



INTERNATIONAL TURKIC WORLD CONGRESS ON SCIENCE AND ENGINEERING

# INTERNATIONAL TURKIC WORLD CONGRESS ON SCIENCE AND ENGINEERING

# BOOK OF PROCEEDINGS

**17-18 JUNE 2019**

Niğde Ömer Halisdemir University

Niğde - TURKEY

ISBN:978-975-8062-32-4



[www.utufem.org](http://www.utufem.org)

[utufem@ohu.edu.tr](mailto:utufem@ohu.edu.tr)



## Geological and Gemological Properties of The Döllük And Gümenek (Tokat) Chalcedonies

Abdurrahman RUŞEN<sup>1</sup>, Fetullah ARIK<sup>2</sup>

<sup>1</sup>Konya Technical University, Graduate Education Institute, Geological Engineering Department, Selçuklu, Konya

<sup>2</sup>Konya Technical University, Faculty of Engineering and Natural Sciences, Geological Engineering Department, 42031, Selçuklu, Konya  
[fetullaharik@gmail.com](mailto:fetullaharik@gmail.com)

**Abstract:** In this study, it was aimed to investigate the relations of chalcedony formations with the rocks located in around of the Gümenek and Döllük villages of Tokat City center and their petrographical and gemological features. In the region, consisting of Paleozoic to today, it is observed magmatic and sedimentary units. The Tokat Massif, which forms the basement of the study area, is low grade metamorphosed in the greenschist facies and is represented by metabasalt, metagraywacke, micaschist, crystallized limestone, marble, amphibolite and less amount blueschists. In the west of the area, Middle Eocene volcano-sedimentary Haydaroğlu formation consisting of conglomerate, mudstone, sandstone and shale intercalations with andesitic-basaltic lava, tuff, agglomerate, volcanic breccia, unconformably covers the Tokat Massif. Blue chalcedony formations are observed along a fault zone close to the E-W trending line passing through the metamorphic units of the Tokat Massif. The chalcedonies were formed mostly in the cracks, fractures and cavities of the recrystallized limestones, which had a more fractured and brecciated structure due to faults along a line approximately 25 m perpendicular to this fault zone. The color of the chalcedonies is mostly light blue and close to white, dark blue and greyish blue. Usually asymmetrical and symmetric vessel filling, gap filling, geoid, banded and lacy structures are observed. Parallel to each other, several mm thick banded structures are common from the outside of the void and some cavities are filled with coarse crystalline quartz. As a result of mineralogical, petrographical, XRD and gemological investigations of the samples selected among the chalcedonies calcites and chalcedonies were observed in some light white bands.

**Keywords:** Chalcedony, Tokat, Gümenek, Gemology, Semi-Precious Rock.

### Döllük ve Gümenek (Tokat) Kalsedonlarının Jeolojik ve Gemolojik Özellikleri

**Özet:** Bu çalışmada Tokat İl merkezine bağlı Döllük ve Gümenek Köyleri civarında yer alan kalsedon oluşumlarının içinde buldukları yankayaçlarla ilişkilerinin ortaya konulması, kalsedon oluşumlarının, jeolojik ve gemolojik özelliklerinin araştırılması amaçlanmıştır. Bölgede, Paleozoyik'ten günümüze kadar oluşan yaşlı metamorfik, magmatik ve sedimanter birimler yüzeylenmektedir. İnceleme alanında temelini oluşturan Tokat Masifi düşük dereceli yeşilşist fasiyesinde metamorfizma geçirmiş, metabazalt, metagrovak, mikaşist, kristalize kireçtaşı, mermer, amfibolit ve az oranda mavışistlerle temsil edilmektedir. Alanın batısında Orta Eosen yaşlı çakıltaşı, andezitik-bazaltik lav, tuf, aglomera, volkanik breş, çamurtaşı, kumtaşı ve şeyl aralanmalarından oluşan volkano sedimanter Haydaroğlu formasyonu Tokat Masifini uyumsuz olarak örtmektedir. Mavi kalsedon oluşumları Tokat Masifine ait metamorfik birimler içerisinde geçen D-B doğrultulu dike yakın eğimli bir fay zonu boyunca yaklaşık 25 m genişliğinde bir hat boyunca gözlenmektedir. Kalsedon oluşumları bu fay zonu boyunca faylanmanın etkisiyle kırıklı ve breşik bir yapı sergileyen rekristalize kireçtaşlarının çatlak, kırık ve boşluklarında oluşmuştur. Kalsedonların rengi çoğunlukla açık mavi olup yer yer beyaza yakın, koyu mavi ve grimsi mavidir. Genellikle simetrik ve asimetrik damar dolgusu, boşluk dolgusu,

