United States Department of Agriculture
Natural Resources Conservation Service

Helping People Help the Land

2008 Soils Planner

Soils Under the Microscope

Soils Under the Microscope

Soil is one of the building blocks of life on Earth. From the soil, plants grow—providing basic elements like carbon, nitrogen, and oxygen necessary to sustain life and feed the creatures of the world. Eventually, all life returns to the Earth, and the basic elements are recycled back into the soil—completing the cycle of life.

Soil's many uses, such as food and fiber production, carbon and nutrient recycling, water storage and filtration, atmospheric greenhouse gas removal, waste disposal, and foundation for construction make it a vitally important resource. Soil science is one of the chief academic fields devoted to the study of soil in order to better use, understand, and protect this resource.

Micromorphology is the branch of soil science concerned with the description, interpretation, and to an increasing extent, the measurement of components, features, and fabrics in soils at a microscopic level. This microscopic study of soil is done with two types of powerful magnification instruments: the standard optical microscope and the electron microscope. The standard optical microscope (Figure 1) uses powerful lenses to magnify the soil, whereas the electron microscope uses high-voltage electron beams to gain ultra-high-resolution images for analyzing the structure and composition of specimens.

Typically, when studying soils under these powerful microscopes, a thin section of a resin-impregnated soil clod is used. These thin sections of the soil are mounted on glass slides for the optical microscope and mounted on an aluminum stub for electron microscopes.

Accumulations of clay, organic matter, or minerals provide distinguishable properties to the soil. Secondary minerals—minerals that crystallize or form in the soil—indicate special microenvironments or specific processes that the soils have undergone. These minerals can best be viewed at a microscopic level as follows: **20X magnification** obtains a general view of the soil in its basic form; **50–150X magnification** reveals the relationship between particles, patterns, and mineral composition; and **100–50,000X magnification** shows the composition of fine particles and mineral surfaces via scanning electron microscopy (SEM). The SEM level of magnification was used for the pictures displayed in this planner. The original images were in black and white.

Helping people to help the land, as well as helping people understand soil science and its importance in land management and conservation, are important goals for the USDA Natural Resources Conservation Service (NRCS). Communities and local governments work with NRCS State Offices and local USDA Service Centers to help them protect their natural resources. To find out more about the soil in your state, county, or local community, visit the National Cooperative Soil Survey Web site at http://soils.usda.gov/ and click on the Web Soil Survey. For more information about natural resources and conservation in your own backyard, contact NRCS at http://www.nrcs.usda.gov or volunteer locally by calling 1-888-LANDCARE.

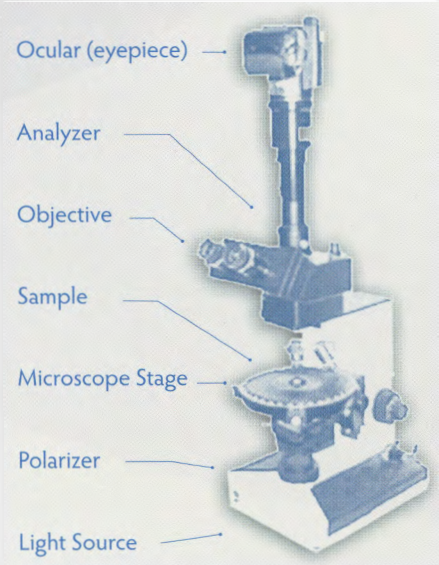


Figure 1

"All natural resources...are soil or derivatives of soil. Farms, ranges, crops, and livestock, forests, irrigation water and even water power resolve themselves into questions of soil. Soil is therefore the basic natural resource."

Aldo Leopold (1924)
"Erosion and Prosperity"

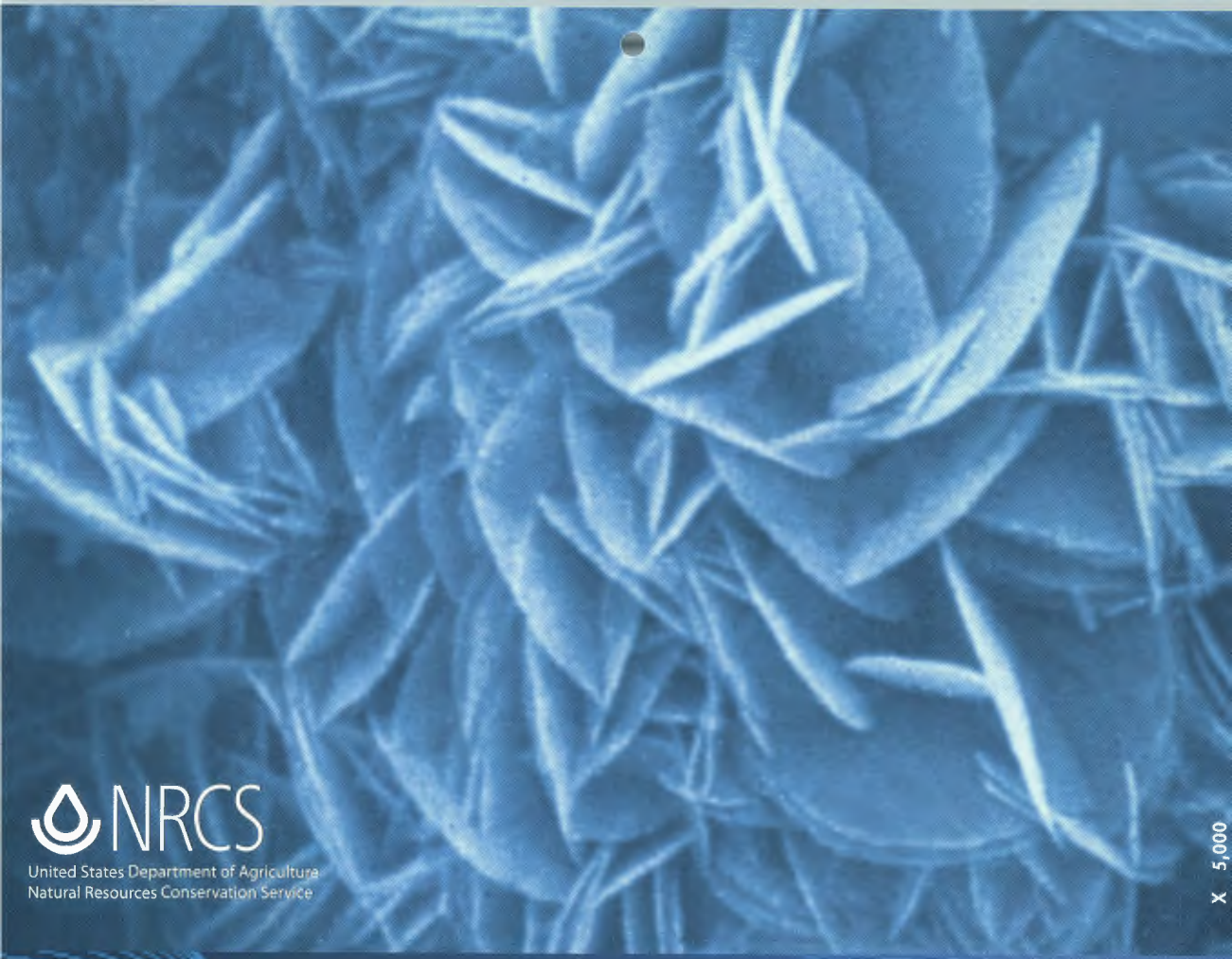
The Natural Resources Conservation Service invites you to take a closer look at soils through the 2008 Soils Planner and enjoy the beauty of their crystalline structure under the microscope. As we inventory the soils of the United States both at the microscopic and the landscape levels, we gain an appreciation of the need to conserve, protect, and sustainably use the Earth's abundant natural resources.

