

# Mineralogical characteristic of amazonite from Čanište- Republic of Macedonia

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**Abstract.** Mineralogy of amazonite from Čanište is presented in this paper including physical properties and chemical composition. Several samples of amazonite were analysed by scanning electron microscope (SEM). SEM is especially useful because it gives elemental, mineralogical and morphological data at the same time. The results of the SEM analysis enable straightforward identification of the studied mineral sample as amazonite. He has characteristic beautiful pale green color, vitreous lustre and white streak. Hardness is 6 - 6½, while specific gravity is 2.54 - 2.57 g / cm<sup>3</sup>. Because of his beautiful pale green color and great hardness this amazonite can be used for making jewelry in form of necklaces, rings, brooches and also for making various ornaments.

**Key words:** mineral, amazonite, scanning electron microscope.

## Introduction

Amazonite appears in pegmatite which are located in the complex of precambrian rocks around the village Čanište. In form of dyke, sill and irregular magmatic bodies, pegmatites penetrate gneiss-micashists and granitoides (Fig.1). The dimension of pegmatites are in range from ten centimeters to several hundred meters in length and 25 meters in width. Amazonite appears in pegmatite and crystallizes at relatively low temperatures.

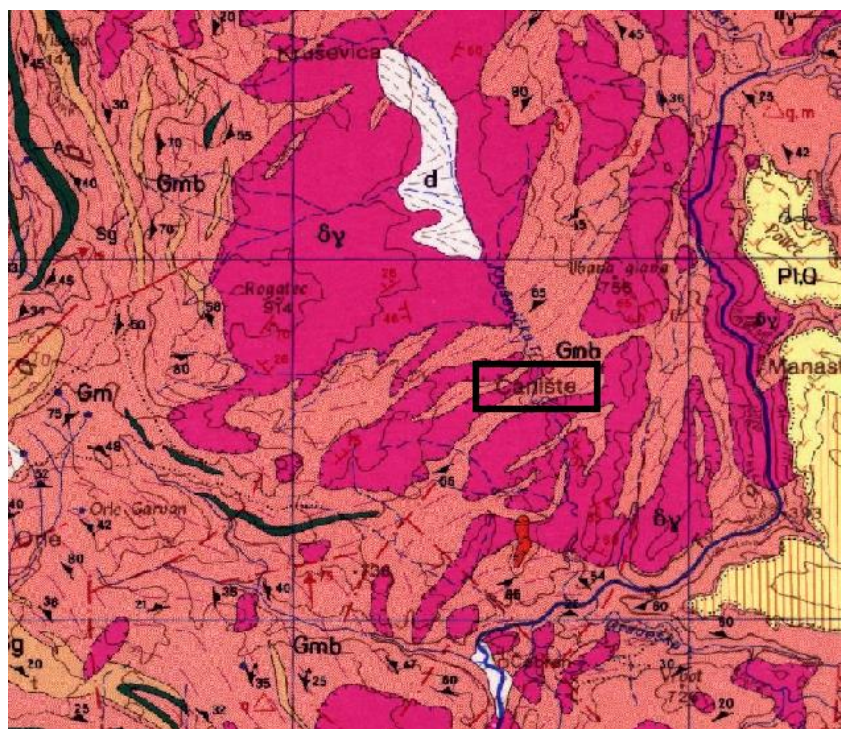


Fig. 1 Geological map of Čanište

1. 2. 3. 4. 5.

1-delluvium; 2-volcanic sediments 3-massive medium to large granular granodiorites; 4-strip muscovite-biotite gneiss 5. amphibolite and amphibolite schist

## Results and discussion

The research was carried out on the mineral samples from Čanište –Republic of Macedonia. Amazonite is named in 1847 by Johann Friedrich August Breithaupt for an unspecified type locality area near the Amazon River.

Crystal system is triclinic. Class-pinacoidal. Cell parameters:  $a = 8.5784\text{\AA}$ ,  $b = 12.96\text{\AA}$ ,  $c = 7.2112\text{\AA}$ ,  $\alpha = 90.3^\circ$ ,  $\beta = 116.05^\circ$ ,  $\gamma = 89^\circ$ .  $Z=4$ .  $V = 720.16\text{ \AA}^3$  Colour is pale green. (Fig. 2, 3 ). Lustre is vitreous. Streak is white. Cleavage is perfect on  $\{001\}$  and good on  $\{010\}$ . Fracture is irregular/uneven. Hardness 6 - 6½, density 2.54 - 2.57 g/cm<sup>3</sup>.

Optical data are:  $n_\alpha = 1.514 - 1.529$   $n_\beta = 1.518 - 1.533$   $n_\gamma = 1.521 - 1.539$ ,  $2V=66^\circ-103^\circ$ .

