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Potentiality of Uranium Mineralisation in the Environs of Chhattisgarh Basin, India: a new occurrence in Chhibra

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Abstract

The Mesoproterozoic intracratonic basins are known for hosting medium to high grade, large tonnage unconformity-type uranium deposits in the world. Besides Cuddapah basin, Chhattisgarh basin is also identified as one of the major favourable targets for uranium mineralisation in India based on its geological evolution, structural and tectonic framework. Extensive uranium exploration carried out along the northeastern and southeastern margins of Chhattisgarh basin and basement Sambalpur Granitoids has brought out significant uranium occurrences hosted by both the basement rocks as well as cover sediments. Unconformity related, fracture bound, significant epigenetic uranium mineralisation is manifested in the newly located uranium occurrence at Chhibra, Mahasamund district, Chhattisgarh which is intermittently exposed over a strike length of 800m and width of 5m to 50m in the pyritiferous feldspathic arenite of Rehatikhol Formation of Singhora Group proximal to the Mesoproterozoic unconformity. Grab samples (n=43) physically assayed 0.010% to 0.120% U_3O_8 and <0.005% ThO_2. Uraninite and pitchblende have been identified as uranium minerals. Uraninite occurs as vein in association with pyrite and at places with galena. The U/Th ratio of Sambalpur Granitoids and trachyte are respectively 1:1.8 and 3.3:1 indicating fertile nature of basement which has great importance in search of unconformity related uranium mineralisation in the southeastern part of Chhattisgarh basin. The favourable factors like geological, geochemical, geophysical, sedimentological, tectonic framework and presence of fertile granitic rocks with <5-26 ppm U (n=36) in the provenance indicate its potentiality for uranium mineralisation. The exploration so far, has been mostly confined around the shallow basin margins leaving deeper part unexplored. The recent discovery of high-grade uranium mineralisation in the cover sediments near Chhibra has opened up new possibilities for further exploration in the deeper part of the basin around suitable litho-structural settings, especially along the N-S, NNW-SSE, NE-SW and ENE-WSW trending shear/fault zones and their intersections.

Keywords: Uranium, Chhattisgarh, Chhibra, Unconformity

Introduction

Globally, the Mesoproterozoic intracratonic basins are highly potential for hosting unconformity-type uranium deposit as it was the first time when uranium from all the sources came to solution after the great oxidation rvent (GOE) and precipitated along the unconformity surface to produce medium to high grade, large tonnage uranium deposits, e.g. Athabasca basin, Saskatchewan, Canada (Fogwill, 1981; Sibbald, 1986, 1988) and Pine Creek geosyncline, Northern Territory, Australia (Needham and Roarty, 1980; Needham et al., 1988). In India, unconformity-related small uranium deposits have been identified at Lambapur-Yellapur-Chitrial in the northern part of the Cuddapah basin (Sinha, et al., 1995, 1996; Sharma, et al., 1995). Based on the geological setting, age and fertile basement provenance, the other Proterozoic basins such as the Chhattisgarh basin has been one of the major exploration targets for uranium mineralisation. The Mesoproterozoic Chhattisgarh basin has evolved on the northern fringe of Bastar craton and occupies an area of about 33,000 sq. km. with 2500 m thick sediments (Murti, 1987; Das et al., 1992) in the central part of Chhattisgarh and western part of Odisha state. The geological evolution, structural and tectonic framework of the Chhattisgarh basin favours its potentiality for hosting uranium mineralisation in association with base metals and other polymetallic mineralisation (Patnaik, 1989; Sinha and Hansoti, 1995; Sinha et al., 1998; Yadava et al., 2007). Uranium investigations in the eastern part of Chhattisgarh basin commenced in early eighties to look for sandstone-type uranium mineralisation and during mid-nineties the exploration switched for basement hosted fracture/shear-controlled vein-type uranium mineralisation. More than forty uranium occurrences having sizeable dimensions has been located mostly along the northeastern and southeastern margins of Chhattisgarh basin and basement Sambalpur Granitoids hosted by both the basement rocks as well as cover sediments of

Chhattisgarh basin. But it covers only 4-5% area of the basin (mostly along the eastern margin) leaving the internal part of the basin unexplored.

The present paper deals with the potentiality of uranium mineralisation in Chhattisgarh basin with emphasis on recently located significant occurrence of uranium mineralisation near Chhibra in Rehatikhol Formation of Singhora Group along the southeastern margin of Chhattisgarh basin and attempts to select new prospecting targets by evolving conceptual models and exploration strategies.

