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NATIVE ROCKS AS FERTILIZER[1]

By

Dr. W. D. Keller*

Abstract

From the Organic Farmer, April 1950

The original fertility of a soil is the result of two processes: the accumulation of humus and the weathering of the source rock. Organic farmers believe that when soil fertility has been depleted it can best be restored by duplicating these natural processes, that is, by adding organic matter and native rocks to the soil. This article focuses attention on the second process - the addition of native rock which when weathered will provide the desired nutrient elements.

Origin of primary fertility

Rocks in general contain the main nutrient elements, except for nitrogen, which plants require. The rocks and minerals must first undergo weathering (alteration) to form soil (soil is composed mainly of sand, clay, and yellow, red, or brown iron oxides). During the weathering process, soluble forms of compounds of potassium, phosphorus, calcium, magnesium, sodium, and trace elements such as manganese, copper, cobalt, zinc, boron, and others are formed. Then, through the action of the colloidal fraction of the clay and humus, the elements listed above are taken from solid rock and are made available in a useful form to the rootlets.

Nutrient transfer via clay and humus

The rootlets withdraw much of the nutrient elements from the clay and humus and exchange hydrogen (acidity) for the calcium, potassium, etc. removed. The acid clay and humus establish chemical balance again by extracting from adjacent rock fragments more potassium, calcium, etc. This weathering action by acid soil and organic matter on rock particles breaks down the rock into more clay, more soil, and releases the desired nutrients.

A useful rock donor must have these two qualifications: it must contain the elements useful as plant nutrients and it must be relatively susceptible to weathering. Possessing these two qualifications, it becomes a long-lasting soil builder.

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[1] The State Department of Geology and Mineral Industries is directly concerned with sources of rocks and minerals which contain possible nutrient elements such as calcium, magnesium, phosphorus, potassium, and sodium, together with various trace elements needed for certain crops. Supplementing the accompanying abstract of article by Dr. Keller there is appended a list of mineral analyses of Oregon samples which show the presence of possible desirable elements. Some of the analyses made primarily to determine trace elements are semi-quantitative. Ed.

Natural versus processed additions

The elements liberated from native rock will be considerably more diverse than those of the more nearly pure, processed fertilizers and will normally include trace elements.

One of the many disadvantages of processed chemical fertilizer is its tendency to overstock the soil with the few elements contained in the fertilizer. Thus, by greatly oversupplying some constituents it creates nutrient deficiencies in others.

Effective rock types

A. CALCIUM DONORS

1. Agricultural limestone (agstone) supplies calcium to the soil. Too much of a dose, however, will blot out the availability of other elements by neutralizing the acid activity. Preference is now swinging from pure calcium limestone to limestone containing a variety of elements, because the primary function of limestone is to fertilize not neutralize.

2. Gypsum supplies calcium and sulphur to the soil. It is slightly soluble in nonacid soils, such as alkali soils of dry western states.

3. Raw phosphate rock supplies calcium, phosphorous, and some trace elements.

B. MAGNESIUM-CONTAINING ROCKS

1. Dolomite supplies calcium and magnesium. Magnesium is very important to the formation of chlorophyll. The magnesium-to-calcium ratio should not be allowed to drop below 1 to 10 because an over-liming neutralizes the acidity which is necessary to liberate the magnesium.

2. Igneous and metamorphic rocks. Those that contain plagioclase feldspars release calcium through reaction with clays and humus. These silicate compounds of calcium are more resistant to weathering than are limestones, hence response of soil to them is slower.

   Dunite and peridotite contain olivine, a magnesium iron silicate, and release magnesium to the soil.

C. POTASSIUM ROCK SOURCES

1. Glauconite-bearing rocks furnish potassium, calcium, and magnesium. Glauconitic dolomites in eastern states average 6 percent potassium.

2. Leucite-bearing rocks. Leucite is an aluminum magnesium silicate which weathers fairly rapidly. Known occurrences in the United States are limited to Wyoming and Montana. Wyoming leucite rock analyses are as follows: 9 percent potassium oxide, 6 percent calcium oxide, 7 percent magnesium oxide, 2 percent phosphorus pentoxide, and trace elements. The rock consequently makes a highly valuable fertilizer. Volcanic ash from Vesuvius in Italy is notably high in leucite.