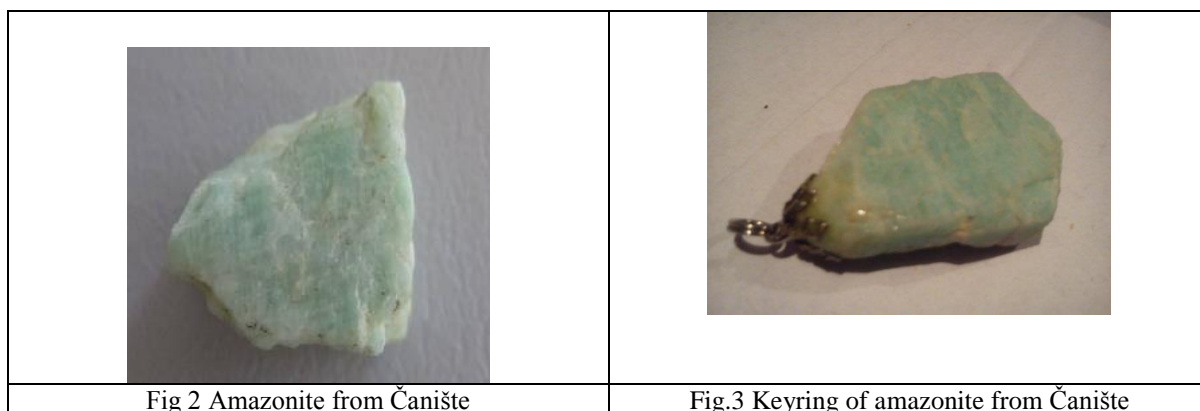
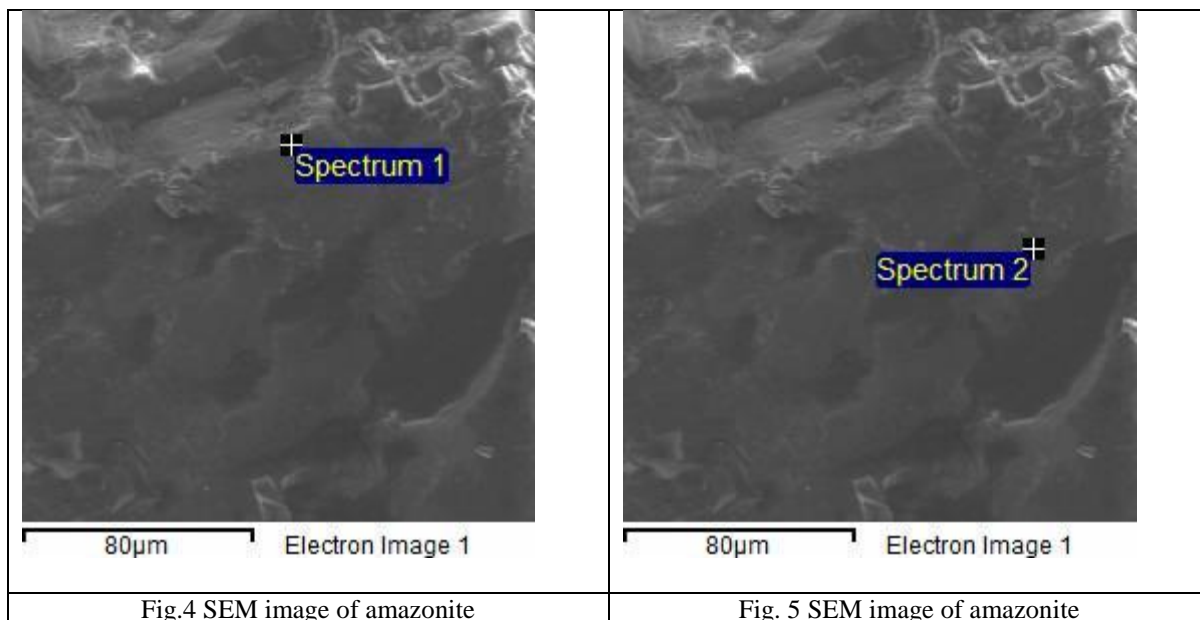
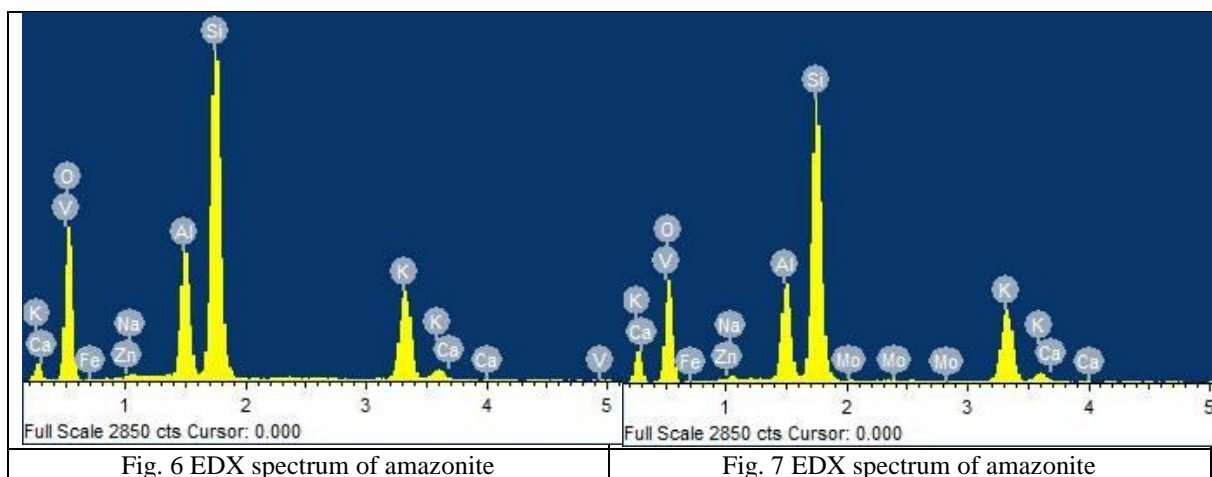


