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## **Petrography of the Vein Rocks of Uckapili Granitoid around Uckapili Village (Niğde/Turkey)**

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**Abstract** Niğde Massif is the southeast part of the CACC (Central Anatolian Crystalline Complex) which is composed of magmatic and metamorphic rocks. In the study area, formations belong to Niğde Group are Gumusler Formation which is composed of mainly gneiss and marble, Kaleboynu Formation which is composed of marble, gneiss and amphibolite, Aşığıdediği Formation which is composed of marble, gneiss and amphibolite, Sineksizyayla Metagabbro and Uckapili Granitoid. Sineksizyayla Metagabbro intrude the Gumusler and partly Kaleboynu Formations. Uckapili Granitoid cuts all the other units. Niğde Massif is covered by Early Pliocene aged Incesu Ignimbrite and Quaternary aged alluviums.

Petrographically, the Uckapili Granitoid is composed mainly of monzogranite and also granodiorite. The mineral paragenesis of Uckapili Granitoid is Quartz, Plagioclase (Albite-Oligoclase), K-feldspar (Orthoclase-Microcline), Biotite, Muscovite, Chlorite and Hornblende. The intrusion age of the Uckapili Granitoid is  $95 \pm 11$  my. The most common assemblage in the peraluminous dikes is potassium feldspar + plagioclase + quartz + tourmaline  $\pm$  garnet  $\pm$  fibrolite– sillimanite  $\pm$  andalusite  $\pm$  xenotime  $\pm$  muscovite.

**Keywords** Vein rocks, Uckapili Granitoid, Petrography, Mineralogy, Niğde Massif

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### **1. Introduction**

In this study, vein rocks associated with Uckapili Granitoid cutting the Gümüşler, Kaleboynu and Aşığıdediği formations in the Niğde massif between Gümüşler and Çamardı are investigated.

The Niğde Massif is an isolated crystalline dome near the Inner-Tauride suture in Central Turkey and represents the southernmost part of the Central Anatolian Crystalline Complex (CACC, [4]), which includes the Kırşehir and Akdağ Massifs in the north. It is bounded on the east by the sinistral Ecemiş Fault (Tertiary) and on the south by the Ulukışla sedimentary basin (Figure 1). So far, there are many geological based studies conducted in the region.

In this study, petrographical features of the vein rocks associated with Uckapili Granitoid in the region has been subjected. For this purpose, vein rock samples were collected from the outcrops in the region. The mineralogical and petrographical features of the vein rock samples were determined on thin sections by using polarizing microscope.

### **Geological Setting**

The Niğde massif, located at the southern tip of the CACC, is a structural dome comprised of a core that primarily consists of high-grade metasedimentary rocks (including migmatite) that record upper amphibolite facies metamorphism and, in the deepest structural units, partial melting [7], [8]. These basement rocks are Gümüşler Formation, Kaleboynu Formation and Aşığıdediği Formation in stratigraphic order from old to young. In the study area, the local stratigraphy starts with the Paleozoic Gümüşler Formation which is made of mostly gneiss, amphibolite, marble and quartzite. During pre-Late Cretaceous time, the Sineksizyayla gabbro intruded



into the Gümüşler Formation. The unit underwent deformation and metamorphism together with the Niğde Group rocks, probably during the emplacement of the Üçkapılı Granitoid. Kaleboynu Formation is dominated by marble, with alternations of quartzite, gneiss and amphibolite. Aşıgediği Formation which covers almost half of the Niğde Massif consists mainly of marbles with intercalations of gneiss, quartzite and amphibolite. All these units are cut by the crustally derived Late Cretaceous Üçkapılı two-mica granite and its vein rocks with a thickness of 30-100 cm like numerous aplite, micropegmatite and pegmatite dykes which are distributed mainly in the Gümüşler Formation. The dykes are also locally present in the Kaleboynu and Aşıgediği Formations. They are the late associates of the granitic intrusions and intrude all the units of the Niğde Group, including the main granitoid stock around Üçkapılı village. Incesu Ignimbrite covers unconformably all the units of the Niğde Massif and is covered by the Quaternary alluvial deposits (Figure 2).