yumrulu, bantlı ve dantelli yapılarıdır. Boşluk dolgusu şeklindeki kalsedonlarda boşluğun dışından itibaren birbirine paralel birkaç mm kalınlığında kalsedon ve kalsit bantları yaygın olup bazı boşluklar iri kristalli kuvarlarla doldurulmuştur. Derlenen kalsedon numuneleri arasından seçilen örneklerle yapılan mineralojik, petrografik, XRD ve gemolojik incelemeler sonucunda, genelde beyaz açık renkte, bantlı yapı gösteren, bazı katmanlarda kalsitler ve kalsedonlar tespit edilmiştir.

**Anahtar Kelimeler:** Kalsedon, Tokat, Gemoloji, Gümenek, Yarı değerli taş.

## 1. Introduction

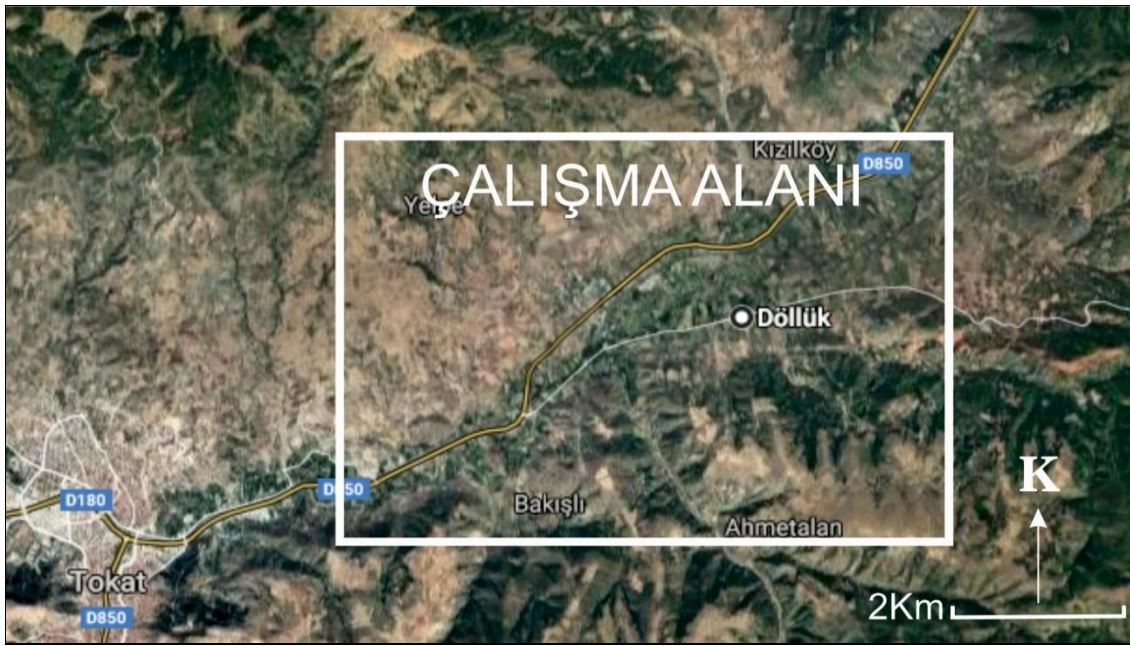
There are numerous and various gemstone formations associated with magmatic and volcanic activities in the Tokat region. In Turhal, Zile and Almus line, Paleozoic and Mesozoic aged units have good quality agate, jasper, chalcedony and tree opals depending on local fracture systems, and chrysoprase formation near Artova (Türel et al., 2000; Başbüyük et al., 2015; Gürbüz et al., 2016; Kaydu Akbudak et al., 2016; Arık, 2018; Ruşen and Arık, 2018, Turhal and Arık, 2018).