Geological and Tectonic Setting

The Mesoproterozoic intracratonic Chhattisgarh basin is third largest Proterozoic basin in Central India. The near crescent-shaped Chhattisgarh basin is situated within the Central Indian craton which is surrounded by Sambalpur granitoids in the east (2380 ± 44 Ma; Choudhary et al., 1996), Khairagarh volcano-sedimentary rocks in the west (2120 ± 35 Ma; Sinha, 1993), Nandgaon volcano-plutonics in the southwest (2462 ± 25 to 2039 ± 79 Ma; Pandey et al., 1995), Bilaspur-Raigarh-Surguja belt of Sausar Group in the north (1541 ± 26 to 1100 ± 20 Ma; Pandey et al., 1995) and metasediments and granitoids of Bastar craton in the south (3610 ± 336 to 2110 ± 41Ma; Pandey et al., 1995). Sonakhan volcano-sediments and volcano-plutonics (2347 ± 16 Ma; Pandey et al., 1995) trending in the NNW-SSE direction divides Chhattisgarh basin into two sub-basins, namely, Baradwar sub-basin in the east and Hirri sub-basin in the west. Baradwar sub-basin is geologically more important for hosting uranium mineralisation than Hirri sub-basin as this part hosts all the three groups of the Chhattishgarh Supergroup namely Singhora (arenites, shales and limestones), Chandrapur (predominantly sandstones/

Table-1: Stratigraphic succession of Chhattisgarh basin (after Das et al., 1992)

	HIRRI SUB-BASIN		BARADWAR SUB-BASIN
	NORTHERN PART	SOUTHERN PART	
RAIPUR GROUP	Maniari Shale	Maniari Shale with gypsum	Saradih dolomite, limestone and black shale
	Hirri dolomite	Hirri dolomite Tarenga argillite, arenite and cherty-clay	
	Pandaria purple calc-argillite with grey bedded limestone, stromatolitic limestone and dolomite as lenses and pockets	Chandi stromatolitic limestone with argillite and arenite member Gunderdehi argillite with arenite band	Bamandihi purple calc-argillite with stromatolitic limestone as lenses and pockets
		Chamuria bedded limestone	
CHANDRAPUR GROUP	Kansapathar glauconite arenite ----Disconformity----	Kansapathar glauconite arenite Chaporadih argillite and arenite	Kansapathar glauconite arenite Chaporadih argillite and arenite
	Lohardih conglomerate and arkose	Lohardih conglomerate and arkose	Lohardih conglomerate and arkose
---------------------------Unconformity---------------------------			-----------Disconformity-----------
Bilaspur-Raigarh-Surguja Metamorphic belt and Chilpi Group		Granite and gneisses of Bastar craton and Sonakhan Group	SINGHORA GROUP: Chhuipali purple argillite and stromatolitic carbonate Bhalukona arenite Saraipali purple argillite with porcellanite Rehatikhol arkose and conglomerate
			--------Unconformity------- Sambalpur Granite of Bastar craton and Sonakhan Group

quartzites) and Raipur (shales/limestones) groups (Das et al., 1992) (Table-1). The oldest Singhora Group is exposed only along the two embryonic basins, namely the Singhora and Barapahar, situated along the southeastern and eastern portions of the Chhattisgarh basin (Fig. 1a). Singhora Group is divided into four formations namely Rehatikhol, Saraipali, Bhalukona and Chhuipali which are exposed in the southern part, overlying the basement rocks of Sambalpur granitoids (Fig. 1b). It was evolved during Paleo to Mesoproterozoic period (1600-1800 Ma) whereas, sedimentation in main Chhattisgarh basin was initiated around 1300 Ma (Das et al., 2001). The siliciclastic detritus contributed from the surrounding fertile provenance and deposited on a stable shelf environment in fluvial fan deposit. The detritus deposited in the basal part of the basin contains high uranium content which is mainly derived from the fertile granitic basement (n=36, <5-26ppm U).

