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# Triangulation proves Geum brocade with the horizontal loom of Gojoseon

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## Abstract

Geum (錦, Jin) is a jacquard brocade silk fabric (or doubled~tripled woven) with multi-colored warps. Because patterns are shown by colored yarns of overlapping warp layers, it is dense and stiff, making bulky silhouette of layerlook suitable in cool or dry weather. This fabric is completely different from the drape and lightweight low-density plain weave of 'China silk'. KyungGeum (經錦, warp direction color yarns) requires a high level of weaving technology, different from WiGeum (緯錦, weft direction color yarns). Geums excavated in Louran and Niya of Xinjiang Autonomous Region, Astana, Pazyrik and Noin-Ula have the pattern of animal flock style of Northern people. The purpose of this study is to find out who wove these Geum fabrics by the triangulation of literatures, relics and loom technology. The pattern was quite complex, so a horizontal and rectangular type of loom or a special loom 'JeHwa-Ru (製華樓)' were required. Since the 'Warring States Period (戰國時代)' of China, all Han (漢) looms were oblique looms with one heald and KyungGeum production was impossible with these looms. The same is true for vertical looms in Central Asia. Also, the Odes (詩經) and the Shujing (書經) told that barbarian and bandits had weaved KyungGeum. Geum as the special products of Goguryeo and Silla it was exported to China and Japan. Therefore it is reasonable to regard the KyungGeum relics of Niya and of Louran as those from Gojoseon, Goguryeo, Silla (Seres) of Korea, as a result of comprehensive examining the year of production, historical documents, pattern symbolism and loom types.

**Keywords:** Kyung-Geum (Jin silk), Gojoseon, Goguryeo, Seres, Horizontal loom

## Introduction

The Battle of Takrok (涿鹿) scene between the emperor Chi-U (蚩尤, Chi Woo) of DongYi (東夷, east archerian) and the emperor Heonwon (黃帝 軒轅氏, BC2679~, Yellow emperor) of ancient China appears on wall painting of the ceremony building of the Chinese Three-Ancestors Hall (中華三祖堂). Heonwon and his army wear official uniforms with advanced weapons, while Chi-U and his army wear animal skin and hold stone axes. Yet, the records stated that Chi-U was Cheon-Ja (天子) in the Soho period (少昊之末 九黎君名- 書經, 蚩尤古天子之號- 史記集解) and the king of Guryeo (九黎) and a war god wearing a bronze helmet of an iron forehead (銅頭鐵額—史記正義), having high technology of metal finishing, and it is also considered as the beginning of the

Bronze Age of the DongYi people. The wall drawing deliberately disregards the Chi-U, the ancestor of DongYi. Also the 'Chi 蚩 and U 尤' words have the meanings of 'stupid, like a worm, ugly, crawl, many faults' and 'again' respectively. Thus it is sure that Chi-U is the ancestor of Myo tribe(苗族) and the great-grandfather of Dangun (檀君) of the (Go) Joseon dynasty (BC2333~) of Korea (Shim, 2014).

China is portrayed as a civilized country, and its neighbors are described as barbaric, paying tribute to China. But the reality is completely different. Among neighboring countries, there were countries with military superiority like the Xiongnu(匈奴), and culturally sophisticated countries like Tibet (Whitfield, 2001). Few people know right that ancient Korea Gojoseon was on the continent as well (Li, 2018; Shim, 2014), that the records that Gojoseon was great are hidden on purpose and anything remarkable has been mistaken as the culture of China or Japan. Also, in the West, ancient Korea is mistaken as part of ancient China. But Gojoseon had brilliant culture, and the representative relics of Gojoseon include jade earrings and jade cover for top-knot hair from Xiajiadian culture (夏家店下層文化) relics, and the colored pottery of DaejeonJa (大甸子) relics, and dolmens in the early period (Bok, 2019), and Lute-shaped Bronze Dagger, DaNyūSeMunGyeong (多紐細文鏡) and MyungDoJeon (明刀錢) of the late period (Oh & Kim, 2018). Therefore, this study examined the origin of Geum and textile technology in ancient Korea Gojoseon.

People had traded with each other, because foreign countries own a lot of things that are rare in that country, or because they have different technology or different resources and the relative price of a product is different in domestic and abroad. Ancient Koreans, who led gorgeous clothing life, produced a lot of Geum, which was a rare commodity in the world (Kim & Na, 2020) and Geum was a very attractive product in long-distance bartering at the time. We can tell that we did East–West long-distance trade very actively, as similar golden swords were excavated in Silla, Kizil Thousand Buddha caves, and Kazakhstan. Silk fabric relics of the fifteenth century BC was also found in Bactria (Whitfield, 2001).

The most ancient Silk Road is the Steppe Silk Road. It is a road that crosses east to west in the steppe zone of the Eurasian continent, about 50 degrees north latitude (Cheong, 2013). The Pazyrik culture on the northern side of the Altai Mountains is a relic of the fourth–fifth centuries BC, and in this tomb, silk fabrics embroidered in the pattern of birds and flowers were excavated, and this culture can be seen as a flower-blossom place in the exchanges of East–West cultures (Nagasawa, 1993). Birds and floral-patterned Geum brocade silk fabrics were excavated from Louran in Central Asia and from Astana. So who were the silk people living at the eastern end at that time?

The black-brown pieces of Geum fabric (52 x 14 threads/cm<sup>2</sup>) excavated from Chaoyang(朝陽) of current Liao-Seo(遼西) is the oldest, although it is a small fragment (Min, 1998). Geum was also excavated from each tomb during the Spring and Autumn Warring States Period(春秋戰國), which was a little later, and the patterns were linear and simple geometric patterns. It was impossible to express curves in Geum pattern in this period, such as those from Imchi in Shandong(山東) in the Spring and Autumn Period, Jangsa in the Warring States Period, the tomb of Masan No. 1 in Gangneung, and Ma Wangtei in the Cho(楚) dynasty (Sim, 1998).

In the Warring States period, Geum have been excavated from the remains of Xinjiang Luran, Astana, and Niya. Geum fabrics with the letters such as ‘韓仁繡文衣右子孫無極, 長樂明光, and 萬世如意’ and with the animal patterns were unearthed, indicating great progress in weaving technology (Sim, 1998). It is estimated that Xinjiang started sericulture and weaving silk fabrics around the third–fourth centuries (Sim, 1998), thus, it was understood that these Geum were woven elsewhere and traded here.

Geum was invented in the eleventh century BC (Huang & Chen, 2016). Early records of Geum include ‘Geum of DongYi(夷錦), Geum clothing fox coat(錦衣狐裘)’. ‘Pae (shell) is Geum’ in the the Odes (詩經), and ‘Gwol-Bi-Jik-Pae’—barbarians and bandits weave Pae’ in the the Shujing(書經- 厥匪織貝). This means that the DongYi had woven and wore Geum, and they put on luxurious furs of fox, black monkey or mink. At that time, fur clothing was a luxury item, and the price was very high. DongYi had lived in the continent centering the Shandong Peninsula (徐亮之, 中國史傳史話). From the Book of Han (漢), DongYi people’s character and residential areas were mentioned, and it was described that they were docile in nature and showed a tendency different from the other Yi peoples of the 3 directions of west, north, and south. DongYi was the countries of Go(gu)ryeo, Baekje and Wae (倭), according to Old Book of Tang (舊唐書 東夷傳) DongYi Jeon definitely. In Han period, Silla also located in Nakrang land(樂浪), the southeast of Go(gu)ryeo (Lee, 2021).

They said there was a revolution in textile technology in Han(漢) Dynasty which was changed to the inclined loom form of a weaving machine, and Geum was popular in Han period. But the change in the form of a loom had made fabric pattern simple, because this slanting loom (Sajikgi, 斜織機) makes Geum production impossible.

On the other hand, the ancient looms that are presumed to be Geum weaving looms remain in the minority tribes. Sichuan(四川) Province’s ‘Jomyun gi’, which uses multiple-hand healds type of multi-step treads, ‘Jukryung gi’ from the Zhuang tribe(壯族, 廣族) district, and the ‘One-man-sikmun gi’ from the Dai tribe(傣族) district, and more (Sim, 1998). What is the reason that looms capable of Geum weaving are being discovered not in Han dynasty, but in the minority ethnic group?

