UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Pollen data from a 2.93-meter Holocene Lacustrine Section from Walker Lake, Coconino County, Arizona

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This report is preliminary and has not been edited for conformity with U. S. Geological Survey editorial standards and stratigraphic nomenclature.

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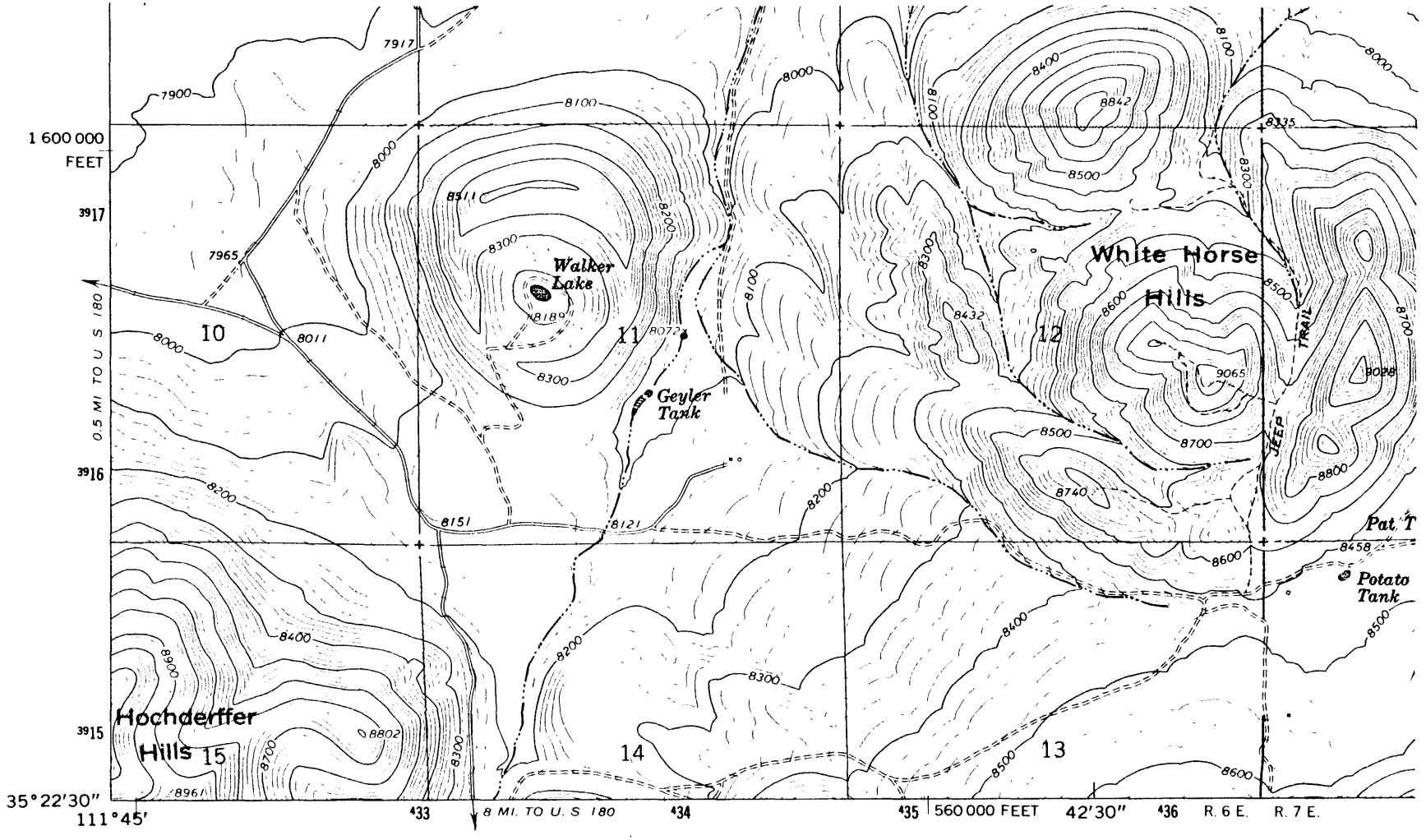
Introduction

Walker Lake, Arizona, lies in the bottom of a small volcanic cinder cone at an elevation of about 2500 m in the San Francisco Peaks volcanic field (Figure 1). The modern lake is quite shallow and occupies only the center of the depression. During upper Pleistocene time, however, the lake was considerably larger and deeper, and a sequence of lake muds was deposited that is at least 5 m thick and extends well away from the modern lake margin towards the crater rim.

