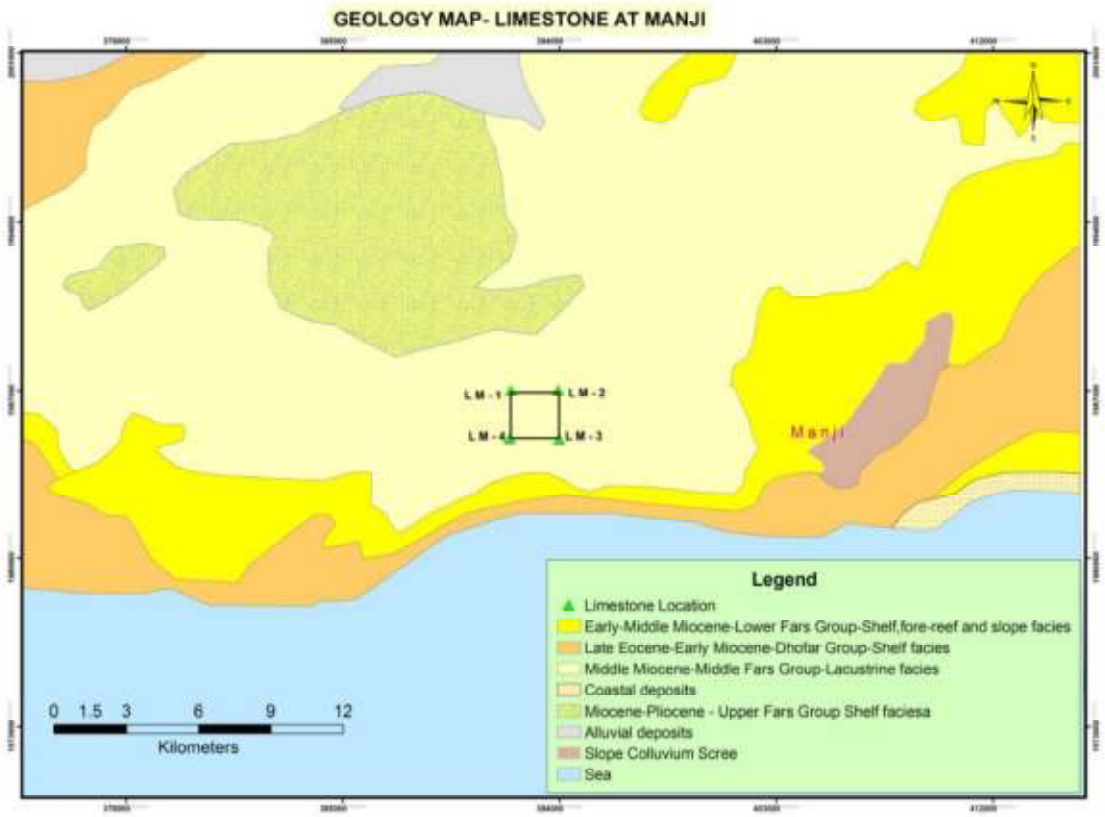

Figure-2

2.2 LOCAL GEOLOGY:

It is dominated by carbonate rocks belonging to Fars Group. They are largely made up of fore-reef limestone with large, spherical corals, and debris-flow deposits. These rocks are mostly similar to the rocks of Dam Formation. The limestone is intercalated with calcareous mudstone, siltstone,

calcareous shale and calc-arenite. At places, limestone has become dolomite. The sedimentary supply to the basin, fluctuations in the level of flow and facies distribution appear to have been largely controlled by the sedimentary tectonics. The lithological and chemical characteristics of the limestone exposed in the concession area are fairly good.

Studies were made at many of the locations selected in the given area. The observations made at some of the interesting locations are written hereunder:

1. **Location number 1 (392006 E and 1987000N):** This location is at the point number 1 of the concession area. The limestone exposed at this location is generally white in color. But, at places, it has variation in color shades from greenish to reddish. This variation may be attributed to the impurities in the bed rocks of limestone. The limestone is fine to medium grained and massive in nature. It is characterized by the emission of small bubbles of gas on the reaction with acid. At places, ferruginous contents are seen present in the limestone. The paucity of outcrop is observed in the concession area which is more or less an even and horizontal land area. The limestone is found exposed on surface at some places. There is almost no overburden on the top of beds of limestone. Because of reddish tinting in the body of limestone at places, presence of various fossils and the observation of oxidation effects on the exposed surfaces, it may be inferred that the depositional environment for these carbonate rocks was shallow-marine to continental. Photo-1 shows the broken fragments of limestone at this location.