Fig. 4 and 5 show SEM images of amazonite



EDX spectrum of amazonite is given in fig. 6 and 7.



The chemistry of amazonite from Čanište is given on table 1.

Table 1 Chemistry of amazonite from Čanište.

Element	Weight%	Atomic%	Weight%	Atomic%
Si	26.46	19.16	28.46	21.09
Al	8.56	6.45	8.49	6.55
Na	0.47	0.42	0.60	0.54
K	10.35	5.38	11.28	6.00
Ca	0.03	0.02	0.02	0.01
V	0.10	0.04	0.11	0.04
Fe	0.04	0.01	0.34	0.13
Zn	0.08	0.02	0.13	0.04
Mo			0.18	0.04
O	53.91	68.50	50.39	65.55

For many years, the source of amazonite's color was a mystery. Naturally, many people assumed the color was due to copper because copper compounds often have blue and green colors. More recent studies suggest that the blue-green color results from small quantities of lead and water in the feldspar. The variable yet characteristic colour of amazonite appears to result from the quantity and valence state of lead impurity [1]. Thus Pb remobilized in metamorphism may be concentrated in the feldspar [2].

[3] suggested numerous possibilities for the color of amazonite but pointed to lead as the primary candidate. In the past three decades, some inconsistencies with this possible correlation have become apparent. Research by [4] shows that some samples of amazonite did indeed have a high lead concentration, whereas other samples that were green had little to no lead. It had also been noted that some non-green samples had unexpectedly high lead concentrations. They propose that while lead does indeed play a role in coloring amazonite, both natural radiation and structural water are necessary to produce chromophoric monovalent or trivalent lead. According to them the color of amazonite could possibly be due to three variables: lead, water and a form of ionizing radiation.[5] made comparison between lead and depth of color in amazonite samples from the Morefield mine but he did not find no correlation. [6] determine the cooperative effects of lead and structural water on color intensity of amazonite.

On Table 1 can be seen that in the investigated amazonite is not specified the presence of copper and lead. It has been noted presence of V, Fe, Zn And Mo. Therefore, we think that the pale green color might be the result from small quantities of Fe.

## Conclusion

After summarizing the data collected in this research, we can confirm that the studied mineral samples are amazonite. Investigated minerals has beautiful pale green color. Lustre is vitreous. Streak is white. Cleavage is perfect on {001} and good on {010}. Fracture is irregular/uneven. Hardness 6 - 6½, specific gravity 2.54 - 2.57 g/cm<sup>3</sup>.

Because of his beautiful pale green color and great hardness this amazonite can be used for making jewelry in form of necklaces, rings, brooches and also for making various profitable ornamental pieces. Because in the investigated amazonite is not specified the presence of copper and lead, but is determined the presence of V, Fe, Zn and Mo we think that the pale green color might be the result from small quantities of Fe. However, to accurately determine the origin of color more investigations are needed.

This paper should form the basis for further investigations which will contribute to determination the origin of the pale green color.

## Reference

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## Резиме

Минералoшки карактеристики на амазонитот од Чаниште, Република Македонија

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**Клучни зборови** минерал, амазонит, сканинг електронски микроскоп.

Во овој труд се презентирани резултатите добиени со испитување на примероци од околината на село Чаниште. Овие испитувања се направени со методот на СЕМ/ЕДС (сканинг електронска микроскопија/ енергетски дисперзивна спектроскопија). Од добиените резултати може да се заклучи дека се работи за минералот амазонит. Тој се карактеризира со убава зелена боја, стаклеста сјајност и бел огреб. Тврдината е 6 - 6½, а густината 2.54 - 2.57 g/cm<sup>3</sup>. Поради убавата светло зелена боја и големата тврдина тој може да се користи за изработка на накит во вид на ѓердани, прстени, брошеви, а исто така и за изработка

на разни украси. Бидејќи во испитуваните примероци не е одредено присуство на бакар и олово кои според некои истражувачи се главни причинители за зелената боја, сметаме дека бледо зелената боја може да биде резултат на малите количини на железо. За точно одредување на потеклото на бојата се потребни дополнителни испитувања. Затоа сметаме дека овој труд треба да биде основа на понатамошните испитувања со кои би се одредило потеклото на светло зелената боја.