Arlen L. Lancaster
Chief, USDA Natural Resources Conservation Service

The Soil Science Society of America (SSSA) is an educational organization with more than 6,000 scientists and professionals in over 80 countries dedicated to the advancement of soil science. We are committed to sharing with the public the role of soils in almost every aspect of environmental function in our complex ecosystem—from the watershed to the chemical and molecular level. SSSA is pleased to continue our active partnership with the USDA Natural Resources Conservation Service and the National Cooperative Soil Survey in producing educational materials such as the **2008 Soils Planner—Soils Under the Microscope** for our members, the public, and the science community.

Gary A. Peterson

President, Soil Science Society of America



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X 5,000

Iron may crystallize as goethite [FeO (OH)] in soils. In well drained soils, a lenticular (lens-like) shape is observed.

December 2007

1 2 | 3 4 5 6 7 8 9 | 10 11 12 13 14 15 16 | 17 18 19 20 21 22 23 | 24 25 26 27 28 29 30 | 31

Phases of the moon: 8 ● 15 ◐ 22 ○ 30 ◑

JANUARY 2008

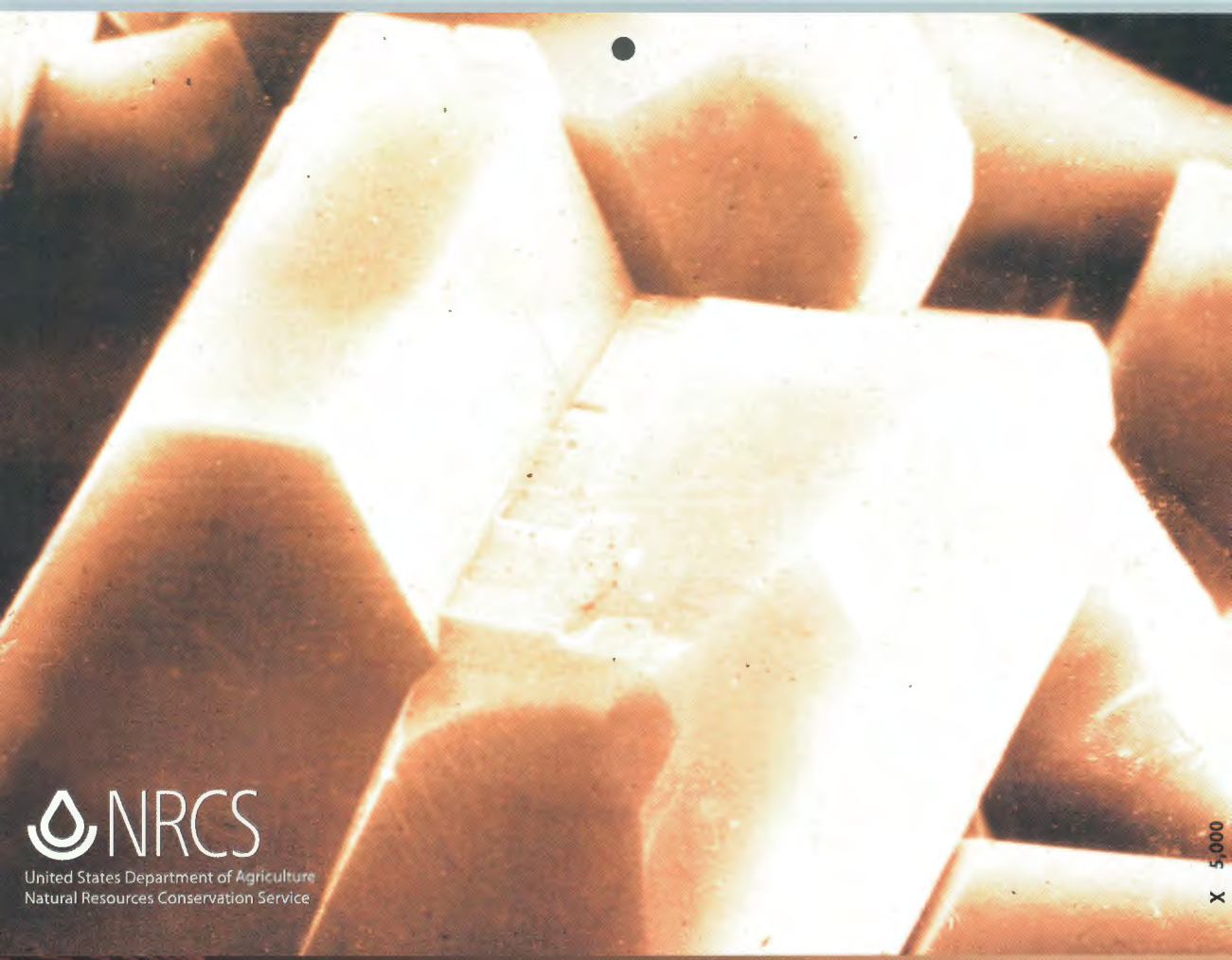
TUE 1 New Year's Day
WED 2
THU 3
FRI 4
SAT 5
SUN 6

MON 7
TUE 8
WED 9
THU 10
FRI 11
SAT 12
SUN 13

MON 14
TUE 15
WED 16
THU 17
FRI 18
SAT 19
SUN 20

MON 21 Martin Luther King, Jr.'s Birthday (Observed)
TUE 22
WED 23
THU 24
FRI 25
SAT 26
SUN 27

MON 28
TUE 29
WED 30
THU 31



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Gibbsite [$Al(OH)_3$] is a mineral found in highly weathered soils such as Ultisols and Oxisols.

January 2008

1 2 3 4 5 6 | 7 8 9 10 11 12 13 | 14 15 16 17 18 19 20 | 21 22 23 24 25 26 27 | 28 29 30 31

