

# LOW GRADE URANIUM DEPOSITS OF INDIA



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# PREVIEW

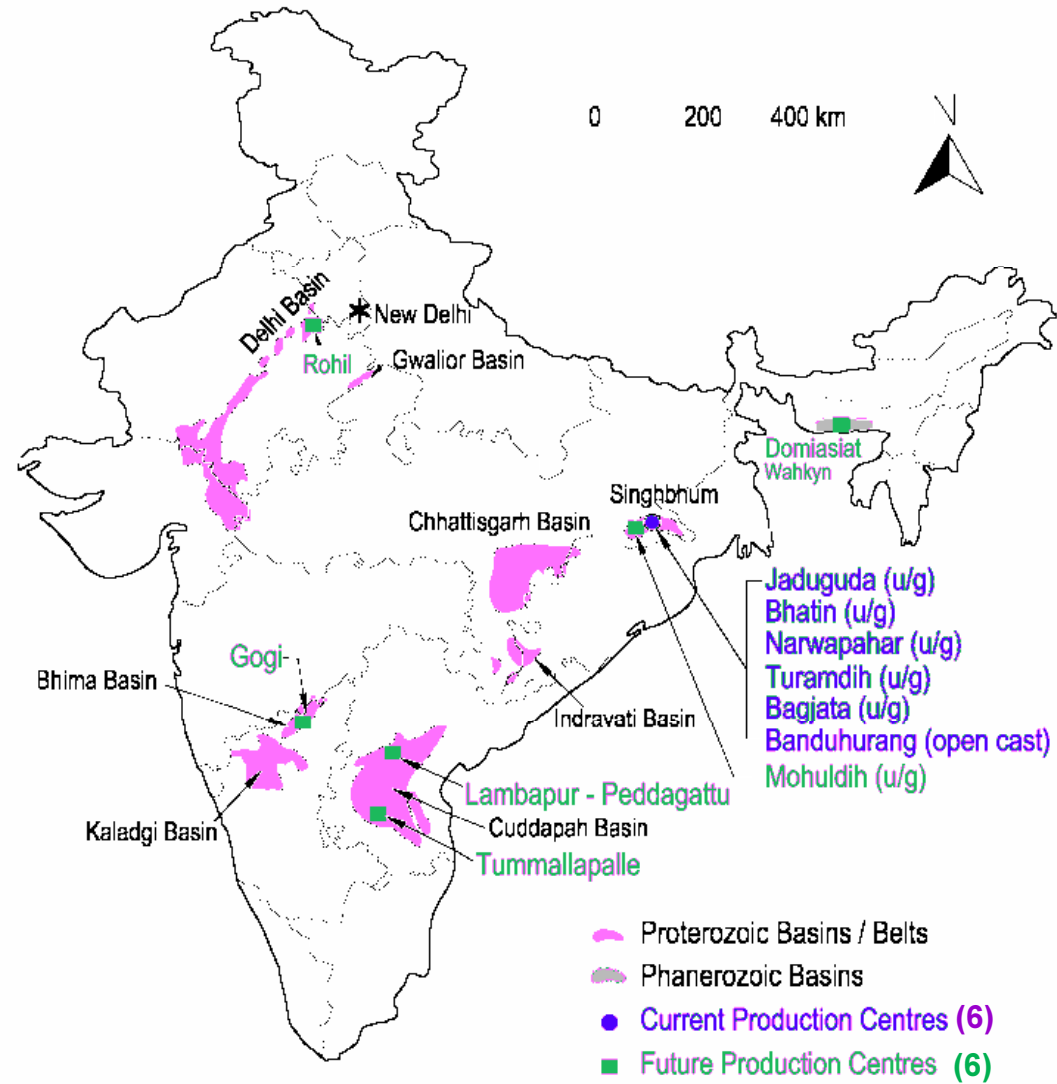
- **Uranium Provinces of India**
- **Characterisation of Indian uranium deposits**
- **Thrust areas of uranium exploration**
- **Cuddapah uranium province, Southern India**
- **Tummalapalle uranium deposit**
- **Uranium deposits around Rohil, NW India**
- **Uranium deposits of Central India**
- **Other potential areas**

# Uranium Exploration

❖ Uranium exploration in India dates back from late forties and the first uranium deposit (vein type) was discovered at Jaduguda in 1951 in the Singhbhum Shear Zone (SSZ) Jharkhand, which has now been proved as an important uranium province with a number of low grade, small to medium size uranium deposits.

❖ Subsequently, number of new uranium deposits were discovered in other parts of the country (Rajasthan, Andhra Pradesh, Karnataka, Chhattisgarh, Meghalaya, etc.)

## Some Important Proterozoic and Phanerozoic Basins of India as targetted for Uranium Exploration



## Distribution of Uranium Deposits

STATE	GEOLOGICAL SETUP	DEPOSIT TYPE	EXAMPLES
Jharkhand	Singhbhum Shear Zone (Paleoproterozoic)	Vein Type	Jaduguda, Bhatin, Narwapahar, Turamdih
Andhra Pradesh	Cuddapah Basin (Proterozoic)	Unconformity Type	Lambapur, Peddagattu, Chitrial, Koppunuru
		Stratabound Type	Tummalapalle- Rachakuntapalle
Rajasthan	Aravalli & Delhi Supergroups (Paleo- Mesoproterozoic)	Vein Type	Umra- Udaisagar & Rohil- Ghateshwar
Karnataka	Bhima Basin (Neoproterozoic)	Vein Type	Gogi, Gulburga district
Chhattisgarh	Dongargarh Shear Zone & North Surguja Shear Zone (Paleo- Mesoproterozoic)	Vein Type	Bodal, Bhandaritola & Jajawal, Dumhat
Meghalaya	Mahadek Basin (Cretaceous)	Sandstone Type	Domiasiat, Wahkyn, Tyrnai, Gomaghat, Lostoin, Phlangdiloin

## Characterisation of Uranium deposits

DEPOSIT TYPE	LOW GRADE DEPOSITS	GEOLOGY	HOST ROCK	MINERALOGY
Vein	Jaduguda and Surroundings	SSZ in Singhbhum Group of rocks	Quartz chlorite schist (granular)	Uraninite, Brannerite
	Bodal and Bhandaritola	Nandgaon Group	Amphybolite & Quartz porphyry	Uraninite, Pitchblende, Coffinite
	Jajawal-Dumhat	Quartzo-feldspathic rock of North Surguja Shear Zone		- Do -
	Rohil	Delhi Supergroup	Albitites	Pitchblende, Uraninite, Coffinite
	Umra	Aravalli Supergroup	Carbon phyllite	Coffinite
Strata-bound	Tummalapalle	Chitravati Group	Dolostone	Pitchblende, Coffinite
Unconformity	Lambapur, Peddagattu and Chitrial	Srisailam Quartzite (Cuddapah Supgr.)	Unconformity of Granite & Srisailam quartzite	Uraninite, Pitchblende, Kasolite
	Koppunuru	Palnad sub-basin (Kurnool Group)	Granite & Banganapalle quartzite	Uraninite, Pitchblende
Sandstone	Domiasiat-Wahkyn, etc	Lower Mahadek Formation	Feldspathic sandstone	Pitchblende, Coffinite

