



Characterization of blue sapphire from Thailand

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ABSTRACT

Blue Sapphire is a precious stone that is a top well-known gem in gems and jewellery market. The beauty in shade of their colour cause blue sapphire in demand. Besides that, a source of the gemstone also another important factor that could increase the value and price. To study the origin, spectroscopic characteristic and analysis of inclusion in blue sapphire is to be the standard for characterized the different in blue sapphire from Chanthaburi and Kanchanaburi, Thailand. These both of source relate to the occurrence of basaltic rock. From the analysis of inclusion found that there is the different in shape and dimension of silk inclusion in blue sapphire (Figure 1). The silk inclusion in blue sapphire from Kanchanaburi is bigger and longer than the one from Chanthaburi. From the result of chemical composition by using instrument found that there is the different in quantity of Fe content in blue sapphire from Kanchanaburi and Chanthaburi and that can affect to those shape and dimension of silk inclusion in blue sapphire.

INTRODUCTION

Nowadays, there are several kinds of minerals in the gems and jewellery markets. Corundum is one of the top well-known gemstones because of colours, which they have many types of colours, and durability. However, blue is one of the most popular among corundum colours. In general, there are many factors that be able to evaluate the value of gems such as colour, inclusion, clarity, even the shape, and size of gemstone. So do gemstone provenance in the gems market, the famous origin of gemstone also could increase the price. The origin of blue sapphire is effective to the value of them absolutely.

The important and famous sapphire origins in Thailand are in Chanthaburi and Kanchanaburi provinces. Both sapphire origins from Thailand are related to the alkali-basalt host rock. Each origin of blue sapphire that related to a similar occurrence and landscape in nearby countries is probably appeared some different characteristics, such as type of inclusions and amount of trace elements. These characteristics can identify the origin of them. The purpose of this study is to generate the database about identification of blue sapphire sources.

METHODOLOGY

The samples from the mine in Chanthaburi and Kanchanaburi were prepared in the tablet shape (both sides were polished). Then, they were collected the appearance of silk inclusions by gemmological

microscope with a high magnification and measured the chemical compositions by using the EDXRF spectroscopy. The inclusion and chemical composition results of sapphire from Chanthaburi and Kanchanaburi were used to determine gemstones provenance.

RESULTS AND DISCUSSION

Silk inclusions in sapphire related to basaltic rocks are hematite (Fe_2O_3) which is an iron mineral. This hematite is the main compound element that can describe as a silk inclusion (Sripoonjan et al., 2014). In this study, the host of each sapphire origin associated with the alkali-basaltic with high Fe content (Levinson and Cook, 1994; Khamloet et al., 2014). These high amounts of Fe content results influence the appearance of blue sapphire inclusion from Chanthaburi and Kanchanaburi mines. Silk inclusions can be found in both Kanchanaburi and Chanthaburi sapphire samples. The dimension and shape of Kanchanaburi sapphire is longer (average 70 μm) and thicker than the one from Chanthaburi (average 35 μm) (Figure 1).

Otherwise, the result of the chemical composition suggested those sapphires have different Fe content (Tables 1 and 2). The Chanthaburi sapphire has a higher amount of Fe content more than Kanchanaburi sapphire significantly.

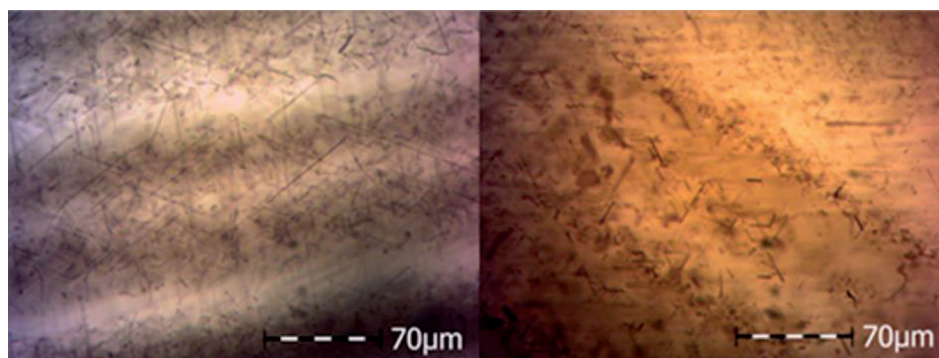


Figure 1. Silk inclusions in sapphire (a) Kanchanaburi sapphire (b) Chanthaburi sapphire.

Table 1. Chemical composition of Kanchanaburi sapphire samples.

Oxide (%wt)	KAN-001	KAN-002	KAN-003	KAN-004	KAN-005	KAN-006
MgO	1.1091	0.8426	1.1462	1.095	1.0199	1.2595
Al ₂ O ₃	97.8656	98.3406	97.9039	98.0805	98.2117	98.0406
SiO ₂	0.361	0.1801	0.2503	0.2635	0.1024	0.1061
CaO	0.0359	0.0311	0.0325	0.0133	0.0287	0.0332
TiO ₂	0.0579	0.0204	0.0537	0.0111	0.0674	0.0262
V ₂ O ₅	0.0087	0.0041	0.0323	0.0086	0.0098	0.0144
Cr ₂ O ₃	0.0132	0.0668	0.0308	0.0141	0.008	0.0064
MnO	0.001	0.0019	0.0031	0.0053	0.0016	0.0019
Fe ₂ O ₃	0.5245	0.478	0.5141	0.4858	0.5242	0.479
CuO	0.0029	0.0141	0.0112	0.0026	0.007	0.0111
Ga ₂ O ₃	0.0201	0.0202	0.0219	0.0202	0.0192	0.0217
Total	99.9999	99.9999	100.0000	100.0000	99.9999	100.0001

Table 2. Chemical composition of Chanthaburi sapphire samples.

Oxide (%wt)	CHAN-001	CHAN-002	CHAN-003	CHAN-004	CHAN-005
MgO	0.9844	1.0809	1.3868	1.2381	1.0002
Al ₂ O ₃	97.2969	97.117	95.891	96.9336	97.2215
SiO ₂	0.1499	0.259	0.906	0.3237	0.1114
CaO	0.0216	0.0138	0.021	0.0038	0.0223
TiO ₂	0.0483	0.0265	0.0478	0.0151	0.029
V ₂ O ₅	0.0042	0.0043	0.0171	0.0052	0.0086
Cr ₂ O ₃	0.0088	0.0098	0.0152	0.0099	-
MnO	0.0011	-	0.0016	0.0015	-
Fe ₂ O ₃	1.4527	1.4587	1.6758	1.4379	1.5738
CuO	0.006	0.0053	0.0068	0.0061	0.0045
Ga ₂ O ₃	0.026	0.0246	0.0308	0.025	0.0288
Total	99.9999	99.9999	99.9999	99.9999	100.0001

CONCLUSIONS

Silk inclusions and Fe content can be used to identify the origin of blue sapphire from Chanthaburi and Kanchanaburi. The appearance of silk inclusions was observed by using a gemological microscope found that the dimension of silk inclusions from Chanthaburi is mostly shorter than the one from Kanchanaburi. The results of chemical compositions present the Fe content of Chanthaburi sapphires are higher than samples from Kanchanaburi. Therefore, silk features can be determining the sapphire sources from both provinces in Thailand.

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