The deposition of lake sediments of the Upper Pleistocene lake was interrupted by a fall of 1-2 m of volcanic cinders from a crater several km distant. The top of the lake sediments immediately beneath the cinders has yielded a radiocarbon age of 15,440±250 B.P. (Sample A-1199; Long and Muller, 1981) which should closely approximate the time of the cinder fall. The cinder layer is in turn overlain by about 1 m of dark soil that appears to be developed in aeolian silt and is equivalent in age to lacustrine sediment above the cinder layer in the existing pond. This report presents pollen data for 60 samples from a 2.93-m core of the lacustrine sediment above the cinder layer. Results of pollen analyses of sediment beneath the cinder layer were presented by Berry, McCormick and Adam (1982).

The modern pond is bordered by a small meadow and contains abundant aquatic flowering plants. The lake and meadow are surrounded by coniferous forest dominated by yellow pine (*Pinus ponderosa*), but also including groves of aspen (*Populus tremuloides*), Douglas fir (*Pseudotsuga menziesii*) and white pine (*Pinus flexilis*). White fir (*Abies concolor*) is scarce at Walker Lake but is more abundant with spruce (*Picea* spp.) on the nearby higher elevations of Hochderffer and White Horse Hills (Figure 1). The plant community is therefore an ecotone of conifer types with a microthermal climate characterized by cool to cold temperatures with about 60 cm of precipitation per year. (Pearson, 1931).

Exploratory studies had previously demonstrated the presence of fossil pollen, algae and invertebrates, so in 1976 the sediments of the modern pond were sampled with a Livingston corer to determine the stratigraphy and locate the thickest section of sediment. The stratigraphy showed little evidence of disturbance by historic human modification of the pond except near the southern margin where pits had been excavated by removal of lake muds down into the underlying cinder. The shallower portions of the pond showed evidence of disturbance by wading mammals such as elk that regularly water there. Marginal mats of vegetation also have occasionally been dislodged and floated to new locations. Sampling for pollen studies was therefore limited to the portion of the pond with deepest water (ca. 1 meter at lowest level in driest season) and thickest accumulation of sediments (almost 3 meters above the underlying cinder). The lake muds slope gently



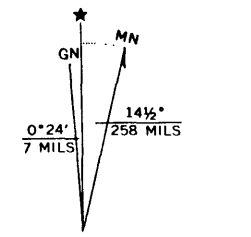
SCALE 1:24 000

1 0 1/2 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



UTM GRID AND 1966 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

QUADRANGLE LOCATION

Figure 1.--Map showing location of Walker Lake. Reproduced from southwest corner of U.S.G.S. White Horse Hills 7½' Quadrangle.

upward toward the margins of the pond where they intertongue with terrestrial soils approximately 1 m thick over the underlying cinder. The sediments within this deep area are not recent accumulations within a man made pit, since radiometric dating of sediment at a depth of 70-90 cm below the mud-water interface yielded a date of about 6,000 yrs. B.P. (Austin Long, personal communication to T.N.V. Karlstrom). In addition, the stratigraphy of the sediment within this deep section shows no evidence of floated mats of vegetation and exhibits stratigraphy typical of shallower portions of the pond. The stratigraphy from the mud-water interface downward is as follows: 40-60 cm of dark brown richly organic mud with abundant roots of aquatic macrophytes; 40-60 cm of brown to gray muds with finely divided organic matter but few well preserved roots; and a variable thickness of brown highly organic clays that continues to the mud-cinder interface.

Sediment from a single core was sampled in 3 cm intervals. Each interval was divided into three sub-samples: one for pollen, one for diatoms and one for analysis of selected invertebrates. Preservation of invertebrates proved to be poor and so was discontinued; however recovery of pollen and diatoms was excellent.

Pollen samples with a volume of 1 ml were disaggregated in a 5% KOH solution which also removed alkali-soluble organics. The samples were next swirled and screened to remove coarse inorganic and organic particles. Since some samples still retained fine silicate particles, all were subjected to HF removal of silicates (no carbonates were detected). The residues were acetylated to remove the acid-soluble organics and washed with KOH and H_2O to prepare them for mounting and staining. A single drop of the pollen residue was mounted on a microscope slide and covered with a 22 mm square coverslip after the residue was stained with basic fuchsin. An attempt was made to count 200 pollen grains from each sample using a magnification of at least 450 x. A single row of the cover slip was always counted resulting in sample sizes of several hundred grains for some samples. In samples with low pollen density (i.e. less than 200 grains) all pollen on the slide was counted. Pollen of aquatic flowering plants and algal relicts were included in the pollen count but an attempt was made to obtain at least 100 grains of pollen derived from non-aquatic plants. Pollen was analyzed by R. H. Hevly and R. E. Diggs, Dept. of Biological Sciences, Northern Arizona University, Flagstaff.

