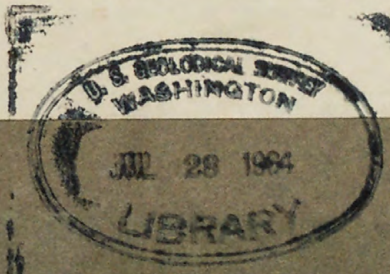

IDRI SALT DEPOSITS
FEZZAN PROVINCE - LIBYA

by
Gus H. Goudarzi
United States Geological Survey

April 1962

U. S. Geological Survey:
Reports - Open file series, no. 656: 1962.

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To accompany (200) R290 no. 656

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Washington, D. C.

For release AUGUST 8, 1962

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3. A geologic report on the iron deposit of the Shatti Valley area of the Fezzan Province, Libya, by G. H. Goudarzi. 77 p., 38 pl., 10 figs., 3 tables.

4. Report on Marada, Pisida, Idri and Tauorga salt deposits in Libya, by G. H. Goudarzi. 31 p., 11 pl.

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8. Description, composition, and tenor of unconsolidated sediments in monazite-bearing tributaries to the Broad River in the western Piedmont of South Carolina and North Carolina, by P. K. Theobald, Jr. A copy from which reproductions can be made at private expense is available in the Library, 1033 GSA Bldg., Washington, D. C.

9. Description, composition, and tenor of unconsolidated sediments in monazite-bearing tributaries to the Enoree, Tyger, and Pacolet Rivers in the western Piedmont of South Carolina, by Norman P. Cuppels. 17 p., 2 figs., 10 tables. A copy from which reproductions can be made at private expense is available in the Library, 1033 GSA Bldg., Washington, D. C.

10. TEI-809. Geology of the Williston basin, North Dakota, Montana, and South Dakota, with reference to subsurface disposal of radioactive wastes, by Charles A. Sandberg. 148 p., 28 figs. Also on file at 468 New Custom House, Denver, Colo.; 437 Federal Bldg., Salt Lake City, Utah; Water Resources Div., USGS, Room 201, 1 North 7th St. West, Billings, Mont.; North Dakota Geological Survey, University Station, Grand Forks, No. Dak.; South Dakota Geological Survey, Vermillion, So. Dak.

11. Bouguer gravity map of the Twin Buttes area, Pima and Santa Cruz Counties, Arizona, by Donald Plouff. 1 map. Also on file at 437 Federal Bldg., Salt Lake City, Utah; 602 Thomas Bldg., Dallas, Texas; Arizona Bureau of Mines, University of Arizona, Tucson, Ariz.; 1031 Bartlett Bldg., Los Angeles, Calif.; 232 Appraisers Bldg., San Francisco, Calif.; 468 New Custom House, Denver, Colo. Copy from which reproductions can be made at private expense are available in the Library, Bldg. 25, Federal Center, Denver, Colo.

Additional depositories are hereby announced for the following report, placed on open file on May 10, 1962:

Aeromagnetic maps of the Twin Buttes area, Pima and Santa Cruz Counties, Arizona, flown at 500 feet above ground and flown at 4,000 feet barometric elevation, by G. E. Andreasen and J. A. Pitkin. 2 maps. Now also on file at 468 New Custom House, Denver, Colo.; 1031 Bartlett Bldg., Los Angeles, Calif.; and 232 Appraisers Bldg., San Francisco, Calif.

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IDRI SALT DEPOSITS

FEZZAN PROVINCE - LIBYA

by

Gus H. Goudarzi 1918–

United States Geological Survey

United States Operations Mission

UNITED KINGDOM OF LIBYA

April 1962

This report is preliminary and has not been edited for conformity with Geological Survey format and nomenclature

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IDRI SALT DEPOSIT

FEZZAN PROVINCE - LIBYA

By Gus H. Goudarzi

Abstract

The Idri salt deposit, located 135 kilometers west of Brack in the Shatti Valley area of the Fezzan province, United Kingdom of Libya, covers an area of about 35 square kilometers. It is connected to the newly constructed black-top Fezzan road by about 250 kilometers of secondary road. The deposit is a salt flat that lies in a closed depression. It consists of a hard crust commonly 20 to 40 cm thick overlying 40 cm of salts and wet sand above the brine.

The origin of the deposit is attributed to the percolating waters that concentrate into a brine and then by capillary action and evaporation form a crust on the surface.

Samples from several pits had the following average composition:

Composition of soluble salt from Idri deposit*

	NaCl	K_2O (Equiv.)	$MgCl_2$
Crust	69.9	3.4	1.6
Undercrust	13.5	0.7	0.4
Brine	11.2	0.6	0.6

*The water insoluble components were not determined.

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Experiments with fractional crystallization by solar evaporation in the field indicated that fairly pure table salt may be obtained in the first stage of evaporation, and a product containing about 6 percent K_2O equivalent may be recovered in the second stage.

Laboratory experiments indicate that by the dissolving of the natural crust and recrystallization by artificial heat a salt mixture containing about 7 to 10 percent potassium may be recovered.

No future geologic work is recommended for the area but it is suggested that the deposit may be worked on a small scale to recover a pure table salt and, if the conditions warrant, the residual brine may be further treated to recover potash as a by-product.