Many people mistakenly believed that the China was the master of the Silk Road by the records, but today’s scholars are paying attention to the role of Central Asia and the Steppe Silk Road after they found out that there were no Chinese contribution according to the archeology (Cheong, 2013; Rezakhani, 2010). As a steppe, in the past, comb-patterned earthenware and metals were exchanged east–west through this road from the Neolithic and Bronze Ages, and the Scythians and Seres ruled this place about the seventh century BC (Kim et al., 2021), and the Xiongnu ruled it in their heydays third century BC (Cheong, 2013). The Xiongnu (匈奴) expelled Wolji (月氏), the original owner of Gansu province (甘肅) and Qilián mountain (祁連山脈) (BC177), who placed the oasis empire in the Tarim Basin under control. At that time, the Silk Road was completely under the control of the Xiongnu (Nagasawa, 2005).

Before Han silkroad, the silk fabrics excavated in the West might be from India and an in-depth study to classify the types of silk fabrics was proposed (Good, 1995). It is known that the Oasis Silk Road was first pioneered by Han Wu-Ti (漢武帝) in the second century BC, but this is not true. Also the scholars of Chinses and Japanese say that the many Geum relics, colorful silk fabrics from Xinjiang are those of Han dynasty

(Huang & Chen, 2016; Nagasawa, 2005), but this is not true, either. This is because Japanese scholars who studied first the history of Central Asia treated ancient Korea as invisible and completely deleted the roles of Gojoseon and Goguryeo. Like the Steppe, the Oasis Silk Road was already actively operated by the Xiongnu and Wolji from a long time ago, and splendid Geum silk textiles were already widely used in Rome in the fifth–sixth century BC. Geum silk fabric was invented in the eleventh century BC at the East and delivered in the fifth–sixth century BC to the West, til north Africa via Persia empire (Miyaji & Motamedi, 1979).

Xiongnu had a northern empire three times larger than Qin-Han(秦漢) until the second century BC, and Han (漢) had offered grains, cotton and silks as a tribute to the Xiongnu every year (Griffin, 1996). Some said that these tributes were delivered to the West, but the West had used silk fabrics since the fifth–sixth century BC according to literature, and the tenth century BC the archeological proofs (Good, 1995). Seres people spread silk KyungGeum to the West through both the Steppe Silk Road and the Oasis Silk Road before the fifth–sixth century BC. The fifth century BC Greek historians Ktesias and Herodotos mentioned Seres of silk people.

Silk was widely known in the Western world as ‘Ser or Seres’ (Nagasawa, 2005), long before the Silk Road of Han Wu-Ti and Zhang Geon (張騫). ‘Seres and Serica’ meant ‘silk people and their land’ in Rome that time, and they were representing the Silla, one of Gojoseon according to the genetical, geographical, and phonological study (Kim & Na, 2020). Also it became the root of the name of sericin, the silk protein.

The Seres, silk people exported their own products, such as silk Geum, fur, and the high quality of iron (Cheong, 2013), or the large amount of iron (Nagasawa, 1993). Iron already existed in the West, so what Seres exported would have been good quality iron, not large amounts of iron. Since the Japanese scholar recorded in this way, a more precise analysis is required. Seres exported colorful silk rather than drape ‘China silk’ (Cho, 2012), for ‘China silk’ refers to thin and lightweight plain structure fabric among silk fabrics (Kim et al., 2013). Gorgeous silk pillows were popular among the wealthy in ancient Rome (Muthesius, 1994), and this pillow cover maybe the Geum, not thin China silk. In Rome of the first century BC, silk was so scarce that even the most likeable citizens could afford nothing but pieces of silk to be sewn as ornaments in prominent positions of cotton, linen, and wool toga. In the first century, sea routes developed and silk stocks began to increase, which further stimulated the Romans’ desire for oriental luxury, and they were traveling to Seres to obtain silk and Gaius Plinius lamented that the Roman had come to accept having their ears pierced with ease (Whitfield, 2001). Because the ancient Chinese did not wear earrings, it can be guessed that Seres, who wears earrings, was not Chinese. When the Rome were in the war with Parthia, the Roman soldiers were terrified when they saw lots of Parthian war flags, because they had seen a scene like this for the first time (Hopkirk, 2000; Kwon, 2011). Maybe this is because the Parthian made the war flags with very expensive Geum silk fabric?

In the Book of later Han DaeJinGuk (後漢書 大秦國條- Rome part), they commented that there were already silk yarn, Geum and silk twill in Rome, as well as many gold and silver and precious treasures. It is said that there are luminous thin jade, bightening ball, red striped horn, coral, amber, glass, turquoise, red dye, blue jade, silk woven embroidered with gold thread (刺金縷繡織成), a gorgeous wool Gye with gold thread (金縷罽),

and a multicolored twill silk (雜色綾) (Nagasawa, 1993). This means that these treasures are expensive and rare in Han dynasty, and they are saying indirectly that these treasures of the list had not been exported by them. When Zhang Geon found Sichuan silk in Bactria and asked them where it came from. The answer he received was that silk from Sichuan province came to Bactria through India.

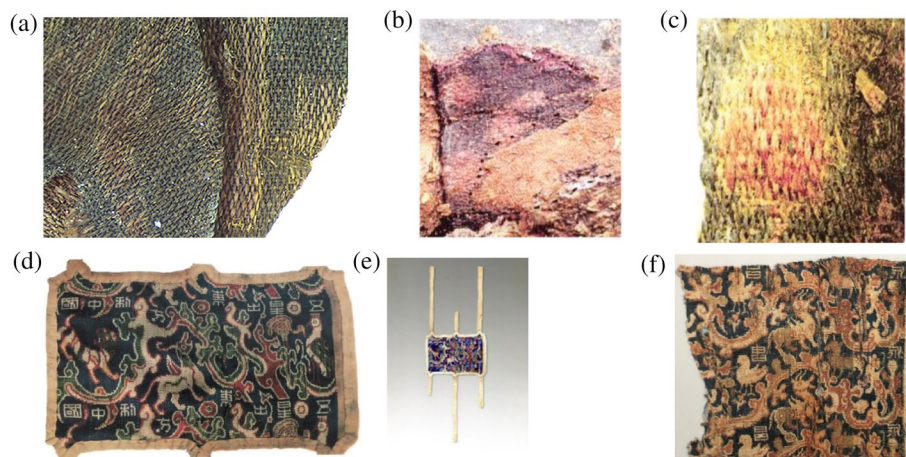
In the Book of Three Kingdoms SeoYung (三國志魏志 西戎傳), it has more detailed items. It is said that in Rome, there are plants (pine, cypress, zelkova, bamboo) as well as paulownia tree of silkworms, five grains are planted, and animals include horses, mules, donkeys, camels, silkworms (桑蠶) and magicians. Notice that the silkworm and paulownia tree are included. It is recorded that all the rare foreign objects in India are imported from Rome (Nagasawa, 1993). Then where did the treasures of Rome come from, such as splendid silk embroidery(繡) and wool fabric Gye(罽), colorful twill silk(綾) and wild silk cocoon? if not Han dynasty, nor India? It is written that Romans had cocoons and silkworms in the third century AD, in addition, the Romans said they made the delicate cloth blended scythian lamb wool (水羊毳) with wild silk cocoon (野蠶繭) together. Is it true that they did not know how to spin silk thread from the cocoon? Why did they continue importing silk fabrics? and what was the kind of silk fabric?

Therefore, the purpose of this study is to search for the characteristics of old Geum fabric remains that can be found in the Silk Road, and to understand the design features and symbolic meanings of the pattern. In addition, it is intended to investigate the social, natural, and technological environmental conditions in which Geum fabric could be woven, and to find its production place as the main character of the Grassland Silk Road and the Oasis Silk Road.

## Methods

The research method was approached through an analysis of ancient relics and comparing the records related in various fields collected over the books, old records, papers and the internet. It focused on finding the hidden content between sentences in the literature and used procedural syllogism argumentation (Lee, 2016a, 2016b). This study examined the followings: East and West archaeological art history, Silk Road history, the time and location of the appearance of the remains of silk in the West, types of silk fabrics, the physical properties of silk fabrics, the characteristics between KyungGeum and WiGeum, and the types of the ancient looms. KyungGeum with multi-colored warps appeared approximately 1800 years earlier than Wi-Geum (緯錦) with multi-colored wefts, and the 'Geum' from the old records means KyungGeum which is the warp-direction silk fabric.