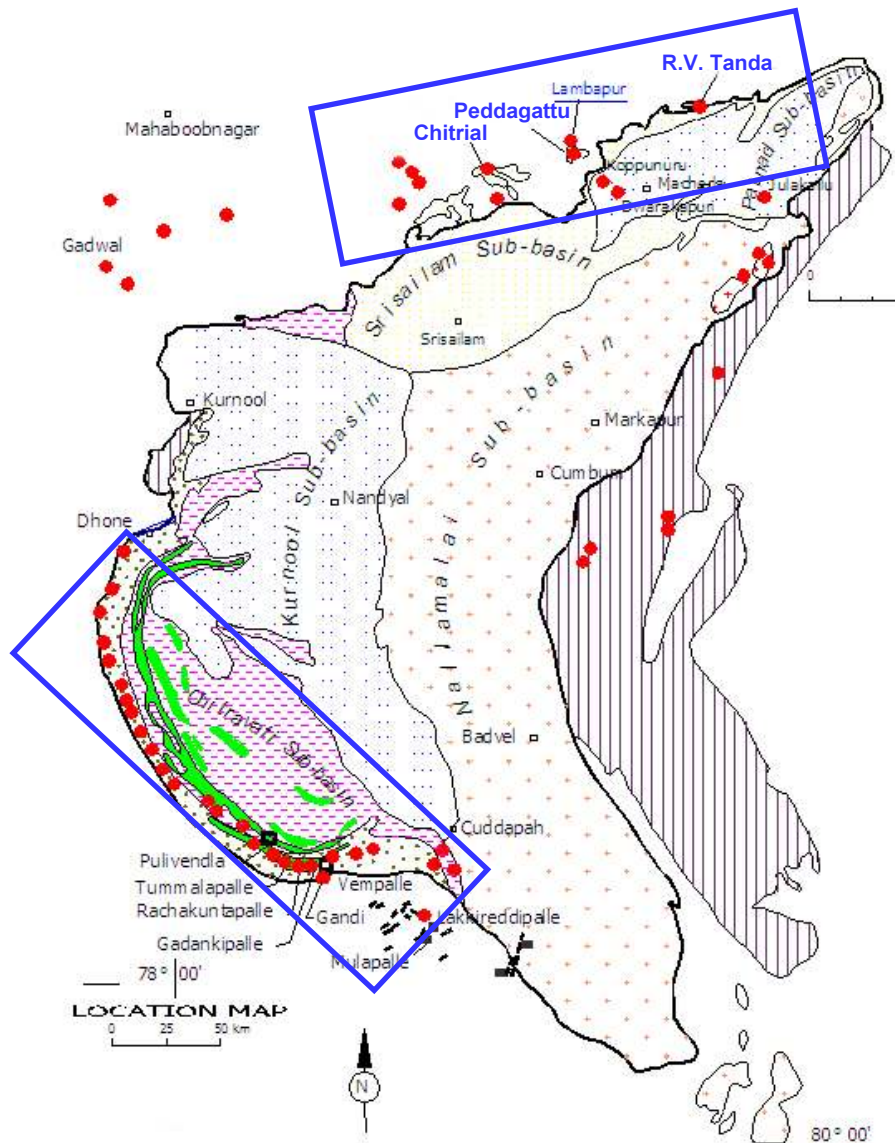
## **Thrust Areas for Low Grade Uranium Exploration in India**

- (A) Paleoproterozoic Singhbhum Shear Zone, Jharkhand**
- (B) Meso- Neoproterozoic Cuddapah and Kurnool Basins, Andhra Pradesh**
- (C) Proterozoic Aravalli and Delhi Basins, Rajasthan**
- (D) Paleoproterozoic Dongargarh and North Surguja Shear Zone, Chhattisgarh**
- (E) Neoproterozoic Bhima and Kaladgi Basins, Karnataka**
- (F) Paleoproterozoic Dharwar (QPC), Karnataka**
- (G) Cretaceous Sedimentary Basin, Meghalaya**
- (H) Meso- Neoproterozoic Chhattisgarh and Indravati Basins, Chhattisgarh**

## Cuddapah Basin, Andhra Pradesh

- ❖ Crescent shaped Paleo to Neoproterozoic Cuddapah and Kurnool basins are spread over 44,500 km<sup>2</sup> area.
- ❖ The Cuddapah Basin has evolved through a series of tectonic & thermal events and the formation of sub-basins viz. Papaghani / Chitravati, Nallamalai, Srisailam, Kurnool and Palnad with major overlap.
- ❖ The basement Archean gneisses / Dharwar meta-sedimentaries are thrust over Cuddapah Supergroup rocks on the eastern margin of the basin while the basin has an unconformable contact with the basement crystalline rocks in the west.
- ❖ Two main types of uranium deposits have been identified in the Cuddapah basin. These are **unconformity related and stratabound type**.

## GEOLOGICAL MAP OF CUDDAPAH BASIN SHOWING URANIUM DEPOSITS AND OCCURENCES



➤ Total Area 44,500 sq km

➤ Thickness of the sediments ~ 12 Km

➤ Known unconformity related U-deposits  
(Northern Cuddapah)

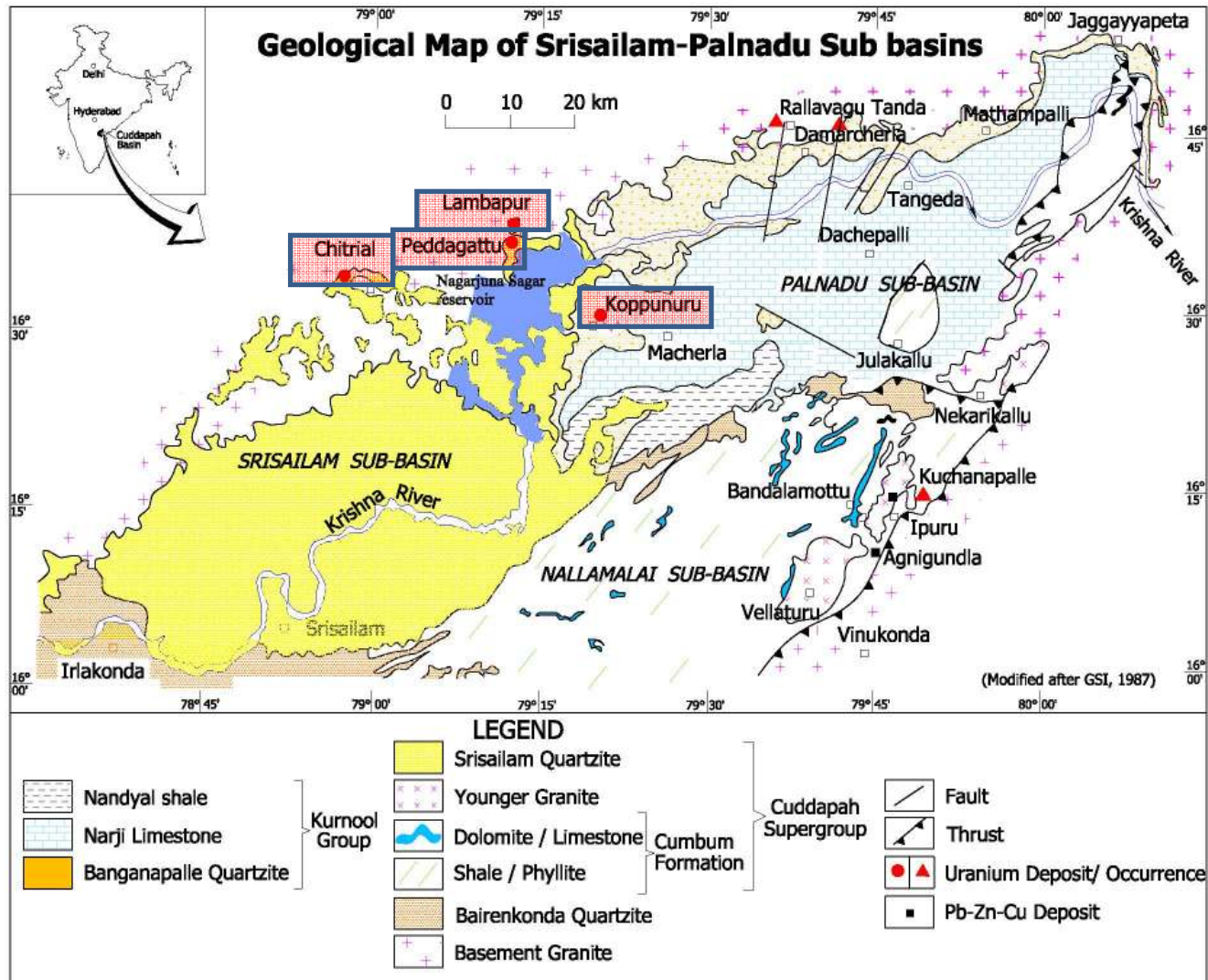
➤ Known stratabound carbonate hosted  
U-deposits (Southern Cuddapah)

