TABLE 1. PRINCIPAL ENVIRONMENTAL AND PEDOLOGICAL FEATURES OF THE SOILS OF THE REEFTON CHRONOSEQUENCE.

Name and	Abbreviation	Landform	Estimated Age (yr)	Altitude a.s.l. (m)	Relief (deg)	Estimated Annual Rainfall (mm)	Vegetation at Site	Soil Type	Classification (N.Z. Soil Bureau, 1968b)
Hokitika	Ho	River floodplain	c 1000	190	0	1920	Red beech, grasses, buttercup	Hokitika sandy loam	Recent soil from alluvium
Ikamatua (Younger Variant)	I(y)	Post-glacial degradational terrace	c 14,000	194	0	1920	Red beech, pepper tree, coprosma	Ikamatua silt loam	Lowland yellow-brown earth
Ikamatua (Older Variant)	I(o)	Post-glacial degradational terrace	c 16,000	198	0	1920	Red and silver beech, pepper tree	Ikamatua fine sandy loam	Lowland yellow-brown earth
Ikamatua (Wetter Variant)	I(w)	Post-glacial degradational terrace	c 16,000	197	0	1920	Manuka scrub, grasses	Ikamatua fine sandy loam (Weakly podzolised, weakly gleyed variant)	Lowland yellow-brown earth
Ahaura	Ah	Low glacial outwash terrace	c 18,000	210	0	1920	Red and silver beech, grasses	Ahaura silt loam	Lowland yellow-brown earth
Kumara	Ku	Intermediate glacial outwash terrace	≥70,000	250	0	1920	Manuka scrub, mosses, sedges, grasses	Kumara silt loam	Lowland podzol; hydrous. (gleyed podzol)
Okarito	Ok	High glacial outwash terrace	>130,000	390	5	1920	Manuka scrub, bracken fern, umbrella fern, grasses, occasional orchids	Okarito loamy sand	Lowland podzol; hydrous. (strongly) gleyed podzol)

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TABLE 2. SIMPLE CORRELATION COEFFICIENTS - Chronosequence.**

	pH (H_2O)	Vol.-Wt	LOI	% Clay	CEC	BS	Exch. Al	Exch. Fe	Exch. Ca	Exch. Mg	Exch. K	Exch. Na
pH (H_2O)												
Volume-Weight	0.325											
Loss on Ignition	-0.367	-0.867										
% Clay	-0.372	-0.505	0.594									
Cation Exchange Capacity	-0.518	-0.781	0.895	0.723								
Base Saturation	-0.130	0.089	-0.124	-0.368	-0.091							
Exchangeable Al	-0.491	-0.348	0.435	0.774	0.721	-0.194						
Exchangeable Fe	0.146	-0.277	0.379	0.127	0.245	0.281	0.106					
Exchangeable Ca	-0.654	-0.483	0.442	0.199	0.591	0.476	0.318	0.053				
Exchangeable Mg	-0.537	-0.616	0.596	0.285	0.695	0.409	0.330	0.249	0.885			
Exchangeable K	-0.277	-0.555	0.421	0.205	0.521	0.335	0.175	0.164	0.622	0.789		
Exchangeable Na	-0.660	-0.577	0.566	0.347	0.695	0.193	0.420	0.029	0.695	0.734	0.582	
Total Ca	0.577	-0.165	0.144	-0.253	0.040	0.309	-0.334	0.334	0.056	0.225	0.353	-0.143
Total K	0.682	-0.118	0.053	-0.184	-0.031	0.106	-0.322	0.272	-0.056	0.119	0.273	-0.247
Total Mg	0.630	0.002	-0.085	-0.338	-0.123	0.314	-0.391	0.255	0.012	0.178	0.366	-0.196
Total Si	-0.654	0.166	-0.125	0.155	-0.040	-0.101	0.275	-0.286	0.037	-0.160	-0.312	0.203
Total Fe	0.583	-0.327	0.333	-0.038	0.173	0.008	-0.256	0.341	-0.047	0.192	0.314	-0.141
Total Al	0.600	-0.284	0.217	0.001	0.140	0.031	-0.160	0.296	-0.009	0.210	0.359	-0.141
Total Ti	-0.320	-0.280	0.363	0.712	0.394	-0.516	0.613	0.085	-0.046	-0.100	-0.286	-0.008
Total P	0.226	-0.454	0.492	-0.009	0.411	0.251	-0.101	0.386	0.383	0.579	0.535	0.236
Total N*	-0.465	-0.875	0.965	0.532	0.895	0.037	0.430	0.360	0.623	0.745	0.529	0.643
Oxidisable C*	-0.492	-0.835	0.965	0.514	0.865	0.001	0.429	0.364	0.529	0.628	0.396	0.614
C/N Ratio*	-0.572	-0.208	0.327	0.245	0.295	-0.170	0.337	-0.089	0.141	0.056	-0.095	0.198
Fieldes & Perrott Test (<2mm)	0.544	-0.094	0.026	-0.055	-0.208	-0.435	-0.364	-0.043	-0.439	-0.357	-0.268	-0.433
Fieldes & Perrott Test (<2 µm)	0.815	-0.174	-0.138	-0.176	-0.303	-0.239	-0.463	0.114	-0.561	-0.399	-0.156	-0.491
Phosphate Retention	0.406	-0.432	0.483	0.370	0.319	-0.497	0.042	0.210	-0.227	-0.032	-0.033	-0.122
Pyrophosphate-extractable Fe	0.011	-0.676	0.786	0.452	0.615	-0.271	0.189	0.274	0.071	0.298	0.342	0.174
Pyrophosphate-extractable Al	0.160	-0.535	0.625	0.489	0.451	-0.512	0.158	0.164	-0.170	-0.004	0.032	-0.034
Oxalate-extractable Fe	0.285	-0.591	0.649	0.320	0.417	-0.293	-0.009	0.266	-0.060	0.147	0.169	-0.061
Oxalate-extractable Al	0.447	-0.431	0.395	0.284	0.192	-0.474	-0.072	0.141	-0.277	-0.084	0.024	-0.170
Montmorillonite (% in<2 µm)	-0.614	-0.113	0.050	0.113	0.141	0.121	0.378	-0.090	0.307	0.078	-0.112	0.264
Gibbsite (% in<2 µm)	0.660	0.230	-0.260	-0.258	-0.414	-0.161	-0.511	0.100	-0.401	-0.338	-0.264	-0.539
I Quartz (100)/I Feldspar (002)	-0.522	0.313	-0.170	-0.174	-0.193	0.009	-0.128	-0.401	0.027	-0.135	-0.235	0.127
NH_4F-P*	0.526	-0.161	0.164	-0.232	-0.030	-0.212	-0.337	0.209	-0.232	-0.063	0.004	-0.166
Non-occluded P*	0.369	-0.408	0.471	-0.009	0.297	-0.162	-0.151	0.304	0.015	0.229	0.224	0.065
Occluded Inorganic P*	-0.054	-0.751	0.891	0.411	0.727	0.006	0.202	0.478	0.402	0.546	0.353	0.344
Acid-extractable P*	0.156	0.134	-0.239	-0.454	-0.151	0.624	-0.325	0.022	0.401	0.340	0.352	0.054
Residual P*	0.119	-0.703	0.669	0.358	0.611	-0.103	0.207	0.268	0.284	0.532	0.566	0.286