Notes on Counting Procedures

Pollen identifications were based primarily on a collection of reference material from local plants, supplemented by the pollen identification keys of Faegri and Iversen (1964) and Kapp (1969). A list of the variables counted is given in Appendix A. Most of the variable names are self-explanatory; specific notes are given below:

Pinus

Four species of *Pinus* are found in the Flagstaff area; these are *P. ponderosa* (ponderosa pine), *P. flexilis* (limber pine), *P. aristata* (bristlecone pine), and *P. edulis* (pinon pine). Two groups were established based on the modern pollen reference material. The first group includes *P. ponderosa* and *P. flexilis*, and is referred to here as "large pine"; the other group includes *P. aristata* and *P. edulis*, and is referred to as "small pine". No attempt was made to identify pine grains as belonging to the subgenera Haploxylon or Diploxylon, although such a procedure whould be able to distinguish between *P. ponderosa* (Diploxylon) and *P. flexilis* (Haploxylon). Similar shapes and sizes made it impractical to separate the two pollen types within each group. However, it may be safely assumed from modern geographic distributions that most "small pines" occurring with high frequencies of *Abies-Picea* pollen are *P. aristata* while those associated with warmer, more xeric types are *P. edulis*. Broken pine grains were common, and were counted as thirds.

Abies-Picea

Abies and *Picea* grains were identified to genus. Fragments were counted as for *Pinus*.

Pseudotsuga

This genus may be underrepresented since practically all grains found were collapsed and usually badly fragmented.

Tsuga

Rare. Those found had continous saccate fringes, and may simply represent aberrant pine pollen grains. No other records of *Tsuga* pollen have been reported from Arizona Quaternary deposits.

Quercus

No attempt was made to identify individual species but at the levels of greatest abundance several species appeared to be involved. The most common species throughout appeared to be *Q. gambellii*.

Populus

Populus pollen is often not well preserved (Havinga, 1971) or is strongly underrepresented in the pollen rain by comparison with its abundance in the vegetation (Lichti-Fedorovitch and Ritchie, 1965). *Populus* is included in the sum of total pollen shown on the count sheets, and presently grows in the Walker Lake drainage basin.

Juniperus

Juniper pollen occurs only sporadically, even where other pollen types suggest that it should be abundant. Differential preservation or low resistance to the extraction process may be responsible for this apparent anomaly (see, for example, Bradfield, 1973; Potter, 1967; Hevly, 1968; Havinga, 1971).

Compositae

Compositae are separated into *Artemisia*, low-spine, and high-spine types (Martin, 1963).

Cheno-Ams

The Cheno-Am category includes pollen of the Chenopodiaceae and the related genus *Amaranthus* (Martin, 1963).

Pediastrum

Some samples contained Pediastrum remains so abundant that they greatly outnumbered the pollen grains. For those samples in which *Pediastrum* was abundant and pollen grains were also common, an arbitrary count of 400 was assigned to *Pediastrum*. In addition, pollen was very scarce or absent but *Pediastrum* was abundant in samples found at depths of 186.5, 189.5, 198.5, 228.5, 258.5, 276.5, and 279.5 cm. No attempt was made to differentiate between species within this genus.

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APPENDIX A -- Variables counted. Types marked with a single asterisk include emergent aquatic plants; types marked with a double asterisk include aquatic types.

Variable number	Variable name
1	*Pinus*, large
2	*Pinus*, small
3	*Abies*
4	*Picea*
6	*Pseudotsuga*
7	*Tsuga*
8	*Quercus*
9	*Populus*
10	*Juniperus*
11	*Juglans*
12	*Alnus*
13	*Acer*
14	*Betula*
15	*Fraxinus*
16	*Artemisia*
17	*Franseria*
18	Other Compositae
19	Cheno-Ams
20	*Sarcobatus*
21	Gramineae **
22	Saxifragaceae
24	*Ephedra*
25	Rosaceae
26	Leguminosae
27	Cruciferae **
28	*Malva*
29	*Plantago*
33	*Polygonum* **
34	*Rhamnus*
36	Cyperaceae *
44	Spores
45	Unknowns
46	*Pediastrum* (undiff.)
47	*Salix*
48	*Celtis*
49	*Eriogonum*
51	Polemoniaceae
52	Ranunculaceae *
53	Valerianaceae
54	Nymphaeaceae
55	*Typha/Sparganium* *

