

GOVERNMENT OF INDIA
MINISTRY OF MINES
RAJYA SABHA
UNSTARRED QUESTION No.2822
ANSWERED ON 18.08.2025

DEPLOYMENT OF DEEP-TECH TOOLS FOR MINERAL EXPLORATION

2822. SHRI KARTIKEYA SHARMA:

Will the Minister of MINES be pleased to state:

- (a) the current deployment of deep-tech tools such as AI-driven geospatial surveys, drone-based mineral mapping, and predictive analytics, for mineral exploration, and manner in which these compare in efficiency, accuracy, and cost against the traditional methods;
- (b) the number of exploration projects completed and currently underway using such technologies, along with their outcomes in terms of yield, resource discovery, or reduced timelines; and
- (c) State-wise list of these deep-tech exploration initiatives, detailing the minerals targeted, project partners (public/private), and plans to scale successful models across additional mining districts?

ANSWER

THE MINISTER OF COAL AND MINES
(SHRI G. KISHAN REDDY)

(a): The Geological Survey of India (GSI), an attached office of the Ministry of Mines, has implemented the deep-tech tools like AI-driven geospatial surveys, drone based mineral mapping, mineral predictivity mapping programs for expeditiously targeting remote and complex geologic domain. GSI has taken up Mineral Prospectivity Mapping (MPM) projects based on integration of geological, geophysical, geochemical and aero-geophysical data and other relevant data on GIS platform using statistics and predictive analysis modelling with the aid of Artificial Intelligence (AI) and Machine Learning (ML) tools. The Mineral Exploration and Consultancy Limited (MECL), a PSU under the Ministry of Mines, is also using deep tech tools such as Ground Penetrating Radar (GPR), Magneto-Telluric (MT) and Time Domain Electro-Magnetic (TDEM) for geophysical surveys to predict the deep-seated mineralization.

Deep-tech tools in mineral exploration offer significant advantages over traditional methods by leveraging advanced technologies for faster, more efficient and potentially more accurate discovery of mineral deposits. These tools enable the analysis of vast datasets, identify subtle anomalies and pinpoint potential mineral resources with greater precision.

(b) & (c): From field season 2024-25 to 2025-26, GSI has taken up 12 MPM projects across the country and the details are given at Annexure.

GSI has adopted satellite-based remote sensing and AI-driven data analysis for mineral targeting in collaboration with the Space Applications Centre (SAC), ISRO and initiated a two-year project to develop mineral prospect models for gold exploration leveraging Machine Learning, Hyperspectral Remote sensing and Aero-geophysical datasets in Hutti-Muski schist belt, Karnataka during field season 2024-25.

GSI has undertaken drone-based magnetic surveys in Madansahi-Kesarpura-Dudhiasol Sector in Odisha and Ladera sector in Rajasthan with an aim to expedite the survey of sub-surface geology and enhance mineral exploration for targeting deep-seated mineral prospects in concealed terrains during field season 2024-25.

Further, drone technology has also been utilized by GSI in G3 stage exploration projects in the States of Madhya Pradesh and Odisha for detailed mapping through outsourced surveying agency, from field seasons 2022-23 to 2023-24.

GSI conducted Hackathons titled “Innovative Mineral Hunt Techniques” and launched “India AI Hackathon on Mineral Targeting” aimed at leveraging AI and ML technologies to enhance mineral discovery and geological analysis. This initiative integrate AI driven techniques with geoscience data to identify new target areas for mineral exploration, particularly critical minerals as well as deep-seated and concealed ore bodies.

Details of Mineral Prospectivity Mapping (MPM) projects taken up by GSI using AI/ML modelling technique from field season 2024-25 to 2025-26

Sl. No.	FSP Title
Field Season 2024-25	
1	Mineral Prospectivity Mapping using geostatistical (with geological, NGCM, NGPM data sets) and AI/ML modelling of Betul belt, Madhya Pradesh & Maharashtra.
2	Mineral Prospectivity Mapping (MPM) using geostatistical (with geological, NGCM, NGPM, remote sensing and Aerogeophysical data sets) and AI/ML modelling in north-eastern parts of Singhbhum craton.
3	Mineral Prospectivity Mapping using geostatistical (with geological, NGCM, NGPM data sets) and AI/ML modelling for Hutti-Muski schist belt and surrounding area in Karnataka & Andhra Pradesh.
4	Mineral Prospectivity Mapping using geostatistical (with geological, NGCM, NGPM add remote sensing and aerogeophysical data sets) and AI/ML modeling of Mahakoshal Group, Dudhhi Granitoids and Vindhyan Supergroup of rocks in Sonbhadra (Uttar Pradesh), Sidhi (Madhya Pradesh), Sarguja (Chhattisgarh), Garwa (Jharkhand) and Kaimur (Bihar) districts.
5	Mineral prospectivity mapping using geostatistical (with Geological, NGCM, NGPM datasets) and AI/ML modeling for the area in parts of Pali, Sirohi, Udaipur districts of Rajasthan and Banaskantha and Sabarkantha districts of Gujarat in degree sheet 45H.
6	Development of mineral prospect models for gold exploration leveraging Machine Learning, Hyperspectral Remote sensing and Aero-geophysical datasets in Hutti-Muski schist belt and adjoining areas, Karnataka.
Field Season 2025-26	
1	Mineral prospectivity mapping using geostatistical (with Geological, NGCM, NGPM datasets) and AI/ML modeling for the area in parts of Alwar, Jaipur and Sikar Dist., Rajasthan.
2	Mineral Prospectivity Mapping using geostatistical (with geological, NGCM, NGPM data sets) and AI/ML modelling for Ramagiri-Penakacherla Schist Belt and surrounding area in parts of Andhra Pradesh & Karnataka.
3	Mineral Prospectivity Mapping using geostatistical (with Geological, NGCM, NGPM datasets) and AI/ML modeling for Barapani – Tyrsad Shear Zone and surrounding area in parts of Meghalaya and Assam.
4	Mineral Prospectivity Mapping using geostatistical (with geological, NGCM, NGPM data sets) and AI/ML modelling of Sonakhan Granite Greenstone Belt, Chhattisgarh.
5	Mineral Prospectivity Mapping (MPM) in parts of the Singhbhum Craton, North Singhbhum Mobile Belt (NSMB), and Chhotanagpur Granite Gneiss Complex (CGGC), using geostatistical datasets (geological, NGCM, NGPM, and remote sensing data sets) and artificial intelligence and machine learning (AI/ML) modeling.
6	Development of mineral prospect models for gold exploration leveraging Machine Learning, Hyperspectral Remote sensing and Aero-geophysical datasets in Hutti-Muski schist belt and adjoining areas, Karnataka.