هيئة المساحة الجيولوجية السعودية
SAUDI GEOLOGICAL SURVEY

REPORT

CYCLE 2 – STAGE 1

Data collection, Digitization and Validation of Data and Reports

Al Khashabi



Prepared for: **The Accelerated Exploration Programme Initiative, Saudi Geological Survey**

Effective Date: 31 July 2024

MSA GC
GOLDEN COMPASS MSA CONSORTIUM

Submitted on 31 July 2024
Revised 22 August 2024

Report prepared by The Golden Compass Mining and MSA Group Consortium (GCMSA) in conjunction with the SGS Accelerated Exploration Programme Initiative Team.

Authors & Reviewers GCMSA	General Manager	Dr Murigeppa Malapur	MAusIMM, FMEAI
	Gold & Base Metals Expert	Mike Robertson	Pr.Sci.Nat., MAusIMM, MGSSA
	Exploration Manager	André Vorster	Pr.Sci.Nat., MGSSA
Contributors GCMSA	Senior Geologist - QAQC	Wesson Reid	MGSSA
Contributors & Reviewers SGS	Initiative Owner	Zaben Al Harbi	
	Project Manager	Anwar Al Jahdali	
	Operations Manager	Abdulrahman Al Obaidi	
	Team Leader	Tariq Jahlan	
	Exploration Geologist	Abdullah Al Otaibi	
	Technical Consultant	André Oelofsen	Pri.Sci.Nat., MAusIMM, MGSSA

Project Code: SGS-009-001
Effective Date: 31 July 2024

Primary Author
Dr Murigeppa Malapur

Exploration Manager
André Vorster

This document has been prepared for the exclusive use of **The Saudi Geological Survey** on the basis of instructions, information and data supplied by them. No warranty or guarantee, whether expressed or implied, is made by The Golden Compass MSA Group Consortium (GCMSA) with respect to the completeness or accuracy of any aspect of this document and no party, other than **Saudi Geological Survey**, is authorised to or should place any reliance whatsoever on the whole or any part or parts of the document. GCMSA does not undertake or accept any responsibility or liability in any way whatsoever to any person or entity in respect of the whole or any part or parts of this document, or any errors in or omissions from it, whether arising from negligence or any other basis in law whatsoever.

Table of Contents

1 INTRODUCTION 1

1.1 Location 2

1.2 Project Overview 2

1.3 Methodology 3

2 DATA RECEIVED 4

2.1 Additional Data Requested 5

3 SCANNING AND DIGITIZATION OF HISTORICAL DATA 6

3.1 Scanning 6

3.2 Digitization and Georeferencing 6

3.2.1 Maps Georeferenced 6

3.2.2 Maps Digitized 12

3.2.3 Digital Data 12

4 DATABASE POPULATION 14

5 HISTORICAL DATA REVIEW 15

5.1 Desktop Review and Validation 15

5.1.1 Reports 15

5.1.2 Geological Maps 18

5.1.3 Remote Sensing 18

5.1.4 Petrography and Mineralogy 20

5.1.5 Topographic Survey 20

5.1.6 Lithogeochemical Sampling 20

5.1.7 Historical Geophysical Surveys 22

5.1.8 Recent Geophysical Surveys 24

5.1.9 Drillhole Data 25

5.1.10 Deportment and Beneficiation Studies 25

5.1.11 Geological Model 25

5.1.12 Mineral Resource Estimate 25

5.1.13 Competent Persons Reports 25

5.2 Field Validation 25

5.2.1 Field Visit Objectives 25

5.2.2 Field Visit Observations 25

5.2.3 Field Visit Outcomes 27

6 CONCLUSION 28

7 REFERENCES 31

List of Tables

Table 1-1 AEP Overview 1
Table 2-1 Summary of Data Received 4
Table 5-1 Summary of Occurrences listed in BRGM-74 JED 9 16
Table 6-1 Suitability and Usefulness Rating Scale 28
Table 6-2 Suitability and Usefulness Rating of Data provided 29

List of Figures

Figure 1-1 Al Khashabi Project Location 2
Figure 3-1 Part of Metallic Mineral Deposits Map of the Arabian Shield (BRGM, 1995) with 7
Figure 3-2 Explanation for Metallic Mineral Deposits Map of the Arabian Shield (BRGM, 1995) 8
Figure 3-3 Geological map of part of Wadi Al Mulayh Quadrangle (GM-92C 22H) (Manivit et al, 1985) with Al Khashabi license and MODS occurrences 9
Figure 3-4 Legend and Explanation for Geological map 22H (Manivit et al, 1985) 10
Figure 3-5 Geological map of part of Umm Sulaym Quadrangle (22/45C) (Brosset, 1973) with Al Khashabi license and MODS occurrences 11
Figure 3-6 Digitised 1:100 000 scale Geological map after Brosset (1973) BRGM 74 JED 9 with transparent overlay on scanned basemap 13
Figure 4-1 Data Package Directory Structure 14
Figure 5-1 Satellite (Bing) Image of Al Khashabi license and MODS occurrences 19
Figure 5-2 Location of wadi sediment samples from the GSAS project within the Al Khashabi Project Area 21
Figure 5-3 Legacy Geophysics Survey 1VD of RTP (SGS 2024b) 23
Figure 5-4 2023 Airborne Magnetic AMF_RTP sunshade(SGS 2024c) 24
Figure 5-5 Al Khashabi (Wadi Araqah) AEP site visit, December 2022 27

Appendices

APPENDIX 1: Directory List of Data Received from SGS

1 INTRODUCTION

The Accelerated Exploration Programme ("AEP") aims to identify prospective locations and conduct mineral exploration on the selected Projects in order to improve the level of geoscientific confidence and to upgrade those Projects with best potential to a level at which third parties may wish to invest in their further development.

During Task 2 of Phase 1 of AEP, a total of 60 locations were evaluated. Six locations were selected for further work in Cycle 2. Later another three projects were added to the list, one of which is **Al Khashabi ("KSB")**. The reader is referred to Robertson (2022) for further information on the location review and selection process.

A three-stage process is followed to develop detailed work programmes for each of the selected Projects before exploration activities commence in Stage 4:

- Stage 1 (this report): receipt and compilation of data, digitisation of any relevant data, validation of the data and delivery of a final dataset which will be an input into Stage 2.
- Stage 2: involves conducting technical review of the validated data compiled in Stage 1 by an expert and presenting an opinion on the prospectivity of the project.
- Stage 3: perform a gap analysis on prospective projects highlighting deficits towards achieving the desired Exploration Target/Mineral Resource and Competent Persons Report and design an appropriate exploration programme and project road map in order to close the gaps and deliver the expected outcomes.

An overview of the AEP is provided in **Table 1-1**.

Table 1-1
AEP Overview

Cycle 2		Objective	Deliverable	Status
Phase 1	Task 2	Desktop Review and Ranking of 60 Targets	Report documenting the assessment of the review of 60 (Cycles 1, 2, 3) Task 2 targets with a ranking of each and recommendations	Completed
Phase 2	Stage 1	Data collection, validation, and digitization of data/reports	Database for each of the 15 projects containing all data provided by the SGS and data digitized by GC-MSA	This Report
	Stage 2	Specialist Technical Review	Technical report for each of the 15 selected projects (Cycle 1: 6; Cycle 2: 6; Cycle 3: 3)	
	Stage 3	Gap analysis, design of exploration plan and design of exploration project roadmap	Gap analysis for each project, a standardized roadmap to progress projects and an exploration program for each of the 15 projects (Cycle 1: 6; Cycle 2: 6; Cycle 3: 3)	
	Stage 4	Oversight of the execution of project	Monthly progress reports for each project during the execution phase	
	Stage 5	Resource estimation and project evaluation	Mineral Resource / Exploration Target statement for each of the 15 projects and comprehensive supporting documentation Geological models in Datamine™/Leapfrog Geo™ format JORC (2012) compliant Technical Report authored by a Competent Person and signed off by the independent QAQC Manager for each of the 15 projects Mineral Assessed Valuation for each of the projects. Comprehensive Auction Package	

This document is a summary of the outcome of the Phase 2, Stage 1 data compilation and verification process. It includes a description of the available data for the location and the veracity thereof.

1.1 Location

The location covers an area of 92.12 km^2, located about 10km southwest of Brudan, a small town which is approximately 315km southwest of Riyadh, in central part of Saudi Arabia (Figure 1-1).

Figure 1-1
Al Khashabi Project Location



1.2 Project Overview

The Al Khashabi Location (also known as Wadi Araqah in historical literature) is centred on a cluster of mineral occurrences (MODS 0427-0432 & 0444) and consist of sulphide bearing quartz veins within Hulayafah volcanic units and associated diorite. The mineral occurrences of Al Khashabi are

recorded as multiple small old workings in the form of pits and trenches up to 30m long and generally NW-trending. These old workings are reported to be targeting the quartz veins in shear zones within metavolcanics or proximal to the metavolcanics-granite contact. The quartz is reported to be of milky white to smoky in nature varying from 0.70m to 3m in width and 30m to 100m in length. The quartz veins are reported to be brecciated in places with malachite. The 7 MODS occurrences are aligned along a NW-SE trending fault zone that controls the mineralization.

In 1973-1974, BRGM carried out mapping and sampling of 6 ancient workings within Hulayfah volcanic rocks and associated diorite intrusions. The grab samples returned between 1 and 10.5g/t Au with anomalous Cu and Pb values (Brosset, 1973). Detailed information on ancient workings is available in Brosset, 1973 as well as a geological map of Quadrangle 22/45C Umm Sulaym on 1:100,000 scale in BRGM-74 JED 9 04.pdf, is the product of regional mapping by BRGM (Brosset, 1973).

1.3 Methodology

The objective of Stage 1 is to collate, digitise (maps and reports where applicable and possible) and validate the available data set, delivering a reliable dataset which will be the subject of a Technical Review in Stage 2. The methodology utilised is as follows:

- **Receipt of data** provided by the SGS and compiling this into a standardised folder structure.
- **Scanning and Digitisation** of any historical data including, digitising maps into ArcGIS shapefile format, and entry of data such as borehole logs or samples. Digitisation will be conducted where relevant and feasible at the discretion of the General Manager and in consultation with SGS.
- **Data Validation** involves a two-step process. An initial desktop validation was conducted by reviewing the data and identifying any obvious errors or issues. This was followed by a site-based validation.