Uranium Mineralisation

Exploration for uranium in Chhattisgarh basin commenced in early 1960s by Atomic Minerals Directorate (AMD) for exploration and research and till 1990s, thoriferous anomalies associated with the basal conglomerates of Singhora and Chandrapur groups were reported. Uranium mineralisation of 0.032% eU_3O_8 x 0.80m (eU_3O_8 is equivalent uranium oxide) was reported for the first time in greenish black shale in the borehole drilled by Bhilai Steel Plant (BSP) near Stadium at Durg in the western part of the basin in 1980. Subsequent exploration shows that the uranium mineralisation occurs in two distinct geological settings in the vicinity of the unconformity i.e., (1) cataclasites in shears/fracture zones within basement granites/migmatites and metabasic/basic rocks, and (2) arenites of Singhora and Chandrapur groups. A number of uranium occurrences were also reported from Chhattisgarh basin associated with both cover sediments e.g., Juba-Banjhapali, Govardhangiri-Bagia *nala*, Sapnai *nala*, Chitakhol, etc. and basement granite e.g., Kashipali, Karichhapar, Dulapali, Damdama, Malaikhaman, Makarmunda, Jhal, Dumarpali, Jharmunda, Amlipali, Samarbaga, Telan, Borjha, etc. (Sinha and Hansoti, 1995; Sinha, et al., 1998; Bhattacharjee, et al., 2005; Gupta, et al., 2008; Tiwary, et al., 2004; Kumar, et al., 2000; Mukundan, et al., 2000; Bhairam, et al., 1998; Mukundan, et al., 2000; Pant, et al., 2001; Sharma et al., 2014) (Fig. 1a, Table-2). Though reconnoitory drilling has been carried out in few areas but sizeable persistency and grade of uranium mineralisation could not be established. These uranium mineralisations invariably occur in association with polymetallic sulphides (Sinha and Hansoti, 1995; Sinha, et al., 1998; Patnaik, 1989; Yadava, et al., 2007).

Table-2: Uranium occurrences in basement and cover sediments of Chhattisgarh basin

Locality	District, State	Host Rock	$\%U_3O_8$
Juba-Banjhapali	Mahasamund district, Chhattisgarh	cover sediments	0.010-0.078
Govardhangiri-Bagia Nala	Bargarh district, Odisha		<0.010-0.80
Kalangpali	Bargarh district, Odisha		up to 0.017
Sapnai Nala	Raigarh district, Chhattisgarh		<0.010-0.044
Chitakhol-Renkhol-Bokarda	Korba and Janjgir-Champa district, Chhattisgarh		<0.012-0.39
Kashipali-Jaipur	Raigarh district, Chhattisgarh	basement granitoids	0.010-0.96
Karichhapar	Raigarh district, Chhattisgarh		0.011-0.41
Dulapali, Dongaripali, Paraskol-Sonabela, Damdama	Raigarh district, Chhattisgarh		0.026-0.43
Malaikhaman	Bargarh district, Odisha		0.026-0.11
Makarumunda	Bargarh district, Odisha		0.013-3.3
Ghoghara	Bargarh district, Odisha		0.086-0.30
Kanhari	Rajnandgaon district, Chhattisgarh		<0.010-0.045
Jhal- Dumarpali	Bargarh district, Odisha		0.010-0.87
Jharmunda	Bargarh district, Odisha		0.010-0.62
Amlipali	Bargarh district, Odisha		0.032-0.33
Negimunda	Bargarh district, Odisha		0.011-0.040
Bidhanpali	Bargarh district, Odisha		0.017-0.052
Samarbaga-Telan-Borjha	Jharsuguda district, Odisha		0.011-0.63

