Hertisch, Franz (1926), Studien über den Chemismus der Granaten: *Jb. Min., Beil. Bd.* **A 55**, 60–91.
Pabst, Adolf (1931), The garnets in the glaucophane schists of California: *Am. Mineral.*, **16**, 327–333.
Schürmann, H. M. E. (1953), Beiträge zur Glaukophanfrage (2): *Jb. Min., Abh.* **85**, 303–394.

LAUMONTITE AND LEONHARDITE CEMENT IN MIOCENE SANDSTONE FROM A WELL IN SAN JOAQUIN VALLEY, CALIFORNIA

M. E. Kaley and R. F. Hanson, *California Research Corporation, La Habra, California.*

The occurrence of a zeolite cement was noted in a feldspathic sandstone at a depth of approximately 11,000 feet in the Standard Oil Company of California Well C.C.M.O. 4, No. 35, Tejon Field, 30 miles southeast of Bakersfield, California. The zeolite mineral was identified by microscopic and x-ray powder diffraction methods as laumontite and its alteration product, leonhardite.

The occurrence of zeolites in rocks of igneous origin is a matter of common knowledge but their occurrence in rocks of sedimentary origin is less well known. Zeolites, nearly always secondary minerals formed by hydration of aluminum silicates of Ca, Na, etc., are derived chiefly from lime-bearing plagioclase feldspars.

Laumontite and leonhardite were found as an important alteration product in graywackes of New Zealand by Hutton (1949) and by Coombs (1952); laumontite as a cement in Cretaceous (?) sandstones from Anchor Bay, Mendocino County, California, is reported by Gilbert (1951). Hutton states that laumonitite and leonhardite probably have a much wider distribution than supposed; that in graywackes and similar rocks which have been subjected to low grade dynamothermal metamorphism the feldspars may be completely altered to laumontite and leonhardite instead of to albite.

The chemical composition of laumontite is given by Coombs (1952, p. 812) as:

$$Ca_x(Na, K)_yAl_{2x+y}Si_{24-(2x+y)}O_{48}\cdot 16H_2O$$

where $x+y/2$ does not exceed 4
and $x+y$ is not less than 4.

On exposure to the atmosphere or gentle heating laumontite loses approximately $\frac{1}{8}$ of its water to form leonhardite. This process is readily reversible and is accompanied by changes in the refractive index, optic angle, and extinction angle.

Optical properties as reported in the literature are listed in Table 1.

TABLE 1. OPTICAL PROPERTIES OF LAUMONTITE AND LEONHARDITE ACCORDING TO SEVERAL AUTHORITIES

	Larson	Gilbert	Coombs	Shannon	McClellan	Hutton
Laumontite	$(-)2V=25°$ ca	45°± 5°	33°–37°	Med.		
	$\alpha=1.513$	1.515	1.510 to 1.514	1.505	1.505	
	$\beta=1.524$		1.518 to 1.522	1.515		
	$\gamma=1.525$	1.525	1.521 to 1.525	1.517	1.513	
	$\gamma-\alpha=.012$	.010		.012		
	$Z\wedge c=20°–30°$	10°	8°–11°	large	50°	
	$Z'\wedge c$		11°–14°			
Leonhardite	$(-)2V=$	30°–35°	26°–44°			21°
	$\alpha=1.506$	1.506	1.502 to 1.507			1.505
	$\beta=1.512$		1.512 to 1.516			1.514
	$\gamma=1.517$	1.517	1.514 to 1.518			1.515
	$\gamma-\alpha=.011$	.011				.009
	$Z\wedge c=44°$	32°–34°	8°–35°			
	$Z'\wedge c=$	39°–41°	11°–47°			

TABLE 2. ZEOLITE *X*-RAY POWDER DIFFRACTION DATA; STANDARD OIL COMPANY OF CALIFORNIA WELL C.C.M.O. 4, NO. 35

Intensity	d/n in Å	Intensity	d/n in Å
vs	9.42	vw	1.97
s	6.81	vw	1.94
w	6.20		
w	5.04	vvw	1.86?
vvw	4.73	mw	1.808
w	4.46	vvw	1.748
vs	4.16	vvw	1.657
vw	3.67	w	1.618
s	3.49	mw	1.536
vs	3.32	w	1.51
vvw (b)	3.20	vvw (b)	1.49?
m	3.02	vw (b)	1.46
w+	2.87	mw (b)	1.37
w+	2.77	vvw	1.32?
vvw	2.56	vvw	1.31?
vvw	2.52	vvw	1.296
m	2.42	vvw	1.27?
w	2.34	vvw	1.25
w	2.27	vw	1.22
m (b)	2.15	vw	1.21
vvw	2.06	vvw	1.176
		vw	1.157

s = strong, m = medium, v = very, w = weak, b = broad.

The crystals are prismatic with perfect 010 and 110 cleavages. The optic plane is 010 (Winchel, 1951).

The zeolite mineral in the sandstone core sample from the Standard Oil Company of California Well C.C.M.O. 4, No. 35, San Joaquin Valley, was isolated from the rock by hand picking under a stereoscopic microscope.

Optical properties of the mineral are as follows: crystals are prismatic with two good cleavages; $(-)2V=$ moderate; $\alpha=1.508\pm.002$, $\gamma=1.516\pm.002$; $\gamma-\alpha=.008$; Ext. to $c=40°-45°$.

X-ray diffraction data were obtained with a G. E. powder camera of 7.1744 cm. radius. The powder sample, mounted with Duco cement on a rotating glass filament, was exposed to Cu K_α radiations for 6 hours. Intensities of the lines were estimated visually.

These *x*-ray data agree closely with the data reported by Coombs (1952) for laumontite and leonhardite.

References

Coombs, D. S. (1952), Cell size, optical properties and chemical composition of laumontite and leonhardite. With a note on regional occurrences in New Zealand: *Am. Mineral.*, **37,** 812–830.

Gilbert, C. M. (1951), Laumontite from Anchor Bay, Mendocino County, California: *Geol. Soc. Am. Bull.*, **62,** 1517.

Hutton, C. O. (1949), Occurrence of leonhardite: *Geol. Soc. Am. Bull.*, **60,** 1939–1940.

Larson, E. S., and Berman, H. (1934), The microscopic determination of nonopaque minerals: *U. S. Geol. Survey Bull.* **849.**

McClellan, H. W. (1926), Laumontite from Southern Oregon: *Am. Mineral.*, **11,** 287.

Shannon, E. V. (1921), Massive laumontite from Montana: *Am. Mineral.*, **6,** 6–7.

UNIT CELL DIMENSIONS OF URANINITE

Eleanor R. Berman, *Department of Mineralogy, Harvard University Cambridge, Massachusetts.*

It appears that, in general, samples of pitchblende from hydrothermal veins have a smaller cell size than uraninites from pegmatites (Table 1). The values of a_0 of uraninites from different sources reported in the literature (1) support this observation.

The relatively small cell size of pitchblende is due to the following factors: (*a*) Relatively high oxidation, due to the fine-grain or fine fibrous permeable nature of the material and the resulting large surface area. The oxidation involves the conversion of U^{IV} to U^{VI} with valence compensation effected by the entrance of oxygen into the vacant 8-fold