The final deliverable for Stage 1 is a data folder populated with all the reviewed and validated historical data for each of the 15 projects (Cycle 1: 6; Cycle 2: 6; Cycle 3: 3) and a database of information and digitized data that can be used by GCMSA for the Stage 2 Technical Review.

This document presents the data review outcomes for Stage 1 of the **Al Khashabi** project (ranked number 2 by Robertson, 2022).

2 DATA RECEIVED

The decision regarding the additional three projects of Cycle 2 was communicated by SGS to GCMSA on 3 June 2024. GCMSA was provided with data in a formal handover which took place on 16th March 2023 and 12th April 2023. All the data received from SGS is listed in **Table 2-1** below.

Table 2-1
Summary of Data Received

Data Type	Reference
Technical Reports	***Laval, M; Le Bel, L.*** (1985). Assessment of the felsic plutonic rocks in the South Al Amar Area. BRGM-OF-05-19. ***Brosset, R.*** (1973). Geology and Mineral exploration of the Umm Sulaym Quadrangle 22/45C. BRGM-74 JED 9 01. Including Appendices **Extract from Watts, Griffis and McQuat Ltd** (1992), Extent, Status and Adequacy of Exploration, Eastern Arabian Shield. Prepared for the Petroleum and Mineral Resources Directorate General of Mineral Resources, Jiddah. Confidential Report Watts, WGM-CR-11-11 – Page 123 and 143. **Extract from Watts, Griffis and McQuat Ltd** (1992), Recommendations for Further Mineral Exploration in the Eastern Arabian Shield. Prepared for the Petroleum and Mineral Resources Directorate General of Mineral Resources, Jiddah. Confidential Report Watts, WGM-CR-11-12 – Page 121 and 122.
Geological Maps	***Brosset, R.*** (1973). Geologic Map and Sections of the Umm Sulaym Quadrangle (22/45C). BRGM-74 JED 9 04, Appendix 1 ***Brosset, R.*** (1973). Mineral Exploration Map of the Umm Sulaym Quadrangle (22/45C). BRGM-74 JED 9 05, Appendix 2
Remote Sensing	No remote sensing data was received.
Petrography	***Brosset, R.*** (1973). Geology and Mineral exploration of the Umm Sulaym Quadrangle 22/45C. BRGM-74 JED 9 01. Appendix 4-1 and 4-2 : List of thin sections and thin section studies.
Topographic Survey	No Topographic survey data was received
Lithogeochemical Sampling	**SGS** (2024a) GSAS wadi geochemical sampling data was downloaded from the SGS National Geological Database web portal containing 20 wadi sediment samples.
Historical Geophysical Survey	**SGS** (2024b) Regional magnetic and radiometric survey was conducted in 1966 mentioned but was not received. Downloaded from the National Geological Database web portal.
Recent Geophysical Survey	**SGS** (2024c) Recent 300m spaced Airborne Magnetic Survey data was Accessed from the SGS National Geological Database web portal.
Drillhole Data	No drillhole data was received
Mineralogy and Beneficiation Studies	No mineralogy or beneficiation data was received

Table 2-1 Summary of Data Received	
Data Type	**Reference**
Geological Models	No geological models were received
Mineral Resource Estimate	No previous studies have been conducted
CPR Reports	No previous studies have been conducted

2.1 Additional Data Requested

The following additional data was requested following a preliminary review of the data received:

- Any geophysical (airborne/ground) surveys that cover the license area entirely or partially.
- High resolution satellite images of the license area

3 SCANNING AND DIGITIZATION OF HISTORICAL DATA

3.1 Scanning

No hard copy maps were received by GCMSA, and to the best of the author's knowledge no detailed maps at suitable scales for prospect/licence scale exploration exist that require scanning. As a result, no scanning was undertaken

3.2 Digitization and Georeferencing

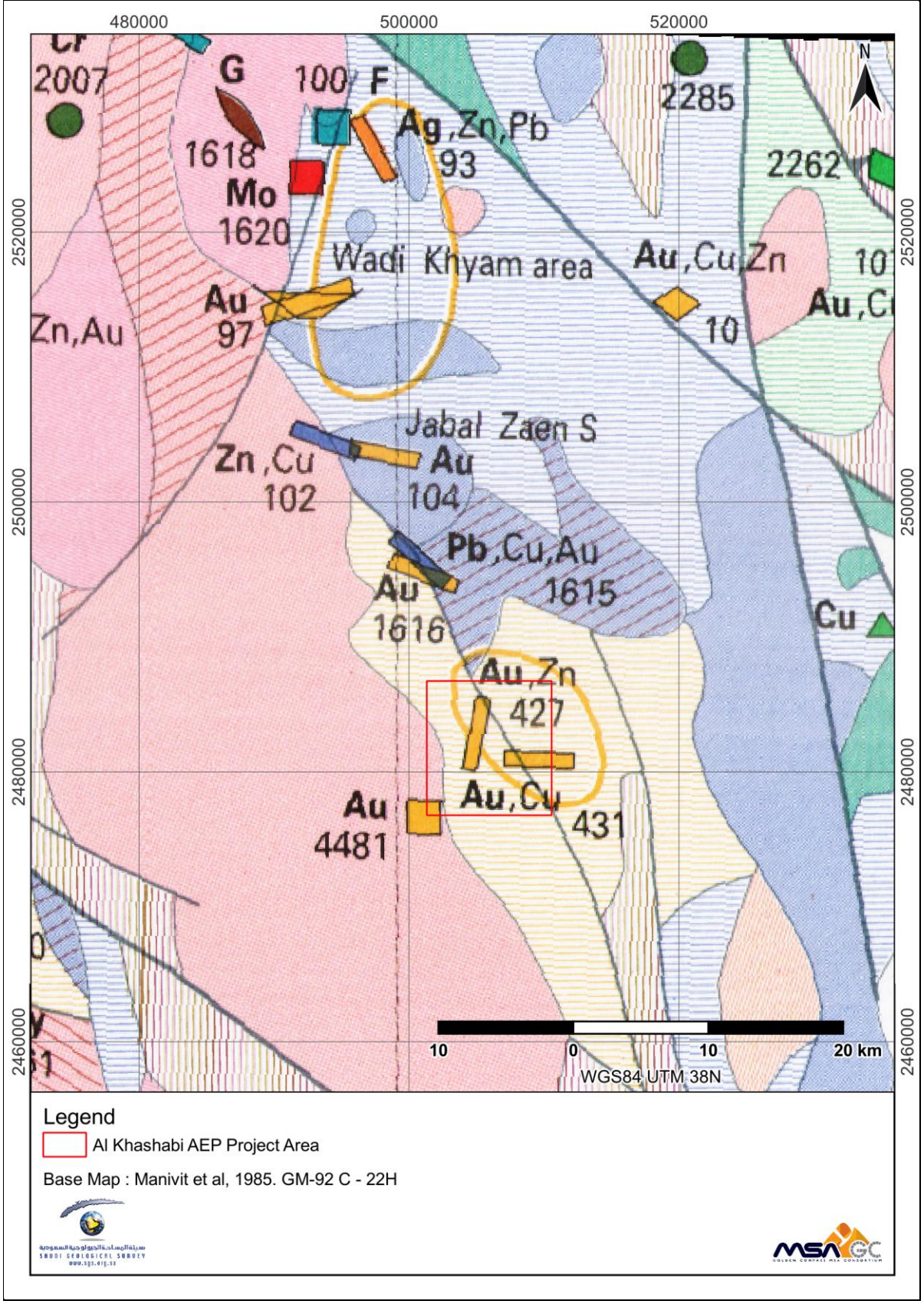
3.2.1 Maps Georeferenced

The following maps were georeferenced by GCMSA:

- The North Sheet of Metallic Mineral Deposits Map of the Arabian Shield (BRGM, 1995) was georeferenced. **Figure 3-1** shows the part the same superimposed with the Al Khashabi AEP project location. The Explanation is presented in **Figure 3-2**.
- Geological map on 1:250,000 scale of Wadi Al Mulayh Quadrangle (sheet 22H) of Manivit et al, (1985) was georeferenced. **Figure 3-3** shows part of the same superimposed with Al Khashabi AEP and MODS occurrences. The figure legend is presented in **Figure 3-4**.
- Geological map on 1:100,000 scale of the Umm Sulaym Quadrangle (sheet 22/45C) of Brosset (1973) was georeferenced. **Figure 3-5** shows part of the same superimposed with Al Khashabi AEP and MODS occurrences.

A map is contained within WGM-CR11-11 and WGM-CR11-12 showing the location of the Al Khashabi cluster of mineral occurrences relative to other known belts of gold occurrences in the region. This map was found to be unsuitable for georeferencing as it does not contain suitable co-ordinates shown on the map.

