INTRODUCTION

In the introductory chapter, the main scope and objectives of the study along with the general description of study, History and formation of the graphite, the belt study which includes khondallite suites of rocks in association with various parent rocks details are presented.

1.1 GENERAL DESCRIPTION ABOUT GRAPHITE:

Graphite a soft, allotropic crystalline form of carbon and grey to black, opaque, and has a metallic luster, polymorphous form of carbon occurs in different areas.

Graphite occurs in two forms: Natural graphite which includes (a) crystalline and (b) amorphous varieties, and artificial/manufactured graphite. The inherent qualities of graphite, for which it is so much in demand in the manufacturing industries, are its high lubricity, refractoriness or ability to withstand high temperature, good electrical and heat conductivity, and resistance to reaction with ordinary chemical reagents. Thus, flaky graphite is used in the manufacture of crucibles for melting metals. It is also used in the manufacture of lead pencil, batteries, lubricants and brushes. It is also used in atomic reactors. The commercial graphite is graded mainly on its carbon content. Graphite can develop by four different geological processes: regional metamorphism and contact metamorphism; crystallization in igneous rocks, such as in basalts and nepheline syenites, and through hydrothermal solutions from deep-seated magma, such as vein graphite in pegmatites. The Majority of graphite deposits form by the metamorphism (both contact and regional) of sedimentary carbonaceous matter, such as, those present in black shales. It is flexible, but not elastic. Graphite occurs naturally in
metamorphic rocks such as marble, schist, and gneiss. It exhibits the properties of a metal and a nonmetal, which makes it suitable for many industrial applications. The metallic properties include thermal and electrical conductivity. The non-metallic properties include inertness, high thermal resistance, and lubricity. Some of the major end uses of graphite are in high-temperature lubricants, brushes for electrical motors, friction materials, battery and fuel cells.

Graphite is important for one or more combination of properties like high lubricity, low coefficient of thermal expansion, good electrical, heat conductivity and flexibility over a wide temperature range, chemically inert, non-toxic and generally not wetted by metals.

The major graphite producing Indian states are Andhra Pradesh, Orissa, Bihar, Rajasthan, Gujarat and Tamilnadu. Indian graphite deposits usually occur in garnet-sillimanite-muscovite gneisses of the Khondalite group.

In Andhra Pradesh Graphite occurs in khondalites of East Godavari district of the Easternghat belt. Graphite is reported in the form of irregular lenses and pockets and rarely as veins of varying thickness. In Visakhapatnam district graphite occurs in the form of irregular veins and as highly disseminated material in an area called Marupalli. Krishna and west Godavari districts also have graphite occurrences. It poses an interesting complex problem as it contains study contains a wide variety of rock formations exhibiting complex structural and mineralogical features. This is not exhaustive study on graphite and associated mineral deposits from Easternghats with special emphasis on their origin, geochemistry and processing.
The present study is mainly on Trace Element Geochemistry in the Exploration and Processing of Low Grade Graphite Ore from Easternghat's, India. An attempt has been made to reconstruct the possible environment of graphite mineralization and the post depositional environment. To evaluate the genesis and economic aspects, this study helps to establish the degree of correspondence and mutual relationship between major and minor elements in the ores and associated rocks.

Origin of graphite with parent khondallite suite of rocks of various palaeo environmental incident showed a quantitative study of major, minor, trace elements (Li, Rb, Cs, Cu, Ag, Be, Sr, Ba, Zn, Cd, B, Ga, Ti, Sc, Y, Th, U, Sn, Pb, Zr, Hf, As, Sb, Bi, V, Nb, Ta, Sc, Te, Mo, W, Cr, Co and Ni) both in graphite ores and the associated rocks were also made to study the response of the parent or host rock and the mineralization geographical regions to varying geochemical controls under which the deposition of graphite minerals took place.

To check the grades of graphite ores and their genesis, physical and chemical properties, field characteristics like structural study of the deposits and the associated rocks were investigated. The chemical analysis data of the graphite ores and the associated rocks have also been used to study the behavior of the elements between the graphite ores and associated rocks.