Photo-1

2. **Location number 2 (392001 E and 1985001 N):** This location represents the point number four of the concession area. At this location, pure white limestone occurs. Some chert or flint nodules are seen at places in the beds of limestone. This limestone appears to be similar in its physical and chemical properties to the one seen at location number 1. The primary source of calcite seems to be from the marine organisms. Photo-2 shows this location.

Photo-2

3. **Location number (393090 E and 1983778 N):** At this location, weathered limestone is seen. It is usually of white color. Because of impurities, such as clay, sand and organic remains, this limestone exhibits different colors, at places. The crystals of calcite and quartz appear to line small cavities in the bed rocks. Photo-3 shows the general view of limestone towards the coastal side.

Photo-3

4. **Location number 4 (393995 E and 1985001 N):** The limestone exposed at this location is generally calcium rich. But, at places, it grades to flaggy limestone as well. Because of impurities, such as clay, sand, organic remains and other materials, it exhibits different colors, particularly on the weathered surface. All the other qualities of limestone specially related to its chemical characters appear to be uniform in most of places. Photo-4 shows point number 2 of the concession area.

Photo-4

Limestone was observed at other locations also in and around the concession area. The quality of limestone appears to be similar and more or less uniform. It is mostly found to be pure white or almost white limestone.

2.3 SAMPLE COLLECTION:

In total, 13 representative samples were collected during the field traverses in the concession area. The figure-3 shows sample location Map.