Appendix A (continued):

Variable number	Variable name
57	*Potamogeton*
57	*Myriophyllum*
58	*Botryococcus*
59	Campanulaceae
70	*Pinus*, broken
71	*Lemna*
72	*Zannichellia*
73	*Rhus*
74	*Rumex* **
75	Caryophyllaceae
77	Umbelliferae **
77	*Spirogyra* zygospores
78	Caprifoliaceae
79	Portulacaceae
71	*Equisetum*
72	Geraniaceae
73	Solanaceae
74	Scrophulariaceae

APPENDIX B: POLLEN COUNTS

Pollen counts follow.

Walker Lake, Arizona - Pollen counts
for 2.93-meter section above cinders

Sample number	1	2	3	4	5
Sample depth (cm)	1.5	10.5	19.5	28.5	31.5
Arboreal pollen types:					
Pinus, large	68	50	50	43	80
Pinus, small	29	21	22	19	25
Pinus, broken	35	29	18	7	21
Picea	2	5	12	16	7
Pseudotsuga	2	0	0	1	2
Abies	2	1	4	9	5
Juniperus	8	5	8	3	15
Quercus	8	6	6	1	5
Celtis	1	0	0	0	1
Betula	1	0	0	0	0
Salix	1	0	0	0	1
Populus	0	0	0	0	6
Non-arboreal pollen types:					
Gramineae **	39	21	4	5	91
Artemisia	5	8	2	2	3
Low-spine Compositae	6	36	63	66	17
High-spine Compositae	6	8	3	6	7
Cheno-Ams	12	15	4	20	11
Sarcobatus	1	0	4	3	0
Ephedra	0	0	0	1	1
Rhamnaceae	0	1	0	0	0
Rosaceae	1	0	0	0	1
Polemoniaceae	0	1	0	0	0
Leguminosae	1	0	0	0	0
Valerianaceae	0	1	0	0	0
Eriogonum	1	0	0	0	0
Polygonum **	1	0	0	0	0
Umbelliferae **	1	0	0	0	0
Cruciferae **	0	0	0	0	2
Aquatic pollen types:					
Cyperaceae *	22	7	1	1	46
Potamogeton	9	4	0	0	47
Typha/Sparganium *	0	1	0	0	4
Ranunculaceae *	0	1	0	0	1
Nymphaeaceae	0	1	3	1	1
Lemna	0	0	0	0	1
Myriophyllum	0	19	20	32	0
Total pollen	262	241	224	236	401
Non-pollen:					
Pediastrum (undiff.)	5	15	400	400	17
Botryococcus	5	4	0	2	60
Spirogyra zygospores	0	0	0	0	11

Sample number	6	7	8	9	10
Sample depth (cm)	37.5	40.5	49.5	52.5	55.5
Arboreal pollen types:					
Pinus, large	82	78	36	49	58
Pinus, small	22	34	22	16	56
Pinus, broken	22	35	17	10	11
Picea	12	4	3	2	0
Pseudotsuga	1	1	4	2	3
Abies	0	0	2	5	1
Juniperus	6	4	24	17	11
Quercus	2	2	2	2	2
Celtis	1	0	0	0	0
Salix	0	0	13	7	0
Populus	0	0	0	1	2
Non-arboreal pollen types:					
Gramineae **	20	21	54	36	44
Artemisia	4	11	6	2	0
Low-spine Compositae	34	5	17	11	3
High-spine Compositae	2	3	1	3	0
Cheno-Ams	8	4	4	10	5
Sarcobatus	1	0	0	0	0
Ephedra	2	0	0	1	1
Rhamnaceae	0	0	2	1	0
Rosaceae	2	0	0	1	0
Plantago	0	0	1	1	0
Portulacaceae	0	0	0	1	0
Cruciferae **	0	0	0	1	0
Aquatic pollen types:					
Cyperaceae *	2	14	0	4	1
Potamogeton	8	3	0	8	0
Zannichellia	0	0	0	0	1
Typha/Sparganium *	0	3	0	1	2
Ranunculaceae *	2	0	0	0	3
Nymphaeaceae	0	1	0	0	0
Myriophyllum	0	0	0	1	0
Unknown pollen types:	0	0	0	4	4
Total pollen	233	223	208	193	204
Non-pollen:					
Pediastrum (undiff.)	36	12	0	0	0
Botryococcus	22	12	0	0	0
Spirogyra zygospores	0	0	2	1	0