	Total Ca	Total K	Total Mg	Total Si	Total Fe	Total Al	Total Ti	Total P	Total N	Oxidisable C	C/N Ratio
Total K	0.936										
Total Mg	0.935	0.935									
Total Si	-0.957	-0.986	-0.936								
Total Fe	0.922	0.920	0.839	-0.953							
Total Al	0.916	0.954	0.882	-0.974	0.955						
Total Ti	-0.466	-0.375	-0.576	0.368	-0.247	-0.236					
Total P	0.861	0.792	0.745	-0.823	0.840	0.822	-0.299				
Total N*	0.154	0.027	-0.059	-0.098	0.275	0.191	0.278	0.530			
Oxidisable C*	0.027	-0.107	-0.194	0.037	0.166	0.040	0.324	0.382	0.968		
C/N Ratio*	-0.549	-0.657	-0.628	0.595	-0.435	-0.545	0.333	-0.405	0.315	0.448	
Fieldes & Perrott Test (<2mm)	0.353	0.491	0.305	-0.478	0.548	0.515	0.171	0.213	-0.106	-0.134	-0.207
Fieldes & Perrott Test (<2 µm)	0.596	0.688	0.566	-0.669	0.673	0.647	-0.162	0.381	-0.264	-0.327	-0.668
Phosphate Retention	0.453	0.559	0.337	-0.593	0.726	0.685	0.327	0.492	0.331	0.274	-0.144
Pyrophosphate-extractable Fe	0.394	0.315	0.149	-0.404	0.611	0.495	0.285	0.549	0.699	0.650	0.100
Pyrophosphate-extractable Al	0.265	0.305	0.051	-0.356	0.549	0.454	0.473	0.353	0.467	0.446	0.030
Oxalate-extractable Fe	0.532	0.527	0.330	-0.581	0.775	0.663	0.236	0.582	0.539	0.492	-0.024
Oxalate-extractable Al	0.436	0.530	0.326	-0.561	0.697	0.660	0.233	0.398	0.259	0.200	-0.109
Montmorillonite (% in<2 µm)	-0.615	-0.660	-0.590	0.663	-0.672	-0.655	0.269	-0.519	0.117	0.238	0.645
Gibbsite (% in<2 µm)	0.490	0.656	0.569	-0.590	0.548	0.550	-0.112	0.273	-0.344	-0.385	-0.461
I Quartz (100)/I Feldspar (002)	-0.679	-0.774	-0.638	0.762	-0.695	-0.796	0.006	-0.611	-0.139	-0.014	0.513
NH_4F-P*	0.632	0.675	0.562	-0.677	0.710	0.664	-0.087	0.593	0.078	0.030	-0.332
Non-occluded P*	0.700	0.693	0.577	0.726	0.809	0.744	-0.036	0.789	0.407	0.335	-0.248
Occluded Inorganic P*	0.479	0.389	0.241	-0.446	0.617	0.514	0.211	0.742	0.870	0.819	0.060
Acid-extractable P*	0.614	0.529	0.638	-0.510	0.351	0.418	-0.636	0.543	-0.095	-0.247	-0.595
Residual P*	0.645	0.628	0.519	-0.696	0.770	0.787	0.046	0.803	0.660	0.531	-0.134

	Fieldes & Perrott Test (< 2 mm)	Fieldes & Perrott Test (< 2 µm)	Phosphate Retention	Pyrophosphate-extractable Fe	Pyrophosphate-extractable Al	Oxalate-extractable Fe	Oxalate-extractable Al	Montmorillonite (% in<2 µm)	Gibbsite (% in<2 µm)	I Quartz (100)/I Feldspar (002)	NH_4F-P	Non-occluded P	Occluded Inorganic P	Acid-extractable P
Fieldes & Perrott Test (<2 µm)	0.630													
Phosphate Retention	0.787	0.610												
Pyrophosphate-extractable Fe	0.355	0.316	0.727											
Pyrophosphate-extractable Al	0.630	0.478	0.878	0.883										
Oxalate-extractable Fe	0.618	0.496	0.869	0.890	0.887									
Oxalate-extractable Al	0.835	0.574	0.932	0.664	0.813	0.852								
Montmorillonite (% in<2 µm)	-0.407	-0.884	-0.510	-0.373	-0.418	-0.469	-0.453							
Gibbsite (% in<2 µm)	0.750	0.636	0.505	-0.033	0.206	0.307	0.518	-0.456						
I Quartz (100)/I Feldspar (002)	-0.377	-0.477	-0.551	-0.336	-0.376	-0.459	-0.498	0.428	-0.417					
NH_4F-P*	0.723	0.613	0.656	0.365	0.448	0.527	0.620	-0.479	0.643	-0.495				
Non-occluded P*	0.560	0.522	0.720	0.592	0.557	0.686	0.638	-0.499	0.459	-0.538	0.915			
Occluded Inorganic P*	0.192	0.152	0.611	0.800	0.652	0.781	0.508	-0.222	0.014	-0.395	0.363	0.660		
Acid-extractable P*	-0.203	0.175	-0.239	-0.137	-0.326	-0.114	-0.245	-0.331	0.089	-0.312	0.073	0.110	0.030	
Residual P*	0.339	0.254	0.698	0.734	0.594	0.743	0.650	-0.356	0.154	-0.629	0.528	0.750	0.759	0.1

*Relevant data obtained from Tan (1971). ** Excluding I(w) 1.

Correlation coefficients at the 5%, 1% and 0.1% levels of significance are 0.344, 0.441 and 0.547, respectively.

Note: Values compared were those for individual horizons.

TABLE 3. HORIZON DEPTHS, pH, % MOISTURE AND LOSS-ON-IGNITION-Chronosequence.

Soil and Horizon		Depth (m)	pH (H_2O)	pH (KCl)	M(%)	LOI(%)
Ho 1	A_{11}	0.18	4.2	3.8	3.1	11.0
	A_{12}	0.20	4.5	4.1	2.0	6.0
	C	n.d.	5.4	4.5	0.3	1.2
I(y) 1	O	0.03	n.d.	n.d.	14.1	76.5
	A	0.07	4.5	3.7	4.8	15.4
	AB	0.09	4.9	4.1	3.2	9.0
	B_2	0.13	5.1	4.2	2.4	5.7
	B_3	0.12	5.1	4.3	1.8	3.5
	C	n.d.	5.2	4.7	0.1	1.0
I(o) 1	OA	0.03	4.5	3.8	8.9	49.8
	A	0.07	4.7	4.0	6.2	21.3
	B_{21}	0.15	4.9	4.3	5.6	13.2
	B_{22}	0.17	5.3	4.5	3.7	6.6
	C_{11}	0.13	5.2	4.7	1.4	2.7
	C_{12}	n.d.	5.2	4.6	0.4	1.2
I(o) 2	A_2	0.09*	3.7	3.1	5.8	31.2
I(w) 1	OA	0.13	4.2	3.4	8.4	36.3
	A	0.17	4.7	3.8	3.9	18.3
	A_{2g}	0.08	4.9	4.1	6.1	13.9
	B_{21}	0.23	5.4	4.4	2.5	5.2
	B_{22}	0.15	5.4	4.4	2.0	4.2
	C_{11}	0.05	5.4	4.5	0.7	2.0
	C_{12}	n.d.	5.2	4.4	1.1	2.7

TABLE 3. cont.

Soil and Horizon		Depth (m)	pH (H_2O)	pH (KCl)	M(%)	LOI(%)
Ah 1	A	0.08	4.6	4.0	7.3	27.6
	AB	0.10	4.7	4.2	6.4	17.6
	B_{21}	0.14	4.9	4.5	8.2	10.1
	B_{22}	0.19	5.2	4.8	6.0	6.0
	B_3	0.15	5.1	4.7	4.4	5.5
	C_{11}	0.15	5.1	4.6	3.4	4.4
	C_{12}	n.d.	5.0	4.8	1.5	2.3
Ku 1	A	0.15	4.4	3.5	2.3	12.8
	A_2G	0.10	4.5	3.5	1.4	6.5
	G	0.21	4.7	3.4	1.8	4.7
	B_hG	0.11	4.3	3.6	3.1	8.7
	B_2G	0.04	4.7	3.8	1.4	3.6
	B_3G	0.15	4.8	4.1	1.4	2.5
	C	n.d.	4.7	4.1	2.3	5.3
Ok 1	A	0.14	4.1	3.2	1.9	12.6
	AG	0.06	4.3	3.4	1.0	6.5
	G	0.12	4.4	3.6	0.7	2.0
	B_2G	0.19	4.6	4.1	1.3	2.7
	B_3G	0.11	4.6	4.1	0.8	1.5
	C	n.d.	4.7	4.3	0.8	1.6

* Depth from surface 0.07 m.