Phases of the moon: 7 ● 14 ◐ 21 ○ 29 ◑

FEBRUARY 2008

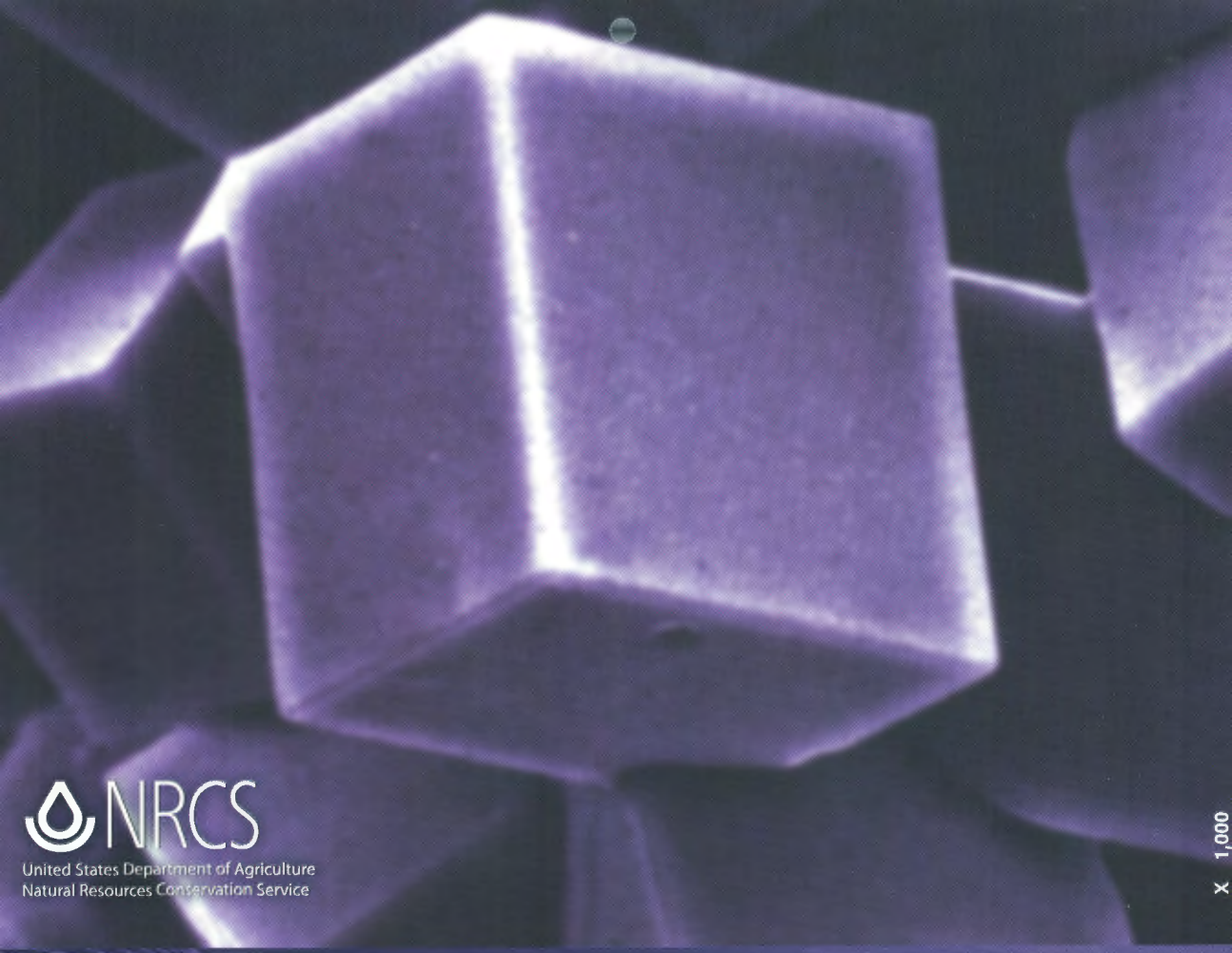
FRI 1
SAT 2
SUN 3

MON 4
TUE 5
WED 6
THU 7
FRI 8
SAT 9
SUN 10

MON 11
TUE 12
WED 13
THU 14
FRI 15
SAT 16
SUN 17

MON 18 Presidents' Day
TUE 19
WED 20
THU 21
FRI 22
SAT 23
SUN 24

MON 25
TUE 26
WED 27
THU 28
FRI 29



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Halite [NaCl] is present in salt- affected soils.
Under the Scanning Electron Microscope, its shape is cubic or pseudo-cubic.

February 2008

1 2 3 | 4 5 6 7 8 9 10 | 11 12 13 14 15 16 17 | 18 19 20 21 22 23 24 | 25 26 27 28 29

Phases of the moon: 7 ● 14 ◐ 21 ○ 29 ◑

SAT 1
SUN 2

MON 3
TUE 4
WED 5
THU 6
FRI 7
SAT 8
SUN 9

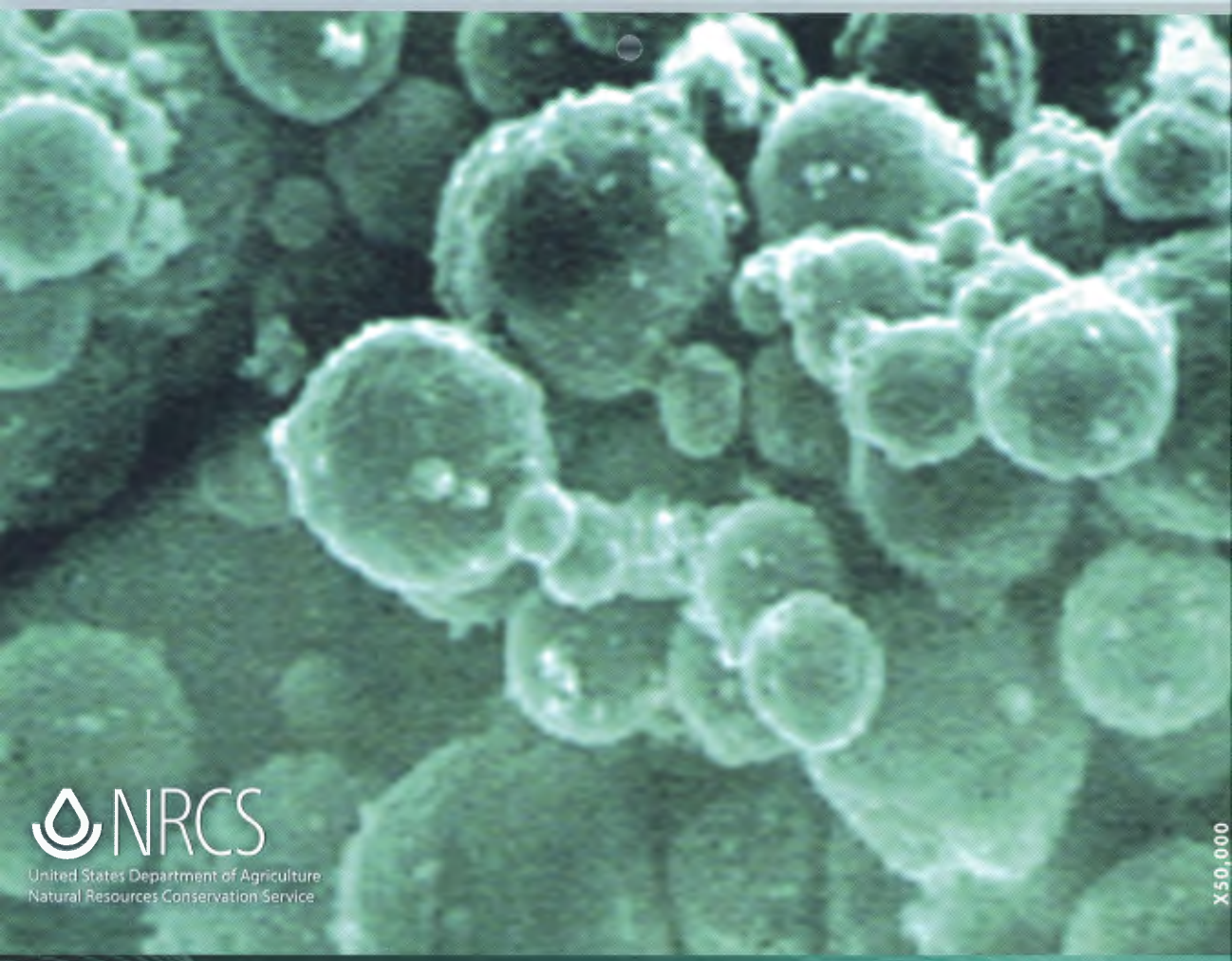
MON 10
TUE 11
WED 12
THU 13
FRI 14
SAT 15
SUN 16

MON 17
TUE 18
WED 19
THU 20
FRI 21
SAT 22
SUN 23

MON 24
TUE 25
WED 26
THU 27
FRI 28
SAT 29
SUN 30

MON 31 ●

MARCH 2008



Pyrite [FeS_2] forms in soils developed on recent marine sediments. Bacterial decomposition of organic matter releases sulfur, which combines with iron to form pyrite. When soils with pyrite are drained, the mineral oxidizes to release sulfuric acid. The extreme acidity makes the soils unproductive.

