Sandstone-type uranium deposit at Domiasiat, West Khasi Hills District, Meghalaya, North-east India

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Sandstone-type uranium deposits represent one of the eight categories of ore types, and constitute a major uranium resource of the world. Exploration for uranium in the Upper Cretaceous Mahadek sandstones along the southern fringe of the Meghalaya plateau has led to the discovery of a sandstone-type uranium deposit at Domiasiat, 140 km south-west of Shillong in North-east India. This deposit—the largest of its type in India—contains pitchblende and coffinite, with channel samples assaying up to 0.394% eU_3O_8, 0.263% U_3O_8 (beta/gamma) and 0.02% ThO_2.

INTENSIVE exploration by the Atomic Minerals Division of the Department of Atomic Energy, Government of India, to locate sandstone-type uranium deposits in India commenced during the early seventies. Sedimentary basins fulfilling most of the favourability criteria (proximity of a uraniferous provenance, a fluvio-deltaic environment, and the presence of reductants like carbonaceous matter, framboidal pyrite, clays and hydrolysates) for hosting such uranium deposits were chosen as first-order targets. Exploration in the Upper Cretaceous Mahadek sandstones along the southern fringe of the Meghalaya plateau[1] gave encouraging results, as several small sandstone-type uranium deposits were located at Gomaghat, Sateek and Phlangdiloin[2–4]. Follow-up detailed investigations, including evaluation drilling, led to the discovery of a major sandstone-type uranium deposit at Domiasiat—the largest so far known in India. In this note we briefly describe the geology and nature of uranium mineralization at Domiasiat.

Domiasiat (25°20′ N, 91°13′ E; Survey of India Toposheet 78 O/3) is located in the West Khasi Hills district of Meghalaya in North-east India and lies 140 km south-west of Shillong (Figure 1). The southern part of the Meghalaya plateau comprises platform sedimentary rocks of Cretaceous and Tertiary ages unconformably overlying Precambrian metasedimentary rocks, gneisses and granites or the Sylhet Trap (Table 1).

The Upper Cretaceous Mahadek Formations are dominantly composed of grey, immature sandstones and conglomerates with impersistent clay bands. These directly overlie the Precambrian basement granites and gneisses at Domiasiat, unlike the Mahadeks of Gomaghat, which rest on the marine Jadukata Formation overlying the Jurassic Sylhet Traps. The thickness of the sedimentary rocks at Domiasiat ranges from less than 30 m to 60 m. In some sections, however, the rocks are up to 100 m in thickness. The beds have gentle dips of 5° to 8° towards south-west.

Detailed radiometric surveys around Domiasiat village during 1983–84 led to the discovery of radioactive zones in the Phot Killung nala about 2.5 km south-west of Domiasiat. A radioactive zone of 340 m was traced along this nala in the Mahadek sandstones overlying the basement granite-gneiss. The maximum thickness of the Mahadek sandstone overlying the basement in this nala is about 40 m. The radioactive zones, in general, recorded radioactivity 3 to 10 times the background, with several patches showing higher orders of radioactivity, up to 50 times background. During 1984–85, additional significant radioactivity anomalies were located at Phot Rangam, Phot Pyrnotbri and Phot Umla. Grab samples from these localities assayed 0.024 to 8.6% eU_3O_8 and 0.01 to 4.4% U_3O_8 (beta/gamma). Systematic channel sampling of the vertical faces of radioactive zones exposed along the nala banks of Phot Killung, Rangam and other localities gave encouraging and consistent results (Table 2).

Petrographic and mineralogical studies indicate that the host rock for uranium mineralization is an