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Introduction

Location and extent.--The Idri salt deposit, located at approximately 27°30'N latitude and 13°10'E longitude, covers an area of about 35 square kilometers. It lies about 135 kilometers west of Brach in the Shatti Valley area of the Fezzan province, United Kingdom of Libya. The area is connected by about 250 kilometers of secondary road to the newly constructed hard surface Fezzan road at a point 500 kilometers south of the main Tripoli-Benghazi coastal highway. (See plate I).

Nature of the deposit.--The Idri salt flat (sebcha) lies in a closed depression in a region of Devonian rocks whose interbedded sandstone and sandy siltstone are capped by a conglomeratic ferruginous sandstone (duricrust).

A measured section southeast of the salt flat is shown on plate II.

The origin of the deposit is attributed to the percolating meteoric waters which dissolve the soluble constituents from the surrounding sandstone and siltstone and carry them into the Idri depression. These waters are concentrated to a brine that saturates the sand, then by percolation, capillary action, and evaporation, salts accumulate on the surface in the form of evaporites, fig.1.

The deposit consists of a hard crust of fairly pure salt

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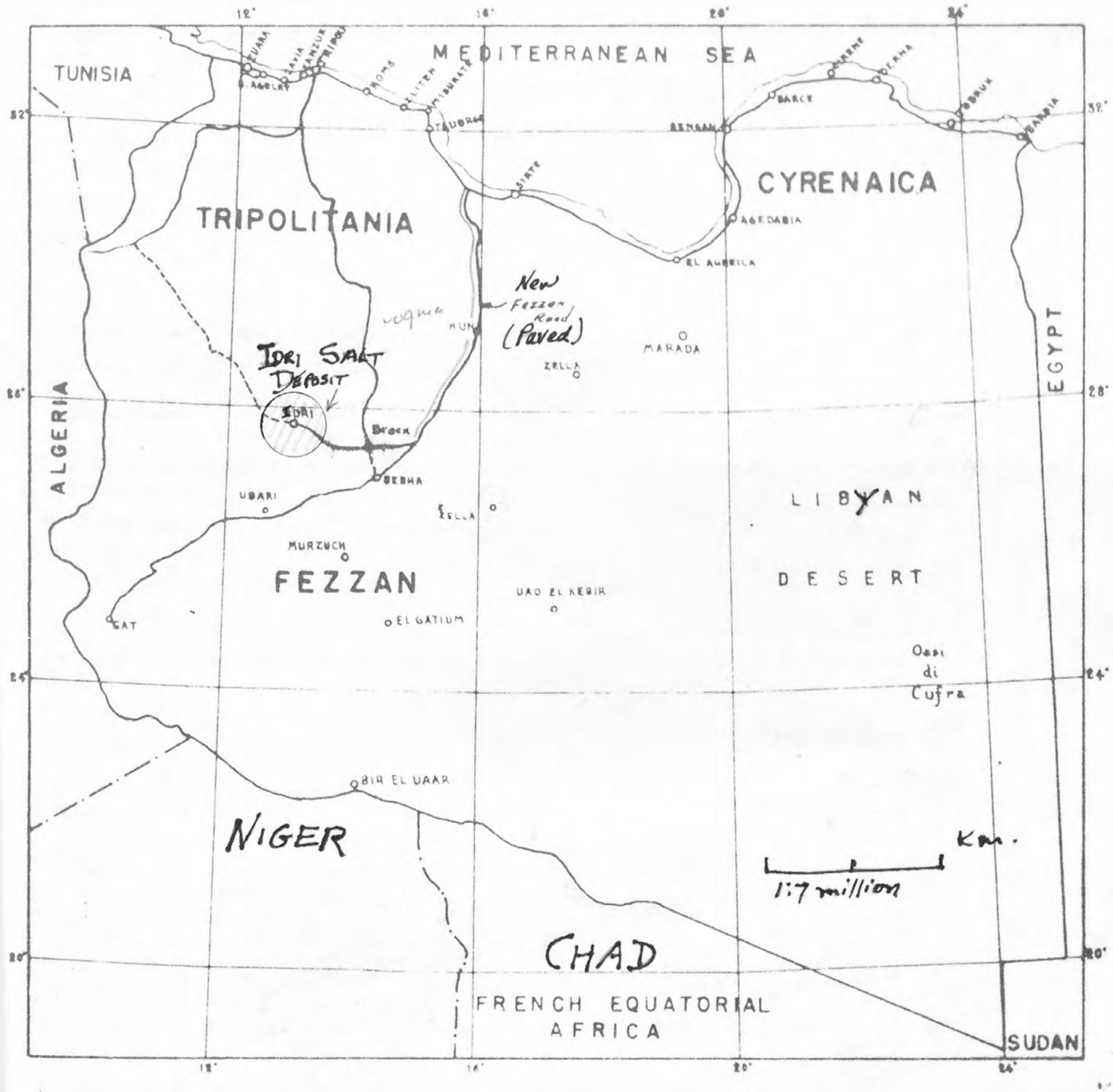


INDEX MAP SHOWING THE LOCATION OF IDRI SALT DEPOSIT
AND THE NEW ~~HARD SURFACE~~ FEZZAN ROAD

PLATE I

meters

Sandstone: dark-brown (desert tarnished)medium to coarse-grained, quartzitic. — 4.5

