# Solution Mining Test Site—Carlsbad Basin, New Mexico

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## ABSTRACT

*This paper discusses the physical plant and types of experiments conducted at the solution mining test site in New Mexico. The primary purpose of the experiment was to test the ability to use the hydraulic fracturing along with solution extraction to perform a well to well extraction of values from thin-bedded potash deposits. The well configuration and a summary of the tests performed will be discussed.*

The development of the salt cavern storage cavity via horizontal hydraulic fracturing and solution as reported in our paper to the Second Salt Symposium seemed sufficiently successful to warrant investigation of the technique in solution mining potash (Shock, 1966). A location where an adequate section of salt and potash, where water, gas and electricity were available was thought desirable.

Search for a suitable pilot test site centered in the Carlsbad Potash Basin Area of New Mexico. There, several ore zones are being mined conventionally; and the potash reserves have been reasonably well-mapped. Also, the mineral deposits are fairly uniform with a minimum of cross-bedding and folding.

A consulting geologist familiar with the area was hired during the search for available potash leases. Land with potash reserves of probable commercial size was found, but asking prices were too high for speculation on an unproven process. Fortunately, less desirable deposits under Federal and State Lands were also available—these via permits and leases for nominal annual rentals. Federal potassium prospecting permits were subsequently obtained on several tracts totaling some 2,000 acres in the vicinity of the existing potash mines (Fig. 1).

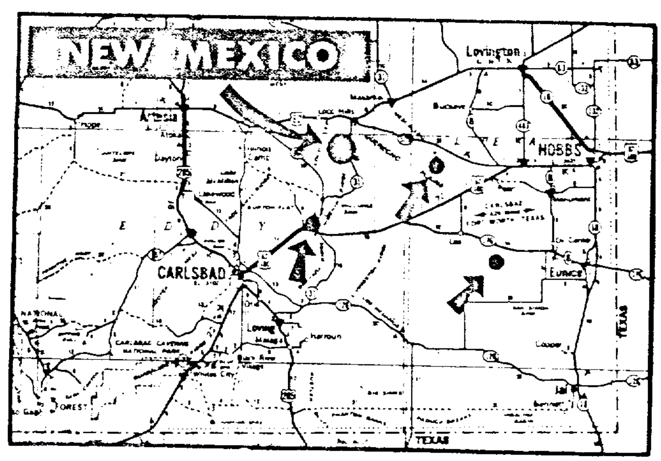


**Figure 1.**

Several factors influenced the decision to conduct the pilot test at the location finally selected. Freeport Sulfur drilled a core test on the tract several years ago, recovering about two feet of 30 per cent KCl ore from the Third Ore Zone at a depth of 1,100 feet. In addition, the area is reasonably accessible by car or truck; water for process use is common in the surface sands; fuel gas is available within two miles; a primary electric transmission line crosses the property; in addition CONOCO conducts oil field operations out of a nearby office at Maljamar.

The local geologic profile shows about 600 feet of alluvium, sand, limestone and dolomite above the 1,000 foot thick Salado Salt Section (Fig. 2). The Salado contains as many as twelve potash ore zones scattered through its upper 700 feet. These are known by numbers starting with the first ore deposit as the lowest zone. The first and third ore zones were of interest to us at the best probabilities for the test work. The first (which is the zone mined by Southwest Potash) was found to be all carnallite at our location. The third zone therefore was used.

The third ore zone under the test site consists of about four feet of potash ore averaging approximately 15% $K_2O$. A composite of the ore zone based on log and core data from several wells is shown on Figure 3. The ore was quite thin, but usable for the test. This thinness actually may have been good for the test, because it required more finesse to precisely establish the floor and roof levels.