The study area covers the Döllük and Gümenek Villages and its environs, approximately 12 km northeast of Tokat (Fig. 1). In the region, there are chalcedony formation as vein and cavity filling along the fault lines within the metamorphic rocks of the Tokat Massif. (Fig. 2).

In this study, it was aimed to determine the geological, mineralogical, petrographic features of the calcedony and wall rock.

## 2. Material and Method

During the field studies conducted in the study area in 2018, the boundaries of the geological units were monitored and updated by taking advantage of previous studies in the region (Yılmaz et al., 1997; Sümengen, 2013, Göçmengil et al., 2017; Göçmengil et al., 2018). In order to determine the mineralogical, petrographic and geochemical features, the fault lines in the region were checked and samples were collected from the chalcedony samples and the rocks in which fractures and fractures in the vicinity of the Döllük village were found.



**Figure 1.** Location map of the study area (<https://www.google.com/maps>, 2019)

For mineralogical and petrographic observations, thin sections from the chalcedony and its wall rocks samples taken from the study area were prepared in the Department of Geological Engineering at Pamukkale University and examined in polarized microscope at Konya Technical University. In order to support petrographic observations, samples taken from some chalcedonies were carried out by X-Ray Diffractometer standard qualitative mineral analyzes (XRD) at the General Directorate of Mineral Research and Exploration (MTA). The chalcedony samples (Fig. 2) were examined and polished at Selcuk University SUKOP Gemstone Atelier and then the gemological studies were performed at MTA Gemology Laboratory.



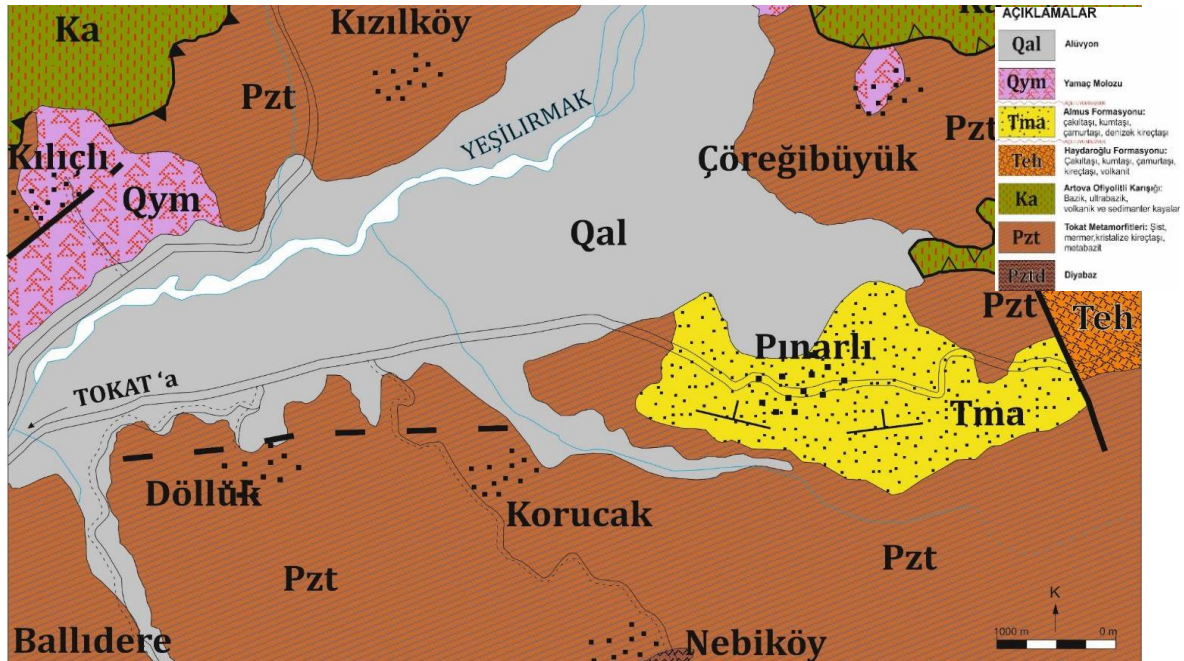
**Figure 2.** Döllük chalcedonies from study area

