Hong Kong, March 2011

Fancy Coloured Sapphires:

The Beauty beyond "Blue" of Sapphire and "Red" of Ruby

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Switzerland

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The range of colours...

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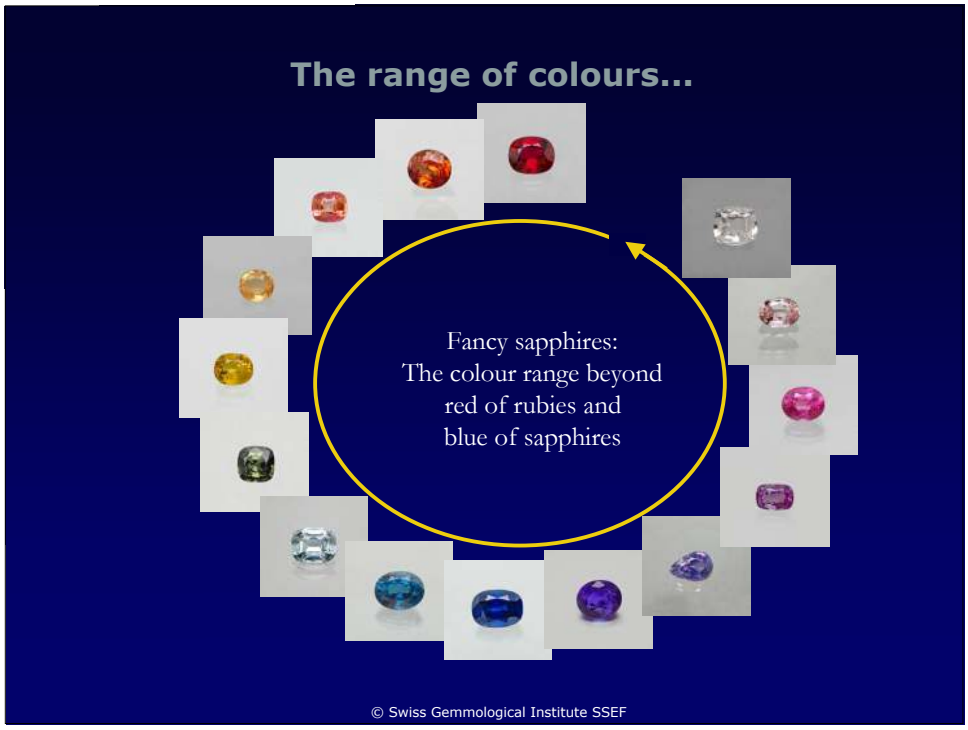
The range of colours...
Fancy sapphires:
The colour range beyond
red of rubies and
blue of sapphires
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The range of colours...

Photo: © SilkenEast Ltd, Bangkok

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The range of colours...

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Jewellery with fancy sapphires

Photos © Luc Phan, SSEF

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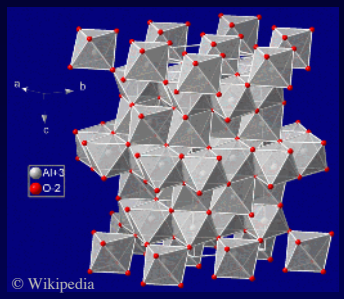
Corundum



© Wikipedia

Chemical composition: aluminium oxide, Al_2O_3

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

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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).

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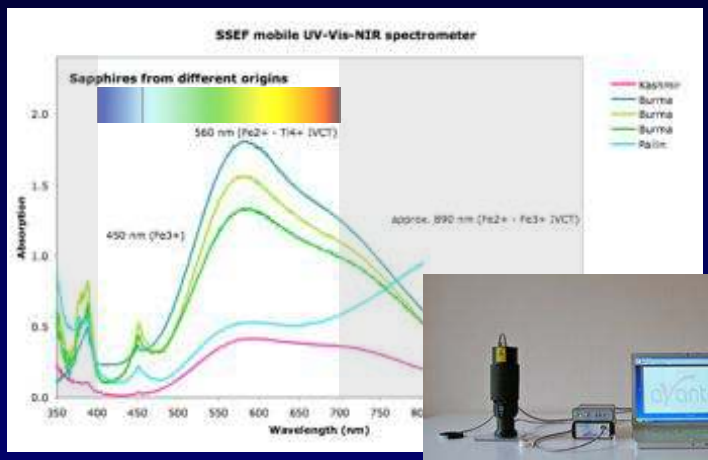
Corundum colours

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



Absorption spectra of blue sapphires.