Figure 3-1
Part of Metallic Mineral Deposits Map of the Arabian Shield (BRGM, 1995) with Al Khashabi location and known gold occurrences



Note : Map Legend and Explanation included in **Figure 3-2** *overleaf.*

Figure 3-2
Explanation for Metallic Mineral Deposits Map of the Arabian Shield (BRGM, 1995)

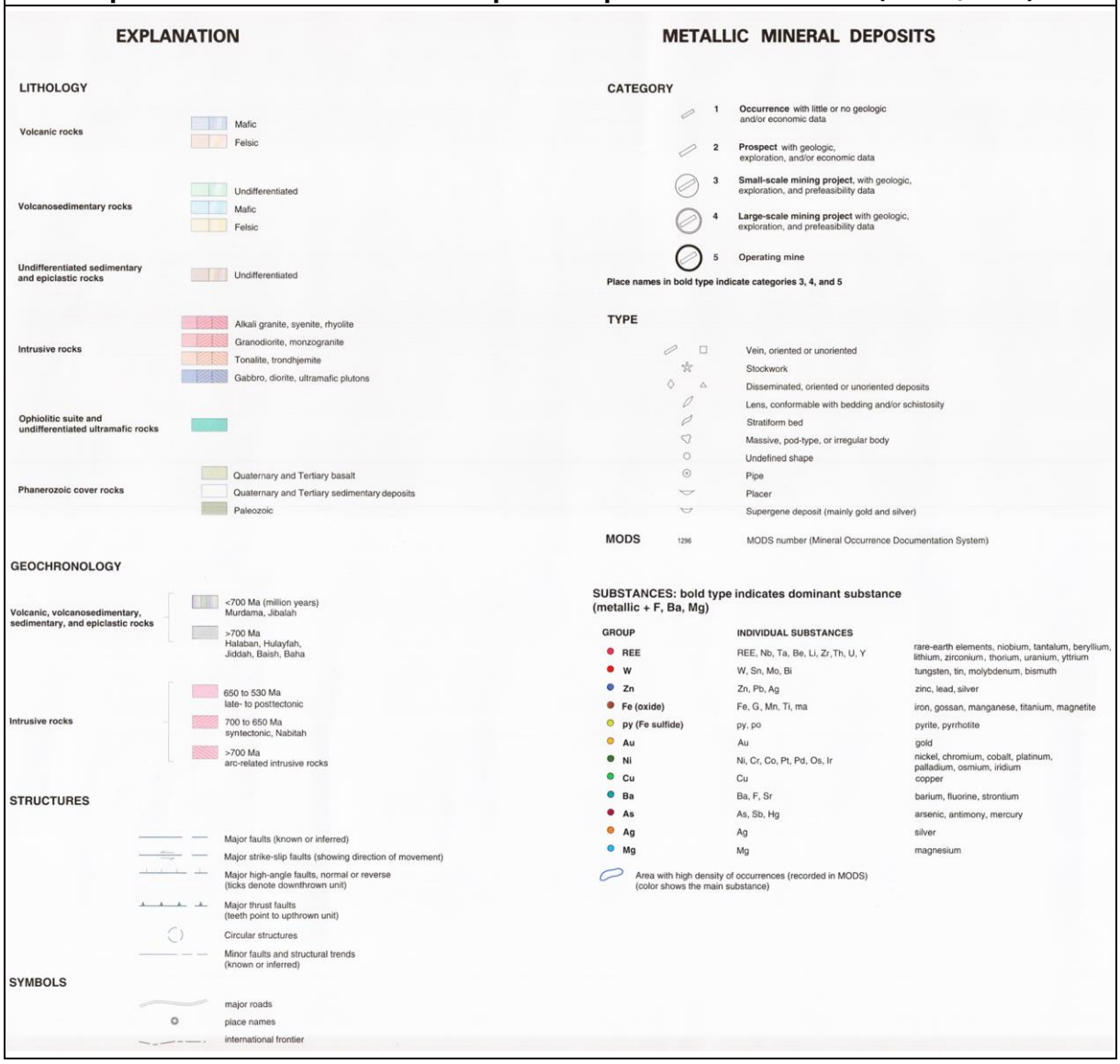
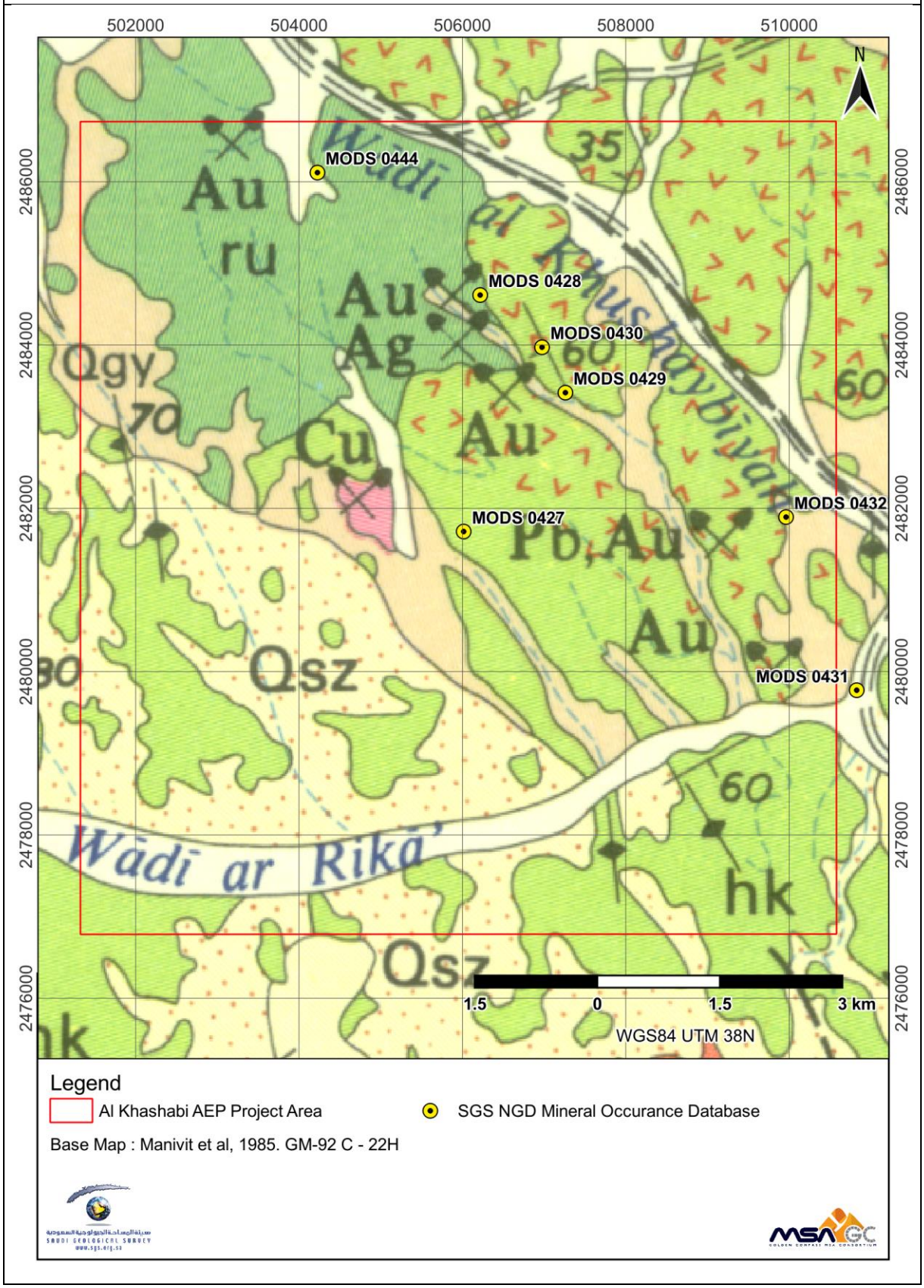


Figure 3-3
Geological map of part of Wadi Al Mulayh Quadrangle (GM-92C 22H) (Manivit et al, 1985) with Al Khashabi license and MODS occurrences



*Note : Map Legend and Explanation included in **Figure 3-4** overleaf.*

Figure 3-4
Legend and Explanation for Geological map 22H (Manivit et al, 1985)

