SHORT COMMUNICATION

A NOTE ON THE OCCURRENCE OF URANIFEROUS PHOSPHATIC FERRUGINOUS BRECCIA IN THE LOWER VINDHYAN SEDIMENTS OF SON-VALLEY, AROUND BASKATI, SIDHI DISTRICT, MADHYA PRADESH

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Uranium mineralisation associated with phosphatic ferruginous breccia has been located for the first time within the Lower Vindhyan Semri Group of basal sediments in Son Valley around Baskati, Sidhi district, M.P. The phosphatic ferruginous breccia occurs along the reactivated basement fracture that follows the structural grain of Son-Narmada megalineament, and also marks the tectonic contact zone between Vindhyans to the north and Crystallines/Mahakoshals to the south. Detailed geological investigations at Baskati reveal uranium enrichment intermittently over a stretch of 2500 m at Baskati block and 400 m in Paniha block further east with an average width of 3 to 5 m. Samples from radioactive horizon analysed upto 670 ppm U and 36. 87% P_2O_5. Petromineralogical studies reveal that the association of uranium is mostly with the phosphatic phase.

Introduction

Phosphatic rocks distributed among Proterozoic, Mesozoic and Tertiary Formations are known to be potential secondary uranium sources world over Early Proterozoic phosphorites of Aravalli, Bijawar and Cuddapah are reportedly enriched in elements such as U, V, Mo and Ni and forms large tonnage, low-grade uranium deposits (Ravi Kaul et al 1989) Similarly, Tertiary phosphate deposits of Mussorie have analysed as high as 0 1% U_3O_8 (Ravi Kaul et al 1989) with high abundance of Mo, Ni, Ba and V (Saraswat et al 1971) However, Vindhyan Supergroup of rocks showed phosphatic horizons in very limited areas The marbles of Raialo Group and dolomitic limestones of Nathdwara Group analyse upto 28 68% P_2O_5 and 0 12% U_3O_8 Similarly stromatolitic carbonates containing chert lenses of Kajrahat limestone formation analysed upto 20% P_2O_5 They are exposed at Dala, Susnai, Agarah, Chandi and Basuhai areas (Banerjee,1988) In these places the porcellanite beds of the Lower Vindhyan contain phosphatic intercalations Minor phosphorite occurrences are also reported in sandstones and shales of Vindhyan Supergroup from Bundi and Chittorgarh districts of Rajasthan (Chauhan and Sisodia, 1989) Uranium mineralisation (up to 0 1% U_3O_8) is also reported in Vempalle dolostones of Papaghni Group of Cuddapah Supergroup (Sundaram et al 1989) Mineralisation is traced near village Vempalle in southwestern margin of the Cuddapah basin Radioactive samples analysed 0 1% U_3O_8 and 28 03% P_2O_5 Exploration efforts of AMD led to the discovery of impure dolostone hosted stratabound type low-grade uranium mineralisation at Tummalapalle–Gadenkipalle–Rachakuntapalle area in Cuddapah district (Vasudeva Rao et al 1989, Dhana Raju et al 1993) Similar efforts in Neoproterozoic Bhima basin in parts of Gulbarga district of Karnataka resulted in identification of uranium mineralisation in phosphatic limestone and phosphorites near Ukinal (Achar et al 1997) In Central India, episodic reactivation since Proterozoic times along the Son-Narmada mega rift zone led to the formation of several volcanic and hydrothermal deposits (Abhinaba Roy and Bandyopadhyay, 1990, Rajurkar et al 1990, Nair et al 1995) In the present study occurrence of uranium in a phosphatic ferruginous breccia of the Lower Vindhyan Semri Formation over a limited extent at Baskati, Sidhi district, Madhya Pradesh along the contact with crystallines is reported This note includes the details on the mineralisation and its mode of occurrence at Baskati and adjoining areas

Geology

The study area forms part of the Son-Narmada mega rift zone trending E-W to ENE-WSW, which marks the tectonic contact zone between the cover of Lower Vindhyans in the north and an elongated inlier of Basement Sidhi Crystalline Complex in the south (Nair et al 1995) These crystallines are in turn tectonically juxtaposed against the Mahakoshal fold belt further south Basement crystallines comprising biotite gneisses, talc-schists, actinolite-tremolite-schists, granites, syenites, basic dykes, quartzo-feldspathic and quartz veins are exposed to the south of Baskati village (Lat 24°26'25"N Long 81°58'00"E), Sidhi district, Madhya