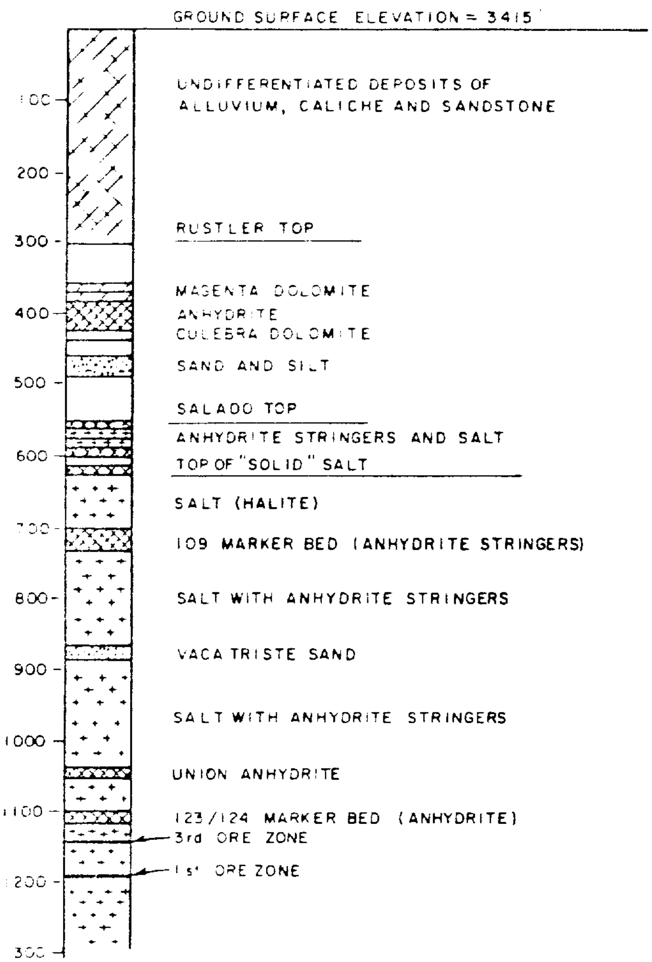


Figure 2. Geological section at the test site.

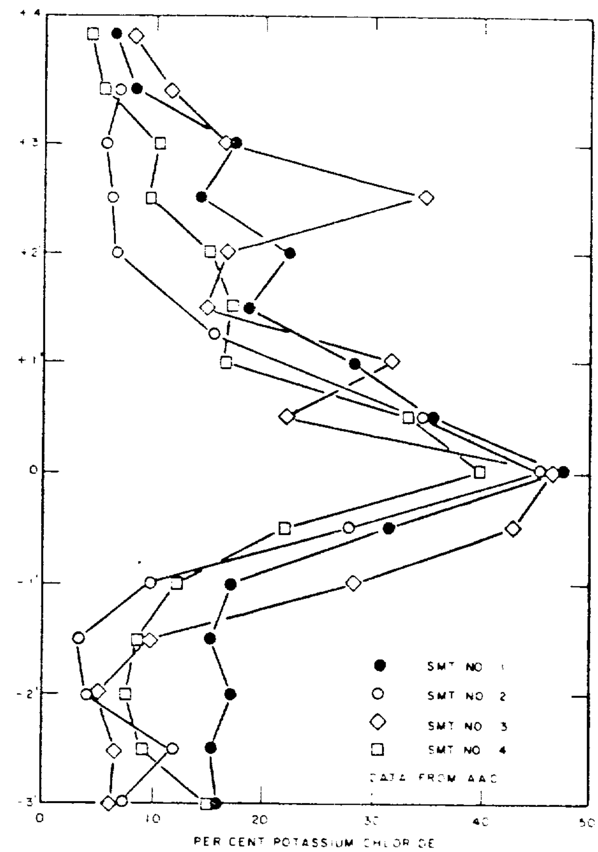


Figure 3. Four well composite of KCl content of third ore zone.

Although the site was acquired for the solution mining of potash, its usefulness is not limited to this work, since numerous thick sections of halite are available for additional work in either solution mining or cavity construction.

The prospecting permit expired after the completion of the test set out in the original research proposal. Because of the potential value of the site for further work, CONOCO has applied for a lease on the permit area.

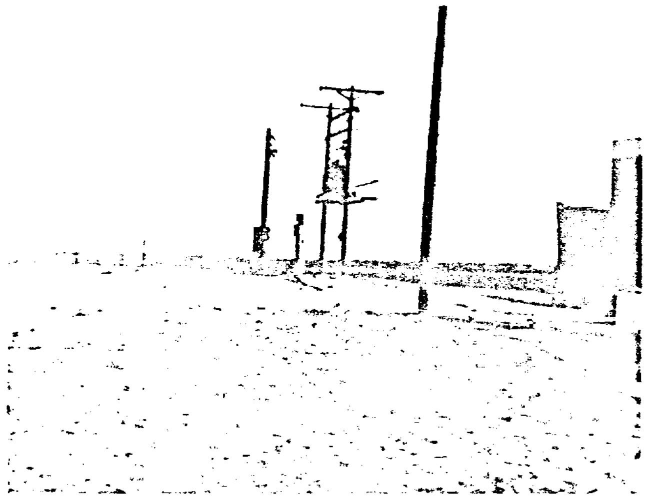

Figure 6. Power panel.