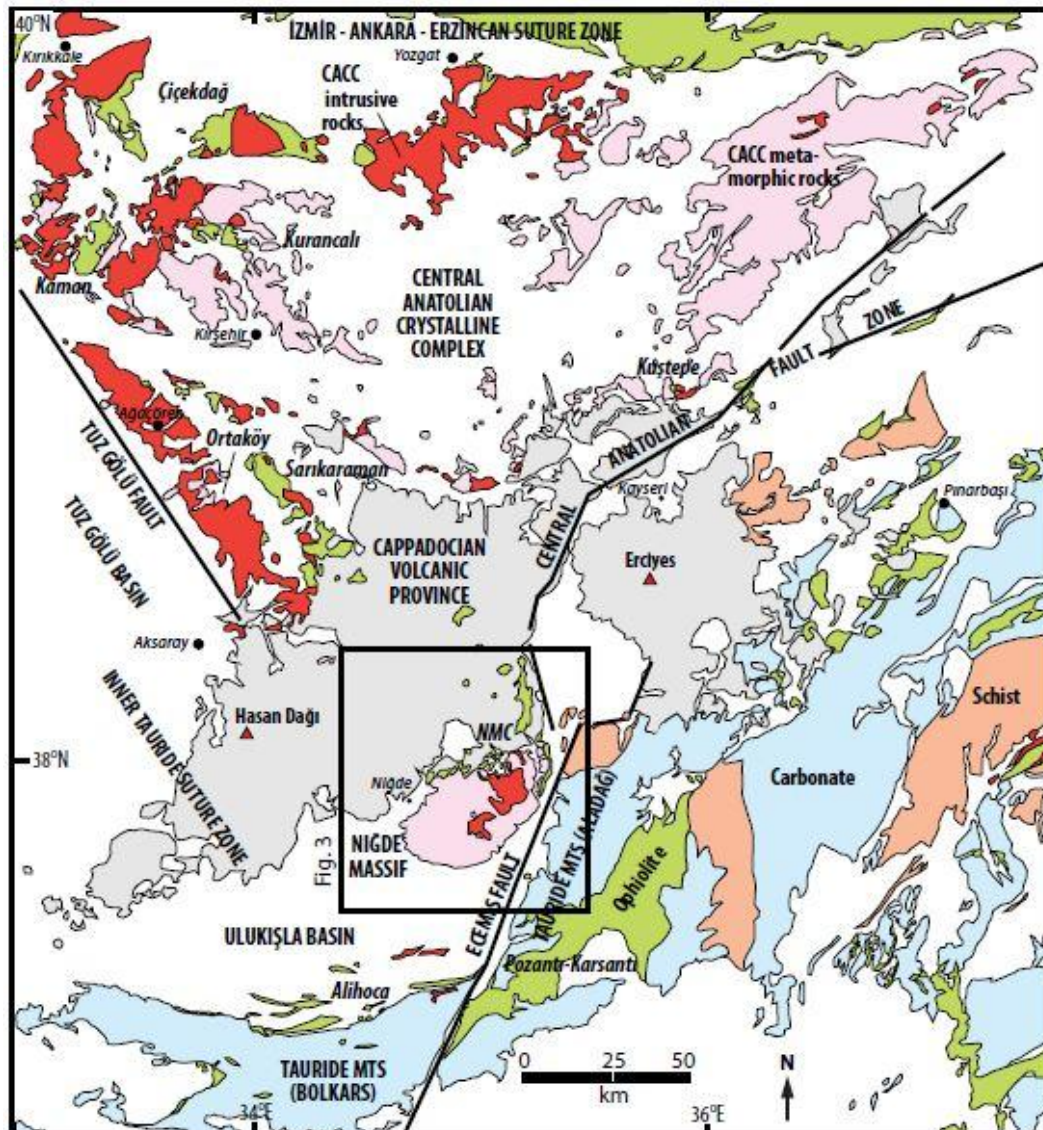


Figure 1: Map of some major geologic features of Central Anatolia, including metamorphic and granitic rocks of the Central Anatolian Crystalline Complex (CACC); fragments of the Central Anatolian Ophiolite (Çiçekdağ, Kaman, Kurancalı, Kuştepe, Ortaköy, and Sarıkaraman), Tauride Ophiolites (Alihoca and Pozantı-Karsantı), and the Niğde Massif Complex (NMC); the Tauride Mountains (carbonate platform units); Cappadocian volcanic province (including two stratovolcanoes: Erciyes and Hasan Dağı); Neotethyan suture zones (İzmir-Ankara-Erzincan and Inner Tauride); fault zones (Central Anatolian fault zone and its southern segment, the Ecemiş fault; TuzGölü fault); and the Ulukışla Basin [6].



Granitoids are abundant in the Niğde Massif, intruding the high-grade metamorphic series. The main intrusion is the Üçkapılı granite [3], exposed from the center of the massif to the northeast. Smaller exposures of granitoid, similar in appearance to the main body, are also widespread further northwest and south. The most common facies is a two-mica granite. Analyses on samples from several small intrusions in the northwest document that the magma was peraluminous, with a high initial Sr ratio ( $0.7104 \pm 0.0009$ ) [3], [1].