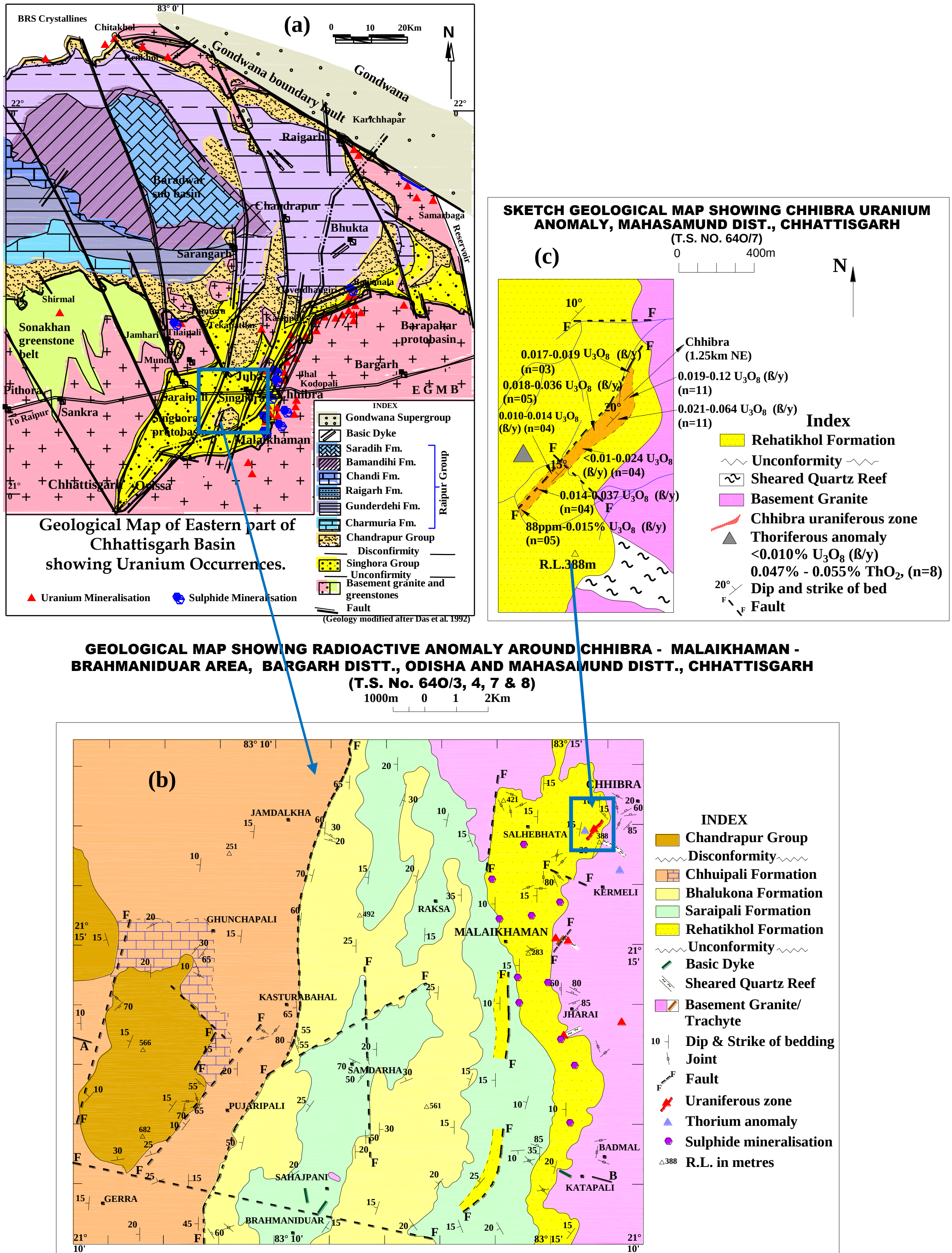

Figure 1. Geological map of (a) Eastern part of Chhattisgarh basin showing uranium occurrences, (b) Chhibra-Malaikhaman-Brahmaniduar tract and (c) Chhibra uranium occurrence in details

Recently located occurrence of uranium mineralisation of Chhibra (lat. 21°16.904'N: 21°17.250'N and long. 83°15.648'E: 83°15.921'E), Mahasamund district, Chhattisgarh (Fig. 1b & c) has enhanced the potentiality of uranium along the southeastern margin of Chhattisgarh basin. The uranium mineralisation here occurs in pyritiferous feldspathic arenite of Rehatikhol Formation along a shear zone trending N60°E-S60°W direction nearly 40m above the Mesoproterozoic unconformity between Singhora Group and Sambalpur Granitoids intermittently over 800m strike length with width from 5m to 50m and thickness from 1m to 4m. The physical assay of the mineralized rock samples (n=43) indicated 0.014 to 0.140% eU_3O_8, 0.010 to 0.120% U_3O_8 (β/γ) and <0.005% ThO_2 (Table-3). Rehatikhol Formation consists of basal conglomerate which directly rests over the Sambalpur Granitoids and the conglomerate followed by pebbly feldspathic to sub-feldspathic arenite and cross bedded medium to coarse grained arenite with thin layers of pebbly arenite horizon at places.

The petrographic and mineralogical studies indicate that the host rock for uranium mineralisation is poorly to moderately sorted feldspathic arenite. It is medium to coarse grained, pale greenish to light grey coloured and mainly consists of angular to sub-angular grains of quartz, microcline, minor plagioclase feldspar and numerous opaque minerals with approximately 10-15% matrix (visual estimation) composed of clay, chlorite and sericite (Fig. 2a). Pyrite also occurs in the matrix along grain contact of quartz and feldspar (Fig. 2b). Feldspars are commonly altered into clay and sericite (Fig. 4b). The Cellulose Nitrate (CN) film auto-radiographic study indicates medium to high density alpha tracks over CN-film due to the presence of radioactive phase which has been identified as pitchblende. It occurs as vein in association with pyrite and at places with galena along grain boundary of quartz and feldspar (Fig. 3a, 3b). The XRD study shows presence of traces of uraninite along with quartz, pyrite, chalcopyrite, microcline, jarosite and titanite (Table-4). Patches of secondary uranyl mineral (Fig. 4a) as well as adsorbed uranium are also observed over clays, hydrated iron oxides and altered feldspar (Fig. 4b, 4c). Pyrite is the main sulphide ore mineral identified occurring as vein material filling the space between the grain contact of quartz and feldspar in the matrix of feldspathic arenite. The pyrites generally occur as cubic to anhedral in shape. Other ore minerals identified are galena, chalcocite, covellite and chalcopyrite occurring as vein along grain boundaries or fracture-filling in quartz.