➤ Known fracture controlled granite  
hosted U-deposits

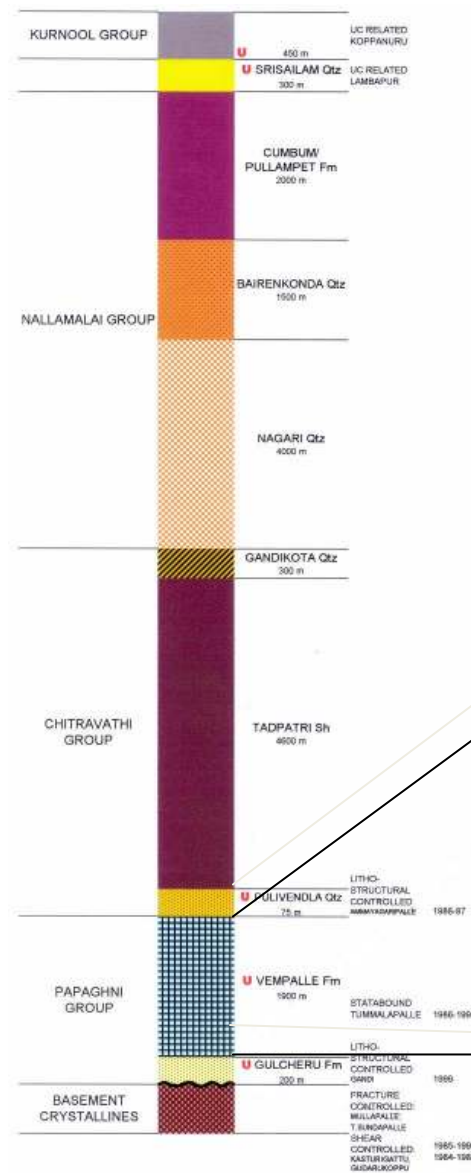
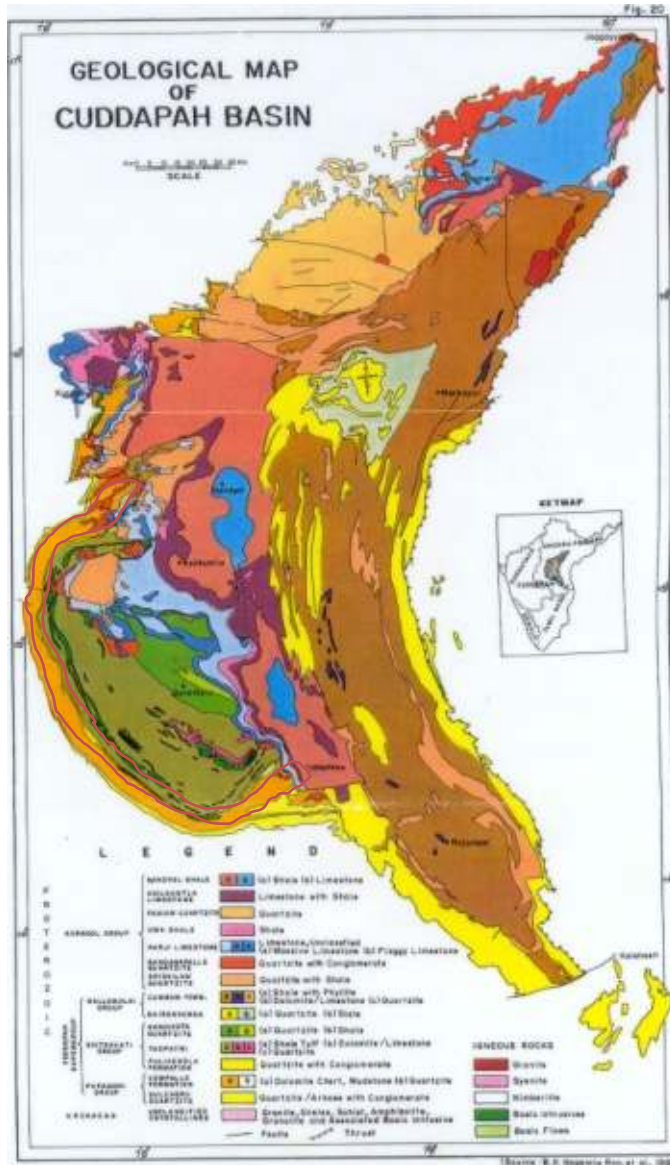
## *Unconformity-related deposits (Northern Cuddapah)*

- ❖ Evaluation and exploratory drilling at **Lambapur, Peddagattu and Chitrial** explored unconformity between the Basement Granitoids and the overlying Srisailam quartzite (Srisailam sub-basin) and medium tonnage, low grade deposits have been established.
- ❖ A small, low grade deposit has also been established around **Koppunuru** at the unconformity between Basement Granitoids and overlying quartzite of Banganapalle Formation (Palnad sub-basin) of Kurnool Group.
- ❖ Surveys indicated uranium occurrences in Basement Granitoids and overlying Banganapalle Formation (Palnad sub-basin) around **Rallavagu Tanda, Damarcherla and Mathampalle.**

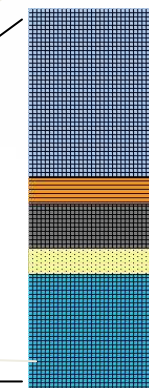
# Geological map of northern part of Cuddapah Basin



