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Aerial Drone Survey and Geological Interpretation for Exploration and Reserve Estimation of Quartz Mineral in the Vicinity of Village Jawad, Tehsil Mavli, District Udaipur – A Comprehensive Study on Land use and Geological Mapping

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Abstract

This technical research explores the application of drones for geological and land use mapping, focusing on the exploration and reserve estimation of quartz minerals in the vicinity of Village Jawad, Tehsil Mavli, District Udaipur. Drones offer unparalleled capabilities in terms of resolution and spatial coverage, enabling the acquisition of high-resolution imagery capable of discerning individual rocks. By utilizing multiple ground-control points, the drones achieve a high level of geo-referenced accuracy for the produced Orthomosaic product. Integration of field observations with drone data enables rapid and precise documentation of exposed outcrops. The resulting products provide exploration experts with an expanded and comprehensive perspective, facilitating the verification and validation of data collected through conventional field surveys.

The drone mapping survey covered an area along the quartz ridge near Village Jawad, Tehsil Mavli, District Udaipur, encompassing 101.528 hectares. The primary objectives of the survey were to determine the extension of quartz mineral occurrences, assess the surrounding area, and delineate and differentiate between government and private land use. The drone mapping operation followed an east-west flight path, while ground control points were established with the assistance of rovers equipped with Differential Global Positioning System (DGPS) technology. The findings of the drone mapping and geological interpretation contribute valuable insights for understanding the distribution and characteristics of quartz mineral deposits, as well as the land use patterns in the study area.

Keyword: *Drone survey, geological interpretation for exploration, Reserve estimation, Quartz mineral, mapping, Comprehensive*

1.0 Introduction

Scope of work: Project overview

Conduct a technical research study on the application of drones for geological and land use mapping.

Focus on exploring and estimating quartz mineral deposits in the vicinity of Village Jawad, Tehsil Mavli, District Udaipur.

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A. Objectives

1. Determine the extension of quartz mineral occurrences in the study area.
2. Assess the surrounding area and differentiate between government and private land use.
3. Delineate and document exposed outcrops of quartz minerals.
4. Provide exploration experts with comprehensive data for verification and validation.

5. Contribute insights for understanding the distribution and characteristics of quartz mineral deposits.
6. Identify land use patterns and types of land where minerals are occurring.
7. Assist in the demarcation of land use and planning of mining leases demarcations and operations.
8. Contribute to the development of sustainable mining strategies.

B. Survey Area

1. Cover an area along the quartz ridge near Village Jawad, Tehsil Mavli, District Udaipur.
2. Survey an area encompassing 101.528 hectares

C. Drone Mapping Survey

1. Utilize drones to acquire high-resolution imagery for geological and land use mapping.
2. Conduct the survey along an east-west flight path.
3. Establish ground control points using rovers equipped with Differential Global Positioning System (DGPS) technology.
4. Achieve a high level of geo-referenced accuracy for the produced Orthomosaic product.
5. Ensure the integration of field observations with drone data for documentation of exposed outcrops.

D. Geological Interpretation

1. Perform a comprehensive analysis of the acquired drone mapping data.
2. Identify and document the characteristics of quartz mineral deposits.
3. Estimate mineral reserves based on outcrops and mineral exposures.
4. Differentiate quartz deposits from surrounding Feldspar and Schist rocks.

E. Data Analysis and Reporting:

1. Analyze the findings of the drone mapping and geological interpretation.
2. Provide detailed reports on the extension and characteristics of quartz mineral occurrences.
3. Present insights into land use patterns and types of land where minerals are occurring.
4. Deliver data and analysis to support the demarcation of land use and planning of mining leases and operations.
5. Include recommendations for sustainable mining strategies based on the study's findings.

F. Deliverables

1. High-resolution imagery and Orthomosaic products of the survey area.
2. Detailed reports on quartz mineral occurrences, extension, and characteristics.
3. Documentation of exposed outcrops and geological observations.
4. Insights into land use patterns and types of land where minerals are occurring.
5. Recommendations for sustainable mining strategies.

