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Institutional Report

Atomic Minerals Directorate for Exploration and Research

DK SINHA*
Director, Atomic Minerals Directorate for Exploration and Research, Hyderabad 500 016, India

India is pursuing a comprehensive three-stage nuclear power program to cater to the country's long term energy security, which demands an uninterrupted supply of atomic minerals resources. The Atomic Minerals Directorate for Exploration and Research (AMD) is mandated to identify the resources of Uranium (U), Thorium (Th), Niobium (Nb), Tantalum (Ta), Zirconium (Zr), Beryllium (Be), Lithium (Li) and Rare Earth Elements (REE) required for various programs of Department of Atomic Energy (DAE).

AMD is one of the oldest units of DAE and plays a vital role in the front and back end of the nuclear fuel cycle. AMD was established as Rare Minerals Survey Unit in 1949, subsequently renamed as Raw Materials Division (RMD) and brought under the Atomic Energy Commission on October 3, 1950. RMD was later renamed as Atomic Minerals Division in 1958 and rechristened as Atomic Minerals Directorate for Exploration and Research (AMD) in 1998. From a small nucleus of 17 earth scientists in 1950, AMD has grown into a large organization with the present strength of more than two thousand three hundred employees, comprising scientific, technical, administrative, and auxiliary personnel.

The survey and exploration activities of the Directorate, with Headquarters at Hyderabad, are spread all over the country and are executed through seven Regional Centres, with Headquarters located at New Delhi, Bengaluru, Jamshedpur, Shillong, Jaipur, Nagpur, and Hyderabad. Besides, two regional offices operate from Thiruvananthapuram and Visakhapatnam to carry out beach sand minerals investigations.

The multidisciplinary exploration program of AMD is ably supported by Geochronology, Stable Isotope, Petro–mineralogy, XRD, XRF, Electron Microprobe, Mineral Technology, Radiometric and Chemical laboratories equipped with state-of-the-art equipments like Gamma-ray spectrometer, INAA, Radon Measuring System (RMS), ICP-MS, ICP-AES, AAS, EDXRFS, WDXRFS, EPMA, IRMS, and TIMS. Minerals of U, Th, Nb-Ta, REE, Be & Li are identified based on their characteristic radioactive, mineralogical, physical and chemical properties.

Uranium Exploration

The history of uranium exploration in India dates from 1949. Until the mid-1970s, uranium exploration was mainly confined to uranium provinces in the Singhbhum Shear Zone (SSZ), Jharkhand, and Umra-Udaisagar belt in Rajasthan targeting vein-type of mineralization, that resulted in establishing 16 low-grade uranium deposits of varying size in Singhbhum Shear Zone, Jharkhand and one deposit at Umra, Rajasthan. Seven out of the fourteen deposits in SSZ are under exploitation. Presently, exploration is being carried out in several sectors of the 160 km long Singhbhum Shear Zone. Subsequently, investigations were expanded to other favorable geological domains, which resulted in establishing several small uranium deposits such as Bodal and Bhandaritola, Chhattisgarh in Paleoproterozoic amphibolites; Jajawal, Chhattisgarh in Paleoproterozoic sheared migmatites of Chhotanagpur Granite Gneiss Complex and Walkunji, Karnataka in basal quartz-pebble conglomerates of Dharwar Group.

During the mid-seventies, exploration was initiated in several potential geological sectors targeting sandstone-type uranium deposits. The pursuit of sandstone-type uranium mineralization resulted in establishing a high-grade, medium-tonnage deposit at Domiasiat (Kylleng – Pyndengsohiong-Mawthabah) in the Cretaceous sandstones of Meghalaya.

**Author for Correspondence: E-mail: director.amd@gov.in, amdhyd@ap.nic.in*

Exploration in the contiguous sectors has developed several small uranium deposits.

During the mid-1980s, a low-grade, stratabound deposit hosted by dolostones of the Vempalle Formation was established at Tummalapalle, Andhra Pradesh, in the Cuddapah Basin. Since the dolostone ore was not amenable for conventional leaching procedures in vogue at that time, exploration in this sector was discontinued. However, the development of an economically viable alkali pressure leaching process rejuvenated the exploration activities in Vempalle Formation along the Southern part of the Cuddapah Basin, targeting carbonate-hosted uranium mineralization. Intensive multi-parametric exploration has been carried out in Tummalapalle and adjacent sectors, which led to the establishment of substantial uranium resources.

During the early 1990s, a near-surface deposit was discovered adjacent to the unconformity contact between basement granites and overlying Proterozoic Srisailam Quartzite at Lambapur in the Nalgonda district, Andhra Pradesh. These occurrences were further investigated, and several areas were subsequently identified. Favorable geological criteria and sustained exploration efforts resulted in establishing deposits at Peddagattu and Chitrial. Exploration in the adjacent Palnad Sub-Basin has found a small deposit at Koppunuru. The investigation is continuing in the nearby sectors.

