

Precious and Semiprecious Stones in Kayah State

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Abstract

Kayah State is fairly rich in mineral resources. Sapphire, spinel, topaz, tourmaline, aquamarine, quartz and fluorite occur as precious and semiprecious stones in Kayah State. They are mainly found in Pawn Chaung Series of Shadaw and Bawlake Townships. And also fairly found in other townships. They may be extracted economically but it is difficult in accessibility because of poor transportation. The present investigation is just only for collection and description of some varieties of the precious and semiprecious stones in Kayah State and not for the origin.

Key words: precious, semiprecious, Pawn Chaung Series, Shadaw

Introduction

There are 14 States and Regions of Myanmar. Among them, Kayah State is the second smallest State and the least number of populations. It lies between North Latitude 96° 45' - 97° 50' and East Longitude 18° 30' - 20° 00' in one-inch topographic map No. 94/E-2, 3, 6, and 7. Some authors have described the geology, stratigraphy and economic aspects of the Kayah State. But the investigation on precious and semiprecious stones has been left. So, present investigation mainly proposes some varieties of precious and semiprecious stones. There are fairly rich in mineral resources. Among them the most common precious and semiprecious stones are sapphire, spinel, topaz, tourmaline, aquamarine, quartz and fluorite. The study area can be accessed by motor vehicles, trains, and planes. Location map of the study area is shown in Fig. 1.

Purposes of study

This paper is mainly intended: to describe and collect the precious and semiprecious stones in Kayah State; to identify the properties of precious and semiprecious stones in Kayah State; to inform the distributions of some varieties of the precious and semiprecious stones in Kayah State.

Materials and methods

The samples (mainly gem quality) were collected from local peoples, especially from U Saw Than Naing. Samples were identified under the standard Gemmological Microscope. The photographs of characteristics of the samples were taken. The values of specific gravity of the samples were found by hydrostatic weighting method. The optical characteristics of the samples were analyzed by the Polarizing Microscope.

General geology of Kayah State

Many geologists had described the general geological mapping and stratigraphy of Kayah State since 1900. Among them, Hobson (1941 in Clegg, 1953) reported the Mergui, Moulmein and Mawchi Series in parts of Kayah and in southern Shan State. In 1961, Ba Than Haq and Searle stated that the geology and economic possibilities of the area between the Pawn Chaung and Thanlwin River at the south-east of Loikaw in Kayah State. Later, the IGCP (National Committee) had made the geological map of the Kayah State in 1977. Maung Maung et al., (2006 a,b) firstly mentioned the geology and some evidences of Permian reef types of the Loikaw area. More recently, Kyi Pyar Aung (2010) pointed the sedimentary facies of the Loikaw area in Kayah State.

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Fig.1 Location map of the study area

According to Ba Than Haq and Searle (1961), the lithologic units exposed in the Shadaw area to the southeast of Loikaw in Kayah State are: Plateau Limestone Group (Permocarboniferous); Mawchi Series (Silurian); and Pawn Chaung Series (pre-Silurian). Plateau limestone with inliers of Mawchi Series and a few outliers of younger rocks is the most widespread in the area. The Mawchi Series with the overlap of the Plateau limestone is mostly found in the west of the Pawn Chaung and Pawn Chaung Series has been limited to the area between the Pawn Chaung and Thanlwin River. Moreover, Hutchison (2007) had proposed that the Taungoo- Mawchi pluton is 240 km long with a maximum 60km width. The most abundant rock type is fine to medium grained biotite granite. Sn-W mineralization is closely associated with the small pluton. The igneous rocks of the Mawchi area have located in the entral granitoid belt of Khinzaw (1990).

Common precious and semiprecious stones in Kayah State

The term semiprecious is used to refer to the entire world of colored gemstones, not including the four so - called precious gems, diamond, ruby, sapphire and emerald. Most of them may be produced as economic importance. Kayah State is fairly rich in mineral resources. There are many rock-forming and ore minerals. Among them some rock-forming minerals have gem quality. The most common precious and semiprecious stones in Kayah State are sapphire, spinel, topaz, tourmaline, aquamarine, quartz and fluorite. The general characteristics of precious and semiprecious stones are as follows.