# URANIUM MINERALISATION IN VEMPALLE FORMATION



1900m Thick



Cherty Limestone

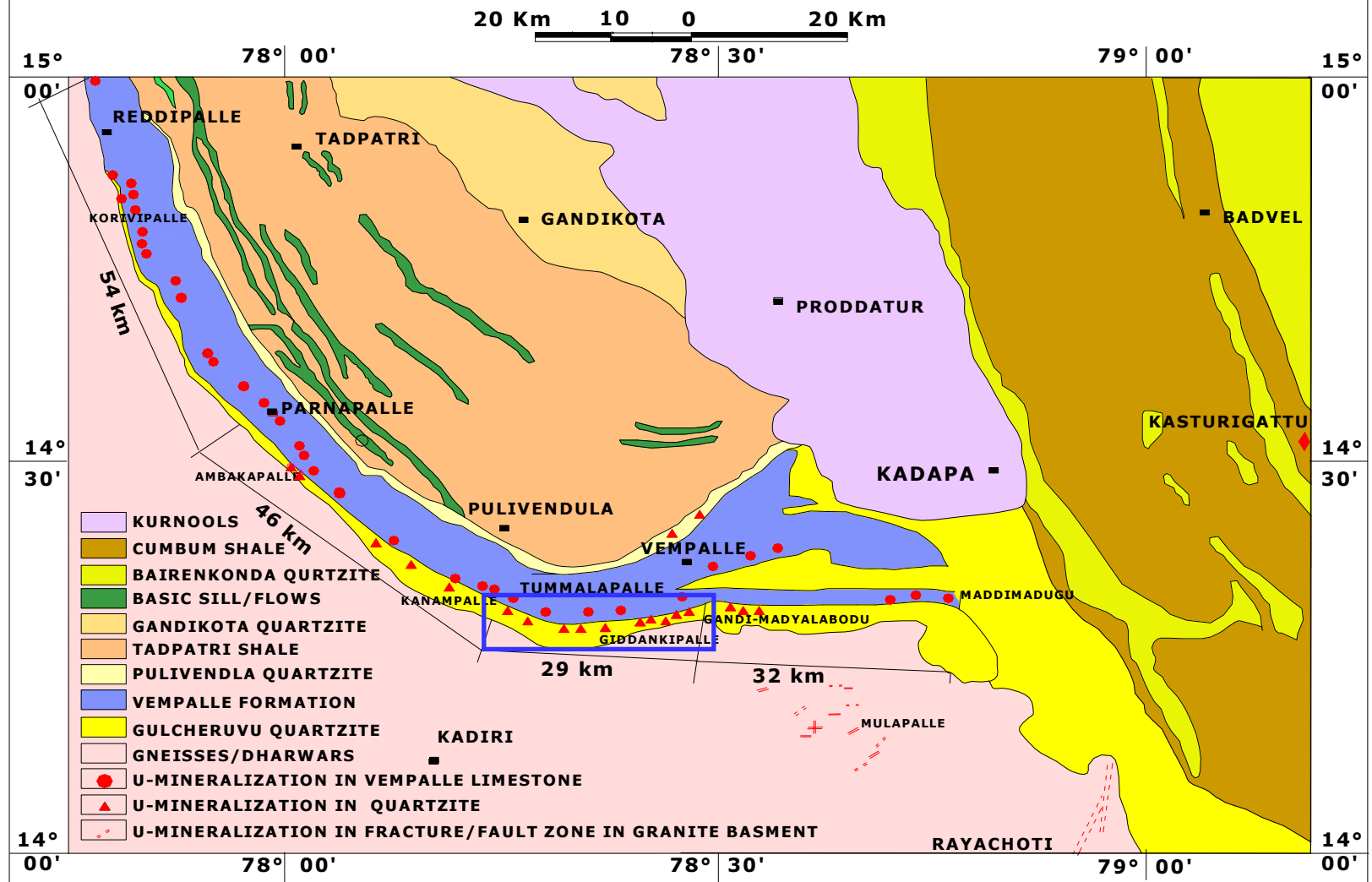
Purple Shale

Uraniferous Dolostone

Conglomerates

Massive Limestones

# GEOLOGICAL MAP OF PARTS OF CUDDAPAH BASIN SHOWING URANIUM OCCURRENCES

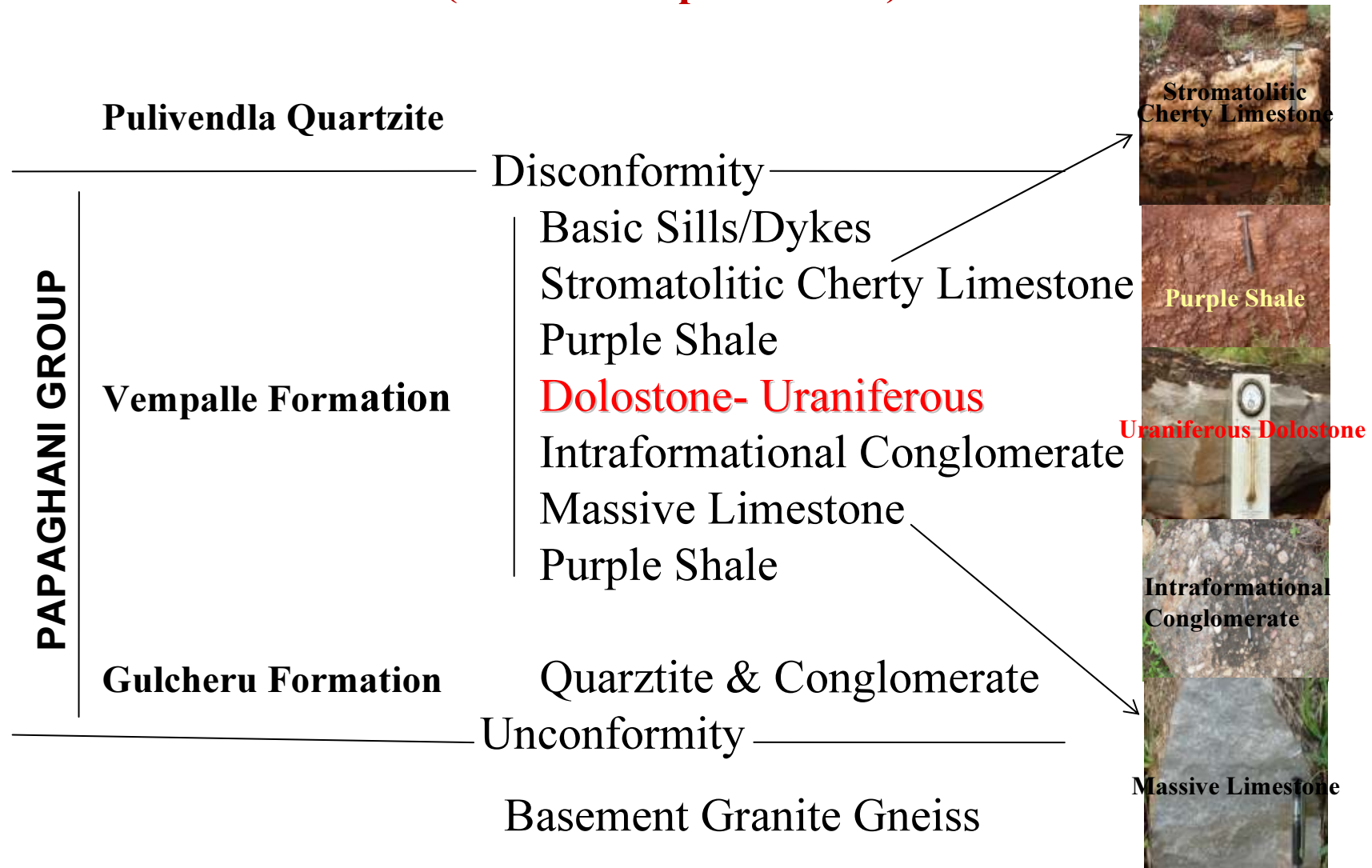


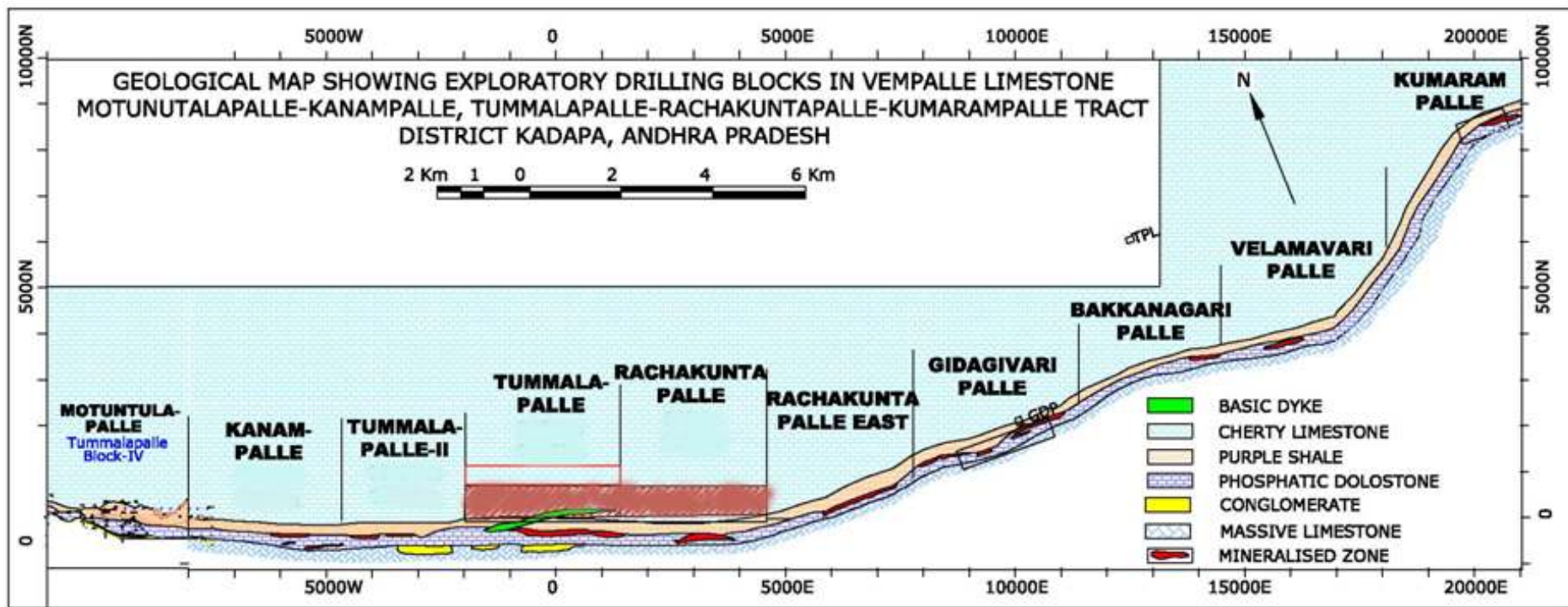
Tummalapalle & extension areas

## *Stratabound Uranium Deposit (Southern Cuddapah)*

- ❖ Dolostone hosted stratabound uranium deposit at **Tummallapalle** in the southern part of Cuddapah basin was established in the early nineties.
- ❖ As a consequence of the development of an innovative **pressure alkali route beneficiation process** and prevailing high uranium cost turned the deposit economical.
- ❖ Exploration work has been intensified in **extension areas of Tummalapalle in 30 km belt (10 blocks)**, out of 160 km potential uranium occurrences in Vempalle Formation along southwestern margin of Cuddapah Basin.
- ❖ A low grade, large size deposit has already been proved in **Tummalapalle-Rachakuntapalle (3 blocks)**.