Sustained exploration in the North Delhi Fold Belt (NDFB), in parts of Rajasthan and Haryana targeting the metasomatic type of uranium mineralization has established the Rohiluranium deposit, Rajasthan. Exploration is being carried out in various sectors of the ~300 km long albitite line in Rajasthan and Haryana.

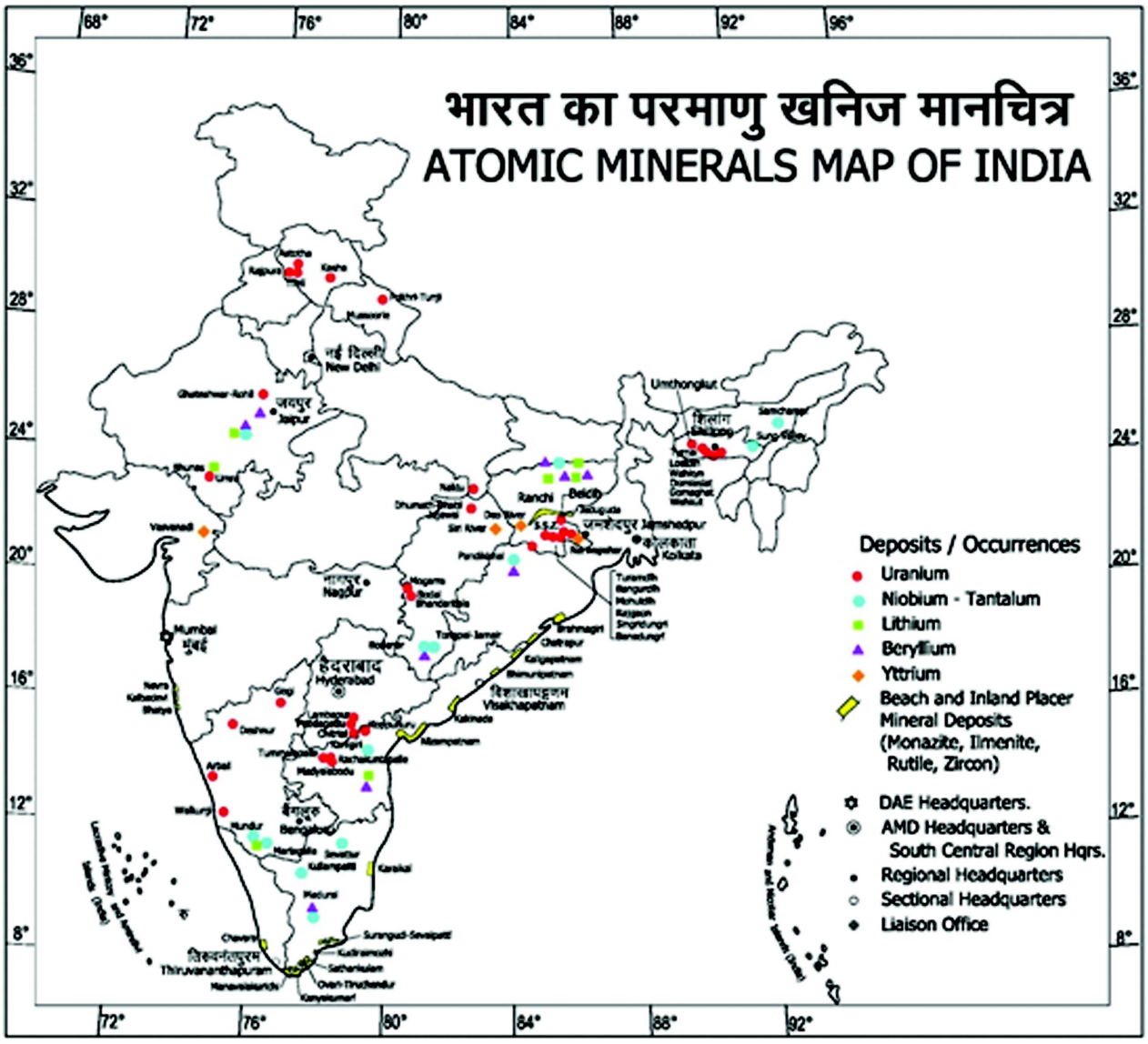
During the last four years, AMD is carrying out intensive uranium exploration in the following geological domains

