

ABSTRACT

The thin section petrographic studies of sheared, uranium bearing metasedimentary rocks from parts of Singhbhum shear zone, eastern India have shown characteristic optical dislocation features in the major mineral constituent, quartz. The radiometric contour mapping supports the wide distribution and occurrence of mostly uranium and its daughter radionuclides in parts of the shear zone including in the zones of weathering and soil formation. Large-scale iron rich solution formation along the grain boundaries in thin sections and wall rock alteration along copper rich zones associated with uranium are the important laboratory and field investigations that emphasise moderate to extensive oxidation in the region.

The low SiO_2 , high Fe_2O_3 (tot) with very low CaO and Na_2O are the major geochemical dissimilarities for the metasedimentary rocks of the study region compared to the other regions of global origin. The high total iron content is in fact supports the oxidation at the surface level among the chlorite-muscovite-quartz-schists. The fragile nature and clay formation along the schistose planes is exhibitivite of alteration for surface exposed rocks. The Pelite index calculated has large variation among low-grade metamorphosed schists of the study region but the average values are close to Chitaldurg metasedimentary rocks of Dharwar craton. Moderate to high degree of weathering has been proposed to the metasedimentary rocks based upon Chemical Index of Alteration values calculated considering 'total CaO ' content. The $\text{Al}_2\text{O}_3 - \text{CaO} + \text{Na}_2\text{O} + \text{K}_2\text{O} - \text{Fe}_2\text{O}_3$ (tot) + MgO (A-CN-K-FM) ternary plot is validated indication for the compositional similarity between the schists of study region and shales of Whim Creek Group, Australia.

The positive relationship between uranium and total iron may be implicative of secondary uranium formation in the study region in association with possibly secondary iron. The potassic metasomatism is also supportive of uranium enrichment among schistose rocks.

Use of natural uranium rich equilibrium standard in extended form for calibrating as well as for the efficiency determination of low energy HPGe (High Purity Germanium) photon detector is innovative, reliable can be repeatable being non-destructive in methodology. Activity measurements for uranium series γ -emitting daughter radionuclides from the natural samples using long counting methods are proved to be substantially reliable. Natural standards with low activity would also be helpful in limiting the required

protocols applicable to the university laboratories in dealing with strong artificial radioactive sources. The uranium series daughter to parent activity ratios measured from the possible γ -emitting daughter radionuclides at approximately 90% of confidence level is to understand basic equilibrium-disequilibrium conditions for the uranium host rocks exposed at the surface. The natural oxidation and weathering processes have a definite role on the disequilibrium studies as found in the present studies based upon γ -activity ratios. The soils associated with phyllites and chlorite – quartz schists are receptive for unsupported ^{210}Pb (atmospheric origin) content leading to high ^{210}Pb to ^{234}Th and /or ^{210}Pb to ^{214}Pb activity ratios among soils.

The positive correlation between uranium and lead determined geochemically, has also confirmed a similar positive correlation between radiometrically determined ^{210}Pb to the lead determined using XRF. These notable positive relationships have to be further investigated on the time of formation of stable lead in parts of the study region where reported age of the uranium mineralisation was ~ 1600 m.y. ago.

Indoor radon investigations carried out for more than one year comprising of four quarters in the populated regions of Singhbhum shear zone is part of all India indoor radon mapping program that can be globally inter-calibrated. These studies are the first attempts made to bring awareness among the uneducated, socially and economically backward human settlements of the region on the advantages of introducing better and improved ventilation measures in the dwellings to avoid any health complications from the presence of radon in their ambient environment. Radon potential mapping of the study region based upon averaged annual indoor radon levels is a better representation by limiting natural, meteorological parameters that influence presence of radon in the ambient atmosphere.