Sandstone: brown ferruginous,quartzitic — 1.5

Claystone: varicolored, sandy, inter-bedded with fine-grained sandstone. — 13.5

Sandstone: brown, fine-grained, ferruginous — 0.9

Claystone: gray, yellow, sandy — 3.0

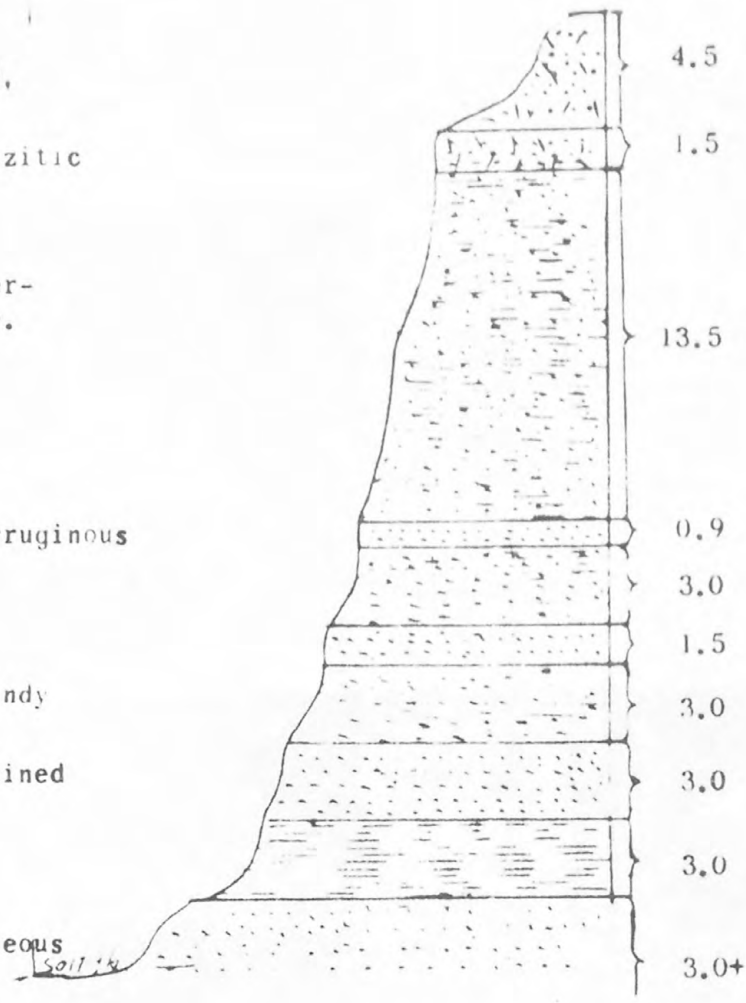
Sandstone: white, fine-grained — 1.5

Claystone: purple,yellow, gray, sandy and shaly. — 3.0

Sandstone: tan, fine to medium-grained — 3.0

Clay: gray, soft, gypseous — 3.0

Claystone: yellow, tan, sandy gypseous — 3.0+

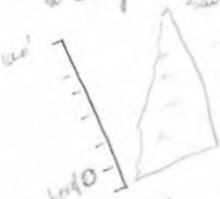


DEVONIAN SECTION SOUTH-EAST OF EDRI

Scale 1:250

PLATE II.

Author: Show elevations if available, Vertical scale could be shown directly on the section and thickness limits given in capture. I suggest scanning your graphic column to the left side with captions to right. Thus:



No elevations available in U.S. data given is sufficient for purpose. GFS per author

Figure 1. Idri salt flat. Extensive accumulation of salt crusts (Evaporite) cover an area of about 35 square kilometers (width of immediate foreground 21 feet).

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(NaCl) as much as 40 cm thick overlying an undercrust of salts and wet sand 40 cm thick. The brine occurs below this undercrust at an average depth of about 60 cm.

The chemical analyses show that the crust is composed essentially of halite (NaCl), but that small quantities of potassium and magnesium chlorides are present. The undercrust is a mixture of wet sand and salts and the brine contains comparatively little dissolved solids.

Previous work.--Local residents have worked the deposit on a very small scale as a source of table salt, but so far as known it had not been previously studied or investigated.

Present investigations.--The deposit was first examined by the writer in the spring of 1955 while carrying out geological reconnaissance studies in the Fezzan province. Several grab samples collected at that time had the following average composition in percent:

Na	27.40
K	5.55
SO_4	4.42
Cl	41.45
Mg	negligible

In 1956 the Libyan American Reconstruction Commission allocated funds for investigations of the deposit as a possible source of table salt and potash. The writer, on behalf of the

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Ministry of National Economy, undertook the investigation of the area.

Acknowledgement.--The work was carried out in the desert with Libyan Nationals who received on-the-job training in sampling techniques and other aspects of the field investigation.

Many thanks are due to the Fezzanese government officials and to Mohamed Jihani, Hameda Buazza, and Mohamed Burkais who assisted in all the field work and did the sampling during the different phases of the investigations.

