Editor's note: 84 I.D. 309

UNITED STATES

v.

UNION CARBIDE CORPORATION

84 I.D. 309

IBLA 75-29 Decided June 24, 1977

Appeal from a decision of Chief Administrative Law Judge L. K. Luoma holding that the mineral deposit embraced within the limits of the EZ No. 225 placer mining claim and the J.C. 75 and J.C. 76 lode mining claims is locatable under the Mining Act of 1872, as amended. A-7345.

Affirmed as modified.

1. Mineral Leasing Act: Applicability--Sodium Leases and Permits: Generally

   A silicate will be considered to be a sodium silicate and subject to disposal under the Mineral Leasing Act either where the sodium within the deposit is commercially valuable or where the sodium is essential to the existence of the mineral. Robert E. Simpson, A-4167 (June 22, 1970), overruled to extent inconsistent. Wolf Joint Ventures, 75 I.D. 137 (1968), distinguished.

APPEARANCES: Fritz L. Goreham, Esq., Office of the Field Solicitor, United States Department of the Interior, Phoenix, Arizona, for the appellant; Howard Twitty, Esq., of Twitty, Sievwright & Mills, Phoenix, Arizona, for the appellee.

DECISION BY ADMINISTRATIVE JUDGE HENRIQUES

The United States has appealed from a decision of Chief Administrative Law Judge L. K. Luoma, United States v. Union Carbide Corporation, Arizona 7345, dated June 14, 1974, holding a deposit of zeolite embraced within the limits of the EZ No. 225 placer mining claim and the J.C. 75 and J.C. 76 lode mining claims locatable under the Mining Act of 1872, as amended, 30 U.S.C. § 22 et seq. (1970).

The sole issue on appeal is whether the deposit of zeolite-bearing ore found within the claim is locatable under the general mining laws, 30 U.S.C. § 22 et seq. (1970), as Judge Luoma found, or is subject to leasing under the provisions of the Mineral Leasing Act of 1920, as amended, 30 U.S.C. § 181 et seq. (1970), as the Geological Survey contends. We find ourselves in substantial agreement with Judge Luoma and hereby adopt his decision with certain modifications noted below. A copy of his decision is appended hereto.

Our major difficulty with the Judge's decision is his treatment of the Bureau of Land Management decision in Robert E. Simpson,

A-4167, June 22, 1970. In Simpson, the Office of Appeals and Hearings, BLM, vacated a decision of the Arizona Land Office rejecting Simpson's sodium prospecting permit application for zeolite minerals in certain lands. The Land Office had rejected the application because the lands requested were embraced within various mining claims located for zeolite. The Office of Appeals and Hearings, BLM, recognizing that the rejection was implicitly premised on the locatability of the zeolite, examined this question on appeal.

Starting from the premise that "silicates of sodium are subject to disposition only in the form and manner provided in the Mineral Leasing Act and are not subject to location under the mining laws," Simpson drew an analogy between zeolite and dawsonite which had been held, in Wolf Joint Ventures, 75 I.D. 137 (1968), to be subject to mineral leasing. Thus, it concluded that "deposits of sodium silicates classed as sodium zeolites" were not subject to location.

Judge Luoma held that the zeolites found within the claims, i.e., chabazite and erionite, were calcium sodium aluminosilicates, not sodium zeolites, and that the deposit did not contain a significant presence of sodium. Therefore, he held the deposit locatable under the general mining laws.

We think this case points very clearly to the peril of using terminological categorization as a facet of adjudication. The appellantseems to be directing its effort to naming the mineral substances as sodium zeolite; the appellee seems to be devoted to calling the substance a calcium sodium aluminosilicate. The mineral deposit, however, remains structurally the same no matter how it is designated. The ultimate question is whether this mineral on the claims in issue is a type of deposit containing sodium that Congress intended should be removed from the workings of the general mining laws, and made subject to disposition only under the mineral leasing statutes.

[1] It should first be noted that all substances that contain traces of sodium or other leasable minerals are not necessarily subject to the Mineral Leasing Act of 1920. Thus, in Burnham Chemical Co. v. United States Borax Co., 54 I.D. 183, 189 (1933), the Department clearly considered the mineral "ulexite" to be locatable as a calcium borate. Ulexite's chemical formula shows the presence of sodium, NaCaB[5]O[9]-8H[2]O. 1/

1/ One issue in Burnham Chemical Co. v. United States Borax Co., 54 I.D. 183 (1933) was whether under sec. 23 of the Mineral Leasing Act of 1920, the sodium borate discovered within the limits of the claims was "dissolved in and soluble in water, and accumulated by concentration." The decision found that the deposits were "not within the provisions of Sec. 23 of the Leasing Act at the time such deposits were found." Id. at 189. Subsequent thereto, in United States v. United States Borax Co., 58 I.D. 426 (1943), the Department reversed Burnham Chemical Co., supra, finding that the

The relevant statute speaks of "chlorides, sulphates, carbonates, borates, silicates or nitrates of sodium * * *." 30 U.S.C. § 261 (1970). For the purposes of this appeal we are concerned with the meaning of the term "silicates * * * of sodium" as used in the Act. The term "silicate minerals" is defined as "minerals with crystal structure containing SiO[4] tetrahedron arranged as (1) isolated units, (2) single or double chains, (3) sheets, or (4) 3-dimensional networks." Paul W. Thrush, ed., A Dictionary of Mining, Mineral and Related Terms at 1011 (1968). Zeolites are a class of hydrated silicates of aluminum and either calcium or sodium or both. Id. at 1252. Zeolites are clearly silicates. But the question is whether the casual or fortuitous presence of sodium within the molecular structure causes the zeolites in the instant case to be classified as "silicates of sodium." We think it does not.

We believe that a zeolite could properly be classified as a silicate of sodium, as contemplated by the Mineral Leasing Act, supra, if either of two contingencies occur. First, the sodium must be present in sufficient quantity so as to be commercially

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fn. 1 (continued)
sodium borate was accumulated by concentration and thus leasable. The question then was wether the lands were known to be valuable for sodium borate on September 2, 1927, the date of the discovery of the deposit of colemanite and ulexite. Thus, the decision in United States v. United States Borax Co. did not reverse the implicit finding that ulexite was locatable.

valuable. An analogy can be drawn with the situation that may occur with granite deposits. Theoretically, an uncommon variety of granite would be locatable under the Building Stone Act of August 4, 1892, 27 Stat. 348, 30 U.S.C. § 161 (1970). Various amounts of potassium naturally occur within granite deposits. Potash, loosely defined as a carbonate of potassium, is subject to the Mineral Leasing Act of February 7, 1927, 30 U.S.C. § 281 et seq. (1970). The Geological Survey has taken the position that if an uncommon variety deposit of granite contains potash in sufficient quantity to be commercially recoverable, that deposit is disposable only under the provisions of the Mineral Leasing Act. (See e.g., Tr. 101.) The logical and necessary corollary to this position is that if a deposit of such granite contains certain amounts of potash but at too low a level to permit economic recovery, that deposit is subject to location pursuant to the Building Stone Act, supra. This, in our opinion, is one proper criterion by which to determine that a deposit is leasable under the Mineral Leasing Act as amended. Both sides admit that the sodium present in the deposits in the instant case is not commercially valuable. 2/

2/ We think that the legislative history of the Potassium Act of 1927, Act of February 7, 1927, 44 Stat. 1057, 30 U.S.C. § 282 et seq. (1970), supports appellee's assertions that leucite and alunite were seen as within the ambit of that Act because of their potential value as a source of potash and not simply because the minerals contained some potassium. See e.g., Hearings before the House Committee on the Public Lands on H.R. 9029, 68th Cong., 2d Sess., 31-32, 38-39 (1925).

Secondly, the molecular structure of the mineral must be ascertained in order to determine whether the mineral is locatable under the general mining laws, or is disposable only by lease under the Mineral Leasing Acts. If the presence of sodium or any other material listed in the Mineral Leasing Acts is essential to the existence of the mineral, that mineral is leasable and not locatable. Thus, as the decision in Wolf Joint Ventures, supra, found, dawsonite, while admittedly a double salt with aluminum present, requires sodium carbonate for its molecular structure. Regardless of whether the sodium was commercially recoverable, dawsonite would be subject to the provisions of the Mineral Leasing Act. The structure of zeolite on the other hand has no molecular requirement for sodium, but merely for a cation. The molecular structure of zeolite does not vary essentially, dependent upon which cation is present. It is structurally immaterial whether the cation be calcium, sodium, potassium, or magnesium. Therefore, it cannot be said that the presence of sodium is essential to the existence of a zeolite deposit. The decision in Wolf Joint Ventures, supra, does not impel a contrary result.

