



**PMDC**  
PAKISTAN MINERAL DEVELOPMENT CORP.

Head Office

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**Expression of Interest (EOI) for Pre-Qualification of Firms for Miscellaneous Technical and Laboratory Services related to Minerals Exploration**

Pakistan Mineral Development Corporation (PMDC) is an autonomous corporation under the administrative control of Ministry of Energy (Petroleum Division), Government of Pakistan. PMDC invites Expressions of Interest (EOI) from eligible, reputable, and experienced firms/consortia for the Miscellaneous Technical and Lab Services related to Minerals Exploration under different categories/lots as per following

Lot#	Description/Category
1	Petrography, Stable isotopes, and Fluid inclusion studies for mineral exploration
2	Geochemical lab services for mineral exploration
3	Geophysical Surveys for Mineral Exploration
4	Firms providing Ai-Based Mineral Exploration Services
5	Services for Core drilling, Core logging and Sample preparation (as per international standards) for mineral exploration
6	Hiring Consulting firm for Mineral Resource Estimation (MRE) Studies.

Shortlisted/Prequalified firms will be invited to participate in inquiries on case-to-case basis. **Firms already Shortlisted/Prequalified may not need to submit documents for these lots.**

EOI documents having detailed terms & conditions can be downloaded from PPRA Website.

The firms shall submit documents in accordance with the instructions contained in the EOI documents manually in the under-signee office on or before **April 20, 2026, at 11.00 AM**. The opening of tender will take place on the same date at **11:30 AM**, with the participation of representatives from interested firms (if interested). This advertisement is also available on PPRA website.

Note: -

In case of any technical difficulty in downloading documents, prospective bidders may contact PPRA Office, 1st floor, FBC building Sector G-5/2, Islamabad. Contact Number 051-111-137-237. For any other inquiry firms may contact undersigned regarding any information.

**DGM (Procurement)**  
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**PRE-QUALIFICATION OF FIRMS TO PROVIDE MISCELLANEOUS LAB TESTING & OTHER SERVICES RELATED TO MINERALS EXPLORATION**

**1. Introduction**

Pakistan Mineral Development Corporation (PMDC), a state-owned enterprise under the administrative control of the Ministry of Energy (Petroleum Division), Government of Pakistan, invites pre-qualification documents from eligible and experienced firms/consortia for the provision of miscellaneous services as per following different categories.

Lot#	Description
1	Petrography, Stable isotopes, and Fluid inclusion studies for mineral exploration
2	Geochemical lab services for mineral exploration
3	Geophysical Surveys for Mineral Exploration
4	Firms providing Ai-based Mineral Exploration Services
5	Services for Core drilling, Core logging and Sample preparation (as per international standards) for mineral exploration
6	Hiring Consulting firm for Mineral Resource Estimation (MRE) studies.

TORs (term of reference) for each lot/category are given below. Pre-qualification will be for the initial period of two years, further extendable for one year. Firms interested in participating in more than one category can apply separately against each lot by clearly mentioning the relevant category as per Annexure A.

Pre-qualified firms will be invited to participate in relevant procurement requirements on case-to-case basis. Firms participating as a consortium must designate a Consortium Leader, who will be responsible for submitting all required documents on behalf of the consortium. PMDC reserves the right to cancel the process at any stage. **Firms already Shortlisted/Prequalified with PMDC against above categories are not required to participate again.**

Interested firms may participate in this EOI for PQ through manual submission to PMDC, Head Office, Islamabad by downloading documents from PPRA website/PMDC official website and submit documents before closing date on April 20, 2026, till 11:00 AM and opening of Pre-Qualification will take place on the same date at 11:30 AM.

(Sajid Hussain)  
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## Category/Lot # 1

### Terms of Reference for Petrography, Stable isotopes, and Fluid inclusion Studies for Mineral Exploration.

#### **1. Introduction**

PMDC is initiating an exploration study in designated mineral exploration blocks. Sampling has been completed in the target area. PMDC requires the services of a qualified Firm or Laboratory ("The Service Provider") with relevant experience in petrography, mineral identification in thin section, and classification of alteration minerals.

#### **2. Purpose and Aim**

The purpose of this mineral exploration project is to explore metallic and non-metallic mineralization, including precious minerals and base metals, within the PMDC's exploration blocks. The target area is characterized by features known to host hydrothermal mineralization. The purpose is to engage a Firm or Laboratory for conducting detailed petrographic and mineralogical analysis of a specified number of rock and alteration mineral samples collected from the narrowed-down prospects. The samples typically include host rocks, hydrothermal veins, and brecciated rocks. The objective is to obtain comprehensive petrographic descriptions supported by thin section analysis and to deliver detailed written reports for each sample.

#### **3. Objective: Petrographic Analysis**

- **Sample Analysis:** To conduct detailed petrographic analysis of the total number of rock samples collected from the exploration blocks, including specialized samples (e.g., host rocks, veins, alteration).
- **Mineral Identification:** To categorize each sample based on its alteration status (altered or unaltered) and host rock type, and to identify and document all primary and secondary minerals present.
- **Classification:** To classify each sample according to its lithology, identifying whether the sample is a host rock (e.g., sedimentary, volcanic, metamorphic) and further classifying it into specific rock types.



- **Mineralization Potential:** To assess the potential for target mineralization by analyzing whether the samples provide any indications or clues of the presence of economic minerals or related pathfinders.
- **Textural Analysis:** Evaluate potential indicators of mineralization, including the identification and classification of hydrothermal breccia and other related textures (e.g., tectonic, hydraulic, and crackle breccia).
- **Reporting:** To produce a comprehensive set of petrographic reports, including detailed descriptions, mineral identifications, interpretations, and paragenesis studies for all samples.

