

PALYNOLOGY ANALYSIS

HILL AIR FORCE BASE GEOTHERMAL WELL #2

LOCATION: SEC 5-5N-1W
Davis County, Utah

PROCEDURE: Palynology samples were collected from cuttings between 0 to 3200 feet; each sample was composited over each 100 feet of interval. Routine processing included preparation of one slide mount from unoxidized residue for maturation estimate. The balance of the residue was oxidized, stained, and sieved through a 20u mesh. Mounts were prepared of both the +20u and -20u fractions; the -20u fractions contained no useable palynomorphs. Preservation of palynomorphs was generally quite good and abundance per slide ranged from fair to excellent. Three samples were barren of palynomorphs.

RESULTS OF STUDY (Plate 1): Plate 1 displays the stratigraphic occurrences of 45 palynomorph taxa. In addition, 12 reworked taxa were recorded. Through the application of the Composite Standard correlation technique, the interval between 0-2887 feet was determined to be Pleistocene. From 2887 to 3200 feet, the rocks are dated as uppermost Pliocene. The correlations were obtained from the data accumulated in the study of 22 wells and coreholes in the Salt Lake Basin. Through these correlations, it is calculated that about 1400 feet of Pleistocene have been removed by erosion.

Figure 1 was prepared to show the diversity of various palynomorph taxa, and their relationship to various plant groups.

MAJOR PLANT GROUPS

REWORKED TAXA: Syncolporites, Triporopollenites, Ulmoideipites, Pterocaryapollenites, Maceopolipollenites, Momipites, Caryapollenites (from Lower Tertiary), and Hamulatisporites, chorate dinoflagellates, Proteacidites, Cyathidites, Extratriporopollenites (from Upper Cretaceous).

The rather consistent appearances of reworked taxa reflect fluvial deposition. Good preservation of these forms suggests locations of Tertiary and Cretaceous outcrops were not remote from the site of deposition; these sources probably lay eastward.

AQUATIC TAXA: Ovoidites, other algal cysts, Carex, Equisetum, Marsilea, Alisma.

All aquatic taxa observed came from plants favoring swamp habitat, not open lacustrine.

FUNGAL PALYNO MORPHS: Fungal spores and microthyreaceous fruiting bodies.

Fungal remains reflect high moisture demand, moderate to warm temperatures, and rotting conditions (marsh or wetland). A fruiting body noted at 400 feet implies a period of abundant rainfall. The genus is found today in areas where mean average rainfall is 40 inches or more.

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FERN AND MOSS SPORES: Laevigatosporites, Gleicheniidites, Leiotriletes, Cicatricosisporites.

These spores reflect high moisture demand and moderate to warm temperatures.

HERBACEOUS: Onagraceae, Persicaria, Polemoniaceae, tricolpate and tricolporate pollen.

The three identified types are widely distributed in local marshy areas in semi-arid climate.

GRASSES: Gramineae.

The grasses require a lower amount of moisture than do the lower plant groups, and thrive in well-drained soils. As the grasses appear only at 600 and 2200 feet, there is no significant savanna or prairie development in or near the site of deposition.

ARBOREAL: Carya, Myrica, Betula, Corylus, Alnus (Alnipollenites).

Arboreal plants require, in general, good soil drainage, moderate moisture, and moderate temperatures. The consistent appearance of arboreal taxa, although not diverse, suggests the area had at least patchy deciduous forest cover throughout the Pleistocene. The occurrence of Carya is perhaps rework inasmuch as Carya has not been observed elsewhere in the Basin in the Pleistocene. The most consistent occurrence of arboreal taxa is Corylus which, although strictly speaking is a shrub, is included in the arboreals owing to the same living requirements. Alnipollenites, in the lower part of the section, reflects mountain, river and swamp conditions, and is widespread in areas of cooler temperatures.

CONIFERS: Picea, Pinus, Abies, Taxodium (T-C-T)

The identification of conifer species through pollen character has never been practical; accordingly, conifer diversity never exceeds five taxa. The presence of conifers in conjunction with other groups can indicate the presence of montane environment adjacent to site of deposition. Pinus indicates lower and warmer montane environment, Picea the higher and cooler elevations, and Abies higher and colder. Taxodium is of questionable value; identical pollen grains may come from two distinct conifer groups that indicate warm, moist climate, or cold, dry climate.

ARID CLIMATE FORMS: Compositae, Chenopodiaceae, Ephedraceae.

