

Review of Rubies and Sapphires from Chanthaburi-Trat and Kanchanaburi Gem Fields, Thailand

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For over 40 years, Thailand has been globally known as an important source of ruby and sapphire. The Geological Survey of Thailand studied numerous gem occurrences in Thailand and found that the potential gem fields were located in Tha Mai and Khlung Districts of Chanthaburi Province and some areas in Khao Saming District of Trat Province (Chanthaburi-Trat gem field); Bo Phloi District of Kanchanaburi Province (Kanchanaburi gem field); Wang Chin, Den Chai and Si Satchanalai (Phrae-Sukhothai gem field); Wichian Buri (Petchabun gem field); and Nam Yuen (Ubon Ratchathani gem field). Almost all those gem fields were sapphire deposits, except some areas in Trat Province where significant ruby deposits have also been found. In the past, it was estimated that approximately 70% of all good quality rubies in the world came from Thailand. All ruby and sapphire deposits in Thailand were essentially associated with Cenozoic alkaline basaltic volcanism (Barr and MacDonald, 1978, 1981; Vichit, 1992; Sutthirat et al., 1994). They are usually found as secondary deposits, both eluvial and alluvium ones. Among those occurrences, the two most important sources are from the Chanthaburi-Trat gem field (ruby and sapphire); and the Kanchanaburi gem field (sapphire).

Chanthaburi-Trat Gem Field

Gem corundums from the Chanthaburi-Trat gem field have been widely known for a long time by Thais and foreigners as the “Ploy Chanthaboon” (Vichit, 1992). The stones are rubies and blue, green, yellow, purple sapphires as well as parti-coloured stones. The source areas in this gem field can be separated into 3 major zones (see Figure 1).

The Western Zone of Chanthaburi is where only sapphires of different colours have been recovered from the areas of Khao Wua, Khao Ploi Waen, and Ban Bang Kacha areas. The Khao Ploi Waen area has been mined for over 100 years. Nowadays, the stones in this Zone are almost depleted, except some sporadic mining activities are still active at the Ban Bang Kacha area. The deposits of this Zone are related to basaltic volcanism dated from 0.44 ± 0.11 Ma (Barr and Macdonald, 1981) to 3.3 ± 0.11 Ma (Sutthirat et al., 1994).

The Central Zone is between Chanthaburi and Trat (East of Chanthaburi). Various quantities of both ruby and sapphire have been recovered in Ban Bo Welu, Ban Tok Phrom, Ban Bo Na Wong, Nong Bon Noi, and many other smaller occurrences.

The Eastern Zone is in Trat. Most of the stones are ruby and rarely sapphire. The areas include Ban Suea Dao, Ban Nong Bon, Ban Bo Rai, and many other smaller deposits (see Figure 1). The geological setting here is mostly tuffaceous sandstones and volcanic agglomerates.

Based on the geochemical studies of mineral inclusions in ruby and sapphire hosts as well as sapphire-bearing and ruby-bearing xenoliths from Chanthaburi-Trat gem field, the researchers suggested that sapphires originated from incompatible-element enriched, volatile-rich, alkaline felsic magma in lower crust/upper mantle conditions (Coenraads et al., 1995; Sutherland et al., 1998; Intasopa et al., 1999), whereas the rubies derived from mafic granulite deeper in the mantle (e.g. at 30–50 km depth and 700 - >1000°C, Sutthirat et al. (2001); Sutthirat et al. (2018)). The mantle-derived alkaline basalts were later erupted and carried the sapphires in the Western Zone, ruby and sapphire in the Central Zone, and ruby in the Eastern Zone to the surface during <~3 Ma.

