# Mineral Resources of Cuddapah Basin

V. Sunitha, B. Muralidhara Reddy and M. Ramakrishna Reddy

ISSN 0970-4973 (Print) ISSN 2319-3077 (Online/Electronic)

J. Biol. Chem. Research Volume 31 (1) 2014 Pages No. 226-235

# Journal of Biological and Chemical Research (An International Journal of Life Sciences and Chemistry)

Published by Society for Advancement of Sciences®

J. Biol. Chem. Research. Vol. 31, No. 1: 226-235 (2014) (An International Journal of Life Sciences and Chemistry) Ms 31/1/22/2014, All rights reserved ISSN 0970-4973 (Print) ISSN 2319-3077 (Online/Electronic)



**REVIEW ARTICLE** 

Dr. V. Sunitha http:// <u>www.jbcr.in</u> jbiolchemres@gmail.com <u>info@jbcr.in</u>

Received: 17/12/2013 Revised: 10/01/2014 Accepted: 12/01/2014

# Mineral Resources of Cuddapah Basin V. Sunitha, B. Muralidhara Reddy and M. Ramakrishna Reddy\*

Department of Geology, Yogi Vemana University, Kadapa – 516 003, Andhra Pradesh, India

\*Department of Earth Sciences, Yogi Vemana University, Kadapa – 516 003, Andhra

# Pradesh, India

Cuddapah basin, Andhra Pradesh, endowed with rich mineral wealth, is one of the important and fairly well studied geological units in peninsular India. The Middle-Upper Proterozoic Cuddapah basin, has been well known for a variety of mineral resources, such as barite, asbestos, copper and Iron, Fullerene, Uranium, clay, black granites besides limestone and Cuddapah slabs. The mineral sector plays a crucial role in the industrial development of the country.

Key words: Cuddapah basin, Mineral resources, Asbestos, Barytes, Fullerene and Uranium.

# INTRODUCTION

Minerals constitute the back-bone of economic growth of any nation and India has been eminently endowed with this gift of nature. The mineral sector plays a crucial role in the industrial development of the country. India is Asia's third and world's eleventh largest economy. The metallurgical and mineral industries constitute the bedrock of industrial development as they provide the basic raw materials for most of the industries (TERI 2001). The linkage between the mining and the industry and the economy through the supply of goods and services creates value multipliers for the country. *Mining is a major economic activity in many developing countries.* (*Tauli-Corpuz V.1997, UNEP 1997*).Andhra Pradesh is the fifth largest state in the area (275,000 sq Km) in the country.