In the lower part of the section arid climate forms are of low diversity or absent. At 1500 feet the diversity increases upward to the top of the section.

COMPONENTS OF PALYNOLOGIC RESIDUES (Figure 2): Palynologic preparations, excluding palynomorphs, contain varying amounts of organic and

inorganic materials. A visual estimate is made of residues to a) determine relative abundance of plant remains for estimate of hydrocarbon source potential, and b) estimate inorganic component for assessment of depositional energy.

The organics consist of plant structures, tissues, leaf cuticle, and tracheids. Inorganics consist of very finely divided black grains, partly pyrite, and semi-transparent gels that often contain agglutinated black grains. Calcium fluoride may be present, and may appear as small transparent grains or resemble broken glass; it is the result of imperfect removal of carbonates, by conversion to calcium fluoride, during processing.

Through previous observation, in the Salt Lake Basin, several inferences can be drawn from residue composition:

1. Inorganics increase at the expense of organics.
2. Inorganic abundance reflects increased depositional energy (coarse clastics).
3. Organic abundance reflects decreased depositional energy (fine clastics).
4. Calcium fluoride reflects carbonate content.
5. Black carbonized content (oxidized slide mounts only) indicate presence of older reworked sediments.

From 1300 feet downward, inorganics average high in abundance, and organics average low. From 1300 feet upward organics average high in abundance, and inorganics are absent. Carbonates (probably calcareous cement) are sporadic. Reworking occurred more frequently above 1500 feet than below that point.

MATURATION: All samples indicate this Pleistocene section was in pre-generation stage. Organics, all of rather good preservation, indicate gas generation potential only. There was no evidence that the interval had at any previous time been subjected to elevated temperature.

TIME DETERMINATION: The use of the Composite Standard correlation technique, used by Amoco biostratigraphers to establish the relative age of a given section, was used experimentally in this study to convert relative time values into an approximation of absolute time, assuming, according to available data, the age of the Pleistocene is 1.8 million years. This conversion included placement of Kansan and Nebraskan glacial maxima, and the Aftonian interglacial event. Results of this experiment are shown on Figure 1; it is believed the reliability of these "absolute" ages is better than 85%.

CONCLUSIONS: From the various observations discussed, several reasonable conclusions may be drawn. These are:

1. The Pleistocene interval in this well was laid down under largely fluvial conditions.
2. The lower half of the interval was laid down when the climate was wetter than was the upper half. The upper half became nearly semi-arid.
3. The lower part was laid down under fairly high energy conditions, the upper part under decreased energy conditions.
4. Light forest and shrub covered the area in the lower part, opening later to patchy forests and extensive "sagebrush" areas.
5. Stream drainage transported coarse clastics in the lower half. Drainage became sluggish, and developed local swamps in the upper, with no significant open water.
6. Approximately 1400 feet of upper Pleistocene have been removed by erosion.
7. Direction of sediment transport was westward by streams flowing off the Wasatch Front.
8. Sediment sources included rocks of lower Tertiary and Upper Cretaceous age.
9. Stratigraphic levels of Kansan and Nebraskan glacial maxima, and the Aftonian interglacial event are suggested.
10. Pleistocene geothermal paleotemperature was never appreciably higher than it is at present.