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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

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Pink sapphires from Madagascar

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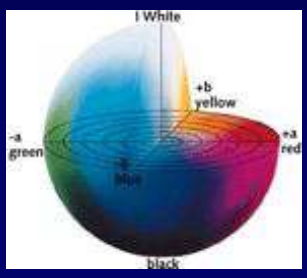
Understanding colour

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)



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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.

Photo © H.A. Hänni, SSEF

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Understanding colour

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

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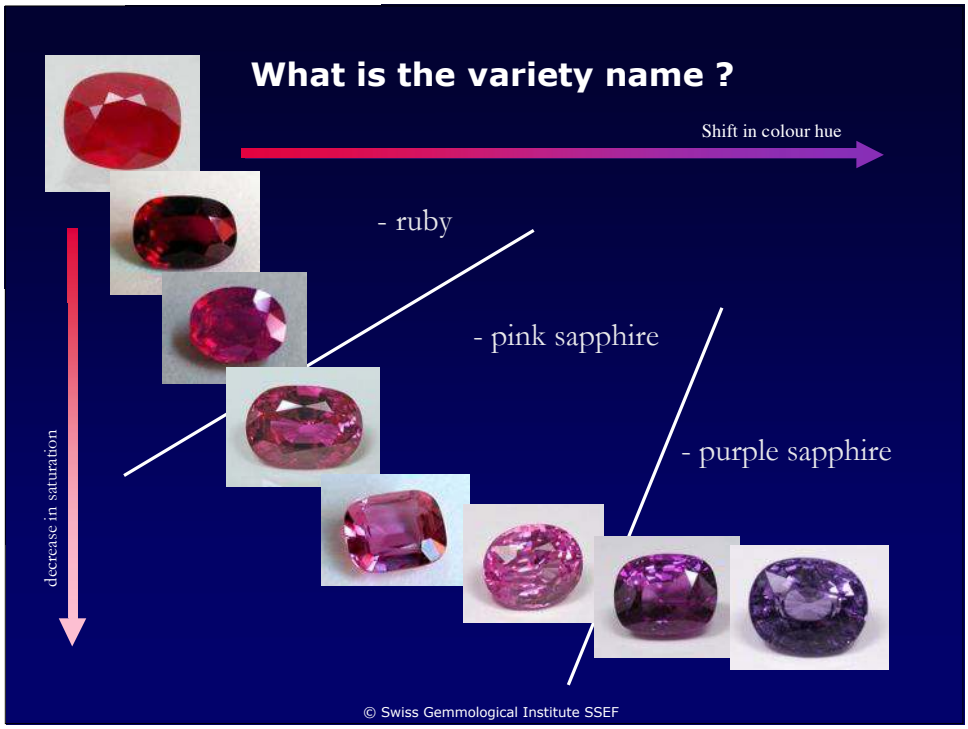
What is the variety name ?
Shift in colour hue
decrease in saturation
- ruby
- pink sapphire
- purple sapphire
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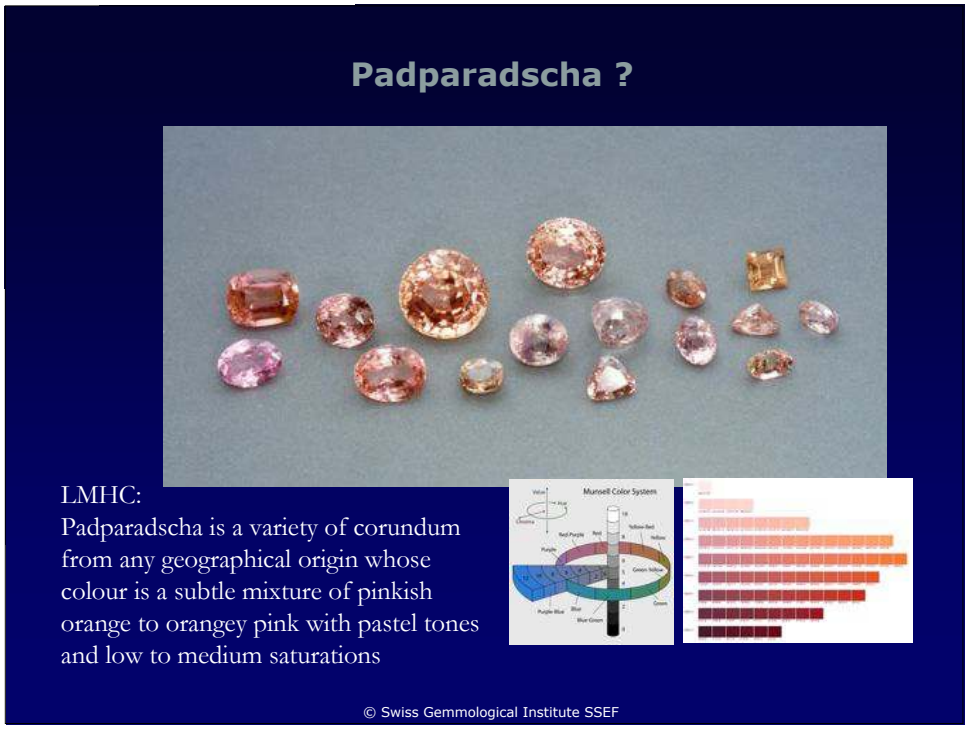
Padparadscha ?
LMHC:
Padparadscha is a variety of corundum from any geographical origin whose colour is a subtle mixture of pinkish orange to orangey pink with pastel tones and low to medium saturations
Munsell Color System
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Pleochroism in fancy sapphires

