MORDENITE IN RHYOLITE AT YOSHIDA AREA, KAGOSHIMA PREFECTURE

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Abstract: A fibrous mordenite was found in cavities in a rhyolite. The mordenite was formed probably by a result of hydrothermal mineralization.

INTRODUCTION

Mordenite is found in an authigenic mineral in sediments (Hayashi and Sudo, 1957). Mordenite occurs in vesicular andesite, basalt and dolerite vesicles. Some mineralogical data of a mordenite found in a rhyolitic rock are described in this paper.

OCCURRENCE

Andesite is widely distributed in Yoshida area, Kagoshima Prefecture, and some small lenticular blocks of rhyolite are placed on the andesite. The rhyolite rock has been regarded as the product of the Pliocene intrusion. The rhyolite rock is covered by welded tuff which is distributed widely in this area. The welded tuff is regarded to be the deposits accumulated during the period of transgression ranging from the Pliocene to the Pleistocene. Pleistocene deposits of pumice flow (so-called Shirasu) were successively occurred on the welded tuff. The mordenite is found as finely fibrous or cottony material in vesicles in rhyolite. The mineral is white with a pink tint and its length is about 3 mm. The host rock is reddish rhyolite. A chemical analysis of the rhyolite shows a lower silica content than average rhyolite composition.

MINERALOGICAL DATA

The sample which was pulverized in an agate mortar was examined by means of X-ray, thermal, infrared absorption and chemical analyses.

X-ray analysis

X-ray powder pattern of the mordenite was taken employing an X-ray

diffractometer (CuK α , Ni filter). The mineral is well crystallized and gives many measureable peaks. Table 1 compares the powder data for the mordenite and a natural mordenite examined by Harris and Brindley (1954). The powder data have been indexed for the lower order reflections and the orthorhombic cell dimensions derived therefrom are given in Table 2 where they are compared with those given by Harris and Brindley. There was little difference between the diffraction pattern of the original

Table 1. X-ray powder data for mordenite
(CuK α =1.5418Å)

hkl	1			2	
	d _{obs.} (Å)	I	d _{calc.} (Å)	d _{obs.} (Å)	I
110	13.7	20	13.6	13.7	6
200	9.12	43	9.12	9.10	9
111	6.60	7	6.59	6.60	8
130	6.41	60	6.36	6.39	5
021	6.09	2	6.06	6.09	2
201	5.82	20	5.81	5.80	5
221	—	—	—	—	—
131	—	—	—	—	—
330	4.529	44	4.528	4.535	8
420	4.152	10	4.160	—	—
150	3.990	100	3.975	4.008	9
241	3.840	7	3.830	3.854	4
002	3.770	4	3.770	3.778	4
112	3.640	3	3.632	—	—
510	3.576	4	3.590	—	—
202	3.480	20	3.483	3.486	10
060	3.394	64	3.394	3.398	9
222	3.290	2	3.295	3.315	1
530	3.209	40	3.213	3.224	9
441	3.100	3	3.096	—	—
531	2.950	4	2.955	—	—
402	2.903	40	2.905	2.899	7
152	2.740	2	2.735	2.746	1
621	2.706	6	2.717	2.706	1
370	2.636	4	2.623	—	—
461	2.560	15	2.560	2.569	3
422	2.522	7	2.522	2.534	5

1. Mordenite in rhyolite.

2. Natural mordenite, examined by Harris and Brindley (1954).

Table 2. Unit cell dimensions of mordenite

	1	2
a	$18.16 \pm 0.10 \text{ \AA}$	$18.24 \pm 0.10 \text{ \AA}$
b	20.45 ± 0.10	20.36 ± 0.05
c	7.54 ± 0.05	7.54 ± 0.05

1. Data by Harris and Brindley (1954).
2. Present data.

specimen and the one heated at 950°C for one hour except the slight changes of the very faint diffraction lines. This result shows little or no change in the crystal structure after heating at 950°C .