March 2008

1 2 | 3 4 5 6 7 8 9 | 10 11 12 13 14 15 16 | 17 18 19 20 21 22 23 | 24 25 26 27 28 29 30 | 31

Phases of the moon: 6 ● 12 ◐ 20 ○ 28 ◑

APRIL 2008

TUE 1
WED 2
THU 3
FRI 4
SAT 5
SUN 6

MON 7
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WED 9
THU 10
FRI 11
SAT 12
SUN 13

MON 14
TUE 15
WED 16
THU 17
FRI 18
SAT 19
SUN 20

MON 21
TUE 22
WED 23
THU 24
FRI 25
SAT 26
SUN 27

MON 28
TUE 29
WED 30

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Gypsum [$CaSO_4$-$2H_2O$] is a common mineral in Aridisols found in the Western United States. It often has a fibrous structure.

April 2008

1 2 3 4 5 6 | 7 8 9 10 11 12 13 | 14 15 16 17 18 19 20 | 21 22 23 24 25 26 27 | 28 29 30

Phases of the moon: 5 ● 12 ◐ 20 ○ 28 ◑

THU 1
FRI 2
SAT 3
SUN 4

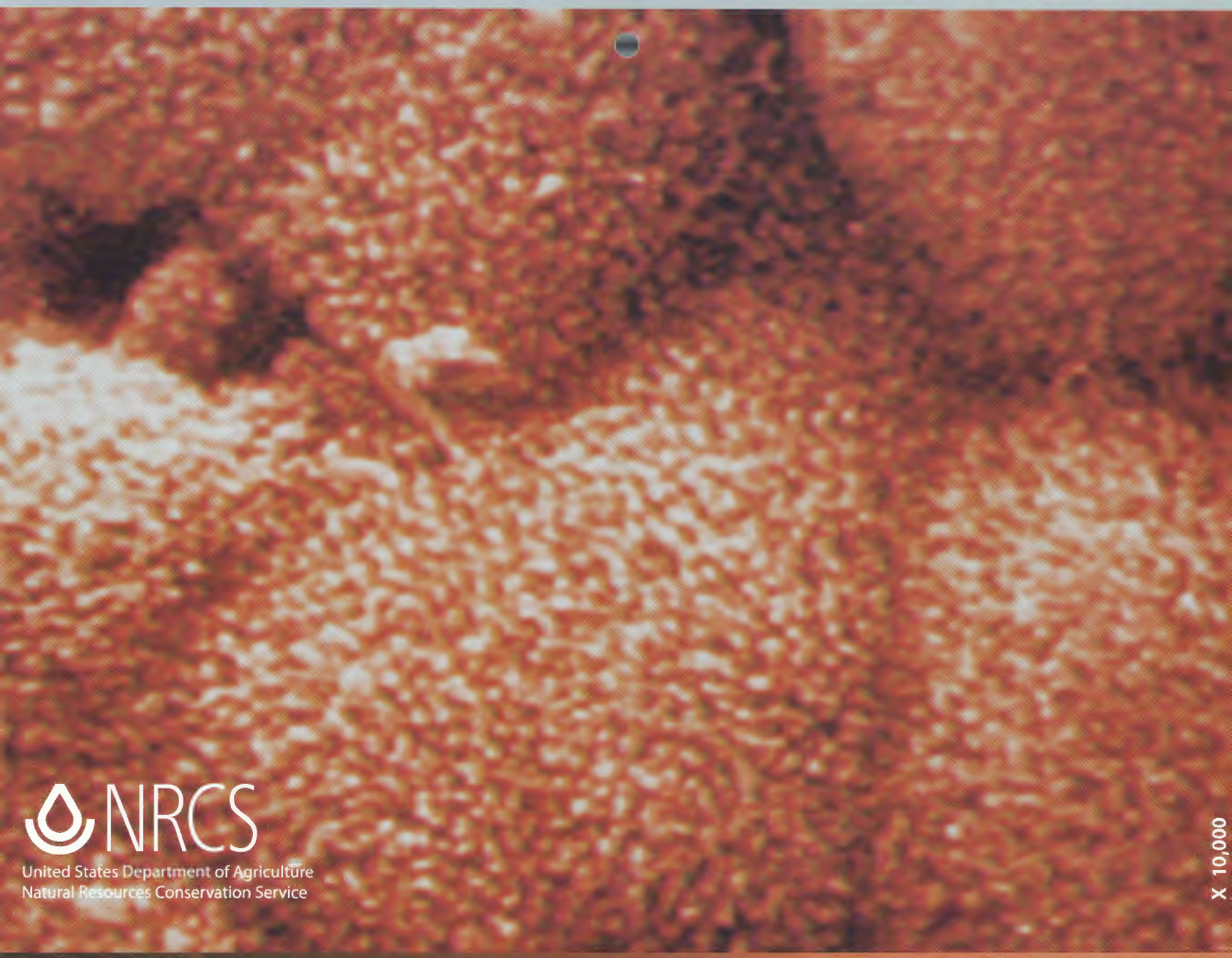
MON 5
TUE 6
WED 7
THU 8
FRI 9
SAT 10
SUN 11

MON 12
TUE 13
WED 14
THU 15
FRI 16
SAT 17
SUN 18

MON 19
TUE 20
WED 21
THU 22
FRI 23
SAT 24
SUN 25

MON 26 Memorial Day
TUE 27
WED 28
THU 29
FRI 30
SAT 31

MAY 2008



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Manganite [MnOOH] is a common mineral in most well drained soils.

May 2008

1 2 3 4 | 5 6 7 8 9 10 11 | 12 13 14 15 16 17 18 | 19 20 21 22 23 24 25 | 26 27 28 29 30 31

Phases of the moon: 3 ● 10 ◐ 18 ○ 26 ◑

SUN 1

MON 2
TUE 3
WED 4
THU 5
FRI 6
SAT 7
SUN 8

MON 9
TUE 10
WED 11
THU 12
FRI 13
SAT 14
SUN 15

MON 16
TUE 17
WED 18
THU 19
FRI 20
SAT 21
SUN 22

MON 23
TUE 24
WED 25
THU 26
FRI 27
SAT 28
SUN 29

MON 30 ●

JUNE 2008

Celestite [$SrSO_4$] is a sulfate mineral, similar to gypsum and, though it is rare, has been reported in Aridisols commonly found in the southwest part of the United States.