Location of the area

The project area spans from latitude 24° 52' 13.87" N to 24° 52' 50.77" N and longitude 73° 50' 20.37" E to 73° 51' 19.85" E, corresponding to GT sheet No. 45L/10.

The project area is easily accessible via National Highway 58, starting from Udaipur to Nathdwara, with a distance of 65 kilometres. From Nathdwara, there is a 5-kilometre stretch to reach Jawad, and from Jawad, the project site is approximately 600 meters away. The nearest railway station, Mandiyana, is located on the route from Mavli Junction to Mewar Junction, and it is about 7 kilometres away from the project area.

Drone used for survey

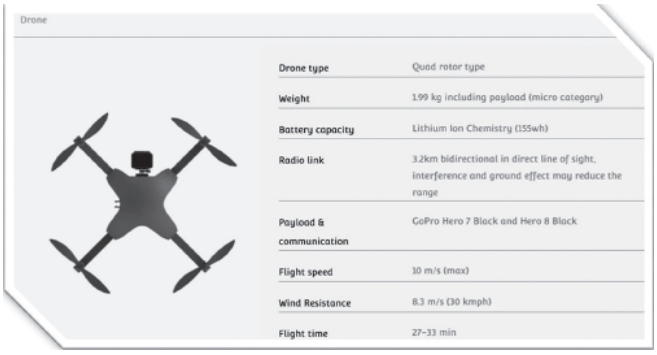


Figure 1: Technical description of drone used for survey and mapping

Defining Drone Survey Flying Path

A drone flight plan is a predetermined combination of instructions, including coordinates, speed, altitude, direction, heading, gimbal actions, camera actions, and more that serve the purpose of guiding a drone in accomplishing a flight, and carrying out a particular mission:

1. Flight path: determined most using a series of longitudes/ latitudes and altitudes (waypoints) that automatically navigates the aircraft.
2. Speed: you may want a lower, consistent speed throughout the flight plan, ideal for mapping, or you may want to zoom to specific waypoints to perform specific tasks, such as 'hover' or '360.'
3. Heading: the drone does not have to face in the direction it is moving; for example, you may want to orient it toward