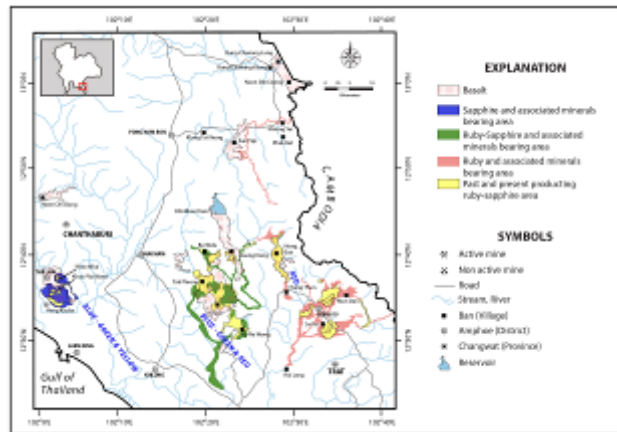


Figure 1 A map illustrating locations of rubies, and blue-green-yellow sapphires in 3 major zones of the Chanthaburi-Trat gem field. (Modified after Vichit (1992)).

Characteristics of rubies and sapphires from the Chanthaburi-Trat gem field

Ruby from this gem field has been famously known as the “Siamese Ruby”, and is becoming increasingly rare in the global market. Thai ruby usually contains purple hue, except the stones found in Bo Rai and Bo Welu possess bright red colours with very minor purplish tint. Ruby from Nong Bon is being known for its relatively dark red colour, while blue sapphires from this area are relatively dark with some greenish tint.

Internal characteristics

The most diagnostic inclusions of ruby from the Chanthaburi-Trat gem field are negative crystals with healed fissures, similar to a thin film, locally called “Lai Thai” by gem traders (Figure 2a) and common diopside crystals (Figure 2b). Other internal features are repeated twinning (Figure 2c), boehmite tubes in box work pattern (Figure 2d).

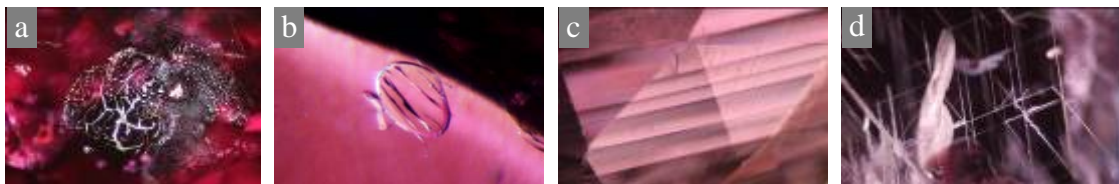


Figure 2 Inclusions in ruby samples from Bo Rai: Negative crystals with equatorial thin-film (a; Field of View (FoV) 0.60 mm), diopside crystal (b; FoV 0.76 mm), repeated twinning (c; FoV 3.00 mm), and boehmite tubes in box work pattern (d; FoV 0.80 mm).

Examples of inclusions in blue sapphires from Chanthaburi gem field are solid crystal (Figure 3a), oriented minute particles along angular growth zones (Figure 3b), healed fissures (Figure 3c), and silks (Figure 3d).

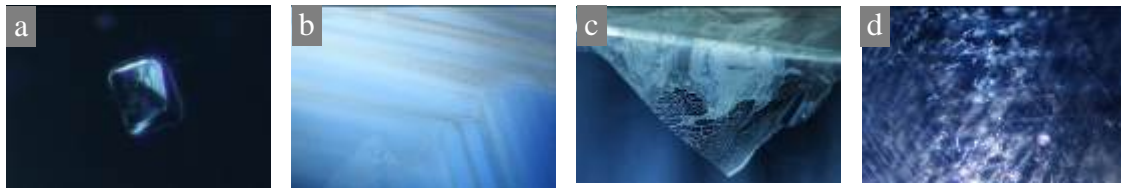


Figure 3 Inclusions in blue sapphires from Chanthaburi: solid crystal (a; FoV 0.60 mm), minute particles along angular growth zones (b; FoV 1.50 mm), healed fissure (c; FoV 1.20 mm), and silks (d; FoV 1.75 mm).