### 3. Results

Geological and stratigraphic features were determined in the field studies performed in the study area and petrographical, gemological and geochemical analyzes were performed.

#### 3.1. Geology

In the study area, the Tokat Massif is represented by Paleozoic aged metabasites, marble, phyllite, serpentinite, mica-schist, amphibolite and a lesser blueschist with low grade metamorphic rocks (Yılmaz, 1984; Bozkurt and Koçyiğit, 1996; Özcan and Aksay, 1996; Yılmaz et al., 1997; Sümengen, 2013; Göçmengil et al., 2017; Fig. 3).



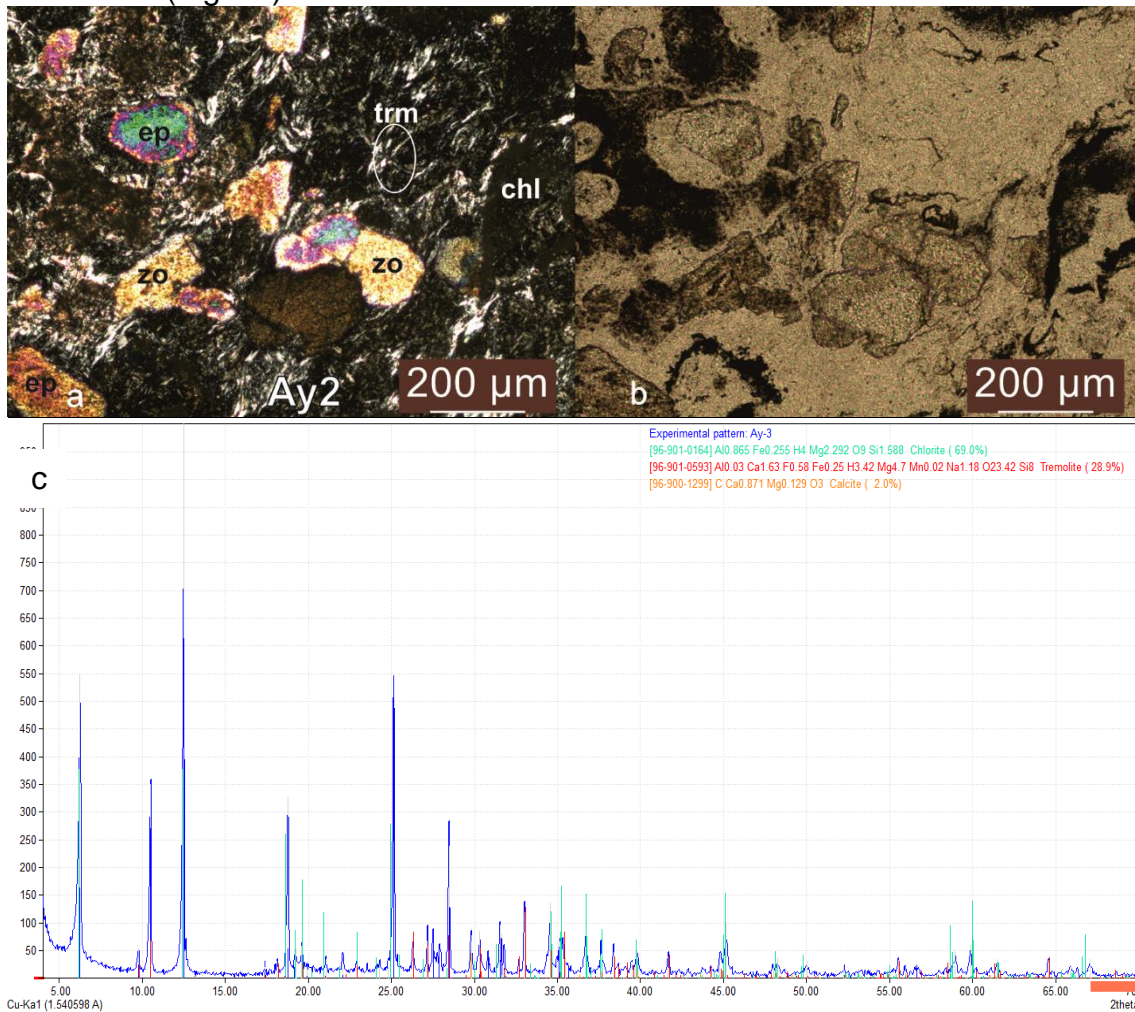
**Figure 3.** Geological map of the study area (modified from Sümengen, 2013; Ruşen and Arık, 2018)