We note that the decision of Judge Luoma found, pursuant to the test established in Simpson, that the deposit did not possess a significant presence of sodium. In a very real sense we are attempting to formulate a test which might determine this question.

We do not believe, as the Government contends, that the fact that sodium has a higher unit cell occurrence than calcium or magnesium has any intrinsic bearing on whether the presence of sodium is significant. Rather, we believe that the two-fold test we have outlined deals with this question more concretely than the analysis undertaken in Simpson, supra.

Inasmuch as the zeolite deposit at issue meets neither of these tests, it must be held to be locatable under the general mining laws. Furthermore, we believe that, analyzed in the light of this decision, the decision in Robert E. Simpson, supra, cannot be maintained, and it is hereby overruled to the extent it is inconsistent with the views expressed herein.

Judge Ritvo, in dissent hereto, argues that: "the question should be whether the sodium is essential to the existence of the zeolite deposit, not whether there can be other zeolite deposits with another cation." Infra at .

He then states: "while it [sodium] is there it is essential to the stability of the zeolite."

In our opinion, Judge Ritvo mistakes the concept of "present" with the concept of "essential." The fact that something is present does not make it essential. The evidence clearly points out

that the deposit of zeolite is chiefly a calcium-type, rather than a sodium. The sodium cation is present in the mineral, but it is not essential to its structure. In the instant case, the majority of the cations are provided by calcium.

The dissent's discussion of the failure to join George Hunker, who in September 1972 filed a prospecting permit application covering the lands embraced by the mining claims herein, confuses two disparate concepts: the existence of an interest that would be sufficient to support intervention in an appeal by a party and the existence of an interest that is of such a nature as to be legally termed "indispensable" to a resolution of the case.

In the instant case it is important to note that the party who is argued to be "indispensable" would not be a party defendant, but rather would be a party plaintiff. Surely the respondent herein cannot be required to join a party inimical to its interests, particularly where, as here, the appellant and not the respondent was the moving force behind the contest proceeding.

Moreover, even should the Government prevail on the merits of a case such as this, Hunker would not necessarily receive any benefits. At best, all that Hunker would be possessed of would be a preference right of priority to be considered when and if the Department decided

that issuance of sodium prospecting permits for the land in issue was in the Government's interest. As Judge Ritvo noted in a previous case involving a phosphate prospecting permit application, "* * * the filing of a phosphate prospecting permit application creates no vested rights in the applicant * * *." William F. Martin, 24 IBLA 271 (1976).

The applicable regulation, 43 CFR 3510.0-3, provides that "the Secretary is authorized to issue permits to prospect unclaimed and undeveloped land areas subject to the provisions of the Mineral Leasing Act, as amended * * *." The Department has consistently held that "* * * prospecting permits are to be issued only where the existence or workability of the phosphate bed underlying the land has not [yet] been determined." William F. Martin, supra; Atlas Corp., 74 I.D. 76 (1967). There seems little question that regardless of whether the deposit of zeolites is deemed locatable or leasable its workability has been demonstrated and thus, if leasable, the lands could only be leased by competitive bidding.

We stress that our decision in this case relates only to the claims in issue where the zeolites have not been shown to have a significant amount of sodium. Zeolites having a different composition from those at issue here are not passed upon.

Accordingly, pursuant to the authority delegated to the Board of Land Appeals by the Secretary of the Interior, 43 CFR 4.1, the decision appealed from is affirmed as modified, and the contest complaint is dismissed.

Douglas E. Henriques
Administrative Judge

I concur:

Frederick Fishman
Administrative Judge

DECISION

UNITED STATES OF AMERICA, Contestant	:	Arizona 7345
	:	
v.	:	Involving the EZ No. 25 placer mining Claim and the J.C. 75 and 76 lode claims situated in Sec. 13, T. 11 S., R. 28 E. GSR Mer., Graham County, AZ
UNION CARBIDE CORPORATION, Contestee	:	

Complaint Dismissed

The Bureau of Land Management, United States Department of the Interior, filed a complaint against the above-named placer mining claim on November 7, 1972. The complaint charged:

> The EZ No. 225 placer mining claim is invalid because the minerals sought to be located are not locatable under the general mining law.

Contestee field a timely answer denying the charge.

A prehearing conference was held on January 30, 1973, at Phoenix, Arizona. Contestant was represented by Fritz L. Goreham, Esq., Office of the Solicitor, Department of the Interior, Phoenix, Arizona. Contestee was represented by Howard A. Twitty, Esq., Twitty, Sievwright & Mills, Phoenix, Arizona.

By agreement of the parties, the complaint was amended to include the lode claims, J.C. 75 and J.C. 76. Mr. Twitty stated that the lode claims embraced the same ground as the placer location and that the only reason the lode locations were made was to prevent others from top locating over the placer. The parties agreed that the mineral deposit [if locatable] was properly located as a placer and that no lode versus placer issue would be raised. The parties also agreed:

1. That neither party would challenge the other party's manner of cutting samples, where they came from and handling of the analyses.

2. That prior to hearing they would exchange papers showing each party's analysis of the mineral or minerals involved.

3. That prior to hearing they would make every effort to agree on the chemical compound or formula of the mineral or minerals involved and reduce it to writing which could be received in evidence by stipulation.

4. That prior to hearing they would make every effort to reach agreement on the specific issue or issues involved.

5. That there was no issue on the prudent-man rule of discovery and marketability.

The hearing was held on July 17, 1973, in Denver, Colorado. Contestant was represented by Mr. Gorham. Mr. Twitty and Patrick J. Morgan, Esq., of the Union Carbide Corporation, New York, New York, represented Contestee.

The basic issue herein is whether the deposit of zeolite-bearing ore found on the EZ No. 225 claim is locatable under the general mining laws, 30 U.S.C. § 22 et seq. (1970), or subject to leasing under the provisions of the Mineral Leasing Act of February 25, 1920, as amended, 30 U.S.C. § 181 et seq. (1970).

The EZ No. 225 claim, covering lands in Graham County near Bowie, Arizona, was located for zeolite on April 15, 1961, by T. H. Eyde, as agent for Union Carbide Corporation (Ex. 6). As a protective measure, the lands embraced by the EZ No. 225 claim were also located as two lode claims, the J.C. 75 and J.C. 76, on September 14, 1972 (Ex. 7 and 8).

General Background of Zeolites

Zeolites belong to a group of naturally occurring minerals called framework silicates. There are several groups of framework silicates: the feldspars, the feldspathoids and the zeolites. Zeolites were first recognized as a new group of minerals by a Swedish minerologist in 1756. There are more than 40 naturally occurring zeolites. All the zeolites are crystalline hydrated aluminosilicates of alkali (e.g., sodium and potassium) and alkaline earth (e.g., calcium and magnesium) elements (Ex. G, p. 1; Ex. 5, p. 8, Tr. 19-20). The two principal zeolites found in the ore deposit on the EZ No. 225 claim are chabazite and erionite (Tr. 17; Ex. 5, p. 24).

Zeolites have three components: a crystalline aluminosilicate framework structure, cations and water molecules (Tr. 30). The framework structure is based on an infinitely extending three-dimensional network of A10[4] and SiO[4] tetrahedra linked to each other by the sharing of all the oxygens (Ex. 5, p. 3). The structure encloses interconnected cavities occupied by the cations and water molecules (Ex. G, p. 1).

The tetrahedra of four oxygen ions surrounding a silicon or aluminum ion act as the building blocks of the zeolite framework. A silicon ion has four positive charges which neutralize one of the two negative charges on each oxygen. The remaining negative charge on each oxygen combines with another silicon or aluminum ion. The aluminum ion has only three positive charges. (Ex. 5, p. 5). The deficiency must be made up by an additional positive charge of alkali metals, such as sodium or potassium with one positive charge (M+) for each atom, or alkaline earths, such as calcium or magnesium with two positive charges (M++) for each atom (Ex. 5, p. 6). Such positive charges, known as cations, in most cases may be completely interchanged for other cations without destroying the crystalline framework structure. Such an interchange of cations is called cation exchange (Ex. G, p. 6).

