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Blood Red Rubies from Madagascar

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Fig 1 Four untreated Rubies from Madagascar
Photo: Wimon Manorotkul/Lotus Gemology; Courtesy: Richard Hughes

In the recent years Madagascar has produced some amazing blood red rubies.

And to alayman it can be very confusing to understand the fine nuances of genuine Burma ruby and the equally attractive blood red ruby from other localities. Some data for this present article has been taken from the website of Lotus Gemology with the kind permission of Richard Hughes.

According to the article published in Lotus Gemology website by Hughes et al (2015), the recently discovered blood red rubies from Ambodivoahangy in Madagascar may look like the rubies from Mozambique but have totally different inclusions. The most distinctive inclusion feature of these new rubies from Madagascar is the dark red to black rods of what appears to be primary rutile along with the zoned cloud of exsolved particles. It is amazing that inside a ruby inclusions of rutile can occur as very fine exolved particles, as thin long needles as seen in Sri Lankan ruby, as thick short stubby needles as exhibited in the old Burma ruby or as large opaque crystals observed in the Indian ruby.

Fig 2: Black rods of primary rutile and zoned cloud of exolved particles Photo: R.W. Hughes/Lotus Gemology

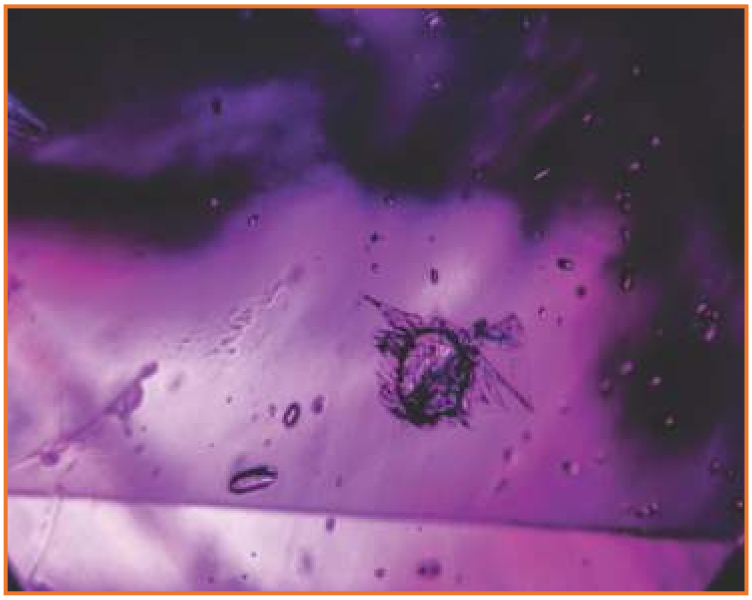

Fig 3: A crystal of what appears to be mica hovers over a backdrop filled with rounded crystals of what are probably zircon in this ruby from the new Madagascar find. Photo: R.W. Hughes/Lotus Gemology

Another very characteristic inclusion from this area, are the small rounded crystals of zircon as seen figure 3 and some mica crystals.

Fig 4 Rods of what are most likely amphibole in one of the new Madagascar rubies. Photo: R.W. Hughes/Lotus Gemology