# STRATIGRAPHIC SUCCESSION – TUMMALAPALLE AREA (Paleo- Mesoproterozoic)





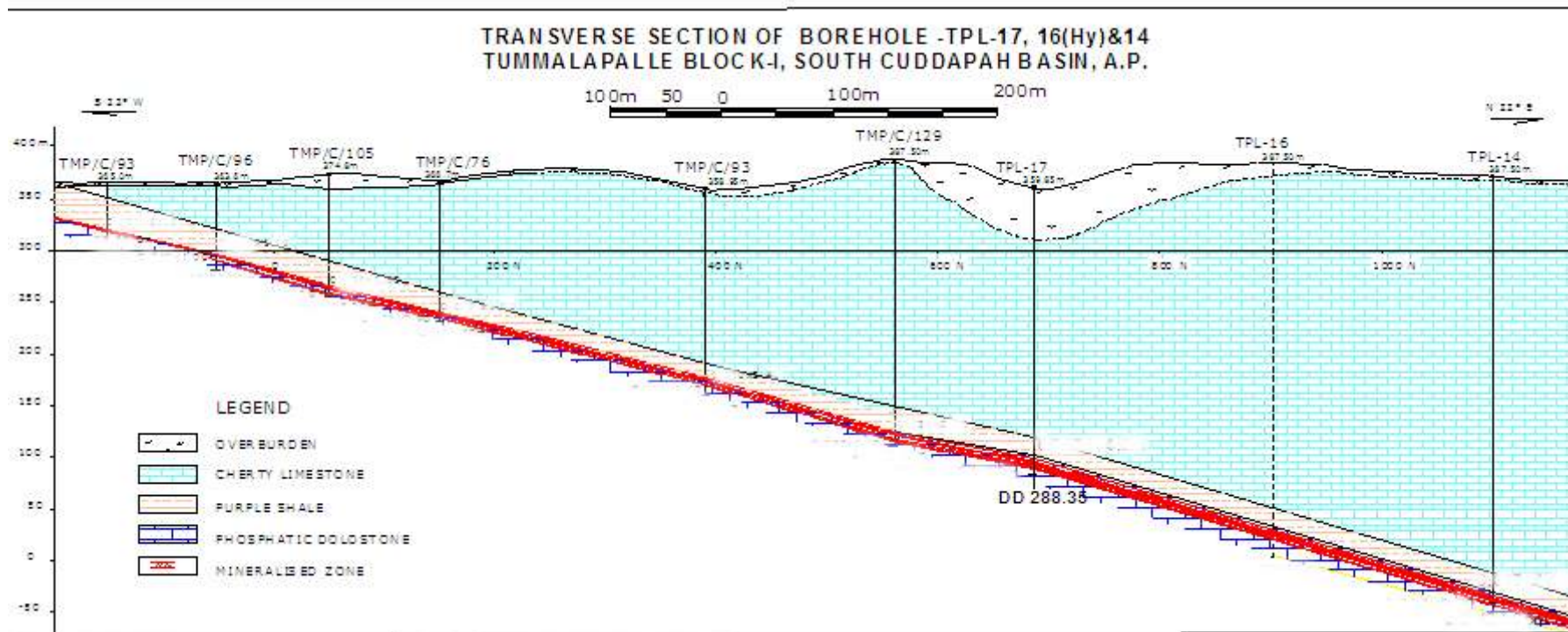
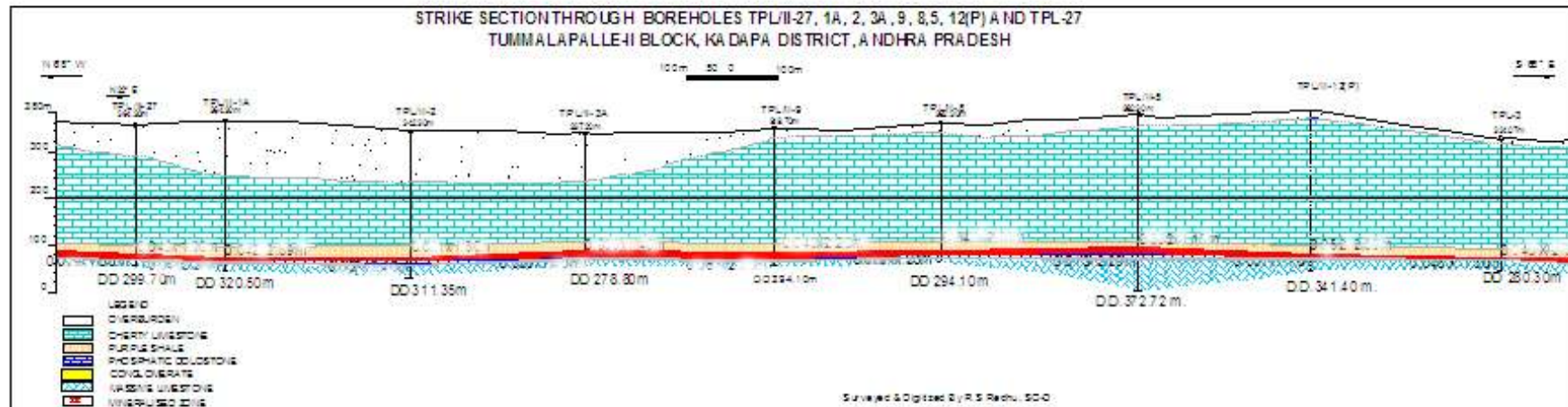
### Disequilibrium in favour of uranium

Out of 160 km U-Occurrence  
10 blocks identified in 30 km

1. Based on Chemical Value : 19%
  2. Based on  $\beta/\gamma$  value : 34%
- 365 samples

Low grade, Large size deposit has already been proved in Tummalapalle-Rachakuntapalle

70% Recovery by pressure alkali route



**Homogeneous nature of ore body in strike as well as dip wise**

# URANIUM MINERALISATION IN VEMPALLE DOLOSTONE

## *Mode*

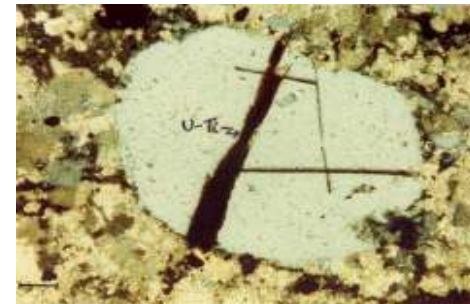
- Thin stringers of pitchblende within phosphatic dolomitic groundmass
- Thin fracture filled veins within quartz clasts
- Intergranular fillings within collophane rich portion
- Inclusions in quartz clasts

## *Loci*

- Carbonate-phosphate contact
- Sutured boundary of microstylolites
- Layer of stromatolite
- Grain boundary of quartz clasts
- Within cavities filled with fibrous dolomite and framboidal pyrite



Vein-like pitchblende (P) in phosphate, calcitic dolostone from Tummalapalle.



U-Ti complex (U-Ti) within a clast of quartz in mineralized phosphatic, siliceous, calcitic dolostone.



Ovoid grain showing intimate association of pitchblende (P) and pyrite (Py) in phosphatic siliceous calcitic dolostone