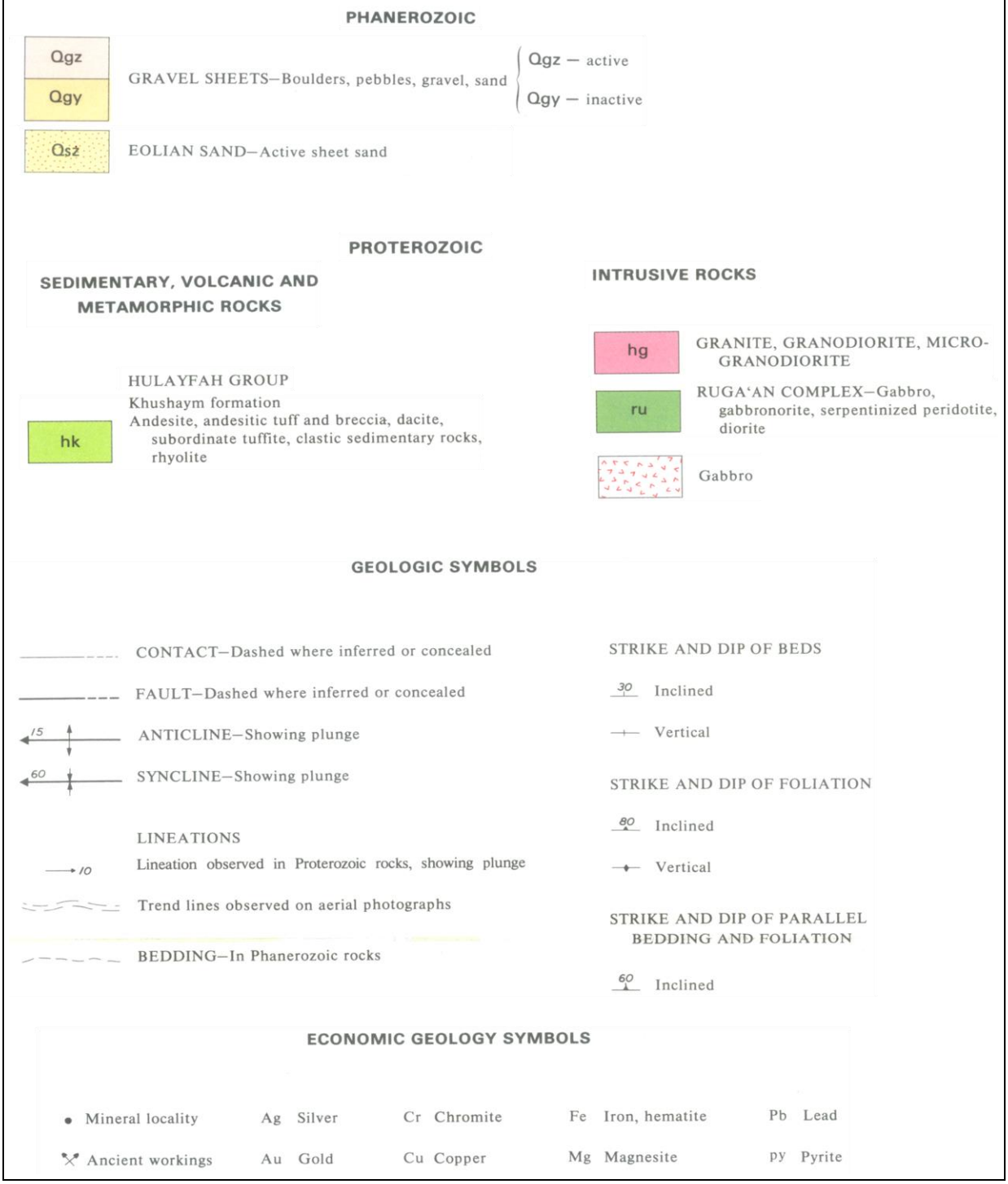
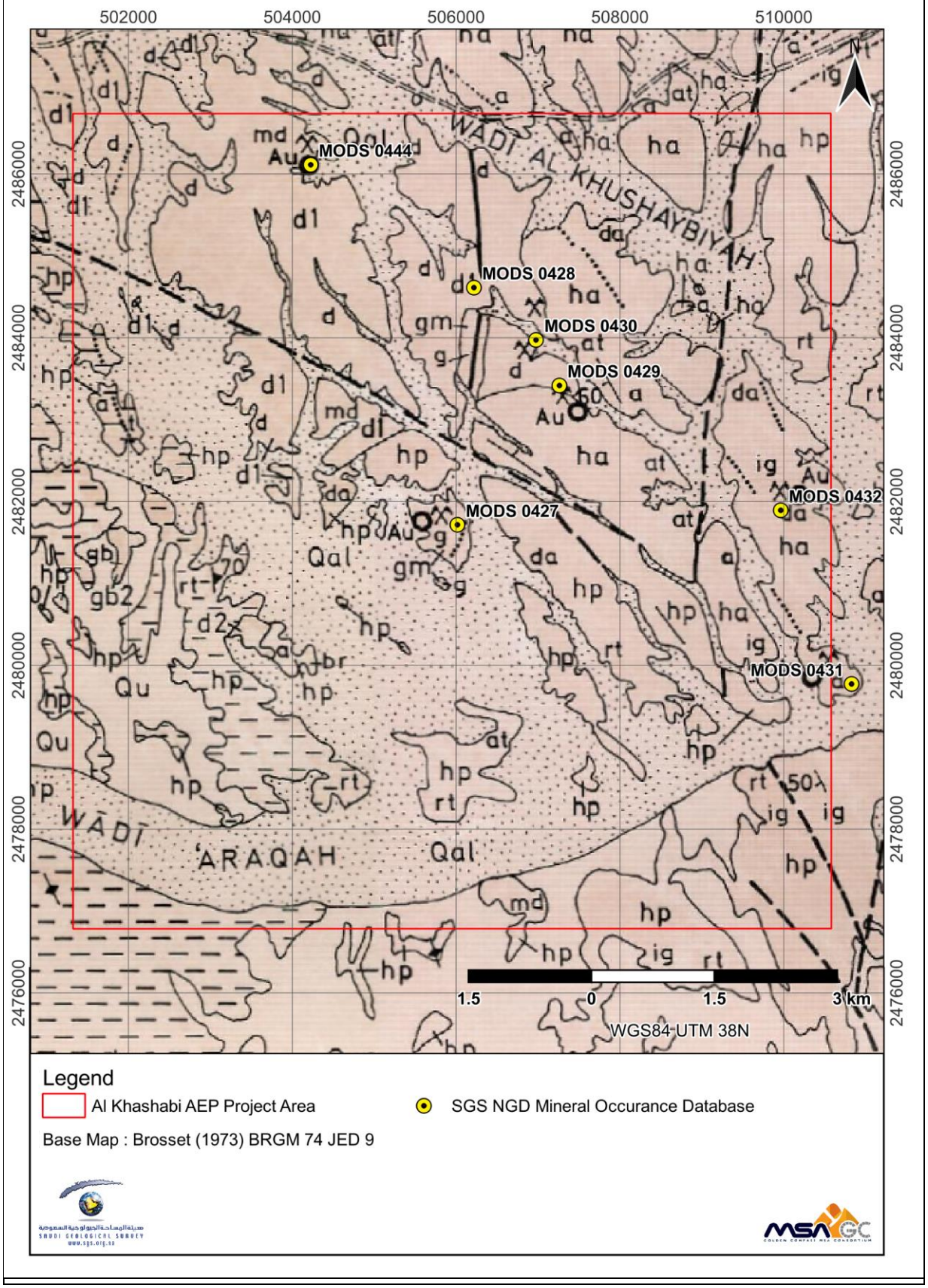


Figure 3-5
Geological map of part of Umm Sulaym Quadrangle (22/45C) (Brosset, 1973) with Al Khashabi license and MODS occurrences



3.2.2 Maps Digitized

Brosset, R. (1973). Geologic Map and Sections of the Umm Sulaym Quadrangle (22/45C). BRGM-74 JED 9, Appendix 1, 1:100 00 scale geology. One file was produced as follows

- KSB_240724_74 JED 04 Geology.shp contain geology polygons of the 1:100 000 scale map. Attributes digitised per geology polygon include Lithology, description and code as per the map legend. Refer to **Figure 3-6** which shows a transparent overlay of digital vector data on the georeferenced raster basemap.
- KSB_240724_74 JED 04 Structures.shp contains lines as digitised from the 1:100 000 scale map shown on **Figure 3-6**.

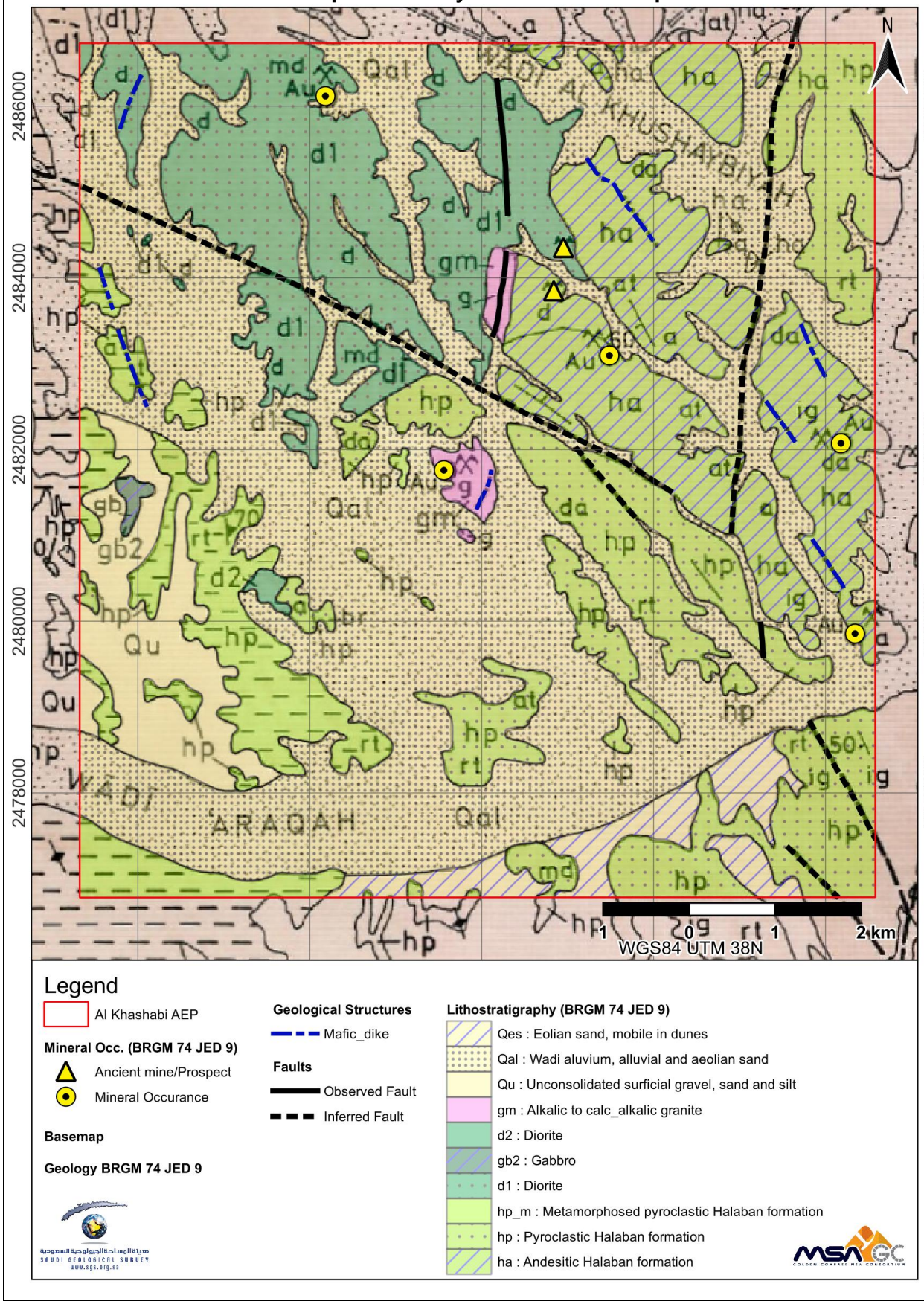
Brosset, R. (1973). Mineral Exploration Map of the Umm Sulaym Quadrangle (22/45C). BRGM-74 JED 9, Appendix 2, Mineral Exploration Map. One file was produced as follows

- KYM_2024-07-10_Mineral Investigations Map MI-17 Samples and Mines.shp contains point data such as sample stations and abandoned mines as per the map sheet. Refer to **Figure 3-6**. Attributes digitised include
    - Type (Mineral Occurrence or Ancient Working),
    - Commodity 1 (Gold, QV),
    - MOD Number,
    - Chem An. (Chemical Analysis Number).

3.2.3 Digital Data

The author did not identify any data which required capturing during the course of the data review and as such no digital data is produced.

Figure 3-6
Digitised 1:100 000 scale Geological map after Brosset (1973) BRGM 74 JED 9 with transparent overlay on scanned basemap.