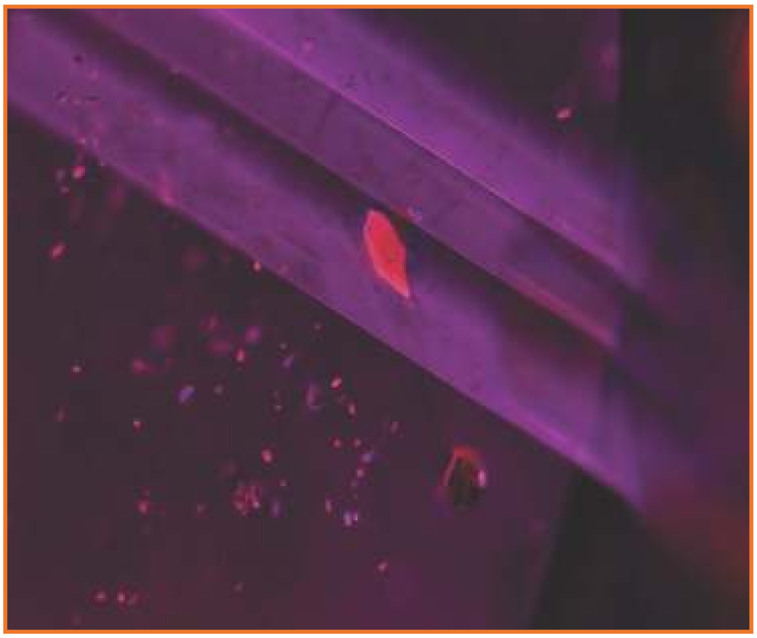

Fig 5 Two orange crystals of what is probably monazite observed amidst polysynthetic twin planes in the new Madagascar ruby. Photo: R.W. Hughes/Lotus Gemology; crossed polars.

The Madagascar new rubies show some distinctive monazite crystals in their assemblage of inclusions. Polysynthetic twinning planes are common in these rubies. As clearly stated in the article by Hughes et al the Madagascar rubies have as inclusions large crystals of primary rutile crystals. These inclusions of rutile crystals appear almost black in color and have high relief. Sometimes when the rutile crystals are thin and very small then the colour is a deep orange colour. These rutile crystals are sometimes right on the surface of the host ruby andwhen present on the surface they have a strong metallic lustre compared with the surrounding ruby.

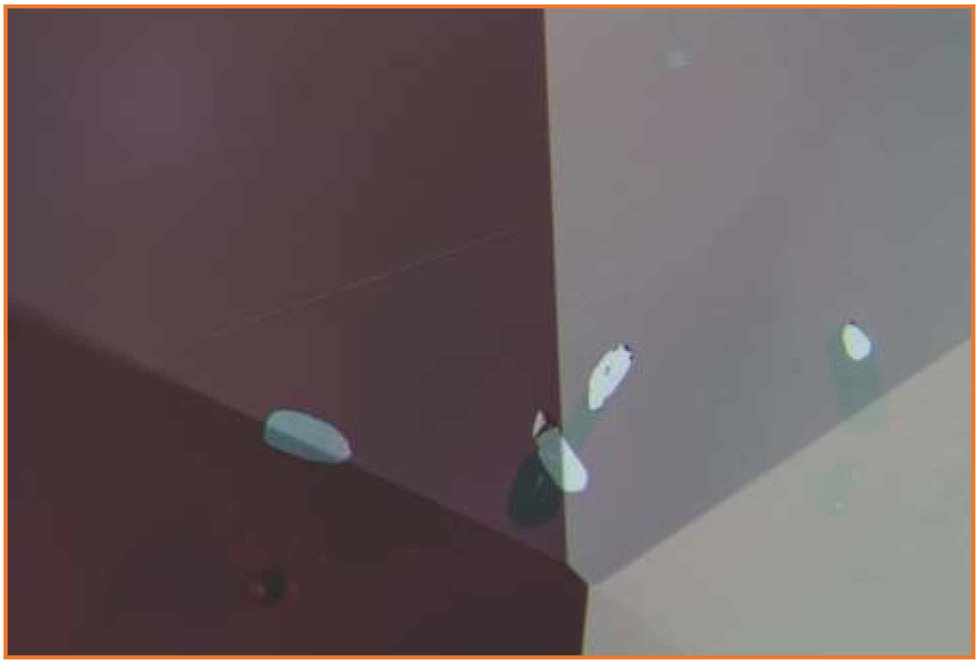

Fig 6 When observed in reflected light the metallic lustre of the primary rutile present on the surface.
Photo: R.W. Hughes/Lotus Gemology

Another very striking feature of these rubies is the rounded transparent and birefringent colourless crystals as individuals or clusters. These appear to be zircon or in some cases possibly xenotime (Hughes et al. 2015). Some rubies do show rounded transparent and birefringent orange yellow crystals of what appears to be monazite. Like in many rubies from different sources there are transparent to white mica crystals, muscovite as well as biotite sometimes as "books," while other times in thin transparent plates. There are structural inclusions like hexagonal or angular zoned clouds composed of minute exsolved particles and rutile silk intersecting in three directions in the basal plane.