Sampling.--As a first step, the area was sampled by digging 25 sample pits about 60 cm in diameter and as much as 1 meter deep to the water table. Samples were collected from the crust, the undercrust, and the brine. The locations of the sample pits, together with summaries of the chemical analyses of the samples, are shown on plate III. (In pocket)

The average composition of the 25 samples is shown on table I.

TABLE I

Composition of soluble salt from Idri deposit*

	NaCl	K_2O (Equiv.)	$MgCl_2$
Crust	69.9	3.4	1.6
Undercrust	13.5	0.7	0.4
Brine	11.2	0.6	0.6

*The water insoluble components were not determined.

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Solar evaporation.--The second phase of the study was the selection of 14 plots each 30 meters square for evaporation tests. As a first step, the crust was removed and samples of the crust, undercrust, and brine were collected. The locations of the plots, together with summaries of the sample analyses, are shown on plate IV. (In pocket).

In each plot 25 pits each about 3 meters square and one meter deep were dug to allow the brines to accumulate and evaporate. Brine samples were collected each week and although a trend towards gradually higher concentration was noted, no appreciable increase in the total dissolved solids was observed. Tables 2 to 15 show the range of composition of the brine during the experimental period.

A few inconsistencies in some of the tables probably result from errors introduced during field sampling, labelling, transportation, analysis, or other steps before reporting. The tabulations made in various tables are copied from the chemical laboratory analytical statements.

Figures 2 to 5 show the different stages of evaporation and figure 6 shows salts crystallized in a pit. Table 16 shows the comparison of the composition of the salt crystals formed in a pit with those of two samples of the naturally formed crust.

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TABLE 2

COMPOSITION OF BRINE AT IDRI PLOT No.1
(Weekly Samples Collected from May to Aug.1956)

Sample	Na	K	Cl	SO4	Mg	HCO3	Dissolved solids	Remarks
1	4.094	.373	6.574	1.349	.23	.026		
2	4.479	.409	7.208	1.445	.26	.026		
3	6.942	.595	11.042	1.965	.395	.038		
4	5.514	.493	8.715	1.642	.312	.030		
5	5.846	.486	9.353	1.726	.333	.021		
6	6.044	1.040	10.638	1.909	.352	.020	20.140	
7	6.104	1.075	10.736	1.859	.376	.019	20.260	
8	7.182	1.083	11.336	2.008	.374	.018	22.160	
9	7.339	1.097	11.797	2.074	.393	.018	22.820	
10	9.646	1.176	14.077	2.111	.526	.023	27.64	
11	12.395	.917	15.075	2.096	.443	.037	31.044	
12	9.978	.874	9.125	1.747	.413	.023	22.25	

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TABLE 3

COMPOSITION OF BRINE AT IDRI PLOT No.2
(Weekly Samples Collected from May to Sep. 1956)

Sample	Na	K	Cl	SO4	Mg	HCO3	Dissolved solids	Remarks
1	.721	.097	1.193	.23	.048	.03		
2	.997	.137	1.664	.315	.067	.03		
3	7.003	.776	10.46	1.67	.377	.020	20.420	
4	1.232	.222	1.985	.422	.094	.035	4.020	
5	1.223	.243	2.127	.442	.096	.036	4.220	
6	1.554	.271	2.268	.534	.102	.028	4.800	
7	1.524	.278	2.411	.540	.107	.034	4.940	
8	1.574	.280	2.66	.564	.115	.033	5.280	
9	2.221	.466	2.526	.450	.118	.03	6.016	
10	2.090	.432	2.773	.481	.030	.030	5.896	
11	1.994	.491	3.120	.584	.125	.040	6.420	
12	1.732	.458	2.721	.452	.091	.016	5.540	

TABLE 4

COMPOSITION OF BRINE AT IDRI PLOT No.3
(Weekly Samples Collected from May to Aug.1956)

Sample	Na	K	Cl	SO4	Mg	HCO3	Dissolved solids	Remarks
1	2.02	.148	3.287	.300	.053	.015		
2	2.601	.189	4.180	.375	.066	.023		
3	2.442	.201	4.535	.408	.078	.026		
4	3.406	.397	5.496	.502	.106	.031	10.006	
5	2.421	.571	4.722	.502	.073	.024	8.360	
6	2.264	.574	5.07	.518	.075	.025	8.580	
7	2.211	.579	5.071	.567	.094	.028	8.620	
8	3.074	.584	5.106	.526	.093	.025	9.480	
9	3.050	.586	5.141	.609	.087	.024	9.560	
10	3.092	.587	5.248	.510	.089	.030	9.620	
11	4.161	.906	6.52	.499	.126	.019	12.300	
12	3.851	.81	5.868	.642	.097	.028	11.36	

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TABLE 5

COMPOSITION OF BRINE AT ADRI PLOT No. 4
(Weekly samples collected from July to Aug. 1956)

Sample	Na	K	CL	SO_4	Mg	HCO_3	Dissolved solids	Remarks
1	2.351	.834	3.528	.425	.037	.024	7.298	
2	3.746	.523	4.361	.540	.120	.022	9.420	

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TABLE 6

COMPOSITION OF BRINE AT EDRI PLOT No.5
(Weekly Samples Collected from May to Aug. 1956)