Table-3: Physical assay result of the radioactive feldspathic arenite samples of Chhibra

Sample No.	% eU_3O_8	% U_3O_8 (β/γ)	% ThO_2	% K		Sample No.	% eU_3O_8	% U_3O_8 (β/γ)	% ThO_2	% K
CHB-1	0.140	0.078	<0.005	---		CHB-25	0.028	0.025	<0.005	---
CHB-2	0.089	0.062	<0.005	---		CHB-26	0.033	0.037	<0.005	---
CHB-3	0.090	0.050	<0.005	---		CHB-27	0.023	0.030	<0.005	---
CHB-4	0.066	0.050	<0.005	---		CHB-28	0.015	0.014	<0.005	1.4
CHB-5	0.076	0.041	<0.005	---		CHB-30	0.016	0.014	<0.005	1.4
CHB-6	0.056	0.038	<0.005	---		CHB-31	0.014	0.013	<0.005	2.3
CHB-7	0.058	0.035	<0.005	---		CHB-32	0.014	0.013	<0.005	1.7
CHB-8	0.043	0.043	<0.005	---		CHB-33	0.015	0.010	<0.005	1.9
CHB-9	0.036	0.034	<0.005	---		CHB-34	0.017	0.015	<0.005	<0.5
CHB-10	0.040	0.036	<0.005	---		CHB-35	0.017	0.015	<0.005	<0.5
CHB-11	0.034	0.036	<0.005	---		CHB-36	0.014	0.013	<0.005	1.6
CHB-12	0.031	0.027	<0.005	---		CHB-37	0.048	0.043	<0.005	---
CHB-13	0.023	0.018	<0.005	---		CHB-38	0.032	0.030	<0.005	---
CHB-14	0.024	0.024	<0.005	---		CHB-39	0.029	0.025	<0.005	---
CHB-15	0.021	0.024	<0.005	---		CHB-40	0.018	0.019	<0.005	---
CHB-16	0.021	0.019	<0.005	---		CHB-41	0.020	0.023	<0.005	---
CHB-17	0.017	0.019	<0.005	2.5		CHB-42	0.022	0.025	<0.005	---
CHB-18	0.018	0.017	<0.005	---		CHB-43	0.022	0.024	<0.005	---
CHB-19	0.019	0.023	<0.005	---		CHB-44	0.024	0.026	<0.005	---
CHB-22	0.120	0.120	<0.005	---		CHB-45	0.025	0.028	<0.005	---
CHB-23	0.088	0.078	<0.005	---		CHB-46	0.024	0.028	<0.005	---
CHB-24	0.074	0.064	<0.005	---						

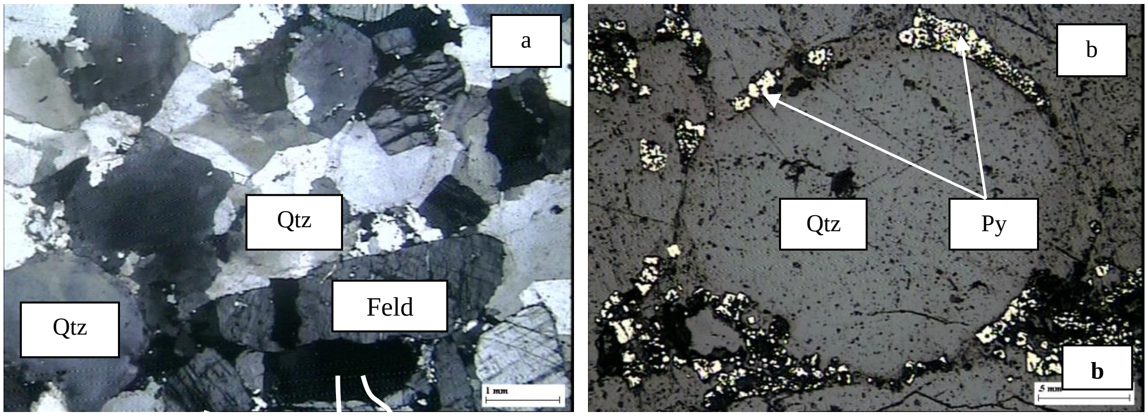

Figure 2. (a) General view of feldspathic arenite, Chhibra area, Chhattisgarh, TL, air, 2N., (b) Pyrite (Py) as matrix along grain boundary of quartz grains (Qtz) in feldspathic arenite, Chhibra area, Chhattisgarh, RL, air, 1N.