Earl T. Peterson 11-24-80
Earl T. Peterson

ETP/ds

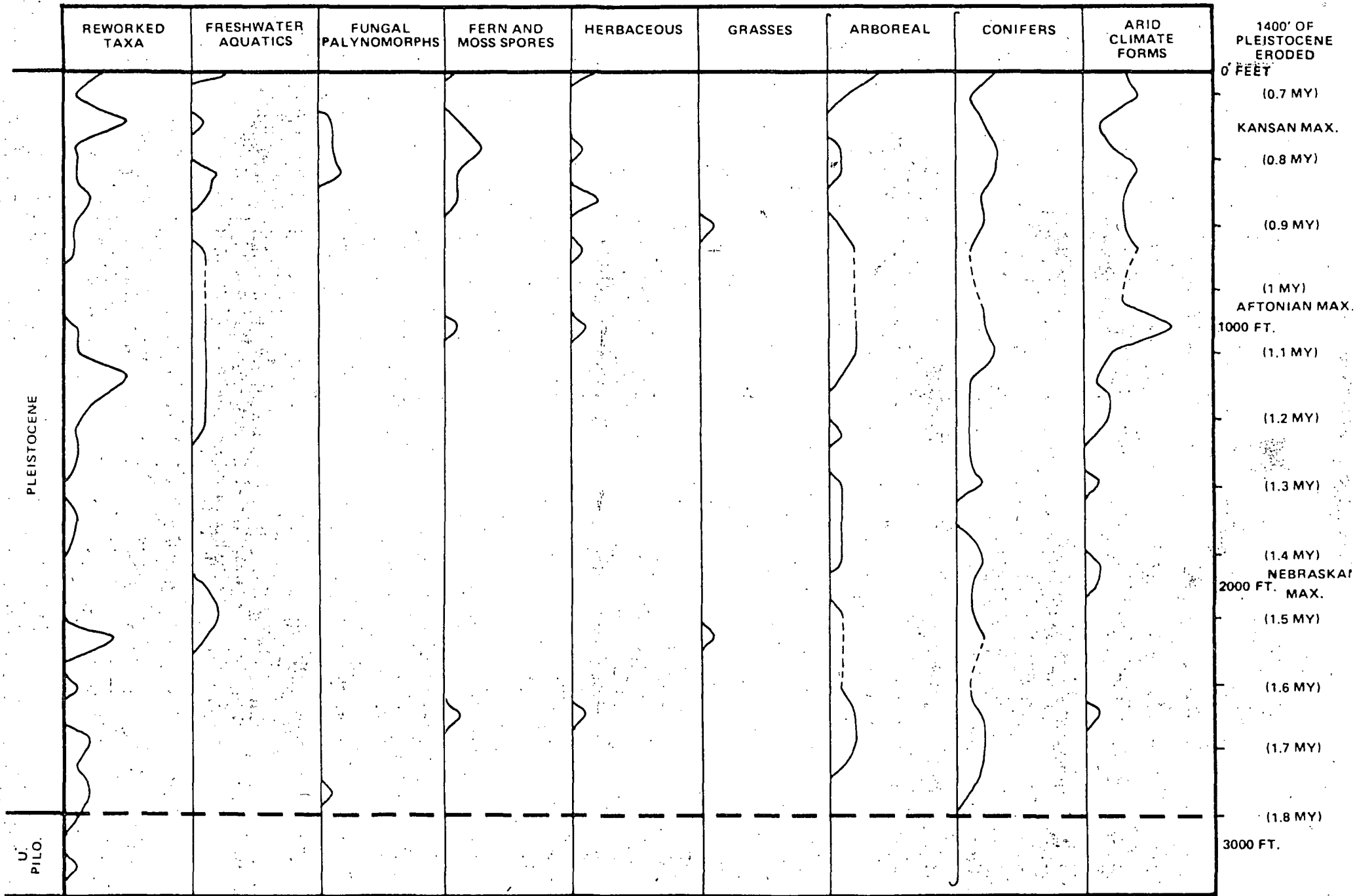
Enclosure - Palynologic range chart

cc: W. G. Brock
J. M. Rakowski
R. H. Calvert
H. R. Ritzma

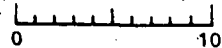
*no historic
evidence for
geothermal
collected!*