June 2008

1 | 2 3 4 5 6 7 8 | 9 10 11 12 13 14 15 | 16 17 18 19 20 21 22 | 23 24 25 26 27 28 29 | 30

Phases of the moon: 3 ● 10 ◐ 18 ○ 25 ◑

TUE 1
WED 2
THU 3
FRI 4 Independence Day
SAT 5
SUN 6

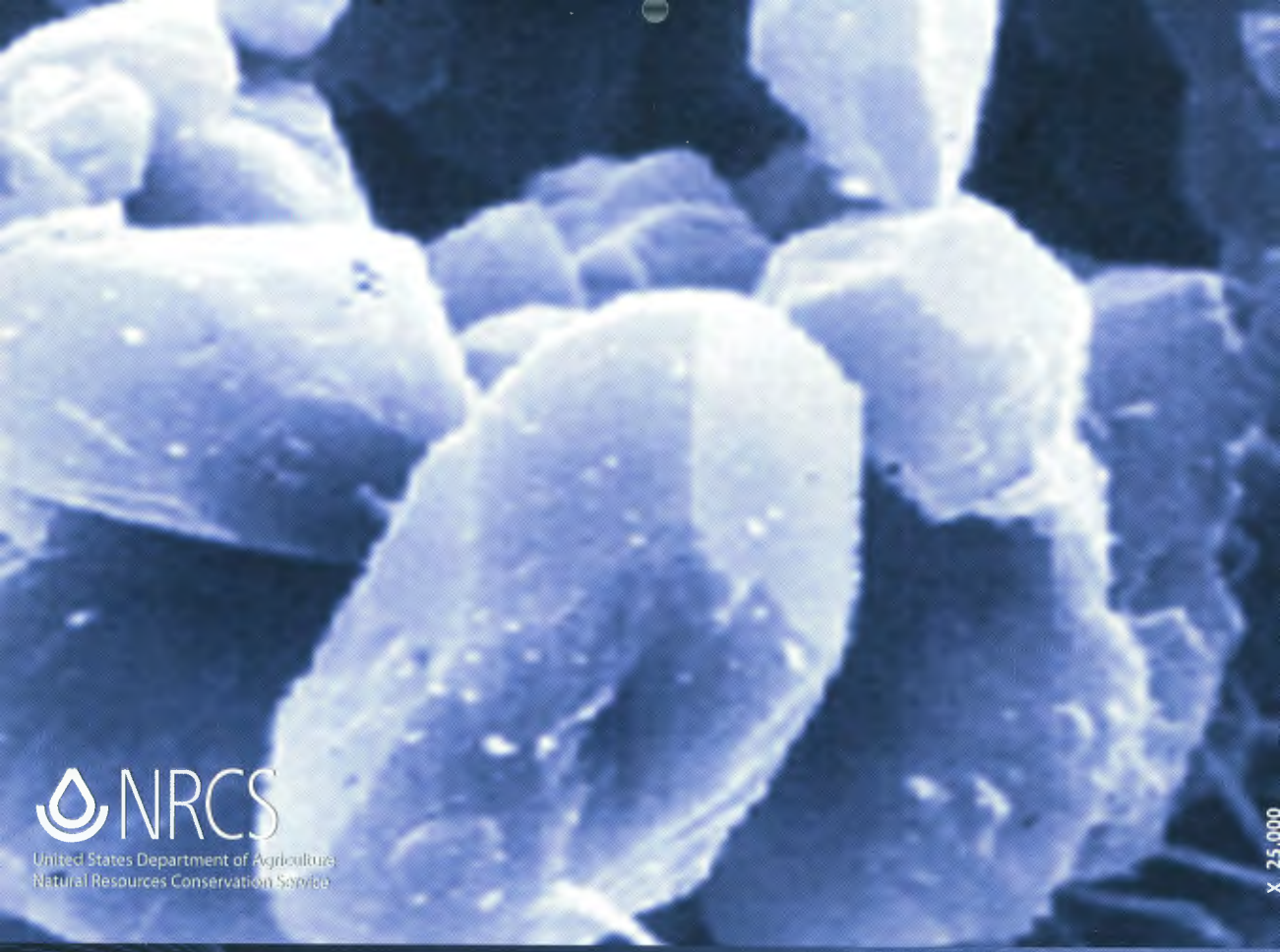
MON 7
TUE 8
WED 9
THU 10
FRI 11
SAT 12
SUN 13

MON 14
TUE 15
WED 16
THU 17
FRI 18
SAT 19
SUN 20

MON 21
TUE 22
WED 23
THU 24
FRI 25
SAT 26
SUN 27

MON 28
TUE 29
WED 30
THU 31

JULY 2008



Barite [$BrSO_4$] crystals are found in Aridisols.
Barite is very insoluble and does not break down in solution with water.

July 2008

1 2 3 4 5 6 | 7 8 9 10 11 12 13 | 14 15 16 17 18 19 20 | 21 22 23 24 25 26 27 | 28 29 30 31

Phases of the moon: 1 ● 8 ◐ 16 ○ 23 ◑ 30 ●

FRI 1
SAT 2
SUN 3

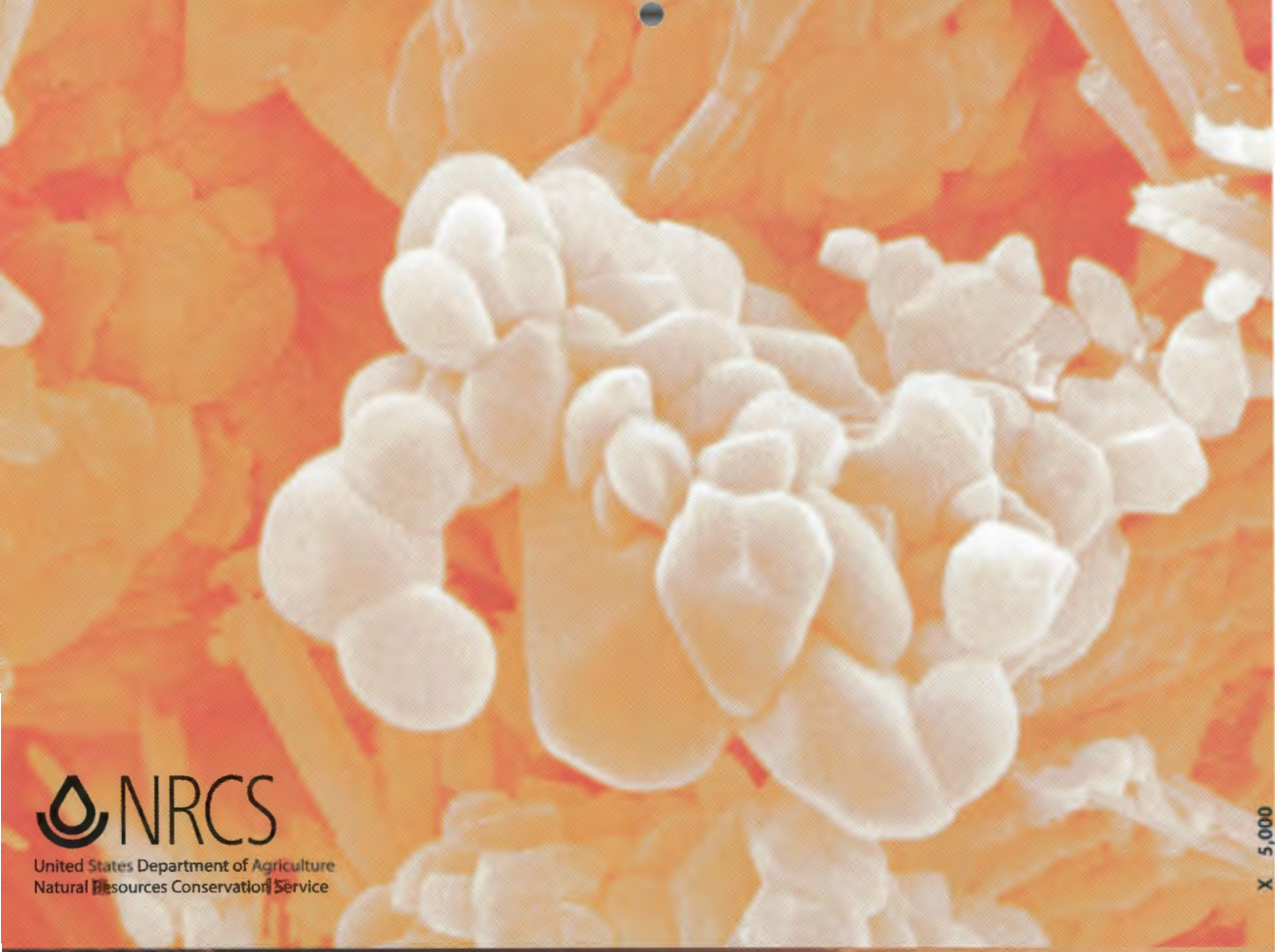
MON 4
TUE 5
WED 6
THU 7
FRI 8
SAT 9
SUN 10

