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QUALITY OF GEMSTONES FROM KRISHNA AND GUNTUR DISTRICTS, ANDHRA PRADESH, INDIA

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ABSTRACT

The area form a part of the north eastern corner of the Cuddapah basin and part of the Krishna river valley. Gemstones are recognized from Paritala, Ustapalle, Kolluru, Kodavatkallu, Nagaluru and Atkuru villages. The physical and optical properties are studied using laboratory techniques. Four varieties of gemstones were identified in the study area. They are diamond, chalcedony, quartz (milky) and garnet (almandine and grossular). The properties useful for assessing value of gemstones are explained.

KEYWORDS: gem quality, physical properties, optical properties.

INTRODUCTION

The area under exploration (Fig.1) lies on the banks of the Krishna river falling in Survey of India toposheet 56 P/14 and D/2. It is about 60 Km from Guntur and 25 Km from Vijayawada in between 16º32'00" and 16º43'40" N latitude and 79º57'00" and 80º03'00" E longitude.

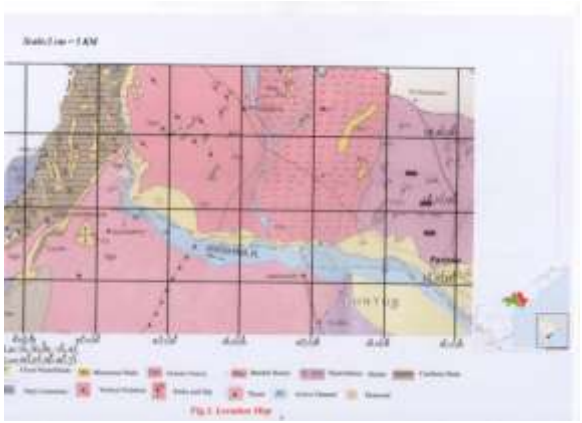

Fig. 1 Location map

History

Earlier, the gemstones are recognized from Paritala, Ustapalle, Kolluru, Kodavatkallu, Nagaluru and Atkuru villages. According to Munn (1929), Heyne has stated that the Kodavetkallu was yielded bullock loads of diamonds on first discovery. The diamond strata was not nearly exhausted, being intact close to the pits when famous stones had taken Voysey (1825). In 1850, Walker saw only two mines at work which were let for Rs.8 per month. The alluvial tracts had yielded many world famous diamonds. The Kohinoor (787 ct), the Pitt (410 ct), the Orloff (194 ct) and the Hope (45ct) are some of the examples.

Geology

Cuddapah Super group of rocks are exposed in the study area. The area was studied by GSI Geologists (Srirama Rao, 1949-50, Rao, 1954-55, Setti and Rajurkar, 1961-62, Deshpande 1968-69) examined the area.

The area forms a part of the north eastern corner of the Cuddapah basin. It exposes an interbedded sequence of phyllites and quartzite, with bands of pebbly / gritty sandstone and dolomite, of Cumbum Formation (Nallamalai Group) of Cuddapah Super group, Narji Limestone of Kurnool Group and Archean granites and gneisses. Quaternary deposits comprising of the colluvial fans, channel fill gravel, flood plain alluvium are deposited over the phyllite, limestone or gneissic bedrock. The general geological succession is as worked out is given below:

Kurnool Group

----------Unconformity/ Thrust---------- -

Nallamalai Group	-Narji Limestone
Cuddapah Super group	-Srisailam quartzite
	-Cumbum slates and phyllites with intercalated quartzite and limestone /

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dolomite
----------Unconformity/ Thrust----------
Archean Dolerite dykes
Graphites & gneisses
(after Ramalinga Swamy, 1976)

Geomorphology

The area is a part of the Krishna river valley and elevation of the area ranges from 40 to 430m, above MSL with a general slope towards north-west. River Krishna is the main drainage flowing in a north-easterly direction. Some hill streams contribute to the main drainage. The main type of land forms are structural landforms, denudational landforms and depositional landforms. A few ephemeral streams drain the area and join the Krishna river.

The summer temperature in this area rise up to 49°C. The average annual rainfall is about 1016 mm. Soil occurs as a blanket over the bedrock and the outcrops are highly localized. It is developed over the flood plain areas and is intensively put to use for agricultural practices. Mainly three types of soils are observed in the area (i) reddish brown soils, (ii) black cotton soils and (iii) alluvial deposits.

METHODOLOGY

Repeated field checks were made for a period of 13 months during the August 2010 to October 2011. Samples were collected from the pits (1*2*2 meters) and were washed for gemstones, which were separated in the laboratory. The physical and optical properties were studied and presented in Table 1.

RESULTS AND DISCUSSION

Quality of Gemstones

Four varieties of gemstones were identified in the study area. They are diamond, chalcedony, quartz (milky) and garnet (almandine and grossular). The physical, optical properties and their value are explained here. Photos are shown in Plate 1.

Plate 1. Gems collected from the study area

Diamond

Diamond commonly used as ornamental stones and has a remarkable physical and optical characteristics. It can be contaminated by very few impurities, such as nitrogen and boron. Nitrogen is responsible for the yellow and brown colour and boron for the blue colour.

Diamonds are classified into two types, based on Nitrogen and Boron. They are 1) Type I diamonds-Nitrogen high and 2) Type II diamonds –Boron high. The diamonds occurred in the area are belonged to Type II. The diamonds collected are green, yellow, brown and black in colour (Plate I- A, B). The streak is white and luster is adamantine. They are transparent to opaque.

Quartz

Quartz is the abundant mineral in the Earth's continental crust, next to feldspar. In the study area milky quartz (Plate I- C,D) and crystal quartz are identified.