#### 4. Scope of Work

The petrography service provider (Firm or Lab) shall undertake the following tasks:

- The scope involves conducting detailed petrographic analysis of the total number of rock samples, including thin section preparation, mineral identification, and identification and classification of lithology and alteration mineral assemblages.
- Mobile metal ions (MMI) analysis/studies for primary and secondary dispersion of elements.
- Stable isotope studies and fluid inclusion studies to develop deposit type/ models.
- Evaluate potential indicators of mineralization, including the identification of key textures and breccia types.
- Provide detailed separate reports for sample batches, as specified by PMDC, with clearly labeled outputs.

#### 5. Timeline

The petrographic analysis and reporting shall be completed within the contractually agreed-upon number of calendar days from the date the samples are dispatched to the firm or lab.

#### 6. Qualifications

The petrography service provider (Lab or firm) shall possess the following general qualifications:



- Must have experts on staff who hold advanced degrees (M.Sc. /Ph.D.) in mineralogy or petrology.
- Possess a proven number of relevant years of experience in rock and mineral identification, particularly in the context of petrographic analysis for mineral exploration.
- Must have expertise in the exploration of structurally controlled hydrothermal and epithermal mineral deposits.
- Have a proven track record of providing petrographic services in a minimum number of mineral exploration projects.

## 7. Compliance

The Lab or firm shall comply with all best exploration practices, applicable laws, regulations, and mineral exploration standards as per the National Instrument 43-101 (NI 43-101), the Australasian Joint Ore Reserves Committee (JORC) Code), or equivalent International Standards.

## 8. Deliverables

- **Comprehensive Petrographic Reports:** Detailed reports for all samples, including identification, classification, detailed descriptions of alteration minerals, host rock types, depositional environment, and paragenesis of minerals.
- **Detailed Classification:** Provide the detailed classification of each sample based on its lithology.
- **Photomicrographs:** High-quality, labeled photomicrographs of each sample in both plane-polarized light (PPL) and cross-polarized light (XPL), clearly indicating key minerals and mineralogical features.
- **Textural and Mineralization Indicators:** Evaluation of potential mineralization indicators, including the identification of key textural features
- **Find Reports:** Stable Isotope Study and Fluid Inclusion Study for Deposit Type/Model
- **Thin Sections:** All prepared thin sections must be submitted to PMDC.



- **Presentation:** A final presentation of findings to the PMDC Exploration Team, summarizing key results and interpretations.
- **Paragenesis Study Report:** Determines the sequence of target mineral formation, geological events, and depositional environments (structural and depositional) associated with the target mineralization (microscopic examination report of ore-bearing minerals, alteration, texture, rock identification (ore facies), and determination of the sequential formation of minerals and geological events)
- Petrographic & Paragenesis Study Reports:

#### **9. Payment Terms:**

- 30 days after completion of the job unless agreed otherwise on case-to-case basis.
- Payment will be made in PKR (Pakistani Rupees) less all applicable taxes.

#### **10. Miscellaneous Arrangements:**

Service provider will be responsible for arranging all required tools, equipment, testing, reports, reperformance, security, travelling, accommodation and approvals required to complete the deliverables.

#### **11. Monitoring and Reporting**

PMDC will monitor the Service Provider's performance throughout the engagement. Deliverables will be subject to review and approval by PMDC's oversight team to ensure compliance with the contract terms and international standards.

#### **12. Confidentiality**

All project data and outputs shall remain the property of PMDC. The consultancy firm shall maintain strict confidentiality and shall not disclose or use any project information for any purpose other than completion of this assignment.



**Evaluation Criteria for LOT # 1**

Sr. No	Evaluation Criteria	Max Marks	Obtained Marks
1	<p style="text-align: center;"><b>Academic Qualifications</b></p> A PhD in mineralogy and petrology is mandatory (30 Marks) Additional marks will be awarded for relevant postdoctoral research or specialized training in petrography.	30	
2	<p style="text-align: center;"><b>Relevant Experience</b></p> Assessment of the firm's experience in petrography, particularly in rock and mineral identification. A minimum of 5 years of relevant experience is required. Extra marks will be given for experience in Isotope and fluid inclusion study for deposit type.	20	
3	<p style="text-align: center;"><b>Track Record in Exploration Projects</b></p> Evaluation based on the number and quality of previous exploration projects where the applicant provided petrographic services, Isotope and Fluid Inclusion study for mineral deposit type. A minimum of three projects is required. Supporting documentation or references must be provided. Proportional marks will be allocated for each project.	30	
4	<p style="text-align: center;"><b>Financial Soundness &amp; Tax Registration</b></p> Firms have annual average revenue of PKR 50 M in last three years with registration with FBR for Sales Tax. Half marks will be given if annual average revenue is less than PKR 50 M. No marks will be given if annual average revenue is less than PKR 20 M	20	
<b>Total</b>		<b>100</b>	

**Qualification Marks: 60**



## Category/Lot # 2

### Terms of Reference for Geochemical lab for Mineral Exploration.

#### **1. Introduction**

The Pakistan Mineral Development Corporation (PMDC) is an autonomous body under the administrative control of the relevant Ministry of Energy (or equivalent). PMDC has initiated an exploration program in designated exploration areas. PMDC requires the services of a qualified Firm or Laboratory ("The Service Provider") to conduct comprehensive geochemical and mineralogical analyses for mineral exploration.

