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This issue of Industrial Minerals Notes includes brief reviews of manuscripts recently placed on open file at the Survey offices, one dealing with gypsum and anhydrite in Illinois and the other with the use of fluorspar to control vanadium staining on light colored clay products.

Also a part of the issue are two capsule reports, one covering the results of an investigation on the relation of sulfate and chloride content of Jo Daviess County rocks to the occurrence of zinc and lead ore deposits, and the other the possibility of subsurface calcitic limestone in Kankakee and Iroquois counties.

GYPSUM AND ANHYDRITE

The presence of gypsum and anhydrite in the cores and cuttings from wells drilled in certain parts of Illinois has been known for some time and has been briefly noted in print. However, a report by D. B. Saxby and J. E. Lamar, recently placed on open file at the Survey offices, presents for the first time a reasonably complete preliminary picture of the occurrence and extent of these two minerals in Illinois.

The report will be printed later this year as Circular 226. In the meantime the manuscript copy may be consulted at the Survey offices in Urbana.

The gypsum and anhydrite occur in the St. Louis Limestone. They do not crop out and are restricted to the southern half of Illinois. In the deeper parts of the Illinois structural basin anhydrite is dominant, but along the shallower marginal area (extending roughly from Madison County to Sangamon County) both gypsum and anhydrite occur. In a general way the amount of gypsum present increases with decreasing depth. The minimum depth at which gypsum and anhydrite were found was 470 feet.

The maximum thickness of gypsum, devoid of other materials, encountered in six diamond-drill cores from southwestern Illinois, was 2 feet at a depth of 896 feet in Sangamon

County, but $3\frac{1}{2}$ feet of material averaging 93 percent gypsum was found in a Madison County core at 722 feet.

If beneficiation of a gypsum ore is possible by a suitable ore processing method, as seems likely, greater thicknesses of material are available, as for example, roughly $8\frac{1}{2}$ feet of material containing an estimated composition of 78 percent gypsum and 22 percent limestone at a depth of 943 feet in a Macoupin County diamond-drill core, 5 feet of material containing an estimated 83 percent gypsum at a depth of 918 feet in a Sangamon County diamond-drill core, and 6 feet of material containing an estimated 62 percent gypsum at 711 feet in a Madison County diamond-drill core.

All well data used in the study came from records of wells drilled for water, oil, or coal, and thus it is possible that drilling specifically directed to the discovery of gypsum might find greater thicknesses of this mineral than are reported above.

Gypsum is used in making plaster of Paris which is the basis of the manufacture of a wide variety of plasters, prefabricated lath, wall board, sheeting board, and other building materials. More than eight million tons of gypsum were mined in 1952. Anhydrite is not widely used commercially in the United States.

No gypsum is produced in Illinois and none is known to crop out. The proximity of some of the gypsum reported in the wells mentioned above to the greater St. Louis area should place it in a favorable market position if suitable deposits can be found.

FLUORSPAR FOR CONTROLLING VANADIUM STAINING

The cause and cure of yellow, green, or brown stains on light colored clay products, such as buff brick, have been matters of interest to the clay products industry for many years. Generally the stains have been ascribed to vanadium, although molybdenum, iron, chromium, and nickel likewise may contribute secondarily. The addition of fluorspar to clays that develop vanadium stain is known to control the staining, but how the fluorspar accomplishes this has been uncertain. Of interest, therefore, are the results of an investigation to obtain information on how the vanadium occurs in clays and the effect of fluorspar upon it. An account of this study is given in the Survey's Report of Investigations 202, "Vanadium efflorescence and its control by the use of fluorspar", by D. L. Deadmore, A. W. Allen and J. S. Machin, which is now on open file for inspection at the Survey offices and scheduled for publication later this year.

Four samples of clay that developed vanadium stains were studied, two from Illinois and two from Indiana. The stains produced on fired specimens of these clays were found to be due principally to vanadium but partly to a lesser amount of molyb-

denum. The vanadium in all four clays was essentially insoluble in water, but heating of the clays converted some of it to a water-soluble form.

The vanadium was most abundant in the finer sized-fractions of the clays. Although the presence of minute particles of vanadium-bearing minerals cannot be ruled out, its distribution suggests that the vanadium occurs as an integral part of the clay minerals in the clays, possibly replacing aluminum. This is emphasized further by the fact that the clays yielded the largest amount of water-soluble vanadium after they had been heated to the same temperatures as those at which the crystalline structure of the clays broke down, roughly between 700 and 900 degrees centigrade.

The addition of fluorspar in small amounts to clays that develop a vanadium stain is believed to inhibit staining by inducing the formation of a glass, in which the vanadium is incorporated, during vitrification of the clay when it is burned.