TABLE 4. HORIZON DEPTHS, pH, % MOISTURE AND LOSS-ON-IGNITION - Transect 1.

Soil	Distance from Stump (m)	Horizon	Depth (m)	pH H_2O	pH KCl	M(%)	LOI(%)
Ah 1	7.25	A	0.08	4.6	4.0	7.3	27.6
		AB	0.10	4.7	4.2	6.4	17.6
		B_{21}	0.14	4.9	4.5	8.2	10.1
Ah 2	5.25	A	0.06	4.4	3.5	6.0	28.4
		AB	0.12	4.5	3.8	5.7	21.4
		B_{21}	0.14	5.0	4.5	5.3	8.7
Ah 3	3.25	A	0.07	4.4	3.8	6.4	32.2
		AB	0.11	4.6	3.7	6.5	27.8
		B_{21}	0.14	5.0	4.4	7.6	13.8
Ah 4	2.10	OA	0.06	3.9	3.2	11.0	54.1
		A_2	0.14	4.6	3.7	7.4	22.8
		B_{21}	0.15	4.9	4.4	6.5	12.8
Ah 5	0	A_{21}*	0.08	3.6	2.9	2.8	13.7
		A_{22}	0.04	3.8	3.2	6.6	23.3
		B_{21}	0.16	4.7	4.3	7.5	13.8

* Depth from surface 0.20 m.

TABLE 5. HORIZON DEPTH, pH, % MOISTURE AND LOSS-ON-IGNITION - Transect 2.

Soil	Distance from Trees (m) From Beech 1.11 m (dbh)	Distance from Trees (m) From Beech 0.68 m (dbh)	Horizon	Depth (m)	pH H_2O	pH KCl	M(%)	LOI(%)
Ah 6	1.75	13.70	O	0.09	3.2	n.d.	28.7	89.9
			A_2	0.06	3.4	2.8	7.9	40.2
			B_{21}	0.14	4.7	4.2	5.9	15.8
Ah 7	4.00	11.45	O	0.05	3.6	2.7	11.9	81.4
			A	0.10	4.0	3.4	9.0	34.0
			B_{21}	0.15	4.7	4.4	5.1	12.5
Ah 1	7.70	7.75	A	0.08	4.6	4.0	7.3	27.6
			AB	0.10	4.7	4.2	6.4	17.6
			B_{21}	0.14	4.9	4.5	8.2	10.1
Ah 8	11.95	3.50	A	0.12	4.6	3.7	5.8	25.8
			B_1	0.18	5.0	4.2	7.3	17.4
			B_2	0.15	5.1	4.5	5.5	10.0
Ah 9	14.40	1.05	OA	0.09	4.3	3.5	9.7	46.7
			AB	0.17	4.7	3.9	6.3	23.5
			B_{21}	0.16	5.1	4.5	5.1	10.2

TABLE 6. WEIGHTS OF SIZE SEPARATES AND OF ORGANIC AND INORGANIC FRACTIONS - Chronosequence.

Soil and Horizon		Size > 2 mm	Size < 2 mm	Total	Inorganic**	Organic**
		(kg ha^{-1} x 10^4)				
Ho 1	A_{11}	0	138	138	123	15.2
	A_{12}	0	221	221	208	13.3
	C*	537	293	830	289	3.5
Total to:	0.38 m	0	359	359	331	28.5
	0.76 m (actual)	537	652	1189	1157	32.0
	0.76 m (est.)	0	955	955	920	35.6
I(y) 1	O	0	n.d.	-	-	-
	A	0	51	51	43	7.8
	AB	0	89	89	81	8.0
	B_2	0	140	140	132	8.0
	B_3	0	148	148	143	5.2
	C*	67	495	562	490	5.0
Total to:	0.38 m	0	354	354	328	26.4
	0.76 m (actual)	67	923	990	956	33.9
	0.76 m (est.)	0	958	958	925	34.3
I(o) 1	OA	0	10	10	5	5.0
	A	0	39	39	31	8.4
	B_{21}	0	122	122	106	16.1
	B_{22}	0	191	191	178	12.6
	C_{11}	23	159	182	155	4.3
	C_{12}*	243	200	443	198	2.4
Total to:	0.38 m	0	318	318	279	39.1
	0.76 m (actual)	266	721	987	939	48.7
	0.76 m (est.)	0	874	874	824	50.6

TABLE 6. cont.

Soil and Horizon		Size				
		> 2 mm	< 2 mm	Total	Inorganic**	Organic**
				($kg\ ha^{-1} \times 10^4$)		
I(w) 1	OA	0	59	59	38	21.6
	A	0	129	129	105	23.7
	A_{2g}	0	72	72	62	10.0
	B_{21}	0	247	247	234	12.9
	B_{22}	0	171	171	164	7.2
	C_{11}	76	31	107	30	0.6
	C_{12}	n.d.	n.d.	-	-	-
Total to:	0.38 m	0	260	260	205	55.3
	0.76 m (actual)	0	678	678	603	75.4
	0.76 m (est.)	0	678	678	603	75.4
Ah 1	A	0	40	40	29	11.0
	AB	0	64	64	53	11.3
	B_{21}	0	100	100	90	10.1
	B_{22}	0	180	180	169	10.7
	B_3	0	205	205	194	11.3
	C_{11}	0	207	207	198	9.1
	C_{12}	n.d.	n.d.	-	-	-
Total to:	0.38 m	0	261	261	225	35.8
	0.76 m (actual)	0	727	727	666	60.5
	0.76 m (est.)	0	727	727	666	60.5

TABLE 6. cont.

Soil and Horizon		Size				
		> 2 mm	< 2 mm	Total	Inorganic**	Organic**
				($kg\ ha^{-1} \times 10^4$)		
Ku 1	A	0	70	70	61	9.0
	A_2G	0	103	103	96	6.7
	G	0	293	293	279	13.7
	B_hG	0	129	129	118	10.8
	B_2G	0	48	48	46	1.7
	B_3G	0	209	209	204	5.2
	C	n.d.	-	-	-	-
Total to:	0.38 m	0	354	354	330	24.1
	0.76 m (actual)	0	852	852	804	47.1
	0.76 m (est.)	0	852	852	804	47.1
Ok 1	A	0	113	113	99	14.4
	AG	0	83	83	78	5.4
	G	0	185	185	181	3.7
	B_2G	0	340	340	331	9.2
	B_3G	0	189	189	186	2.8
	C*	0	208	208	205	3.3
Total to:	0.38 m	0	488	488	462	26.4
	0.76 m (actual)	0	1118	1118	1080	38.9
	0.76 m (est.)	0	1118	1118	1080	38.9

* To a depth of 0.76 m.

** Calculated from Loss-on-Ignition data.

TABLE 7. MECHANICAL ANALYSIS- Chronosequence.

