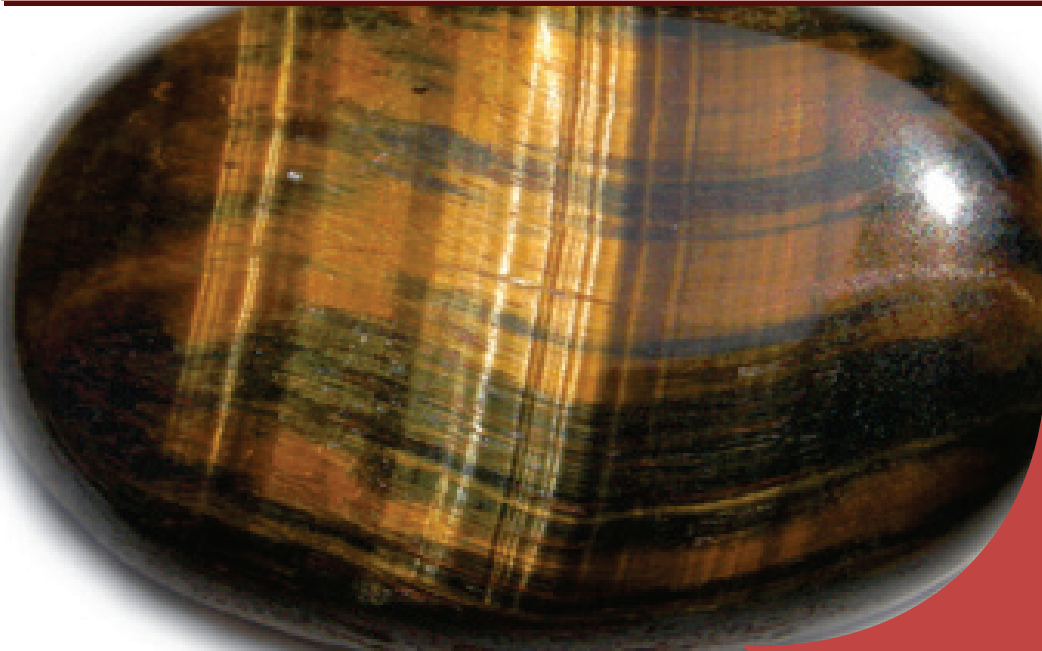




Commonly Encountered Gemstones



GEM TESTING LABORATORY

**DEPARTMENT OF MINING AND GEOLOGY
GOVERNMENT OF KERALA**

2010



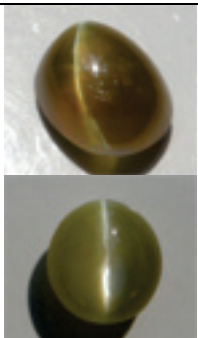
Commonly Encountered Gemstones

A mineral is a naturally occurring, inorganic, homogeneous substance with a definite chemical composition and a regular three dimensional arrangement of atoms. A rock is an aggregate of minerals. From time immemorial several minerals and rocks have been used as gemstones. Nowadays not only minerals and rocks, any material, say metallic, amorphous, synthetic, organic or inorganic, that has substantial beauty, rarity and durability and can be fashioned into a desirable and attractive form is being used as a gem.

The table given below shows the gem varieties of some of the minerals/rocks commonly used as gemstones. The photos of the gemstones in the table below have been captured in the Gem Testing Lab of the Department.

Name of mineral	Chemical composition	Hardness	Gem Varieties (Indian Names, if any)	
Andalusite	Al_2SiO_5	7 - 7.5	1) Andalusite (brown, yellow)	
			2) Viridine (green)	
			3) Chiasolite (black cross-like core in a dark brown background)	
Apatite	$\text{Ca}_5(\text{PO}_4)_3 (\text{F}, \text{Cl}, \text{O}, \text{OH})_3$	5	1) Apatite (white, rose, orange, yellow, red, pink, blue, green)	
			2) Apatite cat's eye	
Azurite	$\text{Cu}_3(\text{CO}_3)_2 (\text{OH})_2$	3.5 - 4	Azurite (light blue to dark blue)	
Beryl	$\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$	7.5 - 8	1) Emerald (green) <i>Marathakam / Panna</i>	
			2) Aquamarine (blue) <i>Beruj</i>	
			3) Heliodor (golden, yellow)	
			4) Morganite (pink)	
			5) Bixbite (red)	
			6) Maxixe Beryl (deep blue)	