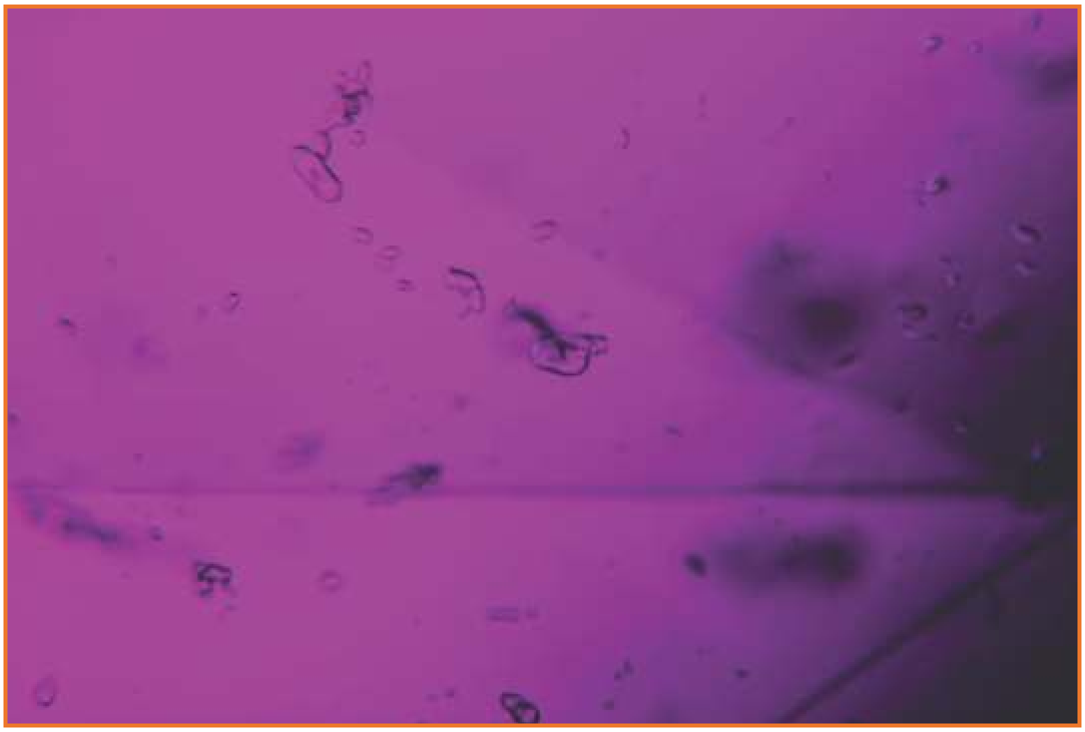

Fig 7 Small rounded crystals and clusters of what is probably zircon. These crystals are common in Madagascar rubies and sapphires but not observed in rubies from Mozambique. Photo: E. Billie Hughes/Lotus Gemology.

Pigeon-Blood Type Red Rubies

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Fig 1. Bracelet containing 120 pigeon blood type rubies of African Origin Photo: Pangem Tech

Recently our laboratory had the chance to observe and study some very nice rubies. Sold to the client as pigeon blood red rubies, these were pigeon –blood type rubies in that the shade could be similar but they were much cleaner and devoid of the silk or rather very little silk if at all. The inclusions observed were much different from the well known Burma ruby. There were many liquid filled voids and crystals which similar to those seen in Winza Rubies. Black colour crystals and thick rod like needles were seen in some of the rubies.

