CLAY MINERALS FROM ASZTAGKŐ OF GYÖNGYÖSSOLYMOS

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ABSTRACT

In the Asztagkő of Gyöngyössolymos at the boundary of the quartzite and the tuff there occurs a colloidal substance which mostly consists of halloysite, limonite and hematite. The site of the exotherm peak appearing at 900—1000°C varies according to the amount of the iron content. The greater the amount of iron the lower the temperature at which the exotherm peak appears. The shift of the exotherm peak also takes place in the case of artificial mixtures.

As the result of the volcanic action which took place in Tortonian in the Mátra Mountains andesite tuff and lava occur on the surface very extensively and in thick layers. Owing to the strong denudation the original forms became blurred particularly on those sites where the hydrothermal rock alterations also played a role. After this eruptive period, post-volcanic actions introduced by tectonic movements, or simultaneously with them started, producing hydrothermal rock alterations, quartzitic ore veins and geyser actions. In directions determined by tectonic movements fissure systems cut across the andesites and their tuffs. These fissure systems became the channels of the hydrothermal solutions. Asztagkő is situated on the south side of the Mátra Mountains about 5 km to the north of Gyöngyössolymos 550 m over sea level. The earlier data of the literature deal mainly with the quarzite of Asztagkő. Thus, J. Noszky[8,9] and Gy. Márton[5] dealt mainly with the quartzite occurrences. Szurovy, G.[13] examined these minerals of the environment of Asztagkő. B. Mauritz[4] and Gy. Vigh[15], as well as J. Noszky[9] described the geological and petrographical conditions in the southern part of the Mátra Mountains. The author[6] mentions in relation to the quarzite occurrence of Asztagkő the kaolin vein extending throughout the upper part if the mine which can at the present owing to the small amount of the opening-up not be utilised economically, although it is of first rate quality. G. Pantó[10] and A. Vidacs[14] examined in detail the hydrothermal rock alterations of the neighbouring ore mine of Gyöngyösoroszi and of its environment.

The recent opening-up rendered possible the more exact recognition of the kaolinization and hydrothermal rock alterations in general, as well as that of the extension of the quartzite from Asztagkő. The quartzite mass is situated in a tectonically strongly disturbed zone. Along the faults of

315—135° and 225—75° the rocks show a brecciated structure and a strong kaolinization and baritization may be observed. According to the opening-up quartzous parts alternate with kaolinized silicified tuff. Here also like on most sites of the mountains the kaolinization is so extensive that it cannot be decided in every case whether we are dealing with andesite, with tuff or with agglomeration. It should be remarked that kaolinization, or silicification respectively, does not always indicate the presence of some lode.

Fig. 1. Andesite tuff stained by pigment granules. 70 ×

On the action of the hydrothermal fluids different modifications of the kaolin group may be found.

The kaolinized tuff which can be mainly observed in the adit mentioned above occurs in yellowish-white frequently ochre yellow or red patches visible with the naked eye. It is porous, crumbles easily and accessory minerals cannot be detected in it. The weathering of the presumably pyrite impregnation may cause the yellowish-reddish colouration. If it is examined under the microscope pumiceous parts can be frequently detected. Sometimes twinned plagioclase feldspars may also be found.

Under the microscope the ochre coloured parts are stained by pigment granules (Fig. 1.) which are often located parallel to the glass threads of the pumice-stone, or along the fissures (Fig. 2. and 3.). The lighter or darker colouration is due to the density of these pigment granules.

According to the DTA examinations the kaolinized tuff contains kaolinite. Concerning the characteristic curve of kaolinite it may only be remarked that on the thermal curve of the ochre coloured substance the exotherm peak appears somewhat lower (Fig. 4.).

