ABSTRACT

The thesis embodies the results of detailed investigation carried out on the apatite mineralization of the area around Beldih (Lat.23°02' 45"N; Long. 86°18' E) in Purulia District of West Bengal, India which is a part of Northern shear zone of Satpura Orogeny.

The polymetamorphic sequence of this area consists of phyllites, mica-schists, ortho-quartzites, amphibolites, granites, gneisses, calc-silicates and migmatites. Diastrophic structures have been recognized in this area. Structural analyses on macroscopic and microscopic scales reveal that the area had undergone two generations of major deformations. The first generation had resulted in tight isoclinal folds (F_1) on bedding (S_o) with the development of axial plane schistosity (S_1). During the second generation, steeply plunging open folds (F_2) with subvertical axial plane had been developed. During this stage, initial schistosity (S_1) had been puckered and crenulation cleavage (S_2) had formed. This is followed by the development of kink bands (S_3) and conjugate folds which may be related to F_3 folds of restricted nature. Different types of lineations, joints, faults and shear zone have been recorded and an attempt has been made to find out the relationship of these structures with apatite mineralization. The major episode of metamorphism is of regional type ranging from greenschist to amphibolite facies which is followed by syn- to late- kinematic (with reference to F_1 deformation) in-situ granitization. The detailed petrographic study shows that the mylonitization is related to the occurrence of tectonic slice demarcating the closing phase of F_2 deformation.

IRS 1A LISS II satellite data of the area has been studied to delineate lineaments as well as the drainage pattern of the area. The extensive straight line feature coinciding with the Northern shear zone or Beldih-Kutni shear zone, and a few small arcuate features coinciding with the Jhalda shear zone in the north-west of the study area are distinctly observed in the digitally processed satellite data of the area. The drainage pattern in the study area is dendritic except along the Northern shear zone.

The mineralization is mainly controlled by lithology and structure. On the basis of structure, petrography and REE (rare earth elements) geochemistry studies, the hydrothermal origin of apatite ore is inferred. It is presumed that the apatite rich solution upwelled through the zones of weaknesses, namely, shear zone, fractures etc. in the phyllites, and precipitated to form deposit of workable grade. The mineralization is, in general, syn- to late- kinematic with reference to F_2 deformation.

Chemical analyses of the apatite ore and mineral separate with wet chemical, energy dispersive X-ray analysis (EDXA), atomic emission spectrograph (AES) and hyphenated inductively coupled plasma (ICP) - AES methods indicate that the ore from the study area contains high proportion of oxides of silicon and iron with wide variation of P_2O_5 content. The presence of considerable proportion of

ne trace elements and rare earths, namely, Sr, Ba, Nb, Zr, W, Sb, V, La, Ce and Nd is worth mentioning. In case of apatite mineral)arates of the area, it is found that they have typically high ιorine and strontium content, while SiO_2, Al_2O_3, TiO_2, Fe_2O_3, FeO,), MgO, Na_2O and K_2O are considerably low.

The mineralogies of the apatite ore, apatite mineral)arate, and other rock types from the study area have been :ermined with the help of microscope, X-ray diffraction (XRD), :ra-red spectroscope (IRS) and scanning electron microscope (SEM). ι apatite mineral is of mixed composition with fluorapatite struc- ·e. It may be explained as due to replacement of F^- by OH^- in fluo-)atite lattice. Quartz, chert, magnetite, hematite (martitised), :thite and ilmenite are the associated minerals. In addition to :se, the presence of muscovite, vermiculite, kyanite, biotite, .tmorillonite, uranocircite, torbernite, tyuyamunite and uraninite ·e also been observed.

Computer based grade characteristic studies of correla- n, regression and trend surface analyses have been carried out with help of available bore-hole data. The studies show, in general, k in depth persistency of P_2O_5 content of the ore. Trend surface s reveal a wide variation in the distribution pattern of P_2O_5 tent and of band thicknesses of apatite ore in the investigated a. The above study has aided in grade prediction and for further loration and exploitation of the apatite deposits of the area.

The apatite ore of the investigated area has been treated different upgradation techniques to remove silica and iron in order nake it suitable for fertilizer industry. The ore is found to be nable to upgradation, as good grade concentrate with high recovery P_2O_5 has been obtained.