The Upper Cretaceous Artova Ophiolitic mélangé, represented by serpentinite, gabbro, dolerite dykes and fine-grained detritics, has tectonic contact on Paleozoic units. Middle-Late Eocene volcanic sedimentary Haydaroğlu formation unconformably covers other units (Sümengen, 2013). The Almus formation, which is formed by the alternation of the Lower Miocene aged conglomerate, sandstone, siltstone and limestone, unconformably overlies older units (Sümengen, 2013; Göçmengil et al., 2017). All these units are covered by Pleistocene - Current alluviums (Fig. 3).

#### 3.2. Mineralogical and Petrographical Analyses

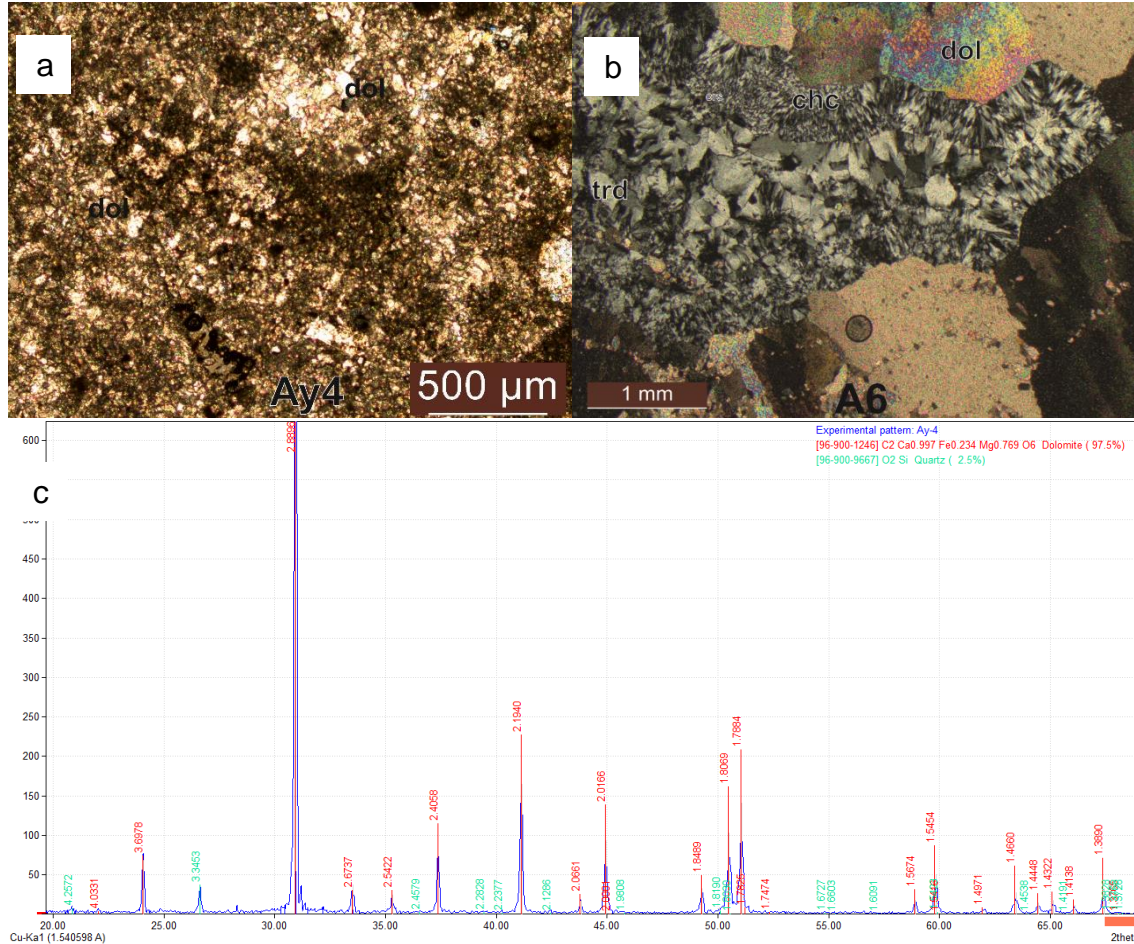
In the petrographic studies of metadiabases belonging to Tokat metamorphics, 35-40% tremolite, 15-20% chlorite, 13-15% residual pyroxene, 5-8% epidote, 4-5% zoisite-clinozoisite, 6-8% albite, 4-6% calcite and very little quartz, sphene and opaque mineral formation were observed. The primary pyroxene have been transformed into tremolite and chlorite from its edges. According to the tremolite density and

