VEIN TYPE URANIUM MINERALISATION IN JADUGUDA URANIUM DEPOSIT, SINGHBHUM, INDIA

By

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Abstract:

The Jaduguda uranium deposit lies in the Proterozoic metasediments of the Singhbhum Shear Zone (SZZ), a zone of intense and deep tectonisation in the eastern part of India. This shear zone is a site of acid and basic volcanism and hydrothermal metasomatic activity extending in arc shape over a length of 160 km. Rocks on both sides of the shear zone belong to two contrasting ages – Proterozoic rocks in the south (sediments, basic intrusives and batholithic Singhbhum granite) and Archean sediments in the north (a thick pile of metasediments). The rocks along the shear zone have undergone varying grade of metamorphism and also exhibit different level of chloritisation, biotitisation, sericitisation and feldspathisation. The shear zone hosts a number of copper and uranium deposits with associated nickel, molybdenum, bismuth, gold, silver, tellurium and selenium. There is a spatial relationship between uranium and base metal mineralisation. The major mineralized rocks of the shear zone are quartzites, brecciated conglomerates and quartz-chlorite-biotite-tourmaline-magnetite schists. Metamorphosed basic rocks (mostly represented by epidiorites and amphibolites) are devoid of mineralisation. Jaduguda uranium deposit lies almost in the center of the SSZ. Besides Jaduguda, several other uranium deposits are also located in this belt.

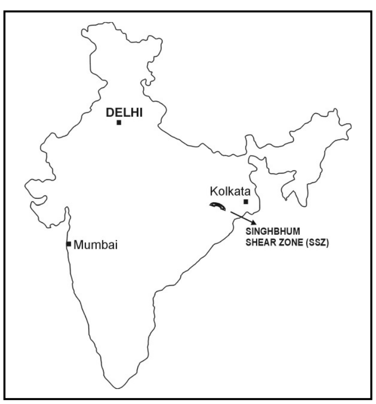

Fig. 1 (a) Map of India showing Singhbhum Shear Zone

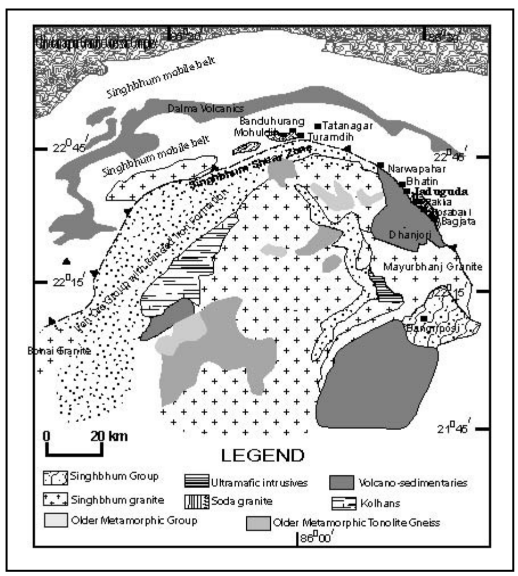

Fig. 1 (b) Simplified Geological map of Singhbhum Shear Zone and adjoining areas

At Jaduguda, the principal lithological units are autoclastic conglomerate (brecciated quartzite), quartz-chlorite-biotite-magnetite schist, biotite-chlorite schist and epidiorite of `which first two rock units host the mineralisation. Two mineable uranium lodes extend as thin veins from surface following the general trend of the schistosity with fairly uniform persistence both along strike (600m length) and dip (900m depth). The primary uranium minerals are uraninite and pitchblende and most common secondary uranium mineral is autunite. The uranium minerals are associated with a wide variety of sulphides of copper, nickel, cobalt, molybdenum, arsenic and bismuth. Some prominent ore minerals are magnetite, ilmenite, uraninite, rutile, chalcopyrite, pyrhotite, marcasite, mackinawite, violarite, tellurobismuthite, tetradymite, cubanite and molybdenite. Molybdenite veins are found in the ore zone along with strike-slip faults. A distinct Cu-Ni zone occurs just in the footwall side of uranium mineralisation. A few interbedded basic sills in the footwall side of mineralisation act as the marker horizons for orebody.

