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# 一种仿海蓝宝石(染色石英岩)的特征分析

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**摘 要**：近期,北京北大宝石鉴定中心在日常检验中陆续收到了一些自称是“海蓝宝石”的样品,尤以素面,刻面手串常见。采用常规仪器对该样品的折射率,密度,硬度等参数进行检测。结果表明,该送检样品的折射率约为 1.54,相对密度为 2.66,摩氏硬度为 7。虽然样品的颜色,外观,密度,硬度都与海蓝宝石的接近,但其放大观察特征与海蓝宝石的略有不同。为了确定其真伪,采用傅里叶变换红外光谱仪对样品进行了测试分析。结果表明,该样品是由石英组成,为染色石英岩。该仿制品虽然在外观上与海蓝宝石很相似,常规宝石学参数也相似,但是其放大观察特征与海蓝宝石有所区别。建议检验机构在对海蓝宝石的鉴定中应重点观察其放大特征及偏光镜下特征,如果发现疑点,应引起警惕,采取其它手段进一步测试。

**关键词**：仿海蓝宝石;石英岩;红外光谱;放大观察
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# Study on Gemmological Characteristics of an Imitated Aquamarine

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**Abstract**: Recently, Gem Appraisal Center of Peking University in daily inspection has received some samples claimed to be “aquamarine”. The shapes of samples are various, such as cabochon and faceted bracelets. Aquamarine is a light blue, green-blue to blue-green beryl, an important gem of the beryl family. The English name of aquamarine comes from Latin, meaning “seawater”, which indicates its resemblance to the colour of seawater. Aquamarine wins people's affection with its elegant, beautiful sky blue colour. It has been popular since the middle ages, and has a long history. The gem industry also declares it as the birthstone of March, symbolizing composure, braveness and courage. Due to the price increase of natural aquamarine recently, there is a large variety of imitations in the market, most of which can be easily distinguished from aquamarine. But the samples in this paper have a relative high degree of similarity. First, conventional instruments are adopted to test refractive index, relative density and hardness of the samples. Results show that the samples have refractive index of 1.54, relative density of 2.66 and Mohs' hardness of 7. Although these conventional gemmological parameters of the samples are similar to those of aquamarine, the characteristics in magnification observation are different for both. The magnification obser-

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vation shows that blue colour in the samples is distributed along the fractures, which is non-directional. The distribution characteristics of colour in the samples are caused by dyeing. It is important to note that the natural fractures in the aquamarine is also common, which is hard to be distinguished from that of dyeing samples by naked eye. Therefore, more careful observation is required. The fractures in natural aquamarine are usually oriented, and colour is well distributed. The samples under polariscope show all-bright phenomenon, an indication of a heterogeneous aggregation. It is clearly different from aquamarine, a member of hexagonal system, which shows "four bright and four dark" phenomenon. In order to determine its authenticity, Fourier transform infrared spectrometer is used to analyze the samples. Reflection method is used for their mineralogical species and the results show that the mineral component is quartz. Combining the previous test results, it is concluded that the samples are dyeing quartzite. Compared with the general dyeing quartzite, the dyeing quality of the samples are obviously much better. Since quartz class exists widely in the crust, it is cheap, easy to obtain, and is often used to imitate all kinds of gemstones. Gemmologists should always pay attention to them. Although the samples in this paper are similar to aquamarine in appearance, as well as conventional gemmological parameters, some of its magnification characteristics are different from those of aquamarine. The authors suggest that inspection institutions should focus on the identification characteristics of aquamarine, by microscope and polariscope. If suspicious feature is noticeable, other testing methods should be used.