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

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Colour zoning in fancy sapphires

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

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Colour zoning in fancy sapphires

Colour zoning in fancy sapphires from Marosely, Madagascar

© Laurent Cartier, SSEF

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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!

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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)!

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Heat treatment of corundum

Difficult to detect with the microscope

Heating

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 flux

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 diffusion

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.

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Heated fancy sapphires

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

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Heated fancy sapphires

Intensifying of the yellow colour possible

Before...

After...

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Microscopic features of heated corundum

Molten inclusions forming disc-like patterns

Photos © H.A. Hänni, SSEF

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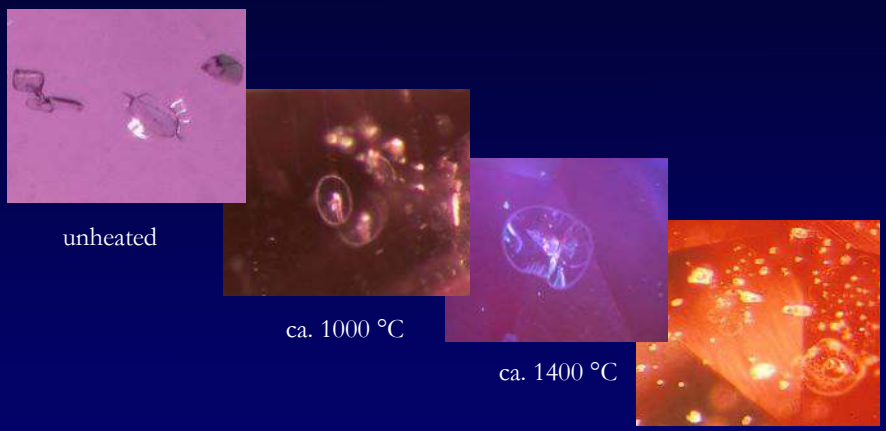
Microscopic features of heated corundum