This study investigated the pattern characteristics of the silk relics excavated on silk-road, KyungGeum fabrics of Baekje and Silla of Korea, and those remains of Nara period of Japan. The focus was on the fact that the clothing and their aesthetic sense of people living in the north, the west, the east, and the south differ from the center because of the natural environment and geographic location, so that the ancient glory of the ethnic tribes lead them still wanting independent. The conditions under which ancient silk can be manufactured, such as material supply and technology, the weather and geographic conditions, and the closeness or trade with the surrounding areas were investigated



**Fig. 1** Dark background KyungGeum brocade with the pattern by the colored multiple warps in delicate outlines. **a** Dark blue green KyungGeum from the Miruksaji temple of Baekje (639) (Kim et al., 2021). **b** Dark KyungGeum with pink flowers from Cheon-Ma-Chong of Silla (514) (Jang & Kwon, 2014). **c** Close-up of pink flowers (Jang & Kwon, 2014). **d** 'O-Seong-Chul-Dong-Bang' KyungGeum of arm protector from Niya (尼雅), Xinjiang Autonomous Region shows animal flocks and puffy clouds (BC third–fifth century). This close-up shows the pattern of old letters of prayer and 2 stars, crane and eagle, a heavenly animal and a tiger (Huang & Chen, 2016). **e** Whole view of the arm protector with 6 GoRum straps of MyungJu silk (Huang & Chen, 2016). **f** Saekdong YoungChang (永昌) KyungGeum from Louran, Xinjiang Autonomous Region: three-legged crow (三足鳥) and heavenly animal flocks of dotted skin, the letterings of prayer (Huang & Chen, 2016) (All photos are with permission from the copyright holders)

based on historical data. The weaving of silk Geum requires complex technical skills and a special loom, so the related data was collected.

The newly discovered KyungGeum relics of Baekje and Silla were analyzed comparing with the Geums of Xinjiang. The characteristics and symbolism of KyungGeums of 'O-Seong-Chul-Dong-Bang and YoungChang' excavated in Xinjiang Uighur were examined for the Northern oldest piece which was the period of Gojoseon. This study examined the pattern similarity shown at the KyungGeum of Silla and Nishijin Geum of Kyoto from the pattern of KyungGeum of Xinjiang. In addition, the correlation of the patterns of Baekje KyungGeum was evaluated with regards to Nara KyungGeum remaining in Japan. The shapes of the Korean traditional looms and the looms of the surrounding areas were analyzed, focusing on the level of silk fabric production in neighboring countries. The weaving technology and the shape of the loom were analyzed, and the evidence related to ancient Korean looms was studied.

## Results and Discussion

### Newfound KyungGeum pieces from Baekje and Silla

The pieces of Geum discovered in Baekje and Silla are all characterized by a curved pattern with outlines on a dark background. They used the border lines in detail on every pattern to enhance the shapes. Figure 1 presents the colorful KyungGeum of Baekje (百濟) and Silla (新羅) around the sixth century AD. Figure 1a shows blue KyungGeum layers found in the stone pagoda, which is a colorful woven fabric of a purple pattern with a yellow outline on a dark background. In this surviving remains, the curve pattern appeared relatively large with a asymmetrical shape.

In Fig. 1b a KyungGeum of Silla Cheon-Ma-Chong (天馬塚) has small pink flower circles with a yellow outline ikat in a dark background. Three kinds of warp (dark blue, pink and yellow) are woven together with two kinds of weft (ground weft and core weft). KyungGeum fabrics from Cheon-Ma-Chong used 2–3 times more warp threads than a plain weave, and the warp density ranged 1.32–2.50 times higher than the weft density. This means that the warp of KyungGeum was used in a high density. The warp thickness ranges 0.104–0.267 mm (average: 0.176 mm), and the weft thickness ranges 0.078–0.173 mm (average: 0.140 mm) and the thickness ratio is 0.522–1.606 (average: 0.835). Unlike general fabrics, the warp for colored pattern is relatively thick compared to the weft. The yarn density ranges  $121.9\text{--}254.0 \times 76.2\text{--}101.6/\text{inch}$  (average:  $160.0 \times 93.8/\text{inch}$ ) and the density ratio is 1.32–2.50 (average: 1.74) (Jang & Kwon, 2014).

The relics of KyungGeum also mean the development of other fabrics in the period because it is the most complicated fabric that requires advanced weaving technology. Most silk relics of the Hwangnam Dae-Chong (皇南大塚) of Silla were KyungGeum (Jang & Kwon, 2014). Background black color symbolizes the depths and the north, meaning the sky that embraces infinite time and space in ancient time, thus the ancient high ranked people preferred black for the clothes, and used pink or orange, not red. The high density of threads result in stiffness of fabric. KyungGeum, MyungJu (明紬, 綿紬), Habutae and Shantung(山東) silk are stiff and make a bulky silhouette (Min, 1997), while China silk makes slim (Kim et al., 2013). In Gojoseon's silk, the outer protein of cocoon threads was left without completely removing the sericin during the yarn processing, leaving it stiff and suitable for making fabrics for a bulky silhouette (Kang, 2019). Ethnic standard of beauty does not change easily, and the preferred silhouette was conserved for hundreds of years in the ancient times.

#### **KyungGeum of the North Asian people, 'O-Seong-Chul-Dong-Bang'**

KyungGeum 'O-Seong-Chul-Dong-Bang' (五星出東方 利中國 南羌四夷 服單于 降與天 無極) is an arm guard excavated from Tomb M8 of the Niya (尼雅) #95MN1 ruins as known in third–fifth century BC in the Xinjiang Autonomous Region (Fig. 1d and e) (Choi, 2019). At that time, Wolji, Seres or Xiongnu was the hegemon of this region (Kim & Na, 2020), and in its heydays Xiongnu had the strong power that frightened Qin Shi Huang (秦始皇) who built the Great Wall was constructed, At the time of the enthronement of the Xiongnu Mòdú SeonU (冒頓, BC 201~), (Go)Joseon was strong and bordered the Xiongnu, according to the Book of SaGi(史記) (Hwang, 2012).

This beautiful KyungGeum has the patterns of 5 stars, 2 birds, 2 animals, old characters, and windy wavy clouds with buds in a lateral direction. The following letters of Seal Characters(篆書) were woven into the fabric, not print. It shows a high level of weaving technology to weave delicate curved animal patterns and even complex characters. Five stars emerge from the East (五星出 東方) and it benefit all the land of the center(利中國), Southern Gang tribes (南羌) and the four Yi tribes (四夷). This wish concept maybe resulted from the founding ideology of Gojoseon that described 'wide benefits to humans (弘益人間)'. At that time, as the country named '中国' did not exist, and this should mean 'the centered land', not the China. Sometimes '中国' meant India where they could study the Buddhism and where the Buddha's way started (Seo, 2020). The king of Xiongnu had the power over the Qin(秦) Han(漢) dynasties (Sarianidi, 2016).

'SunU (單于) was the king of Xiongnu,' and clothes '服' in '服單于' means 'emperor's cloth' or 'surrender' to SunU, '降與天' means who was descended from heaven and '無極' means eternal. Therefore, the owner of this Geum had thought himself as 'son of sky(天孫); and this lettering means that the good sign from the sky will benefit all the land and bless Xiongnu king of heaven last forever.

'Five stars arranged in a line' is a sky phenomenon called 'O-Seong-Chi-Ru 五星就樓,' which occurs once in approximately 250 years in which the five stars are located in a straight line in the sky (Park, 2002). The five stars are the five planets that can be seen with the naked eye: Venus, Jupiter, Saturn, Mercury, and Mars, and this is a good symbol if they rise from the East and are positioned in a straight line. Since the king was appointed from heaven, the ancients thought that an evil omen—a solar eclipse—would appear in the sky if the king's reign was bad. Prof. Park had located capitals of Goguryeo, Baekje, and Silla based on the records of ancient solar eclipses. Rare O-Seong-Chi-Ru was interpreted as a good sign. Among them, the earliest record of 1753 BC (檀君世紀) means 1754 BC actually, which is only a one year difference from the true year computed from a computer simulated run (Park, 2002). As for this record of O-Seong-Chi-Ru in the 50<sup>th</sup> year of Huldal (屹達) Dangun of Gojoseon in 1753 BC, which proves the Gojoseon people had been steadily recording the changes in the universe along with solar eclipses. There is one more record of observing the similar astronomical phenomenon '五星就於東方' during the reign of king Cha the Great (次大王 146–165), the 7th king of Goguryeo in the Samguk-sagi of Korea (Kim et al., 2021).