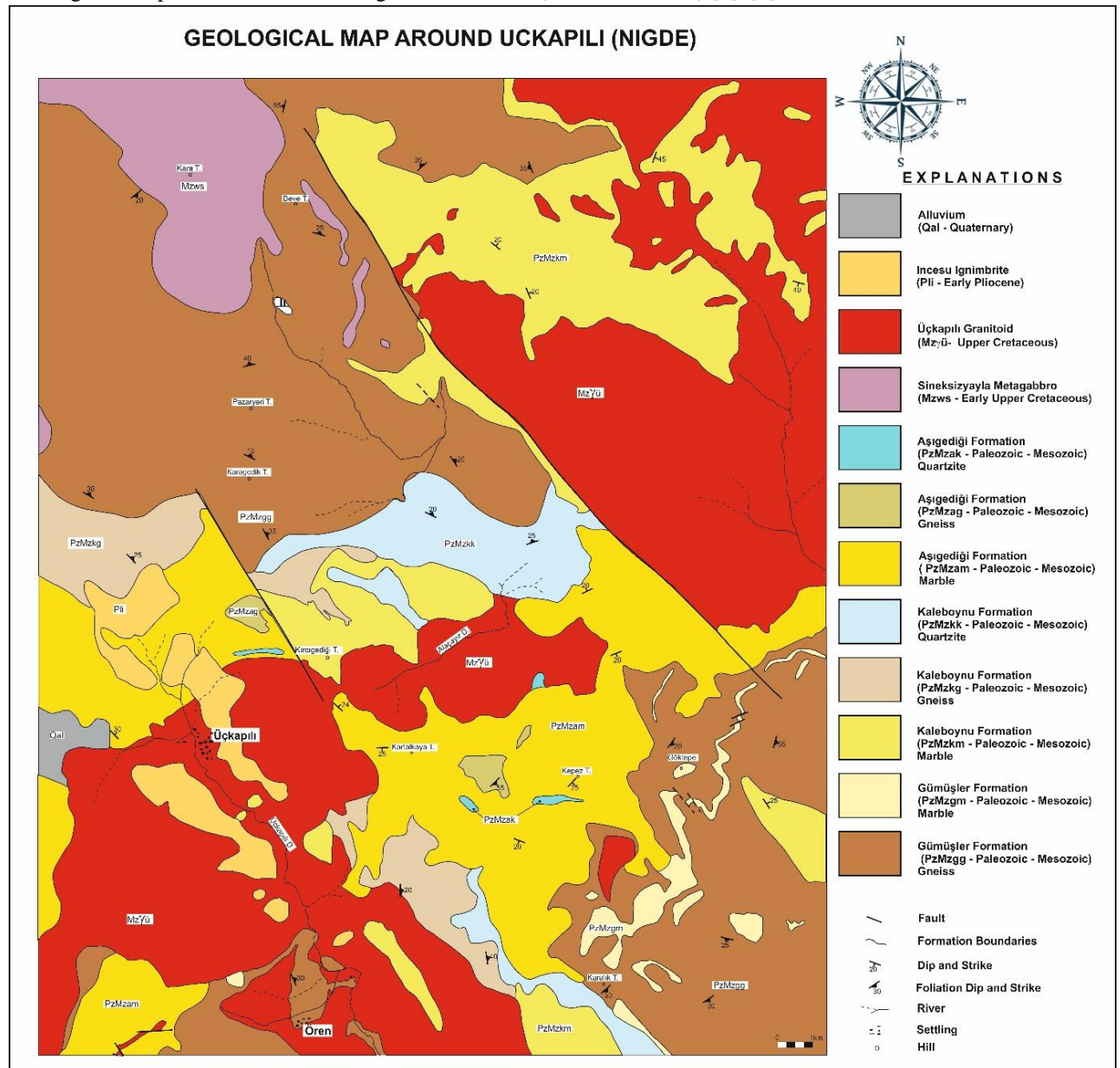


Figure 2: Geological map of the study area [5].

U-Pb geochronology on a sample from the main body shows that most zircons include an inherited core [8]. These features indicate that Üçkapılı-type magmas originate from partial melting of the continental crust [3], [8].

Pressure conditions during emplacement were probably around 3–4 kbar [7]. The Üçkapılı granite usually shows very weak ductile fabrics. It is locally associated with a dense