Geologically, Andhra Pradesh is covered by peninsular Gneissic complex mainly of Archean age. Overlying the Archeans are the sedimentary rocks belonging to Cuddapah Super Group and deposited in Cuddapah and Pakhal basins. Geologically, the Kadapa district forms a part of south-western and southern part of Cuddapah Basin which is named after the town "Kadapa" where the Cuddapah Systems of rocks best developed. The rocks exposed in the district belonging to Archaean (oldest rocks) or early Proterozoic Era, Cuddapah Super group and Kurnool Group of middle to upper Proterozoic age. Gneisses and granites with Veligallu, and Tsundupalli schist belts constitute the main rock types of the Archaean. The Cuddapah Super group of rocks unconformably overlie the Archaeans and consists of Gulcheru and Vempalli Formations of Papaghni Group, Pulivendula, Tadipatri and Gandikota Formations of Chitravathi Group, Bairenkonda (Nagari) and Cumbum (Pullampeta) Formations of Nallamalai Group. The next younger groups of rocks are the Kurnools comprises of Banganapalli Quartzites. Narji Limestone, Ouk Shale, Paniam Quartzite, Koilakuntla Limestone and Nandyal Shale. The town "Kadapa" is situated over the Nandyal Shale of Kurnool Group. The intracratonic Proterozoic Cuddapah Basin, ~2.0 Ga old, located in the eastern part of the Dharwar Craton, occupies an important place in Indian geology and tectonics. It extends over a length of 440 km and trends in NNE-SSW in the north and NNW-SSE in the south through N-S in the middle. It has a maximum width of 145 km in the middle and occupies nearly 44,550 sq. km. The Cuddapah Basin has more than six kilometers thick sedimentary pile and rests over a granite gneiss and schist basement with a profound unconformity. The sedimentary pile is broadly classified into a lower Cuddapah Super Group and an upper Kurnool Group. Studies on the geology and tectonics of the Cuddapah Basin were first carried out by King (1872) and are continued by several workers even today, though intermittently. Stratigraphically, the Cuddapah Basin is divided into Papagni, Chitravathi, Nallamalai Groups and Srisailam Quartzite. The Basin comprises mainly Ortho-quartzite-carbonate suite and basic to acid volcanics and sills in the lower part and siliceous shales/tuffs with quartzite inter bands in the upper part (Nagaraja Rao et al 1987). Resting Unconformable over the Cuddapah sediments, the Kurnool Group sediments are exposed in two isolated tracts, in the central (Nandyal depression) and north-eastern (Palnad depression) parts of the Cuddapah Basin. Both these sub-basins are separated by the Nallamalai rocks and Srisailam plateau. The Cuddapah sediments were laid under quiet and submergence conditions. The Craton around the Cuddapah Basin (except in the east) was the source for the Cuddapah (barring the Nallamalai Groups) and Kurnool rocks and the Nallamalai Group from the Eastern Ghats terrain. The Cuddapah Basin has progressively evolved through the formation of a series of sub-basins, viz., the Papagni and Chitravathi Groups in the western sub-basin, Nallamalai sub-basin in the eastern sub-basin, Srisailam Quartzite in the Srisailam sub-basin and the Kurnool and Palnad Groups in the Kurnool/Palnad subbasins. The Basin hosts a wide spectrum of rich mineral resources like barites, asbestos, base metals, diamond, uranium, limestone, etc., even "methane gas shows" are also reported in the south western region of the Basin.

Further, recent studies on analysis of rock samples from the Cuddapah Basin have added a new dimension to the mineral wealth that holds the Cuddapah Basin. Five black tuff samples from the Mangampeta area of the Cuddapah Basin, analyzed at the Stanford University (Sreedhar Murty 2005) indicated presence of naturally occurring fullerenes  $C_{60}$ ,  $C_{70}$  and  $C_{84}$  in this part of the world, which is unique. It is not an isolated occurrence, unlike in the case of several reports from different parts of the world. Encouraged by such convincing results and realizing the vast application potential of this very important and strategic mineral, the Andhra Pradesh Mineral Development Corporation (APMDC), a Government of Andhra Pradesh Enterprise, has come forward to support further studies under a research project and entrusted the responsibility of executing the same to M/s. Geo Resources and Technologies Consultants Private Limited (GRTC), Hyderabad.

## MINERAL RESOURCES

Mineral resources in the Kadapa district, in geological parlance, are widely distributed in time and associated with rocks from Archaean to Kurnool Group of rocks are discussed. Barytes, chrysotile asbestos, clays, cement grade limestone and Kadapa slabs/napa slabs are some of the well known workable mineral deposits associated with Proterozoic sedimentary rocks belonging to Cuddapah Super group and Kurnool Group in Kadapa district. Mining in all the mineral deposits except chrysotile asbestos are essentially open cast operation. Base metals (copper, lead and zinc), diamond, gold, iron ore, dolomite, steatite, magnesite, yellow ocher, guartz and granite/black granite (dimensional stone) are some of the other minerals occurred in the district. Besides, the district has extensive reserves of building material in guartzites, limestones granites and granite gneisses which are guarried throughout the district. In the ancient time (before 1900), exploratory work for minerals is evident from many scattered, abandoned old workings for base metals (copper, lead and zinc) along Zangamarajupalle - Varikunta zone of Badvel Mandal, for placer diamond along the terraces of Penner river around Chennur, Kondapetaa and Olavampalle of Kadapa Mandal, for iron around Chabali of Vempalli Mandal and Yerraguntla kota of Koduru Mandal. The underground works are in the form of narrow drives, cross cuts and winzes. A diamond recovered from Olavampalle is said to have been sold for Rs 1,450/- in 1839. Diamonds are reported to have been obtained also at Indur and Pinchetgapadu to the west of Chennur and at Galagurita, Gasapur and Hassanapur near Chennur.