MAJOR PLANT GROUPS REPRESENTED IN WELL FIGURE 1

HILL AIR FORCE BASE GEOTHERMAL
WELL NO. 2



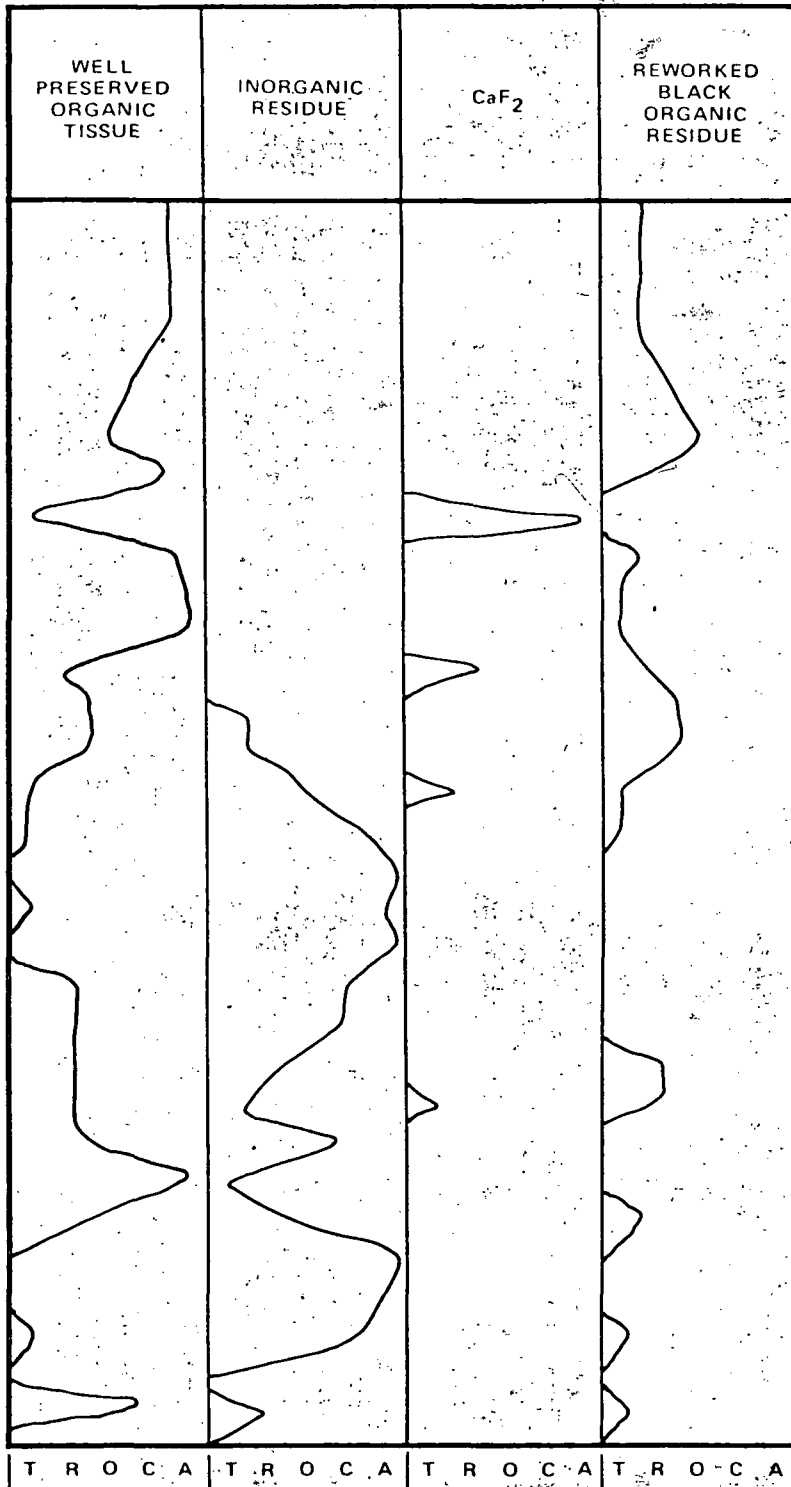
NO. OF TAXA:



COMPONENTS OF PALYNOLOGIC RESIDUES
(EXCLUDING PALYNOMORPHS)

FIGURE 2

HILL AIR FORCE BASE GEOTHERMAL
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VISUAL ESTIMATE OF RELATIVE
ABUNDANCE