The kaolin lode extending in the upper mine is white and porous. Under the microscope fibrous radiated vermiform appendixlike kaolinitic parts may frequently be detected resembling those described by Ross and

Kerr (Fig. 5.). Its thermal curve also agrees with that of the pure kaolinized tuff (Fig. 4.), but the endotherm peak appeared at a somewhat higher temperature.
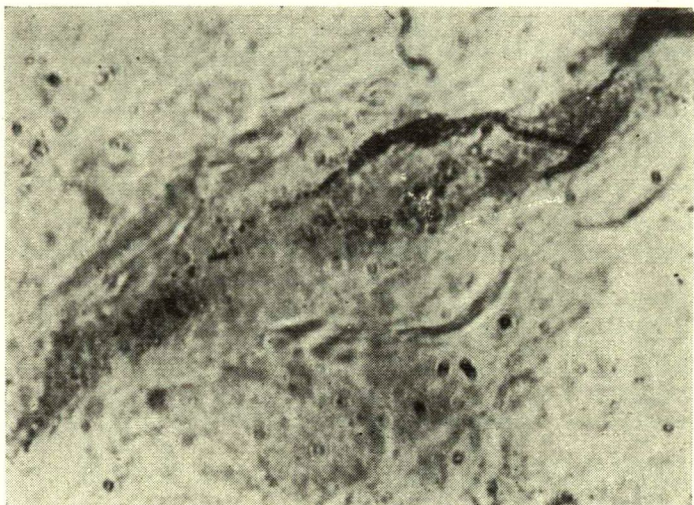

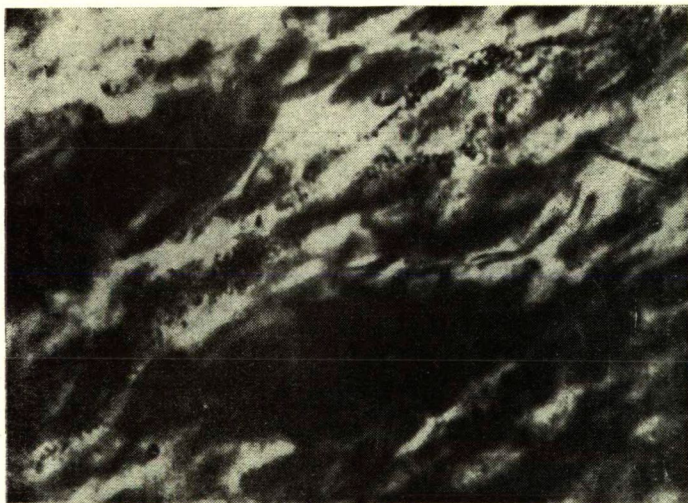*Fig. 2.* Pigment granules in kaolinized tuff along the fissures. 70 ✕

Fig. 3. Pigment granules in kaolinized tuff along the fissures. Crossed nicols. 70 ✕

An interesting modification occurs directly below the upper mine at the boundary of the quartzite and the tuff. A darker ochre coloured substance with very fine granules — almost colloidal in size — may be found in a 5—10 cm thick layer there resembling the bolus well known from dif-