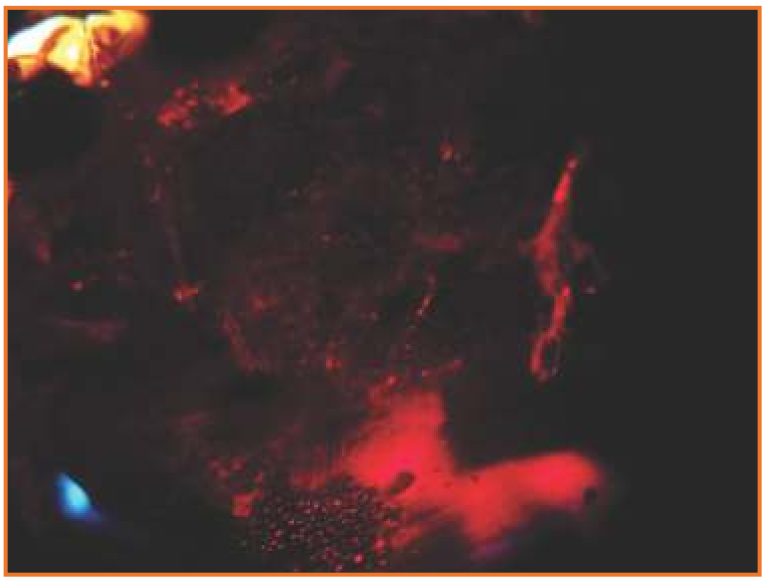

Fig 2 Fluid inclusion feathers and voids with fluid Photo: PangemTech

"Pigeon-blood ruby" is how the red colour-shade of Burma ruby is described. Federico Barlocher, the expert on mining in Burma (now Myanmar) says that the term "old Burma ruby" has a magic to it, eyes pop out, gem dealers drool, what it simply means that it is a gem of tremendous value. It is true any gem dealer, any gemmologist, any connoisseur of gems, any one of the big auction house will vouch for this. Ever since glass filled rubies and beryllium treated rubies started flooding the market, the value of the genuine old Burma rubies has sky rocketed! Rubies which are mined in Mogok proper are the "Old Burma Ruby" while those that are found in Mong Hsu and Nanyaseik are considered as the "New Burma Ruby" In this context when pigeon blood ruby started appearing in the market from African mines gemmologists started getting jitters.

Fig 3 Fluid inclusion and crystals Photo: Pangem Tech

Then two days later we got genuine Burma Ruby strands which had all the text book type inclusions besides the typical absorption spectra.

Fig 4 Thick rod like needles Photo: Pangem Tech

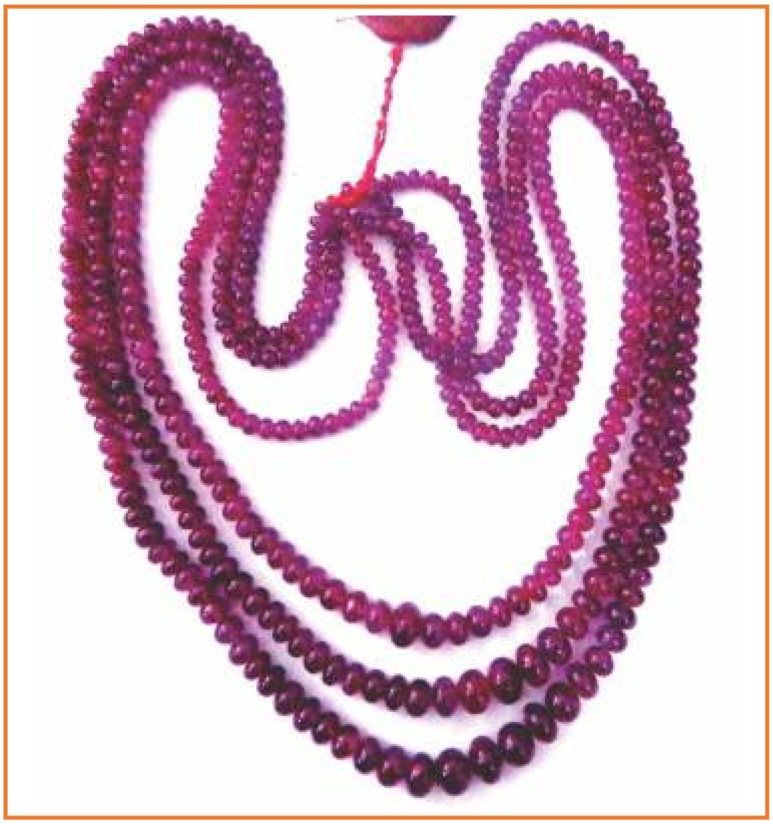

Fig 5: Three strands weighing 767.8 carats of pigeon blood red Burma rubies Photo: Pangem Tech