3. Granite contains potassium feldspar but responds slowly to weathering.

4. Volcanic ash, the extrusive equivalent of granitic rock, is ordinarily more susceptible to weathering than its crystalline equivalent. In many respects volcanic ash is close to the ideal, naturally pulverized rock fertilizer.

D. Other materials such as slags from metallurgical furnaces, portland cement clinkers, and waste products due to improper burning of lime or dolomite may be effective as rock fertilizers.

Pulverizing of rocks essential

Silicate rocks should be pulverized finer than carbonates (limestone and dolomite), volcanic ash excepted. Some pulverized materials available in nature may be applied to the soil in their natural form. These are: silt from river bottoms, wind-blown dust (loess), and volcanic ash.

Agricultural stone, once considered to be the "poor relative" of fertilizers, now ranks with them as a native fertilizer. Moreover, agricultural limestone producers are now blending their products with other native rocks and minerals to meet particular soil needs. The rock-fertilizer industry is still in its infancy, consequently many deposits of potential fertilizers are yet to be recognized.

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SOME ANALYSES OF OREGON ROCKS INDICATING POSSIBLE FERTILIZING VALUE

Chemical analyses of samples of rhyolite and perlite from Lady Frances mine on the Deschutes River, 14 miles south of Maupin, Wasco County:

		Rhyolite	Perlite
SiO_2	(silica)	75.88 %	73.28 %
Al_2O_3	(alumina)	12.63	12.55
Fe_2O_3	(ferric oxide)	1.05	.58
FeO	(ferrous oxide)	.27	.63
MgO	(magnesia)	.14	.08
CaO	(lime)	.60	.80
Na_2O	(soda)	2.80	2.97
K_2O	(potash)	5.32	5.00
H_2O+	(combined water)	.54	3.60
H_2O-	(water below 100°C.)	.43	.19
TiO_2	(titania)	.09	.09
P_2O_5	(phosphorus pentoxide)	.03	.01
MnO	(manganese oxide)	.01	.02
	Total	99.79	99.80

Analyses by James Kerr, University of Minnesota, October 23, 1946.

Volcanic cinders

Laidlaw Butte, Deschutes County
$N\frac{1}{2}$ sec. 36, T. 16 S., R. 11 E.

SiO_2	38.04 %
Fe_2O_3	8.23
Al_2O_3	19.00
CaO	7.35
MgO	3.77
H_2O+	1.50
H_2O-	0.14
Na_2O	12.76
K_2O	8.50
Total	100.09

Analysis by State Department of Geology and Mineral Industries.

Pumice

North of Chemult, Klamath County
Sec. 8, T. 27 S., R. 8 E.

SiO_2	68.56 %
TiO_2	.58
Al_2O_3	14.22
Fe_2O_3	1.42
FeO	1.49
MnO	.03
MgO	.83
CaO	2.35
Na_2O	5.18
K_2O	2.47
P_2O_5	.10
CO_2	None
H_2O	3.32
Total	100.55

Analysis by U.S. Geological Survey. Bull. 875, p. 159.