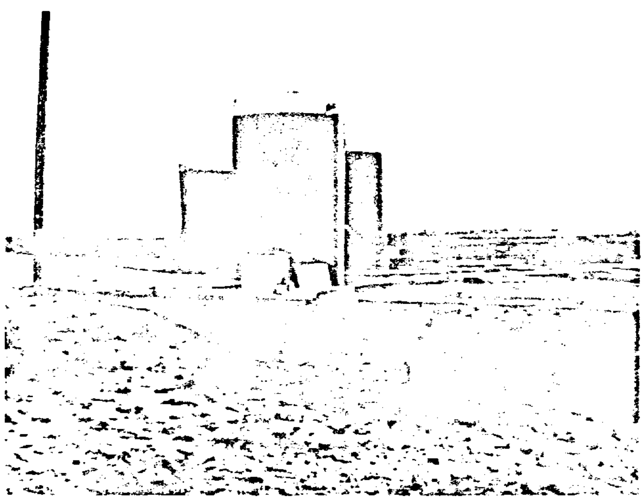

Figure 7. Storage tank and circulation pump.

test site and the water flow automatically controlled into a 500 barrel fresh water tank.

Another 500 barrel tank was provided for brine retention when desired during the test and a smaller tank for diesel storage. Diesel during the mining tests was used in the control of the upper level (roof level) of the mining. Two more 500 barrel tanks were moved in later for handling diesel in and out of the wells during the well-to-well mining when larger quantities of diesel were needed.

Water injection was handled with two National J 150 Triplex Pumps. These had a combined output as rigged of 4,000 BPD at 1,500 PSI and were skid-mounted. Diesel injection was handled with a smaller Bethlehem Triplex Pump. A single pole pulling unit was rented to manipulate pipe strings in the wells. A camping trailer was used as a laboratory and a house trailer was rented as on-site living quarters (Figs. 8 and 9). Data gathering equipment used during the test included recording pressure gauges, a densometer on the brine production line, and a small flame photometer for brine analysis. A diagram of the equipment layout for the test site is shown in Figure 10.

New Mexico laws were changed while the test was in progress to prohibit the surface disposal of brines. Therefore, the use of the two pits for brine

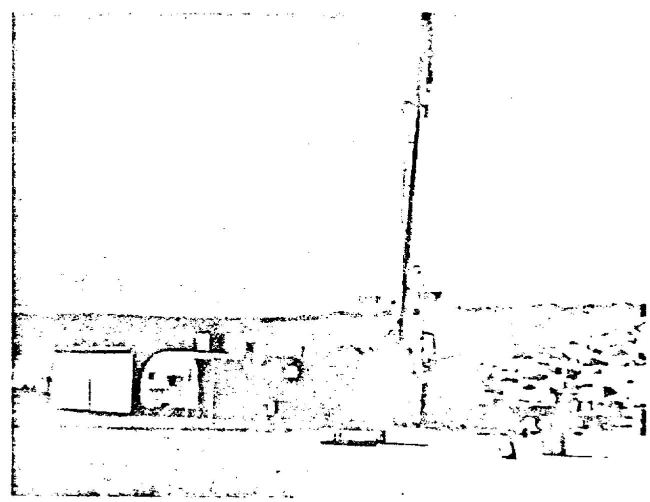

Figure 8. Laboratory and well equipment SMT No. 3.

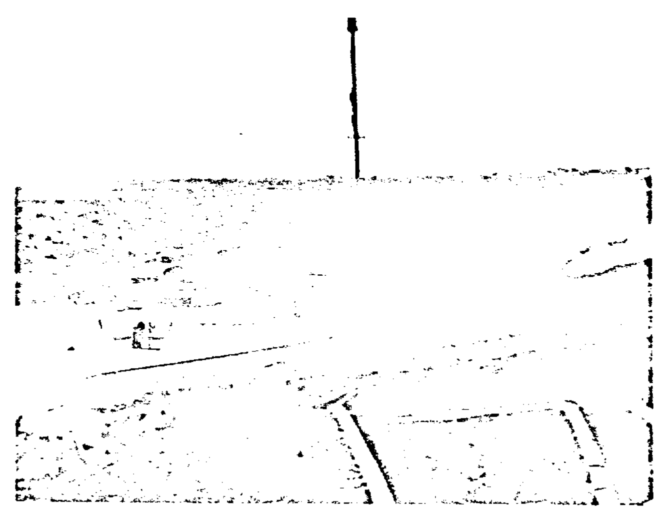

Figure 9. Field trailer and well SMT No. 3.