Water molecules, along with the exchangeable cations, occupy channels and interconnected voids within the crystalline framework structure of the zeolites (Ex. 5, p. 11). The water may be reversibly removed without significant structural distortion (Ex. G, p. 7; Tr. 34, 132). The dehydration of zeolites is necessary to free the cavities and channels of the zeolites for their commercial use as molecular sieves and as adsorbents (Ex. G, p. 8; Ex. 5, p. 1-4).

Zeolites exhibit molecular sieve properties based on the size of the apertures that connect the voids (Ex. G, p. 8). Zeolites form microporous molecular sieves whose apertures or pores are less than 10 A in diameter 1/ (Ex. 5, p. 1).

The term molecular sieve may refer to microporous solids which can separate molecules based on differences in size and shape. The molecular sieve action can be total; certain large molecules may be totally prevented while diffusion of smaller molecules may occur, or there may be a partial sieve action where different size molecules may diffuse or penetrate the solid at varying rates under various conditions (Ex. 5, p. 3).

Such properties make zeolites very useful in the removal of water and substances such as sulfur dioxide and hydrogen sulfide from gas streams (Ex. 5, p. 21) and in selective adsorption of other materials (Tr. 108).

Applicable Law

The general mining laws, 30 U.S.C. § 22 *et seq.* (1970), provided for the location of valuable mineral deposits on lands belonging to the

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1/ 1 A is one angstrom. An angstrom is a unit of linear measurement. One inch equals 254,000,000 A (Ex. 5, p.1).

United States. However, the Mineral Leasing Act of February 25, 1920, as amended, 30 U.S.C. § 181 et seq. (1970), removed deposits of certain listed minerals from acquisition under the general mining laws and made them subject only to lease. Sodium was one of those minerals.

The provisions of the Mineral Leasing Act applicable to deposits of sodium are as follows:

30 U.S.C. § 181 (1970) reads in pertinent part:

> Deposits of * * * sodium * * * shall be subject to disposition in the form and manner provided by this chapter to citizens of the United States, or associations of such citizens, or to any corporation organized under the laws of the United States, or of any State or Territory thereof, * * *

30 U.S.C. § 193 (1970) provides in pertinent part:

> The deposits of * * * sodium * * * herein referred to, in lands valuable for such minerals, * * * shall be subject to disposition only in the form and manner provided in this chapter, except as to valid claims existent on February 25, 1920, and thereafter maintained in compliance with the laws under which initiated, which claims may be perfected under such laws, including discovery.

30 U.S.C. § 261 (1970) provides in pertinent part:

> The Secretary of the Interior is hereby authorized, under such rules and regulations as he may prescribe, to grant to any qualified applicant a prospecting permit which shall give the exclusive right to prospect for chlorides, sulphates, carbonates, borates, silicates, or nitrates of sodium, in lands belonging to the United States for a period of not exceeding two years: * * *

30 U.S.C. § 262 (1970) provides in pertinent part:

> Upon showing to the satisfaction of the Secretary of the Interior that valuable deposits of one of the substances enumerated in section 261 of this title have been discovered by the permittee within the area covered by his permit and that such land is chiefly valuable therefor,

> the permittee shall be entitled to a lease for any or all of the land embraced in the prospecting permit * * *.

The law relating to the question of whether a body of ore may be considered a deposit of sodium within the meaning of the Mineral Leasing Act is limited to a few decisions of the Department of the Interior. Such a question arose in Wolf Joint Venture et al., 75 I.D. 137 (1968). Therein, certain sodium preference right lease applicants were afforded the opportunity to request a hearing at which evidence was to be presented about certain enumerated questions relating to the nature of the occurrence of the minerals in certain deposits, the extent of such deposits and the feasibility of the development of the various minerals in the deposits. Id. at 139-140. The principal mineral of question in Wolf Joint Ventures was dawsonite, which is a double salt -- a sodium aluminum carbonate. About the locatability or leaseability of dawsonite, the Solicitor stated:

> Notwitstanding the presence of aluminum as a constituent element of the mineral, dawsonite is among the sodium substances enumerated in section 23 of the Act. As such, dawsonite, as well as all of the other enumerated substances of sodium, is subject to disposition only under the provisions of the Mineral Leasing Act. (Footnote cited, E.g. analcite (NaAlSi[2]O[6].H[2]O)) United States v. U.S. Borax Co., 58 I.D. 426, 432 (1943).

In Robert E. Simpson, A-4167 (June 22, 1970), the Office of Appeals and Hearings considered an appeal from a decision of the Arizona Land Office which rejected Simpson's sodium prospecting permit application for zeolite minerals in certain lands in sections 18, 19, 20, 28, 30 and 33, T. 11 S., R. 29 E., G.S.R.M., Graham County, Arizona, because the applied for lands were already appropriated under the general mining law. The Land Office decision was reversed and the Office of Appeals and Hearings stated:

> * * * we have concluded that the sodium zeolites are silicates of sodium subject to disposition only under the Mineral Leasing Act of 1920, as amended, and are not subject to location and acquisition under the mining laws of the United States.
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> * * * * * * *
>
> * * we conclude that deposits of sodium silicates classed as sodium zeolites are subject to disposition

> only under the sodium provisions of the Mineral Leasing Act of 1920, and that such deposits are not subject to location and disposition under the mining laws of the United States. It is our opinion that with respect to a particular zeolite, the cation of the framework must be sodium or contain a significant presence of sodium in order for the zeolite to be described as a sodium zeolite or a sodium silicate compound.
>
> * * * * * * *
>
> In our opinion, both herschelite, which has a nearly pure sodium cation (91 percent), and the intermediate chabazite, which contains a significant presence of sodium in the cation charge, would be subject to the sodium provisions of the Mineral Leasing Act. So long as an occurrence of a particular zeolite may be properly identified, in the mineralogical sense, as an intermediate sodium-calcium zeolite, it would be a silicate of sodium enumerated in section 23 of the Mineral Leasing Act.

The Conservation Division, Geological Survey, by memorandum dated March 10, 1971, concurred with the technical statements and findings in Simpson and the Solicitor expressly approved of the conclusions therein. Disposition of Sodium Zeolite Under the Mineral Leasing Act of 1920, M-36823, May 7, 1971.

In an early Departmental decision, Burnham Chemical Co. v. U.S. Borax Co. and Western Borax Co., 54 I.D. 183 (1933), the Assistant Secretary dismissed as untenable an argument that kernite was not a leasable mineral because the commercial products made from kernite, namely borax and boric acid, were valuable for their boron content and not for the sodium therein. The Assistant Secretary stated:

> The act [Mineral Leasing Act] specifies among the salts named "sodium borate," and relates to the deposit found in the ground, and it is immaterial what constituents thereof are the most useful after it has been made into a commercial commodity. If that argument were valid it would, of course, follow that no sodium borate from which borax is made would be within the purview of the Leasing Act, either as it originally stood or as amended. Id. at 186.

Evidence

Contestant's analyses of its samples from the EZ No. 225 placer claim are contained in a report (Ex. G) prepared by Dr. Richard A.

Sheppard. 2/ A comparable report (Ex. 5) on the samples taken by Union Carbide Corporation was compiled by Dr. Donald W. Breck. 3/ Dr. Sheppard's report consists of three parts: a general statement about zeolites outlining their properties, structure, chemistry and occurrence; a general statement about the two principal zeolites on the claim, chabazite and erionite; and the mineralogy and chemistry of the ore and ore minerals from the claim (Tr. 16-17). Dr. Sheppard was not involved in the sampling nor in the testing of the samples. He merely assembled the raw data and prepared the report (Tr. 17).

Dr. Sheppard reported that the deposit on the claim consisted chiefly of zeolites. By X-ray diffraction the percentages were determined to be about 70 to 80% chabazite, 10 to 20% erionite, 5% clinoptilolite and about 5% other materials (Tr. 18). He believed that zeolites could be divided on the basis of their predominant cations. He considered a sodium zeolite to be one in which the sodium cation was predominant. Based on the analyses, he felt sodium was the predominant cation in the ore from the EZ No. 225 claim and that the zeolites should be considered sodium zeolites, which in turn generally could be considered sodium silicates (Tr. 21, 26).

2/ Dr. Sheppard is a geologist for the Geological Division of the United States Geological Survey in Denver, Colorado. He was graduated from Franklin & Marshall College in 1956 with a B.S. in geology. Four years later he received a Ph.D. in geology from Johns Hopkins University and since that time has been employed by the Geological Survey. From December 1962 until the present he has been the project chief for the zeolite project in southeastern California. He has authored or co-authored numerous publications dealing with zeolites (Ex. A).