Almost each and every bead had some telltale signs of its Burma origin. The fine short stubby rutile needles had the typical rainbow coloured interference in reflected light indicating that no heat treatment or any other enhancement had been done and that the colour intensity was due to natural causes. Negative crystals, crystals of spinel and other transparent colourless crystals were observed. Burma rubies are indeed a treat to the eyes and as a gemmologist when one sees the characteristic inclusions the joy is beyond description

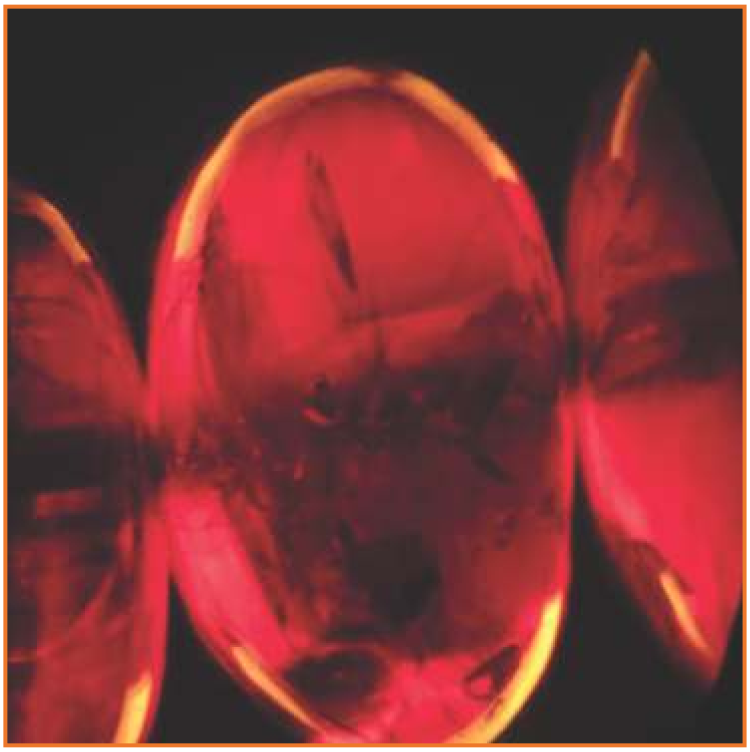

Fig 6: Negative crystals Photo: Pangem Tech

Fig 7: Short thick needles of Rutile characteristic inclusions for Old Burma Rubies Photo: Pangem Tech

Tialite (Al_2TiO_5) may cause Asterism

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Introduction

Star ruby found in the village of Neriya (12° 58' 40":77° 34' 7") in the Belthangady taluk, Dakshina Kannada district of Karnataka state have been studied. Karnataka was formerly known as Mysore state and has been known for deposits of star corundum and the classic locales produce mainly opaque, low-grade star rubies. In Neriya, the area is largely composed of lateritic soil forming a blanket over Precambrian rocks composed of granitic gneiss, mica schists and mafic to ultramafic schistose rocks. Extensive formation of corundum especially of semi-transparent star ruby with deep red colour has been found in bands of schistose ultramafic rocks intruded by pegmatitic veins. Gemmological properties, values for refractive indices, specific gravity, as well as FTIR and UV-Vis data have been determined. Semi-quantitative analyses were carried out using EDXRF show considerable presence of titanium and iron oxides. Inclusions studies along with Raman spectroscopy identified mineral inclusions as rutile, tialite, ilmenite, zircon, and spinel. Asterism may be due to tialite and rutile.

Figure 1. Nine star rubies from Neriya ranging from 3.57ct to 18.21cts.

Microscopic Observations

In the Neriya star ruby, the crystalline form of titanium oxide (TiO2) was the most common inclusion. But in the case of Neriya star rubies titanium oxide had crystallized in different time periods, in different mineral types as well as in different crystal sizes. Titanium oxide, in the form of fine rutile needles, was observed oriented parallel to the first order prism of the host. The silk occurred