MON 11
TUE 12
WED 13
THU 14
FRI 15
SAT 16
SUN 17

MON 18
TUE 19
WED 20
THU 21
FRI 22
SAT 23
SUN 24

MON 25
TUE 26
WED 27
THU 28
FRI 29
SAT 30
SUN 31

AUGUST 2008



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Mirabilite [Na_2SO_4-$10H_2O$] is a highly soluble salt that has been reported to cause several million dollars of property damage a year to the Las Vegas Valley.

August 2008

1 2 3 | 4 5 6 7 8 9 10 | 11 12 13 14 15 16 17 | 18 19 20 21 22 23 24 | 25 26 27 28 29 30 31

Phases of the moon: 7 ◐ 15 ○ 22 ◑ 29 ●

SEPTEMBER 2008

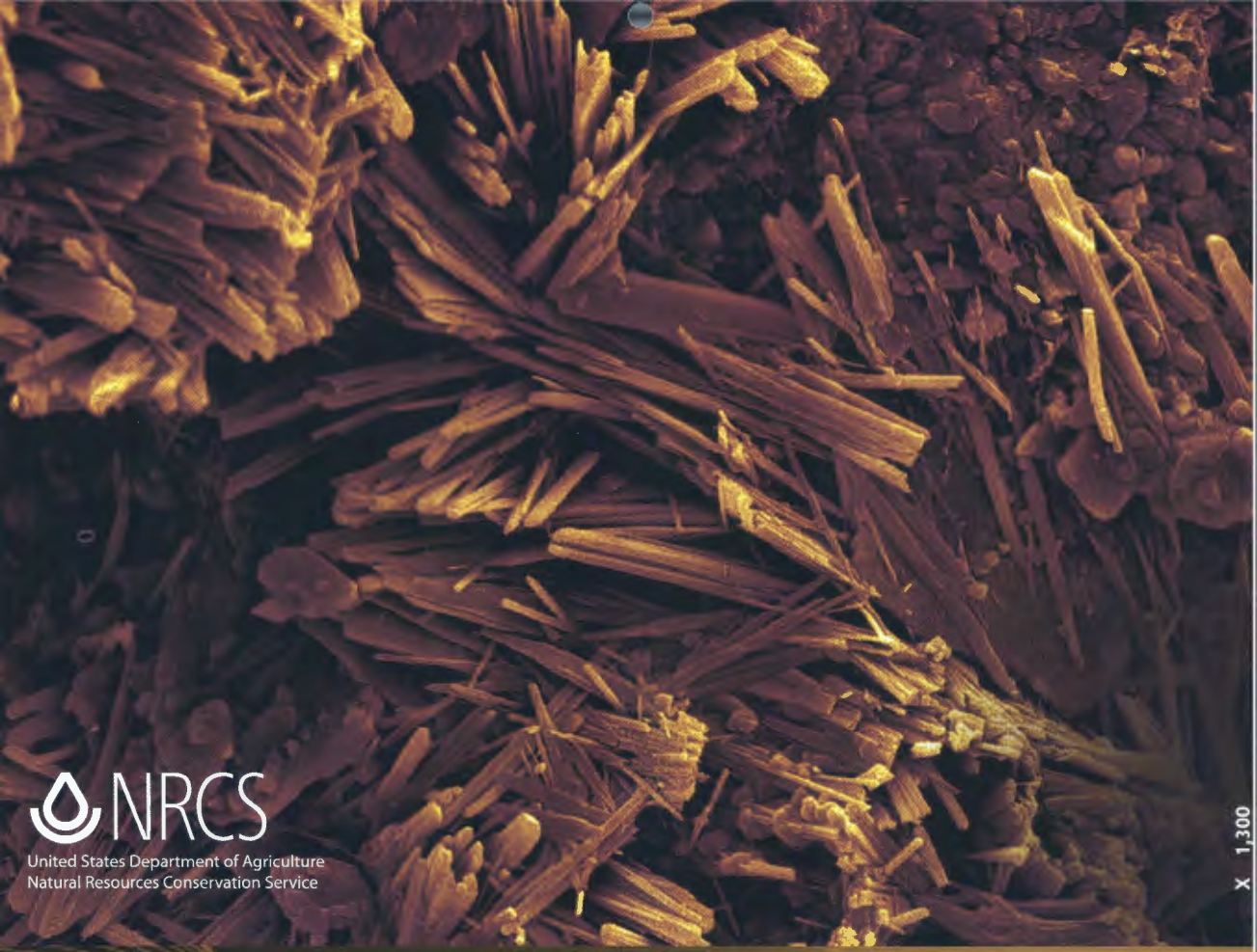
MON 1 Labor Day
TUE 2
WED 3
THU 4
FRI 5
SAT 6
SUN 7

MON 8
TUE 9
WED 10
THU 11
FRI 12
SAT 13
SUN 14

MON 15
TUE 16
WED 17
THU 18
FRI 19
SAT 20
SUN 21

MON 22
TUE 23
WED 24
THU 25
FRI 26
SAT 27
SUN 28

MON 29
TUE 30



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Thenardite [Na_2SO_4] crystallizes in low lying, poorly drained areas, causing property damage in California, Texas, Kansas, and Utah.