Spectrographic Analyses

	Elements					
Name and location	Over 10%	10% - 1%	1% - 0.1%	0.1% - .01%	.01% - .001%	below 0.001%
Marquam limestone (shell marl) Sec. 2, T. 6 S., R. 1 E., 1 mile NE of Marquam Clackamas County	silicon calcium	aluminum iron sodium potassium	magnesium strontium	titanium	manganese vanadium barium	chromium nickel
~~Dallas~~ limestone Oregon Lime Products quarry Sec. 11, T. 8 S., R. 6 W.,Polk County	silicon aluminum calcium	iron sodium	magnesium manganese titanium potassium	chromium copper barium strontium	vanadium nickel	boron
Limestone O.P.C. quarry Secs. 26, 27, 34, and 35, T. 13 S., R. 44 E., Lime Baker County	calcium	silicon aluminum magnesium	iron sodium strontium	potassium	manganese titanium barium	chromium vanadium copper
Limestone Cottrell dust Oswego plant of O.P.C. Company Mixture of Lime and Dallas fines from stack	silicon calcium	aluminum iron magnesium sodium	titanium strontium potassium	lead	manganese chromium barium nickel	vanadium copper
	(Note: Chemical analysis shows sulphur = 1.30% and sulphur trioxide = 2.41%. Spectrograph does not determine sulphur.)					
Volcanic ash Sec. 32, T. 2 N., R. 21 E., 5 miles S. of Arlington Gilliam County	silicon	aluminum potassium	iron calcium	magnesium titanium barium strontium	manganese vanadium gallium boron	chromium copper beryllium nickel
Rhyolite Juniper Ridge $S\frac{1}{2}$ sec. 36, T.23 S. R. 25 E. Harney County	silicon aluminum	iron sodium potassium	magnesium calcium titanium	manganese lead barium strontium	chromium vanadium copper nickel boron	
Volcanic ash from Bend pumice pit Sec. 25, T. 17 S., R. 11 E. Deschutes County	silicon aluminum sodium	iron calcium potassium	barium	magnesium strontium	manganese titanium vanadium	chromium copper nickel boron
Pumice North of Chemult Sec. 9, T. 27 S., R. 8 E. Klamath County	silicon aluminum	iron calcium sodium potassium	magnesium titanium strontium	manganese lead barium	chromium vanadium nickel boron copper	

Name and location	Elements: Over 10%	10% - 1%	1% - 0.1%	0.1% - .01%	.01% - .001%	below 0.001%
Siltstone Keasey shale Sunset tunnel Sec. 24, T. 3 N., R. 5 W. Washington County	silicon aluminum	iron calcium sodium	magnesium manganese titanium potassium	chromium copper barium strontium	vanadium nickel boron	
Peridotite Near Gravelford Coos River Sec. 35, T. 28 S., R. 12 W. Coos County	silicon magnesium	aluminum iron	calcium potassium chromium nickel	sodium manganese titanium vanadium boron	copper barium strontium cobalt	
Powder River silt at Donny Creek Sec. 35, T. 10 S., R. 39 E. Baker County	silicon aluminum	iron magnesium calcium sodium titanium potassium	barium strontium	manganese lead chromium vanadium copper nickel	boron	molybdenum
Powder River silt from entrance to irrigation ditch north end of Baker Sec. 17, T. 9 S., R. 40 E. Baker County	silicon	aluminum calcium potassium	iron magnesium sodium barium strontium	manganese titanium chromium	vanadium copper	nickel boron

All spectrographic analyses were made in the Department's laboratory.

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SUMPTER DREDGE SOLD

According to the Baker Record Courier dated July 20, 1950, the Baker Dredging Company has sold its Sumpter Valley dredge to the Powder River Dredging Company reportedly organized with Portland capital. The dredge will work new ground tested a few years ago in the lower end of the valley. Carl Deibolt, Portland, is president of the new company and L.A.Skillings will be Resident Manager.

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BUFFALO MINE ACTIVE

Production at the Buffalo mine, eastern Grant County, is being continued under the direction of R. G. Amidon. An expanded development program is planned to include a long adit tunnel which will explore the veins at a vertical depth of 650 feet. The Buffalo has been a consistent shipper since World War II. In mining, high-grade gold ore is sorted and low-grade is treated in a flotation plant. Sorted ore and concentrates are usually shipped in the same car.

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ORE BUYER VISITS OREGON MINES

David A. Somerville, ore buyer for the Tacoma Smelter, visited mining districts in both southwestern and northeastern Oregon during the week beginning July 17. Mr. Somerville investigated possibilities of obtaining ore shipments, especially shipments of siliceous ore.

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WE CAN PRODUCE HIGH-GRADE CHROME ORE

By
Fayette I. Bristol*
Rogue River, Oregon

This paper is being written as the United States is undergoing partial mobilization to fight a war in Korea with very good chances of it breaking out in other parts of the world.

As of today there is no domestic production of chrome ore in the United States. Our stockpile of chrome ore is very short.