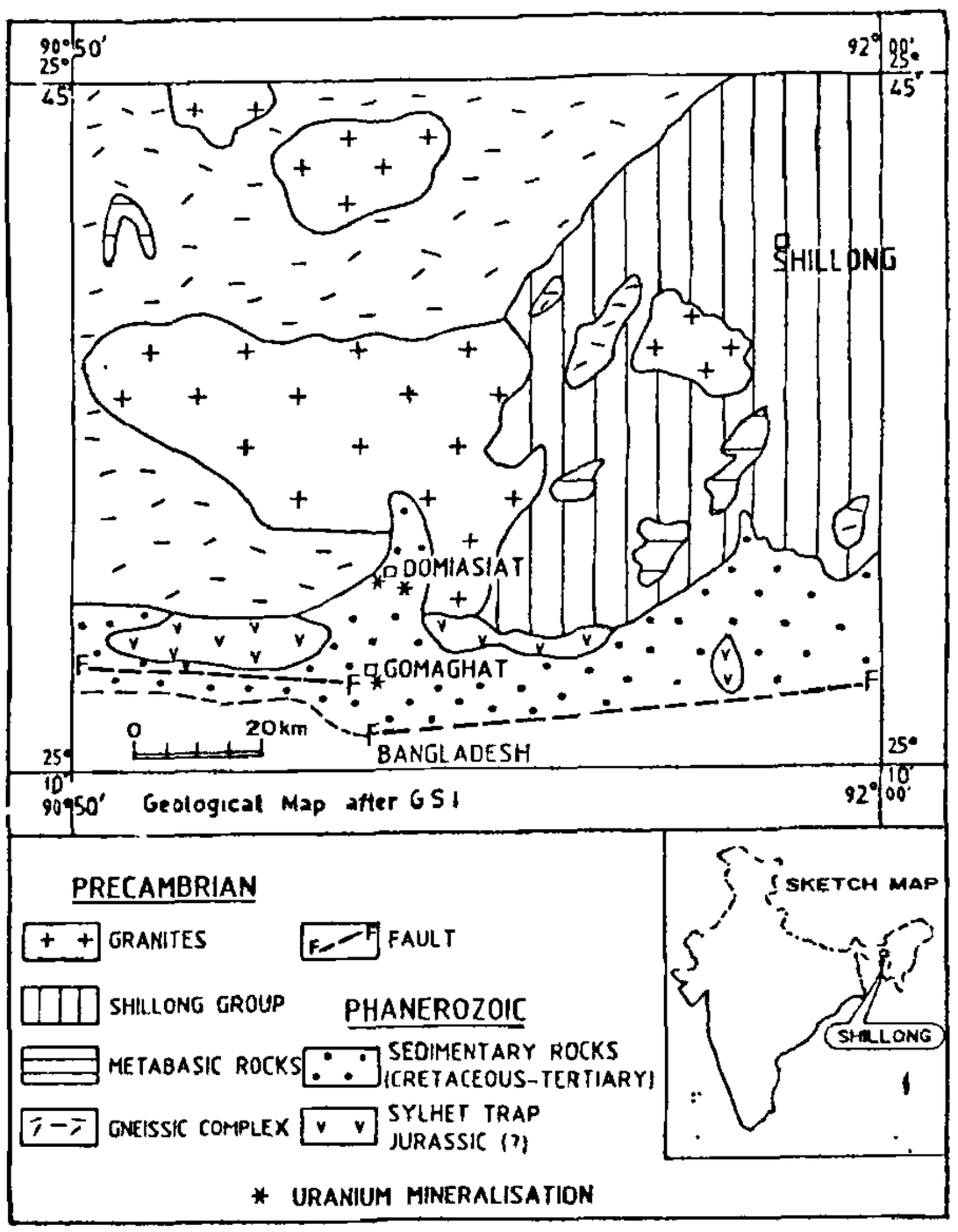

Figure 1. Generalized geological map of a part of the Meghalaya plateau showing the location of Domiasiat area. (Geology after ref. 6)

Table 1. Generalized stratigraphic succession of the Meghalaya plateau[6].

Geological age	Group name	Formation name	Rock types
Tertiary	Garo, Jaintia	Chengapara, Baghmara, Kopili and Shella	Sandstone, shale conglomerates ± marl and clay; limestones in the older shella formations
Upper Cretaceous	Khasi	Langpar	Calcareous shale, sandstone with impure limestone
		Mahadek	Arkosic sandstone
		Jadukata	Sandstone–conglomerate alternations
Lower Jurassic?		Sylhet Trap	Basalt, alkali basalt and tuff
Precambrian	Shillong		Quartzite, phyllite and conglomerate
	Gneissic complex		Migmatite, gneiss schists, amphibolite, granulite and granites

Table 2. Radiometric assay values (averages in %) of mineralized sandstones from Phot Killung, Rangam and other localities, Domiasiat area.

Locality	Number of samples	eU_3O_8	U_3O_8 (beta/gamma)	ThO_2
	Channel			
Phot Killung	15	0.093	0.088	0.010
Tributary of Phot Killung	10	0.394	0.263	0.010
Phot Rangam	49	0.050	0.025	0.010
Phot Umla	12	0.014	0.013	0.020
Phot Pyrnotbri	8	0.076	0.059	0.025
	Grab			
Phot Jimrey	7	0.180	0.160	—
Phot Rang-Teng Peng	3	0.360	0.400	—

immature, feldspathic quartz arenite. The quartzite and feldspar fragments are held in a matrix composed of chloritic and sericitic constituents. The cementing material consists of microcrystalline quartz, organic matter and clays. Marcasite, ilmenite (altered to leucoxene), monazite, garnet and zircon are the associated heavy minerals. The organic material occurs as pore-fillings and veins, and contains tiny framboidal granules of pyrite suggestive of its biogenic origin. Pitchblende and coffinite are the uranium minerals found as micron-sized particles occurring either as dense inclusions or as isolated clusters within organic matter.

The rugged nature of the terrain, thick forest cover and elephant menace, together with lack of proper roads, hampered detailed follow-up exploration efforts in the area. Detailed geological work and exploratory drilling commenced with development of a 5-km road in 1987 (ref. 5) in the Phot Killung, Phot Rangam and Phot Umla blocks (see Table 2). The sandstone-type uranium mineralization in the above blocks is spread over 10 km^2 at depths varying from 8 to 47 m from the surface. Six lenses varying in dimensions from 450 m × 200 m × 2 m to 1500 m × 500 m × 9 m, with grades of 0.05 to 0.41% U_3O_8 have been delineated by drilling. These data on the size and ore grade of the Domiasiat uranium deposit reveal that it is the largest and richest, near-surface, low-cost sandstone-type deposit discovered in India so far.

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Sorghum straw as an efficient remover of metal from waste water

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Jowar (*Sorghum vulgare* L.) straw and a combination of jowar straw and calcium carbonate can be used for removal of heavy metals (copper, lead, nickel, cadmium and cobalt) from waste waters. Sorghum straw is cheap and is easily available. We have compared the efficiency of metal removal of sorghum straw with that of calcium carbonate, activated charcoal and teak sawdust.

Though various methods like ion exchange on resins, adsorption on activated charcoal, electrodeposition and reverse osmosis are already in use for removal of heavy metals from waste waters, there is much emphasis now on evaluation of usefulness of organic wastes, including various agricultural products and byproducts like dried