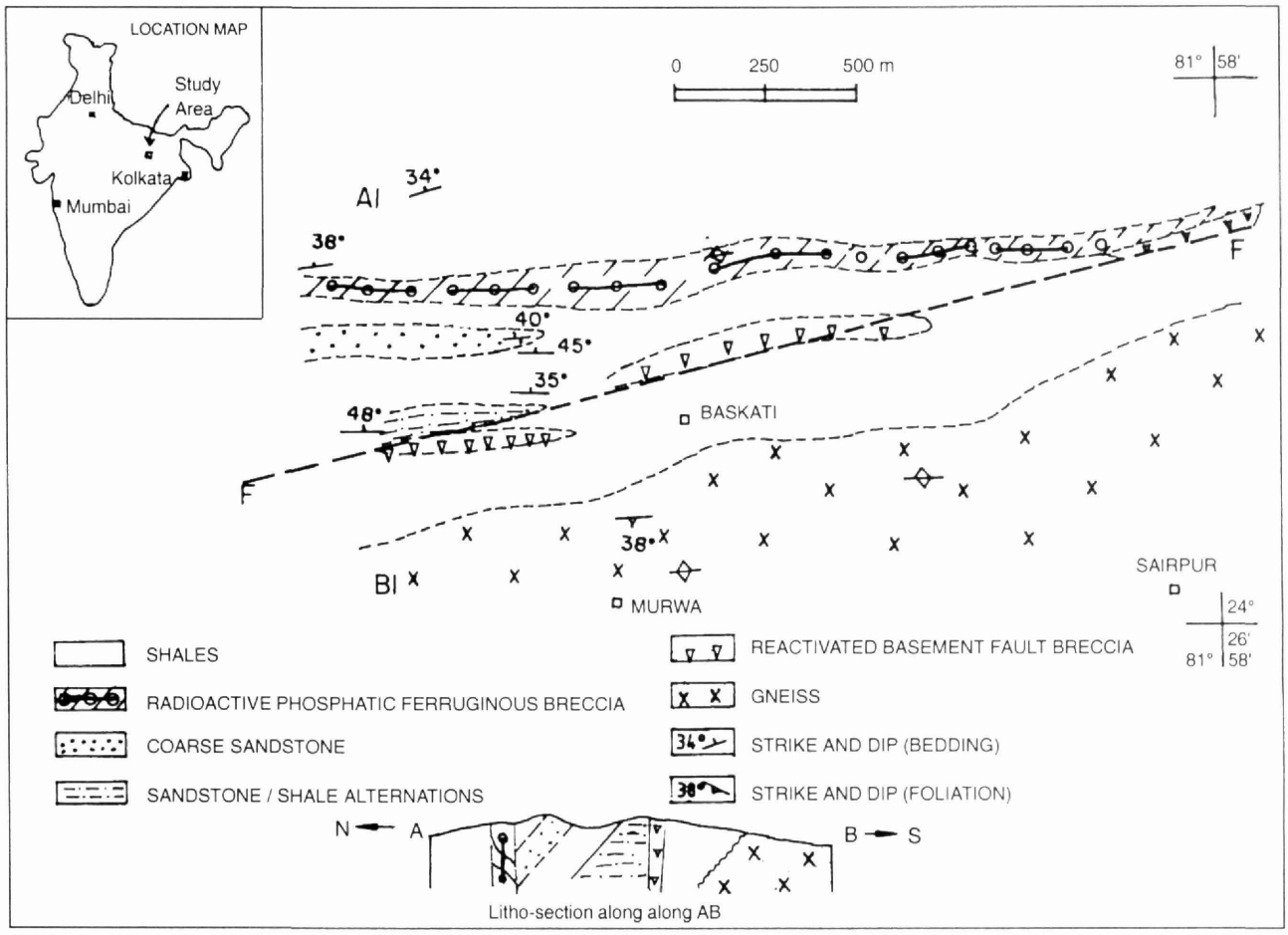

Fig.1. Geological map showing radioactive outcrops at Baskati area, Sidhi District, Madhya Pradesh.