Sapphire

Sapphire is one variety of corundum. Corundum is usually almost pure Al_2O_3 . Blue corundum (sapphire) contains Fe and Ti. Sapphire from the study area is mostly light blue and blue (Fig. 2). The grain size ranges from 1 cm- 3cm.

Crystallography: Most of the sapphires occur as tabular and anhedral grains. Sometimes crystals are hexagonal form. They crystallized in the trigonal system. Sapphire from the study area has hardness of 9 on the basis of the relative hardness of Mohs's scale and it is also brittle. They give conchoidal fracture. The specific gravity of sapphire in the study area ranges from 3.98 to 4.02. It displays vitreous to adamantine luster. Its pleochroism is colored version. It has refractive indices of 1.76- 1.77. The optical sign of sapphire is uniaxial (-).

The crystal habit and great hardness are the characteristics of the sapphire to distinguish from other minerals.



Fig.2 Light blue and blue Sapphire from the Shadaw area

Occurrence: Generally, corundum is infrequently found in Al- rich igneous rocks, poor Si-poor varieties such as syenite and associated feldspathoidal pegmatites and is usually associated with feldspar and feldspathoids, but not quartz. Al-rich pelitic metamorphic rocks may contain corundum associated with aluminium silicates(s); micas, spinel, and other aluminous minerals. Gem quality corundum usually is derived from metamorphosed limestone or dolostone. The Al is presumably derived from detrited clay minerals. But, in the present study, it cannot be observed that which rock is associated with sapphire. As far as I think it is associated with the Pawn Chaung Series of Ba Than Haq and Searle (1961).

Uses: Sapphire is an important gemstone. The color of sapphire can be improved by various processes, although treated samples have less value than naturally colored stones. But in this area, it cannot be widely extracted and used as in Mogok area.

Locality: It is mostly found in the eastern part of the Kayah State especially, in Shadaw Township.

Spinel

Chemical composition of spinel is $(Mg,Fe)(Al,Cr)_2O_4$. In the present investigation, various color such as red, pink, and violet occurred (Fig. 3). So, it is regarded as one of the most colorful mineral. The grain size ranges from 0.3 cm- 1cm.

Crystallography: Most of the spinels occur as octahedral grains (Fig. 4). They crystallized in the isometric system. Spinel from the study area has hardness of 8 on the basis of the relative hardness of Mole's scale and it is also brittle. They have no cleavage and show conchoidal fracture. The specific gravity of spinel is 3.60. It possesses a light streak. It displays vitreous luster and it is opaque.

The crystal habit, hardness and color are the characteristics of the spinel to determine from other minerals. It may resemble magnetite but not magnetic and have a light streak.

Occurrence: Spinel is a common accessory mineral in aluminiumous metamorphic rocks with adalusite, kayanite, siliminite, corundum or cordierite, in contact and regionally metamorphosed in granitic pegmatites and hydrothermal veins. In the present study, spinels can be observed in marble unit of the Pawn Chaung Series.

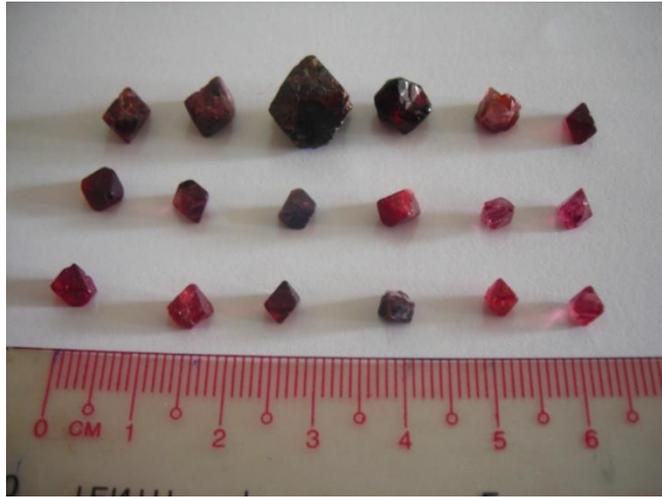


Fig .3 Red, pink and violet varieties of spinel from Shadaw Area

Uses: It has been used as a gemstone but does not have significant industrial applications.

