Abstract

The present research work has evolved from Near Surface Geophysical applications, for the exploration of shallow subsurface uranium deposit around South Purulia Shear Zone (SPSZ). The research work was aimed at providing a better interpretation of the VLF data and to define an improved strategy for exploration of shallow subsurface uranium mineralization using non-invasive, non-destructive and relatively inexpensive methods. This study presents the integration of VLF-EM method, which is capable of delineating isolated and regular conducting features, with radiometric studies that can yield background radioactivity contrast, for the exploration of uranium mineralization. This work demonstrates the effectiveness of the integration of the radiometric and VLF-EM methods, to delineate the zones containing radioactive ore bodies with an added advantage of having simple modus operandi and rapid measurements as compared to other routine methods employed for such exploration. The thesis presents improvement in the VLF data interpretation techniques by identifying the problem in the apparent current density using Karous-Hjelt filtering technique and development of analytical expression to compute magnetic field from the actual current density distribution, which has resulted in better subsurface imaging. The new approach provides better result than the existing Karous-Hjelt filtering. This thesis also presents the 3D modeling and inversion of VLF and VLF-R data, developed to delineate the geometry and resistivity distribution within the subsurface layers. The thesis includes the results of VLF and Gradient Resistivity Profiling survey around Beldih, to extract subsurface information like the presence of multiple mineralized bodies in the region, their geometry and direction of strike. Subsequent, radiometric studies and analysis of the soil and rock samples using HPGe detector were undertaken for estimation of uranium and thorium content. These studies represent the first ever estimates of uranium and thorium content in SPSZ, therefore, they also serve as baseline data for further NORM and TENORM studies. This study also reflects the variation in the concentration of radionuclides in rock and soil samples with respect to its location from the shear zone and suggests that intensity of shearing controls the activity of radionuclides, apart from other geological processes like alteration, metamorphism, and weathering.

Keywords: *3D modeling and inversion, subsurface imaging, VLF and radiometric methods, current density imaging, uranium investigation, SPSZ.*