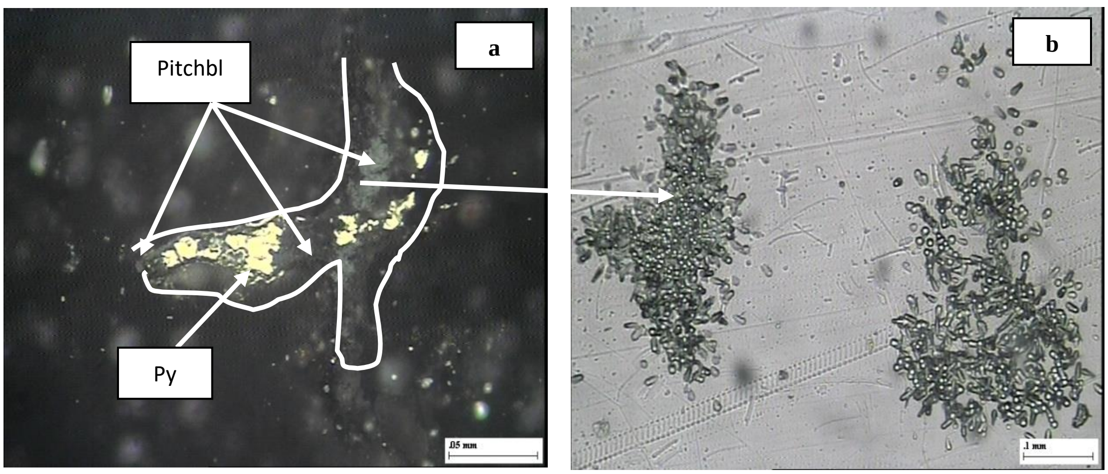

Figure 3. (a) Pitchblende (Pitchbl) as vein material in association with pyrite (Py) in quartz in feldspathic arenite, (b) Corresponding high density alpha tracks over CN films due to pitchblende in feldspathic arenite, in Figure 6a, Chhibra area, Mahasamund district, Chhattisgarh, TL, air, 1N.

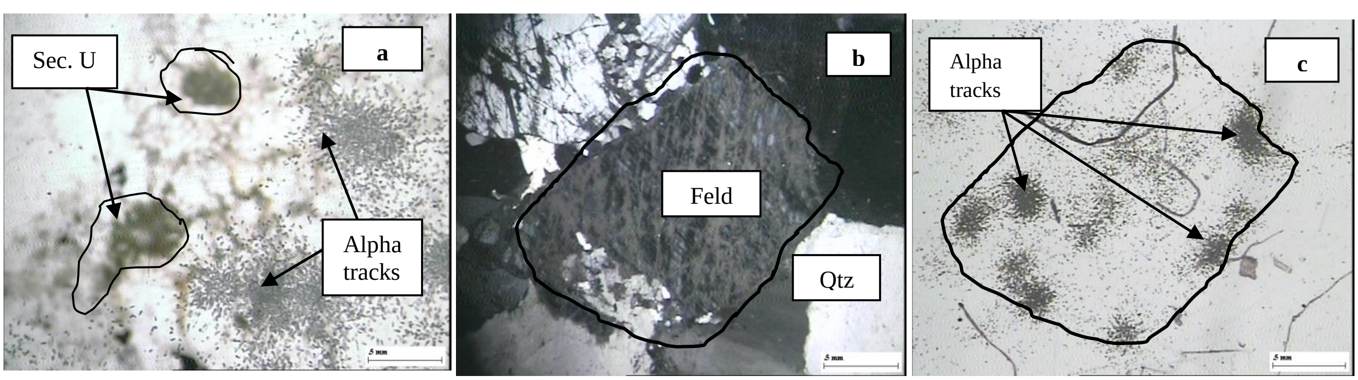

Figure 4. (a) High density alpha tracks due to patches of secondary uranyl minerals in feldspathic arenite, TL, air, 1N, (b) altered feldspar with perthitic texture in feldspathic arenite, TL, air, 2N, (c) moderate to high density alpha tracks over altered feldspar g
TL- Transmitted Light; RL- Reflected Light; 1N- Under Plane Polarised Light; 2N- Under Crossed Nicols; Air- Viewed under air
rain in figure 4b in feldspathic arenite, TL, air, 1N, Chhibra area, Mahasamund district, Chhattisgarh.