C A P S U L E   R E P O R T S

I. - RELATION OF SULFATE AND CHLORIDE TO ORE DEPOSITS IN THE ORDOVICIAN ROCKS OF JO DAVIESS COUNTY

J. C. Bradbury

The zinc and lead deposits of Jo Daviess County occur in Ordovician rocks and generally are regarded as having been emplaced by solutions that contained chloride and possibly sulfate ions. Although the ore deposits are localized, it was considered possible that the ore-bearing solutions might have penetrated areas of rock considerably greater than the immediate vicinity of the ore bodies. If this were true, it was possible that the rocks so penetrated might show a larger content of chloride and/or sulfate than rocks outside the principal zone of mineral deposition. Thus data on the chloride and sulfate content might serve to localize areas of possible promise for ore deposits or might even aid in localizing exploration for specific deposits.

Accordingly, samples were obtained from Jo Daviess County, some within the "principal mineralized belt" and others outside it. In order to eliminate possible vertical variations of chloride and sulfate content in the various Ordovician strata, the samples were taken from the 5 feet of dolomite at the base of the "Buff" (upper Prosser) formation roughly 75 feet above the usual position of the major zinc deposits. Results, shown in the accompanying figure and in the table below, fail to indicate any consistent relationship between chloride and sulfate and/or ore occurrence.

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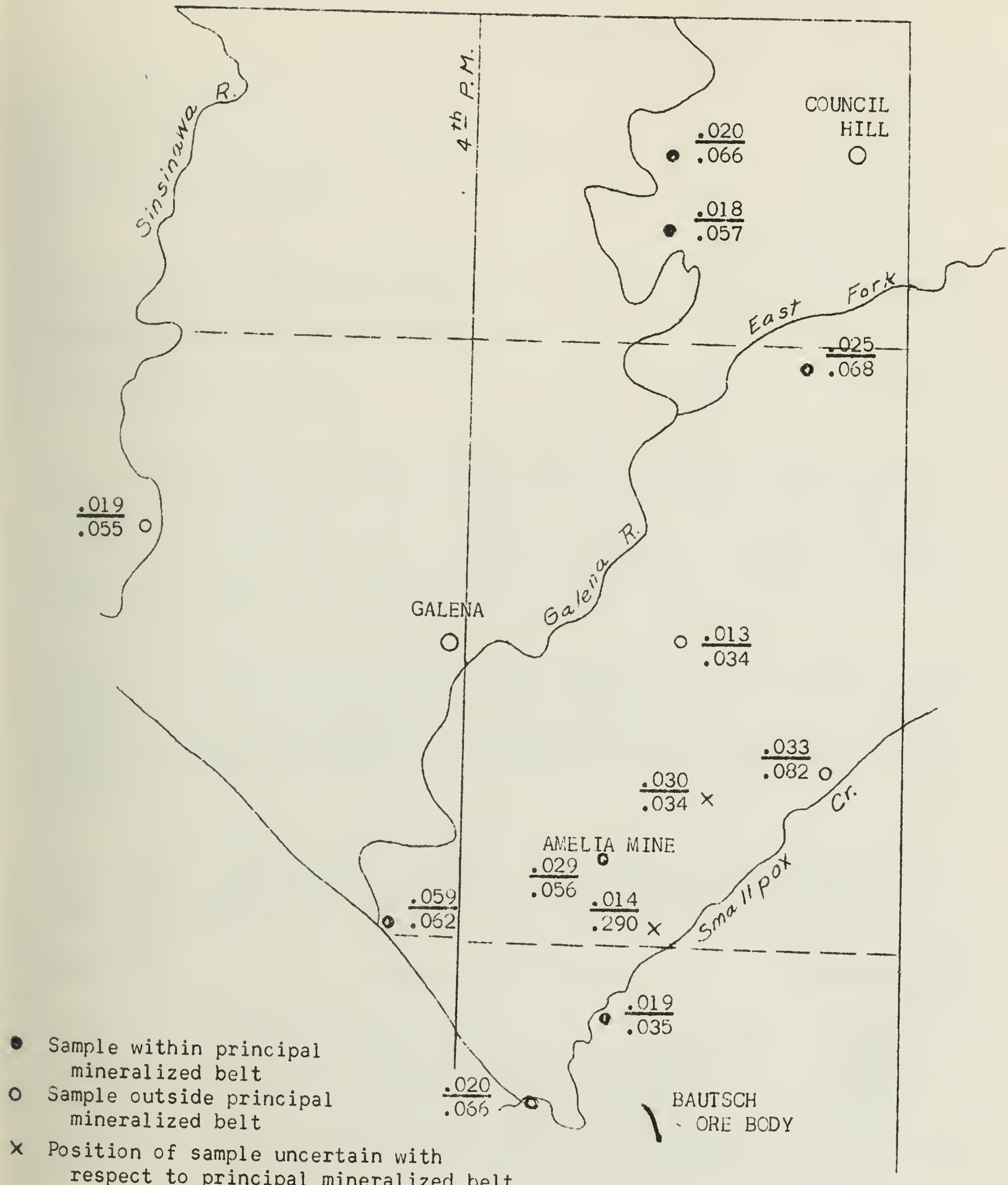