- T = TRACE
- R = RARE
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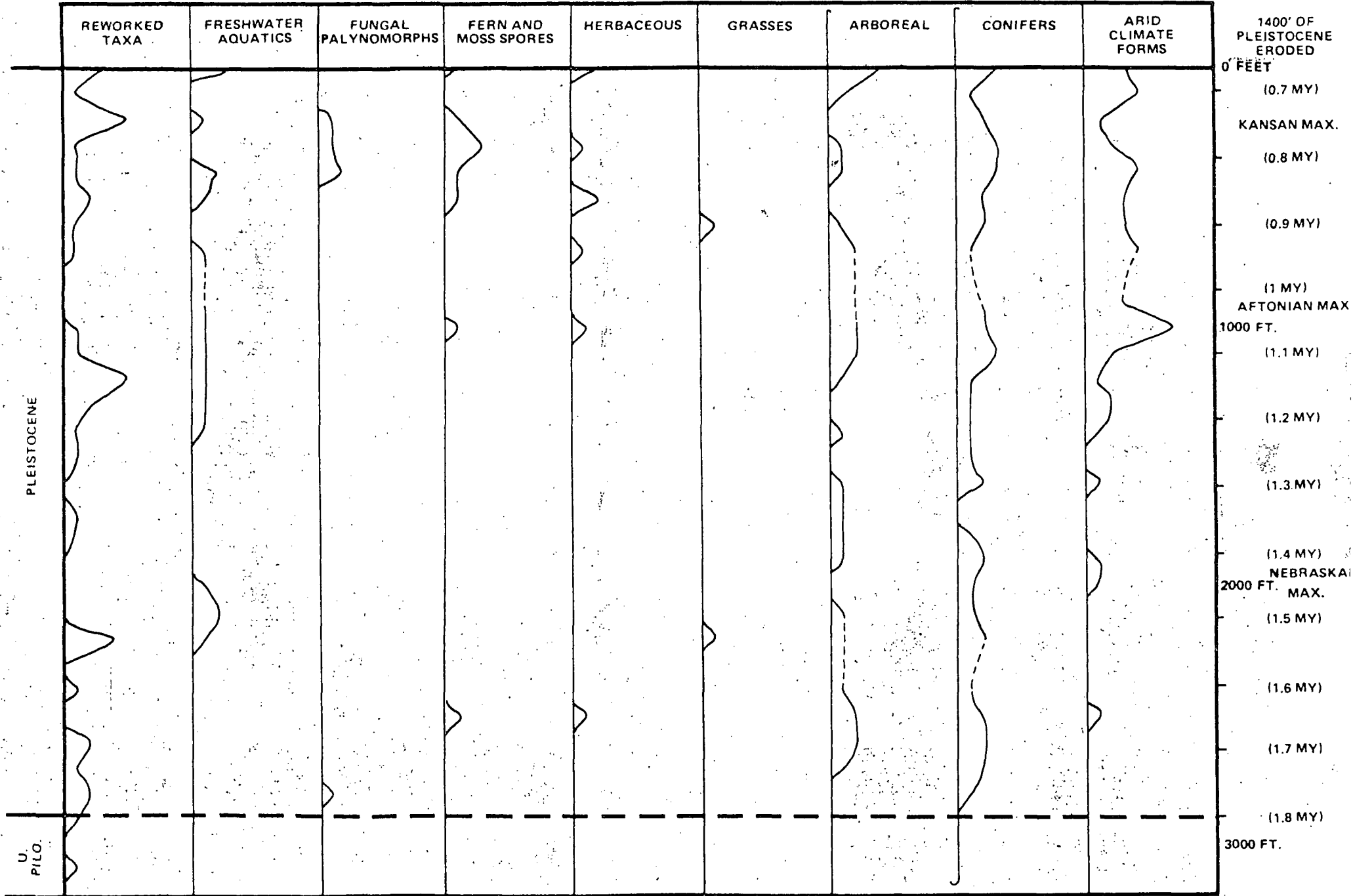
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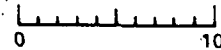
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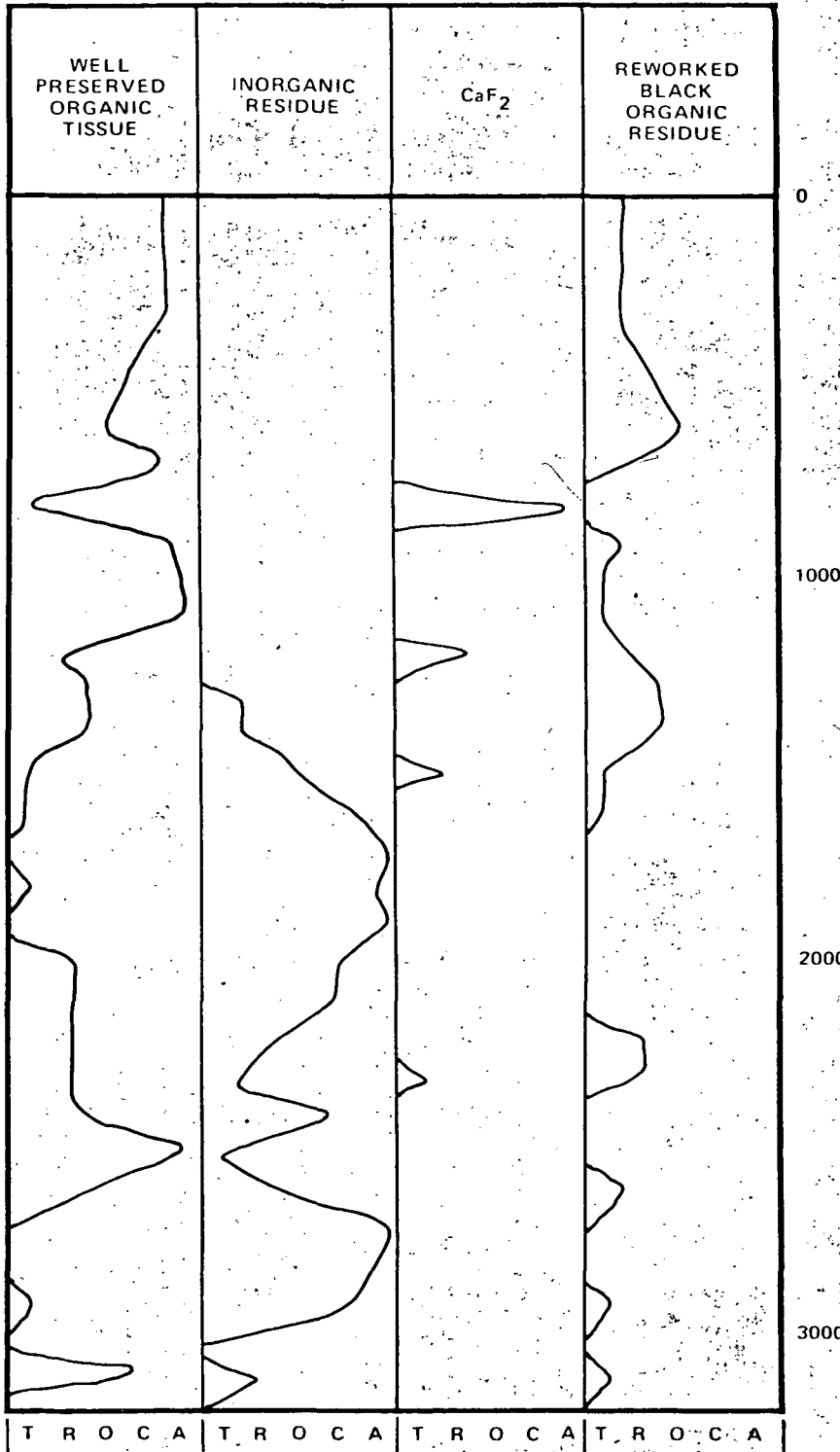
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Δ	Depth	meders meters	°C	HAFB-1 ✓ 10-7-79	Ribi Darling (2/15/80)
	0		23.28		16.62
	10		13.62		11.61
	20		12.80		11.67
	30		12.51		11.74
	40		12.38		11.70
	50		11.81		11.57
	60		11.72		11.63
	70		11.95	water ↓	12.20
	80		12.36		
	90		12.83		
	100		12.40		
	110		11.84		
	120		11.21		
	130		11.50		
	140		11.59		
	150		11.70		
	160		11.82		
	170		11.87		
	180		11.85		
	190		11.91		
	200		11.99		
	210		12.15		
	220		12.54		
	230		12.03		
	240		11.72		
	250		11.49		
	260		11.48		
	270		11.37		
	280		11.36		
	290		11.41		
	300		11.39		
	310		11.48		
	320		11.57		
	330		11.65		
	340		11.87		
	350		11.96		
	360		12.13		
	370		12.34		
	380		12.58		
	390		12.82		
	391		12.84		