Based on texture, structure, grade of carbon and topography, structural features, age etc., the concentrations of graphite source availability is directly proportional to (fine to high grained) texture of the formation. Low concentration of graphite observed while the fine grained texture in oldest archean formations, medium concentrations of graphite is observed in very coarse grained texture in youngest archean formation. High concentration of graphite is observing highly coarse grained texture of youngest Archean
formation. Oldest formations are showing low to medium concentration of graphite and youngest formations are showing medium to high concentration of graphite. In this way the age of formation and texture of the formation are playing major control over resources of graphite mineral concentration.

At the same time the topographical impact on graphite resource availability is as follows. Altitude of the study area is indirectly proportional to availability of resources of graphite. High altitude, Low temperature, fine grained texture oldest formations are showing low resources. Plain, moderate temperature, medium coarse grained texture, youngest formation showing high resource availability. Structural activity is playing major impact on graphite resources availability. Lesser the structural deformation, fine grained texture in oldest formation at high altitude is showing low resources availability. High structural deformation, medium to coarse grained texture at high altitudes and plain are showing medium and high resource availability. It seems tectonically highly disturbed area with medium coarse grained texture at plain areas and at places high altitude with youngest Archean formation is highly resources available areas in the study area. Based on the above observation the tectonic activity on concentration of graphite resource availability is directly proportional to increasing in tectonic activity and increasing in resource availability.

Based on the history and characterization of graphite the area has been selected for detailed study to achieve the objectives mention in above.

1.2 HISTORY OF THE GRAPHITE

Easternghat Mobile Belt includes Khondalites, calc-granulites, leptynites, charnockites, quartzites, pegmatites, migmatites and intrusive rocks. In the Easternghat Mobile Belt (EGMB) the following varieties have
been identified on the basis of their mode of occurrence and association of graphite bearing litho units.

Graphite enrichment along local shear locations. Graphite flakes associated with Khondalites, Quartzites, Calc-granulites and charnockites. Sporadic concentrations associated with granitoids and migmatites. As veins, coarse flakes, pods and lenses are associated with metapelites and pegmatites.

The metasedimentary litho units of Easternghat Mobile Belt (EGMB) are mostly intruded by pegmatites where small narrow deposits of minerals, long narrow cases and pockets of graphite occur. At some places, consisting of large particles assemblage of graphite in the middle portion of the pegmatite (width is ranges from 10cms to 2mts) with random position in relation to the points of the direction. Smaller sized flakes are arranged parallel to the contact geographical region of pegmatite with the large number of metapelites. In Kondamusuru, Burugubanda, Tapaskonda areas, the narrow deposits of graphite observed along the contact of pegmatite bodies. The graphite spreads widely within the garnet sillimanite gneisses as a uniform distribution and higher concentrations are present only in contact with cross cutting pegmatites / quartz deposits. Graphite flakes positions parallel to the foliation plane of the country rocks. The graphite veins are narrow, long, irregular and commonly pinch out and terminate instantly. Graphite flakes associated with calc-granulites (Jeediguppa), charnockites (Shivalingapuram) mostly occur as disseminations having gradational contacts in between them. Graphite schists follow the foliation of migmatised khondallite, calc-granulite and are also confined to the foliation margin controlled quartzofeldspathic pegmatites.
The graphite schists having sharp contacts between pigmatites and country rocks. The graphite schists/ gneisses are structurally controlled by foliation planes and fold hinges which have enormous lodes of graphite. Small disseminated flakes of graphite oriented parallel to gneissosity or occupying grain boundaries of silicate minerals are observed in the Khondalite suite of rocks. The size of an individual flake ranges from 1mm to 3cms length and 0.2 to 0.5mm thickness. The disseminations are more prevalent in garnet silliminite gneisses than in the garnet biotite gneisses. Graphite flake size increases in the silliminite gneisses than in the garnet biotite gneisses. Graphite flake size increases in the migmatised portions of the khondallites which are mostly in association with felsic portions of the rock. Graphite sometimes occurs along the narrow shear geographical regions which are mesoscopic having an average width of 2 to 10cms with very irregular spatial distribution. Graphite in shears mostly occurs as a closely packed coarse elongated flakes, which are oriented perpendicular to the shear plane boundaries and occurs as interlocking aggregates. Masses of coarse graphites, rossets of radiating plates also occur in some cases. Most of these shear geographical regions infilled graphites are hosted by khondalites and leptynites. At the contact of garnetiferous granites (leptynites) and khondalites, the graphite concentration increases up to 5-10%. Pure graphite also occurs as veins, lenses, pockets occupying fissures and cracks in the crystalline rocks. The graphite occurrence in the migmatised rocks is confined to neosome rich locations. The graphite schists may grade into veins which are having distinct boundaries with the country rocks.