Milky quartz

Milky quartz is the most common variety of quartz. The white colour may be caused by minute fluid inclusions of gas, liquid, or both, trapped during the crystal formation (http://en.wikipedia.org/wiki/Quartz#Milky_quartz). Here, it is milky white in colour and shows vitreous luster. The stone is translucent to opaque (Table 1).

Crystal Quartz In the study area crystal quartz is colourless and shows vitreous luster. It is transparent to translucent and shows white streak. Striations can be observed on the crystal surfaces (Table1).

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Chalcedony
Chalcedony is a cryptocrystalline form of silica, and is a semi-precious stone that occurs in many forms, colours, and shapes. Chalcedony, agates, jaspers, bloodstone, cornelian, onyx, and chrysoprase all make up the chalcedony gemstones. In the study area it shows white and brown and waxy like luster. Bands and red colour inclusions are commonly present (Plate I- E, F).

Garnet
Garnets are nesosilicates and occur in six varieties. They are pyrope, almandine, spessartine, grossular, uvarovite and andradite. Grossular and Almandine varieties are identified in the study area (Plate I, G,H). Almandine Garnet ranges from very dark brownish-red to violet-red. Crystals are translucent to opaque and show vitreous luster. Grossular Garnet shows orange-brown colour, vitreous luster and the crystals are translucent (Table1).

Value of Gemstones
The value of gemstones can be assessed using cut, carat, clarity/purity and colour .These parameters are explained here.

Cut
Diamond looks its best when it is faceted in the brilliant cut style, as this reveals the true red colour of the stone. Cabochon cut best suited for chalcedony. If the gem is very dark as in case of almandine garnet, it is cut in 'carbuncle-cut' which is round from the top and hollow from the bottom. Light coloured stones can be cut in any fancy shapes. Few cuts gives more brilliancy of the gem and few cuts decrease the brilliance of the gemstone, Ex. Diamond in RBC (Round brilliant cut) with ideal proportions give more internal light reflections with the table. Other cuts not given internal reflection, the light leaked with the pavilion that's why the diamond becomes dark.

Carat
Gemstones can be found in any size, from the smallest to the largest varieties. Smallest varieties abundantly available and largest size rarely available, that's why the biggest size value per carat is high. The cost of one cent quality diamond worth to Rs.35,000/- approximately, and is 1,50,000/- for 50 cents. Sometimes, it is difficult to estimate the value of large size, i.e., more than 50 carats.

Clarity or purity
Quality of diamonds decrease quickly with more number of inclusions. For ex., price of one carat diamond with more inclusions is Rs. 10,000/- whereas pure one (without inclusions) is 5,50000/-. The less inclusions in almandine garnet gives more beauty and colour that's why the less impurities stone have a more price than high impurities stone.

Colour
Colour is most important and attractive for a gemstone. If the colour is pale that is not look like good, if the colour is dark the appearance of the stone eye catching. That's why colour stones always pricing depend upon the thickness of the colour. More colour also not a good for gemstones because deep colour cannot pass the light that's why the brilliancy of the stone not appear. Medium colour and transparency can pass the light through the stone.

CONCLUSION
Since the antiquity, Krishna river valley is known for world famous diamonds and other gemstones. Gemstones are recognized from Paritala, Ustapalle, Kolluru, Kodavatkallu, Nagaluru and Atkuru villages. Four varieties of gemstones were identified in the study area- diamond, chalcedony, quartz (milky and crystal) and garnet (almandine and grossular). The diamonds are Type II, i.e., boron high. They are green, yellow, brown and black in colour. Quartz is milky white in colour. Crystal quartz is colourless. Almandine Garnet ranges from very dark brownish-red to violet-red whereas Grossular Garnet shows orange-brown colour. The value of gemstones vary with the cut, carat, clarity/purity and colour. It is suggested to resurvey the area to assess the gem potentiality for the exploration.

Price
The price depends upon the colour, clarity, carat, cut and luster of the gemstone.

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Table.1. Physical and Optical Properties of Gemstones

Properties	Diamond	Quartz	Chalcedony	Garnet
Crystal System	Cubic	Trigonal System	Trigonal	Cubic
Habit	Octahedral	Prismatic	Cryptocrytalline	Dodecahedral
Hardness	10	7	6.5 to 7	7 to 7.5
Cleavage	Parallel to Octahedral faces in four directions	None	None	None
Fracture	Step like/Splintery	Conchoidal	Conchoidal	Conchoidal
S.G.	3.52	2.65 to 2.66 Normal 2.66	2.60	Varying with stones
Streak	White	Colourless	White	White
Inclusions	Carbon, Angular growth	Crystals, Needles and Fluids	Bands, Ferrous	Crystals, angular needles
Luster	Adamantine	Vitreous, both on polished stones and fractured surfaces	Dull	Vitreous
Transparency	Transparent to translucent	Transparent to opaque, thin section of opaque stones are translucent	Semi-Transparent to opaque	Transparent to translucent
SR/DR	SR	DR	AGG	SR/ADR
Optic sign	None	Uniaxial positive	U+	None
Optic Character	None	Uniaxial	Uniaxial	None
Pleochroism	None	Dichroic	Dichroic	None
R-I	2.417	1.533-1.544	1.535-1.539	1.74 &1.79
Birefringence	None	0.009	0.004	None
Spectrum	None	None	None	None
UV light	Inert to weak	Inert to weak	Inert	Inert
Phenomena	None	Aventurescence, Chatoyancy, Asterism and Iridiscence	None	Asterism