Soil and Horizon		Pipette									Fractionation			
		c.s	f.s	si	cl	c.s	f.s	si	cl	Total	s	si	c.cl	f.cl
		(%)				(kg ha^{-1} x 10^4)					(%)			
Ho 1	A_{11}	14	49	26	11	19	67	36	15	137	70	23	4.9	2.1
	A_{12}	19	50	23	8	42	111	51	18	222	77	18	3.5	1.5
	C*	86	10	1	3	251	29	3	9	292	95	4	0.4	0.3
		Total to 0.38 m				61	178	87	33	359				
		% of Total				17	50	24	9	-				
		Total to 0.76 m				312	207	90	42	651				
		% of Total				48	32	14	6	-				
I(y) 1	O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	-	n.d.	n.d.	n.d.	n.d.
	A	9	42	31	18	5	21	16	9	51	58	28	10.0	4.1
	AB	9	43	30.5	17.5	8	38	27	16	89	59.5	29	7.8	3.8
	B_2	11	47	30	12	15	66	42	17	140	66	25.5	5.9	2.7
	B_3	18	51.5	21.5	9	27	76	32	13	148	75	19.5	4.0	1.7
	C*	26	65.5	5.5	3	129	325	27	15	496	90	8	1.4	0.6
		Total to 0.38 m				42	163	101	49	355				
		% of Total				12	46	28	14	-				
		Total to 0.76 m				184	526	144	70	924				
		% of Total				20	57	16	8	-				
I(o) 1	OA	n.d.	n.d.	n.d.	n.d.	4	2	2	2	10	63.5	20	7.6	8.8
	A	21	39	19	21	8	15	7	8	38	65.5	21	7.9	5.6
	B_{21}	20.5	41.5	26	12	25	51	32	15	123	67.5	20	7.7	4.8
	B_{22}	31.5	41	22.5	5	60	78	43	10	191	73	17	5.7	4.1
	C_{11}	54	31.5	11	3	86	50	17	5	158	87.5	9	2.1	1.5
	C_{12}*	51.5	43	2.5	3	103	86	5	6	200	92	5	1.2	2.2
		Total to 0.38 m				83	128	74	33	318				
		% of Total				26	40	23	10	-				
		Total to 0.76 m				286	282	106	46	720				
		% of Total				40	39	15	6	-				
I(o) 2	A_2		n.d.			-	-	-	-	-	63	25	7.8	4.3
I(w) 1	OA	n.d.	n.d.	n.d.	n.d.	7	29	16	7	59	60	27.5	7.0	5.6
	A	12	50	20	18	15	65	26	23	129	66	22	7.7	4.5
	A_{2g}	12	51	23	14	8	37	17	10	72	69	18.5	7.8	4.8
	B_{21}	16	53.5	23	7.5	39	132	57	18	246	75.5	15.5	5.8	3.2
	B_{22}	26	49.5	18.5	6	44	84	32	10	170	77.5	15	4.9	2.4
	C_{11}	74.5	18	4.5	3	23	6	1	1	31	93	5.5	1.1	0.6
	C_{12}	38	50	8	4	-	-	-	-	-	88.5	8.5	2.0	0.9
		Total to 0.38 m				30	131	59	40	260				
		% of Total				12	50	23	15	-				
		Total to 0.76 m				113	347	148	68	676				
		% of Total				17	51	22	10	-				

TABLE 7. Cont.

Soil and Horizon		Pipette									Fractionation			
		c.s	f.s	si	cl	c.s	f.s	si	cl	Total	s	si	c.cl	f.cl
		(%)				(kg ha^{-1} x10^{4})								
Ah 1	A	15.5	38.5	22.5	23.5	6	15	9	9	39	57.5	25	9.8	7.5
	AB	11.5	46	31	11.5	7	30	20	7	64	59.5	23.5	9.8	7.2
	B_{21}	12	52	29	7	12	51	29	7	99	61	23.5	8.8	6.9
	B_{22}	15	43.5	27.5	14	27	78	49	25	179	63.5	21	8.4	7.2
	B_3	18	43	23	16	37	88	47	33	205	69	18	7.2	5.8
	C_{11}	26.5	54	15	4.5	55	112	31	9	207	76	15	4.7	4.4
	C_{12}	50	41.5	5.5	3	-	-	-	-	-	93	4.5	1.3	1.3
		Total to 0.38 m				34	121	73	31	259				
		% of Total				13	47	28	12	-				
		Total to 0.76 m				126	337	175	87	725				
		% of Total				17	46	24	12	-				
Ku 1	A	3.5	44.5	37	15	2	31	26	11	70	52.5	36	7.7	3.7
	A_2G	3	42.5	42	12.5	3	44	43	13	103	52.5	35	8.0	4.3
	G	2.5	43.5	36.5	17.5	7	127	107	51	292	52.5	27.5	11.4	8.5
	B_hG	6.5	37.5	30	26	8	48	39	34	129	51	28	11.1	9.6
	B_2G	9.5	43.5	35	12	5	21	17	6	49	57	31	6.7	5.0
	B_3G	9	42	29	20	19	88	60	42	209	56.5	31.5	7.1	5.0
	C	39.5	29	15	16	-	-	-	-	-	72.5	17	5.9	4.5
		Total to 0.38 m				9	154	135	56	354				
		% of Total				3	44	38	16	-				
		Total to 0.76 m				44	359	292	157	852				
		% of Total				5	42	34	18	-				
Ok 1	A	3	60	31	5	3	68	35	6	112	55	40.5	4.1	0.3
	AG	3	43	45	9	2	36	37	7	82	53.5	40.5	4.9	0.9
	G	1	51	40	8	2	94	74	15	185	55.5	36	5.6	2.7
	B_2G	3	49	38	10	10	166	129	34	339	55.6	36.5	5.4	2.5
	B_3G	10	42	36.5	11.5	19	79	69	22	189	54.5	34	6.8	4.6
	C*	34	34	24	8	71	71	50	17	209	69.5	20.5	5.8	4.2
		Total to 0.38 m				10	250	187	39	486				
		% of Total				2	51	38	8	-				
		Total to 0.76 m				107	514	394	101	1116				
		% of Total				10	46	35	9	-				

* to a depth of 0.76 m.

Note: Volume-weights for I(o) 1, OA and I(w) 1, OA calculated from fractionation data, as no pipette values available, and for Ah 1, AB and B_{21}, where incomplete dispersion occurred with pipette method. In these instances the ratio c.s : f.s was assumed to be that observed for the underlying horizon.

TABLE 8. MECHANICAL ANALYSIS - Transect 1.

Soil and Horizon		Fractionation			
		Sand	Silt	Coarse Clay	Fine Clay
		(%)			
Ah 1	A	57.5	25	9.8	7.5
	AB	59.5	23.5	9.8	7.2
	B_{21}	61	23.5	8.8	6.9
Ah 2	A	58.5	26.5	8.6	6.3
	AB	59.5	25	9.3	6.3
	B_{21}	59.5	19.5	8.0	13.3
Ah 3	A	59	25.5	7.6	8.0
	AB	58	25.5	8.1	8.4
	B_{21}	54	22.5	8.7	14.9
Ah 4	OA	58	26	8.0	8.2
	A_2	55.5	27	9.0	7.7
	B_{21}	53.5	23.5	9.5	13.5
Ah 5	A_{21}	61.5	25	7.1	6.3
	A_{22}	54.5	26.5	9.0	9.8
	B_{21}	56	24.5	9.6	9.8

TABLE 9. MECHANICAL ANALYSIS - Transect 2.

Soil and Horizon		Fractionation			
		Sand	Silt	Coarse Clay	Fine Clay
		(%)			
Ah 6	O	39	34	27	
	A_2	55.5	25.5	9.1	10.1
	B_{21}	57.5	24.5	7.7	10.3
Ah 7	O	53	29	18	
	A	57.5	26.5	9.3	7.0
	B_{21}	72	20.5	8.0	9.5
Ah 1	A	57.5	25	9.8	7.5
	AB	59.5	23.5	9.8	7.2
	B_{21}	61	23.5	8.8	6.9
Ah 8	A	56.5	26.5	8.3	8.9
	B_1	53.5	24	10.7	11.7
	B_{21}	54.5	22	9.7	13.8
Ah 9	OA	55	28.5	8.8	7.5
	AB	53	26	10.0	11.0
	B_{21}	55.5	23	9.6	12.0

TABLE 10. CATION EXCHANGE ANALYSES - Chronosequence.