Most of the graphite lodes are lenticular showing pinch and swell structures. These are much more regularly shaped than the veins, many of which show intricate branching and discordant as well as interlinked vein patterns in migmatised khondalite suite of metasedimentary rocks.
In the host rocks graphite is in black to ash grey colour and occurs as linear conformable bands, thin lenses, pockets and stringers. Features of mobilization in the form of cross cutting veins and fracture fillings in geographical regions affected by the quartzofeldspathic injections. Quartz, feldspar, sillimanite and garnet are the linear bands that generally exhibit gneissic texture in the gangue minerals. When the graphite percentage increases with proportionate reduction in feldspars, it exhibits schistose fabric. The graphite content varies from region to region.

The graphite mineral occurs as a small and typical augen shaped clusters along with similar shaped feldspars in highly migmatised geographical regions. In geographical regions intruded by quartz and quartzofeldspathic pegmatite veins, graphite occurs as lenses, pockets and veins of coarse flaky variety. Stringers and disseminations in the vein quartz are common. The occurrence, lithological association, nature of graphite deposits from the study areas.

1.3 FORMATION OF THE GRAPHITE:

Graphite deposits in Vizianagarm, graphite gneisses/schists generally occur along the khondalite, quartzite contacts and occasionally at pegmatitic contacts. In Khondamosuru area, the flaky graphite occurs in the khondalite-pegmatitic contact. Here, the graphite schists showing foliated and layered encrustations of pegmatitic material, smoky quartz, within the foliated graphite layers. Highly folded puckers with alternating layers of graphite, manganese, quartzofeldspathic materials together enclosed within the khondalite is a characteristic feature observed from this geographical region. At Marupalle, the folded limb of khondalite hill looks like a synclinal ridge folding with graphite on the leap side. The fixed carbon in this geographical region varies from 3-45% F.C. The graphite is flaky or amorphous variety.
Graphite deposits in Visakhapatnam, graphite bearing Khondalite intercalations within the quartzite bands extending for more than 400 to 500mts. before finally pinching off. Near Pydipala prismatic graphite tablets in association with feldspar are together enclosed with the graphite schists. Micro fold layers of quartz and graphite veins were also observed. At Shivalingapuram graphite occurs within the charnockite - quartzite contact.

Graphite deposits in East Godhavari, the graphite gneisses/ schists occur as lit-par-lit veins traversed by quartz rich pigmatites and also as steeply dipping lensoid bodies within the charnockites. These gneisses occur as two distinct east-west trending lensoid bodies each about 180mts in strike length. These are disposed in dextral enechelon pattern and separated from each other by a stretch of soil covered ground. The strike of foliation of these gneisses is in E-W direction which swings to NW-SE in the eastern part of the lens with steep dips towards south. In the Burugubanda mines graphite occurs in association with large porphyrite pink feldspars, porphyritic crystals of tungsten minerals expressing acicular needle like forms. Lensoidel bands of graphite, pegmatite, wolframite in micro fold forms and also exhibits stress fractures, foliated layers, augen boudins of tungsten group of minerals observed within the graphite layered complex of Burugubanda mines. Folded limbs of feldspathic pegmatites occur within the lensoidel bands of graphites. Chalcopyrite and associated secondary sulphide group of minerals occur in association with graphite- tungsten deposits from Burugubanda area.

At Utla quartzofeldspathic resistant and non-resistant gneissic materials holds thin layers of graphite flakes. In this geographical region at Utla and Burugubanda nodular tungsten suggests occurs with their original foliation layers. In the Tapaskonda quarries graphite show cross cutting parallel layers of unweathered sheared and locally faulted pegmatitic veins. Graphite gneisses of this geographical region are the host rock for tungsten
mineralization. At Burugubanda, the graphite quarries expressing multiple layers of graphite and tungsten minerals embedded vertically in the pegmatite crosscutting shear planes. Graphite deposits in Khammam occur as lenses and beds in the garnet sillimanite gneisses with crosscutting pegmatites and quartz veins across the foliation.