Kanchanaburi Gem Field

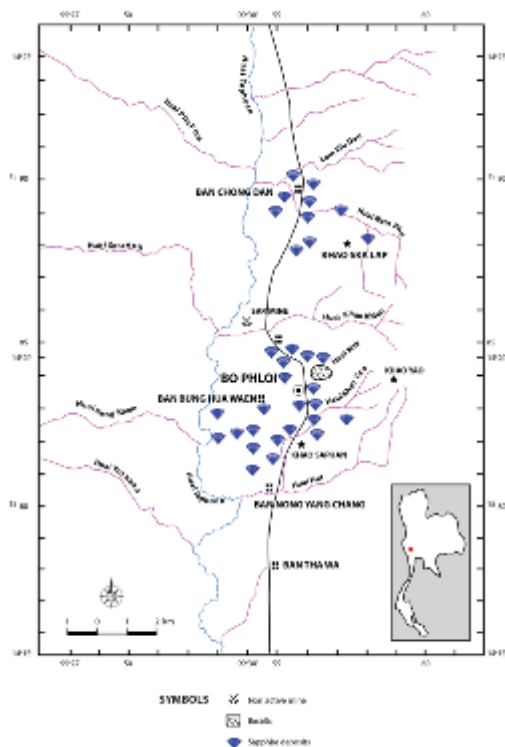


Figure 4 A map illustrating sapphire deposits in Bo Phloi District in Kanchanaburi Province.

Bo Phloi District in Kanchanaburi Province is located towards the north of Kanchanaburi town. This gem field was well known in 1990 when there were the largely mechanised mining activities enabling the exploitation of large amounts of sapphire from this source in a short period of time. Nowadays, there is only one small mining operation here. Source areas of sapphire in Kanchanaburi (Figure 4) were found in recent alluvial gravel deposits of the Lam Taphoen river system. The gems were believed to derive from the weathered 3.14-4.17 Ma alkaline basalt nearby that flowed on top of quartzite basement rocks.

Based on the geochemical studies of mineral inclusions and dating of zircon inclusions in the sapphire hosts as well as zircon+sapphire-bearing xenoliths from this gem field, it was proposed that the sapphires were derived from bimodal origins, syenitic melts and contact metamorphic sources, that occurred episodically during ~24-4 Ma as a result of the hybrid interplay of lower crustal and upper mantle materials (Pisutha-Arnond et al., 1999; Khamloet et al., 2014). Later, the eruption of mantle-derived alkaline basalt carried the sapphires from both origins along with other xenoliths and xenocrysts to the surface during ~3-4 Ma.

Characteristics of sapphires from the Kanchanaburi gem field

Sapphires from this gem field are mostly light to dark blue in colour but brighter and clearer of those of Chanthaburi. Other rare varieties of sapphire found here are yellow, pink, green, purple, and fancy-coloured (Leelawatanasuk et al., 2017).

Internal characteristics

Examples of internal characteristics of sapphires from Kanchanaburi are twin lamellae with needles (Figure 5a), minute particles (Figure 5b), strong colour bands (Figure 5c), and feldspar crystals (Figure 5d).

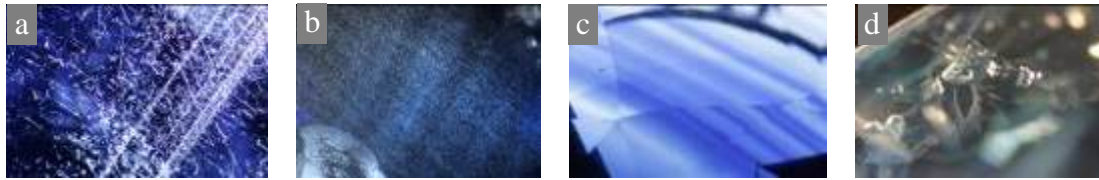


Figure 5 Inclusions in blue sapphire from Kanchanaburi: Twin lamellae with needles (a; FoV 1.75 mm), minute particles (b; FoV 1.00 mm), strong colour bands (c; FoV 7.00 mm), and feldspar crystals (d; FoV 1.00 mm).

Conclusions

The important sources of ruby and sapphire in Thailand are still from the Chanthaburi-Trat gem field and the Kanchanaburi gem field. Though the main resources of these two gem fields have been exploited extensively in the past, some stones are still being supplied from the current mining operations in both fields. The ruby and sapphires from these two Thai gem fields possess distinct and unique characteristics for their colours and inclusions, and they are becoming increasingly rare in the market.

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