#### **2. Objectives**

The primary objectives of the geochemical study are:

1. To conduct Elemental Dispersion and appropriate Geochemical Studies (e.g., Mobile Metal Ion Study) to analyze primary and secondary elemental dispersion in collected samples and identify anomalous samples and pathfinder elements associated with target mineralization.
2. To perform mineralogical analysis (e.g., XRD analysis) to determine the composition of alteration minerals.
3. To perform appropriate analytical techniques and procedures (e.g., Digestion, Aqua Regia, Fire Assay, ICP-OES/MS, AAS) to quantify concentrations of the target element(s) and associated pathfinder elements.
4. To carry out Petrography and Paragenesis studies to examine ore facies, the sequential deposition of minerals, and the identification of host rocks and associated alteration minerals.

#### **4. Geochemical Studies**

The Service Provider shall conduct analysis and interpretation related to:

- Elemental Dispersion (Primary and Secondary Dispersion): Analyzing the natural movement and distribution of target and pathfinder elements from a mineralized source, forming geochemical halos that guide exploration.
- Background Values & Threshold Values: Establishing the normal range of element concentrations in un-mineralized regions (Background Values) and statistically defining the upper limit (Threshold Values) to distinguish naturally occurring metal content from potential mineralization-related anomalies.

#### **5. Analytical Methods (Examples)**



The Service Provider must utilize appropriate, internationally recognized analytical methods to achieve the required detection limits and accuracy for the target elements.

These methods may include:

- **Digestion Methods:** Employing appropriate chemical digestion (e.g., Aqua Regia, 4-acid) necessary to dissolve metals and prepare samples for quantification.
- **Multi-Element Analysis:** Used for rapid, precise, and multi-element analysis of metals in the ppm-ppb range, such as Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) or Mass Spectrometry (ICP-MS).
- **Targeted Geochemical Techniques:** Analyzing loosely bound metal ions in near-surface materials to detect subtle geochemical anomalies, particularly for deeply buried or concealed ore bodies, such as Mobile Metal Ion (MMI) Study.
- **Mineralogical Identification:** Determining the mineralogical composition of alteration zones and identifying host rock minerals and ore-associated phases, e.g., X-Ray Diffraction (XRD).
- **High-Precision Quantification:** Utilizing precise methods to quantify specific elements, including the industry-standard Fire Assay technique for high-precision precious metal determination, such as Atomic Absorption Spectroscopy (AAS) and Fire Assay.

## 6. Deliverable

Submission of a comprehensive report which contains the identification of anomalous areas and proposed drillable prospects based on the results of the following geochemical and mineralogical studies:

- i. **Elemental Dispersion and Geochemical Report:** Detailed report of elemental dispersion study (Primary & Secondary Dispersion) and specialized geochemical method results (e.g., MMI), indicating geochemical anomalies of target and pathfinder elements.
- ii. **Mineralogical & Geochemical Study Reports and Results:**
  - a. XRD Analysis Report: Identifying alteration minerals associated with target mineralization.
  - b. Assay Certificates: Results from Fire Assay, Digestion, Aqua Regia-AAS, ICP-MS, ICP-OES, and other quantitative analysis methods for all submitted samples, including target elements and pathfinder elements.
  - c. Digestion Reports: Results from specific digestion methods (e.g., Aqua Regia).



iii. **Petrographic & Paragenesis Study Reports:** Microscopic examination report of ore-bearing minerals, alteration, texture, rock identification (ore facies), and determination of the sequential formation of minerals and geological events.

iv. **Submission & Recommendations Reports:**

- a. Comprehensive interpretation of all geochemical and mineralogical results to establish elemental anomalies.
- b. Exploration guidance based on anomaly detection.
- c. Identification of anomalous areas and drillable prospects/drilling points based on the anomalous samples.

**7. Monitoring and Reporting:**

PMDC will monitor the Service Provider's performance throughout the engagement. Deliverables will be subject to review and approval by PMDC's oversight team to ensure compliance with the contract terms and International Standards (NI 43-101).

**8. Miscellaneous Arrangements:**

Service provider will be responsible for arranging all required tools, equipment, testing, reports, reperformance, security, travelling, accommodation and approvals required to complete the deliverables.

**9. Payment Terms:**

- 30 days after completion of the job unless agreed otherwise on case-to-case basis.
- Payment will be made in PKR (Pakistani Rupees) less all applicable taxes.

**10. Confidentiality**

- All project data and outputs shall remain the property of PMDC. The consultancy firm shall maintain strict confidentiality and shall not disclose or use any project information for any purpose other than completion of this assignment.



## Evaluation Criteria of Lot#2

Sr. No	Evaluation Criteria	Max Marks	Obtained Marks
1	<b>Academic Qualifications</b> Two number of MSc professionals in geochemistry or chemistry are mandatory 20 marks (Additional marks will be awarded for higher education MS/MPhil and PhD in geochemistry or chemistry)	30	
2	<b>Provide Evidences or Certifications</b> Accreditation from Pakistan National Accreditation Counsel as per accreditation: ISO/IEC 17025-2017 Certification: ISO 45001: 2018 Participation of lab in LQSI and Round Robin Programs QA/QC and internal quality control program of lab	30	
3	<b>Track Record in Geochemical Testing Projects</b> Evaluation based on the number and quality of previous, geochemical testing projects of metallic and nonmetallic minerals and minerals bearing rocks, where the applicant provided geochemical services. A minimum of 10 relevant projects is required. Supporting documentation, evidences or references must be provided.	20	
4	<b>Financial Soundness &amp; Tax Registration</b> Firms have annual average revenue of PKR 50 M in last three years with registration with FBR for Sales Tax. Half marks will be given if annual average revenue is less than PKR 50 M. No marks will be given if annual average revenue is less than PKR 20 M	20	
<b>Total</b>		<b>100</b>	

**Qualification Marks: 60**



## Category/Lot#3

### Term of Reference for Geophysical Surveys for Mineral Exploration

#### **1. Introduction**

PMDC is an autonomous body under the administrative control of the relevant Ministry of Energy (or equivalent). PMDC has initiated an exploration program in designated mineral exploration areas. PMDC requires the services of a qualified Firm/Company/Consultant ("The Service Provider") with relevant experience in Geophysical studies/Methods for mineral exploration (data acquisition, processing, and interpretation).