Soil and Horizon		CEC	TEB	BS	Na	Mg	Al	K	Ca	Fe
					Exchangeable Cations					
		(me/100 g)		(%)	(me/100 g)					
Ho 1	A_{11}	18.3	10.6	58	0.45	2.60	2.76	1.06	6.46	0.10
	A_{12}	11.3	4.68	41	0.37	1.09	1.95	0.38	2.84	0.00
	C	3.41	1.03	30	0.14	0.16	0.43	0.16	0.57	0.00
I(y) 1	O	n.d.	n.d.	n.d.	n.d.	n.d.	1.51	n.d.	n.d.	0.07
	A	23.6	5.34	23	0.46	2.06	6.35	0.82	2.00	0.16
	AB	13.9	2.92	21	0.30	0.69	3.85	0.81	1.12	0.12
	B_2	9.63	1.78	18	0.24	0.28	2.49	0.58	0.68	0.05
	B_3	7.74	1.11	14	0.24	0.10	1.39	0.31	0.46	0.03
	C	1.00	0.85	85	0.21	0.18	0.06	0.21	0.25	0.03
I(o) 1	OA	51.2	n.d.	n.d.	n.d.	n.d.	2.55	n.d.	n.d.	0.31
	A	23.1	3.18	14	0.41	1.07	5.18	0.59	1.11	0.34
	B_{21}	14.5	1.40	10	0.32	0.36	3.22	0.30	0.42	0.10
	B_{22}	7.38	0.65	9	0.26	0.11	1.35	0.20	0.08	0.10
	C_{11}	4.26	0.55	13	0.29	0.05	0.53	0.07	0.14	0.04
	C_{12}	1.71	0.53	31	0.15	0.12	0.18	0.12	0.14	0.04
I(o) 2	A_2	40.0	2.39	6	0.42	1.09	10.2	0.49	0.39	0.64
I(w) 1	OA	49.6	20.5	42	1.19	3.66	6.73	2.77	12.9	0.60
	A	27.6	3.30	12	0.27	0.74	6.72	0.24	2.05	0.12
	A_{2g}	8.31	1.95	24	0.35	0.34	5.44	0.14	1.12	0.01
	B_{21}	8.62	0.82	10	0.24	0.10	1.42	0.13	0.35	0.00
	B_{22}	7.24	0.59	8	0.20	0.10	1.52	0.11	0.18	0.04
	C_{11}	3.02	0.98	33	0.26	0.13	0.91	0.17	0.42	0.01
	C_{12}	4.85	0.82	17	0.19	0.10	1.20	0.16	0.37	0.05

TABLE 10. cont.

Soil and Horizon		CEC	TEB	BS	Na	Mg	Al	K	Ca	Fe
					Exchangeable Cations					
		(me/100 g)		(%)	(me/100 g)					
Ah 1	A	31.4	4.77	15	0.43	1.28	6.07	0.11	2.95	0.27
	AB	19.8	1.20	6	0.22	0.28	4.56	0.40	0.30	0.11
	B_{21}	9.04	0.49	5	0.21	0.09	1.66	0.10	0.09	0.11
	B_{22}	5.21	0.46	9	0.19	0.06	0.34	0.11	0.10	0.06
	B_3	5.86	0.50	8	0.18	0.06	0.50	0.13	0.13	0.06
	C_{11}	5.18	0.50	10	0.21	0.06	0.33	0.11	0.12	0.13
	C_{12}	2.84	0.47	17	0.15	0.04	0.22	0.07	0.21	0.06
Ku 1	A	14.2	3.92	28	0.38	1.00	3.85	0.44	2.10	0.23
	A_2G	9.23	2.08	23	0.19	0.43	4.85	0.11	1.35	0.18
	G	12.2	2.33	19	0.33	0.38	8.89	0.09	1.53	0.10
	B_hG	22.4	2.83	13	0.31	0.40	10.8	0.12	2.00	0.03
	B_2G	9.84	1.40	14	0.31	0.17	4.46	0.20	0.72	0.07
	B_3G	5.58	0.64	12	0.28	0.06	2.47	0.14	0.16	0.03
	C	12.0	1.11	9	0.40	0.14	3.98	0.36	0.21	0.07
Ok 1	A	14.0	4.77	34	0.48	0.89	0.67	0.44	2.96	0.00
	AG	7.23	1.98	28	0.34	0.22	1.31	0.11	1.31	0.00
	G	4.23	0.86	21	0.23	0.10	2.61	0.05	0.48	0.02
	B_2G	6.08	0.59	10	0.19	0.05	2.70	0.04	0.31	0.02
	B_3G	3.22	0.46	14	0.20	0.06	1.83	0.05	0.15	0.03
	C	3.63	0.53	15	0.29	0.05	1.59	0.07	0.12	0.00

Note: Exchangeable Al and Fe are assumed to be present as trivalent ions.

TABLE 11. **CATION EXCHANGE ANALYSES - Transect 1.**

Soil and Horizon		CEC	TEB	BS	Exchangeable Cations					
					Na	Mg	Al	K	Ca	Fe
		(me/100 g)		(%)	(me/100 g)					
Ah 1	A	31.4	4.77	15	0.43	1.28	6.07	0.11	2.95	0.27
	AB	19.8	1.20	6	0.22	0.28	4.56	0.40	0.30	0.11
	B_{21}	9.04	0.49	5	0.21	0.09	1.66	0.10	0.09	0.11
Ah 2	A	33.5	4.06	12	0.44	1.14	11.5	0.62	1.86	0.76
	AB	27.8	1.81	7	0.41	0.47	9.24	0.39	0.54	0.44
	B_{21}	8.24	0.67	8	0.35	0.06	1.47	0.11	0.15	0.02
Ah 3	A	39.2	14.5	37	0.40	3.45	6.80	1.03	9.58	0.56
	AB	34.2	7.65	22	0.44	1.80	8.84	0.87	4.54	0.58
	B_{21}	18.5	1.32	7	0.37	0.13	3.13	0.54	0.28	0.09
Ah 4	OA	65.1	n.d.	n.d.	n.d.	n.d.	9.62	n.d.	n.d.	0.98
	A_2	41.4	1.97	5	0.40	0.65	12.2	0.46	0.46	0.57
	B_{21}	15.7	0.77	5	0.31	0.10	2.95	0.22	0.14	0.05
Ah 5	A_{21}	22.9	1.25	5	0.26	0.38	4.51	0.19	0.42	0.11
	A_{22}	46.1	1.54	3	0.28	0.58	18.3	0.35	0.33	0.95
	B_{21}	15.7	0.69	4	0.34	0.12	3.48	0.08	0.15	0.00

Note: Exchangeable Al and Fe are assumed to be present as trivalent ions.

TABLE 12. CATION EXCHANGE ANALYSES - Transect 2.

Soil and Horizon		CEC	TEB	BS	Na	Mg	Al	K	Ca	Fe
					Exchangeable Cations					
		(me/100 g)		(%)	(me/100 g)					
Ah 6	O	113.9	15.5	14	1.78	7.65	11.0	1.30	4.76	0.90
	A_2	72.4	7.35	10	0.98	2.91	10.8	1.24	2.22	1.74
	B_{21}	19.4	1.19	6	0.30	0.20	5.31	0.51	0.18	0.12
Ah 7	O	94.6	19.6	21	2.42	5.26	4.25	0.48	11.4	0.42
	A	43.1	4.00	9	0.43	1.20	12.7	1.01	1.36	1.06
	B_{21}	13.9	0.81	6	0.31	0.16	3.44	0.21	0.13	0.05
Ah 1	A	31.4	4.77	15	0.43	1.28	6.07	0.11	2.95	0.27
	AB	19.8	1.20	6	0.22	0.28	4.56	0.40	0.30	0.11
	B_{21}	9.04	0.49	5	0.21	0.09	1.66	0.10	0.09	0.11
Ah 8	A	30.2	7.84	26	0.33	1.52	6.45	0.73	5.26	0.28
	B_1	20.8	1.04	5	0.28	0.19	4.83	0.41	0.16	0.01
	B_{21}	7.62	0.80	11	0.28	0.08	1.51	0.26	0.18	0.00
Ah 9	OA	60.9	17.8	29	0.71	4.96	4.86	3.11	9.02	0.72
	AB	26.8	2.37	9	0.34	0.60	8.49	1.05	0.38	0.28
	B_{21}	9.17	1.30	14	0.50	0.14	1.81	0.54	0.12	0.00

Note: Exchangeable Al and Fe are assumed to be present as trivalent ions.