Sample	Na	K	Cl	SO4	Mg	HCO3	Dissolved solids	Remarks
1	5.554	.49	8.865	1.497	.30	.021		
2	6.014	.537	9.708	1.60	.333	.027		
3	1.174	.293	1.95	.460	.086	.050	4.040	
4	7.497	.680	10.106	1.851	.357	.032	20.70	
5	7.67	.565	10.247	1.852	.344	.023	20.90	
6	7.418	.53	10.247	1.695	.369	.023	20.44	
7	8.010	.60	10.708	1.695	.387	.024	21.600	
8	8.057	.668	10.886	1.703	.395	.025	21.92	
9	8.087	.609	10.887	1.571	.389	.026	21.73	
10	11.192	.962	14.487	1.738	.391	.029	28.896	

TABLE 7

COMPOSITION OF BRINE AT EDRI PLOT No.6
(Weekly Samples Collected from Jun to Sep.1956)

Sample	Na	K	Cl	SO4	Mg	HCO3	Dissolved solids	Remarks
1	2.534	.284	3.309	.556	.075	.010		
2	3.003	.308	4.538	.576	.087	.016	8.740	
3	3.150	.313	4.716	.411	.091	.015	8.92	
4	3.125	.289	4.847	.452	.09	.013	9.040	
5	3.189	.316	4.787	.650	.095	.011	9.30	
6	3.162	.329	4.787	.70	.10	.011	9.32	
7	3.310	.329	4.751	.625	.10	.025	9.36	
8	3.406	.851	4.372	.644	.09	.014	9.546	
9	3.484	.867	4.832	.664	.096	.016	10.146	
10	3.297	.60	5.070	.773	.076	.042	10.10	
11	3.478	.347	5.21	.70	.066	.006	9.93	

TABLE 8

COMPOSITION OF BRINE AT IDRI PLOT No.7
(Weekly Samples Collected from May to Sep. 1956)

Sample	Na	K	Cl	SO4	Mg	HCO3	Dissolved solids	Remarks
1	11.837	2.072	17.411	.963	.280	.019	32.76	
2	14.83	2.320	20.034	.946	.370	.019	38.70	
3	12.193	2.257	19.467	.897	.347	.017	35.34	
4	13.489	2.613	20.52	.946	.399	.019	37.66	
5	14.46	2.73	20.318	.954	.432	.019	39.04	
6	20.156	3.176	20.433	1.013	.232	.018	45.100	
7	13.321	3.159	20.46	1.234	.459	.016	38.78	
8	13.617	3.12	19.928	1.201	.488	.016	38.52	

TABLE 9

COMPOSITION OF BRINE AT EDRI PLOT No.8
(Weekly Samples Collected from Jun to Oct.1956)

Sample	Na	K	Cl	SO4	Mg	HCO3	Dissolved solids	Remarks
1	2.391	.241	3.617	.461	.134	.043	7.000	
2	3.052	.243	4.113	.608	.156	.044	8.32	
3	3.075	.284	4.202	.617	.145	.048	8.46	
4	3.101	.282	4.219	.535	.150	.047	8.46	
5	3.284	.291	4.252	.452	.144	.042	8.56	
6	2.670	.494	4.131	.493	.148	.046	8.044	
7	6.836	.688	5.564	.490	.136	.049	13.796	
8	3.148	.265	4.45	.451	.145	.042	8.59	
9	3.204	.261	4.468	.475	.145	.043	8.68	
10	2.576	.246	4.184	.444	.120	.073	7.83	
11	2.073	.254	3.723	.65	.141	.069	8.20	

TABLE 10

COMPOSITION OF BRINE AT [illegible]DRI PLOT No.9
(Weekly Samples Collected from May to Sep. 1956)

Sample	Na	K	Cl	SO4	Mg	HCO3	Dissolved solids	Remarks
1	2.295	.195	3.762	.401	.102	.016		
2	3.608	0.485	4.929	.584	.146	.022	9.98	
3	3.949	.509	5.638	.593	.17	.022	11.02	
4	3.916	.510	6.134	.610	.176	.022	11.46	
5	3.941	.51	6.347	.617	.181	.025	11.74	
6	3.942	.506	6.347	.559	.176	.023	11.68	
7	3.928	.505	6.134	.576	.176	.024	11.46	
8	8.453	1.46	11.33	.636	.176	.025	22.162	
9	10.342	1.15	14.600	1.170	.481	.022	27.668	
10	3.995	.508	6.88	.57	.188	.028	12.270	
11	3.68	.274	5.71	.68	.154	.023	10.26	
12	3.33	.244	5.744	.70	.157	.01	10.31	

TABLE 11

COMPOSITION OF BRINE AT IDRI PLOT No. 10
(Weekly samples collected from Jul to Jul. 1956)

Sample	Na	K	CL	SO_4	Mg	HCO_3	Dissolved solids	Remarks
1	1.596	0.468	3.191	.584	.025	.017	6.04	
2	1.917	0.472	3.546	.633	.052	.019	6.82	
3	2.243	0.412	3.712	.525	.030	.024	7.088	

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TABLE 12

COMPOSITION OF BRINE AT IDRI PLOT No. 11
(Weekly samples collected from May to Sep. 1956)