#### **2. Purpose and Aim**

The primary objective of this project is to evaluate the potential for metallic mineralization, including precious and base metals, within the designated exploration areas/blocks. The area is geologically characterized by features known to host hydrothermal mineralization, which is often structurally controlled. PMDC seeks to engage a qualified Service Provider to carry out detailed geophysical services of IP, Magnetic, Gravity, GPR etc for this purpose.

#### **3. Objective: Geophysical Surveys**

##### **3.1 Conduct Systematic Geophysical Surveys**

The Service Provider shall execute Geophysical studies/Methods for mineral exploration over the designated area, using an optimal grid or line spacing as defined in the final contract. The survey dimensions (total area, line-kilometers, and grid points) will be specified in the final scope of work documents. The methods employed must achieve the minimum required depth of investigation to effectively detect subsurface anomalies associated with the target mineralization.

- The Service Provider must specify the method parameters (e.g., sensor spacing, array setup, station location) to achieve the required depth and resolution.
- The Service Provider must set up the necessary base stations or reference points in the vicinity of the operating area for data correction.

##### **3.2 Geophysical Data Acquisition and Processing**



To carry out high-quality acquisition of geophysical data, followed by systematic processing and interpretation in accordance with internationally recognized industry standards to identify subsurface anomalies related to metallic mineralization.

### **3.3 3D and 2D Modeling**

To develop and deliver detailed two-dimensional (2D) and three-dimensional (3D) geophysical models for all survey locations and profile lines. This includes the generation of appropriate models (e.g., resistivity, chargeability, magnetic susceptibility, gravity/density etc) to visualize subsurface features.

### **3.4 Target Definition for Drilling**

Based on the interpreted geophysical anomalies, to delineate priority drilling targets and provide detailed recommendations including:

- Number of drill holes
- Precise coordinates
- Azimuths and orientations
- Suggested depths

### **4. Scope of Work**

- The scope of work involves the systematic execution of Geophysical studies/Methods for mineral exploration over the target zones, as specified in the contractual documents.
- The project includes the development of detailed 2D and 3D geophysical models (such as resistivity, chargeability, magnetic susceptibility, gravity/density etc ), along with depth slice maps and cross-sectional profiles to visualize the spatial distribution of mineralization.
- Based on interpreted anomalies, priority drilling targets should be defined with specific recommendations on drill hole locations, dip, azimuth, and depths.
- A comprehensive technical report should be prepared, documenting all stages of the survey and including maps, models, anomaly descriptions, and proposed drilling plans for the methods used.

### **5. Timeline**



The geophysical survey and final reporting shall be completed within the contractually agreed-upon period. Non-completion of the job in the agreed time will lead to a penalty as defined in the commercial terms of the contract.

## **6. Qualifications**

The geophysical service provider (Firm/Company/Consultant) shall possess the following general qualifications:

- Must have an adequate number of experienced professionals in geophysics (M.Sc. or higher) on staff.
- Possess proven years of relevant experience in geophysical data acquisition, processing, and interpretations, such as in IP, Mag, Gravity, Seismic, resistivity etc., for metallic mineral exploration.
- Must have the expertise in the exploration of structurally controlled hydrothermal and epithermal mineral deposits.
- Have a proven track record of providing geophysical services in relevant mineral exploration projects.

## **7. Compliance**

The Service Provider shall comply with all best exploration practices, applicable laws, regulations, and mineral exploration standards as per NI 43-101.

## **8. Deliverables**

- Daily Field Logs
- Geo referenced Raw Data
- 2D and 3D Models of different geophysical data
- Drill hole targets on the basis of geophysical data interpretation and geophysical anomalies
- Based on interpreted anomalies, priority drilling targets should be defined with specific recommendations on drill hole locations, dip, azimuth, and depths.
- Georeferenced Delivery Format (GIS-ready files, project files)



- Geophysical anomaly Identification and ranking of anomalies on the basis of ore mineral potential (Catalog of anomalies prioritized by strength)
- Cross sections & Depth Slices
- Integrated Geological Synthesis (Overlay geophysical anomalies with geological maps and geochemical datasets to identify high-potential mineralized zones)
- Draft & Final Technical Report Structure as per NI 43-101 International Standards.

#### **9. Monitoring and Reporting:**

PMDC will monitor the Service Provider's performance throughout the engagement. Deliverables will be subject to review and approval by PMDC's oversight team to ensure compliance with the contract terms and international standards.

#### **10. Miscellaneous Arrangements:**

Service provider will be responsible for arranging all required tools, equipment, testing, reports, reperformance, security, travelling, accommodation and approvals required to complete the deliverables.

#### **11. Payment Terms:**

- 30 days after completion of the job unless agreed otherwise on case-to-case basis.
- Payment will be made in PKR (Pakistani Rupees) less all applicable taxes.

#### **11. Confidentiality**

- All project data and outputs shall remain the property of PMDC. The consultancy firm shall maintain strict confidentiality and shall not disclose or use any project information for any purpose other than completion of this assignment.