That the five stars rise from the East is related with the belief that all ancient Asian civilization originated from the East tribes, DongYi. It cannot be denied that DongYi is a name for the foreign east countries based on the China-centric view of the world. DongYi was a distant place, a bright place, and the origin of civilization (Song, 2013). According to Samacheon's Sagi (史記), the territory of Zhou (周) was 1000 li (里) outside the capital only, and the DongYi was also clearly defined as 1500 li away. 'There are many silkworm trees near the Balhae sea and downstream of the Yellow river, and each house had raised silkworms' and 'the Shandong DongYi brings the cocoons in a basket as a tribute' according to the Books of Odes & Shujing. They said KyungGeum appeared in the eleventh century BC (Huang & Chen, 2016), and it must be invented by DongYi.

Five stars and the old letters of prayers are woven amidst the animals and the clouds. The inlay of these letters on the silk fabric of KyungGeum shows their high weaving technology, and their ancient belief in the North Star (北極星) and begins with thoughts that believes that the blessings of heaven will come down if good words written on fabric. In the Balhae dynasty (渤海國, 698–926 AD), which succeeded Goguryeo, 'when the child is born and the birthday comes, the parents take him to the Dangun shrine and tie his/her hair with a prayered cloth.' Hence, it is called DangGi (땡기) of hair tail (Kim et al., 2016). In Japan, where the tradition is still maintained, when a child is born, parents take him/her to the (Dangun) shrine to pray for good luck (Hong, 2012).

Indeed, who made this gorgeous silk in the world? This fabric was woven before Han dynasty due to its Seal characters (篆書) and woven by Buk-Yi (北夷) people due to its animal patterns. But Chinese said that it is one of their national treasures and it was made in Han period. The colorful silk Geum with a dark background like the night sky was woven by their North people with the religion of worshipping the heavens and

stars in Gojoseon period. Notice that the China of the third–fifth century BC were in their Warring States period and China's territory expanded to the Xinjiang Autonomous Region and Tibet in the Qing (青) dynasty.

Chinese told that the KyungGeum relics excavated from current China territory were made in Han dynasty, but the truth is that Geum were woven by DongYi or Buk-Yi people, not by the Chinese. Its oldest record is 'DongYi's Geum' in the Odes (詩經) (Min, 1998). It is clearly written in the ancient documents of the Spring and Autumn period, in the Shujing Wugong (書經 禹貢), it is written 'Guol Bi Jik Pae 厥匪織貝' means that barbarians and bandits weave shells, and in the Odes Mojeon (詩經 毛傳), it is written 'Pae, Geum Mun Ya 貝錦文也' means that shells are (Kyung) Geum. By these records of syllogism, we had found that KyungGeum was the specialty of DongYi and Buk-Yi.

The colorful silk arm guard is  $18.5 \times 12.5$  cm, and the longest length of the straps is 21 cm. The arm guard has five layers, and it has six straps made of strong MyungJu silk. The strap GoRum is a unique part of Korean traditional costumes. This string is used to tie the straps for wide sleeves when they were uncomfortable during hunting or warring. Protectors were used to wrap the shin, too for the wide pants on riding (Mun, 2013). This attaching Gorum on the clothing was an ingenious invention of the Northern people, who were active, as fastening or blocking cold wind. The bias tape treatment of this protector and strap shows ancient sophisticated sewing skills. MaKhan (馬韓) knew the method of cultivating silkworm (蠶桑), making silk cloth (綿布), put value on beads not on Geum & Gye, adorned beads on their clothing with 'Cheol 綴' (後漢書 東夷傳 韓條—馬韓人知田蠶, 作絺布, 不貴金寶錦罽, 不知騎乘牛馬, 唯重璆珠, 以綴衣爲飾, 及縣頸垂耳). This sewing was called 'Cheol 綴', the advanced sewing techniques meaning stitching, connecting, attaching and sealing techniques, and Korean women had this skillful technique, and bone needles were found from the period of Neolithic ages in Korea (Park, 2011). This arm protector with curved bias taping surely shows high sewing technique of Cheol.

The fabric density of O-Seong-Chul-Dong-Bang KyungGeum is told to be  $220 \times 48$  /cm<sup>2</sup>, five times more warps than wefts. It shows the sophisticated patterns with delicateness, compactness and robustness. When looking at the pattern of KyungGeum, the vertical repeat is short, less than about 10 cm, and widely spanning the fabric horizontally. A bird with long legs (a crane), a bird of prey that looks like a hawk or an eagle, a celestial animal with horns and wings, and a striped tiger looking back are expressed in exceptionally beautiful curves. White or red fine outlines make the motif stand out. The animal pattern is well known as the traditional motif of northern nomad people, and concrete details that even show the joints in animal hooves are possible only if you are familiar with the animals that live with them.

Also notice that these people had a sky god and an earth god, as the wave-shape below, meaning the ground and the mountain, and the above wave-shape, meaning the sky and clouds. The round or puffy clouds in which life buds are riding on a curved flow of the wave up and down as if representing the sky, the round tents and the earth. Surely the artists must have shaped the symbol of mysterious heavenly energy showing the sandstorm when animal flock moving fast. It could also be seen as a masterpiece of ancient culture. Actually, according to the record of Han dynasty, the cloud

symbols in the form of animal flocks and nomadic tents were considered as signs of the north Buk-Yi (北夷)'s attacks (故北夷之氣 如群畜穹閭) and the cloud symbols in the shape of flagpoles and ships were considered as signs of the south Nam-Yi (南夷)'s attacks' (史記 天官書) (Butin, 2019). Thus, there is no way that this pattern could have been made by a person in Han dynasty.

The inlaid 'YoungChang (永昌)' in KyungGeum means 'forever prosperity' and this was excavated from a tomb in Louran (樓蘭), Xinjiang Autonomous Region (Fig. 1f). A closer look reveals the vertical Saekdong of the yarn color, green, yellow, and orange in dark background of high density. There is a limit to the number of colored yarns used for warp. If a lot of colors are wanted, warp density becomes dense and weaving becomes difficult. Therefore, when the warp is arranged, the color compartment is setting by the method of 'dividing the section' (Sim, 1998). The vertical stripes are visible due to the location of each part of colored yarn, and five-colored Geum became the origin of Korean Saekdong.

There is a bird that looks like a duck with three legs, and three heavenly animals of dotted skin with horns and wings. Specially, three-legged crow (三足鳥) was a sun-god symbol to Goguryeo people. In Goguryeo tomb murals, there are three-legged birds, such as the one inside a white or black sun, which symbolizes the sun god. Ancient Koreans worshipped the sun and described it as white, which is a unique compared to the ancient Chinese who thought of the sun as red (Kim, 2004). The three-legged phoenix also appears in the decoration of the gold-copper crown of Goguryeo unearthed at the Jinpari's tomb. They believed that when their king ruled the country poorly, this bird ate the sun, and a solar eclipse occurred (Kim, 2007). Thus, this silk KyungGeum was woven by the people with the religion of three-legged bird.

The theme of mountains, puffy clouds, animal flock patterns with old letters of prayers and outlines and 'the mysterious heavenly energy' cloud are exactly the same as the 'O-Seong-Chul-Dong-Bang' KyungGeum. The dotted skin of animals reminds us of the Gojoseon's specialties of animal furs with pattern, an export to the China (管子—發朝鮮 文皮, 斥山 文皮). These 2 KyungGeum fabrics seemed produced in the same period for the same style. The main motif is many curves like the reindeer antlers, and there are many imaginary celestial animal patterns with horns and wings on the shoulder, which are typical patterns of a northern riding people who have a self-image of celestial-children loving the animals. In the land of Buyeo and Goguryeo, there were abundant flocks of deer and horses (三國志 魏志 東夷傳). The strong and bold curved pattern matches the curved pattern on colored pottery from DaeJeonJa relics (大甸子遺跡) of Gojoseon. This KyungGeum pattern develops adding hunting scenes later in the Goguryeo dynasty.