Name of mineral	Chemical composition	Hardness	Gem Varieties (Indian Names, if any)	
			[fading])	
			7) Goshenite (colourless)	
			8) Beryl cat's eye	
			9) Star Beryl	
			10) Parti – coloured Beryl	
			11) Trapiche emerald (green with black intersecting spokes)	
Calcite	CaCO ₃	3	1) Calcite (white, yellow, brown, pink, blue) 2) Iceland spar (colourless)	
Charoite (rock) Aggregate of minerals like charoite, aegirineaugite, feldspar and tinaksite	..	5 - 6	Charoite (purple with spots of black, white, grey, brown, orange)	
Chrysoberyl	BeAl ₂ O ₄	8.5	1) Chrysoberyl (green, yellow, brown) <i>Karketak</i>	
			2) Chrysoberyl cat's eye (green, yellow, brown) <i>Vaiduryam/ Lasuniya/ Bidalaksh</i>	
			3) Alexandrite (green in daylight and red in incandescent light)	



Name of mineral	Chemical composition	Hardness	Gem Varieties (Indian Names, if any)	
Chrysocolla	$\text{Cu}_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4$	2 - 4	4) Alexandrite cat's eye	
			Chrysocolla (bluish green, brownish black)	
Corundum	Al_2O_3	9	1) Ruby (red, purplish red) <i>Manikyam / Manak</i>	
			2) Sapphire (all colours- white, yellow, blue, green, brown) <i>Indraneelam / Neelam</i> (blue)/ <i>Manjapushyaragam / Pushkraj</i> (yellow)	    
			3) Padparadscha (pinkish orange) <i>Padmapradasha</i>	
			4) Star Ruby / Sapphire	



Name of mineral		Chemical composition	Hardness	Gem Varieties (Indian Names, if any)	
					
				5) Colour changing Sapphire	
				6) Parti-coloured Sapphire	
				7) Trapiche Ruby / Sapphire (with six intersecting spokes)	
Diamond		C	10	1) Diamond (all colours) <i>Vajram / Heera</i>	
				2) Chameleon Diamond (yellow in dark and green in daylight)	
				3) Carbonado/Bort (cryptocrystalline)	
Diopside		MgCaSi ₂ O ₆	5.5 – 6.5	1) Diopside (yellow, black, brown, colourless) Star Diopside Diopside cat's eye	
				2) Chrome Diopside (bright green)	
				3) Violane (violet blue)	
Feldspar	Orthoclase	KAlSi ₃ O ₈	6 – 6.5	Moonstone (white, yellow, pink) Moonstone cat's eye Star Moonstone	
	Microcline	KAlSi ₃ O ₈	6 – 6.5	Amazonite (green, blue,	

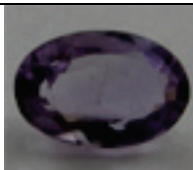


Name of mineral		Chemical composition	Hardness	Gem Varieties (Indian Names, if any)	
				white, brownish red)	
	Plagioclase	(Na, Ca)Al(Al, Si)Si ₂ O ₈	6 – 6.5	1) Labradorite (white/ grey/ yellow with play of colour) Labradorite cat's eye Star Labradorite	
				2) Sunstone Sunstone cat's eye Star Sunstone	
Fluorite		CaF ₂	4	1) Fluorite (all colours)	
				2) Blue John (massive with blue or purple bands)	
Garnet	Pyrope	Mg ₃ Al ₂ Si ₃ O ₁₂	7 – 7.5	Pyrope (red, colourless, orange red) Star Pyrope <i>Tambda</i>	
	Almandine	Fe ₃ Al ₂ Si ₃ O ₁₂	7 – 7.5	Almandine (red, purplish red, brownish black) Star Almandine <i>Tambda</i>	
	Spessartine	Mn ₃ Al ₂ Si ₃ O ₁₂	7 – 7.5	Spessartine (orange, reddish orange, yellowish brown) Spessartine cat's eye	
	Grossular	Ca ₃ Al ₂ Si ₃ O ₁₂	6.5 - 7	1) Hessonite (orange brown, orange yellow) <i>Gomedakam / Gomed</i>	
				2) Tsavorite (green)	
				3) Hydrogrossular (green, pink, white)	
	Andradite	Ca ₃ Fe ₂ Si ₃ O ₁₂	6.5 - 7	1) Demantoid (green)	
				2) Topazolite (yellow)	
	Uvarovite	Ca ₃ Cr ₂ Si ₃ O ₁₂	6.5 - 7	3) Melanite (black and opaque) Uvarovite (green, yellow)	