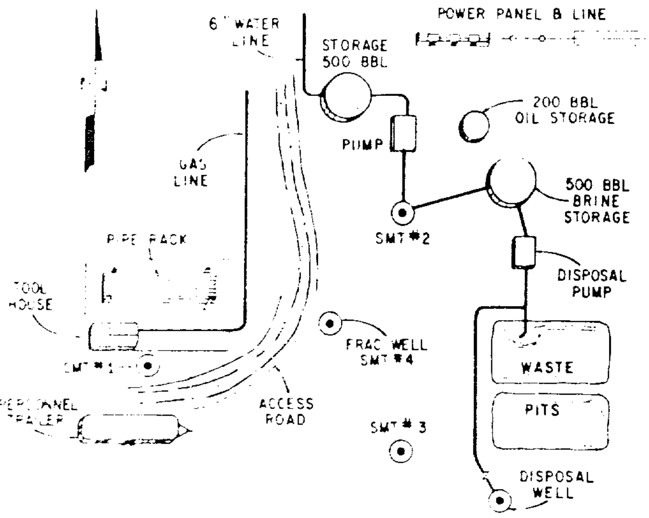


Figure 10. SMT - Test site - Loco Hills, N.M.

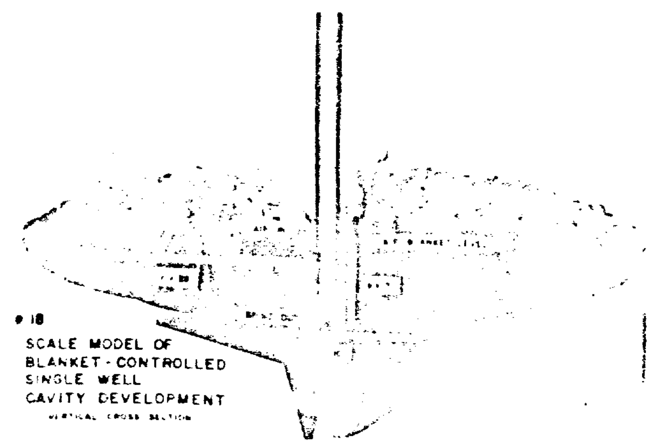


Figure 11.

disposal was stopped and a disposal well was drilled into salt water zones at a depth of about 500 feet. This well accepted salt water very easily.

## TEST PROGRAM

The test program carried out was to (1) test the initiation and propagation of hydraulic fractures in salt, (2) test the rate of solution for both salt and potash in a single well cavity (3) establish the cavity radius vs. height for a single well, (4) check the solution rates of salt and potash from the roof of single well cavities and (5) test the possibility of selective mining the thin potash zone in a well to well system.

The fracture test reported in our paper "Hydrofracing as a Mining Technique" was successfully completed with the fracture staying below the potash bed (Shock and Davis, 1969). Single well tests, run in wells SMT No. 1 and SMT No. 2 verified our conclusions that we could reproduce our laboratory results with respect to single cavity solution. Figure 11 shows the laboratory model of a test to create a cavity of limited height with maximum width. Figure 12 shows the model of the field cavity in SMT No. 1 based on data from a sonar survey. The conclusion of this test was that the laboratory solution experiments could be scaled to field condition. The final field experiment was a well to well test conducted between wells SMT 4 and SMT 3. The conclusions of this test were reported in a recent paper (Davis and Shock, 1969).

Figure 12. Sonar model of field cavity.

## CURRENT STATUS

Several additional tests have been proposed for the test site. These include additional fracturing and potash solution tests as well as evaluation of anhydrous ammonia storage in salt. At the present potash solution tests have been suspended due to the lack of commercial incentive to mine potash. It is anticipated that work will be resumed when it becomes evident that there is sufficient commercial incentive. Meanwhile the site stands a potential test center for numerous solution extraction and salt storage experiments. Its use will depend on the need for the field data.

## ACKNOWLEDGMENTS

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## REFERENCES

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Shock, D.A., 1966, Use of hydraulic fracturing to make a horizontal storage cavity in salt *in* Second Symposium on Salt: Northern Ohio Geol. Soc., p. 406-410.

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