**Evaluation Criteria of Lot#3**

Sr. No	Evaluation Criteria	Max Marks	Obtained Marks
1	<p align="center"><b>Academic Qualifications</b></p> <p>Five (5) number of experienced MSC professionals in geophysics, along with their educational credentials and CVs must be provided.</p>	25	
2	<p align="center"><b>Relevant Experience</b></p> <p>Assessment of the firm's experience in geophysical surveying in mineral exploration, with particular emphasis on Induced Polarization (IP), Ground Magnetic (Mag) and Gravity Surveys in exploration of mineral deposits. A minimum of three successful metallic mineral exploration projects are required. Supporting documentation and references must be provided.</p>	30	
3	<p><b>Availability and Condition of Geophysical Equipment</b></p> <p>The condition, quality, and latest models of IP, magnetic, and gravity geophysical tools after physical inspection by the PMDC exploration team will be the key criteria for the evaluation.</p>	20	
4	<p><b>Audited Bank Statement for bidder/firm for last three years.</b></p> <p>25 Marks are given if the average annual turnover for the last three years is more than PKR 200 M.</p> <p>15 Marks are given if the average annual turnover of last three years is more than PKR 100 M.</p> <p>10 Marks are given if the average annual turnover for last three years is less than PKR 100 M but more than PKR 50 M.</p>	25	
	<b>Total</b>	100	

**Qualification Marks: 60**



## Category/Lot#4

### **Terms of Reference: International Artificial Intelligence (AI)-based Mineral Exploration Services.**

#### **1. Introduction and Background**

The Pakistan Mineral Development Corporation (PMDC) is committed to modernizing its exploration methodologies to enhance discovery rates and reduce risk. PMDC requires the international specialized AI services of the AI Based Mineral Exploration forum (referred to herein as "The AI Exploration Partner"), which possesses expertise in integrating advanced computational intelligence, machine learning, and geological science for mineral targeting.

The AI Exploration Partner will utilize proprietary or industry-standard Artificial Intelligence (AI) and Machine Learning (ML) techniques to analyze vast, multi-layered datasets to generate high-confidence exploration targets in PMDC's designated project areas.

#### **2. Purpose and Aim**

The primary objective is to leverage cutting-edge AI methodologies to process and integrate complex geological, geophysical, and geochemical datasets to:

- **Identify Predictive Signatures:** Discover subtle, non-linear relationships and patterns in existing data that are indicative of metallic mineralization (e.g., precious, base, and strategic metals).
- **Derisk Exploration:** Prioritize exploration efforts by generating ranked, high-confidence drill targets, significantly improving the success rate of the subsequent drilling phases.
- **Optimize Resource Allocation:** Provide PMDC with an objective, data-driven framework for making exploration investment decisions.

#### **3. Scope of Work**

The AI Exploration Partner shall execute a comprehensive data-to-target workflow, including the following key phases:

##### **3.1 Data Ingestion and Normalization**



The Partner will manage the ingestion of all historical and new data provided by PMDC (see Section 4), ensuring all data layers are properly georeferenced, cleaned, standardized, and formatted for model consumption.

### 3.2 Feature Engineering and Selection

The Partner will apply specialized domain knowledge and computational techniques to extract meaningful features from the raw data. This includes:

- Creating derived datasets (e.g., ratios, filters, structural indices).
- Selecting the most statistically and geologically significant features to serve as inputs for the predictive models.

### 3.3 AI/ML Model Training and Deployment

The Partner shall select, train, and deploy appropriate Machine Learning models for mineral Prospectivity mapping. This must include:

- **Supervised Learning:** Utilizing known mineral occurrences (deposits and showings) as training data to build models that predict the probability of new mineralization.
- **Unsupervised Learning:** Employing clustering and dimensionality reduction techniques to identify previously unrecognized patterns, geological domains, or alteration zones.
- **Cross-Validation and Testing:** Rigorously testing model performance using techniques like k-fold cross-validation to ensure model robustness and prevent overfitting.

### 3.4 Prospectivity Mapping and Target Generation

The primary output is a Probabilistic Prospectivity Map that ranks every cell within the study area according to its calculated potential for hosting mineralization. The Partner shall use the final, validated model to:

- Identify high-priority target zones based on a defined confidence threshold.
- Provide a comprehensive justification for the predictive targets, linking model outputs back to observable geological features.

## 4. Required Input Data



The Partner must possess the capability to utilize a diverse range of geological and spatial data, which will be provided by PMDC:

Data Type	Examples (non-exhaustive)
<b>Remote Sensing Data</b>	Satellite imagery (e.g., ASTER, Sentinel, ZY-1E, Landsat etc...), Digital Elevation Models (DEM), and processed alteration indices.
<b>Geochemical Data</b>	Rock, soil, and stream sediment assay results, and specific elemental pathfinder concentrations.
<b>Geological Data</b>	Surface geology maps, structural data/Map (faults, folds), Alteration Map, known mineral occurrence databases (GIS layers) etc...
<b>Geophysical Data</b>	Magnetic survey data, Induced Polarization (IP), Mag, Gravity, Radiometric data, or VTEM data etc...

## 5. Deliverables

The AI Exploration Partner shall submit the following comprehensive deliverables:

1. **Project Inception Report:** Detailed plan outlining the proposed AI/ML methodologies, feature engineering strategy, validation plan, and timeline.
2. **Processed Data Package:** All input datasets in a standardized, clean, and georeferenced format (GIS-ready).
3. **Prospectivity Maps (Digital):**
  - o Final, probabilistic Prospectivity map (raster format) showing the ranked potential for mineralization.
  - o Confidence map (raster format) showing the spatial reliability of the model predictions.
4. **Target Definition Report:** A detailed listing and description of all generated drilling targets, ranked by confidence, including:
  - o Precise coordinates, suggested depth, and a geological rationale derived from model interpretation.