TABLE 13. CATION EXCHANGE ANALYSES - Chronosequence.
(Volume-weight data: calculated from Tables 6 and 10).

Soil and Horizon		CEC	TEB	Na	Mg	Al	K	Ca	Fe
				Exchangeable Cations					
		(me ha^{-1} x 10^6)		($kg\ ha^{-1}$)					
Ho 1	A_{11}	252	146	144	437	342	571	1784	26
	A_{12}	250	103	187	293	387	326	1257	0
	C*	100	30	94	57	113	183	338	0
Total to:	0.38 m	502	249	334	730	729	897	3041	26
	0.76 m	602	279	425	787	842	1080	3379	26
I(y) 1	O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	A	120	27	54	126	289	162	202	16
	AB	124	26	61	75	309	280	198	21
	B_2	134	25	76	47	313	319	189	13
	B_3	114	16	83	18	184	176	135	8
	C*	49	42	240	109	26	407	248	30
Total to:	0.38 m	435	86	232	257	1003	849	657	54
	0.76 m	541	128	514	375	1121	1344	972	88
I(o) 1	OA	50	n.d.	n.d.	n.d.	23	n.d.	n.d.	6
	A	91	12	37	51	184	90	87	27
	B_{21}	177	17	89	53	353	141	103	24
	B_{22}	141	13	115	27	232	148	32	37
	C_{11}	68	9	108	10	76	45	46	12
	C_{12}*	34	10	69	29	33	95	56	26
Total to:	0.38 m	426	39	214	125	737	344	214	85
	0.76 m	561	61	418	170	901	519	324	132
I(w) 1	OA	295	122	163	265	360	645	1539	67
	A	356	43	81	116	781	121	531	29
	A_{2g}	60	13	41	30	354	39	162	1
	B_{21}	229	20	134	31	314	129	172	0
	B_{22}	124	10	80	21	234	75	63	12
	C_{11}	9	3	18	5	25	21	26	1
	C_{12}	-	-	-	-	-	-	-	-
Total to:	0.38 m	711	178	285	411	1495	805	2232	97
	0.76 m	1052	211	517	468	2068	1030	2493	110

TABLE 13, cont.

Soil and Horizon		CEC	TEB	Na	Mg	Al	K	Ca	Fe
				Exchangeable Cations					
		(me ha^{-1}x10^{6})		(kg ha^{-1})					
Ah 1	A	126	19	40	62	219	17	236	20
	AB	128	8	33	22	265	100	39	13
	B_{21}	90	5	47	11	148	38	17	20
	B_{22}	93	8	79	14	55	74	34	21
	B_3	120	10	84	16	93	101	52	24
	C_{11}*	71	7	66	10	41	62	34	35
	C_{12}	-	-	-	-	-	-	-	-
Total to:	0.38 m	372	35	145	99	649	178	303	60
	0.76 m	628	57	349	135	821	392	412	133
Ku 1	A	100	28	61	86	244	121	294	30
	A_2G	95	21	46	53	448	45	276	34
	G	358	68	220	134	2342	105	890	55
	B_hG	289	37	92	63	1256	63	517	7
	B_2G	47	7	35	10	192	38	69	6
	B_3G	116	14	136	15	465	115	68	12
	C	-	-	-	-	-	-	-	-
Total to:	0.38 m	416	91	243	222	2142	231	1121	98
	0.76 m	1005	175	590	361	4947	487	2114	144
Ok 1	A	160	54	126	123	69	195	675	0
	AG	60	16	64	23	98	36	218	0
	G	78	16	98	23	434	36	179	7
	B_2G	206	20	150	21	823	54	212	13
	B_3G	60	9	88	14	311	37	57	11
	C*	76	11	140	13	299	58	50	0
Total to:	0.38 m	368	92	335	176	861	284	1139	11
	0.76 m	640	126	666	217	2034	416	1391	31

*To a depth of 0.76 m.

TABLE 14. CEC AS A FUNCTION OF ORGANIC MATTER, CLAY AND SILT.

I. Characteristics of selected groupings - Chronosequence.**

Grouping	Number of Samples	CEC Range (me/100 g)	CEC Mean	Oxidisable Carbon* Range (%)	Oxidisable Carbon* Mean	Clay Range (%)	Clay Mean	Silt Range (%)	Silt Mean
All Soils:	29	1.00-31.4	11.01	0.12-11.0	2.71	3.0-26.0	12.4	1.0-45.0	26.6
Upper Horizons	11	7.23-31.4	16.91	1.76-11.0	5.23	5.0-23.5	14.4	19.0-45.0	30.1
Lower Horizons	18	1.00-22.4	7.40	0.12-4.40	1.17	3.0-26.0	11.1	1.0-40.0	24.4
Yellow-brown Earths:	18	1.00-31.4	11.73	0.12-11.0	2.90	3.0-23.5	11.8	1.0-31.0	20.6
Upper Horizons	7	11.3-31.4	20.20	1.76-11.0	5.52	8.0-23.5	16.6	19.0-31.0	25.1
Lower Horizons	11	1.00-14.5	6.33	0.12-4.40	1.23	3.0-16.0	8.7	1.0-30.0	17.7
Gley Podzols:	11	3.22-22.4	9.83	0.15-6.50	2.40	5.0-26.0	13.3	29.0-45.0	36.4

* Data taken from Tan (1971).

** I(w) 1 excluded.

TABLE 15. CEC AS A FUNCTION OF ORGANIC MATTER, CLAY AND SILT.

II. Characteristics of selected groupings - Transects.

Grouping	Number of Samples	CEC Range (me/100 g)	CEC Mean	Ignition Loss Range (%)	Ignition Loss Mean	Clay Range (%)	Clay Mean	Silt Range (%)	Silt Mean
All Soils	27	7.62-113.9	33.38	8.7-89.9	26.4	13.4-27.0	18.4	19.5-34.0	25.0
Transect 1	15	8.24- 65.1	28.57	8.7-54.1	21.9	13.4-23.6	17.7	19.5-27.0	24.6
Transect 2	15	7.62-113.9	38.20	10.0-89.9	30.8	15.7-27.0	19.2	20.5-34.0	25.5

TABLE 16. CEC AS A FUNCTION OF ORGANIC MATTER, CLAY AND SILT.

III. Simple correlation coefficients between % oxid. C and CEC, and their respective regression equations - Chronosequence.

Grouping	Simple Correlation Coefficient (r)	Regression Equation ●	Proportion of Variability in Y Attributed to X (%)
All Soils:	0.878^{***}	Y = 4.33 + 2.46 X (3.65) (0.26)	61
Upper Horizons	0.832^{**}	Y = 4.94 + 2.29 X (4.18) (0.51)	71
Lower Horizons	0.788^{***}	Y = 3.15 + 3.62 X (3.26) (0.70)	57
Yellow-brown Earths:	0.962^{***}	Y = 3.75 + 2.74 X (2.41) (0.19)	68
Upper Horizons	0.967^{***}	Y = 8.65 + 2.09 X (1.87) (0.25)	57
Lower Horizons	0.888^{***}	Y = 3.00 + 2.70 X (1.88) (0.46)	52
Gley Podzols:	0.582	Y = 6.23 + 1.50 X (4.80) (0.70)	37

* Significant at 5% level; ** Significant at 1% level; *** Significant at 0.1% level.

● Y = a + bX, where Y represents the estimated CEC, and b is the regression coefficient for the variable, % oxid. C (X). Values in brackets represent standard errors.

TABLE 17. CEC AS A FUNCTION OF ORGANIC MATTER, CLAY AND SILT.