array of dikes with variable orientations, crosscutting at a high angle the foliation of the metamorphic rocks (Figure 3). These features might suggest that the emplacement of the Üçkapılı granite was post-tectonic. The main body, however, has been identified as a late-kinematic intrusion, recording the same shearing deformation as its host rocks [2].



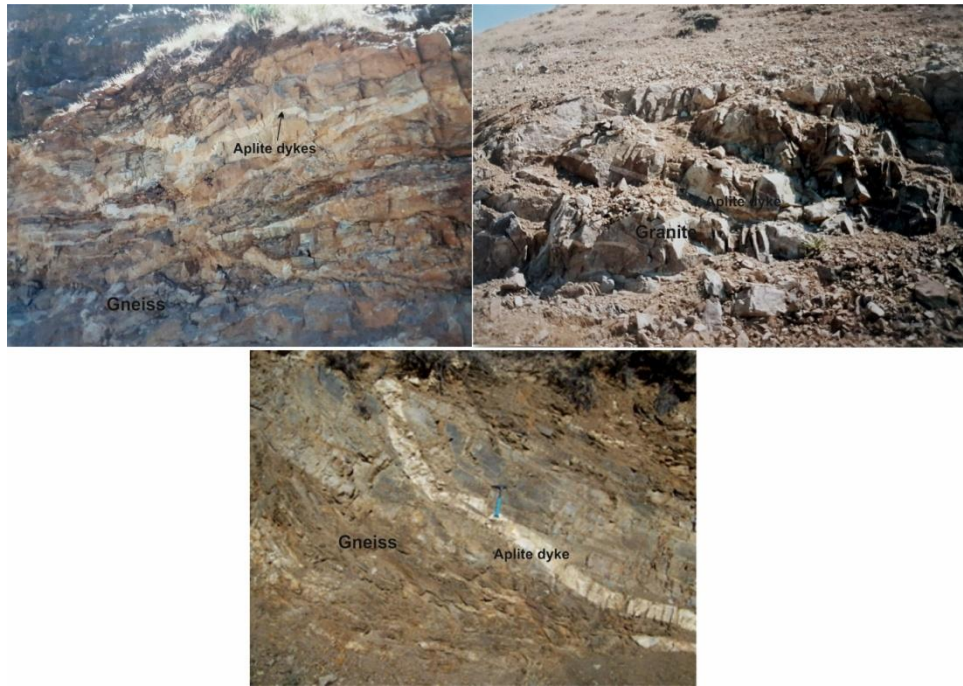


Figure 3: Aplitic dykes cutting the metamorphic rocks and Uçkapılıgranitoid itself.