Name of mineral		Chemical composition	Hardness	Gem Varieties (Indian Names, if any)	
	Pyrope-Almandine	Intermediate variety	7.25	Pyrope-Almandine (purplish red) (Rhodolite)	
	Pyrope-Spessartine	„	7.25	Pyrope-Spessartine (bluish green in daylight and purplish red in incandescent light)	
	Grossular-Andradite	„	..	Grossular-Andradite (green, yellow, brown) (Mali Garnet / Grandite)	
Haematite		Fe ₂ O ₃	5 - 6	Haematite (steel-grey to iron black) <i>Gun Metal</i>	
Iolite (Cordierite)		(Mg,Fe ³⁺) ₂ Al ₄ Si ₅ O ₁₈	7 – 7.5	1) Iolite (blue, purple) <i>Kakaneeli</i> Star Iolite Iolite cat's eye	
				2) Blood Shot Iolite (Iolite with red hematite inclusions)	
Jade	Jadeite	NaAlSi ₂ O ₆	6.5 – 7	Jadeite Jade (white, green, lilac, pink, yellow, black, brown) Imperial Jade (emerald green) <i>Markal, Chashak</i>	
	Nephrite	Ca ₂ (Mg, Fe) ₅ Si ₈ O ₂₂ (OH) ₂	5 – 6	Nephrite Jade (green, brown, grey, black, yellow) Nephrite cat's eye	
Kornerupine		Mg ₃ Al ₆ (Si, Al, B) ₅ O ₂₁ (OH)	6 - 7	Kornerupine (green, brownish yellow) Star Kornerupine Kornerupine cat's eye	
Kyanite		Al ₂ SiO ₅	4 – 7.5	Kyanite (blue, green, pink, yellow, black, colourless) Kyanite cat's eye	
Lapis Lazuli (rock) Aggregate of minerals like Hauynite, Noselite, Lazurite		..	5.5	Lapis Lazuli (blue, greenish blue) <i>Lajwant</i>	

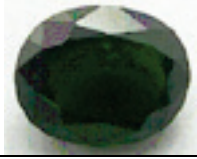


Name of mineral	Chemical composition	Hardness	Gem Varieties (Indian Names, if any)	
Malachite	$\text{Cu}_2\text{CO}_3(\text{OH})_2$	3.5 - 4	Malachite (green, yellowish green, bluish green) <i>Dana firang</i>	
Olivine	$\text{Mg}_2\text{SiO}_4 - \text{Fe}_2\text{SiO}_4$	6.5 - 7	Peridot (olive green, green) Peridot cat's eye	
Opal	$\text{SiO}_2 \cdot n\text{H}_2\text{O}$	5.5 - 6.5	1) White Opal (with play of colour)	
			2) Fire Opal (orange, with/without play of colour)	
			3) Black Opal (with play of colour)	
			4) Water Opal (colourless stone with play of colour)	
			5) Potch Opal (white with no play of colour)	
			6) Boulder Opal	
			7) Matrix Opal	
			8) Opal cat's eye	
Pyrite	FeO_2	6 - 6.5	Pyrite (brassy yellow, yellow)	
Quartz	SiO_2	7	1) Rock crystal (colourless) <i>Sphadik</i>	
			2) Amethyst (purple, violet) <i>Katela</i>	
			3) Citrine (yellow) <i>Sunela</i>	



Name of mineral	Chemical composition	Hardness	Gem Varieties (Indian Names, if any)	
			9) Agate (curved bands)	
			10) Moss Agate (dendritic)	
			11) Fire Agate (iridescence)	
			12) Onyx (straight bands)	
			13) Sardonyx (brown)	
			14) Jasper (red, yellow, black)	
Rhodochrosite	MnCO ₃	4	Rhodochrosite – banded (pink, grey, brown) - transparent (pink, red)	
Rhodonite	MnSiO ₃	6	Rhodonite (pinkish red, orange red, brownish red, massive- pink with black veins)	
Scapolite	(Na,Ca) ₄ Al ₃ (Al, Si) ₃ Si ₆ O ₂₄ (Cl, F,OH, CO ₃ , SO ₄)	6	Scapolite (all colours) Star Scapolite	
Sillimanite	Al ₂ SiO ₅	6.5 – 7.5	Sillimanite (all colours) Sillimanite cat's eye (all colours) Star Sillimanite	
Sphene	CaTiSiO ₅	5 - 5.5	Sphene (yellow, green, brown, colourless) Star Sphene	