- A breakdown of which input data features contributed most significantly to the target's high ranking (feature importance analysis).
5. **Final Technical Report:** A comprehensive document prepared in accordance with National Instrument 43-101 (NI 43-101) or Australasian Joint Ore Reserves Committee (JORC) Code standards, detailing the methodology, model parameters, validation results, and final conclusions.

## 6. Qualifications and Compliance

The AI Exploration Partner must demonstrate expertise in both geological exploration and advanced data science.

- **Personnel:** Must have an adequate number of experienced professionals on staff, including Geologists/Geophysicists (M.Sc. /Ph.D. level) and Data Scientists/ML Engineers.
- **Experience:** Proven track record of at least three successful projects in AI/ML-based mineral exploration targeting that led to successful discoveries or significant de-risking of projects.
- **Software/Platform:** Possess the necessary proprietary or commercial software and computing infrastructure required for large-scale geospatial data processing and ML model training.
- **Compliance:** The Partner shall comply with all best exploration practices, applicable laws, regulations, and mineral exploration standards as per NI 43-101, JORC, or equivalent international standards.

## 7. Monitoring and Reporting

PMDC will monitor the AI Exploration Partner's performance through regular reporting and technical reviews. The Partner must facilitate transparent communication regarding model training, feature selection, and validation results.

## 8. Miscellaneous Arrangements:

Service provider will be responsible for arranging all required software, tools, equipment, testing, reports, reperformance, security, travelling, accommodation and approvals required to complete the deliverables.

## 9. Payment Terms:



- 30 days after completion of the job unless agreed otherwise on case-to-case basis.
- Payment will be made in PKR (Pakistani Rupees) less all applicable taxes.

#### **10. Confidentiality**

All project data and outputs shall remain the property of PMDC. The consultancy firm shall maintain strict confidentiality and shall not disclose or use any project information for any purpose other than completion of this assignment.

#### **11. Consortium:**

If Applicant is a Consortium, there must be a Consortium Leader appointed through a Power of Attorney executed by all Consortium Members individually, authorizing the Consortium Leader to act on their behalf and to enter legally binding obligations.



### Evaluation Criteria of Lot#4

Sr. No	Evaluation Criteria	Max Marks	Obtained Marks
1	<b>Provide CVs and Credentials-Personnel</b> Must have an adequate number of experienced professionals on staff, including Geologists/Geophysicists (M.Sc. /Ph.D. level) and Data Scientists/ML Engineers.	30	
2	<b>Relevant Experience</b> Proven track record of at least three successful projects in AI/ML-based mineral exploration targeting that led to successful discoveries or significant de-risking of mineral exploration projects.	30	
3	<b>Provide Evidence-Software/Platform</b> Possess the necessary proprietary or commercial software and computing infrastructure required for large-scale geospatial data processing and ML model training	20	
4	<b>Financial Soundness &amp; Tax Registration</b> Firms have annual average revenue of PKR 50 M in last three years with registration with FBR for Sales Tax. Half marks will be given if annual average revenue is less than PKR 50 M. No marks will be given if annual average revenue is less than PKR 20 M	20	
	<b>Total</b>	100	

**Qualification Marks: 60**



## Category/Lot#5

### Terms of Reference for Pre-Qualification of Core drilling, Core logging and Sample preparation (as per international standards) for Mineral Exploration.

#### **1. INTRODUCTION**

Pakistan Mineral Development Corporation (PMDC), a public sector entity under the Government of Pakistan, is engaged in the exploration and development of metallic and non-metallic mineral resources across Pakistan. To support its exploration programs and enhance the technical quality of subsurface investigations, PMDC intends to engage qualified and experienced Core Drilling Contractors ("The Contractor") through a pre-qualification / tendering process.

The services are aimed at executing diamond core drilling, core recovery, core logging, and sample preparation for mineralized zones in accordance with international exploration standards such as NI 43-101, JORC (2012/2024), or equivalent industry best practices.

#### **2. PURPOSE AND AIM**

The purpose of this TOR is to define the technical, operational, and qualification requirements for pre-qualification and selection of drilling contractors capable of delivering high-quality exploration drilling, geological logging, and sample preparation services that meet international mineral resource reporting standards.

The aim is to ensure safe, efficient, and high-quality core drilling programs; the collection of reliable geological data through systematic core logging and sampling; and strict adherence to environmental and safety protocols within the designated exploration areas.

#### **3. SCOPE OF WORK**

The scope of work covers comprehensive diamond core drilling, core logging, and sample preparation services within PMDC's mineral exploration projects. The Contractor shall mobilize, execute, and demobilize all drilling and related operations, ensuring all activities are conducted efficiently and to the highest technical standards.

##### **3.1 Drilling Execution**

- Execution of core drilling and non-coring (rotary) drilling as required by geological and site conditions.
- Drilling to variable depths, orientations, and angles as specified in the contractual drilling plan.
- Application of appropriate drilling techniques to ensure maximum core recovery, particularly in fractured, weak, or unconsolidated formations.
- Maintenance of accurate depth records, penetration rates, and lithological observations for every drill hole.

##### **3.2 Core Handling, Logging, and Sample Preparation**



- Accurate measurement, orientation, boxing, and labeling of all recovered core.
- Systematic geological and geotechnical logging of core by qualified geologists and core loggers using standardized templates and coding systems.
- Core photography (dry and wet) and digital cataloging of core trays.
- Core cutting, sampling, and sample preparation for dispatch to the designated analytical laboratory in accordance with PMDC's QA/QC protocols.
- Proper handling and storage of samples, maintaining a complete chain of custody record until delivery to the analytical laboratory.