Locality: It is found in the eastern part of the Kayah State especially in Shadaw Township.

Topaz

Chemical composition of topaz is fluo-silicate of Aluminium $Al_2(SiO_4)(F,OH)$. They are mostly occurred as transparent to nearly transparent and colorless (Fig. 4a and b). Yellow and blue (heat-treated) varieties also observed (Fig. 4c and d). The crystal length varies from 0.5 in – 1.5 in.

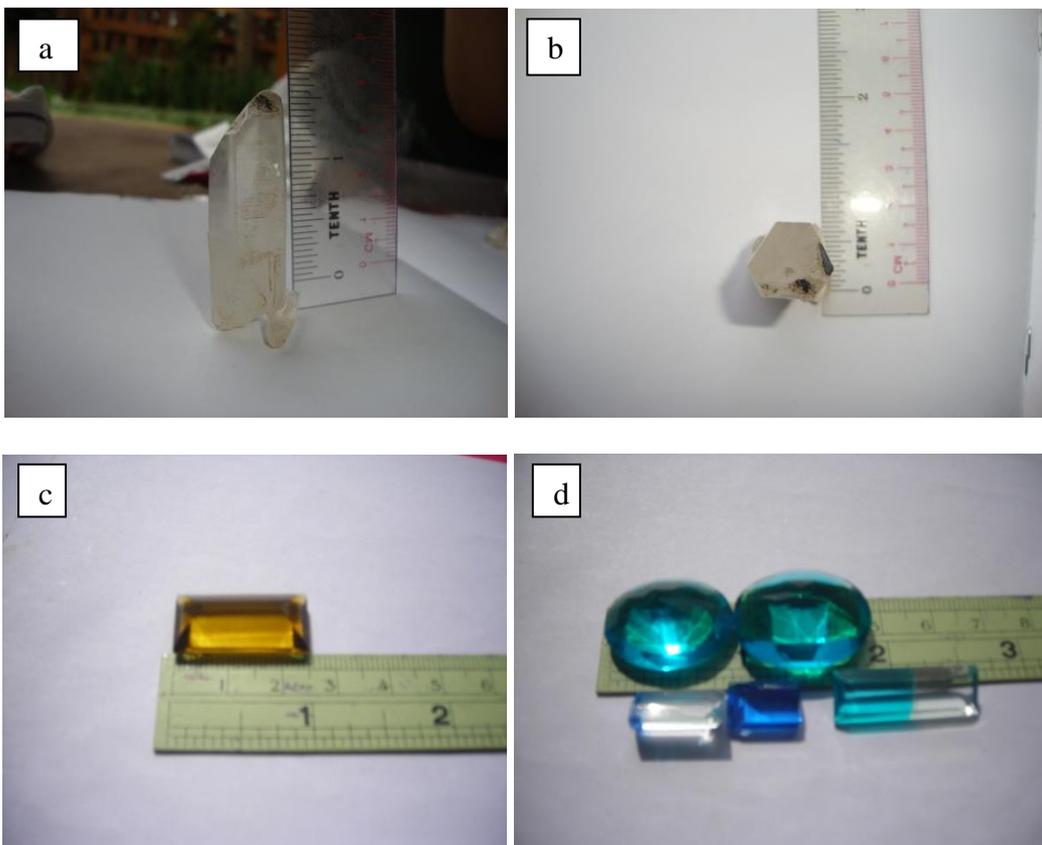


Fig.4 (a and b) Transparent to nearly transparent and colorless (c and d) yellow and blue (heat-treated) varieties of topaz from Shadaw Area

Crystallography: Crystals are usually stably elongate prisms parallel to the c axis. Its crystal system is orthorhombic. Its hardness is 8 on the basis of relative hardness of Mole's scale and it is also brittle. They give subconchoidal to uneven fracture. The specific gravity of topaz ranges from 3.53-3.56. It shows the vitreous luster. The refractive index ranges from 1.610-1.623. The optical sign of topaz is biaxial.

It is resemble quartz, but is distinguished by high specific gravity and hardness.