3/ Dr. Breck is currently Senior Research Fellow for the Union Carbide Corporation in Tarrytown, New York. He received a B.S. and a M.S. in chemistry in 1942 and 1948, respectively, from the University of New Hampshire. He has been employed by Union Carbide Corporation since graduating from Massachusetts Institute of Technology in 1951 with a Ph.D. in inorganic chemistry. His entire tenure with Union Carbide has been spent working with zeolites. He has research experience in inorganic fluorine chemistry, inorganic silicate chemistry, mineralogy and physical chemistry. He has authored a book on zeolites entitled Zeolite Molecular Sieves: Structure, Chemistry and Use, Wiley, New York, 1973. He has also authored or co-authored an extensive number of publications dealing with the physical properties of zeolites. He has received over 20 patents for synthetic zeolites and processes involving zeolites. (Ex. 1).

Dr. Sheppard stated that Table 6 (Ex. G, p. 35) showed that sodium made made up about 55% of the cations for chabazite (Tr. 22). The figures in Table 6 represent atoms per unit cell calculated on the basis of 72 oxygen atoms. Chabazite was separated from the bulk ore and the separation was considered to be about 99% pure. The erionite separation was only about 55% to 80% pure (Tr. 22). The following testimony was elicited from Dr. Sheppard concerning the calculations for Table 6:

> Q. When you calculated the atom weights for this Table 6, you were assuming these samples were pure samples, were you not?
>
> A. I treated them as if they were monomineralic, as if they consisted of only one mineral.
>
> Q. They were pure?
>
> A. Right.
>
> Q. Now, on your Table 6, if, by ion exchange the calcium in the chabazite was replaced with, I mean the sodium in the chabazite in your Sample 1 was replaced with calcium, how many ions of, or atoms of calcium would be required?
>
> A. Say half.
>
> Q. Half of 3.61?
>
> A. Right.

(Tr. 47-48)

He explained that while sodium makes up about 55% of the sum of the magnesium, calcium, sodium and potassium cations (Tr. 23), such percentage represents the exchangeable cations by atoms, not by weight (Tr. 57).

A significant difference in the reports was pointed out by Dr. Sheppard in comparing his Table 3 (Ex. G, p. 25) with Dr. Breck's Tables 7 and 8 (Ex. 5, p. 24) (Tr. 26-27). The tables express the weight percentage of zeolite in the bulk ore. Table 3 and Table 8 show the results of X-ray powder diffraction analyses. Contestant's analysis shows the three sample average to be 75% chabazite, 15% erionite, 5% clinoptilolite, and an average total of 95% zeolites. Union Carbide's three sample average is about 60% chabazite, about 28% erionite, no significant amount of clinoptilolite, and an average total of 87.3% zeolites. The other 12.7% is apparently gangue material (Tr. 109). Table 7 (Ex. 5, p. 24) represents an analysis of the bulk ore samples

by oxygen adsorption. No comparable test was performed by Contestant, nor was Dr. Sheppard familiar with the oxygen adsorption test (Tr. 42-43).

The oxygen adsorption test showed the average percentage of zeolites in the ore to be the same as that shown by Contestee's X-ray diffraction analysis, 87.3%. Clinoptilolite did not show up because the pore size of clinoptilolite following dehydration is too small to adsorb oxygen (Tr. 110). According to Dr. Breck, clinoptilolite is a very minor component of the deposit (Tr. 113).

Dr. Sheppard indicated that the fact that Contestee's analyses showed an average of about 60% chabazite, while Contestant's average was 75% chabazite, could be significant in that Contestant's analyses showed chabazite to contain more sodium than does erionite (Tr. 28-29).

In reference to Table 1 (Ex. G, p. 22) which contains the figures for the weight percentage chemical analysis of ore from the claim, Dr. Sheppard stated that the sum of the sodium and potassium oxides and the sum of the calcium and magnesium oxides were just about equal, being about four percent (Tr. 41). However, in two of the three samples the weight percentage of the alkaline earth oxides did exceed the weight percentage of alkali oxides (Tr. 42). In fact the table discloses that for each sample the weight percent of CaO is greater than that of Na[2]O.

While chabazite was successfully separated from the ore in the laboratory, Dr. Sheppard knew of no commercial operation by which chabazite and erionite are being or could be separated (Tr. 53). Dr. Russell G. Wayland 4/ disagreed with Dr. Sheppard, he believed there were existent processes by which chabazite could be commercially separated (Tr. 93).

4/ Dr. Wayland is the Chief, Conservation Division, United States Geological Survey. Dr. Wayland received a B.S. in mining engineering in 1934 from the University of Washington. In 1936 he was graduated from the University of Minnesota with a M.S. in economic geology. The following year he received an A.M. from Harvard University in economic geology. He then returned to the University of Minnesota and was graduated in 1939 with a Ph.D. in geology. He is a member of a number of professional geological organizations and is a certified professional geologist. He has published numerous articles and reports on a wide range of geological topics (Ex. C).

When asked to define a sodium deposit, Dr. Sheppard responded:

> THE WITNESS: Sodium, being a metal as far as I know, sodium itself doesn't occur in nature, so there are no deposits of sodium. The sodium is a very reactive element and it combines with other things like chabazites and sulphites and enters into the silicates and so forth, but if you would say a deposit of sodium mineral, I mean sodium itself doesn't occur as sodium in nature.

(Tr. 58)

And on whether the deposit on the claim herein could be characterized as a sodium deposit:

> THE WITNESS: Again, it is a deposit of a sodium bearing Zeolite.
>
> JUDGE LUOMA: Do you have expertise or knowledge of commercial uses of sodium?
>
> THE WITNESS: No, I don't.
>
> JUDGE LUOMA: You don't know then whether a sodium as you found it to be present in the Zeolite would be in and of itself commercially useable?
>
> THE WITNESS: I don't know that.

(Tr. 59)

Dr. Russell G. Wayland, Chief, Conservation Division, United States Geological Survey (see above), concurred in the conclusions reached by Dr. Sheppard in his report (Tr. 63). Dr. Wayland felt the deposit was a sodium silicate deposit within the meaning of the Mineral Leasing Act and, therefore, leaseable. When asked whether sodium was a dominant or essential cation in the deposit, he stated:

> A. Whether it is dominant is not a controlling point, that it is essential is a controlling point and it is an essential constituent. Without it, these would not be leaseable and without it these particular deposits would not be Zeolite, they would not be sodium silicate, but they are in my view and also in the view of Dr. Sheppard.

(Tr. 63)

Also, as to the function of sodium in the deposit, he explained:

> THE WITNESS: It is an essential constituent of these [sic] Zeolite. Without its presence there these

minerals would not have the properties that they do to go beyond immediately foreseen properties. And the other function is that it is present and the Government owns the deposit.

JUDGE LUOMA: The fact that the calcium itself is present is important to you?

THE WITNESS: Not very.

JUDGE LUOMA: Was that your testimony?

THE WITNESS: No. The sodium is present, it is required to be there in these crystalline structures, as Dr. Sheppard brought out, and I am sure Dr. Breck will in his report, say the same thing. So without the sodium in these particular minerals you don't have these minerals.

(Tr. 94)

Dr. Breck had a different response on whether sodium was essential:

A. Well, it is certainly not an essential component. There are chabazites that occur that are primarily all calcium and there are, of course, there are some Zeolite minerals that have as many as four cations, so sodium per se is not an essential component either to the formation or to the Zeolite afterwards. We, for example, synthetically manufacture three sodium based Zeolites. In one instance, in fact two instances, we go through deliberately an ion exchange procedure to remove the sodium because we don't want it for the end adsorption unit and in that text the sodium is neither essential nor desirable.

(Tr. 117)

Dr. Wayland was questioned extensively about the effect of the Minutes of the Sodium Board dated December 30, 1960, which attempted to establish standards for the classification of sodium lands (Tr. 69-80). The minutes were not approved by the Director of the Geological Survey until July 24, 1961 (Ex. F). Concerning such approval, Dr. Wayland testified:

A. They are standards which we will apply, they are guidelines to us. We use them. We would use those for broad classifications as opposed to case load questions. We might use them, we are a professional organization and we rely on the judgment of our geologists, our District geologists, our Regional geologists and where we

> have a question we go all the way to the Director. When we are putting out something which is rather systematically and well documented, we go all the way to the Director for his blessing. We don't feel necessarily that we have to, but we think it is the best thing because if we are going to have something which has been rather thoroughly worked up, we feel he should know about it and it becomes a document which we will show anybody who asks or exhibits an interest.
>
> Q. Then the Director's approval does not -- is not the thing that makes them official?
>
> A. It helps a lot.
>
> Q. Well, what is the effect of the Director's approval?
>
> A. It proves he saw it and he had no problem with it.
>
> Q. Other than that, his approval doesn't mean anything?
>
> A. There is nothing in the law or regulations that require he has to approve those standards in that form before we put them into practice. * * *

(Tr. 74-75)

Dr. Wayland's testimony is in apparent conflict with a letter dated June 26, 1973, signed by him in which he stated on p. 2 at 5(e) (Ex. 12):

> Prior to final approval of the minutes, they are used for information purposes only and are not used as classification standards.