## CHARACTERISTICS OF URANIFEROUS VEMPALLE DOLOSTONE

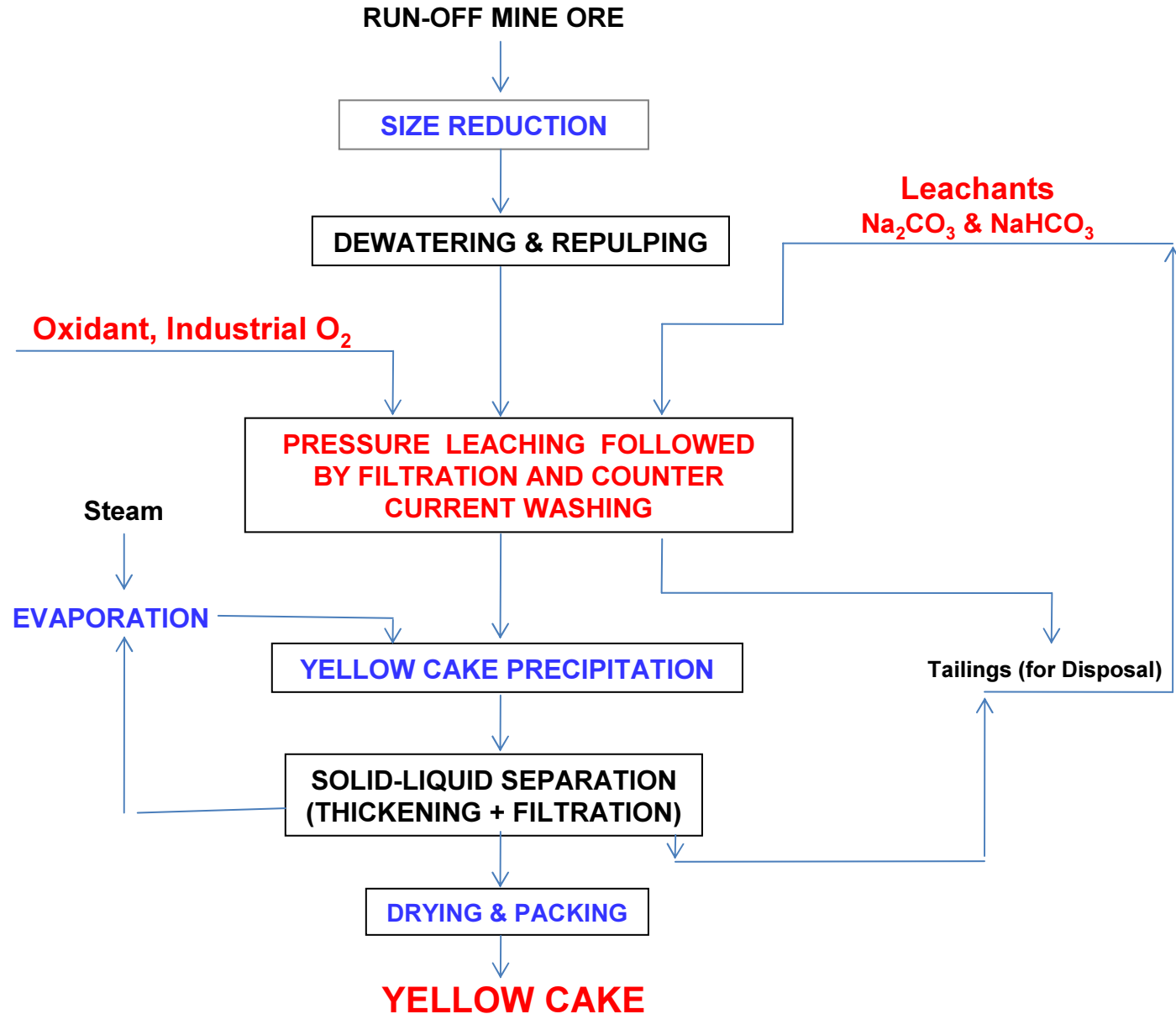
<b>Nature of host rock</b>	Impure, siliceous, phosphatic, dolomitic, stromatolitic Limestone
<b>Uranium Minerals</b>	<i>Pitchblende , Coffinite, U-Ti complex, Collophane</i>
<b>Associated minerals</b>	<i>Pyrite, Chalcopyrite, Molybdenite, Bornite, Digenite, Covellite</i>
<b>Gangue Minerals</b>	<i>Dolomite, Quartz, Microcline</i>
<b>Grade</b>	0.040 to 0.046% eU <sub>3</sub> O <sub>8</sub>
<b>Trace Elements</b>	The average concentration of molybdenum, nickel, copper, cobalt, barium in hangwall lode is 230, 30, 90, 25 and 215 ppm (n=250) respectively and in footwall lode are 44, 42, 55, 10 and 289ppm (n=150). Average P <sub>2</sub> O <sub>5</sub> values are 2.46% in HW and 2.60% in FW.
<b>Controls of mineralisation</b>	Phosphate, silica and organic matter in the impure dolomitic limestone are the main controlling factors for uranium mineralisation

## RECOVERY / LEACHABILITY OF TUMMALAPALLE ORE

- Exhaustive experiments on leachability (alkali route) indicated recovery 65-70%, using  $\text{NaCO}_3$  &  $\text{NaHCO}_3$  as the leachants and  $\text{KMnO}_4$  as the oxidant.
- To increase uranium concentration in leach liquor number of multicycle leaching experiments were carried out by Cross Current Leaching, followed by Filtration and Counter Current Washing (**CCLFCCW**).
- Experiments enhanced uranium concentration in leach liquor (1.5-1.8 g/L) with significant reduction in consumption of leachants, but the cost intensive oxidant ( $\text{KMnO}_4$ ) could not be reduced.

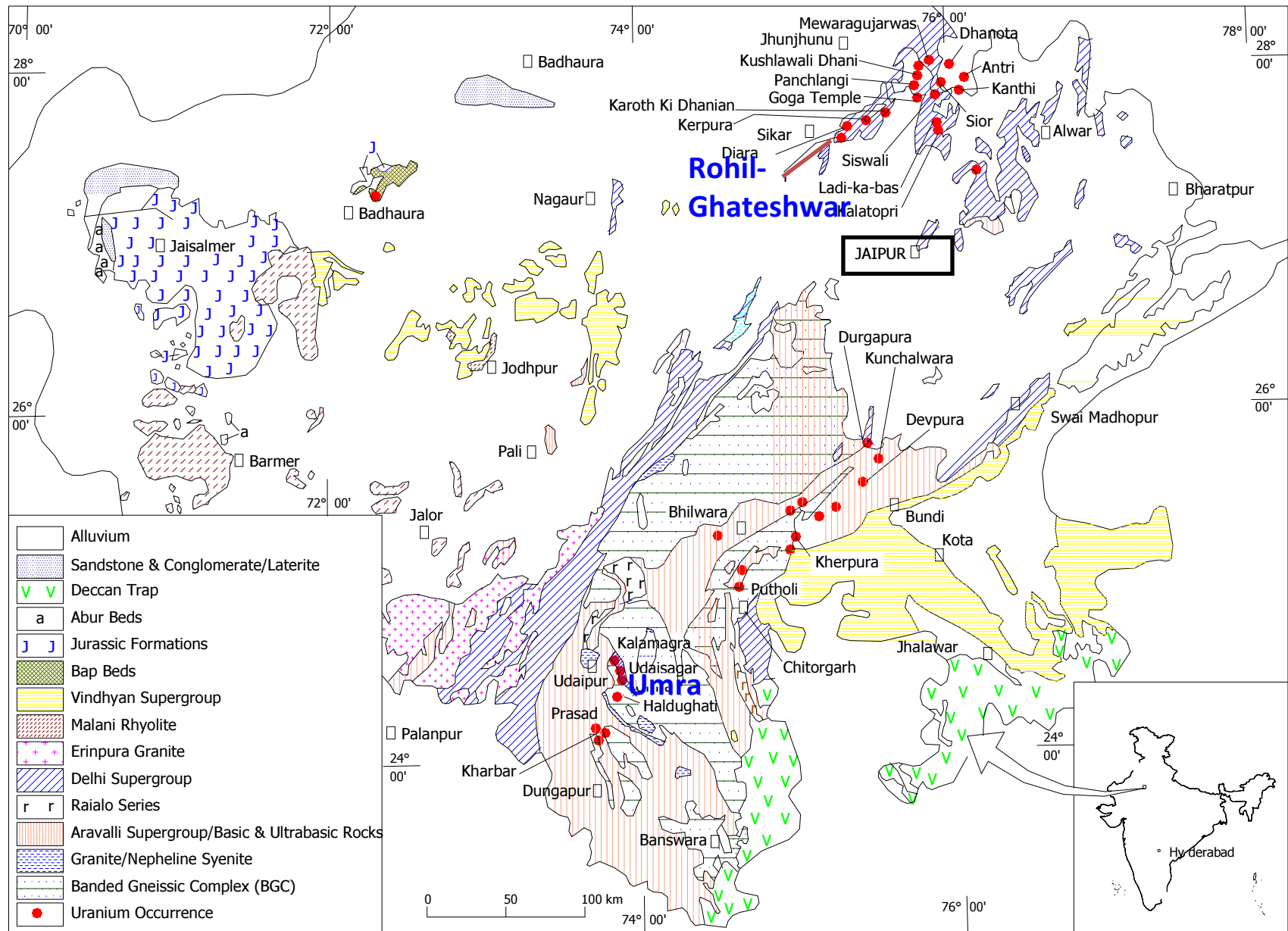
- **Studies indicated suitable alternative cost-effective oxidants in lieu of  $\text{KMnO}_4$  are industrial oxygen or Air.**
- **Precipitation of uranium as sodium di-uranate from the leach liquor obtained by CCLFCCW, showed that it is possible to quantitatively precipitate (>95%) out the uranium values with a high grade (82%  $\text{U}_3\text{O}_8$ ) and purity.**
- **Pilot scale test work on the process flow sheet evolved at Technology Demonstration Pilot-plant, Jaduguda. Results indicate achieving about 75% leachability following alkaline pressure leaching.**

