Abstract

An efficient inversion approach has been developed using Very Fast Simulated Annealing (VFSA) global optimization for interpretation of Self-Potential (SP) anomaly measured over spherical, cylindrical and sheet-type subsurface structures. Since VFSA optimization yields a large number of good-fitting models in a vast multi-dimensional model space, the ambiguity in the interpretation is also investigated simultaneously. Optimization of model parameters of 3-D idealized bodies (sphere and cylinder) shows that shape factor plays an important role in interpretation. The study demonstrates that interpreted model is highly ambiguous when all model parameters are optimized; however, reliable results are obtained with fixed shape factor. Optimization of model parameters of thin sheet-type structure reveals a bi-model ambiguity. However, different natures of ambiguities are obtained using alternative forward formulations for thin sheet-type structure. Analysis of forward response due to closely spaced multiple thin sheet-type structure shows that depth to the top and separation play an important role in the resolution. Further, it is observed that the potential gradient measurement is better to resolve closely spaced structures than the potential difference measurement. Optimization of model parameters of thick sheet-type structure shows that the depth to the top and lengths of the negative and positive poles show ambiguities. Inversion results of synthetic (noise-free and noisy) data generated from various standard geometrical structures as well as various field data (published literature) have been presented to demonstrate the efficacy of the developed approach. In this study, for the first time, large magnitude SP anomalies have been investigated around South Purulia Shear Zone (SPSZ) and interpreted using multiple thick sheet-type structure. Interpretation of data suggests a number of thick sheet-type structures in a broad low anomaly zone across SPSZ that elicit the subsurface structure and possible source associated with hydro uranium anomaly in the study area. Other geophysical data such as Resistivity, Very Low Frequency electromagnetic, Gravity and Radiometric correlate well with SP data interpretation. Finally, the study suggests that there are multiple thick sheet-type structures across SPSZ which could be associated with uranium mineralization in the study area. Deep drilling (300m) at an appropriate location could confirm the nature of anomalous structure present in the area.

Keywords: *Self-Potential*; *Interpretation*; *Ambiguity*; global optimization; *South Purulia Shear Zone*; *Uranium mineralization*.