During the period from 1900-1950, Kadapa district is well known for the occurrence of chrysotile asbestos, barytes and steatite in the dolomites of Vempalli Formation of Cuddapah Super group in the Pulivendula taluk.

# CHRYSOTILE ASBESTOS

Chrysotile asbestos occurs in the zones of serpentinization between dolomite sills and magnesian limestone invariably at the upper contact, of Vempalli Formation of Papaghni Group of Cuddapah Super group along 15 km long belt from Brahmanapalli - Lopatnutala of Pulivendula Mandal.

#### Mineral.....Basin

It is cross fiber type and range in thickness from a few millimeters to about 10 cm and estimated reserve of 2.5 lakh tones up to a depth of 200 m. It is of underground mining developed along the inclines which are subparallel to the bedding planes. Chrysotile asbestos is the most important commercial variety of asbestos for spinning into yarn and woven into fabrics based on properties like fibrous nature, spin ability, incombustibility, resistance to heat, acids and alkalies, filtration



property, terrible strength and property to absorb cements. The other occurrence of asbestos is at the upper contact of dolerite sill in Vempalli dolomite near Rajupalem.

#### BARYTES

Andhra Pradesh is the leading producer of barytes and contributes about 90% of the total country's production. APMDC exploiting the Mangampeta deposit under public sector producing about 5 to 6 lakh tonnes per annum and intends to increase the production level to 1 Million tonnes in the coming years. One of the largest barite deposits in the world occurs at Mangampeta with a resource of 37 Mt with an estimate reserve of 70 million tons (Neelakantam, 1987). Huge reserves of barytes are found in Cuddapah,

Prakasam and Nellore districts. Mangampeta barytes with grade 92% BaSO<sub>4</sub> and an average specific gravity of 4.21 is used in oil & gas well drilling. The other grades are catering the needs of Chemical and Paint industries.

Barytes occurs in Vempalli dolomite and associated basic igneous rocks as veins in Pulivendula, Kamalapuram and Kadapa taluks. On the average the veins are one meter in thickness. Quartz and calcite occur



associated with barites. Pyrite, chalcopyrite and malachite are found disseminated in the barites. The barite is white, buff or pink in colour. It was estimated that there were reserves of the order of about 700,000 tonnes of barytes of all grades within depth of 30 m from the surface in the mineralized belt extending for about 100km form Velidandla in the west to Mittamindapalle in the east.

With the discovery of world's largest bedded barytes deposit of volcano genetic origin at Mangampeta, Koduru mandal, Kadapa district during the year 1970-1975, Kadapa district is well known not only in the country but also in the world.

The barite deposit is unique because of its purity, high grade and volcanogenic origin, confined to tuffaceous sequence of Pullampeta Formation of Nallamalai Group of Cuddapah Super Group. The individual beds of barites are upto 40 cm thick and interbedded with crystal tuff and black tuff. The black tuff shows crystals of pyrite along the bedding planes. Mining is essentially an open cast operation and is estimated an insitu reserve of 74 million tones. Barytes also known as 'heavy spar' is mainly used in oil and gas well drilling as a weighting agent in the heavy drilling muds. The heavy muds provide lubrication and cooling effect for the drilling bits and seals the wells of boreholes to prevent caving in or blowouts.