September 2008

1 2 3 4 5 6 7 | 8 9 10 11 12 13 14 | 15 16 17 18 19 20 21 | 22 23 24 25 26 27 28 | 29 30

Phases of the moon: 7 ◐ 14 ○ 21 ◑ 28 ●

WED 1
THU 2
FRI 3
SAT 4
SUN 5

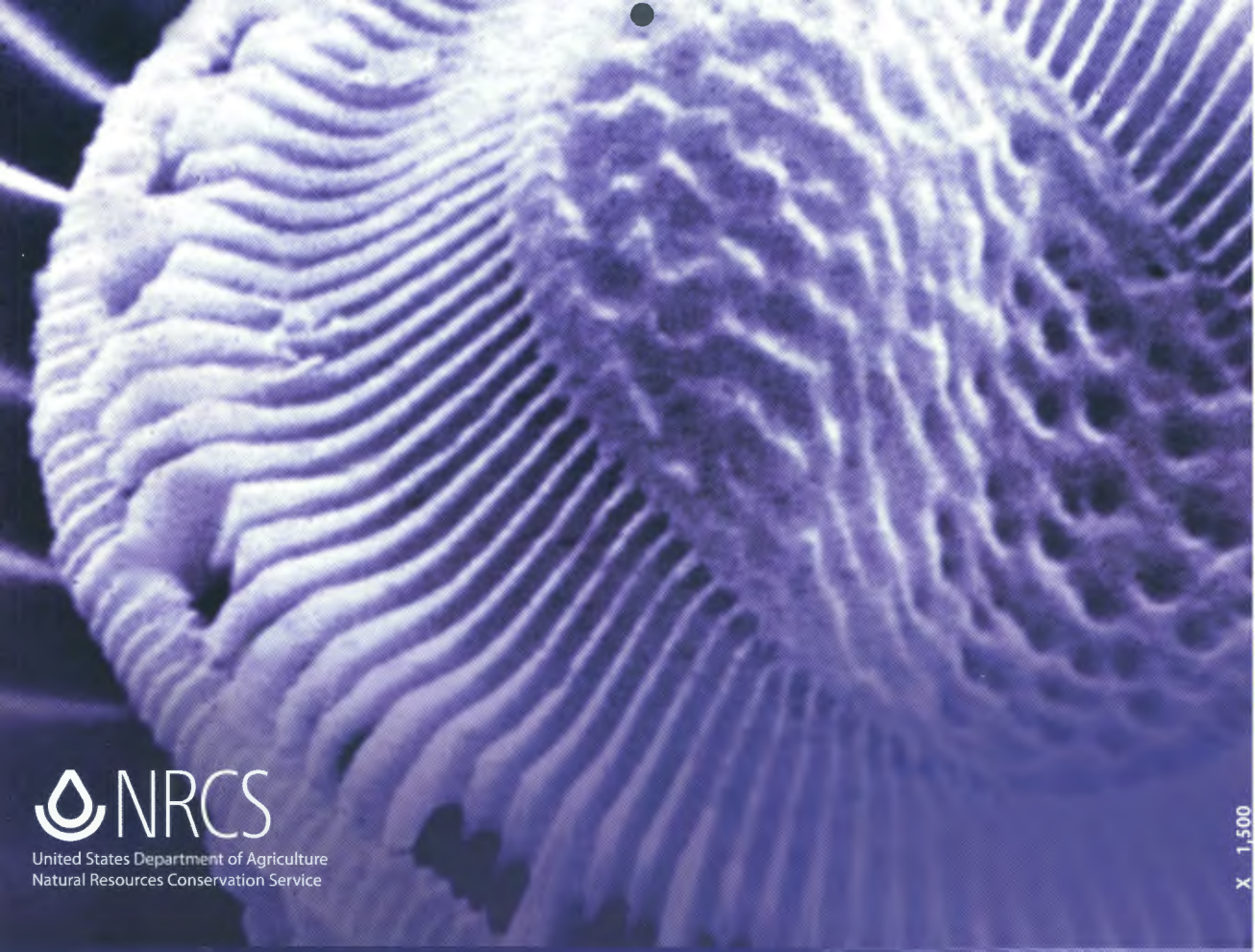
MON 6
TUE 7
WED 8
THU 9
FRI 10
SAT 11
SUN 12

MON 13 Columbus Day
TUE 14
WED 15
THU 16
FRI 17
SAT 18
SUN 19

MON 20
TUE 21
WED 22
THU 23
FRI 24
SAT 25
SUN 26

MON 27
TUE 28
WED 29
THU 30
FRI 31

OCTOBER 2008



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Vertisols found in some coastal marine areas may have diatoms as pictured above.

October 2008

1 2 3 4 5 | 6 7 8 9 10 11 12 | 13 14 15 16 17 18 19 | 20 21 22 23 24 25 26 | 27 28 29 30 31

Phases of the moon: 6 ◐ 13 ○ 19 ◑ 27 ●

SAT 1
SUN 2

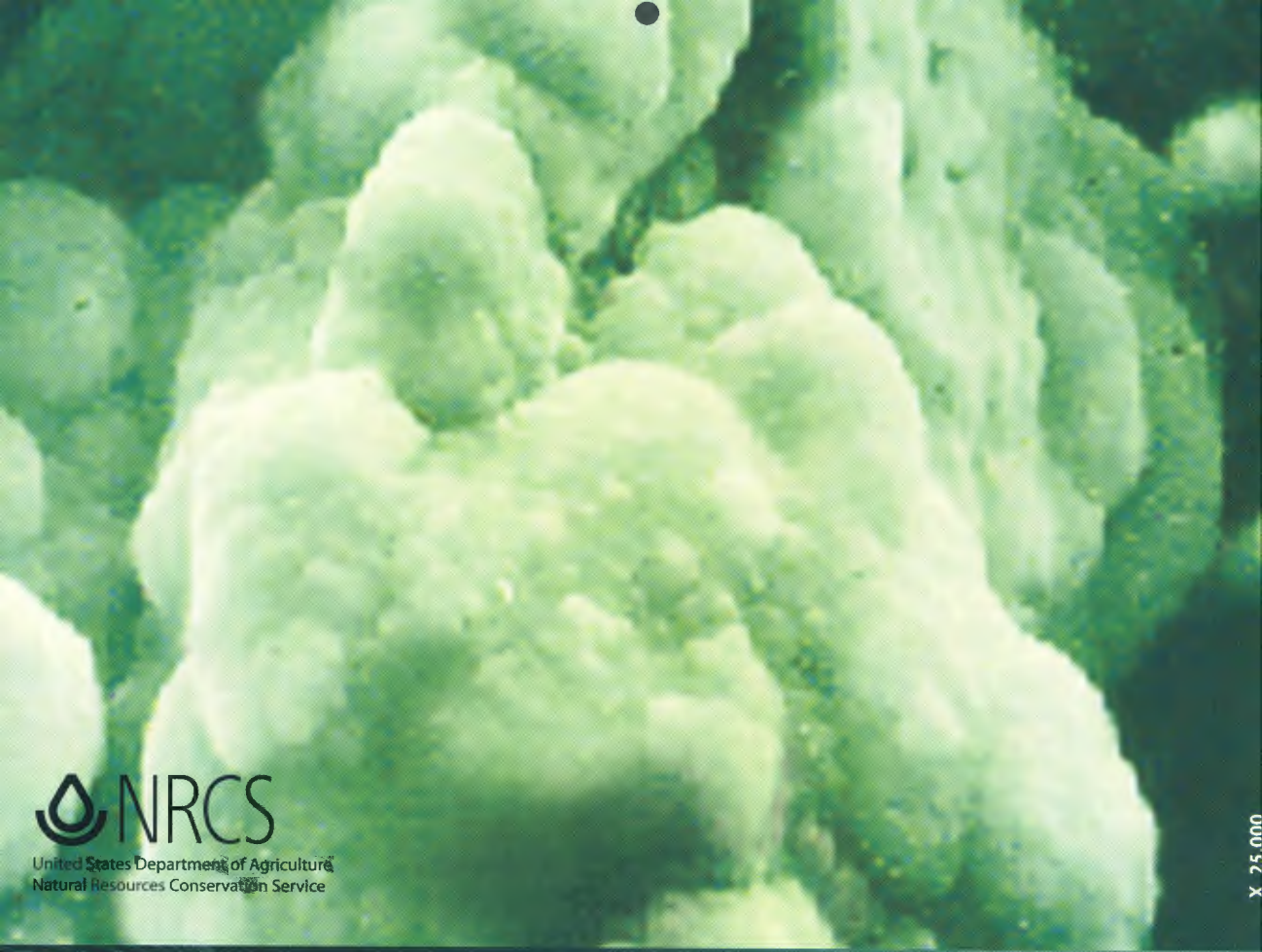
MON 3
TUE 4
WED 5
THU 6
FRI 7
SAT 8
SUN 9

