Fancy Coloured Sapphires:
The Beauty beyond "Blue" of Sapphire and "Red" of Ruby

Dr. Michael S. Krzemnicki
Swiss Gemmological Institute SSEF
Switzerland

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The range of colours...
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The range of colours...
Fancy sapphires:
The colour range beyond red of rubies and blue of sapphires
The range of colours...

Photo: © SilkenEast Ltd, Bangkok

Collection: SilkenEast Ltd, Bangkok
Jewellery with fancy sapphires

Photos © Luc Phan, SSEF

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Corundum

Chemical composition: aluminium oxide, Al₂O₃

Chemical pure aluminium oxide is colourless

In nature always with trace elements (chemical impurities), usually:
- Mg, Ti, V, Cr, Fe, Ga
  - and occasionally rare HFS-elements such as Nb, Sn, Ta, Th

Not all trace elements are affecting the colour (e.g. gallium Ga)

The colouring elements are called chromophores:
- for corundum: Ti, V, Cr, Fe

Corundum colours

The colour in corundum is depending on the presence of colouring elements and in some cases colour centres (especially for yellow).

Fe blue, greenish blue, yellowish green to yellow
Ti + Fe blue
Cr red to pink
V violet (colour change effect)
Mg and colour centre yellow
Mix of chromophores nearly all colour hues of the spectrum!
  (except pure green, only from synthetic corundum).
Corundum colours

We see colours due to partial absorption of light in the stone.

Absorption spectra of blue sapphires.

Corundum varieties

Ruby | red | chromium traces
Sapphire | blue | iron or iron and titanium traces

Fancy sapphires include:
- Padparadscha: subtle orange pink pastel colour, Cr & Fe & Ti & colour centre
- Yellow sapphire: yellow, iron or Mg, Be and colour centre
- Pink sapphire: pink, low chromium traces
- Violet/purple sapphire: violet/purple, Cr & Fe & Ti
- Fancy sapphire: all other colours (greenish, brownish, black, etc...), mix of trace elements and eventually inclusions
Pink sapphires from Madagascar

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Understanding colour

Any colour may be expressed and positioned with coordinates in a three-dimensional colour space such as the CIE Lab system.

Based on
- spectral hue
- saturation
- tone (brightness / darkness)
Understanding colour

The colour is judged by observing the stone from above through the table, using standardised light conditions similar to fancy diamonds, but different to colourless diamonds.

As gemmological experts, gemstone dealers or consumers we categorize colours and give a name to them.

Two approaches:
- naming after spectral colours (hue), adding saturation and tone with a qualifier such as light/dark etc...
- naming with fantasy trade terms, e.g. aubergine, lemon, mint ...

FAQs:
- Which system to use,
- where are the limits of colour ranges
- natural stones may show colour zoning
- pleochroic colours
What is the variety name?

- ruby
- pink sapphire
- purple sapphire

LMHC:
Padparadscha is a variety of corundum from any geographical origin whose colour is a subtle mixture of pinkish orange to orangey pink with pastel tones and low to medium saturations.
Pleochroism in fancy sapphires

Corundum is anisotropic and shows characteristic pleochroic colours (two slightly different colour hues).

Colour zoning in fancy sapphires

Corundum may show distinct colour zoning, which can be very attractive.

Umba, Tanzania

Winza, Tanzania
Colour zoning in fancy sapphires

Colour zoning in fancy sapphires from Marosely, Madagascar

© Laurent Cartier, SSEF

 Colour zoning in fancy sapphires

Colour zoning in sapphire from Diego Suarez, Northern Madagascar

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Colour zoning in fancy sapphires

Vive la France!

Treatment of corundum

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Treatment of corundum

Corundum (rubies, sapphires and fancy sapphires) are often treated to modify their colour and clarity.

- The effect of such a treatment can be quite astonishing.
- Many of these treatments are stable, but not all!
- There is a market for treated gemstone, however

Disclosure is a must (CIBJO)!

Heat treatment of corundum

Difficult to detect with the microscope

- Low temperature heating (<1000 °C), e.g. purplish sapphires become pink when heated in oxidising conditions, effect: colour shift, blue colour component is reduced
- Heating > 1000 °C, e.g. for geuda-type corundum from Ceylon etc., effect: colour modification, reducing visibility of inclusions
- Heating with high refractive glass flux, e.g. lead glass (usually at or below 1000°C), effect: significant enhancement of transparency and colour (and stability)
- Heating with borax flux, e.g. rubies from Mong Hsu (Burma), effect: significant enhancement of transparency and colour
- Heating with titanium or chromium diffusion (shallow), effect: creation of shallow colour zone (blue or red)
- Heating with beryllium diffusion (lattice, bulk), e.g. corundum from Songea (Tanzania), effect: significant colour modification, often yellowish to orange colours.
Heated fancy sapphires

Low temperature heating results in slight colour shifts (removal of blue colour component)

Heated fancy sapphires

Intensifying of the yellow colour possible

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Microscopic features of heated corundum

Molten inclusions forming disc-like patterns

Transformation of zircon inclusions by heating

unheated
ca. 1000 °C
ca. 1400 °C
ca. 1800 °C

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Raman spectra of zircon inclusions in pink sapphires from Ilakaka, Madagascar

Heated 1000°C
Heated 800°C
Heated 400°C
unheated

Beryllium diffusion treated corundum

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Detection of Be-diffusion at SSEF: GemLIBS

beryllium diffusion treated corundum detected with GemLIBS.

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Where do the fancy sapphires come from...

Fancy sapphires are found in many places, some of them mostly famous for rubies and sapphires, such as the Mogok gemstone tract in Burma or the gemstone deposits near Ratnapura in Ceylon.

Other important sources are Ilakaka in Madagascar, and Tunduru, Songea and Umba in Tanzania.

Many basaltic (volcanic) deposits produce fancy sapphires (mostly greenish and yellow) together with sapphires, e.g. in Australia, Laos, N-Madagascar; N-America (Montana) etc.

A guide to the world's major sources of coloured gemstones, diamonds and pearls. GemExplorer: a free App available in iTunes, for more details see www.ssef.ch
East Africa

The Umba valley, Northern Tanzania

© Swiss Gemmological Institute SSEF
The Umba valley, Northern Tanzania

Small mining operation in the Umba valley.
Matombo (Uluguru Mountains) Morogoro Province

Fancy sapphires on their long way...

© Walter Balmer
From the source

Sunset near Umba valley, Tanzania

To the market

Sunset from the Peak, Hong Kong
Thank you for your attention

www.ssef.ch  gemlab@ssef.ch  Visit us at our booth: 3CON-056