Figure 2. Needles of rutile and ilmenite radiating

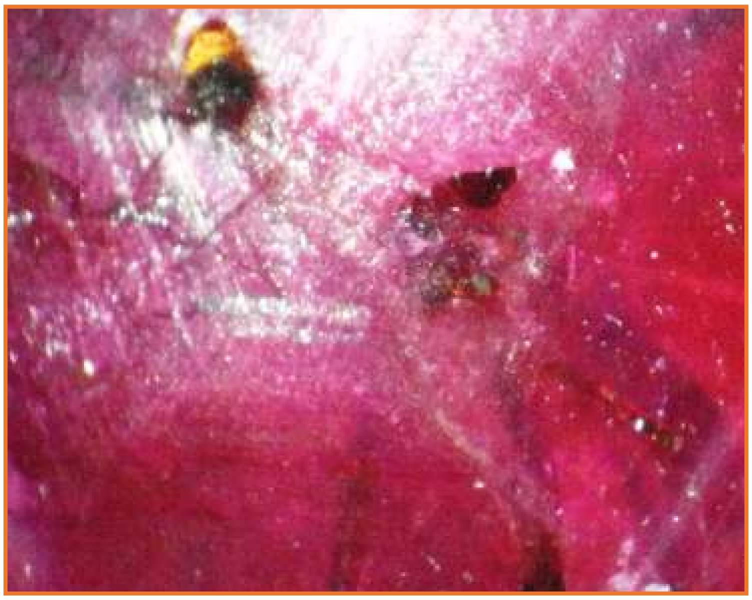

Figure 3. Star ruby of figure2 in reflected light

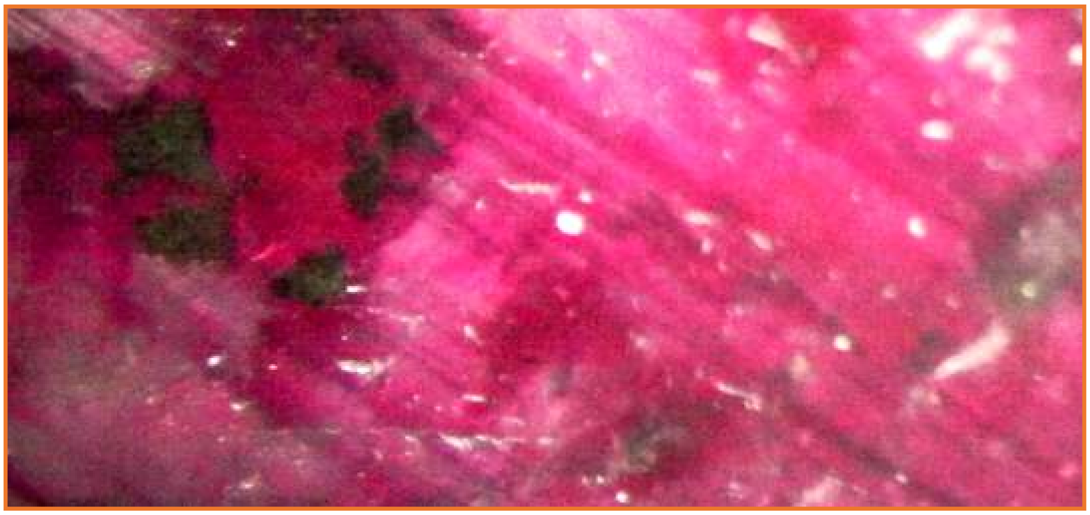

Figure 4. Milky haziness with crystals of tialite

When observed under dark field illumination one could observe the long needles of rutile and ilmenite literally spurting out in a radial manner (Figure 2) and when observed under reflected light source the same stone showed clouds of fine rutile silk arranged in a hexagonal pattern which is due to ex-solution of titanium oxide that occurred as the host cooled (Figure 3). The titanium oxide in some regions had crystallized in the form of tialite Al2TiO5 along with aluminum oxide which was responsible for some of the asterism especially where there was milky haziness (Figure 4). This was confirmed by Raman spectroscopy. At the same time due to temperature variations during crystallization, had led to the short stubby needles of rutile crisscrossing at 120/60 degrees with reflecting spectral colours (Figure 5).