Sample number	11	12	13	14	15
Sample depth (cm)	58.5	61.5	67.5	73.5	85.5
Arboreal pollen types:					
Pinus, large	73	55	43	22	21
Pinus, small	36	70	43	30	30
Pinus, broken	14	19	17	23	8
Picea	2	6	14	7	3
Pseudotsuga	1	1	0	1	0
Abies	3	3	3	0	0
Juniperus	3	4	7	21	8
Quercus	1	1	3	5	3
Celtis	1	0	1	1	2
Betula	0	0	1	0	2
Alnus	0	0	0	0	2
Fraxinus	0	0	1	0	0
Juglans	1	1	1	0	0
Salix	3	0	0	0	0
Populus	1	1	0	0	0
Non-arboreal pollen types:					
Gramineae **	24	5	16	11	9
Artemisia	8	7	11	16	23
Low-spine Compositae	9	17	18	23	17
High-spine Compositae	2	2	7	5	5
Cheno-Ams	6	7	7	9	11
Sarcobatus	0	0	0	0	1
Ephedra	0	0	0	0	3
Rosaceae	0	1	1	1	4
Caprifoliaceae	0	0	0	0	2
Plantago	0	0	0	0	4
Eriogonum	0	0	1	0	0
Umbelliferae **	1	0	0	0	0
Cruciferae **	3	0	0	0	3
Aquatic pollen types:					
Cyperaceae *	5	1	2	10	8
Potamogeton	3	0	0	8	10
Ranunculaceae *	0	1	0	0	0
Myriophyllum	0	0	1	7	5
Unknown pollen types:	0	0	0	0	0
Total pollen	200	203	198	200	184
Non-pollen:					
Pediastrum (undiff.)	5	18	68	253	160
Botryococcus	23	4	1	2	3
Spirogyra zygospores	7	0	2	0	0
Equisetum	0	1	0	0	0

Sample number	16	17	18	19	20
Sample depth (cm)	91.5	94.5	97.5	101.5	103.5
Arboreal pollen types:					
Pinus, large	18	10	14	19	21
Pinus, small	56	70	21	43	31
Pinus, broken	15	18	12	14	18
Picea	1	1	2	1	1
Pseudotsuga	0	0	1	0	1
Abies	0	0	0	1	1
Juniperus	5	9	11	10	14
Quercus	4	11	5	6	2
Celtis	1	5	6	7	0
Alnus	0	1	3	1	0
Fraxinus	0	0	1	1	0
Juglans	0	1	4	2	0
Populus	0	0	0	0	2
Non-arboreal pollen types:					
Gramineae **	12	21	32	28	19
Artemisia	8	5	20	11	17
Low-spine Compositae	16	18	33	47	24
High-spine Compositae	2	3	4	6	4
Cheno-Ams	10	16	25	31	6
Sarcobatus	0	5	6	2	0
Ephedra	2	1	0	0	1
Rhamnaceae	0	0	0	1	0
Rosaceae	0	0	3	0	0
Caprifoliaceae	0	0	3	1	0
Plantago	3	10	27	27	3
Rumex **	0	10	0	0	0
Campanulaceae	0	0	0	0	1
Umbelliferae **	0	0	0	0	1
Cruciferae **	0	1	3	1	0
Caryophyllaceae	0	0	0	1	0
Aquatic pollen types:					
Cyperaceae *	4	5	15	18	12
Potamogeton	0	0	0	1	17
Typha/Sparganium *	0	0	0	0	1
Lemna	0	0	0	0	1
Myriophyllum	6	27	47	20	10
Unknown pollen types:	0	0	0	0	0
Total pollen	163	248	298	300	208
Non-pollen:					
Pediastrum (undiff.)	2	0	0	0	28
Botryococcus	0	3	4	4	14
Spirogyra zygospores	0	0	0	0	2