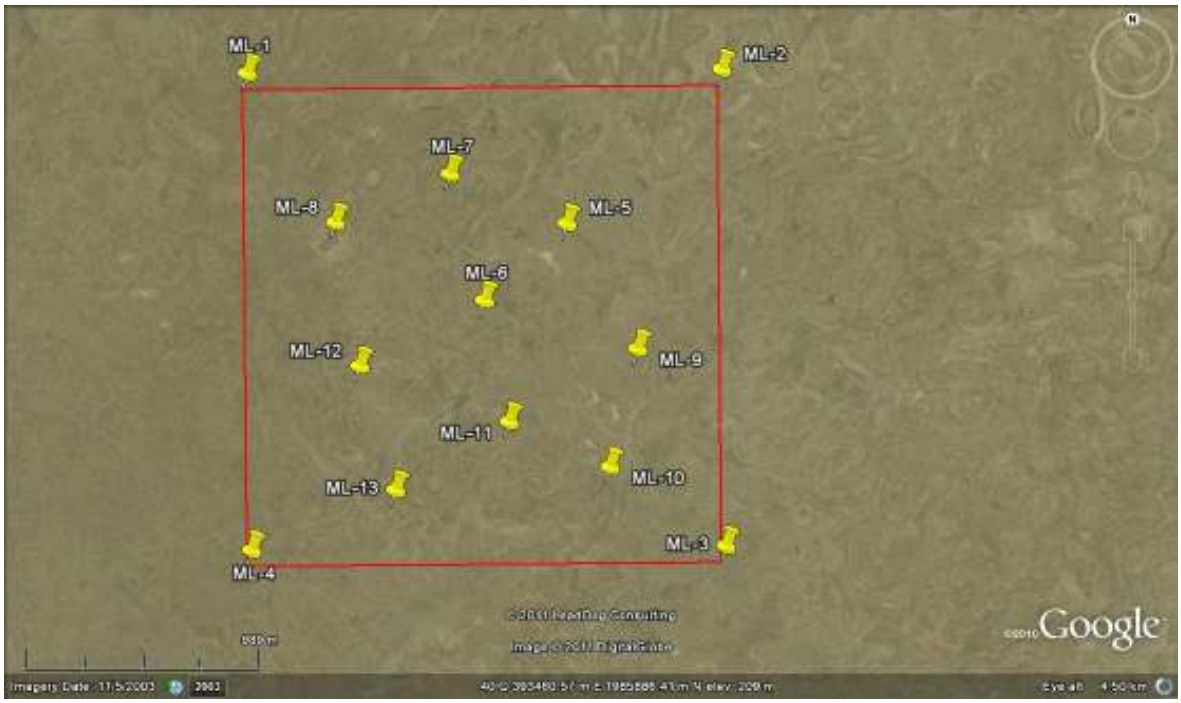

Figure-3

The samples were analyzed for various oxides. The average content of CaO in the samples is 51.012% indicating a very good quality of limestone. The assay results are tabulated in table 2.

Table2

Sr.No		1	2	3	4	5
Sample NO.		ML-1	ML-2	ML-3	ML-4	ML-5
Location (UTM)	Easting	392006	392001	393995	393997	393341
	Northing	1987000	1985001	1985001	1986997	1986359
SiO_2 %		1.03	0.61	17.18	0.98	0.49
Al_2O_3 %		0.1	0.08	<0.01	0.06	0.07
Fe_2O_3 %		0.04	0.04	0.13	0.04	0.04
CaO %		53.14	52.88	43.56	53.09	52.39
MgO %		<0.01	0.503	0.37	0.55	0.67
Na_2O %		<0.01	<0.01	<0.01	<0.01	<0.01
K_2O %		0.02	0.02	0.02	0.02	0.02
$CaCo_3$ %		94.85	94.37	77.75	94.75	93.50
Moisture %		0.04	0.16	0.13	0.03	0.24

The high quality of this limestone can be used in cement manufacture as well in various other industries for which some other commercial testing are to be carried out.

Limestone has a wide range of uses such as in cement, iron-steel, chemical and building construction industries etc. Limestone is also important as a reservoir rock for oil accumulations. Powdered

limestone is an important agricultural commodity. Many limestones (chalk being a notable exception) contain a significant proportion of detrital material like sand and clay as an impurity.

Pure or impure limestone may be used if it has a fairly uniform chemical composition and contains CaCo3 in a higher proportion. The assay results show that the prospect area has an average CaCo3, 91.044 %. The presence of silica from the limestone has to be removed.

Specification of limestone for manufacturing of cement requires CaO 45 % and above (preferred), where as for iron and steel industry, CaCo3 content in limestone should not be usually less than 90 %. For chemical industry, CaO should be in the range of 53 to 54 %. The contents for impurities of various oxides are also specified for limestone to be used in various industries.

It is not possible to estimate total mineable reserves at this stage in the concession area. However, on the basis of visual inspection taking the possible thickness of the body of limestone as 50 m, a probable estimate of reserves is calculated. It comes out to be around 50 million tons.

3. EXPLORATION RESULTS:

A. Limestone Deposits containing higher proportion of CaCo3 with less amount of impurities were identified. The limestone is generally pure white, fine to medium grained, crystalline, more or less uniformly composed and rich in calcite minerals.

B. The assay results show average CaO percentage to be 51.012 %.

C. The results of fieldwork confirm the prospectivity of limestone in the entire concession area.

D. The probable geological reserves of the limestone based on the visual inspection and on the review of the literature in the given area of study are estimated to be around 50 million tones.

4. EXPENSES INCURRED: FIRST PHASE OF EXPLORAITON

Total Expenses Incurred by Company for their Exploration program on Manji Block - From Feb 2011 to April 2011.		
S.No.	**Particulars**	**Amount (OMR)**
1	**Salaries for Employees**	**2750.000**
2	**Transportation & Telephone Allowances**	**195.000**
3	**Medical Allowance**	**12.000**
4	**Vehicle Running & Maintenance**	**120.000**
5	**Tea & Refreshment**	**125.000**
6	**Chemical Lab Expenses**	**520.000**
7	**Printing & Stationery Expenses**	**55.000**
8	**Site Engineering Consumables**	**365.000**
9	**Other Miscellaneous Expenses**	**180.000**
10	**Office Rent**	**1200.000**
11	**Electricity & Water Expenses**	**205.000**
12	**Telephone, Internet & Fax**	**75.000**
13	**Fixed Assets (Computer, Printer Etc)**	**1265.000**
	Total	**7067.000**

5. CONCLUSION:

Based on the results of the fieldwork and results of the chemical analyses of the surface samples, it is concluded that the entire area of concession is prospective and has the potential of economic interest for limestone trading.