## FULLERENE

Fullerene is a pure carbon molecule composed of at least 60 atoms of carbon and exhibits a Bucky ball structure as shown in Fig.1. The discovery of  $C_{60}$ ,  $C_{70}$ , the carbon cage molecules popularly known as fullerenes, named after the famous Architect, Buckminster Fullerene (Kroto et al 1985), opened new and vast vistas in understanding these curious molecules. The fullerenes, like artificial diamonds, can be synthesized from Carbon.



Figure. 1: An association football is a model of the Buckminster fullerene C60.

Synthesis of fullerene from Carbon in the laboratories is complex and expensive, while the reported occurrences of fullerene in nature are rather scanty. The natural fullerenes when they were detected first during early eighties were originally thought to be brought from space since these were found to constitute an important carrier phase for noble gases in Carbonaceous Chondrite meteorites. Though the natural fullerenes were thought to be mainly of extra-terrestrial origin, subsequent studies showed their existence in the terrestrial rocks as well. Its first reported occurrence in natural terrestrial rocks was in "shungite", a ~2.0 Ga. Old Proterozoic Formation from Karelia, Russia, containing highly Carbonified carbonaceous matter (Buseck et al 1992). This paved the way for subsequent studies on natural fullerenes (Buseck 2002, Jan Jehlicka et al., 2003, etc.).



Fig. 2 Map showing the different sub-basins of the Cuddapah Basin.

# Occurrence of Fullerenes in Cuddapah Basin

Five black Tuff samples from the Mangampeta area of the Cuddapah Basin, analyzed at the Stanford University (Sreedhar Murty 2005) indicated presence of  $C_{60}$ ,  $C_{70}$  and  $C_{84}$ , suggesting the presence of naturally occurring fullerenes in this part of the world. Fig.2 shows the location map of fullerene occurrence in the Mangampeta, Cuddapah district, Andhra Pradesh.

Fullerenes, their derivatives and Carbon nano tubes have a number of interesting properties due to their unusual structures and sizes. The size of the individual fullerene molecules makes them ideal building blocks for use in designing molecular units that find application in nanotechnology. The fullerene family of carbon molecules possesses a range of unique properties. A fullerene nano-tube has tensile strength, about 20 times that of high-strength steel alloys, and a density half that of aluminum. Carbon nano-tubes demonstrate superconductive properties, for commercial applications, including computer memory, electronic wires.

Fullerenes can be used in the construction of aerospace vehicles because of the substantial performance gains.

#### URANIUM

Fractured Gulcheru quartzites have indicated high uranium contents (upto 1.00% U<sub>3</sub>O<sub>8</sub>) at several localities spread over 40 km stretch between Madyala Bodu to west of Racha kuntapalle. Uranium minerals such as coffinite and uraninite occur as fracture filling and disseminations with association of sulphide minerals like chalcopyrite, arsenopyrite and bornite. Exploratory drilling undertaken at Gandi and some neighbouring areas has indicated high grade lensoid Uranium mineralisation. The Gulcheru quartzite, affected by structural disturbances and abundance of reductants like sulphides, holds promise for the better grade and easily leachable uranium mineralisation.

### STEATITE

Talc and Steatite are finding a great demand in the ceramic industry because they impart the required properties and the desirable qualities to the ceramic articles. Many

electrical, chemical and laboratory articles are made of steatite and talc. In situ reserves of talc/steatite in Andhra Pradesh is estimated at 2.1 million tones of which 1.6 million tones is considered a recoverable reserves. Anantapur, Chittoor, Kurnool and Khammam districts contribute the total reserves in the state. Minor occurrences of poor quality steatite were recorded within Vempalli dolomites near the contact of basic sill near Nagayapalle, 3 km west



of Tangedupalle, 1.5 km south of Lingala and 1.5 km west of Rajupalem. A low grade crystalline magnesite body occurs at the base of Vempalli Formation, 3 km west of Vempalli town and 2.5 km south east of Kummarampalle.