The writer's background in domestic chrome ore production is as follows:

Was a chrome ore producer in 1942, 1943, and 1944.

Was chairman of Military Affairs Committee hearing and an RFC hearing held in Grants Pass, Oregon. Out of these meetings came the establishment of local buying depots for strategic minerals during the war.

President of Oregon Mining Association and member of American Institute of Mining and Metallurgical Engineers.

During the war with Germany and Japan substantial production of high-grade chrome was made. The stockpile at Grants Pass, Oregon, received approximately 50 percent of the high-grade chrome produced and production continued up to and including the spring of 1949 when operating costs climbed above the market price.

This area of chrome ore producing mines is throughout Jackson, Josephine, and Curry counties in Oregon and Siskiyou and Del Norte counties in California. All of this country is very rugged. In most cases the chrome mines are on high ridges where much snow is encountered during the winter. Truck hauls will average 60 miles. A very few mines can operate during the winter although the climate in the valleys is mild. There are in this area approximately 350 mines and prospects from which some chrome ore can be produced.

Chrome ore occurs in irregular kidneys in the peridotites. The remarkable thing about these kidneys is that the best place to look for another one is in the neighborhood of the one you have just finished mining out. It is very rare that a chrome mine has any real tonnage blocked out. Development work is the biggest part of the cost.

The largest producers in World War I were the largest producers in World War II, even though most of them were considered worked out in World War I.

The modern bulldozer opened up many new areas in World War II. So today after producing more chrome ore than was thought possible during World War II there is now more high-grade chrome ore indicated than was the case in 1941.

In 1941 it was possible to get good miners in this area for $26 per week. The price paid for chrome ore during 1942 and 1943 was based on this wage scale. It so happens that as of the present the lumber mills have moved into this area and it is enjoying the highest wages in the United States, plus a boom. The men in the woods are now getting $85 and $100 per week and are the same type of help needed to mine chrome ore.

The foregoing are the basic problems of producing chrome ore.

This area can produce:

30,000 tons of metallurgical grade chrome ore in 1951
75,000 " " " " " " " 1952
110,000 " " " " " " " 1953

To do this the following must be done:

Program made effective by September 1, 1950, delivery to be accepted in Grants Pass, Oregon, and Yreka, California, after this date in carload lots and truck load lots by January 1, 1951.

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*President Oregon Mining Association.

Prices good through 1953.

As the grade of chrome ore delivered will depend more on the price structure than anything else. The price must favor the highest grade.

Basic Price

$120 per long dry ton of 2240 pounds for ores and concentrates analyzing as follows:

Chromic oxide (Cr_2O_3) 48.00%

Chromium (Cr) to iron (Fe) ratio 3.00:1

(The chromium (Cr) content of any ore or concentrates is 68.4 percent of the chromic oxide (Cr_2O_3) content)

Premiums

Chromic oxide content - above 48 percent $5.00 per ton for each 1 percent of chromic oxide content.

Chromium to iron ratio - above 3.00 to 1: $5.00 per ton for each 0.10 to 1 ratio up to but not exceeding 4.00 to 1.

Penalties

Chromic oxide content - below 48 percent: $4.00 per ton for each 1 percent of chromic oxide content down to and including 40 percent.

Chromium to iron ratio - below 3.00 to 1: $3.00 per ton for each 0.10 to 1 ratio down to and including 2 to 1.

This price schedule means paying approximately $50.00 per ton premium for domestic chrome ore or a total cost to the nation of $5,000,000 per year to insure a supply of high-grade chrome ore.

During the war with Germany and Japan over 63 of the first 68 boats carrying chrome ore to the United States were sunk. So the cost of $5,000,000 per 100,000 tons would be a real saving.

Taxes would recover a substantial portion of the $5,000,000.

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METAL MARKETS

The E&MJ Metal and Mineral Markets, New York, issue of July 20, 1950, reports increased interest in metals because of the Korean crisis. Demand for copper and zinc is in excess of supply. Mercury has been in brisk demand and the price has firmed. Tin prices have increased.