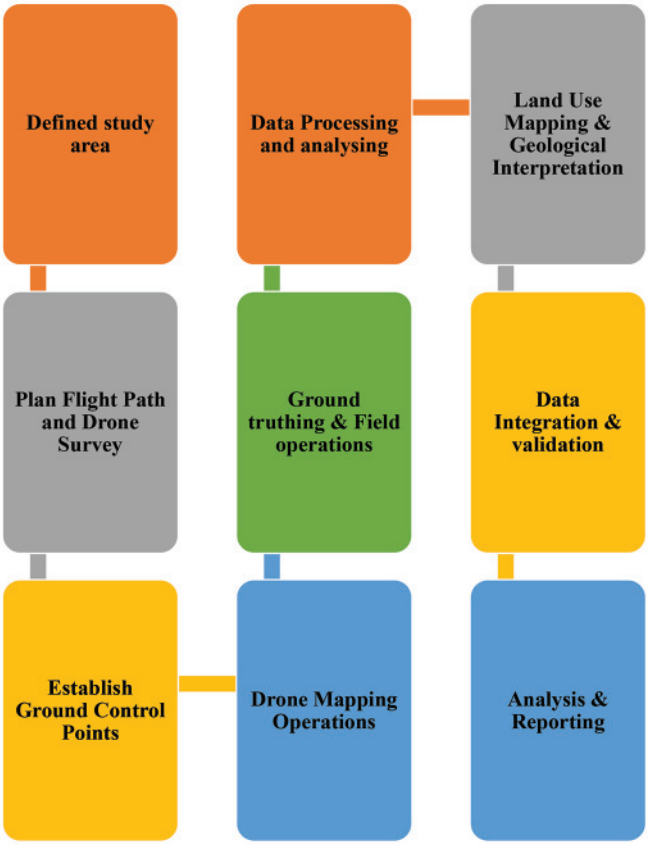


Figure 2: Process flowchart - methodology

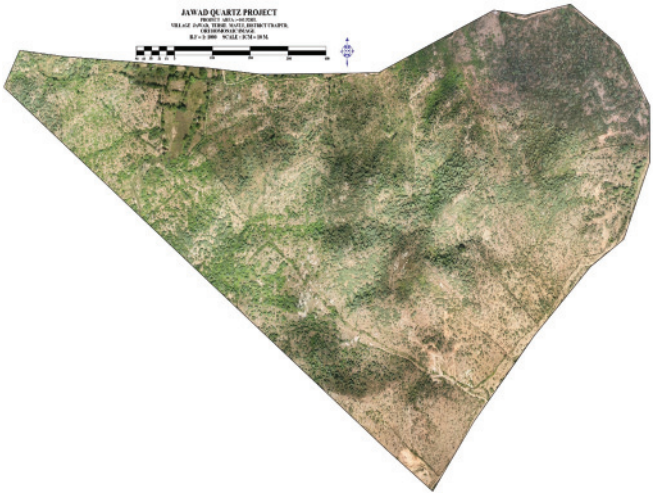


Figure 3: Orthomosaic image of the area

a Point of Interest (POI) which can be set in some flight applications.

4. Gimbal actions: depending on whether you are mapping, inspecting, filming, live broadcasting, etc., you may want to automate gimbal actions or retain manual control.
5. Camera actions: video/image and choosing the right camera settings for your purpose.
6. Situational behaviour: Set action to Return-to-Home or Hover, set the proper return altitude, and be aware of all obstacles that could be present between you and the drone's flight path

Table 1: Khasra details falls in the project area

	Khasra no.	Area in hect.	Land status
1	677	1.1979	Banjad private land
2	678	4.2087	Banjad private land
3	679	3.7396	Banjad private land
4	5440/679	0.4047	Banjad private land
5	5587/679	0.2428	Banjad govt. Land
6	680	1.1574	Banjad govt. Land
7	5632/680	4.2087	Banjad private land
8	681	1.4569	Banjad private land
9	682	0.7851	Banjad private land
10	683	0.3237	Banjad private land
11	684	0.1052	Banjad private land
12	685	4.4515	Banjad private land
13	686	0.3642	Banjad private land
14	687	1.9506	Banjad private land
15	5441/687	1.2950	Banjad govt. Land
16	5592/687	1.9506	Banjad private land
17	688	1.9506	Banjad private land
18	5488/688	1.3597	Banjad private land
19	5489/688	1.3678	Banjad private land
20	689	1.6026	Banjad private land
21	5553/689	1.6106	Banjad private land
22	690	6.3296	Banjad private land
23	691	1.1331	Banjad private land
24	5544/691	1.1331	Banjad private land
25	692	1.4002	Banjad private land
26	693	0.9712	Banjad private land
27	694	0.7932	Banjad private land
28	695	0.9470	Banjad private land
29	696	1.8777	Banjad private land
30	5545/693	0.4856	Banjad private land
31	697	4.6701	Banjad private land
32	698	2.5333	Banjad private land
33	699	7.8914	Banjad private land
Total area		65.8994	
Remaining part		35.6286	Khasra details are not available
Total project area		101.5280	