Transformation of zircon inclusions by heating



unheated

ca. 1000 °C

ca. 1400 °C

ca. 1800 °C

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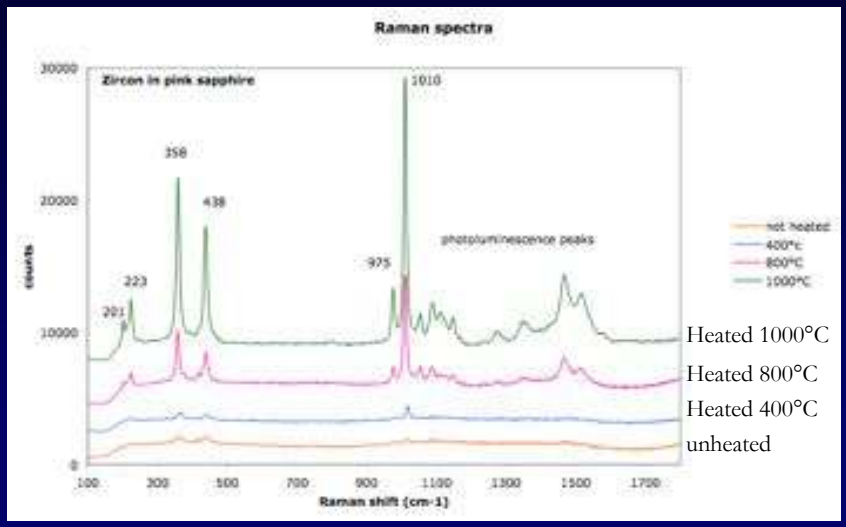
Raman spectra of zircon inclusions in pink sapphires from Ilakaka, Madagascar



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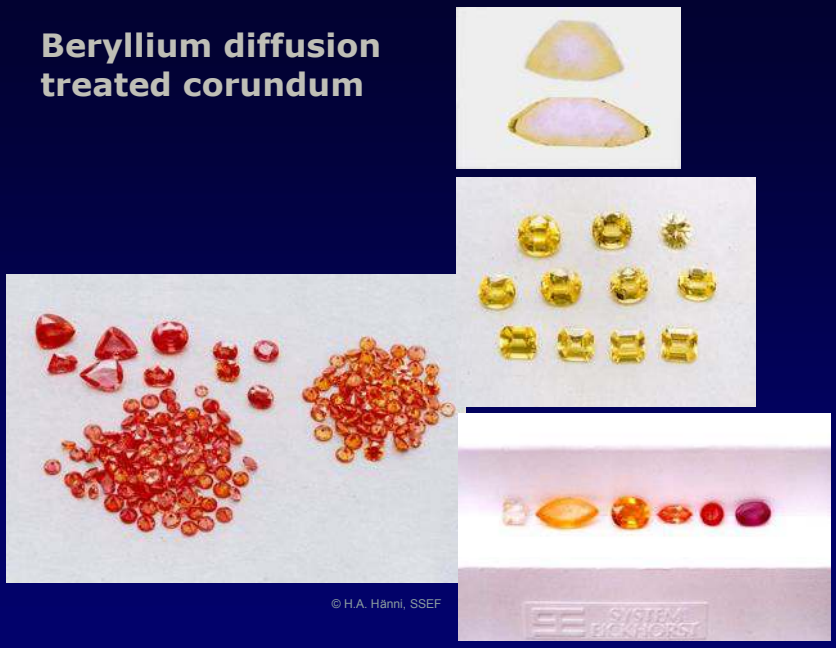
Beryllium diffusion treated corundum



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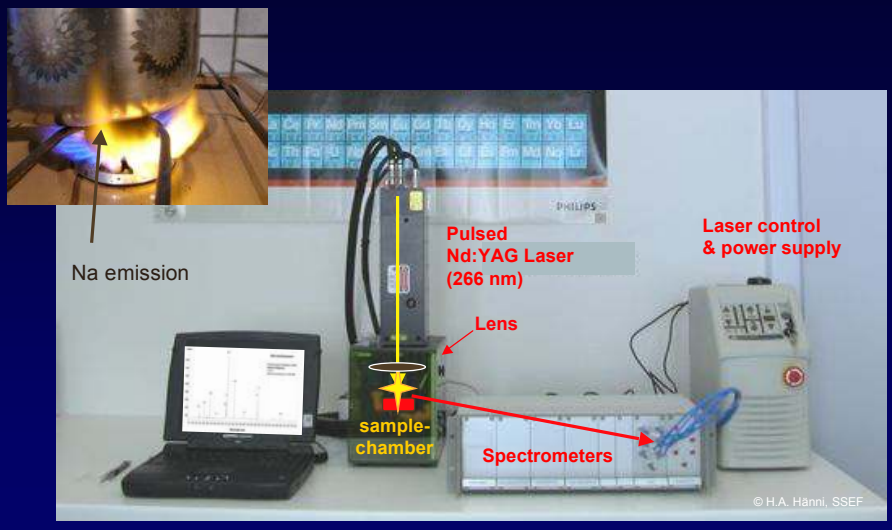
Detection of Be-diffusion at SSEF: GemLIBS