Notice that O-Seong-Chul-Dong-Bang Geum and YoungChang have the pattern of animal flocks with clouds of tent shape, which represents the attacks from the North, Buk-Yi. Thus these masterpieces of animal flocks and tent clouds were surely not woven by the China Han.

Trans-Eurasian launguge originated from the agricultural people in the Hongshan culture of Liao-ho civilization (Robbeets et al., 2021; the Classic of the Mountains and Seas山海經). The lower layer of Xiajiadian's (夏家店下層文化) culture (BC 2500–1600) of Hongshan (紅山) culture is a period that exactly coincides with the starting dates of (Go) Joseon (BC 2333~) (Woo, 2018), and there are no Chinese records about

this period in this location. Because the Northeast Asia near Balhae had a unique and longer culture, it is not the right to equate all of them as Chinese, and necessary to distinguish the culture of Northeast Asia from that of China. It is quite certain Buk-Yi and DongYi were deeply related in terms of culture and religion (Hwang, 2012). Buyeo(夫餘) was the east Tartary according to Dr. Covel (Covel, 1999). Gojoseon had a common language with Xiongnu (魏書 室韋傳) and a strong sense of solidarity. Wolji belonged to Makhan (三國志 魏志), and recently the Seres of silk people were proved to be ancient Silla (Kim & Na, 2020; Choi, 2013). Notice that Chaoyang (朝陽 Joyang) near Balhae sea where the oldest KyungGeum pieces were found was actually a residential area for DongYi people, it was the living area of Gojoseon people (Beguin & Morel, 1999; Li, 2018).

In the economic book (鹽鐵論 BC81) of Han period, there is a record that the common people could only wear silk clothes when they were 60 years old (Min, 1984). According to Mencius book (孟子 372-289BC 仁政說 恒產) during the Warring States period, 'If you plant the mulberry trees in 5 furrows in your house, you will be able to wear silk clothes at the age of 50. Also, if you do not miss the timing of maintaining livestock such as chickens, pigs, and dogs, you will be able to eat meat when you turn 70.' This was what Mencius advised to king Seon of Qi (齊) and king Hui of Yang (梁). It means that in the countries of Qi and Yang, ordinary people could not even try on silk clothes. China, which is commonly known as the silk country, actually did not produce much of silk (Kim et al., 2021). Also it is said that ordinary people cannot use silk fabrics of '素, 縞 and 縑' as the paper substitute (high density makes no leaking), because they are expensive (墨子, 孔子), but Chum(縑) silk fabric was an export product of Silla and SamKhan (Oh & Kim, 2018). And Korean paper was famous and it was called SamKhan- Ji.

The people of Goguryeo (三國志 高句麗條) and DongYi (後漢書 東夷列傳) all had worn Geum clothes at public gatherings, decorated with gold and silver, which means the common people wore silk KyungGeum on national holidays or festivals. This was possible because that Dangun of Gojoseon, Kings of Goguryeo, Baekje, and Silla's all kings recommended raising silkworms to the people, and distributed not only the lands but also the mulberry fields to the people. Currently, Emperor Akihito and Empress of the Japanese royal family have been doing rice planting and silkworm farming by hand every year from April to May (Hong, 2012), and at the Joseon Dynasty the Empress had set an example by performing the Chinjam rite (親蠶禮), a series of ceremonies in which she raised silkworms and collected cocoons before May.

In addition, since China is a limestone zone, the hardness of the spring water made the dyed silk a dull color. On the other hand, Korea is a granite region, and the color of the silk after dyeing was bright and vivid (Cho, 2012). In addition to the basic 5 colors, Goguryeo used various colors such as pink, violet, green, brown, mélange of yellow and white and there were various dyeing methods such as tie-dyeing, wax-proofing, block print and drawing and more (Jang, 2006; Park, 2011). These vivid colors seem to be the reason why the ancient Romans in the fifth–sixth centuries BC were fond of KyungGeum silk of Gojoseon. Buk-Yi and DongYi had a close relationship with each other until the second century BC, when the Xiongnu Modu SeonU attacked Dong-ho (Hwang, 2012). It is certain that Buk-Yi (北夷), Seres or the ancestors of Goguryeo (高句麗) were weaving those KyungGeum fabrics. Therefore, the five-star KyungGeum and Youngchang



**Fig. 2** Similarity of the patterns of birds, flowers and beads of two KyungGeum and two WiGeum. **a** Dark background KyungGeum from Astana (阿斯塔那) (Kim et al., 2021). **b** Green KyungGeum from Kyoto Nishijin (京都 西陣) of Japan (styles of Korean Geum 韓錦) (Baik & Choi, 2014). **c** WiGeum of elaborate stripes, 2 birds and flowers in the armrest pillow cover (70 x 20.5 x 15cm 長班錦御軾) of the king, Shosoin, Japan (Treasure of Imperial, 1999) (<https://shosoin-ten.jp/articles/detail/000038.html>). **d** WiGeum with the pattern design of 2 large birds and 4 types of flowers mounted on Todaiji (東大寺) screen (花鳥浮文錦), Shosoin, Japan (Treasure of Imperial, 1999) (by the courtesy permission of The Imperial Household Agency of Japan) (All photos are with permission from the copyright holders)

KyungGeum have the colorful pattern of a flock of beasts with a tent-shaped cloud, and it should be considered that they were made by Buk-Yi and DongYi at the Warring States period. Also there are many records, the Odes and Shujing: ‘DongYi’ has Geum, barbarian & bandits weave Geum. Therefore, 2 KyungGeums of ‘O-Seong-Chul-Dong-Bang and YoungChang’ are surely the products of ancient Silla of Gojoseon period.

#### Similarities in Astana KyungGeum and Gara Nisigi (韓錦)

Many ancient tribes and countries worshiped birds, as did Gojoseon. Hongshan culture ChaoYang (朝陽) residents among the DongYi countries worshiped birds the most, so they were called the JoYi (鳥夷), the bird totem. Among the bronze relics of the Gojoseon, there is a figure of a bird at the top with its wings spread wide and enveloping a tiger, a bear, and a wolf. Many artifacts decorated with bird motifs were excavated from Siberian Pazyryk burial Kurgans. This is in line with the fact that Mongolians respected birds and did not eat chicken until recently. Thus, it seems that the various bird patterns with flowers were woven on silk fabric in the Northern people.

The name of Silla was the ‘bird’ country, ‘Sae (새, 鳥, bird, new 新) Nara (나라, tribe, country)’ (Hong, 2012). Figure 2a shows the KyungGeum fabric of birds and flowers in dark blue background, which was excavated from the Astana relics (Kim, et al., 2021). They say that this fragment of warp-faced Geum (2/1 twill) was originally used as a banner. The pattern repeated is short, 7.3–7.7 cm in the warp direction. In the corners around the flowers with six heart-shaped petals, green two birds are woven head-to-head in a navy background. Two birds are connected with small beads. This shows the beauty of order, that the pattern is regular and elegant in the same color line of Saekdong in four colors. Here, between the two birds there are beads, and the MaKhan (馬韓) people loved beads more than gold silver and Geum (三國志 & 後漢書). The British museum says this fragment may be dated towards the end of the Tang (唐) dynasty eighth–ninth century AD, but this is surely earlier than that, comparing the similar style with those of Nishijin of sixth–seventh century (Fig. 2b).

The green KyungGeum (Fig. 2b) of the smaller birds and flowers with five colors is exactly the same as above blue Geum. The pattern shows six petals front and behind with two small birds like hummingbirds flying head-to-head. Yellow head color of the birds are made of yellow warp thread of Saekdong. The brown, orange, and yellow colors appeared regularly and vertically on the backside, so this is a type of Saekdong. These KyungGeum fabrics are called Gara Nisigi (韓錦), which means 'Khan Geum' made by Baekje craftsman (Na & Kim, 2019). Also, the style of flower petal shape is the same to the those shown in the brick relics from the tomb king Muryeong (武寧王) of Baekje (462-563). Silk weaving in Kyoto Nisigi is an undeniable tradition of Silla, and Professor Goro (石橋五郎) of the University of Tokyo, said that Joseon was a developed country, and its influence was not only in the material civilization like weaving silk, but also in spiritual academy, religion, and art in Kyoto, Osaka, and Nara, and more (Hong, 2012). Unlike the Chinese, the northerners, the Koreans, and the Japanese have preferred blue color more than red color since ancient times.