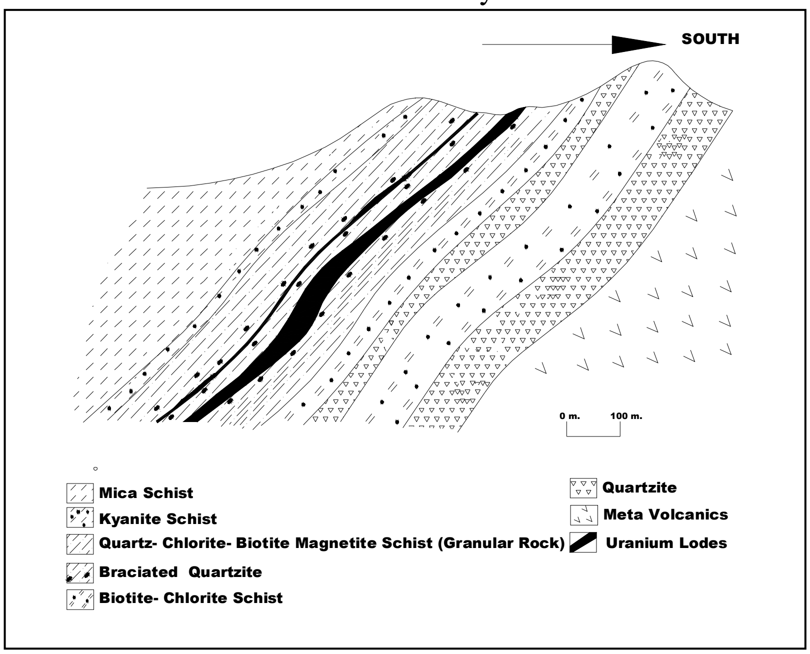

Fig. 2 Transverse section showing orebody and different litho-units around Jaduguda

The age of the uranium mineralisation at Jaduguda has been estimated to be between 1580-1480 Ma. The structural features (mainly schistosity) in the shear zone has played a dominant role in localizing the mineralisation along with some degree of lithological and geo-chemical controls.

Origin of uranium mineralisation at Jaduguda is considered with respect to the aspects of geochemical source of uranium and other ore elements, mode of transportation and deposition and remobilization, re-deposition and concentration into ore deposits.

The Singhbhum granite is believed to be the main geo-chemical provenance of uranium. It has been dated at 3000 - 2900 Ma and its origin has been attributed to the partial melting of a pre-existing granitic basemen. This thermal event has led to the rise of volatile constituents

and other granite forming elements towards the surface. Singhbhum granites, with average uranium content of about 7 ppm are generally foliated and lineated with inconspicuous contact with country rocks. Along the margin, amhipolite bodies are biotitised. Inclusions of quartzite and quartz-schist within the granite contain varying proportions of feldspar porphyroblasts. Petrographically these granites consist of quartz, K-feldspars, albite and perthite. Biotite and hornblende are the common accessories with some minor muscovite, sphene, magnetite, apatite etc.
The base metal mineralisation around the area is largely attributed to volcanism. Two distinct stages of volcanism have been suggested in this area.

The weathering of Singhbum granite started before (during ?) lower Proterozoic period (non-availability of oxygen) and the sediments derived from this granitic craton led to the syngenetic deposition of detrital uranium (tetravalent stage) forming a thick pile of sediments dipping towards north. Along with the cratonic margin of Singhbhum granite, basic rocks (now represented as chlorite schists and epidiorites) were also emplaced forming interlayered volcanic-sedimentary rocks. With gradual availability of oxygen in the atmosphere, detrital uranium was solubilised (hexavalent state), transported into solution through favorable pathways and precipitated where in contact with reductants.
The Singhbhum orogenic cycle (2000 Ma), which is represented by regional metamorphism, emplacement of basic rocks, tectonic activities like shearing etc. helped in concentration of uranium in favourable structural and / or stratigraphic locations. During metamorphism, connate water has helped in uranium remobilization. Emplacement of basic rocks have supplied heat to enrich the circulating water with uranium, introduced sulphides (Cu, Ni etc) and provided the geo-chemical control for uranium deposition in their vicinity. The tectonic activity like shearing and post-shearing folding has helped in continued remobilization and concentration of uranium minerals in structural traps.
The strike slip shears of post mineralized phase are found mineralized with molybdenum. The vein molybdenite, in such structural traps may result from the remobilization at a late stage of disseminated molybdenite.

Some of the similarities of Jaduguda uranium deposit with other vein type uranium deposits of the world are a) time bound character, b) origin attributed to the Lower Proterozoic sediments and c) concentration during oxygenated post 2000 Ma period.

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URANIUM CORPORATION OF INDIA LTD.
JADUGUDA

Dt. 15 May 2006

International Association on the Genesis of Ore Deposits (IAGOD) is organizing a symposium on "**Understanding the genesis of ore deposits to meet the demands of 21st Century**" during 21st – 24th Aug '06. One of the sub areas of the symposium is "**Traditional and new types of uranium deposits**". E-mailed copy of the information to C&MD, UCIL is enclosed. The organizers have been inviting the ABSTRACTS of the paper to be submitted by 20th May '06.

In this regard a paper on "**Vein type uranium mineralisation in Jaduguda uranium deposit, Singhbhum, India**" is being prepared by the undersigned and Sri A. S. Singh, Asstt. Supdt. (Geology). The abstract of the paper has already been finalized to be forwarded to the organsier. The copy of the abstract is enclosed.

Chairman & Managing Director may kindly approve the above following which the abstract of the paper will be forwarded to the organizer of 12th IAGOD Symposium, Moscow.

(A. K. SARANGI)
Chief Supdt. (Geology)

Through: ***Executive Director (Mines)***

Chairman & Managing Director