**Key words**: imitated aquamarine; quartzite; infrared spectrum; magnification observation

海蓝宝石是指浅蓝色、绿蓝色至蓝绿色的绿柱石,它是绿柱石家族的一个重要宝石成员,英文名称 Aquamarine,来自拉丁语,意为"海水",即海水蓝色的宝石(图 1)。海蓝宝石以其淡雅、优美的天蓝色赢得了人们的喜爱,中世纪已流行,历史悠久,宝石界也将其定为三月份的生辰石,象征着沉着、勇敢或勇气[1]。海蓝宝石的蓝绿色是由 $Fe^{2+}$ 致色而成。一般情况下,颜色较浅,市场上出现的深色海蓝宝石多是由黄色绿柱石热处理而成。海蓝宝石的密度为 2.67～2.90 g/cm$^3$,折射率为 1.577～1.583,双折射率为 0.005～0.009,具{0001}方向一组不完全解理,二色性表现为弱—中蓝色或蓝绿色或不同深浅的蓝色;其内部常含有液相,气液两相或气液固三相包裹体以及平行于 $c$ 轴方向排列的管状包裹体,有时呈断断续续的"雨丝状"[2]。由于近期天然海蓝宝石的价格水涨船高,市场上已经发现了多种海蓝宝石的仿制品,尽管大多迷惑性不大。

近期,北京北大宝石鉴定中心潘家园站在日常检验工作中收到了多件客户送来进行委托检验的"海蓝宝石"样品,它们在外观上与海蓝宝石很相似(图 2),天然海蓝宝石虽然具有较高透明度,然而该样品也同样具有相似的透明度,但其放大观察特征与天然海蓝宝石有一定的差异。为了确定这种"海蓝宝石"样品的真伪,笔者对其中一件样品(图 2b)进行了常规仪器的检测和傅里叶变换红外光谱仪检测分析。

## 1　样品特征

测试样品为一件蓝色手串,质量为 16.19 g,透明,玻璃光泽(图 2b)。经放大观察发现,样品中的蓝色沿裂隙分布(图 3a),从颜色的分布特征分析,样品的颜色为后期染色所致。需要注意的是,天然海蓝宝石中的裂隙也普遍存在(图 3b),与样品中的一些部分肉眼观察不易区分,需仔细进行观察。

经常规的宝石检测,样品的折射率约为 1.54(点测),相对密度为 2.66(其中一颗珠子),摩氏硬度为 7,无特征吸收光谱。与海蓝宝石相比,样品的常规宝石学特征与其相差不大。由于样品为弧面型,故点测得到的折射率不能作为决定性证

图 1 天然海蓝宝石手串

Fig. 1 Aquamarine bracelet


图 2 送检手串样品

Fig. 2 Bracelet samples

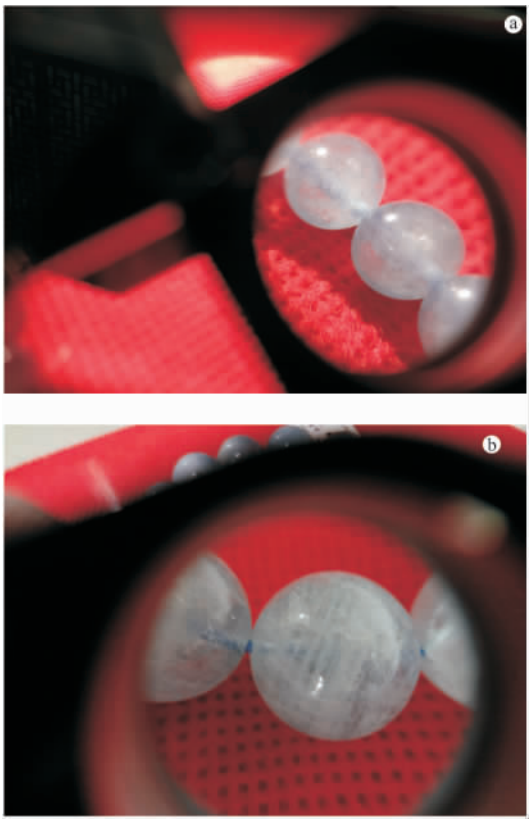


图 3 放大观察(10×)