Occurrence: Well formed crystals occupy vesicles or other cavities in rhyolitic volcanic and large masses may be found in hydrothermal tungsten, tin, molybdenum, gold mineral deposits, and in hydrothermally altered rocks to granitic intrusions. In the present study, topaz may be observed in the Pawn Chaung Series and Mawchi Series of Ba Than Haq and Searle (1961).

Uses: Colorless, brown, or pink topaz may be used as gem. The color of most blue topaz has been produced by radiation.

Locality: It is found in Shadaw Township, Ywathit village, and Phasaung Township, especially in Mawchi area.

Tourmaline

Tourmaline is borosilicate with a very complex structure. Green and black varieties of tourmaline (schorl) can be observed in the study area. Green tourmaline is locally called as Sawlaphaw-Mya.

The green tourmaline from the study area has chemical composition of $\text{Na}(\text{Li}_{1.5}\text{Al}_{1.5})\text{Al}_6(\text{BO}_3)_3\text{Si}_6\text{O}_{18}(\text{OH})_4$ together with trace amount of Cr, Fe and V. It is elbaite variety (Yin Kay Thwe Htun et al., 2012). The chemical properties are also distinct in major and trace elements as compared with other localities (U Tin Hlaing, 2004). Green tourmaline's colors range from pure emerald green to yellowish-green and occasionally, they have light green color (Fig. 5 a, b and c). Different tourmalines have different degrees of clarity. Green tourmaline from the study area is usually transparent. Some are translucent and a few are opaque (Fig. 6 and 7). The colors of green tourmaline from the study area can be caused, among other things, by tiny amounts of foreign matter and trace elements. Green color comes from Fe_2 , or from Cr_3 or V_3 alone. The green tourmalines (Sawlaphaw-Mya) from the study area are mainly fashioned by faceted cuts (Fig. 8 a,b,c,d, and e). The various kinds of faceted cuts have been made such as emerald, oval, rounded, rectangular and fancy cuts for green tourmaline from the study area.

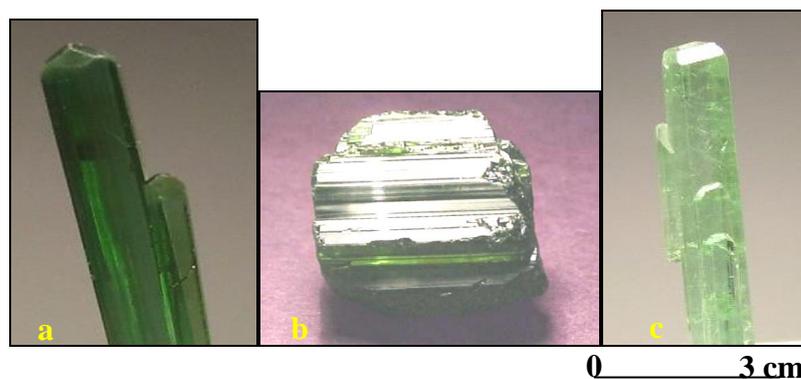


Fig.5 Various colors of green tourmaline from Shadaw area, Kayah State. (a) Emerald green; (b) Yellowish green; (c) Light green (transparent) (Yin Kay Thwe Htun et al., 2012)



Fig.6 Light green color tourmaline with translucent nature Fig 7 Opaque green tourmaline.

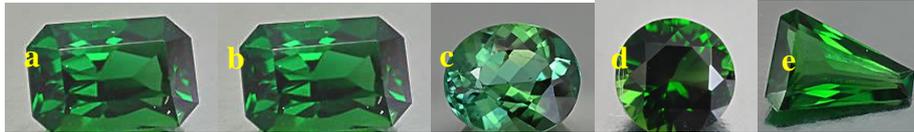


Fig.8 Various cuttings of green tourmaline from the study area: a. emerald cut; b. rectangular; c. oval; d. rounded; e. fancy cut (kite) (Yin Kay Thwe Htun et al., 2012)

The black tourmaline (schorl) from the study area is usually opaque (Fig. 9). The grain size ranges from 1cm - 3cm.

