

# **Gemstones: Their Nature and Origin**

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## **INTRODUCTION**

Gems are a group of minerals and have the following characteristics: rarity, beauty, durability, and value. Organic materials used as gems include pearls, corals, amber, and jet. Gems can be classified as 'diamonds' and 'coloured stones.' In its broadest sense, the term 'coloured stone' is used in the jewellery trade to refer to all gem minerals and organic gem materials, except diamonds. In a narrower sense, pearls are also eliminated from this classification and treated separately.

## **CLASSIFICATION OF GEMSTONES**

Of approximately 2,500 minerals that have been identified, only about 90 varieties produce specimens that possess the requisite characteristics of gemstones (i.e., beauty, durability, rarity and value). Of this 90, only about 20 are important to the jeweller.

As most gemstones are minerals the classification used by gemmologists is not very different from that used by mineralogists. (There are only minor differences between the two classifications.) Each mineral that produces gemstones is considered a 'gem species.' A gem species is characterized by a definite chemical composition and usually by a characteristic crystal structure. Each species, therefore, possesses characteristic properties.

Gem-quality stones can be either 'precious' or 'semiprecious.' Not every ruby is precious and not every piece of jade is semiprecious. This is one reason for calling all gem-quality stones 'gemstones' and not 'precious' or 'semiprecious.'

## **NATURE OF GEMSTONES**

The material we see around us may be divided into two very broad classes: 1). organic and 2). inorganic. Organic material originates from the activities of plants and animals and inorganic material originates from minerals.

In gemstones a distinction is made between the material that originates from the activities of plants and/or animals (those of organic origin) and that which originates from rocks and minerals (those of inorganic origin). Gemstones of organic origin include pearls, corals, amber and jet. All other gem substances are either minerals or other materials of inorganic origin.

## GEMSTONES OF SRI LANKA

Sri Lanka in relation to its surface area is the most dense gem-bearing country in the world (Figure 1). No other country in the world, except perhaps Brazil, has such a wide variety of gem-stones as Sri Lanka (Tables 1 and 2). Unfortunately, however, despite these unique circumstances, gem exploration and exploitation in Sri Lanka are still based on 'scientifically primitive' methods.

Even though gem mining in Sri Lanka has been going on for centuries, the selection of target areas for gem mineral exploration is still based on mere 'hearsay' information from villagers and gem miners. The research input into the gem industry of Sri Lanka has been negligible. In view of the immense potential of gem minerals in Sri Lanka and the valuable foreign exchange that can be earned from gems, the location of new gem fields using modern 'scientific' techniques will be extremely useful, particularly in enhancing the national economy.

In addition to the commonly found gemstones (Tables 1 and 2), minerals such as taaffeite, sinhalite, olivine, and ekanite, which may be useful as index minerals, are associated with gem gravel. The potential of these minerals and valuable elements generally found in the gem gravel such as gold, thorium, uranium, tin, tungsten, platinum, niobium, and tantalum have seldom been considered in terms of the national economy.

There are four types of gem mining in Sri Lanka:

1. Deep mining (*pathal*) — Ratnapura, Balangoda
2. Tunnel mining (*dona*) — Ratnapura, Balangoda, Meetiya-goda
3. River bed mining (*ganga adeema*) — Ratnapura
4. Open pit shallow mining (*pathas*) — Kataragama, Elahera

## GEM INDUSTRY IN SRI LANKA

The uncut gem trade in Sri Lanka is controlled by three groups: the Sri Lankan gem dealers, the Gem Corporation, and foreigners (mainly Thai nationals). The increased involvement of foreigners in the uncut gem trade limits trade opportunities for the Sri Lankan gem dealers and has sharply increased the number of illegal trade transactions.

There are four types of venues for trading rough stones in Sri Lanka:

1. The street market is the most common venue for trading rough stones. Buyers and sellers gather at specific places in the morning for transactions in rough stones.
2. Private gem auction is another trading venue for rough stones. Miners organize these auctions. A commission of about 0.5 percent must be given to the auctioneer and another 0.5 percent is distributed among the assistants.
3. Gem dealers purchase rough stones directly from the miners.
4. Miners sell their rough stones directly to the gem dealers.