In addition, Exhibit F, which is a copy of the approved Minutes of the Sodium Board, has a cover memorandum from the Chief, Conservation Division, to the Director, Geological Survey, which states:

> Your approval of this memorandum will constitute our authority for applying these new standards to land classification.

As to the quantity of sodium necessary in order for him to consider the mineral leaseable, Dr. Wayland testified:

> THE WITNESS: I would not draw the line at 49.9 alkali as opposed to alkaline earth. I would draw the line somewhere down much closer to 20 percent. The mineralogist will consider that he has essentially an end member if he is within 20 percent of one end of it, but what we are talking about here are intermediates in the series and I feel that we have properties that are, due to the presence of sodium as well as calcium, in the intermediate of this isomorphus series and therefore, we are dealing clearly with the mixtures that is described in these papers, technical papers here. (Tr. 96-97)

The testimony presented by Contestee will be discussed next. Dr. Donald W. Breck, Senior Research Fellow for the Union Carbide Corporation (see above), testified that the material processed from the claim herein is designated by Union Carbide as AW 500 (Tr. 109). During the processing of AW 500 there is no attempt made to separate chabazite and erionite nor to remove the gangue material. Dr. Breck knew of no commercial process by which those zeolites could be separated (Tr. 109). Contestee uses the ore from the claim commercially without beneficiation because it makes no difference whether it is chabazite or erionite for Contestee's purposes (Tr. 111).

During ion exchange or dehydration, there is little or no effect on the aluminosilicate structural framework of chabazite or erionite (Tr. 111).

In referring to Contestant's electron micrographs of the samples from the claim (Ex. G, Fig. 3-6, p. 27-30), Dr. Breck stated that they did not provide any helpful information for Contestee's purposes and he felt they were totally irrelevent in terms of Contestee's product use (Tr. 112). He felt the same about Contestant's spectrographic analysis (Tr. 113).

Dr. Breck explained the reason why Union Carbide had not made a separation of chabazite and erionite and done separate analyses on each, by stating:

> A. Because I didn't consider that relevant either. We mine the ore and we processed it as it is and we sell a particular product. We carry through no separation so we are therefore not interested in the chemical makeup of even one component. (Tr. 113)

While Dr. Sheppard felt that sodium was the predominant cation in the ore deposit, based on the results in Table 6, Ex. G, p. 35, which

express the unit cell composition of chabazite and erionite based on 72 oxygen atoms, Dr. Breck disagreed. Dr. Breck testified:

> * * * If you start out with, let's say in this particular case, four sodium ions and we replace only one calcium ion comes in it automatically has to kick out two sodiums. That means you have left two sodium and one calcium, so we are now at the point where we have twice as many sodium as calcium.
>
> JUDGE LUOMA: Same job is being done though?
>
> THE WITNESS: The same job is being done, right. In fact, I won't go into this, in many cases it is preferable to have a calcium form. However, in our processing of the ore, as yet we have not gone into that because it is not necessary, but further refinement in the product might require it.
>
> JUDGE LUOMA: Well, in layman's language then, is the end result that even though by one method it may appear to be predominantly sodium in effect it may in another way of measuring it, [be] predominantly calcium because of the two to one relationship?
>
> THE WITNESS: That's true.
>
> JUDGE LUOMA: Is that a correct statement?
>
> THE WITNESS: That's true in the way I determined this on the mole basis. If you count the Na[2]O and the CaO the divalient ions are in the majority. But if you count numbers of individual ions then because of this two to one relationship you can have or do have more sodium than calcium, but the calcium is performing a dual role for your purposes. It is performing a dual role.

(Tr. 122-123)

Dr. Breck felt the unit cell analysis was irrelevant and that there was a built-in bias in such analysis. He stated:

> * * * you are counting individual atoms and in this case you are forgetting that one calcium is equivalent to two sodium or two potassium because they fulfill the structural function of two of the other ions.

* * * * * * *

> A. Yes, there is a built-in bias. You have expressed these compositions in several other ways. Really, if you want to look at something ludicrous take the compound SiO[2] for quartz. It is 50 percent by weight silicone atoms on a number basis, but not if you got to go to a volume basis it is over 90 percent oxygen so it depends on what you pick as your basis.

(Tr. 116)

Dr. Breck believed that of the three means used to calculate sodium-calcium content, weight percent analysis, mole analysis, and unit cell analysis, weight percent analysis made the most sense for the purpose of the contest as he understood it (Tr. 116).

Dr. Breck did not consider the ore deposit on the claim to be a sodium deposit. In his opinion a deposit containing sodium as a useable chemical component that could be commercially extracted would have to contain much more sodium than the deposit herein (Tr. 119).

When asked whether the sodium found on the claim could be extracted and used in industry, he responded:

> THE WITNESS: It is present in too small a quantity and there is no process that I can envisage whatsoever foreseen that would be economically operable to extract that small amount of sodium, as compared, for example to the occurrence of sodium in other more useable raw material forms.

(Tr. 119-120)

Dr. Breck stated that he absolutely would not agree that the deposit could be classified as a sodium silicate (Tr. 123). He would classify the deposit on the EZ No. 225 claim as a calcium sodium aluminosilicate. He made such classification with the realization that his analyses showed the calcium content to be only slightly greater than the sodium content. In his opinion the deposit is better classified as a calcium sodium aluminosilicate than as a sodium calcium aluminosilicate. In that regard he would disagree with the conclusions of Contestant's witnesses. However, he would not disagree with the analytical data presented by Contestant (Tr. 124-25). Dr. Sheppard stated that it depends upon what basis one uses in analyzing the deposit, but he admitted that on a mole basis one would have to term the deposit a calcium sodium aluminosilicate (Tr. 164). Contestant introduced as evidence (Exhibit P) an excerpt from the Handbook of Geochemistry edited by Wedepohl and published in 1970 (Tr. 162) The excerpt was a table which listed minerals containing sodium as a "major component." Under the heading "silicates" were listed chabazite and erionite. There was no indication of what type of analysis had been used to arrive at the conclusion that sodium was a major component of such minerals (Tr. 163).

Robert Langerhans, Assistant General Manager of the Molecular Sieve Department, Linde Division, Union Carbide Corporation, teatifying as to the uses of AW 500, the only product produced from the deposit on the EZ No. 225 claim, stated:

> A. Well, the present commercial uses taht we find is they are used in acid gas drying, in applications such as removal of water from recycled hydrogen, water from air, generated nitrogen, natural gas like fuel gas, chloroform, carbon tetrachloride, acid gas components, hydrochloric acid, NO[2], CO[2], there are other applications where you can simply dry organic compounds if you want to get them very very dry and pass the compound over AW-500 and it will do a nice drying job. There are further applications for ion exchange in the removal of radioactive cesium. This is from AEC waste. (Tr. 126)

The sales of AW 500 for the years 1970, 1971 and 1972 were 95,000 pounds, 105,000 pounds, and 65,000 pounds, respectively (Tr. 127). The price charged per pound for the material is dependent upon the quantity purchased, the greater the amount, the cheaper the unit price. The price ranges from $1.69 per pound to $1.14 per pound (Tr. 133).

During the manufacturing process no attempt is made to remove gangue material from the ore (Tr. 130). Langerhans knew of no commercial process by which chabazite and erionite could be separated (Tr. 131).

Andrew J. Regis, 5/ Senior Research Engineer for Norton & Company (see above), testified for Contestee. Regis was the co-author of two articles on zeolites whose abstracts were introduced as evidence at the hearing (Ex. 18). He stated that he was familiar with Union Carbide's claims in the Bowie area and that he knew the approximate location of the EZ No. 225 claim (Tr. 135).