Fig. 1. - Chloride and sulfate content in percent by weight in samples from the lower 5 feet of the Buff formation. The upper member of each fraction is sulfate, the lower chloride.

	No. Samples	Percent chloride Average	Range
In principal mineralized belt	7	.0586	.0348-.0684
Outside principal mineralized belt	3	.0569	.0340-.0820
Position questionable	2	.0315	.0290-.0340
		Percent sulfate	
In principal mineralized belt	7	.0272	.0184-.0586
Outside principal mineralized belt	3	.0215	.0126-.0330
Position questionable	2	.0217	.0138-.0340

In the case of chloride, the average for the samples taken within the principal mineralized belt is slightly above that for the samples taken outside the belt, but the range in values for both groups of samples is nearly the same. Two of the samples, from rock directly above ore bodies, contained 0.0348 and 0.0562 percent chloride and are thus below average, whereas they might have been expected to be above average.

The sulfate data show essentially the same relationships except that the spread between the average sulfate content of the samples in and outside the principal mineralized belt is greater. However, it is not definitive when the range of values is considered. The two samples from above ore bodies contained 0.0198 and 0.0292 percent sulfate, one below and the other above average.

A number of other samples were taken from the "Blue" (Ion) and "Drab" (cherty Prosser) formations for chloride tests to determine whether these units differed from the rock unit discussed above. The samples and results of tests are as follows:

Formation	Source of sample	Chloride (%)
"Drab"	Within ore deposit	0.1292
"Drab"	Barren rock associated with ore deposit	0.0514
"Drab"	Outside principal mineralized belt	0.0798
"Blue"	Within ore deposit, soft dolomite	0.0260
"Blue"	Within ore deposit, hard dolomite	0.0342
"Blue"	Within principal mineralized belt but not associated with an ore deposit	0.0402

The data regarding the "Drab" formation suggests that it may have relatively high chloride content whereas the chloride content of the "Blue" formation is about the same as the dolomite at the base of the "Buff" formation. No consistent relationship between the chloride content of the dolomite in ore

bodies and outside of them is apparent.

It is possible that a greater number of samples from the formations investigated or some other formations might bring to light criteria which would distinguish samples taken inside or outside the principal mineralized belt, or, near or remote from ore bodies. However, the data at hand do not encourage such possibilities.

It is not known whether the chloride and sulfate found are related to ore emplacement or are the normal complement of the strata tested. The latter is, however, no doubt involved and may be the major factor indicated by the data, especially as the differences between the data for samples directly associated with the ore bodies are not strikingly different from data for other samples not associated with ore bodies or remote from known ore occurrences.

II. - POSSIBILITIES FOR CALCITIC LIMESTONE UNDERGROUND IN KANKAKEE AND IROQUOIS COUNTIES

James W. Baxter

Dolomite is the only carbonate rock that crops out in the Chicago area and occurs in deposits of such size that they can be quarried on a large scale. Limestone is shipped into the area. Because of this, reports of the occurrence of limestone in wells in Kankakee and Iroquois counties are a matter of interest.

This preliminary investigation was made to evaluate the occurrence and character of the limestone insofar as the available well data permit. Studies were arbitrarily restricted to occurrences shallower than 500 feet. Data on wells in the vicinity of Herscher dome, mostly in T. 29 and 30N., R. 10 E., are excluded from this report because that structure is being used for storage of natural gas and hence the area is presumed to be unavailable for limestone mining.

The well data in Kankakee and Iroquois counties result from cable tool drilling; no diamond-drill cores are available in the area studied. The logs kept by the well drillers generally do not consistently distinguish between dolomite and limestone, hence the principal source of information is the cuttings saved during the drilling of the wells. Conclusions based on studies of such cuttings are regarded as reasonably accurate if the cuttings were carefully saved. The care exercised probably varied.

The cuttings of all wells in which limestone was reported were examined as were the cuttings of 70 previously unstudied wells. Rough tests to determine the amount of the mineral dolomite were made. Principal attention was directed to those cuttings estimated to contain less than 10 percent dolomite.

