Sapphires from a New Deposit at Bemainty near Ambatondrazaka in Madagascar

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Madagascar—island of new gem troves in the last few decades—has seen another *sapphire rush* in recent months after the discovery of a gem deposit at Bemainty, about 35 kilometers east of the small town of Ambatondrazaka in eastern Madagascar (Perkins 2016, Krzemnicki 2017, Pardieu et al. 2017).

With about 50,000 artisanal miners working the gravels of this secondary alluvial deposit since September 2016 (Perkins 2016), this new site has so far reportedly produced quite an impressive amount of mainly blue sapphires, including some large rough stones up to 30 grams of exceptional quality. Interestingly, they show quite variable characteristics, from dark blue and a Burma-like appearance to attractive velvety blue stones visually competing with sapphires from Kashmir, indicating not a single source of these sapphires, but an accumulation of sapphires from several different primary host rocks within these gravel beds.

Additionally, a number of padparadscha to fancy colored sapphires have been reported. These stones of fine quality are currently arriving in the gem market in larger quantities, part of them having been treated (heated) to improve their color and clarity.

Attractive new sapphires with variable characteristics

The Swiss Gemmological Institute SSEF recently analyzed a large number of sapphires and fancy sapphires from this new deposit ranging in size from 1.3 to 50 carats (Figure 1). Most of the sapphires from Bemainty we analyzed so far at SSEF were rather pure with a medium strong to strong blue color, partially with a slight grayish to greenish tint.

Figure 1. Exceptional quality and size (left, 30 cts, right, 13 cts) of "Kashmir-like" sapphires from Bemainty near Ambatondrazaka in Madagascar. (Photo: SSEF)

Absorption spectroscopy revealed that these sapphires can be separated into two categories, both of metamorphic origin, with one group of sapphires exhibiting only small absorption features by Fe^{3+} and somehow reminiscent of sapphires from Kashmir (and Sri Lanka) by their velvety *milkyness*. The other group consists of mostly saturated blue sapphires with rather distinct Fe^{3+} related absorption features, also known among other from sapphires from Myanmar (Burma) (Figure 2).

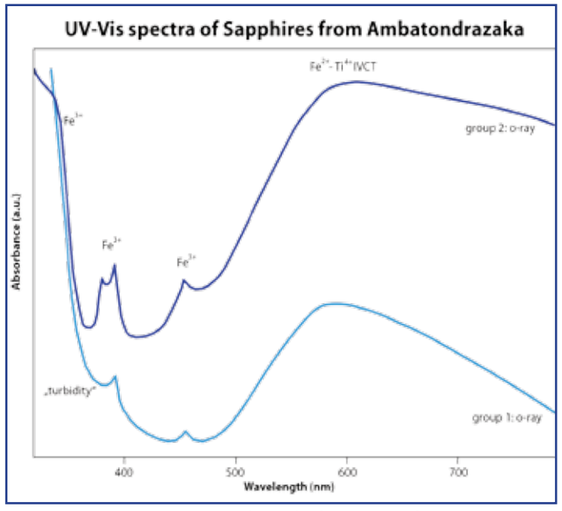

Figure 2. Absorption spectra (o-ray) of sapphires from Ambatondrazaka studied at SSEF. Group 1 sapphires are characterized by velvety *milkyness* (Kashmir-like), whereas Group 2 sapphires are often dark blue and visually reminiscent of Burmese sapphires. The spectra were recorded with the portable UV-Vis spectrometer developed by SSEF (SSEF Facette 15, 2008).

Focus on "Kashmir-like" Sapphires from Bemainty

In recent weeks, especially the sapphires from Bemainty with "Kashmir-like" appearance have received a lot of attention. This is not only due to their outstanding beauty, but also because they challenge gemological laboratories and also that we know some of these Madagascar sapphires are purposely being introduced into the gem market with fraudulent claims of a historic Kashmir provenance.