The formulas used to express the chemical composition of the zeolites in Exhibit 18 were "written in the oxide form, weight percentage converted to oxide, mole ratio." (Tr. 139) Regis stated that that was the only way to write a chemical formula for material based on a

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5/ Andrew J. Regis is an X-ray crystallographer and Senior Research Engineer for Norton & Company, Worcester, Massachusetts (Tr. 135). His work involves responsibility for investigations of the distribution, purity, origin and economic potentials of natural zeolite deposits in the western United States. He graduated from the University of Utah in 1957 with a B.S. in mineralogy and the following year received a M.S. in mineralogy from the same institution. His list of publications dealing with zeolites is extensive (Ex. 4).

chemical analysis because it gives a representation of the true chemical make-up of the material as a bulk composition material (Tr. 139). He testified that the unit cell formula may only be used for a very pure, very homogenous material and that it does not show the true percentage of the oxide in the ore (Tr. 139-140).

Norton & Company has claims located to the south of the EZ 225 claim and based on his work on such claims and in the general area. Regis would expect the ore to become more calcium enriched as one went north. Based on the chemical analyses of the samples from the EZ 225 claim, he would characterize the deposit as a calcium sodium aluminosilicate or a calcium sodium chabazite (Tr. 141). He said that the classification of zeolites as silicates of sodium would be completely erroneous (Tr. 142).

FINDINGS AND CONCLUSIONS

It is undisputed that sodium is present in the ore deposit on the EZ No. 225 placer claim. There is no basic disagreement about the amount of sodium in the deposit except in its relative proportion to the amount of calcium present therein and in the method of expressing such amounts.

Contestant claims that the deposit consists of sodium zeolites which generally can be described as sodium silicates. Contestee asserts that silicate is an incorrect characterization for zeolite minerals. Contestee believes that zeolites should be termed aluminosilicates and that the deposit on the claim is best described as calcium sodium aluminosilicate.

I find that the deposit on the EZ No. 225 claim is a deposit of zeolite minerals. I find that calcium is the predominant cation. The most proper characterization of the deposit is that it is a calcium sodium alumininosilicate. In a very general sense the deposit could be considered a silicate deposit.

Does such a deposit qualify as a silicate of sodium so as to fall within the ambit of the sodium provisions of the Mineral Leasing Act? The language in Robert E. Simpson, A-4167 June 22, 1970, indicates that with respect to a particular zeolite the dominant cation must be sodium or there must be a "significant presence" of sodium in order for the zeolite to be considered a sodium zeolite or sodium silicate compound.

Herein, I have found that the predominant cation in the zeolite-bearing ore deposit on the EZ No. 225 claim is calcium. However, the question still remains: Does the deposit contain a significant 6/ presence of sodium?

I find that there is not a significant presence of sodium in the deposit on the claim nor is the sodium essential to the ore. There are three essential components of zeolite minerals: the aluminosilicate framework, water molecules, and cations. The fact that the cations may be calcium, sodium, magnesium or potassium apparently has little bearing on the physical properties of the ore, although Contestee pointed out that calcium, as a bivalent cation was, in fact, preferable to the univalent sodium for the purposes for which

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6/ Significant is defined in Webster's New International Dictionary, 3rd Edition, 1966 as: having a meaning; suggesting or containing some concealed, disguised or special meaning; having or likely to have influence or effect.

the zeolite ore is used. Also ion exchange has little effect on the framework structure of chabazite and erionite. By such exchange it is possible that all the sodium ions could be exchanged for other cations. Therefore, the sodium ions are not essential to the deposit nor is their presence significant.

There is no single element of chabazite or erionite that makes them valuable minerals. It is not calcium, sodium, magnesium, potassium, aluminum, silicon, hydrogen or oxygen. Sodium could not be extracted and removed from the deposit and marketed at a profit, nor could any of the other individual components of these zeolite minerals. I find that the deposit on the EZ No. 225 placer claim is not valuable for the sodium found therein. The value of the deposit on such claim is derived from the physical characteristics exhibited by the unique combination of elements forming these zeolite minerals. Such characteristics make this zeolite ore commercially valuable for use as adsorbents and molecular sieves.

Therefore, the ore deposit on the EZ No. 225 placer claim is not a deposit of sodium or a silicate of sodium within the meaning of the Mineral Leasing Act, and is locatable under the general mining laws. Having so concluded it is not necessary to deal with the peripheral question presented as to the effective date of leasability of these zeolite minerals.

ORDER

The complaint is dismissed.

L. K. Luoma
Chief Administrative Law Judge

Enclosure: Information pertaining to appeal procedure

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ADMINISTRATIVE JUDGE RITVO DISSENTING:

I must respectfully dissent from the conclusion reached by the majority for reasons of substance and procedure. On the merits I would find that the zeolite deposit is disposable only under the provisions of the Mineral Leasing Act and on procedural grounds I would find the failure to make a prospecting permit applicant a party to the contest was incorrect and may require a substantial repetition of the proceedings to this point.

Examining first the procedural problem, I note that the case originated with an application, A-4167, filed by Robert E. Simpson, for a sodium prospecting permit application for among others, the land covered by other of Union Carbide's mining claims. In a decision dated September 5, 1969, the Arizona Land Office rejected his application because the lands were already appropriated under the mineral land laws by Union Carbide. On appeal to the Director, this decision was vacated and remanded. Robert E. Simpson, A-4167 (June 22, 1970). The decision instructed:

> Accordingly, in view of the conclusions we have reached herein, the land office decision of September 5, 1969, is hereby vacated, and the case is remanded to the land office, through the Arizona State Director, for further appropriate action not inconsistent with this decision: (1) to determine whether the lands applied for are properly subject to the sodium prospecting provisions of section 23 of the Mineral Leasing Act or are subject to

> competitive leasing as authorized by section 24 and the regulations promulgated thereunder; (2) to determine whether any mining claims have been located on lands subject to this appeal involving an asserted discovery of sodium zeolites; (3) if a discovery of zeolites is asserted, to initiate a mining contest for the purpose of challenging the validity of the said mining claims; (4) to determine whether the appellant herein is entitled to the issuance of a sodium prospecting permit for the lands included in his application; and (5) to resolve any other question which may arise in this matter and requires such resolution.

Thereafter, a contest proceeding was initiated, not against the lands involved in Simpson but against another Union Carbide placer claim on the ground that the minerals for which the claim had been located are not locatable under the mining laws. The contest complaint states that the land is also included in sodium prospecting permit application A-7300 filed September 25, 1972, by George H. Hunker, Jr. Although the validity of Hunker's prospecting permit application, under which he intends to explore for the same deposits as Union Carbide claims, is intertwined in the issue raised by the contest, for if the minerals were found locatable, then Hunker's permit application would in all likelihood have to be rejected, Hunker was not made a party to the contest.

In other situations involving a conflict between a mineral claimant and a mineral leasing act permit applicant or lessee, the Department has explicitly directed that both the permit applicant or lessee and the mineral claimant be made parties to the contest

proceeding. Burnham Chemical Co. v. United States Borax Co., 54 I.D. 183, 184, 185 (1933); reversed in part, U.S. v. United States Borax Co., 58 I.D. 426 (1943) 1/ ; Union Oil Co. of California, 65 I.D. 245, 253 (1958), aff'd Union Oil Company of California v. Udall, 289 F.2d 790 (D.C. Cir. 1961).

A determination in this contest that the zeolite deposit is locatable and not leasable will not be binding upon Hunker and presumably he will, if he so desires, be free to litigate the matter when his permit application is rejected as a result of this contest.

Whether Hunker would be assured of a permit or not, if the deposit were held leasable, is immaterial. The point is that if his permit application is denied on the ground that the deposit is locatable it is likely that the proceedings to date may be repeated.

It would have been preferable to have had Hunker made a party to the contest at the outset. That not having been done, an alternative is not to issue a decision on the merits at this time.

I would at least postpone a decision adverse to Hunker until he has been given permission to intervene, if he so desires, and to

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1/ For a summation of later proceedings see Burnham Chemical Co., 59 I.D. 365, 366 (1947).

decide for himself whether he believes the record is complete from his point of view. Despite the majority's apprehension, there are no mechanical difficulties to having Hunker appear in the proceedings.