Chemical analysis

Chemical analysis of the mordenite purified by hand picking was made by the ordinary wet method. The result is compared in Table 3 with the rhyolite host rock. The analysis of the mordenite fraction may be recalculated in conformity with the theoretical mordenite structure ($\text{Ca}, \text{Na}_2, \text{K}_2)_2 \text{Al}_4\text{Si}_{20}\text{O}_{48}14\text{H}_2\text{O}$. The analysis gives a formula ($\text{Mg}_{0.25} \text{Mn}_{0.04} \text{Ca}_{0.94} \text{Na}_{1.06} \text{K}_{0.49}$) ($\text{Al}_{4.14} \text{Fe}_{0.27}$) ($\text{Si}_{19.65} \text{Ti}_{0.04}$) $0.4813.32\text{H}_2\text{O}$, which is reasonably close to the host rock. The analyses show that the main changes are small removals of alkalis and a considerable increase of water content. Total (Si+Al) is close to the theoretical value of 24. Potassium

Table 3. Chemical analyses of rhyolite and mordenite

	1	2
SiO_2	65.68 %	66.32 %
TiO_2	0.64	0.20
Al_2O_3	15.33	11.85
Fe_2O_3 }	3.80	1.23
FeO		
MnO	0.23	0.15
MgO	0.35	0.57
CaO	3.74	2.97
Na_2O	3.70	1.84
K_2O	1.34	1.30
H_2O (+)	2.62	8.71
H_2O (-)	2.46	4.78
P_2O_5	0.02	0.01
Total	99.91 %	99.93 %

(1) Rhyolite, (2) Mordenite.

is less abundant than sodium. Iron is more abundant than normal mordenites. Harris and Brindley (1954) reported that material occurring as the hydration product of pitchstone glass has been shown to have 1.74 per cent. Fe_2O_3 . The pinkish color of the mordenite is possibly related to the content of Fe_2O_3 , 1.23%.

Differential thermal analysis

Differential thermal analysis curve which is shown in Fig. 1 was taken with an automatic thermal analyser at a heating rate of 10°C per minute for the mordenite. The differential thermal analysis curve shows low endothermic reaction due to dehydration. A broad endothermic peak between 100°C and 200°C was identical to that of previous worker (Koizumi, 1953).

Infrared absorption analysis

The infrared absorption curve of the mordenite was obtained with a Shimadzu IR-6 type infrared absorption recording spectrometer using Nujol paste method. The infrared absorption spectrum of the mordenite shown in Fig. 2 is characterized by the presence of absorption bands with peaks at 3640 , 3450 and 1640 cm^{-1} . The bands of absorption around 3450 cm^{-1} are probably due to adsorbed water as indicated by comparison with montmorillonite data of Wolff (1965). The absorption bands at 3450 cm^{-1} in the water-stretching region are spread toward higher frequencies. This phenomenon has also been described in stilbite by Harada and Tomita (1967). Some amounts of water in these zeolite minerals are considered to be structurally bound. The absorption bands around 3600 cm^{-1} may be attributed to structurally bound water. A clear asymmetrical absorption at 1640 cm^{-1} due to adsorbed water is visible.

CONCLUSION

The chemical and X-ray data combine to show that the hydrothermal product is the zeolite mordenite. The close similarity in chemical com-

Fig. 1. Differential thermal analysis curve of mordenite,

Fig. 2. Infrared absorption curve of mordenite.

position of the original rock and the resultant zeolite suggests that the nature of the zeolites formed from rock by its hydration, depends largely on the composition of the original material.

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鹿児島県吉田地域の流紋岩中のモルデン沸石

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摘 要

鹿児島県鹿児島郡吉田村に分布する流紋岩質岩中の孔隙をうめて毛状のモルデン沸石が晶出しているのを見いだした。わが国では、モルデン沸石が酸性岩質岩石中より見いだされるのは珍しいがこの沸石の化学分析値は原岩の流紋岩石のそれとよく一致しており、火成作用の末期に孔隙をうめて結晶が成長したか、その後の熱水変質によってできたものと思われる。