## Abstract

The Singhbhum shear zone is an arcuate belt in the state of Bihar. It has significant deposits of copper and uranium associated with magnetite, apatite, molybdenum, gold and silver. The present area of study was south-eastern part of Singhbhum shear zone. Detailed and reliable geostatistical modeling has been undertaken in the present study, in the south-eastern part of the Singhbhum Shear Zone with special emphasis on Pathargora and Kendadih mines. This was aimed at geostatistical evaluation of copper ore body and fixing exploration strategy and targets of copper and uranium with the help of the large copper and uranium data available. Some preliminary work had been reported earlier on the geostatistical modeling on ore bodies in the Singhbhum shear zone. The significant features of the present geostatistical work are as follows:

(i) The present work is the first reported study for the Pathargora and Kendadih Copper Mines.

(ii) Extensive and closely spaced data has been used for ore body modeling.

(iii) The parameters chosen for modeling has been cross-validated with the actual data.

Unlike other reported work from the belt, the present work has focused on detail geostatistical study of two of the copper deposits of Singhbhum Cu – U belt. The work has been done in the following way:

1. An extensive database of thickness and accumulation of copper mineralisation with precise survey coordinates have been prepared.

2. On the basis of surveyed measurements, partial unfolding of the orebody has been done. On the unfolded orebody, geostatistical study is conducted.

3. Classical statistical study of thickness and accumulation for different orebodies of Pathargora and Kendadih deposits has been made.

4. Experimental semivariograms are constructed for thickness and accumulation in four principal directions namely, $0^0$, $45^0$, $90^0$, and $135^0$ in the Pathargora and Kendadih mines. The experimental semivariograms were graphically modeled and the different parameters, nugget effect, continuity and range are obtained.

5. Both in Pathargora and Kendadih mines, geometric anisotropy is found to be present. With the parameters obtained from graphically modeled experimenal semivariograms anisotropy ellipses are constructed. In case of Parthargora mine it is found that for both thickness and accumulation, range is around 1.5 times more in dip direction than in strike direction i.e. the anisotropy ratio is 1.5. The major axis of anisotropy lies approximately towards dip direction. In Kendadih mine we observe that strong anisotropy is present for thickness and accumulation. The a-isotropy ratio is 4 for thickness and around 15 for accumulation.

6. With the obtained parameters point kriging cross validation technique is applied for refinement of the variogram parameters. By doing so, we could obtain relible semivariogram models.

7. Two dimensional block kriging on Pathargora, Kendadih deposits for thickness and accumulation have been done to develop reliable ore inventory.

Precise and extensive radiometric prospecting using a portable GM counter and laboratory assaying using a gamma-ray spectrometer has been undertaken in and around the copper-uranium ore bodies at Mosabani, Surda, Pathargora and Rakha. The data obtained were from surface as well as sub-surface regions as within mines. Iso-rad map on the surface data has been used to delineate uranium mineralisation in the central part of the shear zone. The results obtained indicate that the variation in U/Th and K/U ratios inside the mine could be a reliable indicator of sub-surface uranium mineralisation in this region. Geostatistical modeling on the in-situ radiometric data obtained was helpful in understanding the distribution of uranium minerals. More extensive and precise radiometric measurements using a gamma-ray spectrometer would be useful for reliable resource evaluation and devising a suitable exploration strategy for future nuclear prospecting in this region. In addition radon emanation from various rocks and soils in this region has also been done. The present work was aimed at delineating the natural radiation environment including the mine environment and for devising a suitable exploration strategy for further uranium exploration in the shear zone. The significant aspects of the present work are:

(i) Significant uranium concentrations (20-200 ppm) have been observed in Rakha, Mosabani and Pathargora. Some of these deposits could be beneficiated and put to economic use. The surface and subsurface radiometric data carried out in such an extensive manner would be useful for exploring high grade ores of uranium specially in the central and eastern part of the Shear zone.

(ii) The mining environment in deeper mines like Mosabani specifically these asssociated with substantial uranium should be properly ventilated for removal of radon and its progeny.

(iii) More closely spaced (~5m interval ) radiometric and radon emanometric measurements should be undertaken in the shear zone for a reliable resource evaluation of the uranium and the associated copper in the deposits from the shear zone.