Fig. 3 Magnification observation

a. 样品中颜色在裂隙中分布；b. 天然海蓝宝石样品中颜色均匀分布，裂隙定向排列

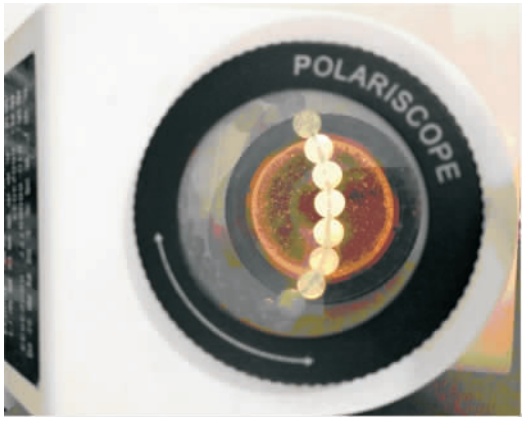


图 4 偏光镜测试

Fig. 4 Polariscope testing

图 2b 样品，结果为非均质集合体

据，仅能作为参考，应引起警惕。另外，该样品在偏光镜下呈全亮现象，显示为非均质集合体(图 4)，与属于六方晶系的海蓝宝石呈“四明四暗”的现象明显不同。

## 2 红外光谱分析

为确定样品的矿物组成，对该样品进行了红

外光谱分析。所用仪器为德国布鲁克傅里叶变换红外光谱仪 TENSOR27 型。采取反射法进行测试,测试条件:测量范围 1 500～400 $cm^{-1}$,分辨率 2 $cm^{-1}$,扫描信号累加为 32 次。测试结果(图 5)显示,样品的红外光谱大体可分为 3 个区:(1)位于 1 250～1 100 $cm^{-1}$范围的最强吸收区,属 Si—O 非对称伸缩振动所致,由一强带(1 080～1 100 $cm^{-1}$)及一弱带(1 160～1 250 $cm^{-1}$)组成,吸收带宽而强;(2)在 800 $cm^{-1}$处有一个中等强度的吸收带,属 Si—O—Si 对称伸缩振动所致,是石英族矿物的特征峰;(3)位于 600～460 $cm^{-1}$范围的吸收峰属 Si—O 弯曲振动所致,460 $cm^{-1}$处的吸收带为吸收谱的第二个强吸收带[3]。由实验结果显示,样品的吸收峰与石英的吸收峰基本一致(图 5),从而可以确定该样品为一种石英质玉石。该图谱与海蓝宝石的图谱(图 6)明显不同。

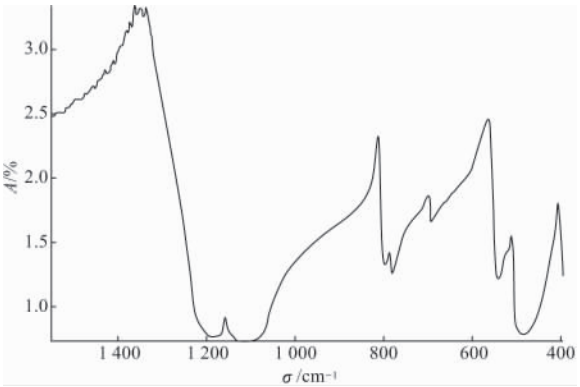


图 5　样品的红外光谱

Fig. 5　Infrared spectrum of sample

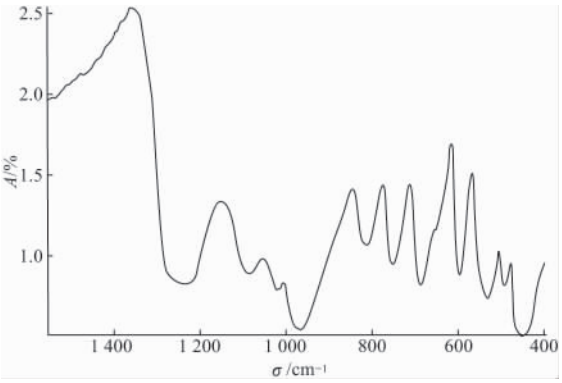


图 6　海蓝宝石的红外光谱

Fig. 6　Infrared spectrum of aquamarine

## 3　结语

本次测试样品的外观特征与海蓝宝石的相似,两者的常规宝石学参数也相近,如果不进行大型仪器分析,则不能将其鉴定为仿制品。通过常规的宝石学方法测定样品时,应采用放大观察和偏光镜测试,如有疑点应引起充分警惕,如采用红外光谱仪则不难区分。虽然石英岩的各项常规宝石学参数与海蓝宝石不相同,但比较接近,如本次样品为珠型,点测折射率难以定论其材质。而且,石英岩与天然海蓝宝石的市场价值差异巨大。因此,如果在进行日常检测时放大观察和偏光检查时存有疑问,应采用红外光谱仪进一步测定送检样品的矿物组成。

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