REE Studies using Mineralogy, Petrography and Multitechniques Approach in and around EDC – P.V. Sunder Raju, CSIR-National Geophysical Research Institute, Hyderabad, Telangana - 500 007

The assessment of REE (rare earth elements) and rare-metal potential and geochemical characterization, with implications for metallogeny, is currently underway at alkaline syenite complexes in Andhra Pradesh. The alkaline complexes are located to the west and southwest of the Paleoproterozoic Cuddapah basin in the Ananthapur district. Several alkaline plutons ± nepheline syenite earlier reported by the Geological Survey of India were relooked for REE bearing minerals and their REE contents using the state of art techniques and multi-techniques approach to resolve the complex mineralogy of Rare Earth Elements (REEs), Around Dancherla, Peddavdaguru, Danduvaripalle, Reddypallae, Chintalchervu areas and Pulikonda complex in Chittoor district of Andhra Pradesh. The main Dancherla syenite body is oval-shaped and has a total area at the current level of exposure of around 18 km². A total of 300 samples were subjected to further geochemical studies and to understand the potential of REE mineralization. The REE mineral phases present as clusters and single entity individual grains viz., apatites, zircon, sphene, titanite and opaques. The SEM studies at higher magnification 10000x reveal clearly REE phases of the mineral allanite La, Ce, Y (Ce,Ca,Y)₂(Al,Fe)₃(SiO₄)₃(OH) belonging to epidote group with inclusions of bright circular-semi-circular or sub-rounded grains of U-Th (patches) by energy dispersive spectra (EDS). Some representative samples were also studied taking the results obtained from whole rock geochemistry obtained from ICPMS, followed by REE contents by Energy Dispersive X Ray fluorescence (EDXRF), Individual mineral analysis using EPMA-EDS, SEM-EDS and subjected to XRD studies. The major element data confirm syenite chemistry as silica under saturated SiO₂ contents of ~40-50% with Al₂O₃ ~10-15% and <10 % FeO (t) respectively and with enriched Zr (260ppm) and appreciable amounts of 20 ppm Nb, Ta, Y and Hf respectively. The total (ΣREE) is >2.01%, ΣLREE (2%) and ΣHREE (0.1%). The size of the Peddavdaguru (PVD) syenite bodies range from 2 km X 100 m between latitude 77°39'30" - 77°39'34" and Long 15°00'38"-15°08'15". The PVD is dyke like body cross cutting with strike N20°E -S30°W to N35°E-S40°W. The REE mineral

phases include apatites, zircon, sphene, titanite, opaques, allanite and fluorite. The major element data confirm with silica understaturated SiO₂ (wt%) contents of ~59.3 %, Al₂O₃ ~15% and <10 % FeO (t) and K₂O + Al₂O₃ ~5% respectively and with enriched Zr >7% and appreciable amounts of 200 ppm Nb, Ta, Y ~600 ppm and Hf ~320 ppm respectively. The total ΣREE is >2.01%, ΣLREE (2%) and ΣHREE 850 ppm. The rock/chondrite normalized REE - REE(n) pattern show enriched LREE with positive europium anomaly and flat HREE. The syenite body in Reddypallae (RDP) is small plug like circular trending in N-S direction with 100 x 100 m occurring at Lat. 78°00'54" – 78°00'58" and Long. 14°12'03" -14°12'04". Reddypallae syenite is a small oval shaped body emplaced into AFGS suite and emplaced along western sheared contact zone of the Kadiri schist belt. The major element chemistry studied for 200 samples (average) show SiO₂ 63.5%, Al₂O₃ 16 wt% and K₂O+Na₂O >1%. The total ΣREE is 5765 ppm, ΣLREE 4500) and ΣHREE 1265ppm. The syenite body in Danduvaripalle (DNP) is oval shaped small plug like trending in NNW-SSW direction with 500x1km occurring at Lat 77°41'36" -77°42'08" and Long 14°38'15"-14°38'20". The major element chemistry studied for 200 samples (average) show SiO₂ 55%, Al₂O₃ 12 wt % and K₂O+Na₂O >5%. The total ΣREE is 2700 ppm, ΣLREE 2400 and ΣHREE 220 ppm.

Mineralogy of REE Mineral Phases

The major REE mineral phases identified were allanite, cerite, thorite, columbite, tantalite, apatite, zircon, monazite, pyrochlore, euxenite, fluorite, etc... The metamict zircon of varying shapes (hexagonal, amebodoial, rounded, sub-rounded and unzoned zircons were observed from Reddypallae and Peddavdaguru. The columbite-tantalite are rounded to sub-rounded grains. The monazite grains show high order pleochroism colours with radial cracks within the grains suggestive of the presence of radioactive elements breaking to daughter and some grains show perfect oscillatory zoning without any perfect grain shape and sizes, they also present as discrete grains and at grain boundaries along the silicate phases.

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