Pradesh. (Fig.1). Vindhyan sediments exposed in the area belong to Lower Semri Formation and include basal conglomerate, pebbly sandstone, sandstone/shale alternations and porcellanite beds. Younger sediments of Kaimur and Rewa Formations are exposed in the north. Vindhyan-Crystalline contact is marked at places by brecciated quartzite representing reactivated basement fault and contain xenoliths of basal conglomerate. North of this brecciated rock, the host phosphatic ferruginous breccia is exposed as detached outcrops recording intermittent radioactivity over a strike length of 2500 m with a variable thickness of 20-100 m. Within this zone radioactivity due to presence of uranium is traced intermittently with a thickness of 3-5 m and remaining part of the zone shows less ferruginisation and records background radioactivity. Further east around Paniha village the phosphatic ferruginous breccia are exposed over 400 m with a variable thickness of 20-50 m.

Petrological Characters of Phosphatic Ferruginous Breccia

Phosphatic ferruginous breccia is a violet-red coloured rock comprising concretions/nodules with diameter upto 8", and clasts of shale, porcellanite in fine-grained ferruginous groundmass with chert and silica veins. Hematitisation, limonitisation and silicification are the different alterations observed in this unit, which appear to control the mineralisation. Clasts of quartz are highly strained, intensely fractured and dominate over clasts of porcellanite, shale sandstone and mudstone within ferruginous groundmass (goethite and limonite). Crystals of apatite as well collophane bands comprise the phosphatic phases in the rock. CN film study on the samples indicated medium density alpha tracks corresponding to uraniferous apatite and collophane. Scattered alpha tracks are associated with ferruginous material, indicative of uranium in adsorbed phase. Other ore minerals identified are pyrolusite, pyrite, goethite and hematite.

Geochemistry

Major and trace elements on 61 representative phosphatic ferruginous breccia samples have been carried out by WDXRF spectrometer. P_2O_5 values vary between 1.48

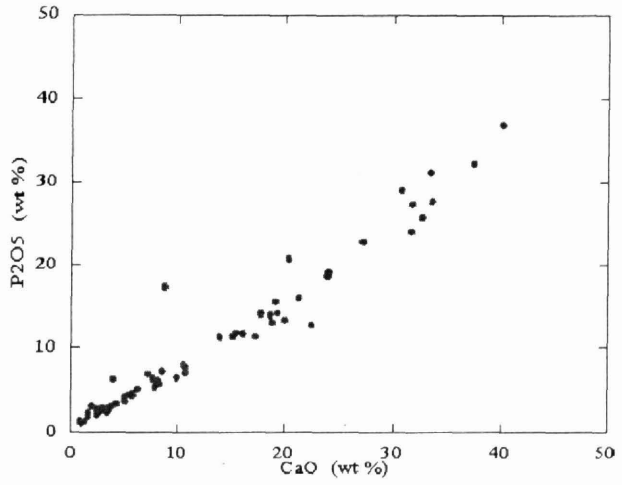

Fig.2. Binary plot of CaO vs. P_2O_5 of radioactive phosphatic ferruginous breccia samples of Baskati.

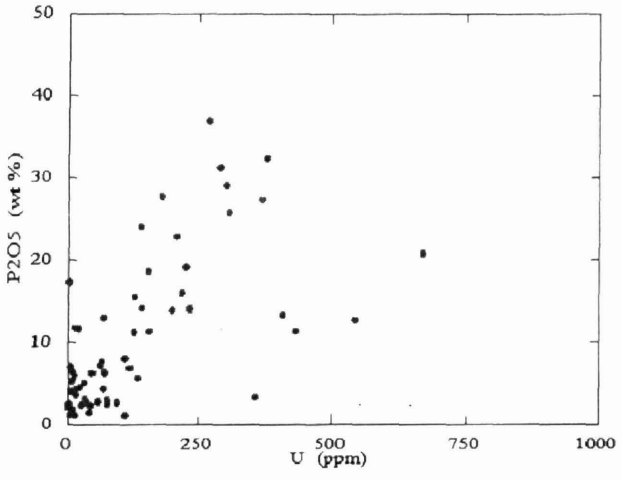

Fig.3. Binary plot of U vs. P_2O_5 of radioactive phosphatic ferruginous breccia samples of Baskati.