# SCHEMATIC FLOWSHEET FOR PROCESSING OF TUMMALAPALLE ORE



## *Aravalli and Delhi Basins, Rajasthan*

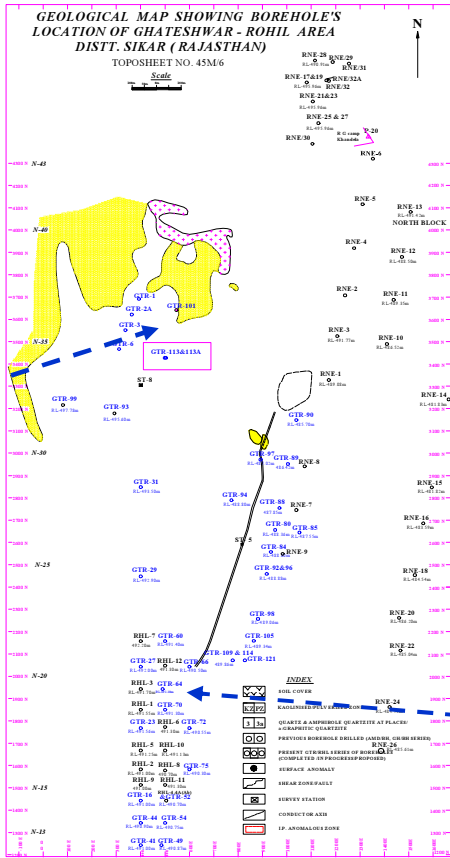
- ❖ Paleo- Mesoproterozoic Aravalli and Delhi Group of metasediments of Rajasthan and neighbouring areas holds potential as several shear zones with anomalous uranium have been identified. Important are **Umra** near Udaipur and **Rohil** close to Jaipur.
- ❖ Uranium mineralisation at **Umra** is associated with dolomitic limestone, carbonaceous phyllite and a dark metasedimentary assemblage ( Aravalli Supergroup)
- ❖ Uranium mineralisation at **Rohil** in the North Delhi Fold Belt is associated with albitites (320 km long zone of albitite-microcline-pyroxinite, also referred to as “albitite line”) with carbonaceous phyllite and mica schist of Delhi Supergroup.