To understand the problems raised by this appeal on the merits we must first consider the nature of the mineral in dispute. The Administrative Law Judge described it as follows:

> Zeolites belong to a group of naturally occurring minerals called framework silicates. There are several groups of framework silicates: the feldspars, the feldspathoids and the zeolites. Zeolites were first recognized as a new group of minerals by a Swedish minerologist in 1756. There are more than 40 naturally occurring zeolites. All the zeolites are crystalline hydrated aluminosilicates of alkali (e.g., sodium, and potassium) and alkaline earth (e.g., calcium and magnesium) elements (Ex. G, p. 1; Ex. 5, p. 8, Tr. 19-20). The two principal zeolites found in the ore deposit on the EZ No. 225 claim are chabazite and erionite (Tr. 17; Ex. 5, p. 24).
>
> Zeolites have three components: a crystalline aluminosilicate framework structure, cations and water molecules (Tr. 30). The framework structure is based on an infinitely extending three-dimensional network of A10[4] and Si0[4] tetrahedra linked to each other by the sharing of all the oxygens (Ex. 5, p. 3). The structure encloses interconnected cavities occupied by the cations and water molecules (Ex. G, p. 1).
>
> The tetahedra of four oxygen ions surrounding a silicon or aluminum ion act as the building blocks of the zeolite framework. A silicon ion has four positive charges which neutralize one of the two negative charges on each oxygen. The remaining negative charge on each oxygen combines with another silicon or aluminum ion. The aluminum ion has only three positive charges (Ex. 5, p. 5). The deficiency must be made up by an additional positive charge of alkali metals, such as

sodium or potassium with one positive charge (M+) for each atom, or alkaline earths, such as calcium or magnesium with two positive charges (M++) for each atom (Ex. 5, p. 6). Such positive charges, known as cations, in most cases may be completely interchanged for other cations without destroying the crystalline framework structure. Such an interchange of cations is called cation exchange (Ex. G, p. 6).

Water molecules, along with the exchangeable cations, occupy channels and interconnected voids within the crystalline framework structure of the zeolites (Ex. 5, p. 11). The water may be reversibly removed without significant structural distortion (Ex. G, p. 7; Tr. 34, 132). The dehydration of zeolites is necessary to free the cavities and channels of the zeolites for their commercial use as molecular sieves and as adsorbents (Ex. G, p. 8; Ex. 5, p. 1-4).

Zeolites exhibit molecular sieve properties based on the size of the apertures that connect the voids (Ex. G, p. 8). Zeolites form microporous molecular sieves whose aperatures or pores are less than 10 A in diameter 1/ (Ex. 5, p. 1).

The term molecular sieve may refer to microporous solids which can separate molecules based on differences in size and shape. The molecular sieve action can be total; certain large molecules may be totally prevented while diffusion of smaller molecules may occur, or there may be a partial sieve action where different size molecules may diffuse or penetrate the solid at varying rates under various conditions (Ex. 5, p. 3).

Such properties make zeolites very useful in the removal of water and substances such as sulfur dioxide and hydrogen sulfide from gas streams (Ex. 5, p. 21) and in selective adsorption of other materials (Tr. 108).

1/ 1 A is one angstrom. An angstrom is a unit of linear measurement. One inch equals 254,000,000 A (Ex. 5, p. 1).

I would first note that while the majority affirms the result reached by the decision below, it rejects the rationale of that

decision and bases its conclusion on different criteria. The decision below accepted in large part the test set out by the BLM in Simpson, supra, and approved by the Solicitor, but held that under that test the zeolite deposits were a locatable and not a leaseable deposit. The majority rejects that test, offers a different two-part one, and then concludes that under one of its criteria, the deposit is locatable. It does not discuss whether it would reach the same conclusion if it applied the same test as did the BLM and the Administrative Law Judge.

In my opinion, on the one hand the second part of the new, two-part test propounded by the majority is not persuasive, and on the other, the Administrative Law Judge's application of the BLM test, which in my view is sound, is incorrect.

First as to the majority's standard. The majority offers as the first of its two criteria for classifying a zeolite as a silicate of sodium the requirement that the sodium be present in sufficient quantity to be commercially valuable. I agree that a zeolite deposit containing sodium which is commercially valuable is disposable only under the Mineral Leasing Act. This would also be the result under the BLM test.

The second criterion is more troublesome. It would deem leasable a deposit of a silicate of sodium (or any other leaseable mineral)

only if the sodium is essential to the molecular structure of the mineral. In applying the test to this zeolite deposit, it points out that the sodium in the molecules of these zeolites can be replaced by another cation, such as calcium. From this it concludes that the molecular structure is not dependent upon which cation is present and therefore that the presence of sodium is not essential to the existence of the zeolite deposits. Thus it finds the zeolite deposit not to be leasable.

This criterion has its origin in a Geological Survey definition of "sodium" for the purpose of the Mineral Leasing Act. The Geological Survey defines a sodium mineral as "any valuable mineral that contains the element sodium as an essential element of the mineral's crystal structure" (Ex. J. at 3). (Emphasis supplied.) More specifically, a sodium zeolite is defined as "a crystalline hydrated sodium aluminosilicate with a framework structure that encloses cavities occupied by a significant amount of sodium and other alkali and alkaline earth minerals." Id. at 14.

The majority accepts the first definition in an abbreviated form by stating that the sodium cation, being replaceable by another, such as calcium, is not essential to the molecular structure of the deposit. Whether and how molecular structure differs from crystal structure is not explored. It then concludes since sodium is not essential to the existence of a zeolite deposit, this zeolite deposit is not a sodium

deposit within the meaning of the Mineral Leasing Act, as amended (30 U.S.C. §§ 261, 262 (1970)).

In Wolf Joint Venture, 75 I.D. 137, 138-139, ftn. 4, the Solicitor, in discussing a related question, referred to analcite ($NaAlSi_2O_6.H_2O$), a zeolite, as an example of a leasable not a locatable mineral. That decision stated:

> Before proceeding to what specific questions must be considered by the hearing examiner, a threshold question is presented as to dawsonite [$Na_3Al(CO_3)_3.2Al(OH)_3$]. That question is whether dawsonite, since it contains aluminum, is a locatable rather than a leasable mineral. The sodium provisions of the Mineral Leasing Act, supra, clearly establish that dawsonite, whatever may be its availability for leasing in the circumstances presented by these applications, is not open to location and disposition under the mining laws of 1872.
>
> Under the sodium provisions a permittee is entitled to a lease upon showing to the satisfaction of the Secretary of the Interior, inter alia, that valuable deposits of one of the enumerated sodium substances, including carbonates of sodium, have been discovered. Dawsonite is a double salt--a sodium aluminum carbonate, but it is nevertheless a sodium carbonate. 3/ Notwithstanding
>
> ---
>
> 3/ The Act speaks broadly of carbonates of sodium. There is no limitation that the form or mode of occurrence be simple salts of sodium. To the contrary, in a hearing on the Potassium Act of 1927, as amended, 30 U.S.C. secs. 282 et seq. (1964), the Director of Geological Survey gave examples of double salts and complex silicates of potassium as leasable minerals: alunite, a potassium aluminum sulphate, $KAl_3(OH)_6(SO_4)_2$; and leucite, a potassium aluminum silicate ($KAlSl_2O_6$). Hearings before the House Committee on the Public Lands on H.R. 9029, 68th Cong., 2d Sess., 39 (1925); see Wayland, Is the Mineral Locatable or Leasable? Mining Congress Journal, pp. 36-40, July (1967). (Emphasis supplied.)

> the presence of aluminum as a constituent element of the mineral, dawsonite is among the sodium substances enumerated in section 23 of the Act. As such, dawsonite, as well as all of the other enumerated substances of sodium, is subject to disposition only under the provisions of the Mineral Leasing Act. 4/ United States v. U.S. Borax Co., 58 I.D. 426, 432 (1943).
>
> ---
>
> 4/ E.g., analcite (NaAlSi[2]O[6].H[2]O).

Thus, if we look to past departmental action I can only conclude that the Department has held deposits such as this one to be leasable. 2/

I cannot accept the conclusion that the possibility of a cation exchange is to be the criterion on which the resolution of this novel problem depends. We must begin with a realization that the Congress had little, if any, thought of how the technical terms of the sodium provisions of the Mineral Leasing Act, supra, could be applied to so odd a mineral as a zeolite. The majority offers a highly technical characteristic of zeolite as the deciding criterion. There is, of course, no support for this test in the legislative history of the sodium or other portions of the Mineral Leasing Act.

2/ The majority refers to "ulexite" as a deposit containing sodium which was held to be locatable. Whatever the chemical composition of ulexite may be it was found locatable because it was a "calcium borate," not a sodium borate. United States v. U.S. Borax Co., 58 I.D. 426, 428 (1943).