Crystallography: Tourmalines in the study had been crystallized in the trigonal system on the basis of the position and lengths of their crystallographic axes. Each of these crystals can have many “forms” and “habits”. They are usually elongated prisms, and occasionally stubby. They have hardness of 7 to 7.5 on the basis of the relative hardness of Mole’s scale and it is also brittle. They give conchoidal fracture and have no cleavage. They have the specific gravity of 3.02-3.26, refractive indices of 1.62-1.64 and double refraction of 0.018. They display vitreous to resinous luster. The optical sign of tourmaline is uniaxial (-). The streak of tourmaline from Kwe-ate Taung in Shadaw area possesses colorless streak.



Fig.9 Black tourmaline (schorl) from Shadaw Area

Occurrence: Tourmalines can be observed as single terminated crystal in quartz and pegmatite veins in marble and in calc-silicic rocks of Pawn Chaung Series. Green tourmaline (Sawlahaw-Mya) is mainly found in Kwe-ate-taung in Shadaw Township. The green

tourmaline can be found as primary and secondary placer. Primary deposits are mainly occurred in Pawn Chaung Series. These crystals are found in narrow bands up to 5 inches and the general trend of the bands is nearly north-south direction.

Vertical striations are the typical of tourmalines from the study area.

Uses: Tourmaline is used as a gemstone. Green varieties are referred to as tourmaline or Brazillian emerald, pink or red stones may be called rubellite, and blue varieties may be called indicolite.

Locality: The Shadaw area, located in Kayah State is a famous source for fine green tourmaline in Myanmar. In this area, green tourmaline deposits are mainly occurred at Kwe – ate Taung and in the eastern part of Pawnchaung especially in Bawlake Township.

Aquamarine

Chemical composition of aquamarine is beryllium aluminium silicate, $\text{Be}_3\text{Al}_2(\text{Si}_3\text{O}_6)$. Most are colorless, orange, yellow, pale green, etc. Color prefix with beryl are their proper gemological terms, such as yellow beryl, green beryl, pink beryl, ect. With trace of iron, water-blue color is called aquamarine (Fig. 10). With trace of chromium, grass green colour is called emerald.

Crystallography: Aquamarine in the study had been crystallized in the hexagonal system. It is euhedral to subhedral. They are usually elongated prisms, and occasionally stubby. They have hardness of 7.5 to 8 on the basis of the relative hardness of Mole's scale and it is also brittle. They give conchoidal fracture and have no cleavage. They have the specific gravity of 2.67-2.78, refractive indices of 1.57 – 1.58. They display vitreous luster.

Crystal habit, hardness, and color are the typical of aquamarine which can used to distinguish from garnet in hand sample.

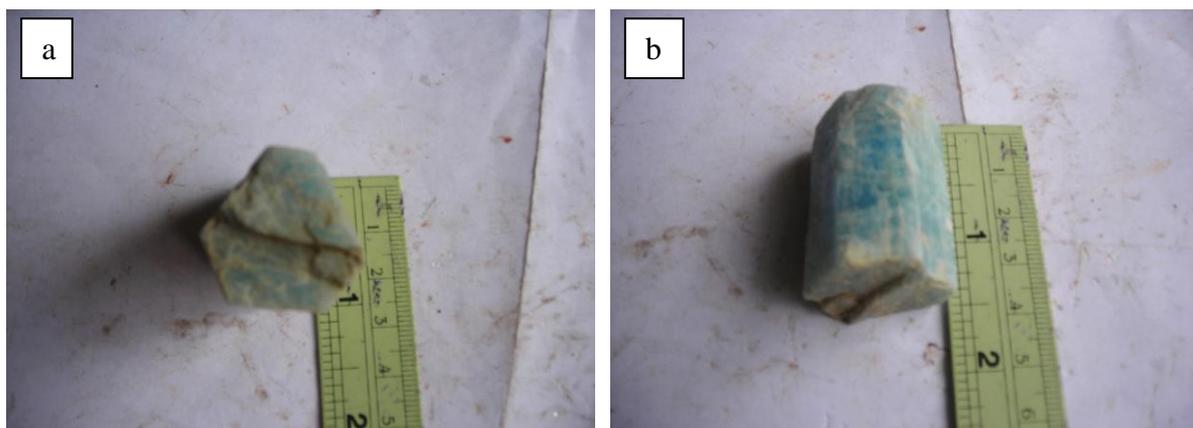


Fig.10 a & b Water-blue color variety of beryl, aquamarine from Shadaw Area

Uses: It is used as a semiprecious gemstone. The irregular fracture makes garnet valuable as an abrasive for particularly for sandpaper.