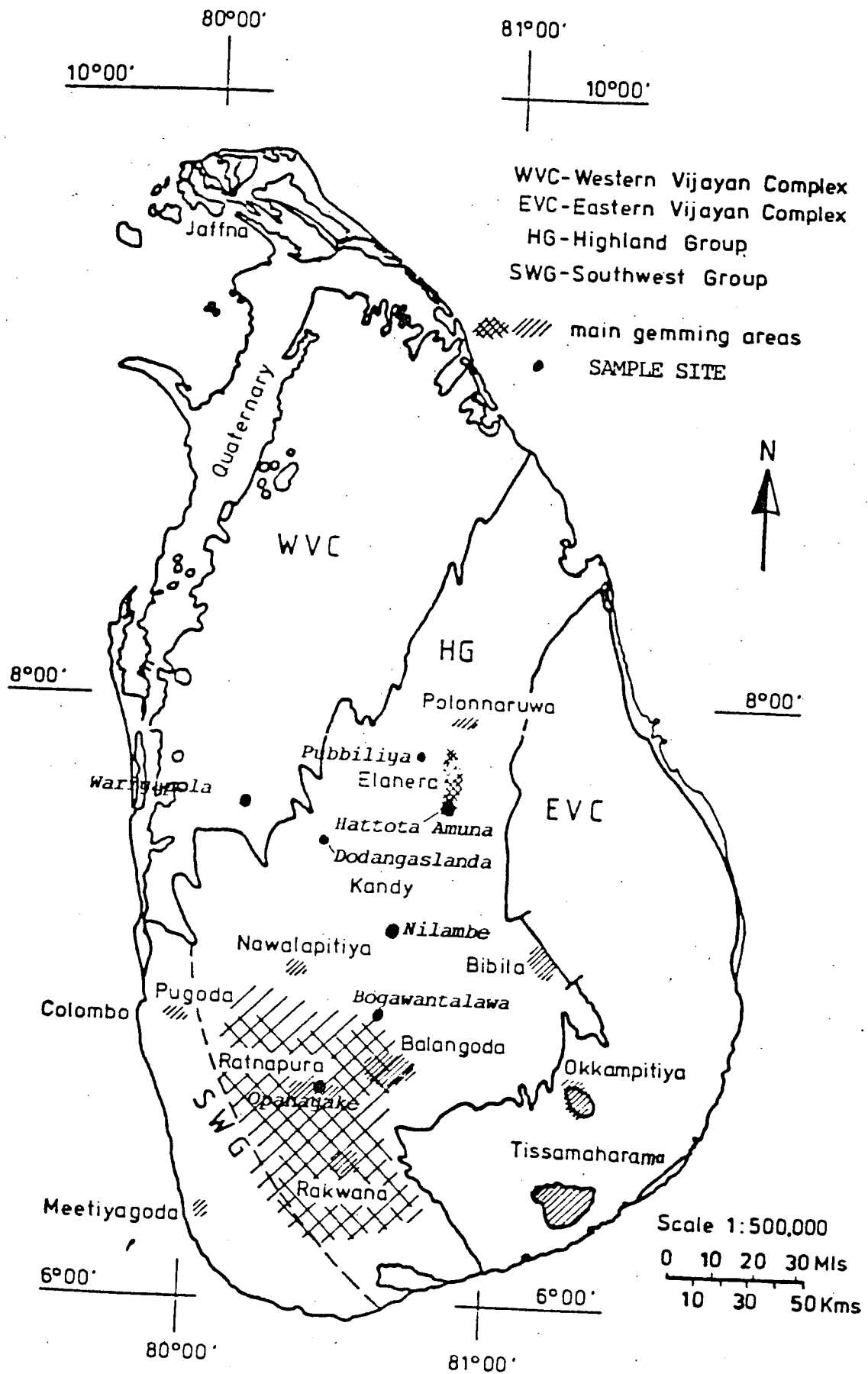


Figure 1. Map of Sri Lanka showing the main geological groups, gemming areas and sample sites.

Table 1. Gemstones Found in Sri Lanka.

Mineral	Chemical formula	Variety
<b>Silicates</b>		
Feldspar	-	Orthoclase Moonstone
Olivine	(Mg,Fe) <sub>2</sub> SiO <sub>4</sub>	-
Garnet	Mg <sub>3</sub> Al <sub>2</sub> [SiO <sub>4</sub> ] <sub>3</sub> Fe <sub>3</sub> Al <sub>2</sub> [SiO <sub>4</sub> ] <sub>3</sub> Ca <sub>3</sub> Al <sub>2</sub> [SiO <sub>4</sub> ] <sub>3</sub> Mn <sub>3</sub> Al <sub>2</sub> [SiO <sub>4</sub> ] <sub>3</sub>	Pyrope Almandine Grossularite Spessartite
Zircon	Zr [SiO <sub>4</sub> ]	-
Titanite (Sphene)	CaTi [O/SiO <sub>4</sub> ]	-
Andalusite	Al <sub>2</sub> [O/SiO <sub>4</sub> ]	-
Sillimanite (Fibrolite)	Al <sub>2</sub> [SiO <sub>3</sub> ]	-
Topaz	Al <sub>2</sub> [F <sub>2</sub> /SiO <sub>4</sub> ]	-
Kornerupine	Mg <sub>4</sub> Al <sub>6</sub> [(O,OH) <sub>2</sub> /BO <sub>4</sub> /(SiO <sub>4</sub> ) <sub>4</sub> ]	-
Danburite	CaB <sub>2</sub> (SiO <sub>4</sub> ) <sub>2</sub>	-
Epidote	Ca <sub>2</sub> (Fe,Al) Al <sub>2</sub> [O/OH/SiO <sub>4</sub> [Si <sub>2</sub> O <sub>7</sub> ]	-
Ekanite	K (Ca,Na) <sub>2</sub> Th [Si <sub>8</sub> O <sub>20</sub> ]	-
Beryl	Al <sub>2</sub> Be <sub>3</sub> [Si <sub>6</sub> O <sub>18</sub> ]	Aquamarine
Cordierite (Iolite)	Mg <sub>2</sub> Al <sub>3</sub> [Al Si <sub>5</sub> O <sub>18</sub> ]	-
Tourmaline	(Na,Ca) (Li,Mg,Fe,Al) <sub>9</sub> B <sub>3</sub> Si <sub>6</sub> (O,OH) <sub>31</sub>	Schrol
Axinite	Ca <sub>2</sub> (Mn,Fe) Al <sub>2</sub> [BO <sub>3</sub> OH/Si <sub>4</sub> O <sub>12</sub> ]	Uwait
Pyroxene	LiAl [Si <sub>2</sub> O <sub>6</sub> ] Mg <sub>2</sub> [Si <sub>2</sub> O <sub>6</sub> ] (Fe,Mg) <sub>2</sub> [Si <sub>2</sub> O <sub>5</sub> ] CaMg (SiO <sub>3</sub> ) <sub>2</sub>	Spodumene Enstatite Hypersthene Diopside
Scapolite	(Na,Ca) <sub>8</sub> [(Cl <sub>2</sub> ,SO <sub>4</sub> ,CO <sub>3</sub> ) <sub>1-2</sub> (Al <sub>1-2</sub> Si <sub>3-2</sub> O <sub>8</sub> ) <sub>6</sub> ]	-
<b>Haloids</b>		
Fluorite	CaF <sub>2</sub>	-