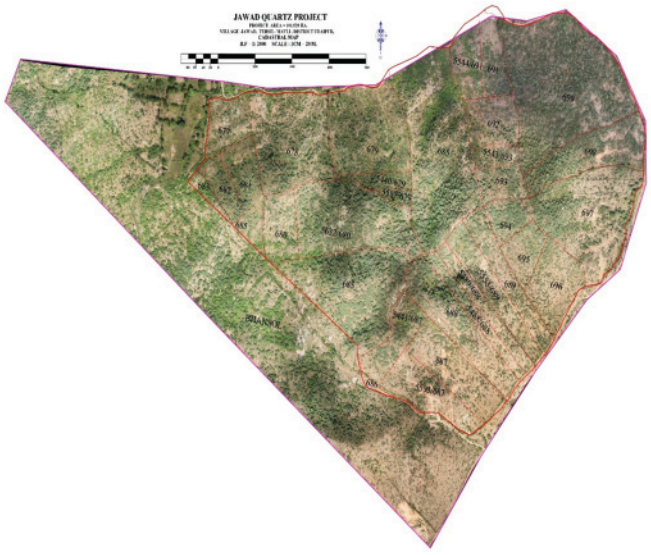


Figure 4: Cadastral map superimposed on project area orthomosaic image

Regional Geology

The initial geological study of the area was conducted by C.A. Hacket, followed by A.M. Heraon in 1935. Dr Heron conducted a detailed analysis of various litho units and classified the Bended Gneises Complex (B.G.C) as part of the Archaean system, while categorizing impure limestone, Quarzite, Phylite, and Biotite under the Aravali System. In the vicinity of the Sarada inlier, B.C. Podar from 1963 to 1965 and Iqubaluddin from 1966 to 1968, both from the Geological Survey of India (GSI), conducted geological mapping. Their findings align with Dr Heron's interpretations, which included considering the Debari conglomerate Quartzite formation as coeval with the basal Aravalli rocks.

Local Geology

The project area is characterized by a predominantly hilly terrain situated near the village Jawad, Tehsil Mavli, District Udaipur. In the southern portion of the project area, the quartz rock formations are prominently exposed. These quartz rocks exhibit sharp crests and form a small ridge with a relatively low elevation, which runs approximately in a North-South direction. Towards the southwestern part of the project area, there is an occurrence of a patch of Granitic feldspar. The remaining portion of the project area is predominantly composed of Feldspar and Schist rocks.

The ridge, along with the presence of buried pediments covered by a layer of soil and scattered local vegetation, contributes to the picturesque landscape of the area. The combination of these geological features and the natural elements in the project area creates a visually appealing setting.

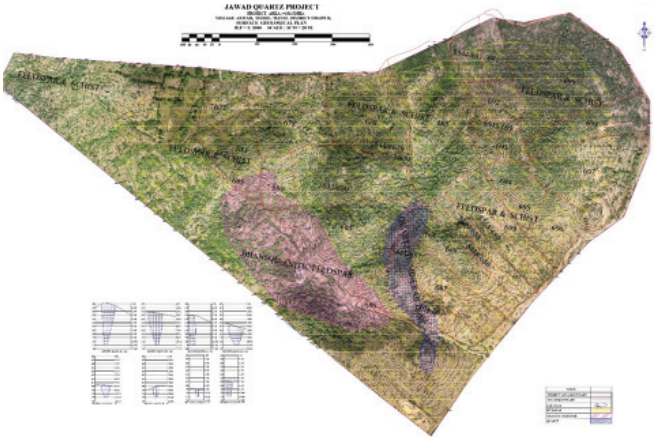
Surface Plan and Geological Sections

The surface plan of the study area was meticulously prepared in Cad software at a scale of 1:2000, with contour intervals set at 3.0 meters. This plan, depicted in Figure 1, encompasses all the relevant features identified in the area. Additionally, a surface geological plan was developed at the same scale of 1:2000, illustrated in Figure 2. Well-defined Quartz bodies, crucial for reserve estimation, were marked with solid lines on this plan. The entire study area has been adequately explored, with outcrops providing valuable information. It has been determined that the mineral exists in the area at varying depths and in the direction of the strike.

Geological sections were prepared on a scale of 1:2000 and are presented in Figure 2. Eight cross-sections were specifically created in the mineralized area to facilitate reserve estimation. The cross-sectional method was employed for estimating the geological reserve. The volume of the mineral was multiplied by the specific gravity of 2.65 per cubic meter, and for Feldspar, the specific gravity of 2.7 per cubic meter was used. These calculations enabled the estimation of the geological reserve in metric tonnes.