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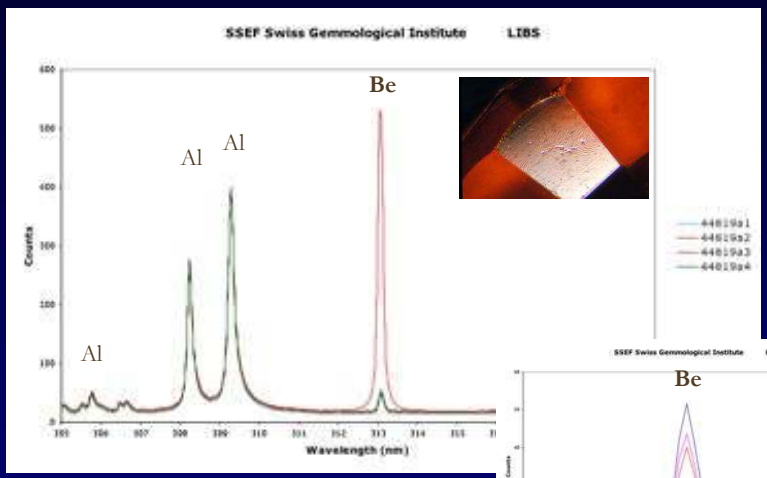
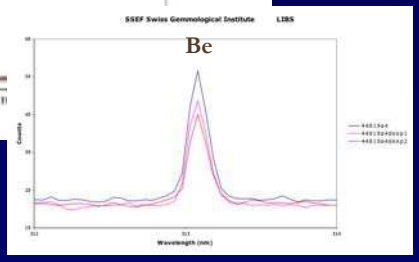
Detection of Be-diffusion at SSEF





beryllium diffusion treated corundum detected with GemLIBS.

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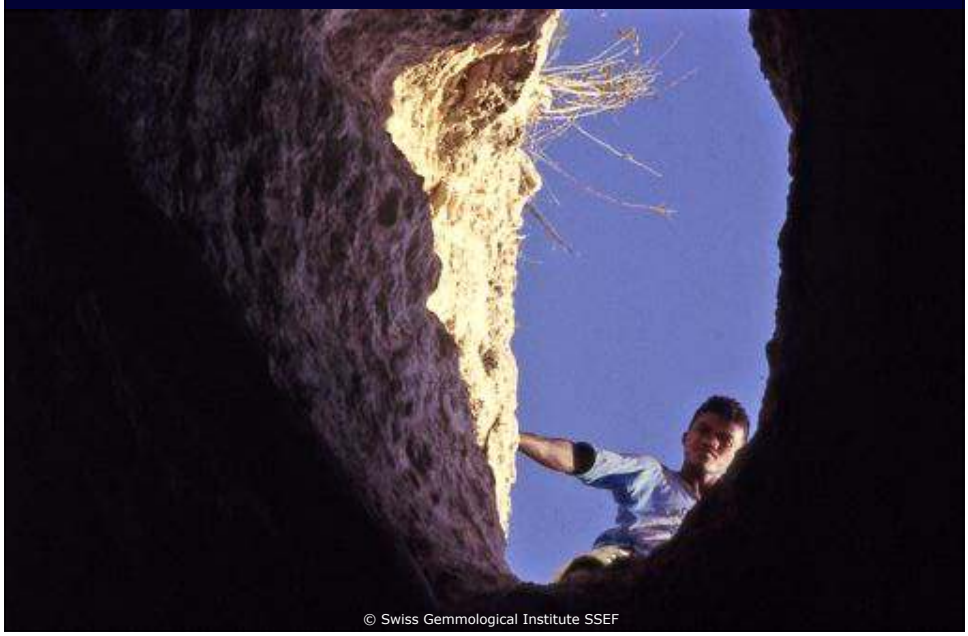
Where do the fancy sapphires come from…