meters	°C	HAFB - 2	
10	14.68	265	11.74
20	13.56	270	11.73
25	13.64	275	11.66
30	13.39	280	11.69
35	13.33	285	11.91
40	13.33	290	11.96
45	13.35	295	12.01
50	13.36	300	12.02
55	13.28	305	12.07
60	13.22	310	11.91
65	13.18	315	11.80
70	13.19	320	12.02
75	13.15	325	12.22
80	12.98	330	12.23
85	12.88	335	12.29
90	12.86	340	12.30
95	12.66	345	12.41
100	12.57	350	12.37
105	12.48	355	12.38
110	12.47	360	12.45
115	12.44	365	12.55
120	12.39	370	12.57
125	12.32	375	12.61
130	12.31	380	12.76
135	12.35	385	12.85
140	12.36	390	12.97
145	12.34	395	13.08
150	12.32	400	13.19
155	12.32	405	13.32
160	12.31	410	13.43
165	12.32	415	13.71
170	12.32	420	13.66
175	12.31	425	13.62
180	12.17	430	13.62
185	12.15	435	13.65
190	12.18	440	13.74
195	12.22	445	13.91
200	12.17	450	14.06
205	12.13	455	14.13
210	12.10	460	14.20
215	12.07	465	14.30
220	12.02	470	14.44
225	11.95	475	14.59
230	11.81	480	14.74
235	11.82	485	14.93
240	11.85	490	15.11
245	11.96	495	15.24
250	11.93	500	15.46
255	11.82		
260	11.70		