The limestone strata occur principally in formations of the Alexandrian and lower Niagaran Series of rocks which are of Silurian age. In the cuttings of some wells, the limestone is

noteworthy because of its whiteness, is generally fine-grained, and dolomite, when present, occurs as dissaminated, minute crystals. In other wells the color of the limestone ranges from light gray, with or without pink or red specks, to reddish brown, usually with an increased amount of silt-sized quartz in the darker rock.

Samples from a few wells suggest that in some places there may be an uninterrupted thickness of as much as 50 feet of limestone having less than 10 percent dolomite. However, the number of samples saved was too small to demonstrate that the limestone is present in a continuous thickness and not as a series of alternating beds of limestone, dolomitic limestone, and dolomite, or possibly as an alternation of limestone and siltstone. The well cuttings do lend encouragement, nonetheless, to the possibility that a thickness of 20 feet or more of limestone strata containing less than 10 percent magnesium carbonate may be present. However, the fact that in most wells in the two counties the lower Niagaran and Alexandrian rocks are mostly dolomite or dolomitic limestone indicates the likelihood of considerable lateral variation in the composition of the formations. The true situation cannot be determined from the well data at hand and probably cannot be assessed accurately without core drilling.

Below are given well data on those limestone occurrences which merit mention because of their relatively low content of the mineral dolomite or because of their thickness.

WELL RECORDS

Kankakee County

	Depth feet	Estimated dolomite content (%)
Wilson - Madison farm #1, SW¼ SW¼ sec. 5, T. 30 N., R. 11 W.		
Niagaran Series		
Limestone, slightly dolomitic, light gray, sublithographic; a little dolomite	390-440	less than 10
Limestone as above but more dolomitic	440-450	10-20
Limestone, slighly dolomitic, light brownish gray, a few white and red grains, dense	450-460	less than 10
Limestone as above but slightly more dolomitic	460-470	10-15
Limestone, slightly dolomitic, light brownish gray; trace of dolomite	510-520	less than 10
Alexandrian Series		
Limestone, slightly dolomitic, light grayish brown to light brownish gray, little pink and yellowish orange; sublithographic; trace of glauconite	540-560	less than 10 to maximum of 15 at base

	Depth feet	Estimated dolomite content (%)
Richmond and Snyder - Mason farm #1, SW$\frac{1}{4}$ SW$\frac{1}{4}$ sec. 27, T. 30 N., R. 11 W.		
Niagaran Series		
Limestone, slightly dolomitic, light gray, pink spots, sublithographic	480-500	less than 10
Alexandrian Series		
Limestone, slightly dolomitic, white, light gray, fine-grained	560-580	less than 10
Ste. Anne Petroleum - Cote farm #1, NW$\frac{1}{4}$ NE$\frac{1}{4}$ sec. 2, T. 29 N., R. 12 W.		
Niagaran Series		
Limestone, slightly dolomitic, light gray, fine-grained and limestone, partly silty, pink to red, fine-grained, a little dolomitic to calcitic red or green siltstone is present	435-445	less than 10
Same but more dolomitic	445-455	10-15
Alexandrian Series		
Limestone, slightly dolomitic, light gray to pale greenish gray, pink spots, fine-grained; becoming more dolomitic towards base	455-465	less than 10 in top half to 15 in lower half

Iroquois County

	Depth feet	Estimated dolomite content (%)
Baines - King farm #1, NW$\frac{1}{4}$ SW$\frac{1}{4}$ sec. 16, T. 28 N., R. 10 E.		
Niagaran Series		
Limestone, partly dolomitic, slightly silty, light yellowish gray, fine-grained	140-170	less than 10
Limestone, slightly dolomitic, silty, clayey, light yellowish gray, fine-grained, some pink and green	170-190	5-15
Berns - Emma Lemenager farm, NE$\frac{1}{4}$ NE$\frac{1}{4}$ sec. 30, T. 28 N., R. 13 W.		
Niagaran Series		
Limestone, slightly dolomitic, slightly silty, light gray, fine-grained	150-158	less than 10
Limestone, as above but slightly more dolomitic	158-174	10-15

	Depth feet	Estimated dolomite content (%)
Jensen - H. Prie farm, NW¼ NE¼ sec. 4, T. 27 N., R. 14 W.		
Niagaran Series (?)		
Limestone, white, fine to medium crystalline (last sample taken)	at 195	less than 5
Berns - Hollome Estate Farm, NE¼ NE¼ sec. 34, T. 29 N., R. 10 E.		
Niagaran Series		
Limestone, slightly dolomitic, light gray, fine-grained	81- 99	5-15