1. Proterozoic Cuddapah Basin, Andhra Pradesh, and Telangana.
2. Mesoproterozoic Singhbhum Shear Zone, Jharkhand.
3. Mesoproterozoic North Delhi Fold Belt, Rajasthan & Haryana.
4. Cretaceous Mahadek basin, Meghalaya.
5. Neoproterozoic Bhima Basin, Karnataka.
6. Proterozoic Kaladgi Basin, Karnataka.
7. Palaeozoic – Mesozoic Satpura Gondwana Basin, Madhya Pradesh.
8. Mesoproterozoic Chhotanagpur Granite Gneiss Complex, Uttar Pradesh, Madhya Pradesh, and Jharkhand
9. Cenozoic Siwalik Group, Himachal Pradesh
10. Proterozoic Aravalli Fold belt, Rajasthan
11. Other potential geological domains such as the Dharmapuri Shear Zone in the Southern Granulite Terrain, Tamil Nadu; Basement for Cuddapah Basin, Andhra Pradesh; Shillong Basin, Assam; Basement Crystallines, Arunachal Pradesh; Vindhyan and Bijwar basins, Uttar Pradesh and Madhya Pradesh and Kotri-Dongargarh belt, Chhattisgarh are under active exploration.

Rare Metal and Rare Earth Exploration

AMD also carries out exploration, prospecting, and exploitation of precious metals (Nb, Ta, Be, and Li) and rare earth minerals (La to Lu & Y) in different parts of the country. The *in situ* and eluvial soils, derived from the mechanical weathering of host rocks, mainly mineralized complex pegmatites, typically contain rare metal minerals namely columbite-tantalite (niobium-tantalum), beryl (beryllium) and spodumene & lepidolite (lithium). The soil containing these minerals is excavated, treated and recovered in the plants normally established near the source. Currently, such recovery plants are in operation in Odisha and Karnataka. Some of the streams in Chhattisgarh and Jharkhand also contain higher concentrations of yttrium bearing placer mineral (xenotime), which is currently recovered through a recovery plant established in Chhattisgarh.

Further, AMD has intensified exploration in the carbonatite complexes, acidic-basic effusive in India. In this direction, substantial extents of REE mineralization have been established Ambadongar, Chhota Udepur district, Gujarat (LREE rich), and Siwana Ring Complex, Rajasthan (HREE rich).



Beach Sand Minerals Exploration

The beach sands of Odisha, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra and parts of Gujarat contain a rich concentration of heavy mineral resources of titanium (ilmenite, leucoxene, and rutile), zirconium (zircon), REEs (monazite) besides magnetite. All these minerals occur as placers in the sand. AMD identifies such heavy mineral-rich placer sand regions along the coast and estimates the resources of individual minerals. The sand containing heavy mineral resources are mined and treated in the plants operated by M/s Indian Rare Earths Ltd (IREL). Further, the inland placer sands of Odisha and Andhra Pradesh and Teri (red-colored) sand occurring in the southern part of Tamil Nadu also contain heavy minerals.

Resources of Atomic Minerals in India

During the Last Four Years, AMD has Established

- Ninety thousand five hundred nine tonnes of uranium oxide. The country's total uranium resources stand at 3,20,445 tonnes of uranium oxide under indicated and inferred categories in 44 uranium deposits located in various geological domains of the country.
- 108.21 Million Tonnes (MT) of beach sand heavy mineral (BSM) resources. The country's

total BSM resources stand at 1,173.07 MT, which includes 648.35 MT ilmenite+leucoxene, 12.47 MT monazite, 33.95 MT rutile, 35.75 MT zircon, 187.46 MT garnet and 255.09 MT sillimanite. These deposits are located in the beach and inland placers of Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Odisha; inland placers in parts of Bihar & West Bengal and Teri red sand in Tamil Nadu.

- 3,46,462 tonnes Rare-Earth Element oxide (REO) and 19,564 tonnes Niobium oxide (Nb_2O_5) in the Ambadongar area, Chhota Udepur district, Gujarat.
- Columbite-Tantalite (Nb-Ta), spodumene & lepidolite (Li), and beryl (Be) in the pegmatites of Bastar district, Chhattisgarh; Jharsuguda district, Odisha; Mandya district, Karnataka and in parts of Bihar and Jharkhand.
- Xenotime (Y & HREE) in the riverine placers of Siri River in Jashpur district, Chhattisgarh; Deo River in Gumla district, Jharkhand and in apatite – magnetite veins at Kanyaluka, East Singhbhum district, Jharkhand.

Other Activities of AMD

- AMD carries out geological/geotechnical studies related to the nuclear establishments of India.
- AMD provides professional and analytical services.
- AMD Studentship Programme has been initiated to impart basic field training and to encourage university students to take up their dissertation work, thereby strengthening the collaboration of AMD with academic institutions. Under the aegis of BRNS, collaborative research-projects are taken up on genetic aspects of uranium deposits and related topics.

Please visit our Website: http://www.amd.gov.in