crystallization degree in the rock, lepidoblastic texture is observed due to fibroblastic and leafy chlorites and the original texture is diabatic texture. The rocks were named as metadiabase (Fig. 4a and 4b). Similar results were observed in XRD analyzes of the samples taken from these rocks, and chlorite, tremolite and calcite were differentiated (Fig. 4c).



**Figure 4. (a, b):** Tremolite (trm), chlorite (chl), epidote (ep) and zoisite (zo) observed in metadiabase of Tokat metamorphics (a: +N; b://N), **(c):** tremolite, chlorite and calcite identified from XRD analysis.

In the petrographic investigations of the chalcedony formations, dolomite and very little quartz were observed. Considering the mineralogical composition of the rock, this rock is named as dolomite and is seen as massive granoblastic texture. Secondary calcite, dolomite, quartz and tridymite were observed in the cracks of the rocks (Fig. 5a and 5b). Dolomite and quartz were also found in XRD studies (Fig. 5 c).

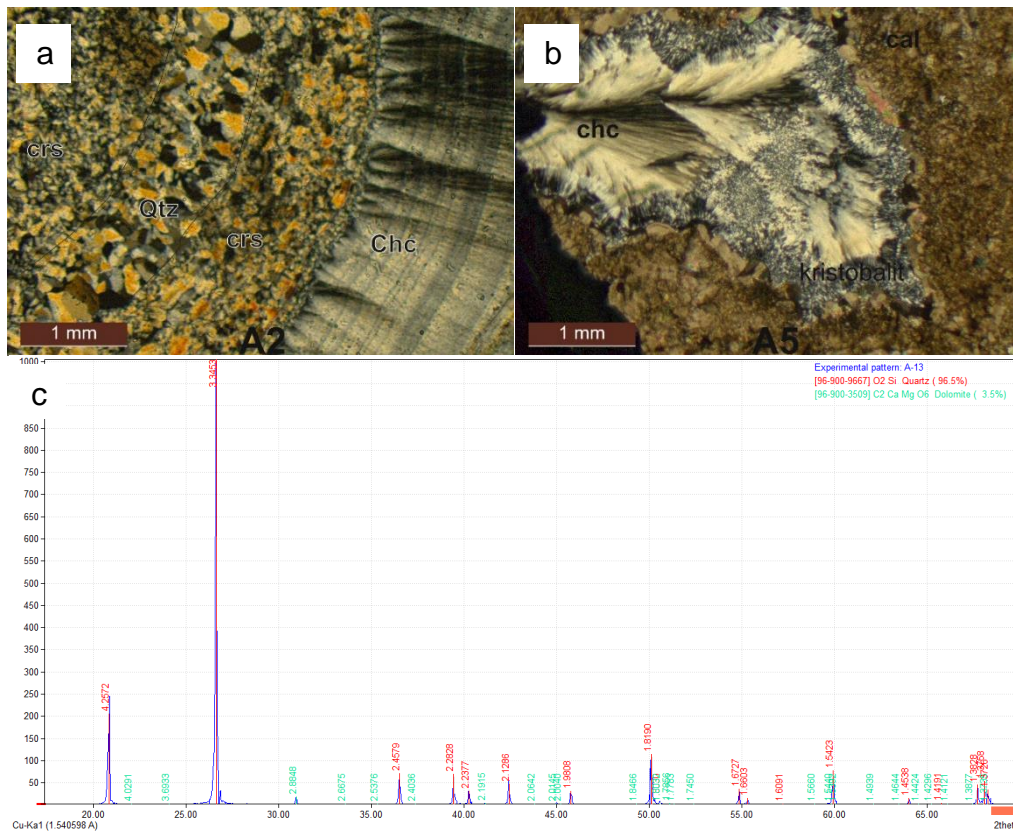


**Şekil 5. (a,b)** Dolomite (do), chalcedony (chc) and tridymite (trd) observed in petrographic investigations of Tokat metamorphics (a: //N, b. +N), **(c)** Dolomite and quartz detected in XRD studies

Chalcedony, quartz, tridymite, cristobalite, dolomite and calcite were found in petrographical investigation in thin sections belonging to chalcedony samples collected from study area (Fig. 6a and 6b). Mostly Quartz and rarely dolomite paragenesis were observed in XRD analysis of chalcedony (Fig. 6c).

### 3.3. Gemological Analysis

After polishing of fertilization chalcedony which was collected from metamorphic rocks belonging to Tokat Massif, gemological analyses were performed and examined in gemology microscope. In the analyzes, chalcedony and calcite minerals were determined (Fig. 7).