### **3.3 Borehole Management**

- Execution of downhole surveys (directional or deviation surveys) to accurately record drill trace geometry.
- Support of downhole geophysical logging activities when required by PMDC.
- Backfilling, sealing, and rehabilitation of drill sites upon completion of each borehole, ensuring compliance with environmental and safety standards.

## **4. OPERATIONAL REQUIREMENTS**

### **4.1 Equipment**

- The Contractor must use modern, well-maintained drilling equipment suitable for a variety of geological conditions and capable of achieving required depths and diameters (e.g., NQ, HQ, PQ).
- All major and support equipment must be certified, safety-inspected, and approved by PMDC prior to mobilization.

### **4.2 Personnel**

- Drilling crews and supervisors must have proven experience in mineral exploration projects, including core drilling, geological logging, and sample handling.
- Key personnel must hold relevant certifications and demonstrate strong knowledge of international safety and QA/QC standards.

## **5. QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)**

The Contractor shall implement a robust QA/QC system throughout drilling and sampling operations, including:

- Verification of drilling depths, collar coordinates, and directional surveys.
- Maintenance of high core recovery rates, monitored daily against contractual targets.
- Strict chain of custody protocols for all cores and samples.



- Implementation of field blanks, duplicates, and Certified Reference Materials (CRMs) for laboratory QA/QC control.

## **6. HEALTH, SAFETY, AND ENVIRONMENT (HSE)**

The Contractor must comply with all relevant international and national HSE standards, including ISO 45001, ISO 14001, and all applicable regulations under the Government of Pakistan.

A site-specific Health, Safety, and Environmental Management Plan (HSEMP) and Emergency Response Plan (ERP) shall be developed and implemented.

## **7. DELIVERABLES**

The Contractor shall submit the following deliverables during and upon completion of the project:

- Daily Drilling Progress Reports (depth, recovery, lithology, downtime).
- Core Recovery and Geological/Geotechnical Logs (digital and hardcopy).
- Core Photographic Records (wet and dry, in digital format).
- Sample Dispatch and Chain of Custody Documentation.
- QA/QC Summary Sheets (blanks, duplicates, standards).
- Final Completion Report including:
  - Drill hole coordinates and depth data.
  - Lithological, recovery, and geotechnical summaries.
  - QA/QC validation and performance summary.
  - Digital files compatible with GIS and modeling software.

## **8. MONITORING AND REPORTING**

PMDC's Exploration Geology Team will supervise all drilling, logging, and sampling activities.

- Weekly review meetings will assess progress, QA/QC compliance, and HSE performance.
- Any deviations from approved procedures must receive prior approval from PMDC's Project Manager.
- Interim and final reports shall be submitted in both hard copy and digital formats.

## **9. Miscellaneous Arrangements:**

Service provider will be responsible for arranging all required tools, equipment, testing, reports, reperformance, security, travelling, accommodation and approvals required to complete the deliverables.



#### **10. Payment Terms:**

- 30 days after completion of the job unless agreed otherwise on case-to-case basis.
- Payment will be made in PKR (Pakistani Rupees) less all applicable taxes.

#### **11. Confidentiality**

All project data and outputs remain the property of PMDC. The consultancy firm shall maintain strict confidentiality and shall not disclose or use any project information for any purpose other than completion of this assignment.

purpose other than completion of this assignment.

#### **12. Consortium:**

If Applicant is a Consortium, there must be a Consortium Leader appointed through a Power of Attorney executed by all Consortium Members individually, authorizing the Consortium Leader to act on their behalf and to enter legally binding obligations.



**Evaluation Criteria of Lot#5**

<b>Category</b>	<b>Sub-Criteria</b>	<b>Marks Allocation</b>
<b>A. Experience (30 Marks)</b>	• Years of experience (minimum 5 years)	10
	• Relevant projects completed (minimum 5 projects)	10
	• Client references and past performance	10
<b>B. Equipment &amp; Capability (25 Marks)</b>	• Availability and condition of drilling/geophysical equipment	10
	• Depth capacity / technical capability	5
	• Support equipment and logistics (vehicles, camp setup, etc.)	10
<b>C. Technical Personnel (15 Marks)</b>	• Crew and supervisor qualifications and experience	10
	• Geologists / core loggers / field experts	5
<b>D. QA/QC &amp; HSE Standards (15 Marks)</b>	• Quality Assurance / Quality Control procedures	7
	• Safety management systems and compliance	8
<b>E. Financial Strength (10 Marks)</b>	Annual average turnover of last three years should be more than PKR 50 Millions	10
<b>F. Compliance &amp; Reporting (5 Marks)</b>	• Understanding and compliance with NI 43-101 / JORC standards	5
<b>Total Marks</b>		<b>100</b>
<b>Minimum Qualification Requirement</b>		<b>60 Marks</b>



**Terms of Reference for Hiring of Consulting firm for Mineral Resource Estimation (MRE) Studies.**

**1. Background**

Pakistan Mineral Development Corporation (PMDC), under the administrative control of the Ministry of Energy (Petroleum Division), Government of Pakistan, is engaged in the exploration and development of metallic and non-metallic mineral resources in Pakistan.

To quantify and classify the identified mineralized zones as per international reporting standards (NI 43-101), PMDC intends to hire reputed National or International Consulting Firms having expertise in Mineral Resource Estimation (MRE) using Leapfrog and Data Mine software platforms.

**2. Objective of the Assignment**

The objective of this assignment is to conduct a comprehensive Mineral Resource Estimation (MRE) Study to estimate Inferred, Indicated, and Measured categories of mineral resources in the identified project area(s) based on geological, geochemical, geophysical and drilling datasets provided by PMDC.