### CLAY

Superior grade clay useful in ceramic ware and sanitary wares occurs in Hastavaram,

Tallapaka and Gadela villages of Rajampeta Mandal and Obulavaripalle Mandal. The clay deposits are confined to Pullampeta formations of Nallamalai Group of Cuddapah Supergroup. Inferior grade clay occurs in Chinna Orampadu, Anantarajupet, Nandalur, Chitvel and Koduru. A variety of clay (Fuller's earth) useful in detergent industries occurs in Venkanarri, Midamala, Chennakesavapuram and Iruvegalapuram along Sagileru River.



Vol. 31, No. 1: 226-235 (2014)

J. Biol. Chem. Research.

#### **KADAPA SLABS**

Napa slabs/Kadapa slabs are black coloured limestone belonging to Koilakuntla Limestones of Kurnool Group. They occur in the area of Niduzivi, Koduru, Valasapalli areas of Yerraguntla Mandal and Sugumanchupalli areas of Jammalamadugu Mandal. Due to the development of perfect basal cleavage planes, this rock can be extracted with a thickness ranging from 10mm to 20mm and any size up to 8 feet length. There are about 150 polishing



industries in the district and these polished slabs mainly utilized for flooring.

### **IRON ORE**

Small deposits of iron ore and hematite occur in the Pulivendula quartzite around Chabali and Pagadalipalle of Pendilimarri Mandal and in Pullampeta quartzite around Mantamampalle of Ontimitta Mandal and Yerraguntla Kota of Koduru Mandal and 22 km west Rajampeta railway station.

Investigation for base metals and gold had been carried out by Geological Survey of India during the period from 1960 to 1990 in parts of Zangamrajupalli - Varikunta zone in Cumbum Formation of Nallamalai Group and Veligallu Schist belt, and Tsundupalle schist respectively.



A possible reserve of 1.42 million tonnes with 4.55 percent Zn, and 2.95 percent pb, at cut of 3 percent and 1.54 million tonnes with 1.08 percent Zn and 0.88 percent pb between 1 percent to 3 percent is estimated up to a vertical depth of about 100 to 150 meters in Zangamrajupalli base metal mineralized zone by Geological Survey of India, Southern Region, Hyderabad. Results are not encouraging for detailed exploration for gold.

The mineral wealth of Kadapa district has been further enhanced by the recent discovery of Uranium occurrences in the Gulcheru Quartzite of Papagni Group near Gandi, and in dolostone of Vempalli formation of Papaghni Group at Mabbuchintapalli and Tummalapalli of Vempalli Mandal of Kadapa district by Atomic Mineral Division, south zone, Hyderabad. Mineralization occurs in the form of lensoid bodies and the minerals identified are Coffinite and Pitchblend.

### **BLACK GRANITES**

Black granites occurr in Tsundupalli, Rayachoti, Galiveedu, Veeraballi and Chakrayapet mandal and limestone/marble occurring in Pulluru and putturu of Khajipet mandal is being used as dimensional stone because of its aesthetic appearance after cutting and polishing.