**Figure 6. (a,b)** Quartz (qtz), cristobalite (crs), chalcedony (chc) observed in petrographic investigations (a: +N; b: //N), **(c)** Quartz and dolomite detected in X-Ray diffractogram of chalcedony



**Figure 7.** Refractometer graphs of chalcedony and calcite detected in gemology microscope



#### 4. Conclusions

Blue chalcedony formations are observed along a 25 m wide line along a fault zone near the E-W trending fault passing through the metamorphic units of the Tokat Massif. Chalcedony formations are observed in cracks, fractures and cavities of recrystallized limestones which have a fractured and brecciated structure due to faulting along this fault zone. The color of chalcedonies is mostly light blue and close to white, dark blue and grayish blue. They are generally symmetrical and asymmetrical with vascular filling, gap fill, tubular, banded and lacy structure. The chalcedony in the form of a gap fill is common to a few mm thick chalcedony and calcite bands from the outside of the cavity and some cavities are filled with coarse crystalline quartz.

According to mineralogical and petrographical studies of the chalcedonies, chalcedony, quartz, tridymite, cristobalite and calcite were observed. The chalcedony and calcite minerals were determined in the gemological studies. In this study, it was concluded that Döllük-Gümenek chalcedony is suitable to use as a gemstone. It is thought that it will contribute to the regional economy as a result of the evaluation of the other chalcedony, jasper, quartz and agat in the region.