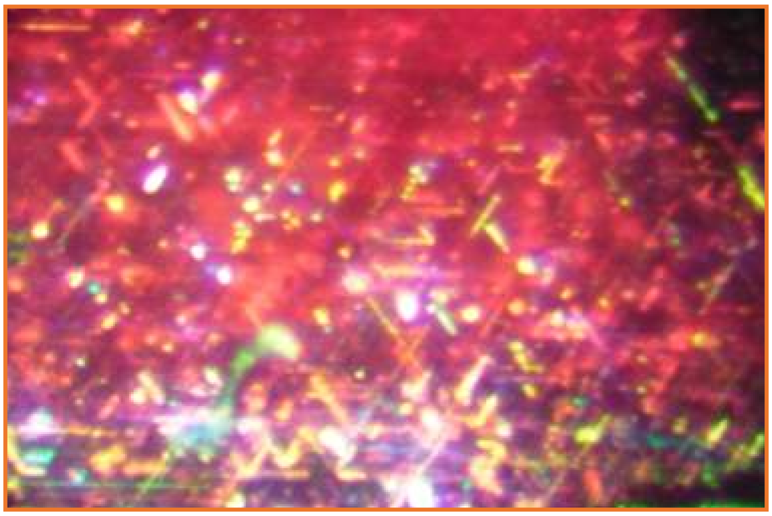

Figure 5. Rutile needles crossing at 120/60 degrees

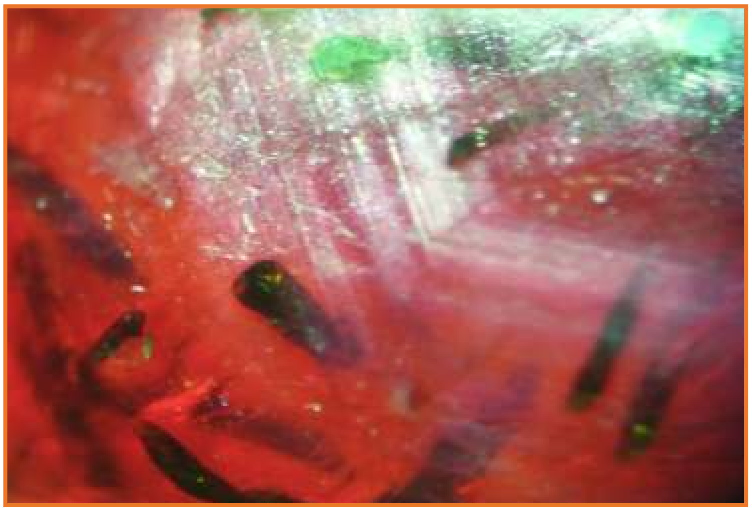

Figure 6. Zircon, ilmenite and rutile crystals

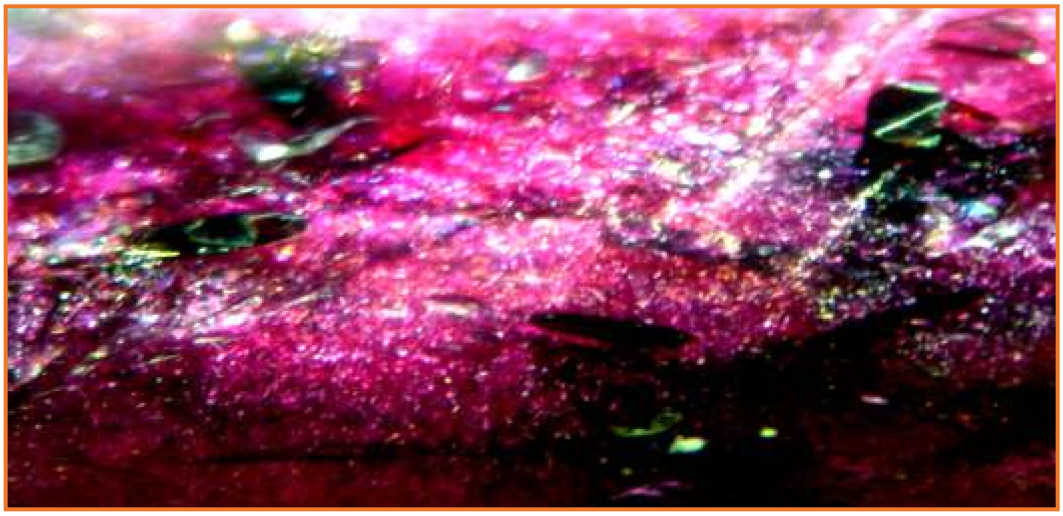

Figure 7. Octahedral crystal of spinel

Besides titanium oxide, the star rubies in this study had a wide variety of internal features indicative of their metamorphic origin, crystals of zircon (Figure6), ilmenite (Figure 6) and mica flakes. In one of the star rubies an octahedral crystal (Figure 7) was clearly visible and was further verified by Raman spectra as spinel. Tiny rounded oval and irregular crystal clusters of zircon were along with lamellar twinning.