Sample	Na	K	CL	SO_4	Mg	HCO_3	Dissolved solids	Remarks
1	8.490	1.130	14.180	2.690	.057	.032		
2	11.310	0.787	14.435	1.706	.241	.025	28.000	
3	8.872	1.247	14.010	1.245	.261	.080	25.948	
4	9.195	0.783	14.077	1.522	.261	.026	25.980	
5	9.063	0.775	12.286	1.349	.309	.022	23.900	
6	7.940	0.773	12.430	1.325	.241	.021	23.980	

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TABLE 13

COMPOSITION OF BRINE AT SUDRI PLOT No. 12
(Weekly samples collected from Aug. to Sep.1956)

Sample	Na	K	CL	SO_4	Mg	HCO_3	Dissolved solids	Remarks
1	4.176	.446	5.996	0.513	.086	.065	11.427	
2	4.318	.484	7.145	0.678	.099	.018	12.900	
3	4.574	.569	7.233	0.658	.098	.033	13.300	
4	4.082	.244	6.737	0.584	.088	.015	12.430	
5	4.255	.269	6.985	0.646	.089	.013	12.850	

TABLE 14

COMPOSITION OF BRINE AT DRI PLOT No. 13
(Weekly samples collected from Aug. to Oct. 1956)

Sample	Na	K	CL	SO_4	Mg	HCO_3	Dissolved solids	Remarks
1	1.985	0.221	2.482	.464	.060	.024	5.279	
2	1.981	0.320	3.155	.641	.077	.048	6.300	
3	2.070	0.176	3.475	.642	.079	.025	7.850	
4	2.310	0.206		.584	.108	.020	8.230	

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TABLE 15

COMPOSITION OF BRINE AT IDRI PLOT No.14
(Weekly samples collected from May to Sep. 1956)

Sample	Na	K	CL	SO_4	Mg	HCO_3	Dissolved solids	Remarks
1	1.004	.145	1.489		.055	.027	3.252	
2	1.386	.185	1.970	.560	.071	.030	4.280	
3	1.000	.171	1.740	.395	.056	.045	3.480	
4	0.891	.113	1.702	.418	.074	.025	3.710	

Figure 2.--Experimental plots at Edri. Crust was removed and 25 pits 3 meters square were dug to the water table.

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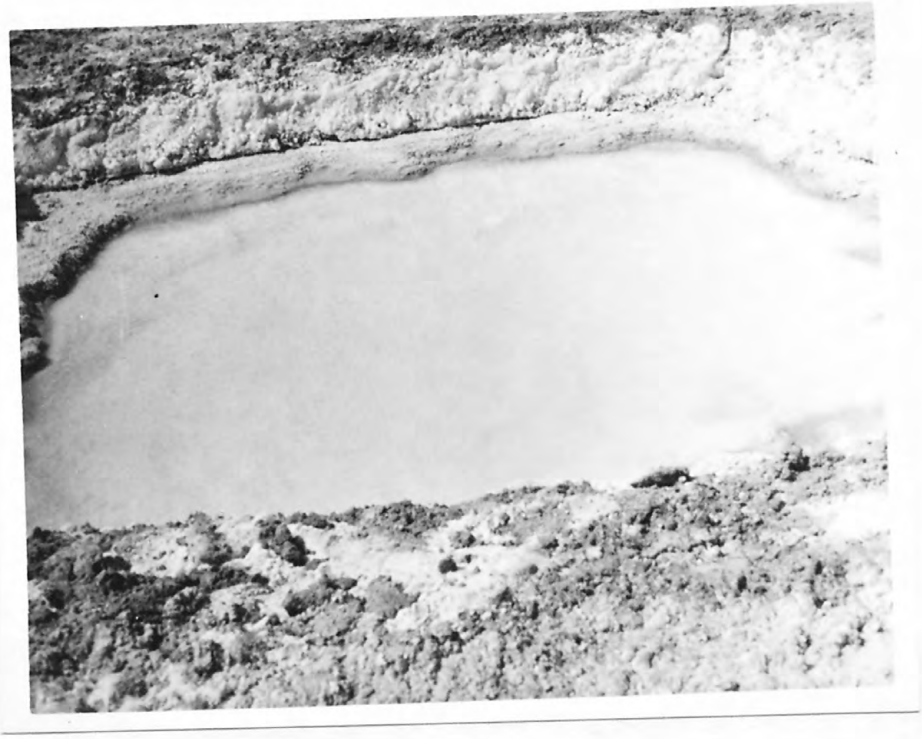

Figure 3. Pit at Idri containing supersaturated salt solution formed after about one week; 3 meters square.

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Figure 4. Crystals formed in bottom of a pit at Idri over a period of about two weeks.

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Figure 5. Crystalline salts forming in bottom of a pit at Idri over a period of about five weeks.