MON 10
TUE 11 Veterans Day
WED 12
THU 13
FRI 14
SAT 15
SUN 16

MON 17
TUE 18
WED 19
THU 20
FRI 21
SAT 22
SUN 23

MON 24
TUE 25
WED 26
THU 27 Thanksgiving Day
FRI 28
SAT 29
SUN 30

NOVEMBER 2008



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Allophane [Al_2O_3-$2SiO_2$-nH_2O] is found in volcanic soils or Andisols. It has a poor crystalline structure and a large surface area. It imparts a tendency in soils to have poor structure and instability like quicksand when wet and disturbed. It also binds very large amounts of phosphorous from fertilizers.

November 2008

1 2 | 3 4 5 6 7 8 9 | 10 11 12 13 14 15 16 | 17 18 19 20 21 22 23 | 24 25 26 27 28 29 30

Phases of the moon: 5 ◐ 12 ○ 19 ◑ 27 ●

DECEMBER 2008

MON 1
TUE 2
WED 3
THU 4
FRI 5
SAT 6
SUN 7

MON 8
TUE 9
WED 10
THU 11
FRI 12
SAT 13
SUN 14

MON 15
TUE 16
WED 17
THU 18
FRI 19
SAT 20
SUN 21

MON 22
TUE 23
WED 24
THU 25 Christmas Day
FRI 26
SAT 27
SUN 28

MON 29
TUE 30
WED 31

EVENTS

January 26-31	61st Society for Range Management Annual Meeting & Trade Show Joint Meeting with the American Forage and Grassland Council, Louisville, KY; http://www.rangelands.org/events.shtml
February 10-13	National Association of Conservation Districts Annual Meeting, Reno, NV; http://nacdnet.org/events/annualmeeting/
February 20-22	8th Annual ESRI Federal User Conference, Washington Convention Center, Washington, D.C.; http://www.esri.com/events/feduc/index.html
March 13-15	7th Biennial Conference on University Education in Natural Resources, Corvallis, OR; http://uenr.forestry.oregonstate.edu/index.htm
March 25-27	Sustainable Agriculture Research and Education National Conference, Kansas City, MO; http://www.sare.org
June 2-7	Northeast National Cooperative Soil Survey Work Planning Conference, University of Rhode Island Coastal Institute, Narragansett, RI
June 15-20	Western Society of Soil Science Annual Meeting and the West Region National Cooperative Soil Survey Work Planning Conference will meet jointly in Spokane, WA

June 22-26	11th North American Forest Soils Conference, Blacksburg, VA; http://www.cpe.vt.edu/nafsc/
June 23-26	North Central Region National Cooperative Soil Survey Conference, Manhattan, KS
July	Smithsonian Soils Exhibit scheduled to open, Washington, D.C; http://forces.si.edu/soils/
July 13-18	South Region National Cooperative Soil Survey Conference, Gainesville, FL
July 13-16	Joint Meeting of the ASA-CSSA-SSSA Northeastern Branch, Canadian Society of Agronomy & Canadian Society of Horticultural Science, Montreal, QC, Canada; http://soils.org/branches/northeastern/
July 26-30	Soil and Water Conservation Society Annual Conference, Starr Pass, Tucson, AZ
October 5-9	Soil Science Society of America International Annual Meeting (Joint Meeting with the Geological Society of America), Houston, TX
October 30-November 3	American Indian Science and Engineering Society, Anaheim, CA

09 Calendar

January

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

4 ◐ 11 ○ 18 ◑ 26 ●

February

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

2 ◐ 9 ○ 16 ◑ 25 ●

March

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
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15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

4 ◐ 11 ○ 18 ◑ 26 ●

April

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
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19	20	21	22	23	24	25
26	27	28	29	30		

2 ◐ 9 ○ 17 ◑ 25 ●

May

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
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17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

1 ◐ 9 ○ 17 ◑ 24 ● 31 ◐

June

Su	Mo	Tu	We	Th	Fr	Sa
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28	29	30				

7 ○ 15 ◑ 22 ● 29 ◐

July

Su	Mo	Tu	We	Th	Fr	Sa
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19	20	21	22	23	24	25
26	27	28	29	30	31	

7 ○ 15 ◑ 22 ● 28 ◐

August

Su	Mo	Tu	We	Th	Fr	Sa
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23	24	25	26	27	28	29
30	31					

6 ○ 13 ◑ 20 ● 27 ◐

September

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
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20	21	22	23	24	25	26
27	28	29	30			

4 ○ 12 ◑ 18 ● 26 ◐

October

Su	Mo	Tu	We	Th	Fr	Sa
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18	19	20	21	22	23	24
25	26	27	28	29	30	31

4 ○ 11 ◑ 18 ● 26 ◐

November

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
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29	30					

2 ○ 9 ◑ 16 ● 24 ◐

December

Su	Mo	Tu	We	Th	Fr	Sa
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27	28	29	30	31		

2 ○ 9 ◑ 16 ● 24 ◐ 31 ○

10 Calendar

January

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
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17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

7 ◐ 15 ● 23 ◐ 30 ○

February

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

5 ◑ 14 ● 22 ◐ 28 ○

March

Su	Mo	Tu	We	Th	Fr	Sa
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14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

7 ◑ 15 ● 23 ◐ 30 ○

April

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

6 ◑ 14 ● 21 ◐ 28 ○

May

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

6 ◑ 14 ● 20 ◐ 27 ○

June

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

4 ◑ 12 ● 19 ◐ 26 ○

July

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

4 ◑ 11 ● 18 ◐ 26 ○

August

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

3 ◑ 10 ● 16 ◐ 24 ○

September

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

1 ◑ 8 ● 15 ◐ 23 ○

October

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

1 ◑ 7 ● 14 ◐ 23 ○ 30 ◑

November

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

6 ● 13 ◐ 21 ○ 28 ◑

December

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

5 ● 13 ◐ 21 ○ 28 ◑

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Evaluating Soils in Another Dimension,
Hari Eswaran, USDA/NRCS World Soil Resources, Washington, D. C., and Richard Drees, Texas A&M University; a cooperative effort within the S884-Soil Micromorphology Committee of the Soil Science Society of America

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