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MICA FROM MEGO KATZ, LOI SHILMAN, KHYBER AGENCY, N.W.F.P.

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Chemical, X-ray, and differential thermal analysis data are presented for Mica from Mego Katz, Loi Shilman, Khyber Agency. This mica has been identified as phlogopite with subordinate amounts of calcite and quartz. Its application for the manufacture of fire – resistance board, high temperature heat insulation bricks and decorative tiles were also studied.

INTRODUCTION

A lens of mica in limestone occurs at Mego Katz, Loi Shilman, Khyber Agency, about 48 km west of Peshawar. The lens is about 165 meter in length and about 37 meter in width. The depth of the deposit is not known. The object of the present paper is to report the chemical, X-ray and thermal properties of the Mego Katz mica and its utilization.

Oxide Composition of the Mineral. Chemical composition of the mineral in weight percent is SiO_2, 34.75; Al_2O_3 13.83; FeO, 5.35; Fe_2O_3, 6.56; TiO_2, 2.07; MnO, trace; P_2O_5, trace; CaO, 0.41; MgO, 23.05; Na_2O, 1.25; K_2O, 6.40; H_2O^-, 3.45; H^2O^+, 2.52 total, 99.64.

The relationships of the ions in octahedral and tetrahedral co-ordination were calculated from the chemical analysis of the sample. Hence, the structural formula for the sample may be written as:

$$K_{1.20}\ Na_{0.36}^{1.86}\ Mg_{0.24}\ Ca_{0.06}\ Mg_{4.84}\ Fe^{2+}_{0.66}\ Ti_{0.22}^{6.00}$$

$$Fe^{3+}_{0.3}\ Si_{5.14}\ Al_{2.42}^{8.00}\ Fe^{3+}_{0.44}\ O_{20}\ OH_{2.48}\ 1.7H_2O$$

X-Ray Diffraction Studies. The X-ray diffraction data of the powder pattern of the Khyber Agency phlogopite is given in Table 1. Most of the reflection of Khyber phlogopite are comparable to those of the standard phlogopite. However the reflections at 3.02A°, I. 92A° and 1.878A° are due to calcite. Faint reflections at 4.23A° and 1.815A° show that some quartz may also be present as an impurity.

The powder pattern of di-octahedral and tri-octahedral micas can generally be differentiated. Thus for the di-octahedrals the strong 060 reflections is close to d = 1.50A° and the basal reflection at d = 5A° (004 for 2 M mica) is strong, whereas for tri-octahedral micas 060 lies between d = 1.53A° and 1.55A° and the basal reflection (002 for 1M) is weak. On this basis, Khyber mica would be classed as tri-octahedral. The monoclinic cell dimension (2M) has been calculated a = 5.23A°, b = 9.42A°, c = 20.23A° and β = 93.19A°

Differential Thermal Analysis. The D.T.A curve of the Khyber Phlogopite (Fig. 1) shows one major endotherm at 120°, medium endotherm at 210°, minor endotherms at 710° and 810°. The first two endotherms seem to be due to dehydration of the mica mineral and the last two may be due to decarbonation of carbonate minerals.

Physical Properties. The density can be estimated from chemical formula (molucular weight = 870.380) and the volume of the unit cell (995.12A° ^{3}). If the unit cell contains 2 formula units, then the density.

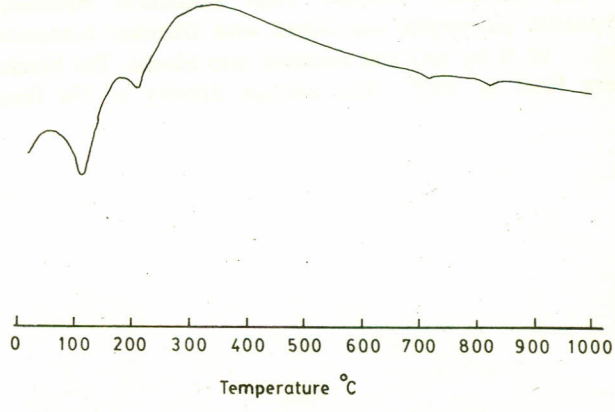

Fig. 1 DTA curve of the Khyber phlogopite

$D_x = (1.66 \times 2 \times 870.38) / 995.12 = 2.90 \text{ mg/cm}^3$

This was found to be in good accordance with tests in water. The density was observed to be of the order of 2.81 – 2.82.

Genesis. The Loi Shilman area is marked by a thick sequence of limestone, interbedded with slates. Most of the formation is phyllitic and heavily intruded by basic igneous rocks. Due to the igneous activity a high degree of metamorphism has occured and the formation has changed to phlogopite and garnetiferous schists. Thin beds of quartzite are frequently interbedded with slates.

The dike-like formation of Khyber phlogopite seems to be pegmatitic and may have formed during the igneous activity. The high M_gO content (23.05 %) of the phlogopite indicates that the magma was predominantly basic However, any reaction with the dolomitic wall – rock may also induce high magnesium in mica.

Application. The Khyber phlogopite contains about 5.97 % water. When it is heated at 750° – 800° the rock particles expand and the colour changes from greenish black to lustrous golden, like vermiculite mineral. However, the average expansion index is 7, which is much lower than vermiculite.

The expanded rock due to its low thermal conductivity, high heat resistance, elasticity and toughness can be used in the manufacture of fire-resistance boards, high temperature heat insulation bricks, as well as in decorative plasters using different binders. The following products were made in the Laboratories:

(a) Gypsum – Phlogopite Fire Resistant Board/Plasters. Expanded phlogopite, powdered to different mesh sizes (1 – 4 mm), was bonded with gypsum plaster. The fire - resistant quality of gypsum plaster is enhanced by adding 20 – 30 % phlogopite. This phlogopite – gypsum plaster besides having heat resistant and insulating qualities has also decorative qualities giving golden and lustrous finish.

(b) Ceramic – Bonded Heat Insulation Materials. Expanded phlogopite was mixed with Dherikot bentonite (30 – 50 % by wt) and moulded into blocks. The blocks were fired at 950°. The average density of the fired mass was 600 – 700 g per litre and the compressive strength varies between 250 and 350 p.s.i. These blocks can be used as high temperature insulating material in furnaces.

Table 1. X-ray powder data.

Kyber Phlogopite	
da	I
10.163	100
4.575	20
4.230	5
3.363	80
3.184	2
3.02	10
–	–
2.636	70
2.528	25
2.440	50
2.275	15
2.178	45
2.015	40
1.878	1
1.920	2
1.815	1
–	–
1.685	40
1.540	60
–	–
1.484	1
1.440	2
1.369	30
1.333	10
1.306	2
1.270	3

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