Discussion

In 1878, Gustav von Tschermak was the first researcher to identify rutile in corundum. Thereafter it has been generally accepted that asterism in star rubies is caused by needles of rutile (TiO2) aligned along crystallographic planes of the corundum (Tait, 1955, Webster, 1962). According to Nassau (1968): "the evidence given by Tait (1955) was: (1) the presence of titanium, (2) the needle like habit, and (3) the square cross-section of the needles. Based on the analogy with rutilated quartz, and by eliminating octahedrite and brookite by the morphology, rutile was accordingly identified. This type of evidence, however, is explained equally well by either TiO2 or the compound aluminium titanate Al2TiO5". Nassau (1968) had felt that on the basis of the phase diagrams he studied [Bunting (1933) and by Lang, Fillmore and Maxwell (1952)], Al2TiO5 is the phase that should separate out from the corundum when the solubility is exceeded at temperatures near the melting point of corundum. Hence there was a strong possibility of the formation of tialite or fine needles of Al2TiO5 instead of rutile needles responsible for the formation of asterism in certain cases of natural star corundum (Fig.8)

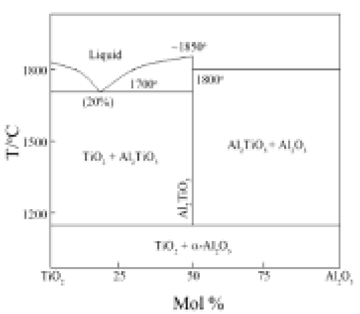

Figure 8. Phase diagram of TiO2:Al2O3 after Goldberg (1968) in Abali (2011)

Neriya ruby are a characteristic case where the rutile has crystallized in several forms; needle like crystals, sometimes as thin, long and slender acicular needles and sometimes as thick almost flat plate-like form. The crystallization of the acicular crystals has a specific pattern in three directions crossing at 120/600 horizontally arranged parallel to the basal plane. One can also observe very fine thin, crisscross arrangement of silk which when illuminated with strong reflected light source, iridescent colours can be observed due the interaction of these short thin needle-like crystals with light. Changes and fluctuations in temperature are said to be responsible for the different morphologies of TiO2 crystals. There is a thick whitish haze of fine needle like inclusions in certain places in the hexagonal arrangement which is generally attributed to rutile. Experiments carried out by Abali (2011) have reiterated Goldberg's theory proved in 1968 that Al2TiO5 and Al2O3 can co-exist according to phase diagram shown in Figure 10. During the present study the Raman spectra of the inclusions in this region showing the milky haziness formed by the titanium oxide gave a strong peak at 748cm-1 which is actually assigned to tialite (Abali, 2011). Further it has been proved by Camaratta et al. (2011) that although tialite is generally said to dissociate into rutile and corundum, if the dwell time is sufficient then tialite can retain its identity at lower temperatures when there are co-precipitations. Hence there is a strong possibility that some of these tiny crystals are indeed tialite. The authors therefore believe that the asterism in Neriya star rubies is also due to the presence of tialite.

Conclusion

Neriya star ruby display a wide range of inclusions especially with titanium oxide. Crystalline inclusions observed and identified were zircon, spinel, mica, ilmenite and rutile. These star rubies from Neriya, crystallized at a high temperature and with fluctuations in temperature. The melt had large quantity of titanium which initially formed tialite Al2TiO5 some of which may have got converted to corundum and rutile. On studying the phase diagram one can see that the formation of tialite is possible. It has been proved that if the dwell time is optimum then tialite can retain its structure (Camaratta et al., 2011). Therefore the asterism in Neriya star rubies is not only due to titanium oxide in the form of rutile but also due to the presence of tialite (Al2TiO5).

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