Sample number	21	22	23	24	25
Sample depth (cm)	106.5	109.5	115.5	118.5	121.5
Arboreal pollen types:					
Pinus, large	126	31	24	38	35
Pinus, small	10	2	30	22	22
Pinus, broken	4	2	12	5	2
Picea	0	0	4	0	0
Abies	0	1	2	3	0
Juniperus	1	2	8	4	2
Quercus	8	18	0	6	5
Acer	0	1	0	1	1
Celtis	0	0	2	0	0
Juglans	0	8	0	0	1
Non-arboreal pollen types:					
Gramineae **	26	13	8	14	2
Artemisia	0	0	44	0	0
Low-spine Compositae	25	8	34	19	14
High-spine Compositae	3	3	4	1	0
Cheno-Ams	13	22	12	32	25
Sarcobatus	0	0	4	0	0
Ephedra	5	0	0	0	0
Rhamnaceae	0	0	0	0	2
Rhus	0	12	2	0	0
Rosaceae	0	22	0	34	4
Polemoniaceae	0	1	0	0	0
Plantago	0	0	4	1	0
Eriogonum	0	1	0	0	0
Polygonum **	0	0	0	1	0
Cruciferae **	0	0	1	0	0
Aquatic pollen types:					
Cyperaceae *	6	3	6	11	1
Typha/Sparganium *	1	0	0	0	0
Ranunculaceae *	0	8	2	13	20
Myriophyllum	2	18	88	44	49
Unknown pollen types:	4	1	0	2	1
Total pollen	230	176	291	249	185
Non-pollen:					
Pediastrum (undiff.)	0	0	171	6	0
Botryococcus	0	0	45	0	0

Sample number	26	27	28	29	30
Sample depth (cm)	124.5	127.5	130.5	133.5	136.5
Arboreal pollen types:					
Pinus, large	13	21	32	22	40
Pinus, small	21	16	20	15	45
Pinus, broken	34	4	1	14	1
Picea	2	0	1	3	0
Pseudotsuga	0	0	0	0	2
Abies	1	3	6	3	0
Juniperus	4	0	2	13	5
Quercus	2	7	4	2	19
Celtis	0	0	0	3	0
Juglans	0	0	0	1	0
Salix	1	0	0	0	0
Populus	1	1	0	0	0
Non-arboreal pollen types:					
Gramineae **	8	1	7	10	2
Artemisia	16	0	0	10	0
Low-spine Compositae	23	16	11	30	8
High-spine Compositae	5	1	1	2	0
Cheno-Ams	10	33	23	10	35
Sarcobatus	2	0	0	0	0
Ephedra	0	1	0	0	0
Rhamnaceae	0	2	0	0	0
Rosaceae	1	8	4	1	6
Plantago	5	0	2	4	2
Eriogonum	0	3	1	0	0
Geraniaceae	0	0	0	1	0
Cruciferae **	1	0	0	1	0
Aquatic pollen types:					
Cyperaceae *	8	3	2	7	1
Ranunculaceae *	1	5	0	1	2
Lemna	1	0	0	0	0
Myriophyllum	180	18	102	77	85
Unknown pollen types:	0	4	36	0	0
Total pollen	340	143	219	230	253
Non-pollen:					
Pediastrum (undiff.)	240	4	2	31	0
Botryococcus	5	1	0	7	0

Walker Lake, Arizona - Pollen counts
for 2.93-meter section above cinders

Sample number	31	32	33	34	35
Sample depth (cm)	139.5	150.5	159.5	165.5	168.5
Arboreal pollen types:					
Pinus, large	38	19	15	18	18
Pinus, small	27	27	33	22	30
Pinus, broken	15	12	16	9	20
Picea	3	2	2	6	2
Pseudotsuga	1	0	1	0	2
Abies	0	1	0	0	2
Juniperus	8	8	3	9	10
Quercus	5	5	2	1	8
Celtis	3	5	2	3	2
Alnus	0	0	1	0	0
Fraxinus	0	1	0	0	0
Populus	0	0	0	1	0
Non-arboreal pollen types:					
Gramineae **	11	22	12	17	12
Artemisia	9	9	7	14	16
Low-spine Compositae	41	47	17	25	30
High-spine Compositae	4	3	5	3	8
Cheno-Ams	25	17	18	9	12
Sarcobatus	1	3	0	0	0
Ephedra	0	0	1	0	0
Rhamnaceae	0	0	0	1	0
Rosaceae	1	0	0	1	0
Plantago	9	11	4	10	6
Campanulaceae	0	0	0	1	2
Cruciferae **	0	0	1	0	0
Aquatic pollen types:					
Cyperaceae *	11	17	10	16	10
Potamogeton	0	0	1	1	0
Typha/Sparganium *	0	0	0	1	0
Myriophyllum	11	18	6	34	46
Unknown pollen types:	0	0	0	0	0
Total pollen	223	227	157	202	236
Non-pollen:					
Pediastrum (undiff.)	1	1	3	12	26
Botryococcus	1	10	56	8	30
Spirogyra zygospores	0	0	1	1	10