ferent collections. Under the microscope under higher magnification, like in the ochre yellow coloured tuff, pigment patches may be observed. The substance did not contain any mineral fragments and under low magnification the whole substance seemed to be almost homogeneous.
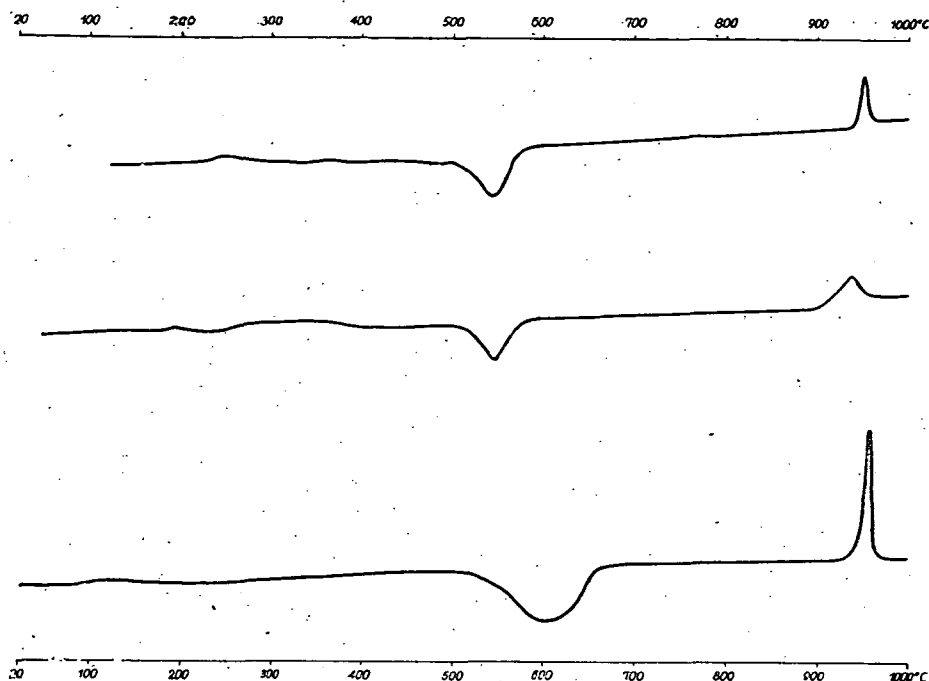

Fig. 4.

Upper: thermal curve of a kaolinized tuff
Middle: thermal curve of a kaolinized tuff impurified by limonite
Lower: thermal curve of the material of kaolin lode
Locality of the samples: Asztagkő, Gyöngyössolymos.

The substance was also chemically analysed and the following data were obtained:

SiO_2	36,50 per cent
Al_2O_3	16,95
Fe_2O_3	27,70
CaO	1,96
$Na_2O + K_2O$	0.10
P_2O_5	0,25
H_2O+	13,27
H_2O-	3,63
	100,36 per cent

If kaolinite is assumed to be the principal mineral and the feldspar and quartz molecules obtained by the analysis are subtracted, Fe_2O_3 may be present in two different forms: expressed in round figures 27 per cent of limonite, and 7,5 per cent of hematite. Considering that limonite is well

soluble in acids, to the substance pulverised to granules of 0,06 mm in size 1:3 HCl was added. The following quantity of iron recalculated to Fe_2O_3 was dissolved from the substance treated for various length of time:

After		
1 day	6,47	per cent
3 days	8,78	
5 days	10,05	
21 days	18,76	
28 days	19,67	

Thus, after three weeks the greater part of the iron present as limonite was dissolved and only that consisting of hematite remained. Hence, the substance got quite light.

This substance treated with hydrochloric acid was used for the X-ray powder diagram too. The values obtained were as follows (FeK, without filter):

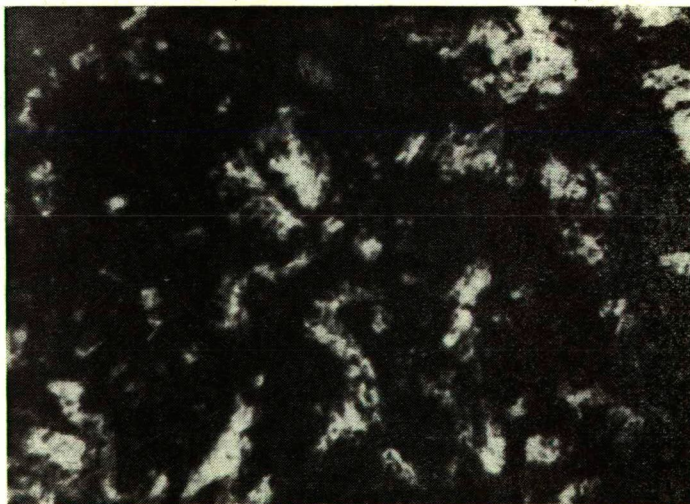| $d_{(hkl)}$ Å	
7,17	kaolin
4,450	kaolin
4,142	kaolin
3,848	kaolin
3,562	kaolin
2,990	kaolin ?
2,565	kaolin
2,470	kaolin
2,328	kaolin
2,196	kaolin
1,989	kaolin
1,836	kaolin
1,696	?
1,646	?
1,600	kaolin ?
1,550	?
1,491	kaolin