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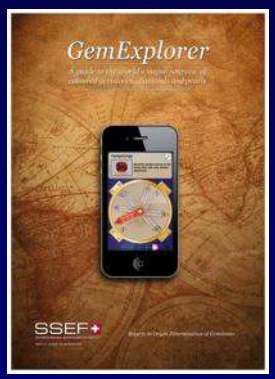
Where do the fancy sapphires come from…

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

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East Africa

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The Umba valley, Northern Tanzania

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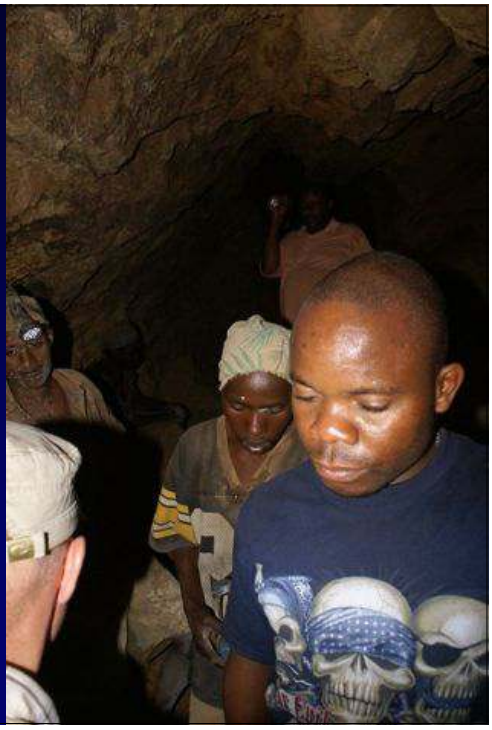
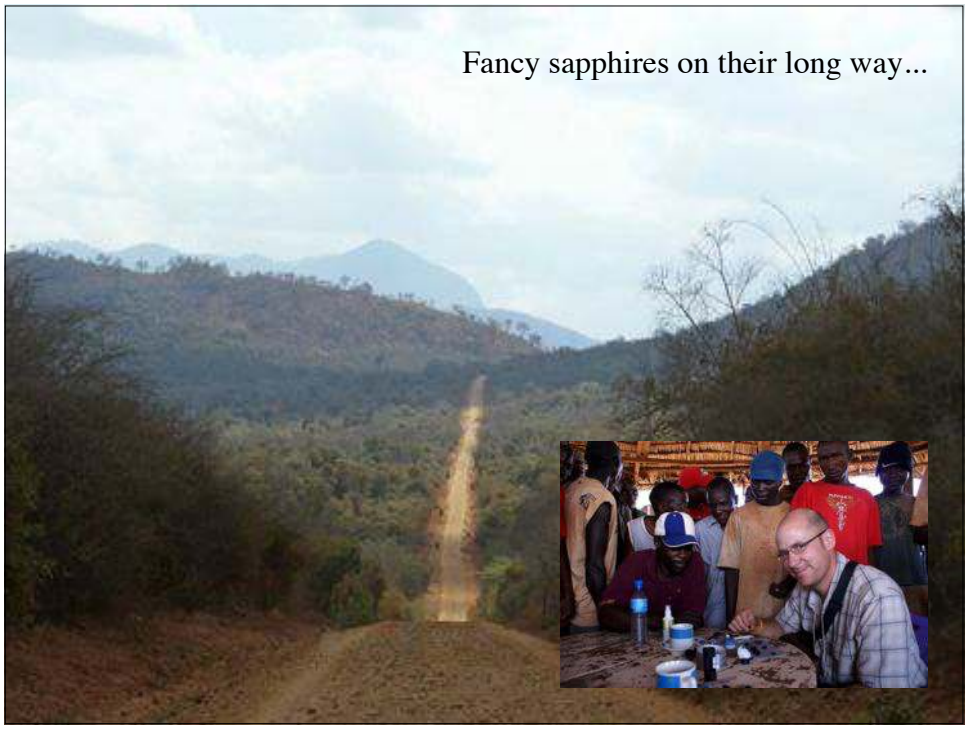
The Umba valley, Northern Tanzania

Small mining operation in the Umba valley




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

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