Sample number	36	37	38	39	40
Sample depth (cm)	171.5	174.5	177.5	180.5	192.5
Arboreal pollen types:					
Pinus, large	9	20	19	16	19
Pinus, small	11	26	30	24	26
Pinus, broken	20	16	12	15	17
Picea	2	4	1	2	1
Abies	0	4	2	0	2
Juniperus	17	4	4	6	9
Quercus	2	4	2	0	13
Celtis	3	4	0	0	3
Salix	1	0	0	1	1
Populus	1	0	1	0	0
Non-arboreal pollen types:					
Gramineae **	17	20	9	13	12
Artemisia	5	12	27	11	11
Low-spine Compositae	28	28	31	23	29
High-spine Compositae	1	4	5	1	5
Cheno-Ams	28	32	15	13	14
Sarcobatus	3	0	0	0	0
Ephedra	0	0	0	0	1
Rhamnaceae	0	4	0	0	0
Rosaceae	0	0	1	0	0
Leguminosae	0	0	1	0	0
Plantago	26	4	0	7	15
Campanulaceae	1	4	4	0	0
Umbelliferae **	0	0	1	0	0
Cruciferae **	0	0	1	2	0
Aquatic pollen types:					
Cyperaceae *	15	4	5	11	13
Potamogeton	0	0	0	1	0
Ranunculaceae *	0	4	2	0	0
Lemna	0	0	1	0	0
Myriophyllum	20	4	2	3	15
Unknown pollen types:	0	0	0	0	0
Total pollen	210	202	176	149	206
Non-pollen:					
Pediastrum (undiff.)	17	64	49	23	5
Botryococcus	13	92	45	15	17
Spirogyra zygospores	9	12	27	1	11

Sample number	41	42	43	44	45
Sample depth (cm)	195.5	201.5	204.5	207.5	209.5
Arboreal pollen types:					
Pinus, large	50	37	28	51	52
Pinus, small	72	43	40	136	82
Pinus, broken	16	25	0	0	16
Picea	4	3	1	0	5
Pseudotsuga	0	0	0	2	0
Abies	6	3	3	4	2
Juniperus	0	9	2	0	21
Quercus	4	5	19	0	8
Celtis	1	1	0	0	10
Juglans	0	0	3	0	0
Populus	0	1	1	0	0
Non-arboreal pollen types:					
Gramineae **	10	8	4	13	24
Artemisia	8	9	3	0	19
Low-spine Compositae	8	25	8	3	51
High-spine Compositae	0	4	0	0	9
Cheno-Ams	12	8	32	1	33
Ephedra	0	0	2	0	0
Rhamnaceae	0	0	5	0	0
Rosaceae	0	0	0	0	2
Caprifoliaceae	0	1	0	0	0
Plantago	6	7	0	0	47
Polygonum **	1	0	0	0	0
Cruciferae **	0	0	0	0	3
Caryophyllaceae	0	0	0	0	1
Aquatic pollen types:					
Cyperaceae *	0	4	2	3	13
Ranunculaceae *	0	0	0	0	5
Myriophyllum	18	7	91	1	98
Unknown pollen types:	0	0	2	0	77
Total pollen	216	200	244	214	501
Non-pollen:					
Pediastrum (undiff.)	30	21	2	0	12
Botryococcus	4	10	1	0	17
Spirogyra zygospores	0	5	0	0	3