Name of mineral	Chemical composition	Hardness	Gem Varieties (Indian Names, if any)	
Spinel	$MgAl_2O_4$	7.5 – 8	1) Spinel (all colours)	
			2) Star Spinel	
			3) Colour changing Spinel	
Sapphirine	$Mg_{3.5}Al_{9.0}Si_{1.5}O_{20}$	7.5	Sapphirine (blue, green, greenish grey)	
Spodumene	$LiAlSi_2O_6$	6.5 – 7.5	1) Spodumene (colourless, blue, yellow, yellowish green)	
			2) Kunzite (pink, purple)	
			3) Hiddenite (green, bluish green)	
Staurolite	$Fe_2Al_9Si_4O_{22}(OH)_2$	7 – 7.5	Staurolite (brown, yellowish brown)	
Taaffeite	$BeMgAl_4O_8$	8 – 8.5	1) Taaffeite (colourless, purple, red, blue)	
			2) Colour changing Taaffeite (bluish in daylight and reddish in incandescent light)	
Topaz	$Al_2SiO_4(F,OH)_2$	8	Topaz (Colourless, blue, orange, pink, red, brown, yellow) Topaz cat's eye	
Tourmaline	$(Na, Ca)(Li, Mg, Fe, Al)_9B_3Si_6(O, OH)_{31}$	7- 7.5	1) Tourmaline (all colours)	 
			2) Parti-coloured Tourmaline (watermelon tourmaline)	
			3) Tourmaline cat's eye	
			4) Colour changing Tourmaline	



Name of mineral	Chemical composition	Hardness	Gem Varieties (Indian Names, if any)	
Turquoise	$\text{CuAl}_6(\text{PO}_4)_4(\text{OH})_8 \cdot 4-5\text{H}_2\text{O}$	5 - 6	Turquoise (blue to green, yellowish green, greenish blue) <i>Phiroza</i>	
Zircon	ZrSiO_4	7 - 7.5	Zircon (all colours) Zircon cat's eye	
Zoisite	$\text{Ca}_2\text{Al}_3\text{Si}_3\text{O}_{12}\text{OH}$	6.5 - 7	1) Tanzanite (blue)	
			2) Thulite (pink)	
			3) Anyolite (green with translucent rubies)	
			4) Zoisite (yellow, brown, violet)	
			5) Zoisite cat's eye	

Organic Gem

An organic gem is one that was made by living things, present or past. Examples include pearls, coral, jet, ivory, shell, ammolite etc. Such gems consist of the molecules formed by the organism, although these molecules may have been altered somewhat due to compression or other geological or chemical forces.

Synthetics and Simulants

Several of these gemstones are synthesized for commercial purposes. Synthetic gemstones correspond to their naturally occurring counterparts in crystal structure, physical, chemical and optical properties. Usually natural stones are distinguished from synthetic stones with the help of inclusions present.

Simulants are imitation gems that look like the natural or synthetic gems they imitate, but do not have the physical, chemical and optical properties of the gems they mimic. Two common gem simulants are **glass** and **plastic**.

Methods used for synthesis of gemstones	Gemstones synthesized
Flame fusion (Verneuil)	Synthetic Ruby/Sapphire Synthetic Spinel
	Synthetic Emerald Synthetic Ruby/Sapphire Synthetic Spinel



Methods used for synthesis of gemstones	Gemstones synthesized
Flux Fusion	Synthetic Chrysoberyl cat's eye Synthetic Alexandrite Synthetic Alexandrite cat's eye Synthetic Diamond
Hydrothermal	Synthetic Emerald Synthetic Beryl Synthetic Ruby/Sapphire Synthetic Quartz
Czochralski Pulling	Synthetic Ruby/Sapphire Synthetic Alexandrite Gadolinium Gallium Garnet Yttrium Aluminium Garnet
Skull Melting	Synthetic Cubic Zirconia
Carbon Vapour Deposition Method	Synthetic Diamond
Gel Growth Process	Synthetic Opal
Ceramic Techniques	Lapis Lazuli Turquoise Coral Jade

Treatments

Several treatments are done on gemstones to improve their colour, clarity and durability, thereby enhancing the general appearance and beauty of the stones. The common treatments done are:

Sl. No.	Treatments	Gemstones usually treated
1	Bleaching	Pearl, Coral, Jade, Tiger's eye, Ivory
2	Coating and foiling	Topaz, Quartz, Ammolite, Jade
3	Fracture Filling with oil, wax, resins, polymers, glass	Emerald, Corundum, Aquamarine, Iolite, Amethyst, Peridot, Tourmaline, Diamond, Jade, Opal
4	Dyeing (Staining)	Lapis Lazuli, Chalcedony, Corundum, Emerald, Opal, Jade
5	Irradiation	Beryl, Quartz, Sapphire, Diamond, Topaz, Tourmaline, Kunzite, Pearl, Chrysoberyl
6	Heating	Ruby, Sapphire, Chalcedony, Beryl, Diamond, Topaz, Tourmaline, Zoisite, Zircon, Quartz, Jade, Amber



Sl. No.	Treatments	Gemstones usually treated
7	Diffusion	Ruby, Sapphire
8	High pressure high temperature (HPHT)	Diamond
9	Laser drilling	Diamond

Frequently asked questions

1) Which all gemstones form the 'Navratnas'?