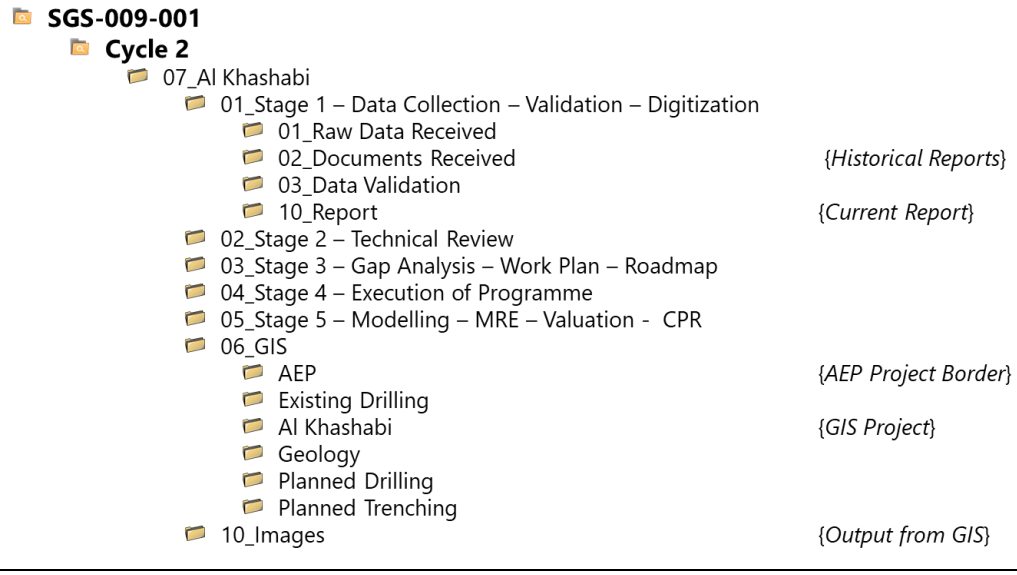


4 DATABASE POPULATION

No borehole logs, boreholes samples, surface samples or assays were received in a format suitable for digitisation and incorporation into the project database.

All files received have been compiled into an organised file structure ready for Stage 2 review. The project directory structure is shown in **Figure 4-1**.

Figure 4-1
Data Package Directory Structure



5 HISTORICAL DATA REVIEW

The data provided by SGS was subject to desk-top review to validate the data and determine the extent to which it can be relied on to inform subsequent Stage 2 technical reviews. The validation was undertaken using a desktop review method supported by a field visit conducted in December 2022.

5.1 Desktop Review and Validation

The geographic accuracy of digital geospatial data sets was verified by importing available georeferenced data into a GIS workspace. This includes Google™ imagery, the georeferenced raster images of maps, the AEP perimeter and MODS occurrences.

5.1.1 Reports

The technical reports were reviewed and a brief description of each report is provided below.

Laval, M; Le Bel, L. **(1985).** Assessment of the felsic plutonic rocks in the South Al Amar Area. BRGM-OF-05-19.

The report deals with the assessment of the felsic plutonic rocks in the South Al Amar Area. The 67 page report reveals the geochronology of the felsic plutonic rocks that are associated with Al Amar and Khnaiguiyah volcanics. The report also gives a comparative study of REE patterns of several peraluminous Arabian Shield granites associated with wolframite-cassiterite mineralization. On page 35, the report cites the old workings describes as decimetre scale NW trending quartz veins which returned gold values of 7-10 g/t within mafic rocks at Al Khashabi (Wadi Araqah). The report indicates that 64 alluvial samples were collected as a prospecting tool to identify additional occurrences but was unsuccessful. The report contains minimal information relevant to exploration at Al Khashabi.

Brosset, R. **(1973**). Geology and Mineral exploration of the Umm Sulaym Quadrangle 22/45C. BRGM-74 JED 9

The report deals with the description of regional geology and historical exploration of the Umm Sulaym Quadrangle 22/45C, located on the eastern edge of the Precambrian Arabian Shield. 2/3rd of the quadrangle is occupied by the Precambrian rocks whereas the 1/3rd part on the eastern side is covered by Paleozoic sedimentary formations and in places by Tertiary and Quaternary sand and gravel.

The Precambrian rocks in this quadrangle are represented by volcanics belonging to Halaban Group followed by volcano-sedimentary formations of Umm Sulaym, Murdamah and Shammar formations.

- The Halaban Group comprises of
    - Ophiolite complex of Halaban with gabbro, pyroxenite, peridotite, serpentinite
    - Andesitic Halaban with alternate andesite and andesitic tuffs with some intercalations of rhyolite

  - Pyroclastic Halaban with rhyolitic and andesitic tuffs and breccia, ignimbrite and dacite

- The Halaban formations have been affected by mafic and felsic intrusions and have been subjected to epizonal metamorphism in the western part of the quadrangle.
- Umm Sulaym Formation is sedimentary sequence composed of marble, conglomerate, tuffite and greywacke covering the Halaban Group unconformably. This formation is folded forming a south-plunging anticlinal structure whose western flank is metamorphosed and granitized.
- The Murdamah formation occupies the southwestern part of the area and lies in contact with the gneissic facies of the Halaban. This formation comprises of conglomerate, "volcanic" sandstone, feldspathic sandstone and siltstone.
- The Shammar formation is found at the southern part of the quadrangle, represented by rhyolite, welded rhyolitic tuff and ignimbrite.

The western part of the quadrangle is characterised by intrusions cut by numerous dykes (felsic), whereas southwest corner has been affected by faults of the Najd Fault System. This fault system shows both lateral and vertical displacement resulting in the north side (Halaban) being thrown up against the south (Murdamah). A regional epizonal to mesozonal metamorphism, characterized by greenschist to amphibolite facies, is developed in the western part of the area and shows increasing intensity from east to west. The eastern part of the quadrangle is covered by Paleozoic sedimentary formations represented by conglomerate and calcareous sandstone of Wajid formation and limestone, dolomite and marl of Khuff formation. Quaternary formations, composed essentially of eolian sand forming large mobile dunes, or "nafuds", mainly in the east and southeast parts of the quadrangle.

Results of mineral prospecting at Al Khashabi is described on pages 38 to 40 for occurrences 131 A-RB 9m to A-RB 15m.

Table 5-1
Summary of Occurrences listed in BRGM-74 JED 9

Occurrence Number	Page Reference	Description	Best Mineralization
RB 9m MODS 0427	Pg 38 App. 3-3	Group of 4 workings on quartz veins over an area 300 m x 100 m hosted by alkali granite Quartz veins locally with hematite and sometimes chrysocolla, malachite, galena and oxidised pyrite	Sporadic samples of up to 10g/t from workings and anomalous Cu., Pb, Zn
RB 10m No equivalent in MODS database	Pg 39 App. 3-4	Two small trenches on quartz veins hosted by diorite and microdiorite. Minor hematite	Not Sampled

Table 5-1 Summary of Occurrences listed in BRGM-74 JED 9			
Occurrence Number	**Page Reference**	**Description**	**Best Mineralization**
RB 11m MODS 0430	Pg 39 App. 3-5	Single trench 20m long, 0.5m deep on quartz vein	Not Sampled
RB 12m MODS 0429	Pg 39 App 3-6	Single trench 20m long, 0.5m deep on quartz vein hosted by microdiorite. Minor chrysocolla noted	1g/t Au
RB 13m MODS 0431	Pg 40 App 3-7	Trenches? On two separate quartz veins hosted by andesite, each 30m long and 0.5m wide.	3g/t Au
RB 14 m MODS 0432	Pg 40 App 3-8	Two groups of ancient workings of circular excavations up to 1m deep on quartz veins with minor malachite, chrysocolla and oligst.	3g/t Au, 860 ppm Cu and 300ppm Pb
RB 15m MODS 04444	Pg 40 App 3-9	Single Trench on quartz vein, 15m long and 0.5m deep. Locally ferruginous and minor chrysocolla. Hosted within diorite and microdiorite.	2g/t Au and 500 ppm Cu

Index Cards of Mineral Occurrences are provided in the report as appendix 3, 3-3 to 3-9 apply to Al Khashabi. Each index card gives the details of location (coordinates) of the occurrence, regional and local geology of each location, description of the mineral occurrence (with attitude & dimensions), it's minerals (gangue and ore) and a table showing the results of chemical analyses of the sample/s. Refer to pages 3 to 10 in Appendix 3.

Brosset (1973), is useful as it provides regional geological context including descriptions of the litho-stratigraphic and structural setting and contains the best available descriptions of mineralisation at Al Khashabi. The chemical analyses mentioned are unverified as the sampling methodology and specifics of the analytical methodologies used are unknown. These chemical analyses may be used as general indicator of the presence of mineralisation and should be used as reliable indication of actual grades. Location data in the report is imprecise and should be used as a general guide only.

Extract from WGM-CR-11-11 and WGM-CR-11-12. Watts, Griffis and McQuat Ltd (1992),

The extracts from these reports are short concise summaries of the information presented in Brosset (1973) and Laval and Le Bel (1985). These extracts are a useful summary but don't add new information.

5.1.2 Geological Maps

Brosset, R. (1973). Geologic Map and Sections of the Umm Sulaym Quadrangle (22/45C). BRGM-74 JED 9 04, Appendix 1

Appendix 1 contains a geological map The details of the map and sections are given in the report BRGM-74 JED 9 01. Al Khashabi license falls in the northwestern corner of the sheet. The major rock units found in the area are the units of Andesitic Halaban and the Pyroclastic Halaban formations, with diorite in some places. The metamorphosed (gneissic) units of Pyroclastic Halaban are found in southwestern corner of the license. The plains and the wadis in between, are covered with Quaternary alluvial and aeolian sand.

The geological map records some of the geological variation within the AEP area and would function as a starting point for prospect scale geological mapping. Comparison of the locations of characteristic topographic features shown on modern satellite imagery and on the map indicate discrepancies of 150 m. Therefore the locational data should be considered imprecise and is unsuitable for detailed applications.