Table 2: Details of Mineralized area

	Particulars	Area in ha
1	Aerial drone survey with geological mapping	101.528
2	Quartz Mineral zone	2.8000
3	Granitic Feldspar	9.162
4	Feldspar & Schist	89.566



Conclusion of Study In exploring the extent of Quartz deposit and land use mapping

Based on the comprehensive study conducted to explore the extent of Quartz deposits and land use mapping, it has been observed that a significant portion of the study area is

Table 3: Summary of quartz reserves

mRL	Sections								Total
	A1 - A2	B1 - B2	C1 - C2	D1 - D2	E1 - E2	F1 - F2	G1 - G2	H1 - H2	
680-670	41905	0	0	0	0	0	0	0	41905
670-660	38547	0	0	0	0	0	0	0	38547
660-650	35371	29387	0	0	0	0	0	0	64759
650-640	34315	39597	20929	0	0	0	0	0	94841
640-630	29020	38653	17160	0	0	0	0	0	84833
630-620	25844	35765	17201	5004	0	0	0	0	83814
620-610	22668	31395	17192	35284	0	0	0	9574	116113
610-600	19494	23877	16635	39147	12706	0	0	16478	128337
600-590	16317	20753	15295	33144	22692	19759	0	15341	143301
590-580	13141	15814	14064	24635	18830	15194	10033	13071	124782
580-570	9957	10951	12797	14595	10416	10372	6923	11419	87430
Total	286578	246193	131273	151810	64644	45326	16956	65883	1008662

Table 4: The calculations of geological reserves of granitic feldspar

Area in sqm	Estimated depth in m	Volume in cum	Specific gravity	Recovery			
				Tonnage	Blockable 5%	Khanda 45%	Rejection 50%
91620	10	916200	2.7	2473740	123687	1113183	1236870

Table 5: The calculations of geological reserves of feldspar

Area in sqm	Estimated depth in m	Volume in cum	Specific gravity	Tonnage	Recovery	
					Feldspar 30%	Rejection 50%
895660	10	8956600	2.7	24182820	7254846	16927974

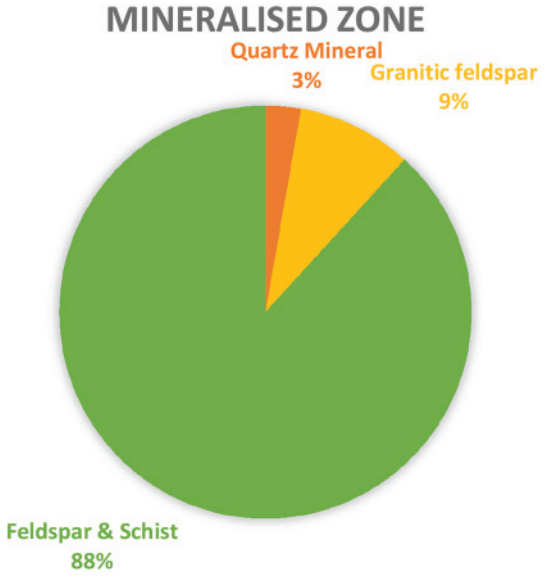


Figure 5: Pie chart shows the distinguished mineralised zone

Table 6: Summary of geological reserves

	Type of mineral	Total geological reserves (tonnes)
1	Quartz	1008662
2	Granitic Feldspar	1236870
3	Feldspar	7254846

concealed beneath the cover of Feldspar and Schist rocks. However, a small patch of the area is exposed and contains Quartz minerals, enabling the determination of the extent of Quartz deposits. The utilization of Drone Mapping and Geological Interpretation has played a crucial role in distinguishing the geological characteristics of the mineral and estimating the mineral reserves based on outcrops and mineral exposures.

Furthermore, this study has also provided valuable insights into land use patterns and the types of land where

minerals are occurring. This information is crucial for the effective demarcation of land use and the planning of mining leases and operations. By incorporating scientific and systematic mining practices, the findings of this study contribute to the development of sustainable mining strategies in the area.

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