Geum & Gye were woven in the pattern of flowers and birds (花鳥紋), which was a pattern commonly used in the Goryeo dynasty, and there are records that it was sent as a special product to various places (高麗史). It is certain that the flower and bird pattern of KyungGeum of Astana of Central Asia corresponding to the style of the Baekje had continued to the Goryeo dynasty. A golden foil relic of bird-flower pattern in the 8th century Silla (線刻團華雙鳥文金箔) was recently excavated in Gyeongju. Two birds facing each other around a flower are expressed with very fine lines on a small and thin gold leaf measuring 3 cm in size. Delicate lines reflect light and are extremely beautiful. From this, it can be seen that ancient Koreans loved the style of expressing two birds facing each other with flowers, so this style of flower and bird (花鳥圖) was very popular, and it can be seen that it spread all over the world through the movement and exchange of people.

Figure 2c and d are not the KyungGeum, but WiGeum of the eighth century of the later generations, but the arrangement of the flowers and birds is still same. WiGeum use the colorful yarns in the weft direction and woven in larger and more delicate patterns.

This WiGeum (Fig. 2c) of seven colors of weft yarns was a cover wrapped around a neck pillow for Royal, and two facing birds are woven around the edge of a large flower along the fancy stripes in white, green, and brown. In ancient Rome, they loved pillows which were made of silk fabrics imported from the East (Malinowski et al., 2012), maybe they used the high-density gorgeous silk fabrics as pillow covers. If you see this WiGeum close, there are rich amount of petals making them look like double flowers, which adds to the splendor, but large stripes still strongly describe the beautiful orderliness. This bold and delicate pattern shows two long-necked birds facing each other, and birds that look like migratory birds, such as geese and ducks, fill the space between flowers. Figure 2d shows larger flower patterns and larger birds woven only in 2 colors, yellow and black (pattern size of 13.5 cm). The flowers and the gaps are larger but are still delicate and gorgeous, and the bird looks like a phoenix with a very long tail and large wings. Similarly, two birds are facing each other, and they are arranged at the four corners around the circular flowers and a flower pot, showing consistency in the patterns. The pattern style of WiGeum is exactly the same to the above KyungGeum except for the addition of fancy stripes and 3 more different types of flowers.

There were various (Kyung)Geums in Goguryeo, such as Khan Geum(韓錦, called Gara Nisigi), White Geum(白錦), Cloud Geum(雲錦), five-colored Geum(五色錦), Purple Ikat Geum(紫地繡文錦) and Go(gu)ryeo Geum(高麗錦) (Min, 2007). Also there were many (Kyung)Geum fabrics among the treasures of Nara(奈良) period build by the Baekje immigrants, such as Go(gu)ryeo Geum(高(句)麗錦), mountain pattern Geum(菱形錦), bird Geum(鳥錦), turtle pattern Geum(龜甲錦), plow pattern Geum(町形錦), wagon bracelet pattern Geum(車釧錦), flower Geum(花形錦), cloud-flag Geum(雲幡錦), small flower Geum(小花錦) and old Geum(古錦) (Treasure of Imperial, 1999). These are all the KyungGeum with different patterns for it was the Nara period.

According to the Book of Later Han(後漢書 東夷列傳 韓傳), gold and silver, Geum and Gye(金銀錦屬) were not valuable in Makhan, and only beads were expensive, so they were connected to the neck, ears, or tied to clothes for decoration(不貴金寶錦屬, 唯重瓔珠, 以綴衣爲飾, 及縣頸垂耳). The reason that the Chinese wrote the MaKhan people's values down their book, is they thought it strange because the treasures were retailed in cheap price in Makhan. MaKhan people could produce many Geum in every houses and Geum was not rare in MaKhan.

#### Weaving technology described in old literatures

In order to weave KyungGeum's complicated colorful pattern, it needs a special loom and weaving technology, and the DongYi people had these. Byeonjin(弁辰) possessed a high level of weaving technology capable of producing the fine and wide fabric(廣幅細布) (Min & Lee, 1984). Buyeo people put on Geum and Gye when visiting other countries abroad(三國志 魏書 烏桓 鮮卑 東夷條). The fine fabric-making technique of Makhan, ByeonJin and Buyeo was surly passed down to Goguryeo dynasty, and the Goguryeo people wove and wore KyungGeum, where it was popular even among ordinary people according to the books(後漢書 東夷列傳 高(句)麗傳, 三國志 魏志 東夷傳, 晉書). The KyungGeum produced in Korea was of a very high level and was a characteristic product that was rare in the world (Sim & Min, 1994). The king(代宗) of Tang Dynasty banned Goguryeo refugees and weaving officers from weaving Goguryeo Baek Geum(高麗白錦) by law and ordered to adhere to the old weaving method, according to Old Book of Tang(舊唐書 本紀 代宗 (771)「纂組文繡, 正害女紅. 今師旅未息, 黎元空虛, 豈可使淫巧之風, 有虧常制. 其綾錦花文所織盤龍·對鳳·麒麟·獅子·天馬·辟邪·孔雀·仙鶴·芝草·萬字·雙勝·透背, 及大綢·綿·竭·縹·六破已上, 並宜禁斷. 其長行高麗白錦·大小花綾錦, 任依舊例織造. 有司明行曉諭.」), and this law seems to try cutting off the source of income from which Goguryeo refugees became wealthy and powerful.

The special products of KyungGeum were sent as a gift or was exported to China and Japan. In Silla, large flower Eo-A Geum(大花於牙錦), small flower Eo-A Geum(小花於牙錦), and Joha Geum(朝霞錦) were exported to the Tang(唐) and Japan (Min, 2007). The Qin king(後晉 936–947) praised Go(gu)ryeo KyungGeum of the pattern (of the sun, moon, dragon, and phoenix, flowers and birds, and dragon fish) with the threads of gold, silver and five-colored, woven together in a red background, 'Goryo Geum(高麗錦) is beautiful with its heavenly pattern, and its gorgeous composition and colors are superior to that of China's Dong-Hwa fabric(幢華布), and the Mapo(麻布) flax of Silla is white as snow'(高麗史). This means that the ancient Korea possessed a creative and high-quality textile technology for silk, and had sent silk KyungGeum as gifts to the neighbors. These

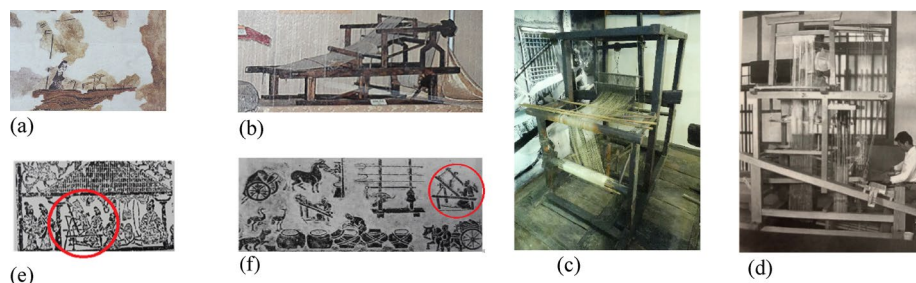
fabrics were produced in the national offices of Goryeo dynasty, such as Gye Jang(罽匠) and Geum Jang(錦匠) (高麗史).

A colorfully patterned wool fabric is called Gye (罽, Kye). Wool fibers have natural various colors, it was easy to make Gye Saekdong, and thus Gye may have appeared early. Thus, it can be inferred that Geum was woven using the silk yarns dyed in colors by the people who had made the colorful Gye. By the way, Gye technique of wool may have led to the Kelim (鷄林 Kilim, Gillim) technique, a carpet production technique in Central Asia (Kwon, 2009). Also 'Kelim' was one of the names of Silla dynasty, and 'Ke (鷄)' means 'rooster' and it sounds 'Sae' in Korea, and Gillim(吉林) is one of the Northeast three regions of Manchu (滿洲).