Fig. 5. Aggregates of kaolinite crystals from the material of kaolin lode. Crossed nicols. 300 ✕

Although the DTA diagram shows an endotherm peak at 100 to 200°C which would be characteristic for halloysite it could not be unequivocally demonstrated. It may be that it is present in such insignificant quantities (and its lines are as it is indistinct) that besides the strong kaolin lines they could not be detected. It could not either be exactly established where several questionable lines belonged to, probably they are due to foreign impurities.
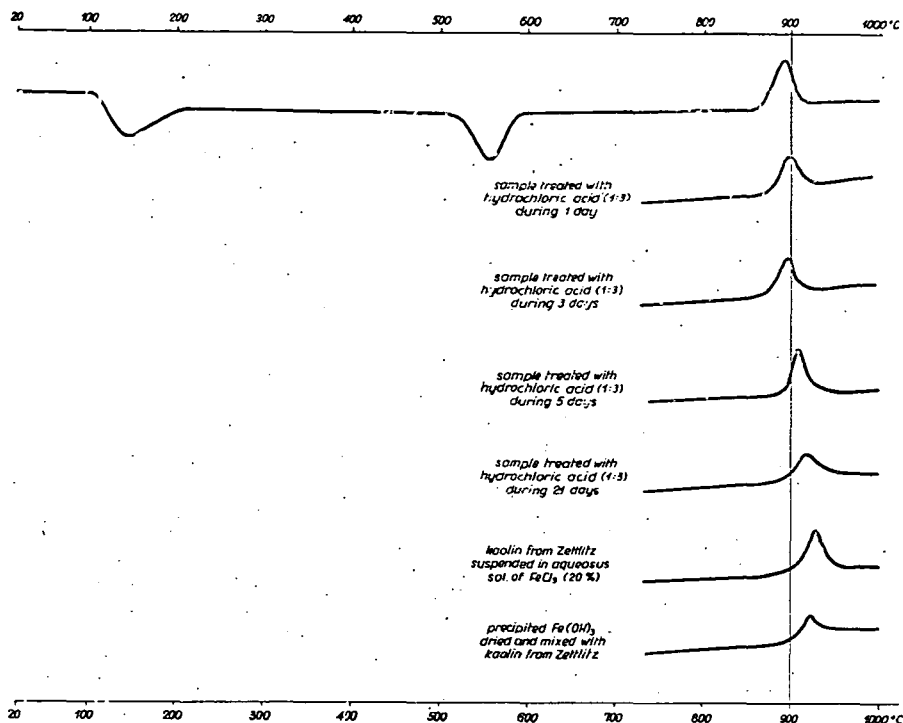

Fig. 6. The change of the exotherm peak on the thermal curves of kaolin depending upont the iron content

DTA diagrams were made from the original substance, as well as from the in which the length of the treatment with hydrochloric acid varied. The DTA curve of the original substance indicated halloysite with the difference that the site of the exotherm peak occurring at 900 to 1000°C showed a considerable shift as it appeared between 880 to 890°C. On the DTA curve the endotherm peak indicating halloysite was not confirmed by the X-ray diagram. Thus, it seems likely that the endotherm peak is due to adsorptive water, which in the case of such a large quantity of limonite impurity as shown by the chemical analysis may be easily visualised.