IV. Simple correlation coefficients between % LOI and CEC, and their respective regression equations - Transects.

Grouping	Simple Correlation Coefficient (r)	Regression Equation●	Proportion of Variability in Y Attributed to X (%)
All Soils	0.969***	$\underset{(6.44)}{Y} = -0.02 + \underset{(0.06)}{1.27}\ X$	100
Transect 1	0.919***	$\underset{(6.30)}{Y} = 1.77 + \underset{(0.15)}{1.23}\ X$	94
Transect 2	0.979***	$\underset{(6.87)}{Y} = -1.58 + \underset{(0.07)}{1.29}\ X$	104

* Significant at 5% level; ** Significant at 1% level; *** Significant at 0.1% level.

● Y = a + bX, where Y represents the estimated CEC, and b is the regression coefficient for the variable, % LOI (X).

Values in brackets represents standard errors.

TABLE 18. CEC AS A FUNCTION OF ORGANIC MATTER, CLAY AND SILT.

V. Simple correlation coefficients between % clay and CEC, and their respective regression equations - Chronosequence.

Grouping	Simple Correlation Coefficient (r)	Regression Equation ●	Proportion of Variability in Y Attributed to X (%)
All Soils:	0.702 ***	Y (5.44) = 0.67 + 0.84 X (0.16)	94
Upper Horizons	0.768 **	Y (4.83) = 3.23 + 0.95 X (0.26)	81
Lower Horizons	0.717 ***	Y (3.70) = 1.04 + 0.57 X (0.14)	86
Yellow-brown Earths:	0.806 ***	Y (5.21) =-0.57 + 1.05 X (0.19)	105
Upper Horizons	0.795 *	Y (4.44) = 3.87 + 0.98 X (0.33)	81
Lower Horizons	0.609 *	Y (3.26) = 2.53 + 0.44 X (0.19)	60
Gley Podzols:	0.534	Y (4.99) = 3.17 + 0.50 X (0.26)	68

* Significant at 5% level; ** Significant at 1% level; *** Significant at 0.1% level.

● Y = a + b X, where Y represents the estimated CEC, and b is the regression coefficient for the variable, % clay (X).

Values in brackets represent standard errors.

TABLE 19. CEC AS A FUNCTION OF ORGANIC MATTER, CLAY AND SILT.

VI. Multiple regression equations relating CEC with % oxid.C and % clay - Chronosequence.

Grouping	Regression Equation ●	R^2	Test of Significance for Partial Regression Coefficient ■		Proportion of Variability in Y Attributed to X_1 and X_2: (%)	
			t_1	t_2	X_1	X_2
All Soils:	$Y = 0.47_{(2.85)} + 1.97_{(0.23)} X_1 + 0.42_{(0.10)} X_2$	0.865**	8.50***	4.27***	48	47
Upper Horizons	$Y = 1.07_{(3.52)} + 1.60_{(0.53)} X_1 + 0.52_{(0.24)} X_2$	0.808**	3.00*	2.17*	49	44
Lower Horizons	$Y = 0.27_{(2.56)} + 2.67_{(0.62)} X_1 + 0.36_{(0.11)} X_2$	0.781**	4.29***	3.32**	42	54
Yellow-brown Earths:	$Y = 2.69_{(2.39)} + 2.47_{(0.32)} X_1 + 0.16_{(0.14)} X_2$	0.929**	7.81***	1.10	61	16
Upper Horizons	$Y = 8.66_{(2.09)} + 2.09_{(0.49)} X_1 - 0.002_{(0.28)} X_2$	0.935**	4.32*	-0.01	57	0
Lower Horizons	$Y = 2.19_{(1.87)} + 2.39_{(0.54)} X_1 + 0.14_{(0.13)} X_2$	0.815**	4.40**	1.06	46	19
Gley Podzols:	$Y = -2.87_{(3.01)} + 1.82_{(0.44)} X_1 + 0.63_{(0.16)} X_2$	0.769**	4.10**	3.86**	44	85

* Significant at 5% level; ** Significant at 1% level; *** Significant at 0.1% level (t-test only).

● $Y = a + b_1 X_1 + b_2 X_2$, where Y represents the estimated CEC, and b_1 and b_2 the partial regression coefficients for the variables, X_1 (% oxid.C) and X_2 (% clay), respectively.

■ t_1 and t_2 are t-test values for b_1 and b_2, respectively.

Values in brackets represent standard errors.

TABLE 20. CEC AS A FUNCTION OF ORGANIC MATTER, CLAY AND SILT.

VII. Multiple regression equations relating CEC with % oxid. C, % clay and % silt - Chronosequence.

Grouping	Regression Equation ●	R^2	Test of Significance for Partial Regression Coefft ■			Proportion of Variability in Y Attributed to X_1, X_2 & X_3: (%)		
			t_1	t_2	t_3	X_1	X_2	X_3
All Soils:	$Y = 1.54 + 1.96X_1 + 0.46X_2 - 0.06X_3$ (2.84) (0.23) (0.10) (0.05)	0.870**	8.49***	4.40***	-1.11	48	52	-14
Upper Horizons	$Y = 13.08 + 1.35X_1 + 0.41X_2 - 0.30X_3$ (2.66) (0.41) (0.19) (0.11)	0.903**	3.26*	2.18	-2.65	42	35	-53
Lower Horizons	$Y = 0.43 + 2.67X_1 + 0.37X_2 - 0.01X_3$ (2.65) (0.64) (0.13) (0.07)	0.781**	4.15***	2.78*	-0.21	42	59	- 3
Yellow-brown Earths:	$Y = 1.12 + 2.71X_1 - 0.13X_2 + 0.20X_3$ (2.00) (0.28) (0.16) (0.08)	0.955**	9.71***	-0.79	2.72*	67	-13	35
Upper Horizons	$Y = 0.46 + 2.58X_1 - 0.20X_2 + 0.35X_3$ (1.64) (0.46) (0.24) (0.19)	0.968**	5.57*	-0.82	1.87	70	-16	44
Lower Horizons	$Y = 1.59 + 2.03X_1 - 0.11X_2 + 0.18X_3$ (1.61) (0.50) (0.17) (0.09)	0.880**	4.05**	-0.64	1.96	39	-15	50
Gley Podzols:	$Y = 2.94 + 1.78X_1 + 0.57X_2 - 0.14X_3$ (3.14) (0.47) (0.20) (0.23)	0.780**	3.82**	2.88*	-0.59	43	77	-52

* Significant at 5% level; ** Significant at 1% level; *** Significant at 0.1% level (t-test only).

● $Y = a + b_1X_1 + b_2X_2 + b_3X_3$, where Y represents the estimated CEC, and b_1, b_2 and b_3 the partial regression coefficients for the variables, X_1 (%oxid.C), X_2(% clay) and X_3 (% silt), respectively.

■ t_1, t_2 and t_3 are t-test values for b_1, b_2 and b_3, respectively.

Values in brackets represent standard errors.

TABLE 21. CEC AS A FUNCTION OF ORGANIC MATTER, CLAY AND SILT.

VIII. Multiple regression equations relating CEC with LOI and % clay - Transects.

Grouping	Regression Equation ●	R^2	Test of Significance for Partial Regression Coefft ■		Proportion of Variability in Y Attributed to X_1 and X_2: (%)	
			t_1	t_2	X_1	X_2
All Soils	$Y = 1.38 + 1.27 X_1 - 0.08 X_2$ (6.55) (0.06) (0.39)	0.939**	20.31***	-0.20	100	- 4
Transect 1	$Y = 3.58 + 1.22 X_1 - 0.09 X_2$ (6.55) (0.16) (0.64)	0.845**	7.37***	-0.14	93	- 6
Transect 2	$Y = -0.55 + 1.29 X_1 - 0.06 X_2$ (7.15) (0.08) (0.62)	0.958**	16.17***	-0.09	104	- 3

* Significant at 5% level; ** Significant at 1% level; *** Significant at 0.1% level (t-test only).

● $Y = a + b_1X_1 + b_2X_2$, where Y represents the estimated CEC, and b_1 and b_2 the partial regression coefficients for the variables, X_1 (LOI) and X_2 (% clay), respectively.

■ t_1 and t_2 are t-test values for b_1 and b_2, respectively.

Values in brackets represent standard errors.