**GEOLOGICAL MAP OF PART OF RAJASTHAN SHOWING URANIUM OCCURRENCES**

# Rohil Exploration Blocks

**Ghateshwar Block**



**Kerpura 8km**

**Khandela Block 1km East**

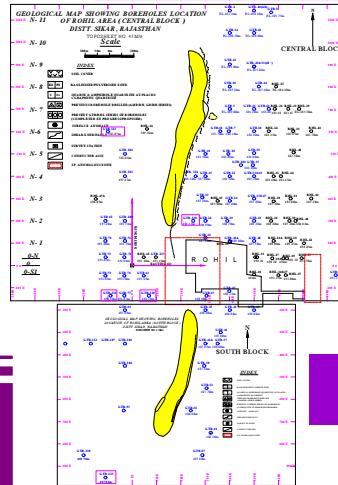
**North Extension Block**

**North Block**

**Central Block 1km x 1km**

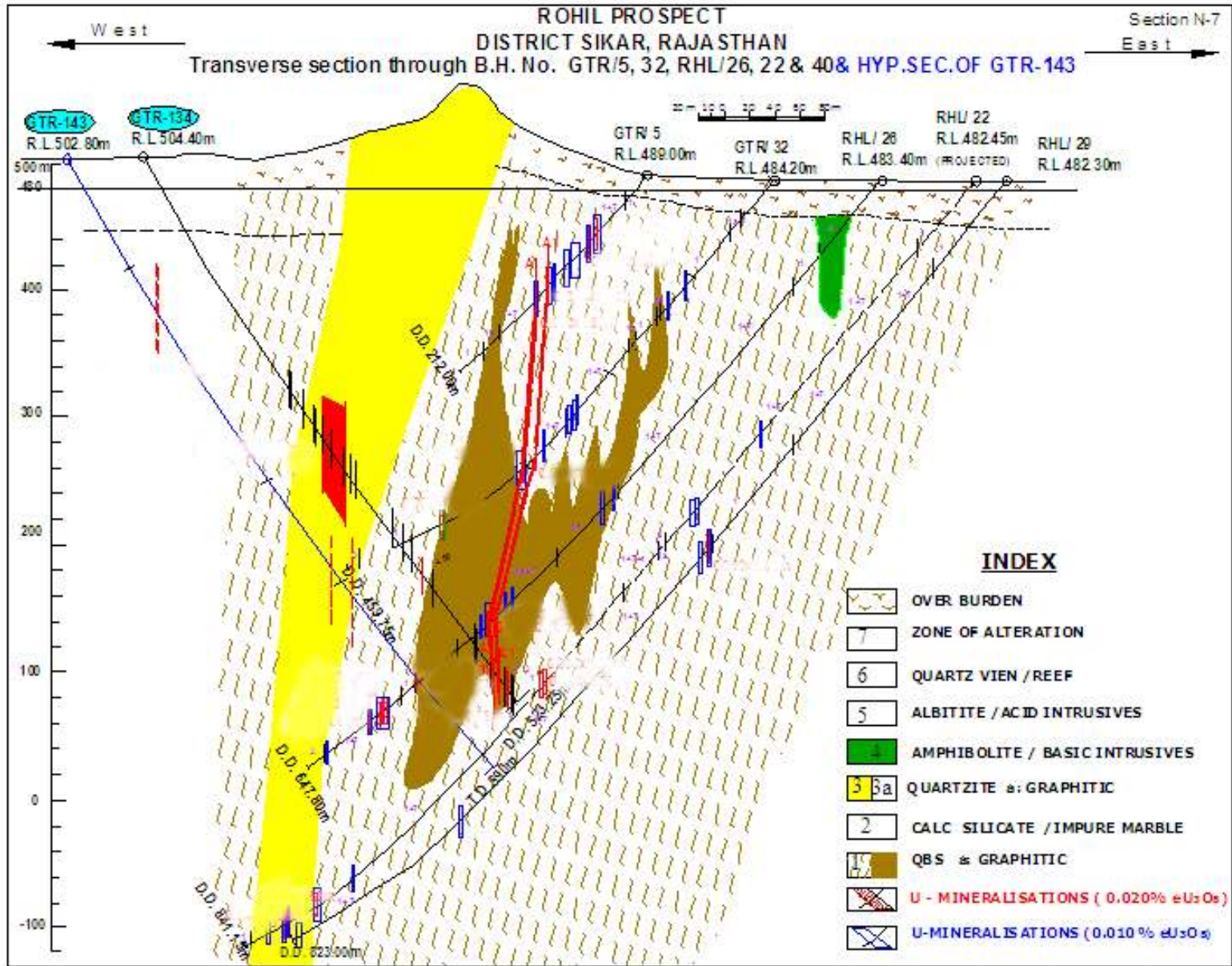
**South Block**

**Khatundra-Goria 4km**  
**Jhumpa-Jajod 8km**

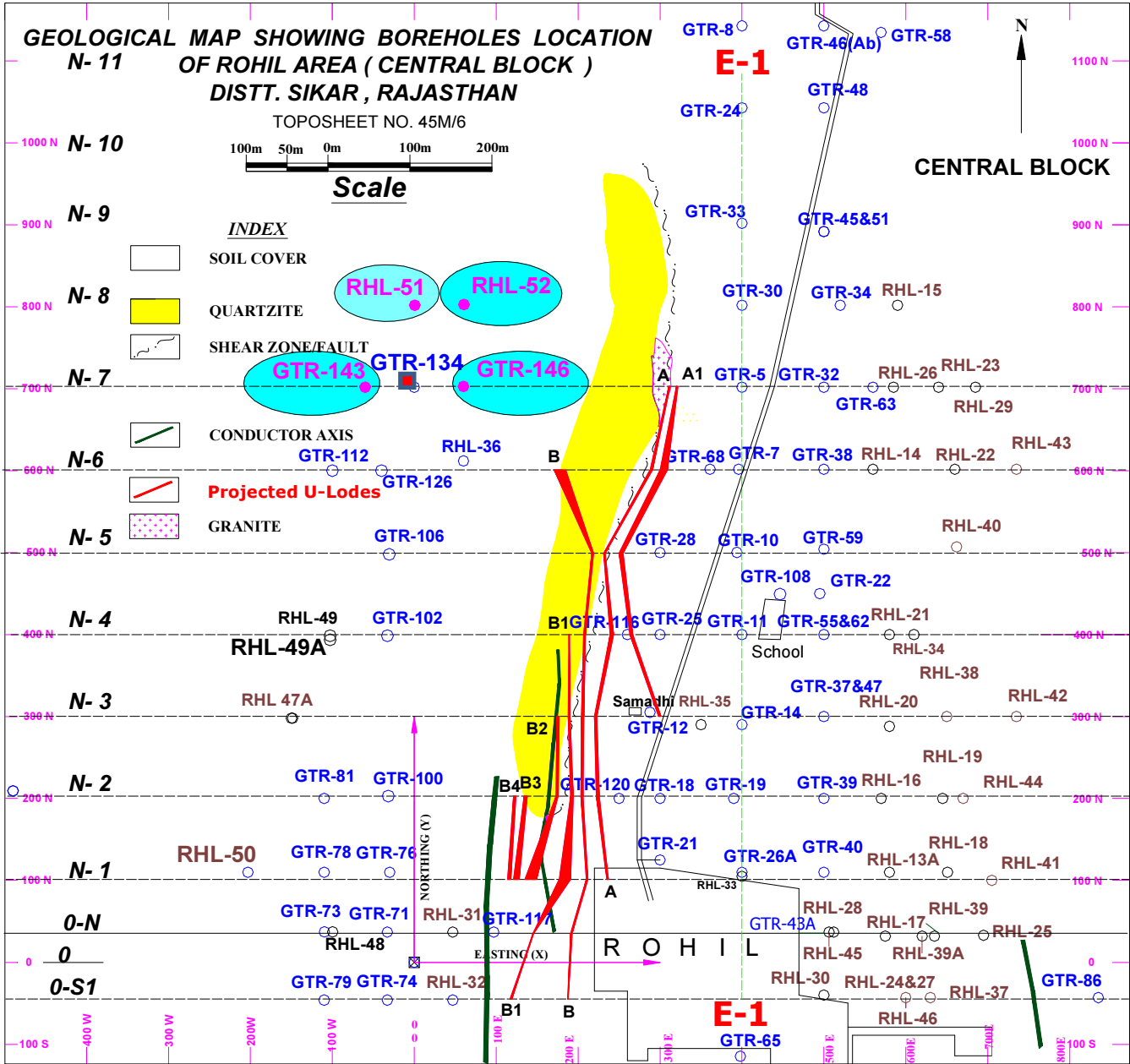


# Rohil Central Block

## Significant U-Mineralisation intercepted in BH. GTR/134



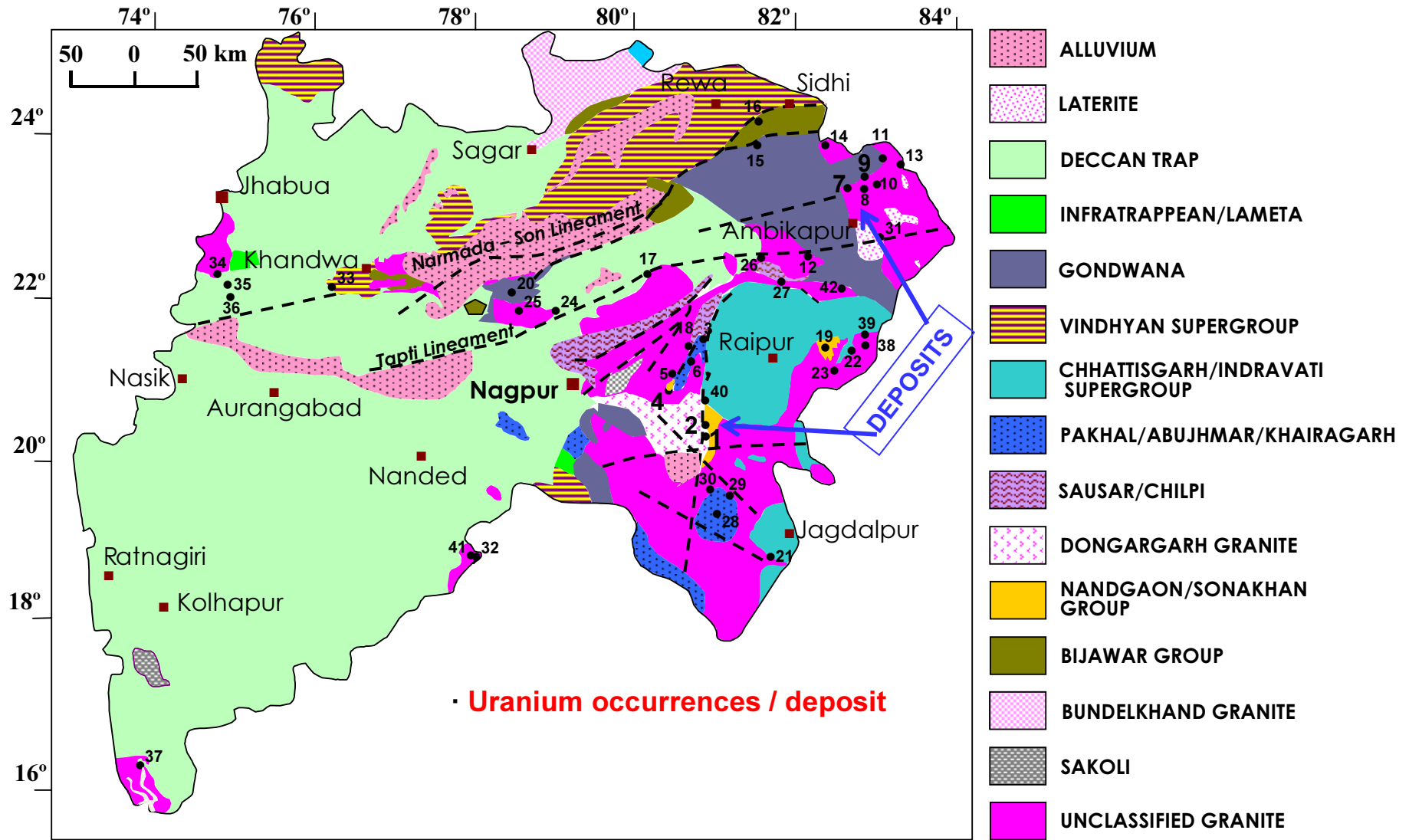
# Borehole Location Plan, Rohil Central Block



## *Dongargarh and N. Surguja Shear Zone, Chhattisgarh*

- ❖ Uranium exploration in Kotri-Dongargarh belt located uranium mineralisation at **Bodal, Bhandaritola**, Baghnadi, Jangalpur, etc. associated with amphibolite (Pitepani), metarhyolite (Bijli) and Dongargarh granite of Nandgaon Group (Paleoproterozoic).
- ❖ Uranium mineralisation at **Mogrra**, Malharbodi, Nalpani, Udarichhapar, etc. is associated with Bortalao sandstone and conglomerate of Khairagarh Group (Mesoproterozoic).
- ❖ Low grade, small size uranium reserves have been proved at **Mogrra**, Maharashtra and **Bodal-Bhandaritola**, Chhattisgarh.
- ❖ Uranium mineralisation as vein, lenses and shoots of variable size & shape confined in the quartzo- feldspathic rocks of North Surguja Shear Zone at **Jajawal-Dumhat**, Chhattisgarh.

# GEOLOGICAL MAP OF MADHYA PRADESH, MAHARASHTRA AND CHHATTISGARH



1. BODAL 2. BHANDARITOLA 4. MOGARRA 7. JAJAWAL 8. DHABI 9. DUMHAT

## *Other potential areas*

- ❖ Mesoproterozoic Gwalior Basin, Madhya Pradesh, Kunjar Basin, Orissa, and Shillong Basin, Meghalaya.
- ❖ Proterozoic Bijawar-Mahakoshal-Vindhyan Basins.
- ❖ Paleoproterozoic Quartz Pebble Conglomerates (QPC) of Sundargarh and Jajpur districts of Orissa.
- ❖ Mesozoic Satpura Gondwana, Madhya Pradesh
- ❖ Cenozoic Siwalik Basin, Lesser Himalaya.
- ❖ South Purulia Shear Zone (SPSZ) exposing alkaline carbonatite complex within tuffaceous phyllite of Singhbhum Group, Eastern India.

## CONCLUSION

- ✓ Indian uranium deposits are of low grade except Gogi, Karnataka.
- ✓ Vempalli Formation (160 km), in SW margin of Cuddapah Basin has very large potential for Stratabound (dolostone) type low grade uranium deposit.
- ✓ Delhi Supergroup (North Delhi Fold Belt) holds large promise for low grade uranium deposit associated with albitites.
- ✓ Low grade large size deposits may be made economically viable by new technology in mining and milling processes.
- ✓ There are many geological settings, which have ample potential for uranium deposits.

THANK YOU