#### References

- Arık, F., 2018, Geological and Gemological Properties of the Jaspers around the Almus Region (Tokat). International Congress on Engineering and Architecture (ENAR-2018) Alanya / Turkey., 1(1), 1892-1901.
- Başibüyük, Z., Kaydu Akbudak, İ. and Gürbüz, M., 2016, Mineralogical, petrographical and geochemical investigation of the Artova chyropras (Tokat-Türkiye), T.C. Ahi Evran Univ. Research project offer, 9 pp.
- Bozkurt, E., and Koçyiğit, A., 1996, The Kazova basin: an active negative flower structure on the Almus Fault Zone, a splay fault system of the North Anatolian Fault Zone, Turkey. *Tectonophysics*, 265(3-4), 239-254.
- Göçmengil, G., Karacık, Z. and Genç, Ş. C., 2018, Volcano Stratigraphic Investigation of the Post-Collisional Middle Eocene Magmatism Around İzmir-Ankara-Erzincan Suture Zone (NE, Turkey), *Türkiye Jeoloji Bülteni (Geological Bulletin of Turkey)* 61 (2018) 131-162.
- Göçmengil, G., Karacık, Z., Genç, Ş.C., Billor, Z., 2017.  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  geochronology and petrogenesis of postcollisional trachytic volcanism along the İzmir-Ankara-Erzincan suture zone (NE, Turkey). *Turkish Journal of Earth Sciences*, 27 (1), 1-31.
- Gürbüz, M., Kaydu Akbudak, İ. and Ulus, Ü., 2016, Mineralogical, petrographical and geochemical investigation of the Tokat agates (Türkiye), International participation 7<sup>th</sup> Geochemistry Symposium, Ankara Univ, Antalya, Abstracts, 124-125.
- Kaydu Akbudak, İ., Gürbüz, M., Başibüyük, Z. and Ulus, Ü., 2016, Mineralogical, petrographical and geochemical investigation of the Aydıncık

(Yozgat) chalcedonies, Ahi Evran Univ., Research project: PYO-MÜH.4001.15.002, 50 pp.

- Özcan, A. and Aksay, A., 1996, Geology of the Tokat-Turhal-Almus- Çamlıbel Region, General Directorate of Mineral Exploration and Prospection Report: 9972.
- Ruşen, A. ve Arık, F. 2018, Petrographical And Gemological Investigation ff The Chalcedonies Around the Gümenek (Komana) and Döllük Villages (Tokat), JMO, İstanbul Ticaret Üniversitesi, Precious and Semi-precious Rocks Workshop-2, 19-20 December 2018,
- Sümengen, M., 2013, 1:100000 Scaled Turkey Geological Maps, No.188, Tokat-H37 Layout. General Directorate of Mineral Exploration and Prospection, Chamber of Geological Investigations Ankara, Türkiye.
- Turhal, E. and Arık, F. 2018, Petrographical and Gemological Investigation of the Agates Around the Kuruseki, Serince, Görümlü (Almus-Tokat), JMO, İstanbul Ticaret Üniversitesi, Precious and Semi-precious Rocks Workshop-2, 19-20 December 2018,
- Türel, K., Teşrekli, R., Çelebioğlu, N., Bektur, Z., Besbelli, A., Erdem, E., Sayılı, S., Lüle, Ç., Atakay, E., Kadrioğlu, T., Özcan, H. and Esat, K., 2000, "Precious and ssemi-precious rocks of Turkey Investigation Project, General Directorate of Mineral Exploration and Prospection 62 pp.
- Yılmaz, A., 1984, Basement Geological Features and location of ophiolitic mellange between the Tokat (Dumanli dagi) and Sivas (Çeltek dagi) Journal of General Directorate of Mineral Exploration, 99/100 1-18
- Yılmaz. Y., Serdar, H.S., Genc, C., Yigitbas, E., Gürer, Ö.F., Elmas, A., Yildirim, M., Gürpınar, O., 1997, The geology and evolution of the Tokat Massif, South-Central Pontides, Turkey. Int. Geol. Rev., 39: 365-382.