- 1) Diamond (Vajram)
- 2) Ruby (Manikyam)
- 3) Sapphire (Indraneelam)
- 4) Yellow Sapphire (Manjapushyaragam)
- 5) Chrysoberyl cat's eye (Vaiduryam)
- 6) Emerald (Marathakam)
- 7) Hessonite Garnet (Gomedakam)
- 8) Pearl (Muthu)
- 9) Red Coral (Pavizham)

2) What is "American diamond"?

"American Diamond" is a man made material called Synthetic Cubic Zirconia with a chemical composition ZrO_2 (Zirconium oxide). It is commonly used as a diamond simulant. Its dispersion value is higher than that of diamond. It can be easily distinguished from diamond.

Properties	Diamond	Synthetic Cubic Zirconia
Hardness	10	8 – 8.5
Specific Gravity	3.52	5.8 – 6.2
Refractive index	2.42	2.15
Dispersion	0.044	0.060

3) What are the factors that can affect the prices of natural gemstones?

- 1) Colour
- 2) Clarity
- 3) Cutting style
- 4) Carat weight or stone size
- 5) Treatments done on the stone
- 6) Distinctness of Phenomena (chatoyancy, aventurescence, asterism, change of colour etc.)
- 7) Place of origin



4) What are synthetic gemstones? What are the commonly encountered synthetic stones?

Synthetic gemstones correspond to their naturally occurring counterparts in crystal structure, physical, chemical and optical properties. Usually natural stones are distinguished from synthetic stones with the help of inclusions present. Some of the stones that are synthetically produced are:

Synthetic Emerald Synthetic Chrysoberyl Synthetic Beryl (red, yellow, blue)
 Synthetic Ruby Synthetic Alexandrite Synthetic Quartz (purple, yellow)
 Synthetic Sapphire Synthetic Diamond Synthetic Spinel
 Synthetic Opal

Stones like Lapis Lazuli, Turquoise, Coral and Jade are also artificially produced.

5) What are the misnomers/trade names used by gem traders?

Sometimes traders sell a gem under a misleading name usually to make it seem more valuable. Some such misnomers are given below:

Correct name of the gemstone	Misnomer/trade name
Amazonite	Korea jade
Aventurine Quartz	Indian jade
Chalcedony(dyed)	Swiss jade, black onyx
Chrysoberyl	Oriental Sapphire
Chrysoprase	Australian jade
Garnet	California ruby, Cape ruby
Garnet (green)	African jade
Iolite	Water Sapphire, Lux sapphire
Jasper (dark green)	Oregon jade
Jasper (dyed blue)	German lapis/ Swiss lapis
Moonstone	Ceylon opal
Peridot	Evening emerald
Quartz (citrine)	Golden topaz
Quartz (rose quartz)	Bohemian ruby
Quartz (dyed)	Indian emerald
Spinel	Spinel ruby, Spinel sapphire, Balas ruby
Topaz	Brazilian ruby
Tourmaline (green)	Brazilian emerald
Zircon	Ceylon diamond



6) What are the common synthetic gemstones encountered in the Mineralogy and Gem Testing Lab of the department?

Synthetic ruby, Synthetic sapphire, Synthetic spinel and Synthetic cubic zirconia



Synthetic Ruby



Synthetic Sapphire



Synthetic Yellow Sapphire



Synthetic Spinel



Synthetic Cubic Zirconia

7) What is “Nagamanikya”?

Nagamanikya (stone obtained from or guarded by snake) is a myth; found only in Indian mythology. The existence of such a stone is just a story spread around by fraudulent people. No standard gemmology text books refer to such a stone.

8) What are the common gemstones found in Kerala?

Kerala does not occupy a prominent place in the gemstone deposit map of India. Meagre deposits of good quality chrysoberyl cat's eye and alexandrite occur in the southern districts of the state. Sporadic occurrences of ruby, sapphire, topaz and aquamarine have been reported.

FOR ADDITIONAL INFORMATION SEND EMAIL TO: gtlgok@gmail.com
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