It seems to me that the question should be whether the sodium is essential to the existence of this zeolite deposit, not whether there can be other zeolite deposits with another cation. As Dr. Wayland testified when asked whether sodium was the dominant or an essential cation in the deposit: "Whether it is dominant is not a controlling point, that it is essential is a controlling point and it is an essential constituent" (Tr. 63). The sodium is not scattered through the chabazite or erionite or clinoptilolite as are pebbles in a sand and gravel deposit, or, like wheat and chaff, to be sifted out by tossing it in the air a few times. It is bound to the framework constituents by its neutralization of the excess negative electrical charge, or ion, of the framework. Wherever the zeolite goes, the sodium goeth also. While it is there it is essential to the stability of the zeolite. Although it may be replaced chemically by another cation, it is essential to the crystal structure of the zeolite so long as it is there. It may not be part of the framework structure of the crystal, as Union Carbide contends, but the framework structure is not the same as the crystal structure.

The sodium cations are chemically, that is, electrically, bonded to the other components of the double salt constituting these zeolites and, except in the more philosophical than scientific

meaning of my colleagues, are essential to the crystal structure of these zeolites and to its stability. 3/

We must also stress again that Union Carbide markets the zeolite without attempting to replace the sodium cations with any others. Thus, they are essential to the product Union Carbide sells.

Further the oft-repeated assertions that the presence or absence of the sodium cation, so long as it is replaced by an equivalent, is immaterial to the zeolite is not necessarily so.

> The framework of the zeolite is not totally rigid and the size of the apertures can be reduced by lowering the temperature. Cations are located near the apertures and partially block them. Aperture size can be increased by reducing the number or size of the cations through ion exchange (Ex. E and G, p. 8).
>
> The size and charge of the cation has an important effect on the properties of the zeolite, such as adsorption and ion exchange. Id. p. 19. See also pp. 5, 6 and 14.

As Dr. D. W. Breck, one of Union Carbide's expert witnesses stated: "In many zeolites cation exchange and/or dehydration may

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3/ The majority refers to casual presence of sodium in the molecular structure. Casual is defined as "1. Happening or coming to pass without design and without being foreseen or expected; coming by chance. 2. Coming without regularity, occasional, incidental." Webster's New International Dictionary (2d ed.). I suggest the relationship of sodium to these zeolites is far from casual.

produce substantial structural changes on the framework and consequently alter physical properties. * * *" (Ex. 5, p. 4,) "The size and charge of the cation has an important effect on the properties of the zeolite, such as adsorption and ion exchange." Id. p. 19.

While Dr. Breck's statement continues with a discussion of the advantages of the calicum cation over the sodium cation for certain uses, his discussion is predicated upon the proposition that not all cations are equal - that the presence or absence of a particular cation can make a difference in the performance and characteristics of a particular zeolite.

Since the majority would not hold a deposit of a silicate of sodium locatable, and thus not leaseable, merely because the sodium was not able to be extracted for use as sodium, or, if it could, it was not to be so extracted and used, we must find another test for such sodium deposits. The Simpson, case, supra, devised such a test, which as we have seen, was approved by the Associate Solicitor.

Simpson held that:

> [W]ith respect to a particular zeolite, the cation of the framework must be sodium or contain a significant presence of sodium in order for the zeolite to be described as a sodium zeolite or a sodium silicate compound.
>
> * * * * * * *

> In our opinion, both herschelite, which has a nearly pure sodium cation (91 percent), and the intermediate chabazite, which contains a significant presence of sodium in the cation charge, would be subject to the sodium provisions of the Mineral Leasing Act. So long as an occurrence of a particular zeolite may be properly identified, in the mineralogical sense, as an intermediate sodium-calcium zeolite, it would be a silicate of sodium enumerated in section 23 of the Mineral Leasing Act.
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> The Conservation Division, Geological Survey, * * * by memorandum dated March 10, 1971, concurred with the technical statements and findings in Simpson and the Solicitor expressly approved of the conclusions therein. Disposition of Sodium Zeolite Under the Mineral Leasing Act of 1920, M-36823, May 7, 1971.

The Administrative Law Judge summarized the technical evidence and the several tests which may be used to measure the relative percentages of sodium and calcium in the chabazite and erionite, and clinoptilolite separately or in the ore. While the proportions differ slightly depending on which method of measurement is used, the results of each method are not disputed. The alkaline earth oxides (magnesium and calcium) and the alkali oxides (potassium and sodium) each constitute approximately half of of the cations. Administrative Law Judge, p. 15, Tr. 114, 123, 125.

Thus even if we were to conclude as did the Administrative Law Judge, that calcium, and not sodium, is the predominant cation, we would still be left with the problem of whether there is a significant presence of sodium in the ore.

Before we consider this issue, we believe it important to point out, as did the Administrative Law Judge, that it has long been settled that the use to which ore is put does not determine whether it is leasable, that is, an ore otherwise leasable remains only leasable even if the commercial product is valuable for a constituent other than sodium.

As the Administrative Law Judge stated:

> In an early Departmental decision, Burnham Chemical Co. v. U.S. Borax Co. and Western Borax Co., 54 I.D. 183 (1933), the Assistant Secretary dismissed as untenable an argument that kernite was not a leasable mineral because the commercial products made from kernite, namely borax and boric acid, were valuable for their boron content and not for the sodium therein. The Assistant Secretary stated:
>
> > * * * The act [Mineral Leasing Act] specifies among the salts named "sodium borate," and relates to the deposit found in the ground, and it is immaterial what constituents thereof are the most useful after it has been made into a commercial commodity. If that argument were valid it would, of course, follow that no sodium borate from which borax is made would be within the purview of the Leasing Act, either as it originally stood or as amended. Id. at 186.

It is this concept which has led the majority to devise its own test in order to avoid at least in this instance the necessity of determining at what point, if any, the amount of sodium in an ore becomes so minor that the deposit is not leasable.

The Administrative Law Judge, however, in my opinion, overlooked this rule in finding the sodium "insignificant." To reach his conclusion he stressed that the sodium in the zeolite is not recoverable and that the sodium ions are interchangeable with other cations. We have indicated earlier our disagreement with the significance the Administrative Law Judge gave to interchangeability. Here we point out that the deposit as it lies in the ground contains sodium and that it is the deposit as found and utilized that is to be examined to see whether it is leasable. In other words whether sodium can be, or if it can, whether it is intended to be extracted from the deposit is immaterial. The only issue is whether the ore contains sodium in one of the forms stated by the Mineral Leasing Act to be leasable.

Having posited the issue in this guise, we recognize at once that the test cannot be so completely simple. No one contends that the merest trace of a silicate of sodium is sufficient to render a deposit only leasable. For example, Dr. Wayland, Chief, Conservation Division of the Geological Survey, stated that he would classify as leasable an ore that contained 20 percent of its cations in the form of a leasable form of sodium (Tr. 96-97). In terms of this deposit I take that to mean 20 percent of 8 percent (the total alkali and alkaline earth in the deposit) or 1.6 percent of the deposit. Here the potassium and sodium oxides furnish about 50 percent of the cations or 4 percent of the ore, with the sodium constituting about 3 percent of that amount. This amount is well above the minimum suggested by Dr. Wayland.

However, we need not decide what the possible minimum percentage of sodium or other leasable minerals may be in other deposits. The silicate of sodium in this deposit is essential to the functioning of this deposit for use as a molecular sieve or in an ion exchange process. Whether the same amount of a silicate of sodium in a deposit of common rock, where the sodium plays no role in the use to which the rock is put, would make that deposit leasable is doubtful, but that issue is not before us.

Where the amount of a silicate of sodium in a deposit is significant and contributes to the characteristics for which the deposit is valued, then the deposit is one that is subject to disposition only under the Mineral Leasing Act. Since this deposit meets that test, I would find it leasable only and not locatable. Accordingly, I would reverse the holding of the Administrative Law Judge and hold the claims invalid.

Finally, I am not persuaded by the appellant's contention that the deposit is locatable because the claim was located prior to the date on which the Geological Survey administratively determined that zeolites would be subject to the Mineral Leasing Act. Whether a deposit is leasable or locatable depends upon the facts existing on the day the claim is located. Here all the relevant facts, both chemical and industrial were known then. It was only the application of the facts to the law that was made later. The Secretary is under

no obligation to clarify in advance which deposits are leasable and which are locatable. He may decide each situation when it is presented to him without being forclosed because he has not done so earlier.

Therefore, I would reverse the decision of the Administrative Law Judge and find the mining claim invalid.

Martin Ritvo
Administrative Law Judge