The Gümüşler gneiss is cut by two suites of granitic dikes. The first occurs near the margins of the Üçkapılı two-mica granite, is mineralogically identical to the pluton, and cuts the mineral foliation and migmatitic layering of the host rocks at steep to moderate angles. The second consists of centimeter- to meter-scale peraluminous dikes. Some of these are concordant to the host gneiss foliation and others cross-cut foliation and migmatitic layering. The most common assemblage in the peraluminous dikes is potassium feldspar + plagioclase + quartz + tourmaline  $\pm$  garnet  $\pm$  fibrolite– sillimanite  $\pm$  andalusite  $\pm$  xenotime  $\pm$  muscovite. Both dike suites contain centimeter-scale xenoliths of the host metapelitic gneiss and most dikes produced a 1–3 cm thick contact zone in the host rock. Both xenoliths and contact zones are depleted in biotite relative to the rest of the country rock and consist of granular, recrystallized plagioclase and quartz. The xenoliths and some of the contact zones also contain abundant, coarse-grained, texturally late muscovite. Unmetamorphosed to greenschistfacies basalt dikes intruded all formations of the massif, including the Üçkapılı granite. Some of these dikes contain angular fragments of their host rocks.

The Kaleboynu Formation consists of weathered, thinly interbedded calc-silicate, marble, metasiltstone, quartzite, and fine-grained schist that are cut by deformed granitic dikes and sills [7].

### Petrographic Features

The color of the ÜçkapılıGranitoid vein rocks changes according to their compositions. Vein rocks are generally leucocratic. Weathered surfaces are greyish - dark grey in color. Granitic vein rocks are generally fine-grained to medium and are considerably altered. Petrographically, the ÜçkapılıGranitoid vein rocks are composed of quartz, plagioclase (Albite-Oligoclase), K-feldspar (Orthoclase-Microcline), biotite, muscovite, with minor amounts of chlorite, amphibole. Accessory minerals include zircon, rutile, apatite, garnet and opaque phases (Figure 4).

Quartz is the dominant mineral in the ÜçkapılıGranitoid vein rocks. Undulatory extinction is very common. Plagioclase is generally hipidiomorph and mainly oligoclase in composition. They exhibit typical polysynthetic twinning. Sericitisation is very common. Zoning is observed in some samples. Microcline is generally present in minor amounts and shows multiple twinning. They are coarse grained. K-feldspar mainly occurs as orthoclase. Perthitic texture is very common. Biotite and plagioclase occur as inclusions in some K-feldspars. Biotite is the most common mafic mineral. It displays reddish-brown pleochroism. Chloritisation is seen in some samples. Light-dark brown- reddish coloredbiotites form as subidiomorphic, bladed shape but rarely xenomorphic crystals. Muscovite is found in minor amounts as short flaky crystals. Muscovite occurs as both individual



crystal and inclusion, particularly in plagioclase. Amphibole is another mafic mineral. It displays a light to dark green pleochroism and occurs as hornblende. Apatite crystals are almost equigranular, and sometimes acicular. The Üçkapılı Granitoid vein rocks are composed mainly of aplite and also pegmatite. Aplitic dykes mainly have xenomorphic granular/aplitic texture and pegmatites have pegmatitic and granophyric texture. Garnet-bearing aplitic dykes cross cut the granite. They are mainly of monzogranitic composition.