[Continued on next page.]

Mineral	Chemical formula	Variety
<b>Sulphides</b>		
Chalcopyrite		Cu Fe S <sub>2</sub>
Marcasite	Fe S <sub>2</sub>	-
Pyrites	Fe S <sub>2</sub>	-
<b>Oxides</b>		
Quartz	SiO <sub>2</sub>	Rock crystal, Amethyst, Rose-quartz, Smoky-quartz, Brown quartz, Citrine
Quartz with inclusions	SiO <sub>2</sub>	Quartz — Cat's Eye Quartz — Tiger's Eye
Quartz (Cryptocrystalline)	SiO <sub>2</sub>	Chalcedony, Asper, Agate
Chrysoberyl	BeAl <sub>2</sub> O <sub>4</sub>	Chrysoberyl Cat's Eye
Spinel	MgAl <sub>2</sub> O <sub>4</sub>	Caylonite
Taaffeite	Al <sub>4</sub> MgBeO <sub>8</sub>	-
Corundum	Al <sub>2</sub> O <sub>3</sub>	Ruby, Star Ruby, Sapphire, Star Sapphire, Yellow Sapphire, Pink Sapphire, <i>Padmaraga</i>
Rutile	TiO <sub>2</sub>	-
<b>Carbonates</b>		
Calcite	CaCO <sub>3</sub>	-
<b>Phosphates</b>		
Apatite	Ca(F,Cl, OH) Ca <sub>4</sub> (PO <sub>4</sub> ) <sub>3</sub>	-
Monazite	Ce(PO <sub>4</sub> )	-
<b>Borates</b>		
Sinhalite	Mg Al(BO <sub>4</sub> )	-
<b>Tungsten</b>		
Scheelite	CaWO <sub>4</sub>	-

Table 2. Varieties of gems exported privately in 1984, 1985, and 1986 (in carat).

Variety	1984	1985	1986
Blue Sapphire	54379.42	47260.71	55976.87
Star Sapphire	183346.67	192154.74	251378.40
Ruby	2287.49	1834.75	1563.55
Star Ruby	6655.22	4445.76	3824.60
Cat's Eye	32447.57	24466.81	28751.89
Alexandrite	895.93	832.12	645.68
Blue Star Sapphire	32907.15	53427.70	60895.86
Yellow Star Sapphire	289.40	2431.04	8345.53
Pink Star Sapphire	5323.62	3573.44	15858.28
Yellow Sapphire	30577.36	47608.56	137875.18
Pink Sapphire	6616.12	5163.59	7949.56
Fancy Sapphire	21291.73	20474.59	16077.54
Orange Sapphire	629.17	448.73	586.70
Purple Sapphire	-	-	117.25
White Sapphire	13944.95	565.61	1254.29
Sapphire mixed	1008.39	4738.68	191511.23
Golden Sapphire	337.53	51.52	119.02
Green Sapphire	-	10.22	89.53
Violet Sapphire	-	26.25	214.32
Quartz	-	16874.26	56280.77
Topaz	630794.03	1244618.26	3191338.35
<i>Padmaraga</i>	1247.33	1472.33	1548.06
Garnet	27440.46	40382.93	33273.17
Moonstone	191747.27	226714.26	345631.68
Spinel	7718.00	9675.74	9743.50
Chryoberyl	2092.63	1546.67	1877.33
Sinhalite	-	479.35	782.65
Zircon	10753.07	8999.14	7594.26
Amethyst	3257.94	4750.27	8348.83
Aquamarine	-	3886.80	2852.98
Tourmaline	16475.37	12974.05	6075.38
Beryl	-	-	351.77
Others	322372.18	77715.30	47795.02
Opal	-	-	7.19
Diamond	-	-	6.15
Sapphire	48830.94	192877.39	-