1.4 IMPURITIES PRESENT FROM THE EASTERN GHAT MOBILE BELT

1.4.1 THE KHONDALITE GROUP OF ROCKS:

Khondalites (garnet sillimanite graphite gneiss) are the dominant rock types in the study area, occurring as strike ridges, individual hills and mounds. They are widely varied in colour, texture and composition. These rocks have undergone varying degree of migmatisation resulting in various textures and composition in different parts of the study area. Mineralogically, these rocks contain garnet, sillimanite, quartz, feldspar + graphite + biotite varying from quartz sillimanite schist to feldspar rich varieties. In thin section, Khondalites are holocrystalline, sub idiomorphic and medium grained with quartz, pathetic feldspars and garnets as dominant minerals and sillimanite, biotite, graphite as accessories.

The khondalite group of rocks in Vizianagaram, these gneisses shows a trend of N-S to NW - SE. These are coarse to medium grained, dusty brown to dark pinkish brown rocks. The increase in pink colour is due to the increase in garnet and iron oxide minerals. Sillimanite occurs as elongated prisms and needles in parallel orientation imparting banding to these gneisses.

The khondalite groups of rocks in Visakhapatnam, the feldspar rich khondalites are exposed in ENE - WSW trending hill ranges. These are highly feldspathised and show feeble foliation. In some migmatised khondalite
geographical regions the sillimanite needles occur as clusters and exhibits a pock marked texture where the clusters are removed. Hard, fine to medium grained and bluish tinged khondalites are exposed as low lying E-W trending ridge in the pydipala area. Coarse feldspar megacrysts are common in feldspathised geographical regions of khondalites.

The khondalite group of rocks in East Godhavari, khondalites are highly weathered and varying in colour from leucocratic to dusty brown. It often shows distinct banding. Khondalites are co-folded together with charnockite bands and vice versa. At some places intrusions of charnockites are along the foliation in khondalites.

The khondalite group of rocks belonging Khammam are banded and bedded with lithological variations from metamorphosed politic, prismatic to calcareous varieties. They form steep strike ridges as well as low lying valleys and characterized by the presence of the graphite.

1.4.2 THE LEPTYNITE GROUP OF ROCKS

Fine to medium grained, leucocratic garnetiferous quartzofeldspathic rock with occasional sillimanite needles exhibits granulitic texture and imperfect foliation. The leptynite at Pydipala, tending ENE-WSW direction with steep dips towards south. The quartzofeldspathic veins cutting across the leptynites.

In thin section, leptynite is holo crystalline and subidiomorphic with dominant quartz followed by garnets, feldspars and sillimanites. Albite and oligoclase feldspar are also present.
1.4.3 THE QUARTZITES GROUP OF ROCKS

Quartzites usually occur as narrow impersistant bands, concordant with the direction of foliation of the khondalites. Quartzites are mostly white in colour; course grained (at places medium grained) and equigranular. Quartzites are characterised by smoky quartz at Kondamusuru and rose quartz at Pydipala and blue quartz at Burugubanda. Quartz grains are recrystallised with well developed crystal borders and having small interstitial grains between the larger ones. In thin section, quartzites exhibit xenomorphic granular texture with quartz as the major constituent and untwinned orthoclase, garnet and biotite are in subordinate amounts. Quartz grains show undulose extinction.

1.4.4 CALC - GRANULITES GROUP OF ROCKS

Representing the calcareous members of the khondalite group which are conformably associated with the garnet sillimanite gneisses. Calc-granulites expressing characteristic ribbed weathering exposed fold patterns and drag feature in calc-granulites. Large number of stigmatically folded pegmatitic veins traversed through calc-granulites. Calc-granulites consist of diopside, scapolite, calcite, microcline and oligoclase minerals in varying proportions.

1.4.5 CHARNOCKITES GROUP OF ROCKS

The charnockite group of rocks and their compositional variants (Pyroxene granulites etc.,) are exposed in the northern as well as southern parts and occur as linear bands, massifs and hillocks. Fine to medium grained melenocratic pyroxene granulites occur as linear bands and as enclaves in migmatites. In pydipala graphite mine area, pyroxene granulites occur as thin
conformable bands in khondalites. In thin section, the rock is holocrystalline, sub idiomorphic, medium grained and equigranular with hypersthene, diopside, and plagioclase feldspars as dominant minerals. Garnets, uralitised hornblende, occasional biotite and opaques are the accessory minerals. Hard, massive, gray toned greasy looking basic to intermediate charnockites are exposed in the study area, exhibiting clear cut concordant. Intrusive relationship occurs with the khondalite group of metasedimentary lithounits. Coarse megacrysts of perthitic potash feldspars occur in the WNW part of the charnockite massif which increases in size and frequency towards the contacts. In thin section, they are holocrystalline, subidiomorphic and medium grained with hypersthene, biotite, plagioclase feldspars and quartz as essential minerals and secondary hornblende, apatite, sphene as accessory minerals.