Locality: It is found in the eastern part of the Kayah State especially in Shadaw Township.

Quartz

Chemical composition of quartz is Silicon dioxide, SiO_2 . Both transparent and opaque materials exist. Most varieties are colorless (Fig. 11 a and b). Varieties are classified depend on

their colors. Color prefix with quartz are white quartz, smoky quartz, rose quartz and amethyst. Purple to blue-violet color is called amethyst (Fig. 11 c and d). With trace of iron, pale yellow to deep brown color is called smoky quartz (Fig. 11 e and f). Pink color is called rose quartz. It can also be observed as rock crystal (colorless, transparent and euhedral crystal) which is mostly colorless. Grain size ranges from 1cm - 4in.

Crystallography: Quartz in the study had been crystallized in the trigonal system. They are commonly forming hexagonal prisms, and occasionally stubby. They have hardness of 7 on the basis of the relative hardness of Mole's scale and it is also brittle. They give conchoidal fracture and have no cleavage. They have the specific gravity of 2.65. The refractive index ranges from 1.544 to 1.553. They display vitreous luster.

Coarsely crystalline samples are distinguished by hardness, conchoidal fracture and luster. Crystals are quite distinctive.

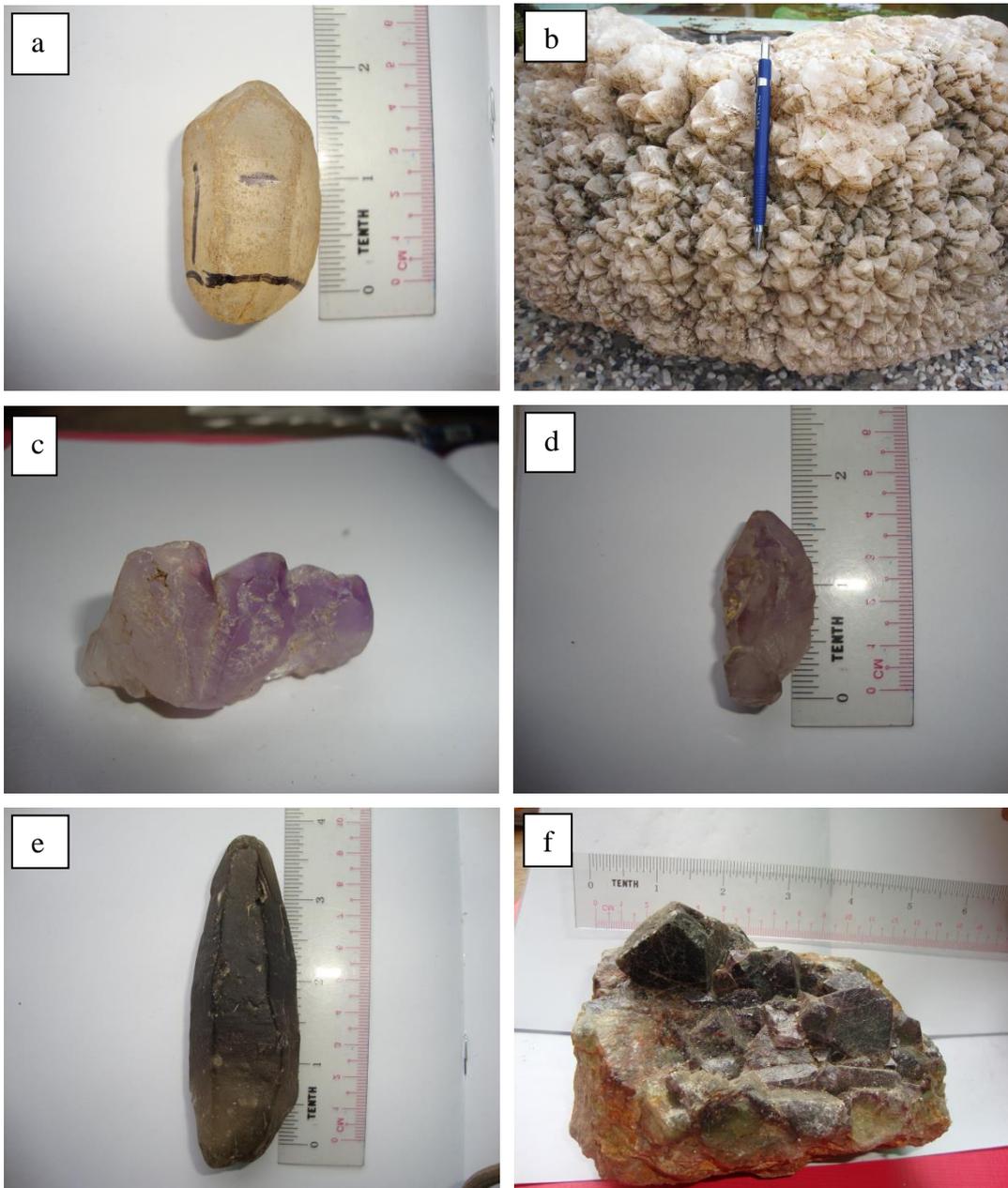


Fig.11 a & b Colorless, c & d amethyst, and e & f smoky varieties of quartz from Shadaw and Bawlake Areas

Occurrence: Quartz is a very common mineral found in a wide variety of geological environments. Hydrothermal vein and replacement deposits typically contain quartz as a gangue mineral, often in the form of beautiful crystals or as microcrystalline and massive varieties.

Uses: Varieties that are colored due to the presence of impurities may be used as gemstones. It is widely used in many industries. Quartz also is widely used as an abrasive or polish and as a semiprecious gemstone in the jewelry industry.

Locality: It is found in the eastern part of the Kayah State especially, in Shadaw and Bawlake Townships.

Fluorite