Copper

The House has approved a bill to suspend the 2 cents-per-pound import duty on copper for another year. The Senate is expected to approve this bill, although the length of the suspension may be shortened. Deliveries of copper to fabricators in June totaled 126,047 tons. Total June deliveries probably exceeded 150,000 tons if those to the Government stockpile are included. The price of copper remains at 22½ cents per pound Connecticut Valley. Demand for copper in foreign countries has increased also and some countries who are receiving E.C.A. funds are requesting authorization to purchase metal from countries other than the United States.

Lead

Demand for lead was strong and the price advanced ½ cent to 12 cents per pound on July 13. Sales for the week totaled 31,574 tons as compared with 19,492 tons for the previous week. Domestic mine production of lead totaled 37,780 short tons in May as compared with 35,612 tons for April, according to the U.S. Bureau of Mines.

Zinc

The zinc market is very tight but higher prices for zinc are not regarded with favor by sellers because such prices would not bring out appreciable additional quantities of zinc. The producers fear Government regulation if the price gets out of hand. Prime western zinc remains unchanged at 15 cents per pound East St. Louis. Domestic mine production totaled 51,576 tons in May as compared with 49,113 tons in April. Canadian exports to the United States totaled 9,827 tons in May. Export business was reported on the basis of 16 cents per pound for the common grade f.a.s. Gulf ports.

Tin

The tin market has been sensitive to changing conditions in the Korean crisis. The London market rose sharply on July 14 and then reversed itself and receded on July 19. An international tin agreement was assured by action of the Economic Social Council at Geneva on July 13. The quotation on 99 percent grade, July 13, was 90½ cents per pound, on the 19th, 88½ cents per pound.

Quicksilver

As would be expected, the Korean situation has caused activity among quicksilver buyers to increase their stocks. The market price firmed to $73 per flask.

Manganese ore

It has been stated in some quarters that the supply situation in manganese ore has not been altered by the international situation. Large users claim that the price range of 79.8 to 81.8 cents per long ton unit c.i.f. United States ports, duty included, is representative of the market. However, some sellers are asking 85 cents and even higher.

Chrome ore

Price per long ton dry basis, Indian and Rhodesian, 48 percent Cr_2O_3, 3 to 1 chrome-iron ratio, lump, \$35-\$36; 48 percent Cr_2O_3, 2.8 to 1 ratio, \$32.50; 48 percent Cr_2O_3, no ratio, \$25. South African (Transvaal) 48 percent Cr_2O_3, no ratio, \$26; 45 percent, no ratio, \$17-\$18.30. Turkish, 48 percent Cr_2O_3, 3 to 1 ratio, \$37.50-\$38.50. Brazilian, 44 percent Cr_2O_3, 2.5 to 1 ratio, lump, \$31. Domestic, 48 percent Cr_2O_3, 3 to 1 ratio, \$39 per ton f.o.b. nearest shipping point.

Tungsten ore

Price per short ton unit WO_3 for ore of known good analysis: Chinese, duty paid New York, \$23-\$23.50; Bolivian, Brazilian, etc., duty paid \$23-\$23.50; domestic scheelite delivered to buyers plant, \$28.50.

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MANGANESE RESOURCES ARE STUDIED BY HOUSE COMMITTEE

The adequacy of the government's stockpiling program for strategic minerals was under fire at a recent hearing of a special Armed Services subcommittee.

In urging government aid to the manganese industry, J. Carson Adkerson, president of the Manganese Producers Association, testified that a 23-year old prediction of his has come true.

"I have constantly warned that Russia would lead us on with just a sufficient supply to get us dependent on her ore - and then at a critical hour cut us off," he said. "Russia, the world's leading manganese producer, has sharply curtailed exports since 1948."

Adkerson reported that there are sources of supply in at least 27 states, yet the number of manganese producers has dropped sharply. In 1944, he said, there were 131 producers, and in 1946 only 10.

James Boyd, director, United States Bureau of Mines testified that. . . . United States supplies of manganese would be short of meeting requirements should an emergency arise in the future, but expressed the belief that within two years, under pressure and at a stiff price, this country could become independent of imports of manganese.

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From Pay Dirt, July 21, 1950, published by Arizona Small Mine Operators.

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