# CONCLUSION

The mineral sector plays a crucial role in the industrial development of the country. The metallurgical and mineral industries constitute the bedrock of industrial development as they provide the basic raw materials for most of the industries Barytes, chrysotile asbestos, clays, cement grade limestone and Kadapa slabs/napaslabs are some of the well known workable mineral deposits associated with Proterozoic sedimentary rocks belonging to Cuddapah Super group and Kurnool Group in Kadapa district. "Methane gas shows" are also reported in the south western region of the Basin. Barites mining activity in the state and in the country was boosted only after the discovery of the deposit in Mangampeta of Kadapa district. Even now almost 95 per cent of the mineral production comes from Mangampeta. The industry is significantly important from the view of export earning and GDP contribution (3.2% approximately) to national income. Chrysotile asbestos occurs in the zones of serpentinization between dolomite sills and magnesian limestone invariably at the upper contact, of Vempalli Formation of Papaghni Group of Cuddapah Super group along 15 km long belt from Brahmanapalli - Lopatnutala of Pulivendula Mandal. Five black Tuff samples from the Mangampeta area of the Cuddapah Basin, analyzed at the Stanford University indicated presence of  $C_{60}$ ,  $C_{70}$  and  $C_{84}$ , suggesting the presence of naturally occurring fullerenes in this part of the world. Uranium mineralization (0.0026-0.492% U<sub>3</sub>O<sub>8</sub>) has been reported from Vempalli Dolomite and Pulivendula conglomerate/quartzite surveys carried out in Vempalli dolomites in the vicinity of Gulcheru quartzites over a width of 8-15m and thickness of about 3-7 m for an overall stretch of 1.75 km. Kadapa slabs occur in the area of Nidujivi, Koduru, Valasapalli areas of Yerraguntla Mandal and Sugumanchupalli areas of Jammalamadugu Mandal. Small deposits of iron ore and hematite occur in the Pulivendula guartzite around Chabali and Pagadalipalle of Pendilimarri Mandal and in Pullampeta quartzite around Mantamampalle of Ontimitta Mandal and Yerraguntla Kota of Koduru Mandal. Superior grade clay useful in ceramic ware and sanitary wares occurs in Hastavaram, Tallapaka and Gadela villages of Rajampeta Mandal and Obulavaripalle Mandal. The clay deposits are confined to Pullampeta formations of Nallamalai Group of Cuddapah Super Group.

# ACKNOWLEDGEMENTS

The first author is grateful to the research grant from the Department of Science and Technology, Government of India, New Delhi.

#### REFERENCES

- Buseck P.R., Tsipursky S.J. and Hettich R. 1992. Fullerenes from the geological environment. *Science* 257, pp. 215-217.
- Buseck Peter R. 2002. Geological fullerenes -review and analysis. Earth and Planetary Sciences Letters 203, pp. 781-792.
- Jan Jehlicka, Ales Svatos, Ota Frank and Filip Uhlik. 2003. Evidence for fullerene in soiled bitumen from pillow lavas of Proterozoic age from Mitov (Bohemian Massif, Czech Republic). Geochemica cosmochemica Acta, Vol.67, pp.1495-1506.
- Kroto H.W., Heath J.R., S.C. O'Brien. S.C., Curl R.F., and Smalley R. 1985. "C<sub>60</sub>: Buckminister fullerene," Nature 318, pp.162-163.
- Nagaraja Rao B.K., Rajurkar S.T., Ramalingswamy G. and Babu B.R. 1987. Stratigraphy, structure and the evolution of the Cuddapah Basin. Mem. Geol. Soc. Ind. V 6, pp.33-86.
- Neelakantam, S. 1987. "Mangampeta Barites Deposits, Cuddapah District, Andhra Pradesh". Mem. Geol. Soc. India, 6, 429-458.
- Sreedhar Murthy. 2005. A report on the analysis of Mangampeta shale samples at the Stanford University, USA.
- Tauli-Corpuz, V. 1997. The globalization of mining and its impact and challenges for women http://www.twnside.org.sg/bookstorehtm.
- TERI 2001. Overview of mining and mineral industry in India New Delhi: Tata Energy Research Institute. 94 pp. [TERI Project Report No. 2001EE42]
- UNEP 1997. Industry and environment mining and sustainable development. http://www.uneptie.org/vol 20 no 4 htm.
- King, W., 1872. The Kadapah and Karnul Formations in the Madras Presidency. Mem. Geol. Surv. Iand. Vol.8, pt.1, pp.1-346.

**Corresponding author: Dr. V. Sunitha,** Department of Geology, Yogi Vemana University, Kadapa – 516 003, Andhra Pradesh, India

E-mail: vangala\_sunitha@yahoo.com bandi.murali@yahoo.co.in reddy.mrk@rediffmail.com

J. Biol. Chem. Research.