Chemical composition of fluorite is generally CaF_2 . Both translucent and opaque materials exist. It is commonly colorless, blue, purple, and green, (Fig. 12). The grain size ranges from 1cm - 3cm.

Crystallography: Crystals are mostly cubic, sometimes modified by octahedron or other forms and anhedral. It is crystallized in the isometric system. They have hardness of 4 on the basis of the relative hardness of Mohs's scale and it is also brittle. They have subconchoidal to even fracture and have no cleavage. They have the specific gravity of 3.18. They show vitreous luster. The refractive index ranges from 1.433 to 1.435.

Cubic crystals, octahedral cleavage, and hardness are distinctive features of fluorites. Anhedral material may resemble quartz but is softer and displays cleavage.



Fig.12 Colorless, blue, purple, and green varieties of fluorite from Shadaw and Pawn Chaung Area

Occurrence: Fluorite is a common mineral in hydrothermal mineral deposits associated with sulfides (pyrite, galena, sphalerite, etc). Fluorite may also found as a minor mineral in granite, pegmatites, syenite, and greisens.

Uses: Fluorite is used in making drinking water, toothpaste, and mouthwash to help prevent dental cavities.

Locality: It is found in the eastern part of the Kayah State especially, in Shadaw Township and along the Pawn chaung.

The distribution of precious and semiprecious stones in Kayah State is shown in table 1 and fig. 13.

Table 1. Distribution of Precious and Semiprecious stones in Kayah State.

| No | Township | Semiprecious stone | Locality | Economic |
|----|----------|--|-------------------------|----------|
| 1. | Loikaw | Quartz | Lawpita | Yes |
| 2. | Demawso | Quartz | Lobarko | Yes |
| 3. | Pruso | Quartz | Hoya | - |
| 4. | Shadaw | Sapphire, fluorite, tourmaline, quartz, topaz and aquamarine | Shadaw environs | Yes |
| 5. | Bawlake | Tourmaline, topaz and quartz, and aquamarine | Ywa thit, Thakhuk Taung | Yes |
| 6. | Phasaung | Aquamarine, fluorite and topaz | Mawchi | Yes |
| 7. | Mese | - | - | - |