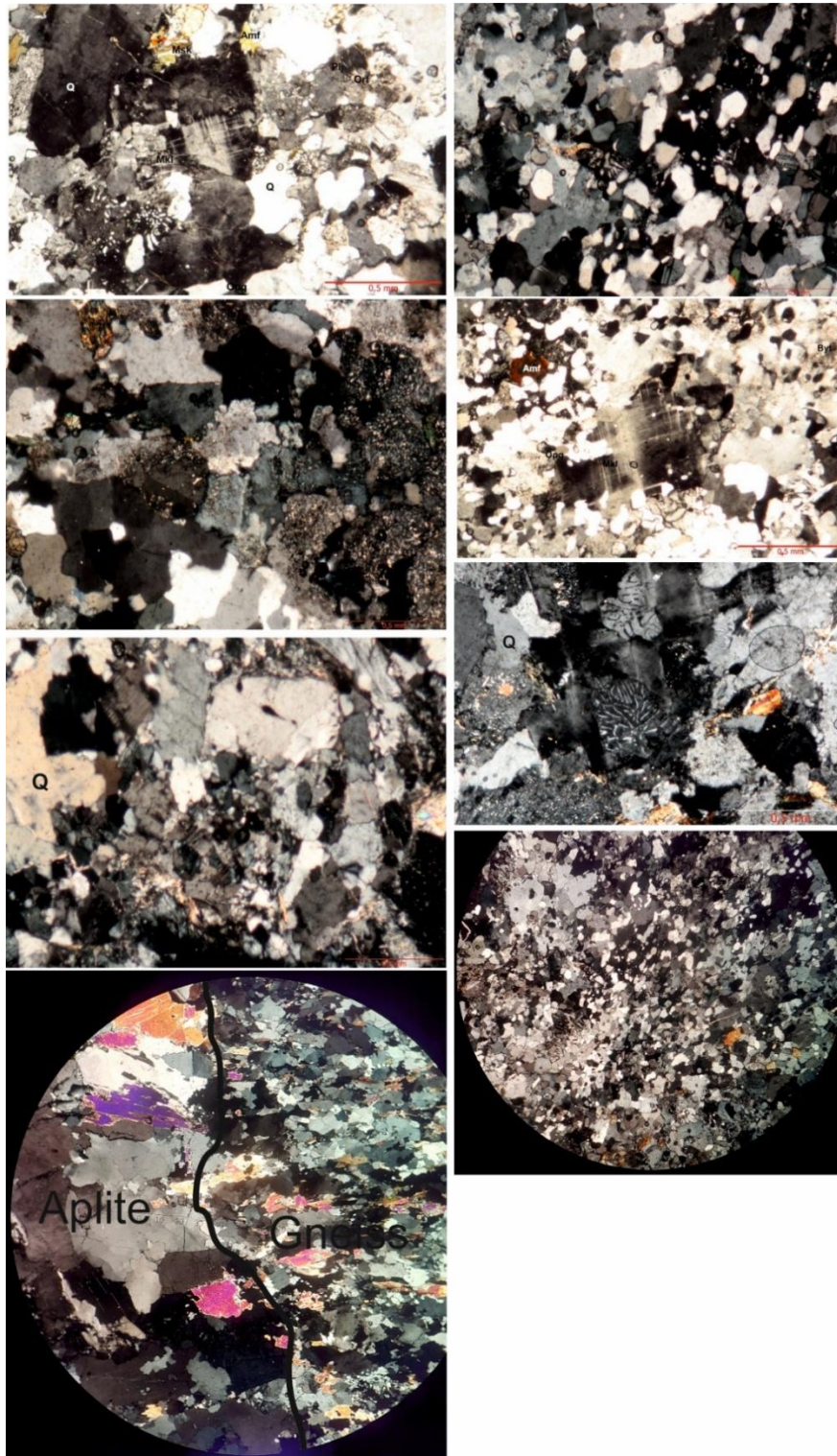


Figure 4: Microphotographs of Üçkapılı granitoid vein rocks (x4, X-nichol). Q: Quartz, Msk: Microcline, Ort: Orthoclase, plj: Plagioclase, amf: Amphibole, Byt: Biotite, Msk: Muscovite, Opq: Opaque.



## Conclusions

All the Niğde metamorphic units are cut by the crustally derived Late Cretaceous Üçkapılı two-mica granite and its vein rocks with a thickness of 30-100 cm like numerous aplite, micropegmatite and pegmatite dykes which are distributed mainly in the Gümüşler Formation. The dykes are also locally present in the Kaleboynu and Aşıgediği Formations. They are the late associates of the granitic intrusions and intrude all the units of the Niğde Group, including the main granitoid stock around Üçkapılı village. In this study, petrographical features of the Uçkapılıgranitoid vein rocks were determined.

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