King Gyeongdeok of Silla (750) made Manbulsan (萬佛山 mountain with ten thousands of Buddha) out of wool carpet (氍毹: carpet of Gye罽) and gifted it to the king (代宗) of Tang Dynasty. It is said that the king was amazed and said that only the heavens could make such beautiful masterpiece. Geum and Gye was a significant trade item with neighboring countries at the time (三國遺事, 王又聞唐代宗皇帝優崇釋氏, 命工作五色氍毹).

Goryeo Geum (高麗錦), Goryeo white Geum (高麗白錦), Khan Geum (韓錦), Joha-Geum (朝霞錦), Joha-Ju(朝霞紬), Eoa-Ju(魚牙紬), Seal skin (海豹皮) of Goryeo and Silla were exported to China and Japan, and their weaving technology also propagated throughout the world (Min, 1984), and Johabang was a government office of Silla that manufactures and manages high-quality silk fabrics (723). In the fifth–sixth centuries BC, Geum was already exported as far as Persia, North Africa, and Rome (Miyaji & Motamedi, 1979).

HoRung (胡綾), barbarian's twill was produced in Sogdia and the Xinjiang region as a combination of wool and silk. According to the Wei book (魏書) written in the sixth century AD told that in the West, the silk fabric of the East was unwound and mixed with wool to re-weave HoRung (Shin, 2012). Even in Rome (魏略 西戎傳), there already were HoRung in the third century AD, and colorful wool carpets, five-colored damask and more. There were also fine silk fabrics that weaved together Scythian lamb wool blended



**Fig. 3** Types of loom according to their structure and shape. **a** JikNyeo-do (織女圖) in a wall painting of Goguryeo tomb (平安南道 龍岡郡大安里 #1 古墳) (Kim et al., 2021). **b** Reproduction loom of Goguryeo waist-type horizontal loom in Joseon JungAngYeokSa Museum of North Korea (Kim et al., 2021). **c** Hwa-Jik Gi (華織機) waist loom with an upper frame in the modern period of Korea (by authors at Folklore and Natural History Museum in JeJu). **d** Reproduction loom of an ancient oriental loom JeHwa-Ru (製華樓) in Nishijin Kyoto, with two operators without waist band (by authors at Nishijin in Kyoto). **e** Slant loom in the Portrait Stone (畫像石) of Han (漢) dynasty (Kim et al., 2021). **f** Diagram of oblique looms in Han dynasty (Shin, 2012) (All photos are with permission from the copyright holders)

with tussah silk (Nagasawa, 1993). This means the Roman could weave the fabric with twill structure. HoRung proves that silk fiber production was insufficient in Central Asia and Rome, where Goguryeo's special thread bobin Sil-kkury was imported to weave HoRungs. This is how 'Sil-kkury' of Goguryeo became the word origin of 'Silk' to the West (Cho, 2012).

### Advanced weaving technology for KyungGeum

KyungGeum requires high-level weaving skills, moreover, it is impossible to weave with an ordinary loom. This become possible when a horizontal-type loom can lift the set of color warp yarns. The loom must be a horizontal shape, in which the warp beam and cloth roll are positioned 'horizontally', securing a large opening when lifting the warps and making it easy to insert the weft.

The form of an ancient 'horizontal' loom at the time can be seen through this 'JikNyeo-do (織女圖)' of the Goguryeo tomb mural (middle of the fourth century AD). On the southern wall of Goguryeo Mural Paintings (No.1, DaeAn-ri), a drawing of a loom was found in which a Goguryeo woman is weaving the fabrics (Fig. 3a). The weaver woman in front of the loom in the mural appears to wear earrings by the aristocratic class, and it can be assumed that aristocratic women participated in weaving labor. There is a proverb saying "an honorable lady weaves a KyungGeum with a large pattern, while a plain lady weaves a KyungGeum with a small pattern," meaning not all could weave the high-level pattern of KyungGeum. Earrings were not worn in ancient China because they were thought to be ornaments of barbarians. Jade earrings were excavated from the Hongsan civilization, and in Korea, which continued this tradition, earrings were worn by men and women until the king SeonJo (宣祖) of mid-Joseon period by degree (1572). Notice that Seres wore earrings.

Looking at the North Korean museum's loom (Fig. 3b) of the reproduction of Goguryeo loom, it can be seen that the main frame is placed horizontally (Jang, 2011). The loom of the Goguryeo mural painting show a peculiarly angled shape of the loom legs, which are similar to the loom of the museum. This is a waist-type loom (body tension loom) with the woven cloth fastend to the waist of the operator.

The loom that appeared in the mural of Goguryeo was a horizontal loom, so the loom of Gojoseon would have also been a horizontal loom. The loom was developed with an additional square frame on top, to hold multiple colored warps. This frame can withstand the weight of warp yarns two to five times more than regular fabrics, so a horizontal shape is required to fix them from above (Fig. 3c). The rectangular waist-type loom, Hwa-Jik Gi (華織機), was capable of weaving the flower patterns in the modern period (Jeju National History Museum, 146 × 147 × 91 cm).

This waist-type horizontal loom of multi-healds had been used by the ethnic minority group, Zhang tribe (藏族) of Xinjiang, too. The device has two type of healds, the basic healds in the front and the pattern healds of 20–30 on the back. The basic healds are opened downwards by stepping on a right foot pedal (脚踏板), and pattern healds are lifted upwards by hand (多綜式) (Huang & Chen, 2016).

The upper supports became more complex as the fabric pattern became more elaborate, and it advanced into a bigger JeHwa-Ru loom (製華襪) where two people sit on one loom and work on it together. In other words, one person inserts the weft to the opening,

where the other person sits on the top and frequently changes the vertical movement of the warps of colors. Figure 3d is a JeHwa-Ru loom used by two people for weaving KyungGeum or Gara-Nisigi (韓錦) that was recently reproduced after a restore study at Nishijin. This is an improved type loom that does not fix the cloth roll at the waist.

Looms of the Manchuria Qing (青) dynasty are similar to the JeHwa Ru loom with a large square frame. Two persons work together, too, and many vertical ropes were used to select the colored warp while weaving. This maybe influence the Jacquard loom of the nineteenth century. The Jaquard machine was invented by Joseph-Mari-Jacquard in 1805, Lyon, France, producing the fabrics of brocade and damask. After the invention of the jacquard machine powered, it was possible to produce the colorful floral fabrics of large pattern quickly and massively.

The miniature looms of SeongDo (成都) in Sichuan (四川) province was discovered in 2012. The largest among the loom models was 70 cm long, 50 cm high, and 20 cm wide. This model loom also had a rectangular shape, and silk threads, dyes, and wooden dolls were excavated together, showing that the excavation site was a weaving workshop. They said that Zhuge Liang (諸葛亮 the chief politician of the Chok蜀) invented 'Jomyun gi' loom (繰綿機) in the third century AD. This excavation led China to claim that the Geum, believed to date from the third–fifth century BC, are that of late Han Dynasty.

Figure 3e and f show a stone relief describing the lifestyles of Han period. A look at the positional angles of the warp frame proves that it is a very steep loom, with an angle steeper than 45°. Suprisingly, all 18 looms from Han stone reliefs (畫像石) were the oblique looms (Shin, 2012). Every loom of Han period from the period of the Warring States (戰國時代) was an oblique loom (Huang & Chen, 2016). Thus KyungGeum found in Xinjiang of the Warring States Period have not been woven with the slant looms of Han dynasty.

There is also literature to prove this. According to the Seo-Kyung-Jap-Gi (西京雜記) written the fourth century AD, it is written 'there had been 120 healds in the loom, which was inefficient, so it was changed to 50–60 healds, and then changed again to 12 healds' (Huang & Chen, 2016). Healds are devices for lifting up multiple warps at the same time, and more healds can make more delicate patterns. Thus this means that the pattern of the fabric gradually simplified over time in old China. Also they entered the age of the 16 kingdoms of the north people (五胡十六國時代: 304–439) after Han dynasty, frequent wars occurred, many countries had been founded and then disappeared, resulted in that those technology was cut off. The complex JeHwa-Ru loom was not used anymore due to the lack of technicians according to Seo-Kyung-Jap-Gi (西京雜記).