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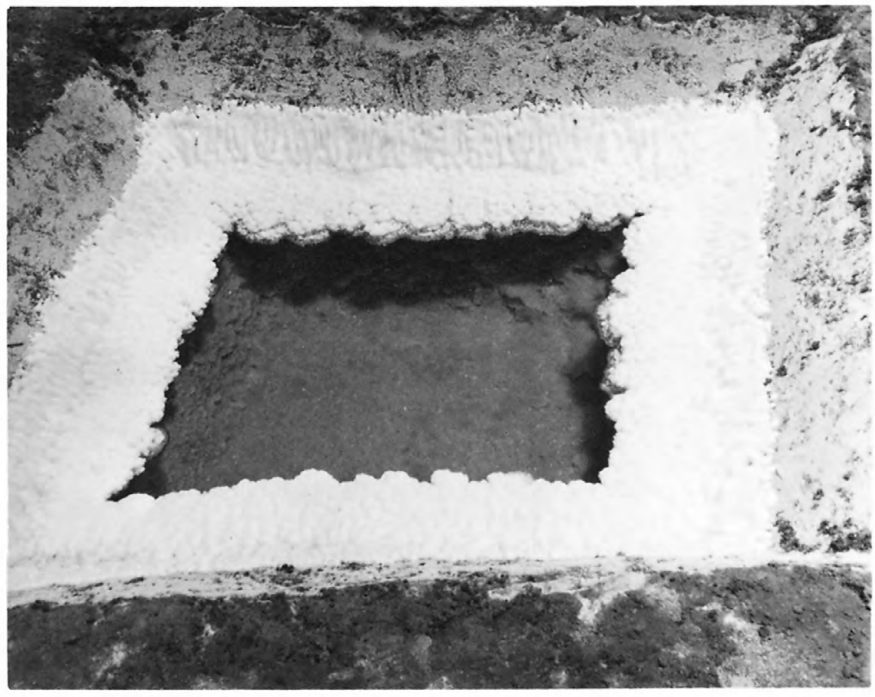

Figure 6. Crystalline crust formed on top and bottom of a pit by allowing brine to accumulate and evaporate.

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TABLE 16

Composition of crystallized salts in a pit at Idri and two samples of the natural crust.

	Na	K	Mg	Cl	SO_4	Insol.
Crystallized salt	37.1	0.5	0.06	59.1	1.1	0.3
Natural salt (1)	32.5	2.0	0.14	53.3	2.5	6.7
Natural salt (2)	35.3	1.9	0.06	54.4	2.4	4.4

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Fractional crystallization by solar evaporation.--As a third phase of the investigation, two tanks were constructed in each plot and designated as Tank A and B. Brines from each plot were poured into Tank A, sampled and allowed to evaporate. After several days the residual brine was transfered to Tank B, sampled, and allowed to evaporate to dryness fig. 7. The crystallized salts from each tank were collected, weighed, and sampled. The initial volume and composition of the brine in each tank, the date sampled and the number of days in the tank including the weight and the composition of the crystallized salts are all incorporated in table 17.

The results of the experiments on fractional crystallization by solar evaporation were not conclusive. However, the tests indicated that a fairly pure table salt may be obtained from the brines at Edri on first stages of crystallization (Tank A). Analyses of the residual brines and those of the salts collected from tank B, the second stage, show that they contain an average of 4.7 percent K_2O equivalent. This residue might be further treated and potash (K_2O) extracted as a by-product on a small scale. It was further noted that plots 8, 9, 11 and 12, located along the edges of the area, yielded an average of 1.11 percent of equivalent K_2O, in Tank B, and almost none in Tank A. Plots 1 to 7, 10 and 14, in the central part of the deposit yielded an average of 4.02 percent K_2O equivalent in Tank A and 5.9 percent in Tank B.

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TABLE 17

IDRI SALT FLATS

Results of Fractional Crystallization

BY SOLAR EVAPORATION

LOCATION		BRINE					SALT CRYSTALS				
		Initial VOLUME	ANALYSIS Na	Mg	K_2O	DATE	Total Days	Weight (Kg)	ANALYSIS Na	Mg	K_2O
		cu.m.									
PLOT Nº 1	TANK A	1.260	21.368	0.362	2.844	8/15/56	26	148	33.284	0.413	5.016
	TANK B	0.360	11.500	1.235	1.872	8/29/56	20	132	28.035	2.030	10.013
PLOT Nº 2	TANK A	1.260	Lost sample			9/9/56			No crystal formed		
	TANK B	0.300	4.231	0.217	0.595	9/23/56		28	32.577	0.632	7.036
PLOT Nº 3	TANK A	1.187	3.542	0.098	0.360	8/28/56	17	26	33.542	0.017	5.200
	TANK B	0.120	11.680	0.308	1.698	9/11/56	5	15	33.734	0.153	4.728
PLOT Nº 4	TANK A	1.089	5.012	0.389	0.762	8/22/56	20	17	13.225	0.192	0.936
	TANK B	0.210	33.505	0.045	5.231	9/5/56	9	35	35.086	0.153	3.908
PLOT Nº 5	TANK A	1.200	12.937	0.446	1.284	8/12/56	28	150	33.623	0.336	5.241
	TANK B	0.295	No sample			8/26/56	16	55	31.684	0.722	4.826
PLOT Nº 6	TANK A	1.200	6.873	0.674	0.408	9/15/56	14		No crystal formed		
	TANK B	0.436	8.003	0.148	1.012	9/29/56		84	30.535	0.384	8.667
PLOT Nº 7	TANK A	1.072	13.617	0.488	3.744	9/1/56	22	238	34.872	0.255	6.152
	TANK B	0.238	8.626	0.706	6.193	9/15/56		83	36.824	1.150	4.005
PLOT Nº 8	TANK A	1.050	2.495	0.140	0.300				No crystal formed		
	TANK B	0.600	3.910	0.158	0.450				No crystal formed		
PLOT Nº 9	TANK A	1.000	3.622	0.168	0.316	10/3/56	14		No crystal formed		
	TANK B		7.190	0.168	0.316	10/17/56		45	34.355	0.117	1.388
PLOT Nº 10	TANK A	1.260	2.424	0.062	0.322	8/4/56	16	6	11.911	0.084	1.588
	TANK B	0.404	8.907	0.056	1.660	8/18/56	30	54	34.655	0.039	6.084
PLOT Nº 11	TANK A		7.762	0.254	0.903	9/27/56	15	144	34.002	0.142	1.353
	TANK B		Lost sample				14		No crystal formed		
PLOT Nº 12	TANK A	0.945	4.140	0.086	0.316			62	35.252	0.096	1.576
	TANK B		7.302	0.096	0.574						
PLOT Nº 13	TANK A		No Record								
	TANK B		Samples Lost				14		No crystal formed		
PLOT Nº 14	TANK A	0.780	0.890	0.057	0.132	9/20/56		22	34.961	0.260	3.745
	TANK B	0.265	2.760	0.093	0.319	10/4/56					
PLOT Nº	TANK A										
	TANK B										
PLOT Nº	TANK A										
	TANK B										