The site of the exotherm peak changed according to the quantity of the iron. If this quantity decreased the exotherm peak also shifted gradually towards higher temperatures. The same could be experienced if

pure, cleaned kaolin from Zettlitz was mixed with $FeCl_3$ or with pure $Fe(OH)_3$. In every case depending upon the quantity of the iron the maximum of the exotherm peak appeared at different temperatures (Fig. 6.).

· Similar phenomena were experienced earlier in the case of montmorillonites and illite. Hence, according to *R. E. Grim* and *R. A. Rowland*[2] in the case of montmorillonites the exotherm reaction following the third endotherm effect always appeared at lower temperatures if the chemical analysis showed larger amounts of iron. They state that if the iron content is minimal this reaction may rise ower 1000°C thus they observed an interval of nearly 100°C. They also note that in the case of illites the exotherm peak in the range of 900 to 1000°C is very variable.

In the clay minerals the exotherm peak in the range of 900 to 1000°C would indicate that the formation of mullite has started. According to *Sztrókay*[12] the process of mullitization and eventually the formation of corundum may be promoted and accelerated by metal oxides like Na_2O, K_2O, CaO, MgO, FeO, almost always present in the system. These foreign metal oxides may occur in varius forms. Generally, a certain amount of these metal oxides promote mullite formation, i. e. the exotherm reaction will take place at lower temperatures. Mullitization is particularly promoted by FeO. In this case an environment liable to take up oxigen is created and mullite forms readily. Considering that the quantity of the metal oxides influences mullitization the shift of the exotherm peak depending upon the iron content of the substance becomes more comprehensible.

REFERENCES

1. Grim, R. E.: Clay mineralogy, London 1953.
2. Grim, R. E. and Rowland, R. A.: Differential thermal analysis of clay minerals and other hydrous materials. Amer. Min. 29. (1942) pp. 746—761, 801—818.
3. Jasmund, K.: Die silicatischen Tonminerale. Verlag Chemie GmbH. Weinheim, 1951.
4. Mauritz, B.: A Mátra hegység eruptiv kőzetei. Math. és term. tud. közlemények. XXX. 4. Budapest. 1909.
5. Márton, Gy.: Előzetes jelentés Gyöngyössolymos Asztagkő és környékén végzett tűzálló kvarcit kutatásról. 1953.
6. Mezősi, J.: Gyöngyössolymos, Mátrafüred és Markaz környékének kőzettani térképezése. Földtani Intézet Évi Jelentése. 1952. pp. 81—83.
7. Mezősi, J.: The determination of kaolinites based on colour reactions. Acta min. petr. Tom. IX. 1956. pp. 47—53.
8. Noszky, J.: Adatok a D-i Mátra geológiájához. Földtani Intézet Évi Jelentése. 1912. pp. 147—153.
9. Noszky, J.: A Mátra-hegység geomorfológiai viszonyai. A Debreceni Tud. Társaság Honismertető Bizottság Kiadványai. III. 8—10. 1926/27.

10. Pantó, G.: Bányaföldtani felvétel Gyöngyösoroszin. Földtani Intézet Évi Jelentése. 1950. pp.

11. Ross, C. S. and Kerr, P. F.: The kaolin minerals. United States Department of the Interior. Proiessional Paper 165—E. Washington. 1931.

12. Sztrókay, K. I.: A mullit szerkezet e'méleti és gyakorlati értelmezéséről. Földtani Közlöny 81. kötet. pp. 238—249.

13. Szurovy, G.: Ásvány- és kőzettani megfigyelések a Mátra-hegység D-i részéből. Akad. Math. Term. Tud. Értesítő. 1940. pp. 701—721.

14. Vidacs, A.: A gyöngyösoroszi ércbánya hidrotermális telérei és bányászatuk. 1956. Manuscript.

15. Vigh, Gy.: A Mátra D-i aljának földtani viszonyai. Földtani Intézet Évi Jelentése. 1933—35. pp. 653—733.