Paraiba Tourmaline Intergrown with Lepidolite Mica

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最近瑞士寶石學院 (SSEF) 收到一串客户的賣家稱之為帕拉伊巴碧璽頸鏈進行測試。該珠串包含33粒淺藍色至綠藍色及灰紫色至紫色、顏色不均並有明顯裂痕的珠子。經詳細檢測後，鑑定其為帕拉伊巴碧璽及鋰云雲母共生的寶石頸鏈。

Recently the Swiss Gemmological Institute SSEF received a necklace for testing, consisting of thirty-three slightly polished triangular beads, which had been sold as Paraiba tourmaline. When our client had to recut some beads due to damage, she was struck by the difference in hardness and resistance to polish of some of the beads and decided to have the item tested at the SSEF.

Paraiba tourmaline entered the gem market in the late 1980s (Koivula and Kammerling 1989; Fritsch et al. 1990). They were originally discovered in a pegmatite at the Mina da Batalha in the state of Paraíba in Brazil (Fritsch et al. 1990; Wilson 2002), hence their name, but later finds were also made in the neighbouring state Rio Grande del Norte in Brazil (Shigley et al. 2002; Milisenda 2005). Right from the start, this copper and manganese bearing variety of elbaite tourmaline found much appreciation in the trade due to the extraordinary bright blue colour some of these stones show. Other colours for tourmalines from these sources include blue green, green, and purple. Further sites for copper bearing tourmalines are known in western Nigeria (Edeko area) near Ilorin (Zang et al. 2001; Smith et al. 2001; Milisenda 2001, Laurs et al. 2002, Breeding et al. 2007) and the Alto Ligonha region, approximately 100 km southwest of Nampula, Mozambique (Abduriyim & Kitawaki 2005, Abduriyim et al. 2006, Laurs et al. 2008).

Whereas the material from Nigeria and Mozambique is found as strongly rounded pebbles in alluvial deposits, the stones from Brazil are still in-situ within a decomposed granitic pegmatite, together with quartz, altered feldspar, and lepidolite (Rossman et al. 1991, Wilson 2002, Berlan et al. 2011). Often, these crystals show distinct colour zones, with a purple rim surrounding the bright blue and pink inner parts.

Samples and methods

The thirty-three beads showed colours varying from light blue to greenish blue and greyish purple to purple, partly with distinct colour zoning within the beads. Most of the beads were heavily fractured and thus only sub-translucent to opaque (Fig. 1). They were all cut to resemble the typical shape of prismatic tourmalines with a slightly triangular curved outline imitating a series of prism faces. A comparison with our reference samples and literature showed that low quality material of similar colours is well known from Paraiba in Brazil, and is generally sold as Paraiba tourmaline.

Fig. 1 Necklace with thirty-three polished beads, sold as Paraiba tourmaline proved to be a complex intergrowth of Paraiba tourmaline with lepidolite. About a third of the beads were identified as lepidolite only, showing purple colour and rather dull lustre.
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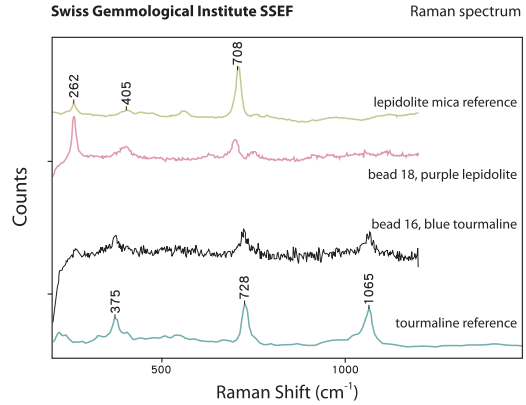

Fig. 2 Raman spectra of the bright blue Paraiba tourmaline and purple lepidolite from the analysed necklace, compared to reference spectra of tourmaline and lepidolite from the H.A. Hänni collection at SSEF.
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Careful visual observation revealed a distinct dull lustre of about one third of the beads, compared to the vitreous lustre of the rest. All these dull beads were purple and exhibited a slightly better transparency and in some cases small reflecting cleavage planes. Some also showed crushed and pressed edges, as would be expected in material much softer than tourmaline.

Results

Semiquantitative chemical analysis by energy-dispersive X-ray fluorescence (Thermo Fisher Scientific Quant'X) on one of the blue beads revealed copper and manganese as minor concentrations, along with silicon, aluminium and sodium concentrations characteristic for Paraiba tourmaline. Refractometer readings (RI = 1.621 – 1.640) on the bright blue sample (No. 32) confirmed its identity as tourmaline.

Raman spectra were taken on a selected number of the beads, using a Renishaw system and a 514 nm argon-ion laser. The spectra were collected from 1200 to 100 cm^{-1} Raman shift. They revealed two distinctly different spectra (Fig. 2), which could be attributed to tourmaline and lepidolite, a lithium bearing mica (phyllosilicate), known mostly from pegmatites in purple to greyish lilac masses and tabular crystal aggregates. Multiple Raman analyses showed that the dull purple beads in fact consisted entirely of polycrystalline lepidolite, whereas a number of blue beads with purple zones were actually intergrowths of Paraiba tourmaline with lepidolite mica. Beurlen et al. (2011) explain this intergrowth of Paraiba tourmaline from Brazil with lepidolite as a retrograde late alteration and replacement of Li-bearing pegmatitic minerals such as K-feldspar, spodumen, Li-phosphates and elbaite (Paraiba tourmaline).

As a conclusion, the described necklace is, in fact, a mix of Paraiba tourmaline and lepidolite (mica), partially even intensely intergrown, and accordingly should be sold as such. Selling this item just as a Paraiba tourmaline necklace is not appropriate.

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