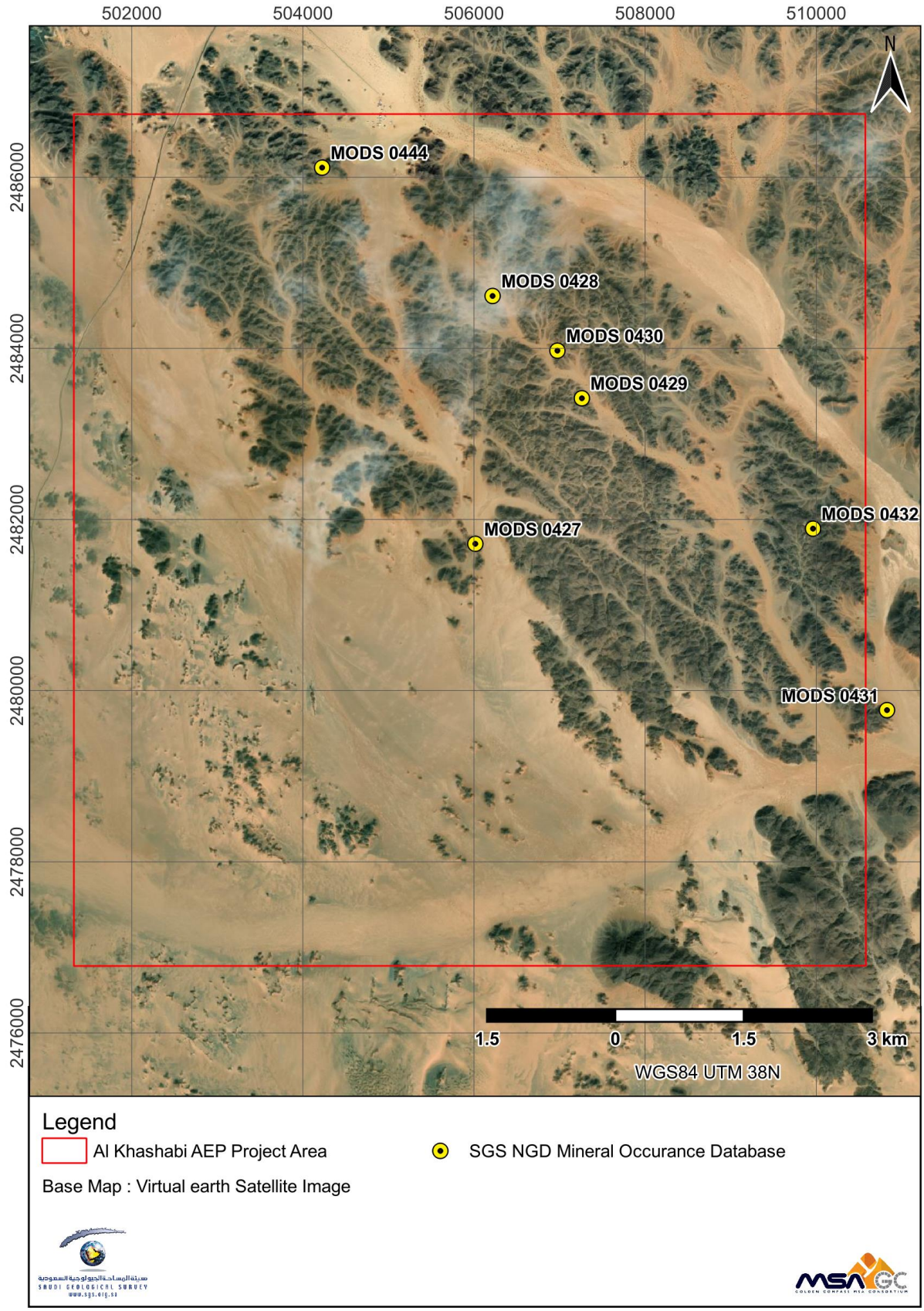
Brosset, R. (1973). Mineral Exploration Map of the Umm Sulaym Quadrangle (22/45C). BRGM-74 JED 9 05, Appendix 2

Appendix 2 contains a map showing mineral occurrences and ancient mining locations which are described in the mineral occurrences index cards. Al Khashabi fall in the northwestern corner of the sheet where 7 mineral occurrences are shown. The map also contains chemical and spectrographic analyses as part of the explanation. Comparison of the locations of characteristic topographic features shown on modern satellite imagery and on the map indicates discrepancies of 150 m. Therefore the locational data should be considered imprecise and is unsuitable for detailed applications.

5.1.3 Remote Sensing

No relevant satellite imagery was available for review. Publicly available Google and Bing satellite images are useful to evaluate surface features on the AEP location.

Figure 5-1
Satellite (Bing) Image of Al Khashabi license and MODS occurrences



5.1.4 Petrography and Mineralogy

Brosset, R. (1973). List of thin sections and thin section studies. BRGM-74 JED 9 03, Appendix 4 (4-1 to 4-2)

This is an Appendix to the report "Geology and Mineral exploration of the Umm Sulaym Quadrangle 22/45C". It consists of a 19 page document which contains a tabular record of 40 thin section analyses. Each thin section is recorded with its number, rock type, texture, a brief petrographic description with notes on minerals and the salient features of each slide as observed under microscope.

5.1.5 Topographic Survey

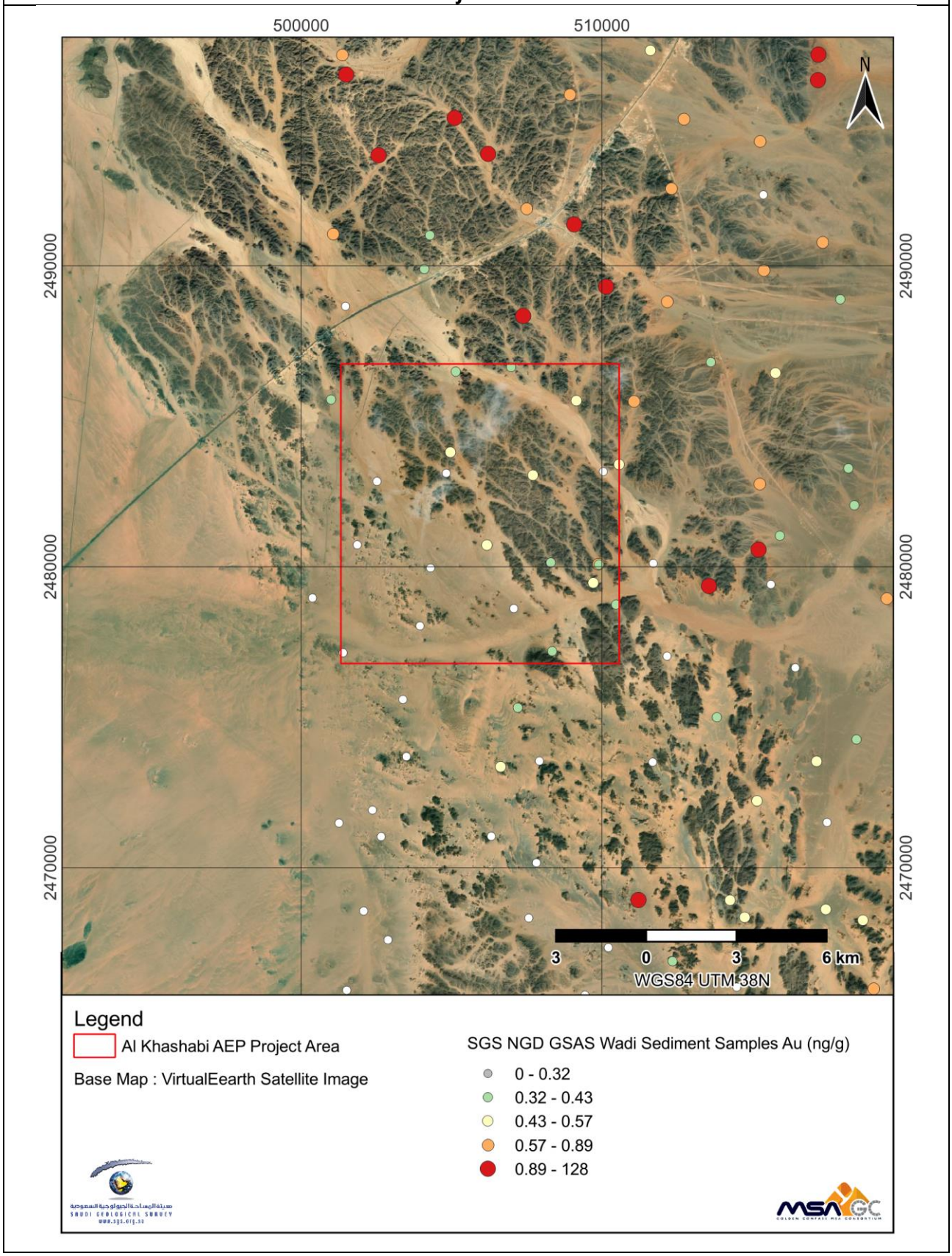
No topographic survey data was provided for review. Open source SRTM topographic data is available, however resolution is 30 m and will be of little value to prospect scale exploration.

5.1.6 Lithogeochemical Sampling

Historically, reconnaissance work of rock chip and grab sampling was conducted in Al Khashabi area confined to old workings as reported in Brosset (1973). Appendix 3 includes the index cards of the 9 mineral occurrences that are mentioned in the report. 8 rock chip samples of quartz veins within mafic-ultramafic rocks resulted 0.5 to 10 g/t Au, <0.5 to 5 g/t Ag, 50 to 860 ppm Cu, <40 to 450 ppm Pb and <25 to 1400 ppm Zn. Two samples returned 240ppm and 745ppm Ni.

An ongoing wadi sediment sampling is being conducted by the China Geological Survey as part of the High-Resolution Geochemical Survey of the Arabian Shield, KSA, through Stream Sediment and Heavy Mineral Concentrate Samples" (GSAS Project). Wadi sediment samples are collected at one sample per 6 km^2 spacing with the samples undergoing a variety of analyses reporting 76 elements (SGS, 2024a). The data is broadly spaced and is intended to identify prospective belts and although 20 samples fall within the project area the samples spacing is too broad to identify mineralised areas (**Figure 5-2**).