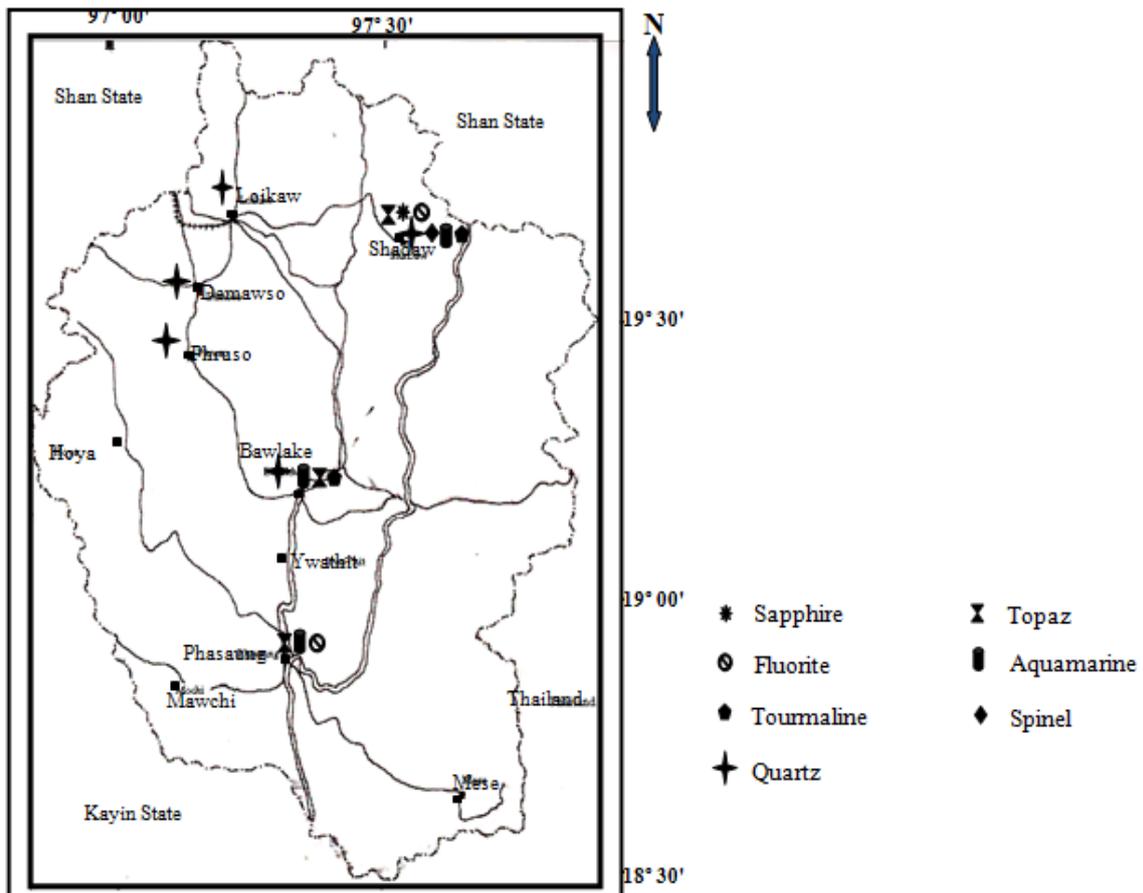


Fig.13 Location map of the distributions of precious and semiprecious stones in Kayah State

Conclusion

The term semi-precious is used to refer to the entire world of colored gemstones, not including the four so-called precious gems, diamond, ruby, sapphire and emerald. Tourmaline, sapphire, topaz, aquamarine, spinel, quartz and fluorite occur as precious and semiprecious stones in Kayah State. They are mainly found in Pawn Chaung Series and Mawchi Series of Shadaw, Bawlake and Mawchi Areas. Pawn Chaung Series is chiefly composed of marble. The marble is coarse-grained and contains narrow black argillaceous bands, green schistose bands, calc-silicate intercalations, and quartz and pegmatite veins. The green tourmaline can be observed as single terminated crystal in quartz and pegmatite veins in marble and in calc-silicate rocks. And also fairly found in other townships. They may be extracted economically but it is difficult in accessibility. Because of poor transportation, we cannot know the detail mode of occurrences of all of the precious and semiprecious stones in Kayah State.

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