Table-4: XRD analysis result of feldspathic arenite

Sample no.	Atomic Minerals	Other minerals
CHB-1	None	Pyrite, quartz, traces of anatase, chalcopyrite, microcline and titanite
CHB-2	Traces of Uraninite	Jarosite, microcline, pyrite, quartz and traces of titanite

Genesis of Chhibra Uranium Mineralisation

Chhibra uranium mineralisation is significant as it occurs continuously along a shear zone forming a linear ridge in N60°E-S60°W direction showing silicification, sulphidisation, kaolinisation and ferruginisation. It is primarily structurally controlled and mineralized fluid source could be the basement pink potassic granite with felsic volcanic rock (trachyte) located nearly 40m below the unconformity between Singhora Group and the Sambalpur Granitoids. Besides, the high potassic granites, the felsic volcanic rocks especially rhyolites and trachytes have been considered to be good source of uranium world over where uranium and thorium abundances in volcanic rocks have been reported to range from 3-26 ppm and 20-32 ppm respectively (Dahlkamp, 1993). Uranium mineralisation associated with felsic volcanic rocks viz., rhyolite, trachyte, etc. have also been reported in different parts of India (Maithani and Srinivasan, 2010; Sinha and Jain, 2008). In the present area, the U/Th ratio of Sambalpur Granitoids and intrusive trachyte are 1:1.8 (n=36; XRF data) and 3.3:1 (n=6; Chemical data) respectively showing fertile nature of the basement source rock (Table-5 & 6).

The sedimentary succession of Singhora basin is thought to be deposited by fault-controlled sedimentation under a shallow-crustal brittle deformational regime (Chaudhuri et al., 2002; Dhang and Patranbis-Deb, 2011; Patranbis-Deb, 2004; Patranbis-Deb and Chaudhuri, 2007, 2008) where the basin margins are mostly affected by several N-S, NNW-SSE, NE-SW and ENE-WSW faults cross-cutting the basement and cover sediments and their subsequent reactivation through multiple tectonic events. The uranium bearing fertile basement granites coupled with tectonic and igneous activities provided thermal gradient and channels through these fault/shear

Table-5: XRF result showing U & Th values of Sambalpur Granitoids

Sample no.	U (ppm)	Th (ppm)	U/Th	Sample no.	U (ppm)	Th (ppm)	U/Th
B13A6	<5	26	0.10	B14A9	<5	31	0.08
B13A7	8	41	0.20	B13A9	<5	36	0.07
B13A8	<5	35	0.07	B13A10	12	13	0.92
B14A5	<5	22	0.11	B13A11	<5	12	0.21
B19A0	<5	<5	1.00	B13A12	<5	<5	1.00
B19A2	<5	<5	1.00	B13A13	<5	27	0.09
B18A3	5	8	0.63	B19A1	13	11	1.18
B18A5	<5	<5	1.00	B16A4’	<5	7	0.36
B17A3’	<5	<5	1.00	B16A4	16	24	0.67
B17A2’	<5	10	0.25	B16A5	<5	24	0.10
B17A3	5	32	0.16	B15A6’	18	10	1.80
B17A4	<5	10	0.25	B15A5’	<5	19	0.13
B17A5	<5	<5	1.00	B15A4’	8	9	0.89
B12A14	<5	21	0.12	B15A4	<5	10	0.25
B11A15	<5	11	0.23	B15A5	<5	<5	1.00
B10A16	<5	14	0.18	B15A7	26	19	1.37
B16A3	8	19	0.42	B14A7	6	9	0.67
B14A6	<5	<5	1.00	B14A8	<5	12	0.21

Table-6: XRF result showing U & Th values of Trachyte

Sample no.	U (ppm)	Th (ppm)	U/Th
XG-4032	47	20	2.35
XG-4033	24	4	6.00
XG-4034	8	3	2.67
XG-4035	6	3	2.00
XG-4036	10	3	3.33
XG-4037	10	3	3.33

zones (here ENE-WSW fault) across the Mesoproterozoic unconformity for uranium migration and enrichment in pyritiferous feldspathic arenite of Chhibra. Occurrences of silica veins cutting across quartz and feldspar grains in feldspathic arenite also indicate post depositional tectonic activity near the basin margin. The discrete uranium in the basement granites and secondary uranium minerals along fractures, fissures, pore spaces might have contributed in the enrichment of uranium in the cover sediments of Singhora Group. The silicification, argillisation, kaolinisation and hematitisation accompanied the uranium mineralisation due to subsequent alteration processes. The late stage hydrothermal solutions might have caused the breakdown of feldspars by losing sodium, potassium and partially silica and subsequently formation of argillitic alteration products, iron oxy-hydrides and uranyl oxide hydrates. The temperature ranging from meteoric water to hydrothermal solutions appears to be instrumental in near surface mineralogical alteration. This may have shifted the pH to alkaline nature causing uranium precipitation in the fractures and as adsorption on the clay minerals and iron oxy-hydrides.