1.4.6 PINK GRANITES GROUP OF ROCKS

Small bands of coarse to medium grained pink granite occurs within the charnockites and granite gneisses. These are mainly composed of potash feldspar, quartz, plagioclase and biotite with some accessories. These granites are rich in microcline which imparts pink colour. Microcline and orthoclase phenocrysts are mostly pathetic with rugged outlines. Quartz is the most abundant mineral with biotite as common accessory.

1.4.7 GRANITE GNEISSES GROUP OF ROCKS

Coarse to fine grained rocks occur in various shades of grey and pink colour which tends to be lighter in the coarse grained and porphyritic varieties. The grey and pink varieties are closely associated and intermingled with each other. Mineralogically, these rocks contain grey quartz, orthoclase, microcline and plagioclase as essential minerals and biotite, sphene, zircon,
apatite as accessories. The potash feldspars are mainly orthoclase and microcline. The microcline rich bands impart pink colour to these granite gneisses. The foliation trend of the granite gneisses differ with the foliation trend of the khondalites. The granite gneisses have sharp contrast to those of the garnet sillimanite gneisses of khondalite group. These are originally granites and subsequently metamorphosed during the different stages of the Precambrian organic cycles. In Khammam, granite gneisses (Diatexite) are represented by quartz, oligoclase gneiss and biotite granite gneiss with local variants of quartzofeldspathic granulites porphyritic granite gneisses. Number of lenticular bodies of pyroxene granulites emplaced conformably with the foliation trend in the granite gneisses.

1.4.8 HYPERSTHENE GRANITE GNEISSES GROUP OF ROCKS

Hyperstene granite gneisses are exfoliated weathering forms of granites emplaced within the garnet sillimanite gneisses of metasedimentary khondalite group of rocks. These gneisses are chiefly or granitic composition and include more femic minerals.

These rocks are coarse to medium grained grading from gneissic to granulitic texture with more feldspar in granulitic rocks. They consist mostly quartz, microcline, orthoclase, oligoclase as essential and hypersthene, magnetite, apatite and zircons as accessory minerals. The presence of biotite is very meagre. These rocks have small porphyroblasts of microcline, microperthite and oligoclase.

1.4.9 QUARTZ VEINS AND PEGMATITES GROUP OF ROCKS

A number of thin quartz veins and quartz rich pegmatite veins criss cross throughout the various lithounits of the study area. The pegmatites at
places carry occasional biotite and magnetite grains. Discontinuous outcrops of muscovite and tourmaline bearing quartzofeldspathic pegmatite bands occur in the study area. The pegmatite bands are highly sheared, with broken muscovite flakes and granulated tourmaline crystals. Quartz veins and quartzofeldspathic pegmatite bands are intruding into the graphite gneisses/schists.

1.4.10 MIGMATITES GROUP OF ROCKS

Exposed in weathered low relief geographical region. These are heterogeneous lithounits comprising admixtures of palaeosomes of khondalites, pyroxene granulites, dark grayish chamockites and neosomes of leucocratic medium grained quartzofeldspathic + biotite bearing granitoid rocks. Migmatites are of two types viz. (1) medium grained quartzofeldspathic rocks with garnets and biotite (2) medium to coarse grained granitoid rocks rich in biotite and coarse megacrysts of feldspar. These types probably represent two phases of granitic activity. The granitoids are aplitic granites with typical fine grained nature differs them form normal granitoids occur throughout the entire study area.