In the eighth century BC in the countries of Qi(齊) and Ro(魯) which were near the DongYi countries of Shandong, the silk industry suddenly developed (Huang & Chen, 2016). This is because they were located near the origin of silk, where it had advanced silk production technology. The comment that the industry developed 'suddenly' can be interpreted as meaning that they received technology from DongYi, indigenous people. Until the peaceful 'the Spring and Autumn' period (春秋時代) of the sixth–eighth century BC, they could have woven simple KyungGeum, but the skills that they had with the looms of 120 healds disappeared amidst the frequent wars and unstable society. From the 'Warring States' period (the fifth century BC ~) through Han to the fourth century AD, the complicated looms weaving KyungGeum disappeared in China.

The 'single' heald slant loom of Han dynasty of the warp frame in an oblique angle of 50°–60° equipped 'double' pedal. It does not have the reed for beeting the inserted weft and uses a single heald as reed instead. They say that this slant loom is good to check whether the warp yarn is broken, and more advanced due to the tension-free in the waist and also saving labor and this oblique loom as a great invention in ancient time of China. However, with this loom of single heald, it is not possible to make the complex curved patterns of birds, flowers, animals, clouds, and letters excavated in Xinjiang.

Yet, the Goguryeo dynasty, which commanded the vast north and kept peace for almost 900 years (Shim, 2014) with powerful army (Kim, 1999), as the Gojoseon (Resigs, 2018) and Silla dynasty for almost 1000 years could maintain the complicated loom and techniques. Note that WiGeum appeared in the seventh century AD at the time Goguryeo and Baekje refugees gradually moved the West or the South. It is difficult to travel long distances with a large loom, so it seems that WiGeum has occurred instead of KyungGeum.

The weaving method of KyungGeum is told to spread to Central Asia and West Asia after BC, but it is not possible to weave without the special loom. Western Asian looms were straight vertical looms, and the warps hanging downward were common, originating from carpet weaving. This is a method for putting colored weft yarn one line at a time. The vertical looms painted on the Dunhuang (敦煌) mural wall could not be used to weave KyungGeum (Shin, 2012).

According to Samacheon's Sagi (史記), silk yarn and lacquer wood were not produced in this region from DaeHa (大夏 Bactria) to DaeWan (大宛 Fergana 拔汗那 BalkhanNa 波洛那). The mulberry tree and sericulture technology took root after the fourth–fifth century AD in Central Asia, there was silkworm-raising technology in GoChang country (高昌國) in Central Asia, and Kucha(龜茲) could produce KyungGeum from the fifth–sixth century AD (Huang & Chen, 2016). Even though silk fabric was produced in West and Central Asia at this time, it did not match the quality of the Goguryeo and Silla's. The tradition of vertical weaving techniques and the natural environment with few silkworm cultivation prevented Western Asia from producing KyungGeum.

As mentioned above, the horizontal, square Hwa-Jik Gi, or JeHwa-Ru of Northeastern Asia were completely different from Han (漢)'s slant loom and the West Asia's vertical loom. The slant loom or vertical loom cannot produce KyungGeum with colored warp and beautiful pattern. Therefore, it is not valid to say that the KyungGeum excavated in the Xinjiang Autonomous Region, Tarim Basin, South Russia, and Palmyra was made in Han dynasty or the Warring States period.

Even if KyungGeum pieces were excavated from the tombs of the China people during the Spring and Autumn and Warring States Period, this does not mean the China weaved by themselves. It was once known that those weavings have flourished during Han period (Sim, 1998), and a large amount of KyungGeum excavated in the Xinjiang region were woven in the Eastern Han (東漢) period (Sim, 1998), but it is not true. We analyzed the pattern symbolism and confirmed who the producer was from the old scripture records.

It is said that during Han dynasty, the rich wore thin embroidery leno fabrics of Yuk-Su-Ra-Hwan (縠繡羅紈), and the middle class wore thick stiff dense fabrics of So-Je-Bing-Geum (素綈冰錦) according to Salt Iron theory (鹽鐵論) of Han dynasty. The ice Geum of

middle class maybe means the stiffness of Geum, and Geum fabrics were not so attractive to the high due to the less drape or the ethnic patterns of DongYi.

Soghdiana and Persia are the countries that had accumulated wealth through intermediary trade, and they were famous worldwide as brokers. In the sixth century BC, Achaemenid Persia maybe built a country after becoming wealthy through East–West trade relay. Rather than producing silk fabrics directly, they relied on the East, that is, Gojoseon, Silla and Goguryeo as an import source. The stiff and high density KyungGeum, fit for the layer look of the Northern area, was produced along with high quality iron and furs in the northeastern area (Cheong, 2013). Gojoseon, Goguryeo and Silla also maybe accumulated enormous wealth through the export of Geum, iron and fur, so they were able to possess great power and territory and finally to reunify. Turk and Parthia interfered with the direct trade between China and the Roman Byzantines from the third century BC to the ninth century AD (Lee, 2016a, 2016b), as there was no reason to avoid conflict with China. This means that they broker traded silk products independently without intervention by China, meaning that they traded the silk fabrics of Goguryeo and Silla, not those of China.

## Conclusions

There are the animal-style Geum silk relics from the BC5–3rd century in Luran and Niya of the Xinjiang Autonomous Region. Among these, there are bird & flower patterns, and this pattern of Astana is similar to those of Baekje and Nara in terms of arrangement and style. The artistic style of bird & flower pattern has continued even in WiGeum of the 8th century AD, and over 1000 years specially birds tradition is kept due to their identity of heaven descendants worshipping the birds as a symbol of the sun. They loved to weave the bird patterns, the sun symbol of Goguryeo and the ‘bird country’ Silla. According to the old records, the colorful KyungGeum was disparaged as being woven by the barbarians and bandits, and this was as a colored pattern of the North people and DongYi(東夷). This study examined the pattern and symbolism of the Geum relics of the ancient Korea, bird-flower pattern remained in Korea, Japan and in Xinjiang and the special loom of the advanced weaving technology. The advanced silk weaving culture of Goguryeo Geum was analyzed through an examination of ancient loom relics and old literatures on Geum. KyungGeum could be woven only through the DongYi’s horizontal loom with advanced weaving skill. KyungGeum woven with a dense structure creates a stiff boxy silhouette. Because the winter is long and windy in the north, Korean’s sewing technique was very developed and the clothes were worn in several layers, and the fabrics usually woven with high-density as in Myungju or Shantung silk. On the other hand, Chinese prefer a drape silhouette, with less layers of clothes, having a sense that prefers a slim silhouette. The KyungGeum patterns presents the Buk-Yi had share many things with DongYi, such as the religion, custom and identity as well as languages. KyungGeum, which requires a high level of weaving technology, could be woven during the long surviving dynasty. It must have a high level of culture that lasted for a long time, and Gojoseon, Goguryeo, and Silla’s dynasty lasted for almost 1000 years. KyungGeum requires a special loom, such as horizontal-style loom or JeHwa-Ru machine, as well as the advanced weaving technology. Since the Warring States period of China, all the looms of Han dynasty were the oblique looms of single heald. It was impossible to weave KyungGeum using

this slant loom, thus the production of KyungGeum was impossible in Han Dynasty and before/after. KyungGeum excavated in the Xinjiang region were proved as the products of Gojoseon and Goguryeo dynasty, according to the 3 factors: production period & pattern symbolism, weaving looms & technology and long distance trade of silk. Korean Geum was exported the the world from BC 5–6 th century, and Parthia made their warflag with this Geum and Romans loved to decorate part in their toga with this Geum, as well as liked Geum pillows. Geum relics and the advanced textile weaving technology with a complicated loom from Gojoseon, ancient Silla and Goguryeo were elucidated in this study, and this study provides a new perspective on the ancient silk history and culture of North–East Asia. These findings will serve as an important cornerstone for the historical research on the ancient silk and this will provide the reasoning technique of syllogism necessary for the ancient records.

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#### Author contributions

JK—analyzed data, wrote her dissertation. This is a part of her dissertation. YN—collected data and wrote manuscript in English. Both the authors read and approved the final manuscript.

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#### Declarations

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