Discussion and Conclusions

Chhattisgarh basin has been one of the favourable targets for uranium exploration among the Proterozoic basins in Central India. It has been correlated with the other Proterozoic basins of Central India viz., Khariar, Ampani, Indravati and Sabari based on their litho-characters similar to siliciclastic-carbonate unit of the Singhora Group and their evolution close to Eastern Ghats mobile belt (EGMB) around 1600-1800 Ma (Ramakrishnan, M., 1990; Das et al., 2001). Based on the synthesis and analysis of data on uranium investigations carried out so far in Chhattisgarh basin, four main facts have emerged. They are: (a) uranium investigations have been carried out mainly along the basin margins which constitutes about 4-5% of the total area leaving internal part of the basin unexplored, (b) applications of required exploration techniques viz., deep borehole drilling, geophysical and geochemical techniques are negligible in the inner part, (c) lack of data on the general distribution of the radioelement concentrations in different litho-units and (d) confinement of all the major uranium occurrences (more than forty) located so far, in the eastern part of the Chhattisgarh basin. In the light of the above facts, the potentiality of uranium mineralisation in the Chhattisgarh basin, and the newly located Chhibra uranium anomaly assumes importance.

The uranium mineralisation generally occurring as fracture filled veins, stringers and around grain boundaries are the signatures of typical epigenetic hydrothermal mineralization. It has been postulated that availability of uranium bearing solutions and pyrite along with other sulphides are the main factors which control mineralisation (Sinha et al., 1998) whereas, in the oxidized zone, iron rich hydrothermal solution might have played a key role in uranium mineralisation (Gupta et al., 2008). The occurrences of uranium, polymetallic sulphides (Pb, Zn, Cu, As±Ag), oxides of Ti and Fe in association with chert±fluorite veins in the basement of Sambalpur granitoids (Yadava et al., 2007) as well as in the arenites of Singhora and Chandrapur groups (Sinha and Hansoti, 1995; Sinha et al., 1998) along the eastern part of Chhattisgarh basin show epigenetic hydrothermal mineralisation. The large number of uranium occurrences in association with polymetallic sulphide mineralisation along the unconformity surface of Singhora Group and basement Sambalpur granitoids all along the basin margin of the eastern part of the Chhattisgarh indicate hydrothermal activity on regional scale, thus makes a favourable target for hosting shear/fracture controlled vein-type as well as unconformity-related uranium mineralisation.

The limitations of deep penetrating geophysical techniques so far, and limited exposures of the basal sequence have been the major constraints in exploration of deeper part and therefore, the exploration was confined mainly to the basin margins. The advancement in the geophysical techniques like airborne magnetic, radiometric and electromagnetic surveys in uranium exploration, the strategy needs to be revised to look into the deeper part of the basin especially along the N-S, NNW-SSE, NE-SW and ENE-WSW trending shear/fault zones and their intersections for better prospect. Along with geophysical techniques, geochemical exploration, especially litho-geochemistry, can be applied to study the alteration features like illitisation, kaolinisation and chloritisation which could prove to be a useful tool in defining the target areas for unconformity-related uranium mineralisation (Sopuck et al., 1983). This technique has become a useful exploration method and become more valuable to examine areas of conductor trends as exploration moves towards deeper areas (Mathews et al., 1997).

In view of the earlier known uranium occurrences in the cover sediments as well as in the basement rocks and the newly located epigenetic uranium mineralisation near Chhibra over a significant dimension in the form of disseminations in the matrix, inclusions in altered feldspar grains, veins and stringers along fractures and adsorbed on clay and hydrated iron oxy-hydrides in pyritiferous feldspathic arenite of Rehatikhol Formation in the vicinity of Mesoproterozoic unconformity having fertile source rock of Sambalpur granitoids and intrusive trachyte dykes in the basement with U/Th ratio of 1:1.8 and 3.3:1 respectively bears a great significance for exploration of unconformity-related uranium mineralisation in this part of Chhattisgarh basin.

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