1.5 USES OF GRAPHITE

Graphite is a soft, black, greasy form of carbon. It occurs in nature in two forms, crystalline and amorphous, each having its own peculiar uses. Artificial graphite, made from coal or other carbonaceous material in an electric furnace, is to a certain extent a competitor of the natural amorphous product. It is even better suited for certain purposes, notably in the manufacture of graphite electrodes, the demand for which has greatly increased on account of the rapid growth of electrochemical industries. Crystalline graphite is commonly understood to mean graphite in crystals
large enough to be seen with the naked eye. It is used in the manufacture of crucibles, as a lubricant, in paints, foundry facings, batteries, and stove polish. Amorphous graphite, while frequently showing a crystalline structure under the microscope, is a trade name applied to amorphous or very fine-grained graphite of varying degrees of purity. It is used for foundry facings, as a lubricant, in pencils (black lead), paints, high explosives, boiler compounds, electrodes, dry batteries, and shoe and stove polishes. Flake graphite is crystalline graphite produced in flakes or scales, while vein graphite is crystalline graphite in other forms, such as lump, chip, and dust. The chief supply of high-grade crystalline graphite comes from Ceylon, and this is the standard grade of crystalline product.

1.5.1 SPECIAL USES:

- Crucibles, retorts, stoppers. Demand for graphite crucibles comes from the makers of crucible steel and of various nonferrous metal and alloy castings. Crucible makers are the largest consumers of graphite. The material must be of high grade, either lump or chip, flake or vein, containing at least 85 per cent graphitic carbon and free from easily fused impurities.
- Lubricants. Both crystalline and amorphous are used. Should be free from silica (sand).
- Foundry facings. Chiefly amorphous. High-grade material is not required. Artificial graphite is also used to a considerable extent.
- Pencils. For better grades, mixtures of crystalline and amorphous are needed. For poorer grades, amorphous is used alone. Artificial graphite may be, but rarely is, used for this purpose.
- Polish for smokeless powder. Amorphous; relatively small consumption. (Used to make the grains flow better and permit more accurate filling of shells.)
Electrodes. Artificial is considered most suitable. Products are usually formed from powdered amorphous carbon (e.g., anthracite, coal) and "graphitized in an electric furnace.

Boiler compounds. Pure material not essential. Either amorphous or artificial. Used for preventing hard scale.

Paints. Amorphous, artificial, or crystalline. High-grade material not necessary.

Stove and shoe polish. Chiefly amorphous.

Dry-lattery fillers. Either amorphous, artificial, or crystalline. Pure material required, but sizes of grain not a factor

Fertilizer filler. Low-grade amorphous. Used only as an adulterant and to give the required dark color.

Graphite is valued for its good conductivity of heat and electricity and high refractoriness. The utility of graphite is dependent largely upon its type viz., flake, lumpy or amorphous. The flake type graphite is found to possess extremely low resistivity to electrical conductance. The electrical resistivity decreases with the increase of flaky particles. Also the bulk density decreases progressively as the particles become more and more flaky. Because of this property in flake graphite, it finds a large use in the manufacture of carbon electrodes, plates and brushes required in the electrical industry and dry cell batteries. In the manufacture of plates and brushes, however, flake graphite has been substituted to some extent by synthetic, amorphous, crystalline graphite and acetylene black. Graphite electrodes serve to give conductivity to the mass of manganese dioxide used in dry batteries.

The manufacture of crucibles is served best by flake graphite, although crystalline graphite is also used. Graphite crucibles are manufactured by pressing a mixture of graphite, clay and sand and fixing the pressed article at a high temperature. They are used for melting non-ferrous metals, especially
brass and aluminium. Coarse-grained flake graphite from Malagasy is regarded as standard for crucible manufacture.

(Ref: http://www.mineralsgeographicalregion.com/minerals/graphite.html)

Flake graphite containing 80 to 85% carbon is used for crucible manufacture; 93% carbon and above is preferred for the manufacture of lubricants, and graphite with 40 to 70% carbon is utilized for foundry facings. Natural graphite, refined or otherwise pure, having carbon content not less than 95% is used in the manufacture of carbon rods for dry battery cells. This grade of graphite is imported from Ceylon and England. After the second World War, clay-graphite crucibles were replaced by silicon carbide crucibles bonded by graphite. Such crucibles are now manufactured in the USA and other advanced countries.

All grades of graphite, especially high grade amorphous and crystalline graphite having colloidal property i.e. remaining in suspension in oil, are used as lubricants. Graphite has an extraordinarily low co-efficient of friction under practically all working conditions. This property is invaluable in lubricants. It diminishes friction and tends to keep the moving surface cool. Dry graphite as well as graphite mixed with grease and oil is utilized as a lubricant for heavy and light bearings. Graphite grease is used as a heavy-duty lubricant where high temperatures may tend to remove the grease.