Unfortunately, some of these new sapphires are accompanied by gemological reports describing them as being of Kashmir origin. Having tested an important number of such 'Kashmir-like' sapphires submitted by clients since the end of last year, we have to conclude that many of these gems of so-called 'Kashmir' origin actually originated from this new deposit near Bemainty/Ambatondrazaka in Madagascar. Our findings are based on meticulous microscopic observations, but also on an array of sophisticated scientific methods, including Raman microspectrometry, UV-Vis absorption spectroscopy, X-ray fluorescence and GemTOF (laser ablation inductively coupled plasma time-of-flight mass spectrometry) for trace element concentration (see also www.gemtof.ch and Hao et al. in InColor 2016). This is the reason why we published a trade alert on 29 March 2017 to inform the trade about this issue (see www.ssef.ch/research-publications/press-releases).

Microscopic features of "Kashmir-like" sapphires from Bemainty and how to distinguish them from Kashmir sapphires

The new sapphires from Madagascar can, to a great extent, be distinguished from Kashmir sapphires by careful microscopic observation. In combination with advanced methods such as trace element chemistry analysis (e.g. GemTOF) and Raman microspectrometry, the conclusion on origin can be even clearer. In the following, we present our findings to date on "Kashmir-like" sapphires from Bemainty (Madagascar) so far analyzed at SSEF.

Under the microscope (or loupe), this specific material from Bemainty is often characterized by an exceptional clarity, apart from a general milkyness (Figure 3). This is very much in contrast to sapphires from Kashmir, which often contain tiny, but frequent inclusions of different kinds (pargasite, tourmaline, feldspar, uraninite), especially in stones above 10 carats.

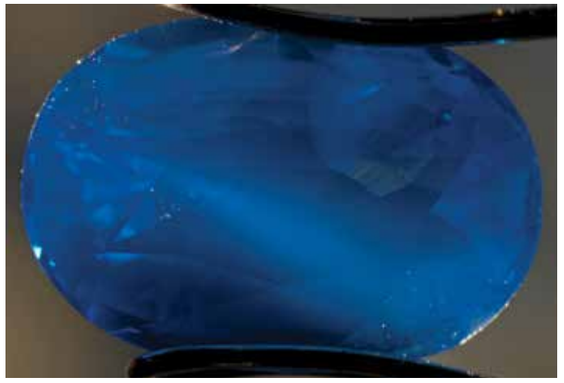

Figure 3. Sapphire from Bemainty revealing its velvety *milkyness* when illuminated by a spotlight from the side. Apart from the general *milkyness*, this sapphire of 6.6 ct is very pure. (Photo: M.S. Krzemnicki, SSEF)

Furthermore, this new material from Madagascar often shows dense and narrow growth zones, compared to much more blocky three-dimensional growth zones in Kashmir sapphires (Figure 4), but has so far never shown the iconic pargasite and tourmaline inclusions highly characteristic for Kashmir sapphires.

Occasionally, the new sapphires from Madagascar show a marked chromium concentration resulting in larger purplish zones with a diffuse outline within the sapphire. This zoning feature is much in contrast to Kashmir sapphires. In fact, Kashmir sapphires may show very thin and well-defined growth layers enriched in chromium, only seen when exposed directly to a strong light source such as reddish visible fluorescent layers (Figure 5). Kashmir sapphires do not, however, show diffuse purplish color zones under normal light.

The new "Kashmir-like" sapphires from Madagascar may show fine dust lines and tracks and flakes (Figure 6), which are to some extent reminiscent of similar structures in Kashmir sapphires. However, we would like to remind readers that similar structures have also been described in 'Kashmir-like' sapphires from Sri Lanka and Andranondambo (SE-Madagascar). Therefore, these features are only of limited use to identify the origin of a sapphire.