Figure 7. Evaporation to dryness was done in vats from which the crystallized salts were collected, weighed, and sampled for purposes of the study.

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Test pits in the bedrock.--In two of the several springs on the slopes of Idri Hill in the center of the area, some secondary sulphur, possibly a product of the decomposition of gypsum or anhydrite, were noted. Consequently 13 test pits were dug on the Idri Hill in the bedrock to the water table for sampling purposes. The pits were about 1 x 0.50 meters and ranged from 0.33 meter to 2.40 meters in depth. Plate V shows the location of these pits on Idri Hill and also the location of sample holes and plots in the area. Each pit was sampled and the average compositions of the sample are shown on table 18.

It is noteworthy that samples collected from the pits on the Idri Hill contained an average of 0.98 percent potassium. This supports the theory that percolating meteoric waters are partially responsible for the comparatively high potassium concentration in the Idri deposit.

Laboratory experiments.--Experiments were carried out at the Sidi Mesri Chemical Laboratory in an attempt to determine the amounts of potassium that could be recovered from the deposit.

Bulk samples were crushed and one kilogram sample of the salt were dissolved in 5 liters of water. The solutions at 10^{0} Baume were heated slowly and evaporated to dryness.

Four samples of the crystallized salts were collected at different times during the process. Table 19 shows the compositions of these salts.

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TABLE 18

AVERAGE COMPOSITION OF THE BEDROCK PIT SAMPLES

Pit No.	Total Depth m.	Fe	K	S	Percent HCl soluble
1	2.10	22.00	0.60	0.03	50.66
2	1.40	9.65	0.83	0.03	22.56
3	2.07	9.54	0.29	0.04	30.51
4	2.40	3.37	0.35	0.03	52.60
5	1.72	11.29	0.84	0.02	31.05
6	0.33	8.16	1.91	0.04	50.80
7	0.67	6.48	1.87	0.04	38.80
8	1.94	6.31	0.75	0.01	16.10
9	2.00	5.21	0.80	0.01	19.71
10	1.08	7.39	1.73	0.02	44.50
11	1.44	7.43	1.15	0.01	38.50
12	1.13	8.25	0.63	0.01	22.00
13	1.39	No samples			

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TABLE 19

Composition of salts recrystallized by ~~artificial heat~~ laboratory methods

	Cl	K	Mg	Ca	Na	SO_4
(1)	56.6	1.1	-	-	36.2	-
(2)	58.0	1.7	-	-	35.9	-
(3)	55.1	6.6	0.2	0.7	32.0	3.1
(4)	53.8	10.0	0.4	0.3	28.9	2.4

The crystals were dried and weighed and the laboratory reported that from 1 kilogram of salt 120 grams of #3 and 80 grams of #4 salts may be recovered by artificial heat.

The above experiments indicate that from one metric ton of the naturally-formed crusts approximately 200 kilograms of a product containing 6 to 10 percent potash (K_2O) equivalent may be recovered.

Summary and recommendation.--No future geologic studies or further investigation of the Idri salt deposit are recommended.

The studies already made suggest that the deposit may be worked on a comparatively small scale as a source of pure table salt for local use. If the conditions warrant the residual brines could be further treated and potash recovered as a by-product.

It is estimated that the present crust of the deposit contains about 3,000,000 metric tons of crude natural salt which represents about 2,000,000 tons of table salt and 100,000 tons of

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potash (K_2O) equivalent. However, the salt crust would continue to accumulate on the surface and it is estimated that within five years the harvested areas would be covered by a new salt crust. Consequently the deposit could be worked repeatedly if selective harvesting is practiced and only 20 percent of the area is mined in one year.

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POCKET CONTAINS
3 ~~X~~ ITEMS.

#2