Walker Lake, Arizona - Pollen counts
for 2.93-meter section above cinders

Sample number	46	47	48	49	50
Sample depth (cm)	213.5	222.5	225.5	234.5	237.5
Arboreal pollen types:					
Pinus, large	38	84	19	20	45
Pinus, small	120	100	23	24	115
Pinus, broken	2	16	0	17	1
Tsuga	0	0	0	1	0
Picea	0	7	0	6	0
Pseudotsuga	4	0	0	2	0
Abies	0	9	0	0	1
Juniperus	0	5	8	10	2
Quercus	4	23	18	6	22
Acer	0	0	1	0	1
Celtis	0	3	0	0	0
Alnus	0	0	1	0	0
Juglans	0	1	0	0	0
Salix	0	3	0	0	0
Populus	0	1	0	0	0
Non-arboreal pollen types:					
Gramineae **	0	20	1	10	10
Artemisia	0	8	0	14	0
Low-spine Compositae	2	22	5	12	16
High-spine Compositae	0	8	1	0	2
Cheno-Ams	24	35	0	6	27
Ephedra	2	4	0	0	2
Rosaceae	0	1	4	2	0
Saxifragaceae	0	1	0	0	0
Plantago	0	7	0	12	0
Eriogonum	0	1	1	0	1
Geraniaceae	0	1	1	0	0
Solanaceae	1	0	0	0	0
Cruciferae **	0	2	2	0	1
Caryophyllaceae	0	1	0	0	0
Aquatic pollen types:					
Cyperaceae *	0	2	1	4	8
Potamogeton	0	1	0	0	0
Ranunculaceae *	0	5	2	0	0
Myriophyllum	2	317	12	14	11
Unknown pollen types:	0	0	1	0	0
Total pollen	199	689	100	160	265
Non-pollen:					
Pediastrum (undiff.)	0	0	268	100	9
Botryococcus	0	0	0	20	0
Spirogyra zygospores	0	0	0	2	0

Sample number	51	52	53	54	55
Sample depth (cm)	249.5	255.5	264.5	267.5	270.5
Arboreal pollen types:					
Pinus, large	38	54	88	58	14
Pinus, small	43	34	202	42	27
Pinus, broken	0	11	4	18	8
Picea	0	1	0	0	1
Abies	4	7	3	10	3
Juniperus	0	1	7	0	0
Quercus	10	5	4	7	5
Alnus	0	0	0	0	1
Fraxinus	0	0	0	1	0
Salix	0	0	0	1	0
Non-arboreal pollen types:					
Gramineae **	4	1	6	3	1
Low-spine Compositae	8	4	0	7	20
High-spine Compositae	1	1	0	0	2
Cheno-Ams	24	12	6	17	17
Sarcobatus	0	0	1	0	0
Ephedra	0	0	0	1	1
Rosaceae	0	0	0	0	3
Plantago	0	4	0	2	0
Eriogonum	0	3	0	0	1
Rumex **	0	1	0	0	0
Cruciferae **	1	2	0	0	1
Caryophyllaceae	0	0	0	0	1
Aquatic pollen types:					
Cyperaceae *	1	25	2	0	0
Ranunculaceae *	0	0	0	0	2
Myriophyllum	20	14	0	0	2
Unknown pollen types:	45	36	0	36	0
Total pollen	154	180	323	167	110
Non-pollen:					
Pediastrum (undiff.)	4	12	0	2	1
Spirogyra zygospores	0	0	1	0	0

Sample number	56	57	58	59	60
Sample depth (cm)	273.5	282.5	285.5	288.5	291.5
Arboreal pollen types:					
Pinus, large	54	30	15	24	46
Pinus, small	36	47	5	15	30
Pinus, broken	44	5	8	27	3
Picea	6	0	3	12	1
Pseudotsuga	2	0	0	12	0
Abies	6	15	2	12	8
Juniperus	0	5	8	3	0
Quercus	8	9	5	6	6
Acer	0	2	0	0	3
Celtis	0	0	3	0	0
Alnus	0	0	0	0	3
Juglans	0	0	0	0	3
Non-arboreal pollen types:					
Gramineae **	4	4	15	3	5
Artemisia	16	0	27	18	0
Low-spine Compositae	18	0	24	36	12
High-spine Compositae	0	0	2	3	1
Cheno-Ams	6	17	9	15	23
Sarcobatus	0	1	0	0	1
Ephedra	0	2	0	0	3
Rhamnaceae	0	0	0	0	4
Rosaceae	0	0	0	3	4
Saxifragaceae	1	0	0	0	0
Caprifoliaceae	0	0	2	0	0
Plantago	0	0	9	0	0
Eriogonum	0	0	0	0	2
Rumex **	0	0	1	0	0
Campanulaceae	0	0	2	6	0
Cruciferae **	0	0	2	0	7
Aquatic pollen types:					
Cyperaceae *	2	0	5	6	0
Ranunculaceae *	0	0	0	3	2
Myriophyllum	0	17	51	12	8
Unknown pollen types:	0	36	0	6	22
Total pollen	203	154	198	216	175
Non-pollen:					
Pediastrum (undiff.)	0	7	400	360	17
Botryococcus	0	0	0	80	0
Spirogyra zygospores	0	0	1	27	0