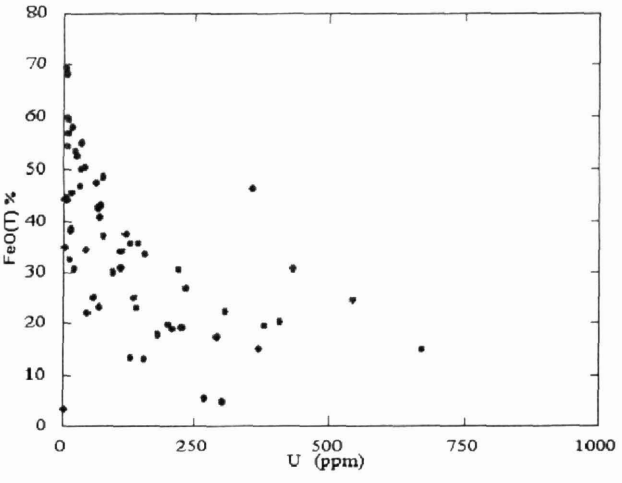

Fig.4. Binary plot of U vs. FeO(T) of radioactive phosphatic ferruginous breccia samples of Baskati.

and 36.87%; correspondingly their CaO ranges 1.54 to 40.10%. A binary plot of CaO vs P_2O_5 shows a strong positive correlation indicating the presence of apatite and collophane phases (Fig.2). A similar positive correlation is also exhibited by the U *vs.* Ca plot (Fig.5). Phosphatic ferruginous breccia in the area assayed between 3 ppm and 670 ppm U. A binary plot of U *vs.* P_2O_5 indicates a positive correlation (Fig. 3). This phenomenon is mainly due to replacement of U and Ca in apatite-collophane structure by double diadochy- U^{+4} replacing Ca^{+2} and $(CO_3)^{-2}$ replacing $(OH)^-$ or P_2O_5 to maintain charge balance. A plot of U *vs* FeO(T) shows their wide variation (Fig. 4). However, few samples analysed very high in both U and FeO(T), which may be due to adsorption of former element by iron oxide. In totality it appears that U is fixed both in apatite /collophane by double diadochy and in Fe by adsorption.

DISCUSSION AND CONCLUSIONS

In light of the present study it is concluded that Baskati uranium occurrence is confined to phosphatic ferruginous breccia emplaced along reactivated basement fracture in Lower Vindhyan sediments of Semri Group trending along ENE-WSW following structural grain of Son-Narmada mega rift zone. Anomalous radioactivity is observed in phosphatic ferruginous breccia for about 3.5 km from Baskati in the west to Paniha village in the east and samples have analysed uranium between 3 ppm and 670 ppm and P_2O_5 from 1.48 to 36.87%. Petromineralogical studies and geochemical data interpretations revealed that uranium mineralisation is closely associated with phosphatic phase and also possibly adsorbed in iron oxide. In totality it appears

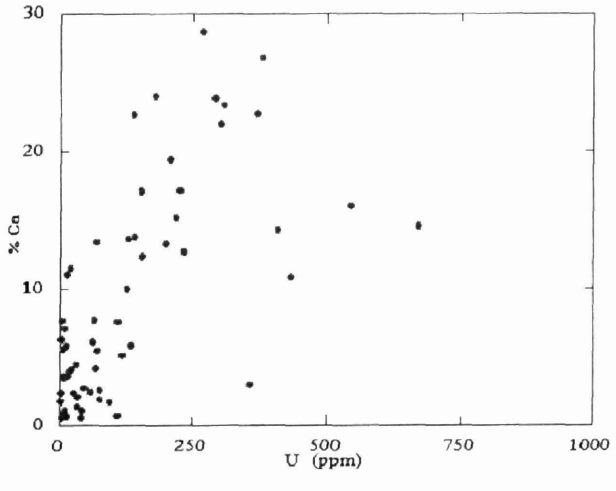

Fig.5. Binary plot of U vs. Ca of radioactive phosphatic ferruginous breccia samples of Baskati.

that U is fixed both in apatite/collophane by double diadochy and in Fe by adsorption

Occurrence of U in apatite /collophane by double diadochy and in Fe by adsorption, signifies that such associations along reactivated faults can be considered as future exploration targets for locating low grade large tonnage uranium deposit in this area

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ANNOUNCEMENT

TRAINING PROGRAMME ON MATHEMATICAL MODELLING OF GROUNDWATER FLOW AND MASS TRANSPORT

The above programme with DST-support is scheduled to take place during 12 11 2004 to 9 12 2004 at the School of Environmental Sciences, Jawaharlal Nehru University, New Delhi For further details, please contact Dr AL Ramanathan, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi-110 067 Email alr0400@mail jnu ac in and alr_jnu@yahoo co in, Phone· 91-11-26704314 (O)