**3. Scope of Work**

The scope of work shall include but not be limited to the following tasks:

**3.1 Data Compilation and Validation**

- Review and validate all available exploration data (geological mapping, sampling, geophysical survey, and drilling).
- QA/QC assessment of sampling, assay, and analytical data.
- Database creation and validation in Leapfrog / DataMine environment.

**3.2 Geological Modelling**

- Develop detailed 3D lithological and structural models in Leapfrog/Datamine.
- Define mineralized zones, orebody wireframes, and domains based on geological and geostatistical parameters.
- Identify controls of mineralization and structural trends.

**3.3 Grade Modelling and Geostatistical Analysis**

- Conduct statistical and variographic analysis of assay data.
- Apply appropriate estimation techniques (Inverse Distance, Ordinary Kriging, or



other suitable geostatistical methods).

- Block model generation in DataMine/Leapfrog Edge with defined block sizes, orientation, and grade interpolation parameters.

### 3.4 Resource Classification and Estimation

- Classify mineral resources as Measured, Indicated, and Inferred as per NI 43-101 guidelines.

- Validate model using reconciliation, swath plots, and visual checks.

- Prepare tonnage-grade curves and resource statements.

### 3.5 Reporting and Deliverables

- Preparation of a comprehensive Mineral Resource Estimation Report including:

- Methodology, parameters, QA/QC, database validation.
- Geological model, block model results, and classification criteria.
- Maps, cross-sections, and 3D views.
- Resource summary tables by category and cut-off grade.

- Submission of digital outputs:

- Leapfrog (.lfm) and DataMine (.dm) project files.
- CSV database and block model files.
- QA/QC reports, assay certificates, and metadata.

## 4. Deliverables and Timelines

S.No.	Deliverable	Description	Timeline
1	<b>Inception Report</b>	Understanding of available data, methodology, and work plan	Within <b>2 weeks</b> after commencement
2	<b>Draft 3D Model</b>	Preparation of preliminary geological and grade model	Within <b>6 weeks</b>
3	<b>Draft MRE Report</b>	Detailed resource estimation and classification as per standards	Within <b>10 weeks</b>
4	<b>Final MRE Report</b>	Incorporating Client/PMDC feedback and submission of final report	Within <b>12 weeks</b>

## 5. Expertise and Qualification Requirements



**The firm must demonstrate:**

- Minimum 10 years of experience in mineral resource estimation and modelling.
- Proven experience in Leapfrog, DataMine.
- Experience of at least 3 similar MRE assignments in metallic mineral deposits.
- Qualified Persons QPs (Qualified Person) as per NI 43-101.

**Strong team composition including:**

- Senior Resource Geologists (Lead CP)
- 3D Modelling Geologists (Leapfrog/DataMine Expert)
- Database/QAQC Specialists
- Geostatistician
- GIS/Remote Sensing Analyst

**6. Data and Support by PMDC**

PMDC will provide:

- Geological, geochemical, and drilling data.
- Topographic and survey data.
- Access to project area for verification or ground-truthing (if required).

**7. Reporting Standard**

All resource estimation and reporting shall be compliant with:

- NI 43-101 or equivalent recognized international standard.

**8. Duration of Assignment**

The assignment shall be completed within twelve (12) weeks from the date of commencement, subject to data availability.

**9. Miscellaneous Arrangements:**

Service provider will be responsible for arranging all required software, tools, equipment, testing, reports, reperformance, security, travelling, accommodation and approvals required to complete the deliverables.

**10. Payment Terms:**

- 30 days after completion of the job unless agreed otherwise on case-to-case basis.
- Payment will be made in PKR (Pakistani Rupees) less all applicable taxes.

**11. Confidentiality**



All project data and outputs remain the property of PMDC. The consultancy firm shall maintain strict confidentiality and shall not disclose or use any project information for any purpose other than completion of this assignment.

## **12. Ownership of Data**

All models, databases, reports, and deliverables shall become the exclusive property of PMDC upon project completion and final payment.



### Evaluation Criteria for LOT #6

S.No.	Evaluation Criteria	Weightage (%)
1	Provide evidence of relevant experience in Mineral Resource Estimation (MRE) projects. Minimum three projects with copies of evidence.	30
2	Provide certificates and credentials of team qualifications and expertise	25
3	Technical methodology and understanding of resource estimation to be presented to PMDC team after PQ document submission	25
4	Provide evidence for software capability (Leapfrog, Data Mine, QA/QC Tools)	10
5	Annual average turnover of last three years should be more than PKR 50 Millions	10
<b>Total Marks</b>		<b>100</b>

**Minimum Qualification Marks: 60**



**ANNEXURE – A**

**APPLICATION FORM FOR PRE-QUALIFICATION**

**(To be submitted separately for each Category / Lot)**

**Pakistan Mineral Development Corporation (PMDC)**

**EOI/PQ Closing Date: 20 April 2026, 11:00 AM**

**CATEGORY / LOT APPLIED FOR:** \_\_\_\_\_

1. Provide copies of required documents/evidence against each point as per sequence given in pre-qualification criteria against each category/lot.
2. Copy of NTN/GST/PST Registration certificate.
3. Copy of certificate of incorporation
4. Copy of undertaking (stamp paper) for having no conflict of interest and no previous dispute with PMDC.
5. Copy of consortium agreement (if applicable)
6. One page summary with details of company name, registered office, contact details of relevant representative etc.
7. Dispatch/submit original set of documents to AM Procurement-PMDC Head office, H9, Islamabad.



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