6. RECOMMENDATION:

Based on the results of the first phase of exploration, it is recommended that the second phase of exploration should be taken up.

7. EXPLORATION PROGRAM FOR SECOND PHASE - PHASE-II: DETAILED STUDY :

a) Drilling and pit sampling
b) Sample analysis and determination of overall grade of the mineral.
c) Estimation of Reserves.

Methodology:

a) **Drilling and pit sampling:** It is envisaged to drill at least 40 boreholes of 25 meter deep. Excavation of few pits at the selected spots close to or on the exposed mineral body shall also be done. The choice for such option shall depend on the results of geological setting.

Core samples will be described and preserved for each meter of drilled depth. Borehole logs and reports will be prepared for each borehole. Alternatively, pits will be excavated in an appropriate numbers as required using rock breaking machines. The pit dimension will be of the order of 1x1x3(m). The rock samples will be collected with change in depth. A profile of mineral quality will be developed. Drilling and pit data will be used to construct cross-sections for different parts of the concession area in order to estimate the available reserves. During the course of mining extension drilling programs will be undertaken to discover beyond 25 m depth.

Stage - 1		
Activity	**Cost (Rial)**	**Time (Months)**
Target generation	6500	**2**
Resource Drilling @ OMR 7.5 per meter		
Total	**6500**	

b) **Analysis of ore samples:** The ore samples collected from drilling of boreholes and excavation of pits will be chemically analysed. The basis and the procedure will be the same as adopted in a standard modern laboratory. The chemical tests will be to analyse the percentage of CaO and other related elements.The presence of tracer elements in the mineral that may have an adverse impact will be ascertained. The mineral quality will be confirmed together with the earlier results of the assay.

c) **Reserve Estimation:** Upon completion of the drilling program, the results will be fully examined and cross-sections extended as appropriate to define the resource. Based on the topographical survey and geological cross sections, the resource reserves will be calculated. Results and all related supporting documents will be compiled in a report that will conclude the reserves available in metric ton.

Stage - 2		
Activity	**Cost (Rial)**	**Time (Months)**
Sample Analysis & Studies	1750	**1**
Resource & Scoping studies		
Total	**1750**	

8. BUDGET FOR PHASE II

Month wise Budget Description

YEAR 1 BUDGET DETAILS	MONTHS		
Stage - 1	**1**	**2**	**3**
Target generation	500		
Resource Drilling @ OMR 7.5 per meter	3000	3000	
Exploration Management & Staff	1225	1225	1225
Stage - 2			
Sample Analysis & Studies			1600
Resource & Scoping studies			150
TOTAL	**4725**	**4225**	**2975**

Logistics / Administration /
Support for 3 months

L/A/S	Month 1	Month 2	Month 3
Office & Office Equipments	600	600	600
Accommodation & Meals	120	120	25
Travel	280	280	50
Vehicle Running and Maintenance	120	100	50
Project Manager	1000	1000	1000
Engineering Consumables	120	120	50
Accounts / Admin	300	300	300
TOTAL	**2540**	**2520**	**2075**

9. BUDGET SUMMARY:

Table - 1 Summary Budget Allocations

Stage	Activity	Cost	Time (Months)
1	Target generation	6500	2
	Resource Drilling		
2	Sample Analysis and Studies	1750	1
	Resource Studies		
	Scoping studies		
	Logistics/ Administration / Support / Misc	7135	3
	Exploration Management Cost & Staff Cost	3675	3
	Total Exploration Cost	**19060**	**3**

10. REFERENCES:

A book entitled, 'Geology and Mineral Wealth of the Sultanate of Oman', and a Mineral Occurrence and Metallogenic Map of North Oman on 1:500,000 scale, published by the Ministry of Petroleum and Minerals, Directorate General of Minerals, Sultanate of Oman have been consulted while making this proposal.