Figure 5-2
Location of wadi sediment samples from the GSAS project within the Al Khashabi Project Area



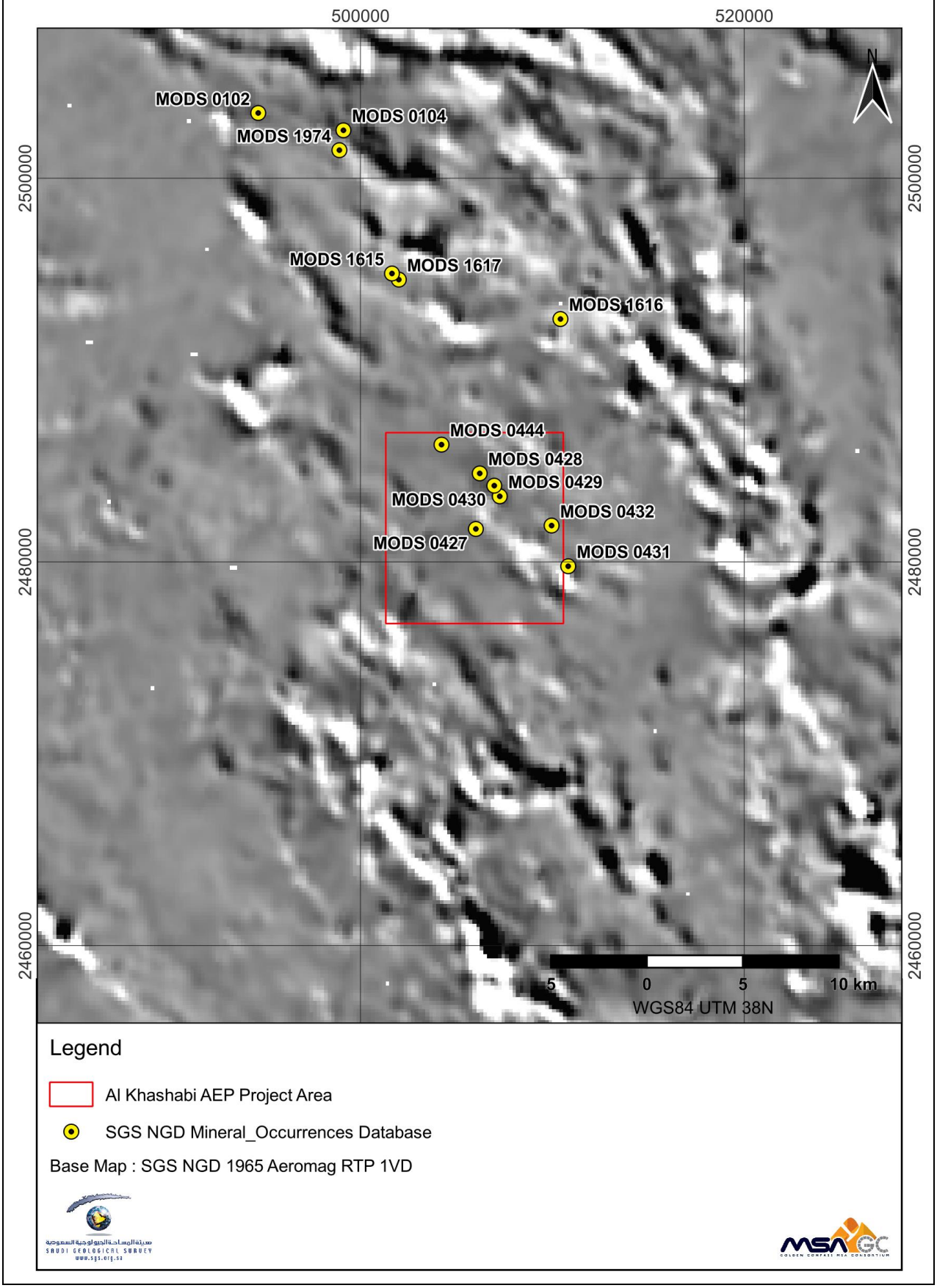
5.1.7 Historical Geophysical Surveys

Brosset, R. (1973). Airborne Magnetometer-Scintillation Counter Survey Interpretation of the Umm Sulaym Quadrangle (22/45C). BRGM-74 JED 9 06, Appendix 5

This is an Appendix to the report "Geology and Mineral exploration of the Umm Sulaym Quadrangle 22/45C". The aeromagnetic and Scintillometric map gives a preliminary magnetic interpretation showing several linear magnetic features and magnetic zones. The linear magnetic features are mainly oriented NNW and NW and are often outlined by elongate magnetic anomalies that might correspond to faults filled with more mafic material. Though the magnetic relief of the generally flat, there are few magnetic zones with high magnetic gradient. These magnetic zones correspond to the mafic rock units and the intrusive.

Airborne Magnetic surveys were conducted in 1965, supervised by the BRGM. Survey line spacing was 800 m oriented N45E with a flight altitude of 150 m (SGS, 2024b). This data can be accessed on the SGS National Geological data portal where various shield wide datasets have been compiled and levelled. The four processed geotiff layers are available, total magnetic intensity(TMI), analytical signal(AS), Reduce to pole(RTP) and first vertical derivative of RTP (1VD) (SGS 2024b) see **Figure 5-3**. Raw data is not available, only processed grids. The data can be displayed at 1:100 000 scale and is therefore useful to identify regional geological and structural trends but resolution is insufficient to resolve geological features within the project area.

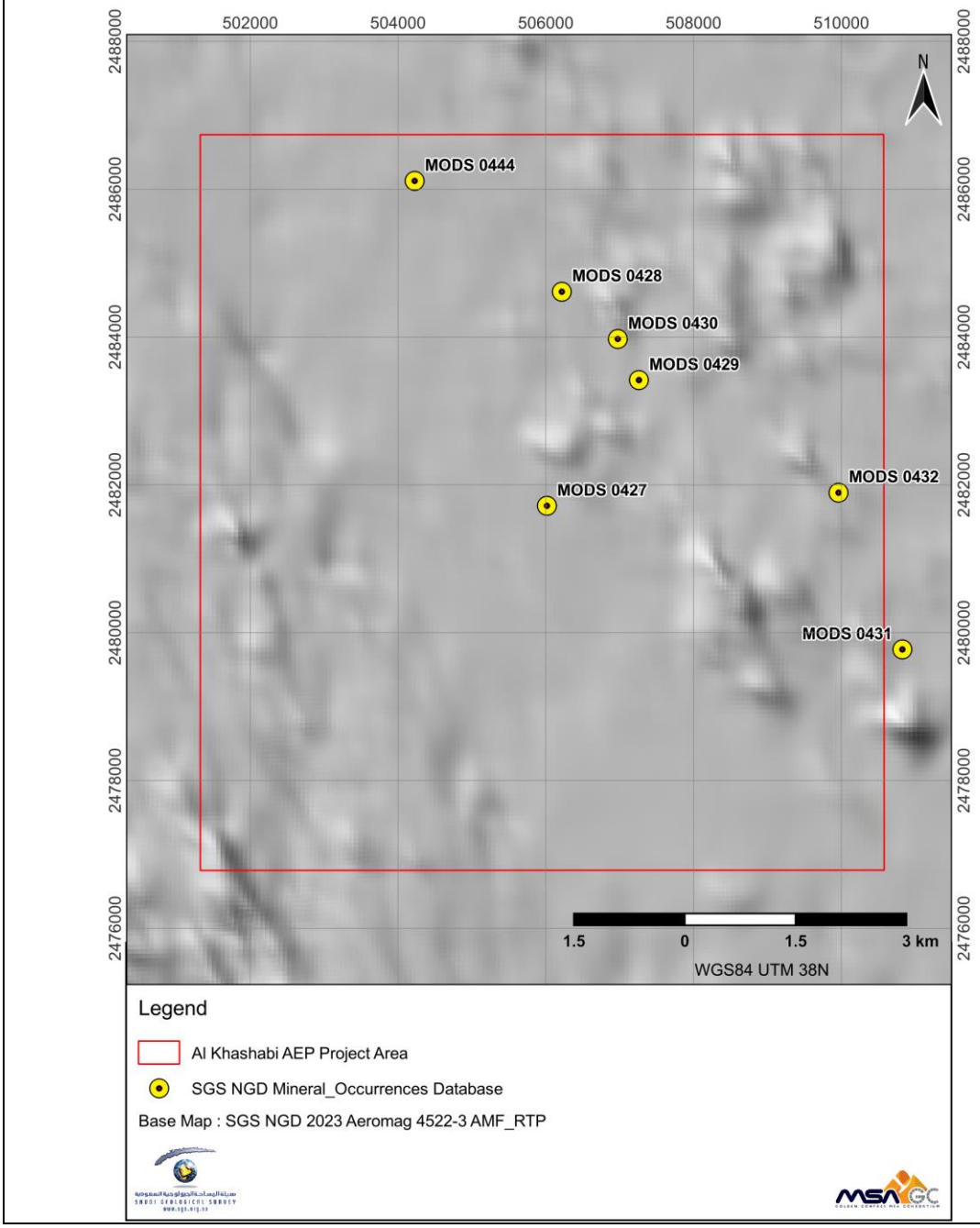
Figure 5-3
Legacy Geophysics Survey 1VD of RTP (SGS 2024b)



5.1.8 Recent Geophysical Surveys

Preliminary data from the 2023 fixed wing airborne geophysical survey executed by Sander Geophysics under supervision of the Saudi Geophysical Survey is available. The Survey is conducted using 300m spaced lines oriented at N45E and a flight elevation of 60m and nominal airspeed of 70m/s. At present only preliminary data is available consisting of gradient-enhanced magnetic anomaly grid is reduced to the pole (AMF_RTP). Raw data is unavailable. While the data represents a significant improvement in data resolution relative to 1965 generation aeromagnetic survey data it is only useful to resolve major geological features within the licence area and lacks resolution to make a significant contribution to the understanding of the project area.

Figure 5-4
2023 Airborne Magnetic AMF_RTP sunshade(SGS 2024c)



5.1.9 Drillhole Data

No drilling has been undertaken on this project area.

5.1.10 Deportment and Beneficiation Studies

No deportment or beneficiation studies have been undertaken on any material from Al Khashabi.

5.1.11 Geological Model

No geological model was available for review.

5.1.12 Mineral Resource Estimate

No Mineral Resource Estimates were available for review.

5.1.13 Competent Persons Reports

No Competent Persons Reports were available for review

5.2 Field Validation

The field site was visited by GCMA General Manager and accompanied by SGS AEP team on 03 December 2022.

5.2.1 Field Visit Objectives

The objectives of the field visit were to:

- Visit the site locality to verify the existence of Mineral Occurrences reported by previous Authors and that exist in the National Geological Database.
- Assess the type and extent of historical workings present.
- Assess the nature of mineralisation, controls and host rocks.
- Assess levels of exposure and topography for work programme planning.
- Undertaken an initial assessment for logistics purposes.

5.2.2 Field Visit Observations

The mineral occurrences reported in Al Khashabi site, are in the form of multiple small old workings, pits and trenches up to 30m long and generally NW-trending. Five of the known Mineral Occurrences at Al Khashabi were visited and the observations are as follows

- MODS0444 (RB 15m) - 22^0 28′ 52.7′′ / 45^0 02′ 24.7′′

Brosset (1973) describes the occurrence as a single ancient trench dug extending 15 m in length in a quartz vein hosted within microdiorite and contains minor chrysocolla and hematite. Analyses returned 2g/t Au, 500 ppm.