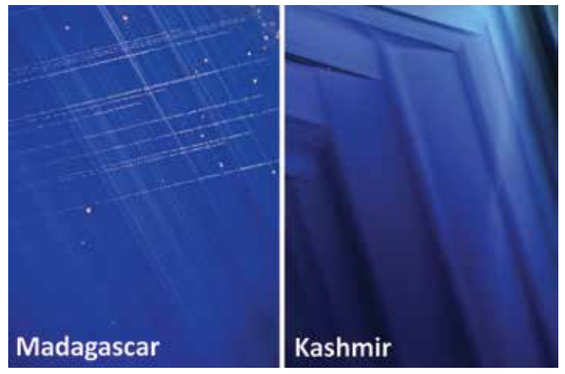

Figure 4. Dense zoning of new sapphires from Madagascar (left, background) crossed by few dust tracks, compared to characteristic blocky zoning (parquet structure) of "classic" Kashmir sapphires (right). Magnification 20X. (Photos: M.S. Krzemnicki, SSEF)

Figure 5. A diffuse purple color zoning due to chromium enrichment is occasionally seen in sapphires from Bemainty, Madagascar (left). This is very much in contrast to the fine and well-defined growth layers with red visible fluorescence (due to chromium) known from Kashmir sapphires (the greenish yellow stripes are resulting from light reflection at the blocky milky bands in Kashmir sapphires). (Photos: SSEF and H.A. Hänni, SSEF)

Figure 6. Dust tracks in "Kashmir-like" sapphires from Bemainty are reminiscent of similar features in Kashmir sapphires. (Photos: M.S. Krzemnicki, SSEF)

The most challenging characteristic is, however, that these new sapphires from Madagascar often contain tiny prismatic zircon crystals (Figure 7), somehow similar to those sometimes found in Kashmir sapphires. However, the zircons in the new sapphires from Bemainty are rather metamict (low crystallinity), very much in contrast to the zircons in sapphires from Kashmir.

Finally, it is possible to further separate these new Madagascar sapphires from Kashmir sapphires on the basis of their trace element chemistry, readily analyzed with the GemTOF instrument at SSEF. This highly sophisticated instrument allows us to quantify chemical elements and isotopes even at sub-trace levels (ppb). (Publication in preparation.)

The Swiss Gemmological Institute SSEF has analyzed in the past few years some of the most prestigious gemstones offered in the trade today, including some very exceptional sapphires from Kashmir showing classical inclusion characteristics described in detail by Gübelin & Koivula (1986 and 2008), Hänni (1990), Schwieger (1990) and Krzemnicki (2013).

With the sudden arrival of similar looking sapphires from Madagascar in the range of 5 carats to 50 carats in recent months at SSEF, we immediately started our investigation and finally have succeeded in establishing stringent criteria to identify this new material from Madagascar and to distinguish it from Kashmir sapphires as far as possible, based on decades of experience in origin determination (Hänni 1994, Krzemnicki 2007), state-of-the-art analytical instrumentation, and an extensive reference collection which is constantly integrating gemstones from new deposits such as the described new sapphires from Bemainty near Ambatondrazaka (Madagascar).

Figure 7. Tiny prismatic zircons in "Kashmir-like" sapphires from Bemainty. Magnification 50-70X. (Photos: M.S. Krzemnicki, SSEF)

New Sapphires from Bemainty – Attractive Gemstones for the Trade

Madagascar emerged in the early 1990s as an important producer of corundum with the discovery of the skarn-related sapphire deposit of Andranondambo (southeast Madagascar), although sapphire and ruby occurrences (including Andranondambo) have been known and documented since the early 20th century.

By the end of the 1990s, a new and even bigger deposit was found in the alluvial gravels at Ilakaka (southwest Madagascar), which had a huge impact on the international market by producing gem-quality sapphires and fancy sapphires in a highly attractive range of colors.

In the last 15 years, the area between the capital Antananarivo towards Toamasina on the eastern coast has come more and more into focus as a source of rubies and sapphires, unfortunately mostly located in protected conservation areas, with deposits at Vatomandry, Andilamena, Didy, and the latest addition Bemainty, near Ambatondrazaka (Pardieu et al. 2017).

The arrival of these new sapphires from the gem-rush area in Bemainty is of great potential and should be an asset to the gem trade and Madagascar, as long as their true origin is correctly disclosed throughout the whole supply chain, and the issues and challenges surrounding mining in protected areas can be addressed.

Some of the stones from this new deposit can compete in beauty and size with the best quality sapphires from Kashmir, Myanmar and Sri Lanka. As such, this new deposit is further strengthening the position of Madagascar as one of the most prominent sources of excellent gemstones today, and as such the trade should also find ways to market them according to their beauty and importance.

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