These days, artificially prepared graphite has replaced natural graphite to a great extent. Artificial graphite is prepared by heating a mixture of anthracite, high grade coal or petroleum coke, quartz and saw-dust at a temperature of 3000ºC, out of contact with air. Graphite carbon is deposited as residue. Manufactured graphite is also used for making furnace electrodes and for modes in the manufacture of chlorine and caustic soda.
A considerable quantity of graphite is used in foundry-facing to prevent the moulding sands from adhering to cast articles. Here too, flake graphite is preferred. Dust or powder of flake, crystalline-graphite are also used.

Graphite bricks of high purity are used as moderators in an atomic reactor. In the nuclear field graphite is a good and convenient material as a moderator but this is only true if the graphite is low in certain neutron absorbing elements notably boron and the rare earths and is of consistent quality particularly with regard to density and orientation. The latest invention in the use of graphite is in the blast furnace operation, experimented by Oesterreichisch - Alpine Mountainagesellschaft, Austria. In view of the lack of cooking coal in Australia, it is likely that the use of graphite in blast furnace will be developed on a commercial scale.

Other uses of graphite are in the manufacture of paints and pencils. Finely powdered lump graphite of 70% purity is generally employed in paint manufacture. Graphite is a great water repellent and thus makes an ideal protective coating for wood.

Amorphous graphite is generally used in the manufacture of lead for pencils. The suitability of graphite for this purpose is judged by the dark streak it leaves on the paper. It is best done by amorphous graphite. The finer the powder, the darker is the smear. The blackness of the smear decreases with increase in flakiness of the graphite. Synthetic graphite, though it has less ash content and a fine particle size, produces very little smears and so it is unsuitable for pencil manufacture.

Thus this area can form an ideal backdrop for recovering of detailed study.
1.6 SCOPE OF THE WORK:

- To find out the geological formation of graphite and graphite purity variation along the region based on its geochemistry.
- To assess deep quality of graphite and related with the geological formation in the geological selected area.
- To find out the relationship between graphite content and trace element mineralogy.
- To find the effect of particle size in the mineral content.
- To make suggestions for recovery of graphite and other minerals.
- Disposal options/ reuse of different minerals present in the ore.
- Arrive at the geological evolution of these minerals in the area.

1.7 OBJECTIVES OF THE WORK:

- To remove or reduce the waste constituents in the ore to a specified percentage.
- To bring the product to a marketable grade by increasing the quality. If the mineral dresser contains more than one important mineral, it is obliged to separate them such that separate marketing of each product it is favored.
- To minimize the losses in the form of tailings as far as possible. Based on an appropriate flow sheet cost of treatment, equipment cost and plant locations, the economics of the processing has to be considered. Unwanted impurities penalties, additional desirable constituent bonus should be taken into account.
- If two different forms of a same element occur as different combinations, they can be separated economically. Content of moisture, assay grade, size of particles are the requirements in which the product may have to confirm.
To understand the basic formation of different grades of carbon based on the constituents of impurities present in different grades of carbon. Explore the utilization potential of non carbon minerals present in the low grade carbon.

To understand the dynamic of equilibrium of different trace elements.

The aim of the study is to make use of gangue material from low grade graphite samples containing 25-30 % fixed carbon from Vizianagaram to East Godavari Districts in Andhra Pradesh, India after detailed characterization and amenability to beneficiation. The graphite is of the well crystallised flaky variety, and is associated with orthoclase, quartz, plagioclase, biotite, garnet, sillimanite, kiaolinite including index trace elements Rb, Ba, Zn, Ga, Th, Pb, Zr, As, V, W, Cr, Ni, as dominant gangue minerals. The textures, microstructures and liberation of graphite and their implications in beneficiation are described. The optimum liberation size of the graphite was determined to be below 200 μm. Beneficiation studies indicated that a concentrate with 30% fixed carbon, at a recovery 99% can be achieved by cleaning the rougher concentrate five times in a conventional flotation cell. Almost similar grade and recovery can be obtained in two stages by column flotation. The associated gangue material which consists above minerals and trace elements are highly useful for the jewelery purpose as these minerals are formed from silica content. All quartz variety minerals like cats eye, chert, Alex (Alexandrite), Moon stone etc., are available for jewelry industry. Hence, the low grade graphite gangue material is worthful soon after beneficiation of graphite.