The infield visit identified a 50m long NNW-SSE trending milky white quartz vein hosted in andesite; with 2m x 2m pit showing minor malachite staining. The field observations are consistent with literature descriptions and the occurrence is considered validated.

- MODS0427 (RB 9m) - 22^0 26′ 33.6′′ / 45^0 03′ 28.5′′

Brosset (1973) reported four small scale ancient workings and trenches over a 300m area on quartz veins and hosted within Alkalic granite intrusive. Minor hematite and chrysocolla is noted and analyses returned 7g/t and 10g/t Au.

A field visit to this location identified a milky white quartz vein, 0.7m wide and 70m long, trending NNW-SSE proximal to metavolcanics-granite contact. 30m long ancient working and smoky quartz veinlets in granite. The mineral occurrence is successfully validated.

- In MODS0428 (RB 10m?) - 22^0 28′ 05.2′′ / 45^0 03′ 35.4′′

Brosset (1973) describes two trenches 6 m and 15 m long excavated on quartz veins with hematite alteration hosted within dioritic and microdioritic country rock.

Field inspection noted three short trenches centred on ancient workings located on quartz veins. The occurrence is considered validated.

- MODS0430 (RB 11m) - 22^0 27′ 44.1′′ / 45^0 04′ 01.6′′

Brossett (1973) describes small ancient working consisting of one trench dug in a quartz vein trending NS, 15 m in length. Hematite alteration is noted as is the host rock of diorite and some granite.

Field validation identified a 30m long ancient working on a milky white quartz vein metavolcanic (dacite) that trends NW-SE. There is minor hematite alteration in the quartz vein and country rock, the quartz vein is brecciated in places. 20m to the east of the quartz vein there is a 2m wide and 200m long zone of pink-white felspathic alteration with pink crystals of feldspar,

The mineral occurrence is validated.

- MODS0429 (RB 12m) - 22^0 27′ 28.0′′ / 45^0 04′ 11.5′′

Brossett (1973) describes a small ancient working consisting of one trench centred on a quartz vein with hematite alteration and chrysocolla trending NNE hosted in diorite.

Field inspection confirmed a 100m long line of shallow workings in hematite altered diorite on the eastern contact of a 1m thick milky white quartz vein that trends at N100. The quartz vein is brecciated in places with malachite mineralization.

The mineral occurrence is considered validated.

Figure 5-5
Al Khashabi (Wadi Araqah) AEP site visit, December 2022



NNW-SSE trending ancient workings proximal to metavolcanic-granite contact (MOD427)



Quartz vein with no associated workings (MOD428)

5.2.3 Field Visit Outcomes

The outcomes inferred from the field visit are noted as follows:

- Observations made at all five of the mineral occurrence locations visited are aligned with the descriptions in literature, therefore the legacy descriptions are considered reliable.
- The Al Khashabi location comprises at least 7 MODS occurrences, all occupying a well-defined NW-SE trend, parallel to Najd fault structures, known to control gold mineralisation in the region. The overall length of the NW trending zone of MODS is about 9 kilometres.
- The lithologies of host metavolcanics range from dacite, andesite to diorite which are intruded by granites.
- The nature of the mineralised lode varies from milky white to smoky quartz, often brecciated or in the form of veinlets and the wall rocks appear to be hematised and silicified near the contacts.
- Historically, no prospect-scale exploration conducted, work confined to only rock chip and grab sampling of old workings. Detailed follow up is warranted to assess the extent of the mineralization in the form of vein systems.

6 CONCLUSION

The ultimate usefulness of each of the evaluated datasets have been ranked according to the Suitability and Usefulness Rating described in **Table 6-1** below with the ranking of each dataset shown in **Table 6-2.**

Table 6-1
Suitability and Usefulness Rating Scale

Rating	Suitability / Usefulness	Description
1	Suitable & Useful	Includes detailed information specific to project location
2	Useful, but with data integrity concerns	Information relevant and makes a significant contribution to the knowledgebase of the project but should be used with caution due to data integrity concerns
3	Somewhat Suitable & Useful	References the project location but makes no significant contribution to knowledgebase of the project
4	Not Suitable or Useful	Data not suitable or useful for project Location. Example: scans of printed historical geophysical surveys which have been surpassed by a more recent survey

It is concluded that the historical exploration reports for the Al Khashabi project and surrounding areas have accurately recorded the regional tectono-stratigraphic framework as well as the characteristics of mineralisation present at the site. These reports contain useful insights into the possible scale of mineralisation and mineralisation controls. Field verification suggests that these texts may be relied on for the regional context, scale and nature of the prospect, but indications of grade should be used with caution as they have not yet been validated.

The regional geological maps (BRGM-74 JED 9, Appendix 1) are the best available, however they are not produced at a suitable scale to be useful for a prospect scale technical review, but do provide suitable regional context.

Detailed satellite imagery is suitable to inform structural assessments and identification of historical and current workings.

The datasets available are considered suitable for inputs into a technical review of an early-stage exploration project, however very little data is available for this early-stage location.

Table 6-2
Suitability and Usefulness Rating of Data provided

Category	Data	Suitability and Usefulness Rating	Comment
Technical reports	Laval, M; Le Bel, L. (1985). BRGM-OF-05-19.	3	Contains useful information but is not specific to Al Khashabi, although the location is mentioned
	Brosset. (1973). BRGM-74 JED 9 01	1	Contains useful regional descriptions and the best available descriptions of mineralisation at Al Khashabi.
	Extract from Watts, Griffis and McQuat Ltd (1992), WGM-CR-11-11 and WGM-CR-11-12	1	Contains useful geological sketch maps, and summary descriptions of Al Khashabi, however no new information is presented.
Geological Maps	Geological map of part of Wadi Al Mulayh Quadrangle (22H) (Manivit et al, 1985	3	1:250 000 scale map which does not contain suitable detail for prospect scale use
	Brosset, R. (1973). Geologic Map BRGM-74 JED 9 04, Appendix 1 Brosset, R. (1973). Mineral Exploration BRGM-74 JED 9 05, Appendix 2	2	Covers the area of interest but at a broad scale. Some spatial location concerns are noted
Remote Sensing	Public Domain Bing and Google Earth	1	Useful for evaluation of surface features on the project location
Petrography	*Brosset, R.* (1973). Geology and Mineral exploration of the Umm Sulaym Quadrangle 22/45C. BRGM-74 JED 9 01. Appendix 4-1 and 4-2	3	Useful for understanding main lithotypes in the area but does not contribute to the understanding of mineralisation and likely deposit controls
Lithogeochemical Sampling	SGS (2024a) wadi sediment sampling as part of the GSAS project	3	Sample spacing is too broad to locate mineralisation within the project area

Category	Data	Suitability and Usefulness Rating	Comment
Historical Geophysical Survey	Brosset (1973). BRGM-74 JED 9 06, Appendix 5	2	Only raster contour data is available and provides little information for prospect scale evaluation
	SGS (2024b) 800m line spaced, 1965 generation aeromagnetic survey data.	3	Data is suitable to place the project within the regional framework but does not resolve geological features within the project area
Recent Geophysical Surveys	SGS (2024c) 300 m line spaced, 2023 generation aeromagnetic survey data	3	Useful to resolve large scale features on the licence but inadequate for prospect scale exploration

7 REFERENCES

BRGM. (1995). Metallic Mineral Deposits Map of the Arabian Shield, Kingdom of Saudi Arabia, North Sheet, 1:1,000,000.

Brosset, R. (1973). Geology and Mineral exploration of the Umm Sulaym Quadrangle 22/45C. BRGM-74 JED 9 01.

Laval, M; Le Bel, L. (1985). Assessment of the felsic plutonic rocks in the South Al Amar Area. BRGM-OF-05-19.

Manivit, J; Pellaton, C; Vaslet, D; Le Nindre, Y; Brosse, J and Fourniguet (1985). Geologic Map of the Wadi Al Mulayh Quadrangle, Sheet 22H, Kingdon of Saudi Arabia. GM-92 C.

Robertson, M (2022). J4302 SGS-TP. Desktop Review and Ranking of Initial 30 Locations – December 2022. Internal SGS report, Accelerated Exploration Program.

SGS (accessed 22 August 2024a). High Resolution Geochemical Survey of the Arabian Shield (GSAS) Metadata Description Document, National Geological Database Portal, RGP – GSAS Grid Code GM 092C, 9p.

SGS (accessed 22 August 2024b). Aeromagnetic surveys description document, National Geological Database Portal, Geophysics (Legacy) Grid Code GM-092C, 7p.

SGS (accessed 22 August 2024c). Aeromagnetic Surveys interim data description document, National Geological Database Portal, RGP – Magnetic Grid Code GM 092C 4522-3,7p.

Watts, Griffis and McQuat Ltd (1992), Extent, Status and Adequacy of Exploration, Eastern Arabian Shield. Prepared for the Petroleum and Mineral Resources Directorate General of Mineral Resources, Jiddah. Confidential Report Watts, WGM-CR-11-11.

Watts, Griffis and McQuat Ltd (1992), Recommendations for Further Mineral Exploration in the Eastern Arabian Shield. Prepared for the Petroleum and Mineral Resources Directorate General of Mineral Resources, Jiddah. Confidential Report Watts, WGM-CR-11-12.

APPENDIX 1:

Directory List of Data Received from SGS

Directory List of Data Received From SGS

01_Stage 1 - Data Collection - Validation – Digitization

- 01_Raw Data Received
    - No data
- 02_Documents Received
    - Al Kashabi Wadi Arakah WGM-CR-11-11.pdf
    - Al Khashabi (Wadi Arakah) WGM-CR-11-12.pdf
    - BRGM-OF-05-19
        - BRGM-OF-05-19.pdf
    - BRGM- 74 JED 9
        - BRGM- 74 JED 9 01.pdf
        - BRGM- 74 JED 9 02.pdf
        - BRGM- 74 JED 9 03.pdf
        - BRGM- 74 JED 9 04.pdf
        - BRGM- 74 JED 9 05.pdf
        - BRGM- 74 JED 9 06.pdf