TABLE 22. TOTAL Mg, Al, Si, K, Ca, Ti, AND Fe - Chronosequence.

(< 2 mm material).

Soil and Horizon		Total Elements						
		Mg	Al	Si (%)	K	Ca	Ti	Fe
Ho 1	A_{11}	0.85	8.17	33.3	1.81	0.96	0.36	3.16
	A_{12}	0.82	8.28	32.6	1.74	1.04	0.36	3.22
	C	0.81	6.80	32.6	1.95	0.92	0.28	2.93
I(y) 1	O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	A	0.85	8.61	32.7	1.64	0.81	0.37	4.01
	AB	0.83	8.69	33.4	1.78	0.82	0.40	3.49
	B_2	0.85	8.38	32.5	1.72	0.83	0.36	3.55
	B_3	0.86	7.70	33.1	1.79	0.89	0.40	3.43
	C	0.94	7.16	33.7	1.69	1.14	0.33	3.20
I(o) 1	OA	0.55	7.73	34.8	1.44	1.30	0.41	3.52
	A	0.46	7.75	35.0	1.40	0.81	0.44	3.51
	B_{21}	0.46	7.80	34.5	1.53	0.75	0.41	3.52
	B_{22}	0.63	7.98	33.4	1.54	0.78	0.40	3.53
	C_{11}	0.83	7.90	33.6	1.74	0.88	0.35	3.38
	C_{12}	0.90	7.01	33.1	1.83	0.91	0.36	3.33
I(o) 2	A_2	0.38	6.70	36.2	1.34	0.78	0.55	2.89
I(w) 1	OA	0.48	6.96	36.9	1.24	0.87	0.48	1.43
	A	0.33	6.99	37.2	1.32	0.69	0.51	1.14
	A_{2g}	0.50	8.14	35.3	1.55	0.69	0.49	1.88
	B_{21}	0.85	7.83	32.6	1.62	0.72	0.45	3.56
	B_{22}	0.82	8.25	32.1	1.67	0.69	0.46	3.50
	C_{11}	0.72	7.26	34.3	1.63	0.83	0.33	2.31
	C_{12}	0.82	7.16	33.1	1.67	0.87	0.46	2.97
Ah 1	A	0.34	7.06	35.3	1.39	0.73	0.52	4.09
	AB	0.34	7.02	35.5	1.29	0.76	0.52	3.83
	B_{21}	0.46	8.08	34.3	1.52	0.66	0.49	3.85
	B_{22}	0.63	8.11	34.6	1.79	0.65	0.45	3.70
	B_3	0.72	8.20	32.7	1.91	0.72	0.43	3.60
	C_{11}	0.81	7.85	32.5	1.91	0.76	0.42	3.35
	C_{12}	0.73	7.32	32.5	2.08	0.93	0.42	3.32
Ku 1	A	0.11	3.03	43.0	0.56	0.13	0.48	0.62
	A_2G	0.10	3.13	42.2	0.53	0.12	0.48	0.47
	G	0.17	4.41	40.8	0.65	0.17	0.52	0.59
	B_hG	0.17	4.13	41.2	0.69	0.19	0.54	0.59
	B_2G	0.14	3.63	42.1	0.59	0.20	0.44	0.55
	B_3G	0.13	3.51	42.2	0.61	0.17	0.46	0.65
	C	0.28	4.20	38.8	1.06	0.27	0.41	1.65
Ok 1	A	0.07	0.71	45.0	0.06	0.13	0.37	0.24
	AG	0.03	1.18	45.1	0.10	0.09	0.37	0.24
	G	0.06	1.86	44.2	0.22	0.09	0.42	0.29
	B_2G	0.05	1.70	44.0	0.18	0.07	0.43	0.56
	B_3G	0.10	2.57	43.6	0.30	0.06	0.49	0.43
	C	0.13	3.18	42.2	0.68	0.07	0.40	0.48

TABLE 23. TOTAL Mg, Al, Si, K, Ca, Ti AND Fe - Chronosequence.

(> 2 mm material).

Soil and Horizon		Total Elements Mg (%)	Al	Si	K	Ca	Ti	Fe
Ho 1	C	1.03	6.72	30.8	2.02	1.49	0.45	2.94
I(y) 1	C	1.04	5.97	30.9	1.76	1.38	0.46	2.51
I(o) 1	C_{11}	1.28	4.97	28.7	1.70	1.50	0.55	2.87
	C_{12}	1.13	6.85	30.3	2.14	1.50	0.44	2.94
I(w) 1	C_{11}	0.62	6.15	31.4	1.91	0.83	0.39	2.19
	C_{12}	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ah 1	C_{12}	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Ku 1	C	0.67	5.41	30.6	2.18	0.80	0.28	2.53

TABLE 24. TOTAL Mg, Al, Si, K, Ca, Ti AND Fe - Transect 1.

Soil and Horizon		Total Elements						
		Mg	Al	Si	K (%)	Ca	Ti	Fe
Ah 1	A	0.34	7.06	35.3	1.39	0.73	0.52	4.09
	AB	0.34	7.02	35.5	1.29	0.76	0.52	3.83
	B_{21}	0.46	8.08	34.3	1.52	0.66	0.52	3.85
Ah 2	A	0.30	6.37	37.3	1.48	0.72	0.59	3.06
	AB	0.31	7.26	36.3	1.32	0.67	0.58	3.20
	B_{21}	0.54	8.64	32.3	1.71	0.70	0.47	3.80
Ah 3	A	0.27	5.55	37.1	1.08	0.75	0.61	2.78
	AB	0.26	5.84	36.7	1.00	0.67	0.56	3.48
	B_{21}	0.44	8.90	32.6	1.39	0.69	0.46	3.75
Ah 4	OA	0.37	6.28	36.0	1.14	1.07	0.60	3.31
	A_2	0.28	6.78	35.7	1.09	0.64	0.57	3.76
	B_{21}	0.44	8.50	33.1	1.62	0.68	0.53	3.86
Ah 5	A_{21}	0.18	5.11	38.0	1.17	0.51	0.58	0.80
	A_{22}	0.26	6.00	37.6	1.08	0.57	0.64	2.25
	B_{21}	0.46	8.62	33.9	1.42	0.62	0.56	4.20

TABLE 25. TOTAL Mg, Al, Si, K, Ca, Ti AND Fe - Transect 2.

Soil and Horizon		Total Elements (%)						
		Mg	Al	Si	K	Ca	Ti	Fe
Ah 6	O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	A_2	0.30	6.04	36.0	1.30	0.71	0.56	2.78
	B_{21}	0.36	7.02	34.8	1.23	0.70	0.49	3.84
Ah 7	O	0.51	5.41	36.2	1.15	1.23	0.36	2.16
	A	0.38	7.67	35.2	1.29	0.74	0.53	3.52
	B_{21}	0.54	8.67	33.1	1.57	0.73	0.46	3.27
Ah 1	A	0.34	7.06	35.3	1.39	0.73	0.52	4.09
	AB	0.34	7.02	35.5	1.29	0.76	0.52	3.83
	B_{21}	0.46	8.08	34.3	1.52	0.66	0.49	3.85
Ah 8	A	0.26	5.47	36.8	1.15	0.70	0.53	3.12
	B_1	0.38	8.46	33.8	1.32	0.59	0.44	4.35
	B_2	0.49	8.50	32.0	1.53	0.73	0.50	3.79
Ah 9	OA	0.28	5.81	35.7	1.11	1.17	0.49	3.03
	AB	0.31	6.28	35.9	1.15	0.72	0.54	4.09
	B_{21}	0.54	8.05	32.5	1.62	0.67	0.50	3.82

TABLE 26. TOTAL Mg, Al, Si, K, Ca, Ti AND Fe - Chronosequence.

(Volume-weight data, <2 mm material: calculated from Tables 6 and 22).

Soil and Horizon		Mg ($x10^3$)	Al ($x10^4$)	Si ($x10^5$)	K ($x10^4$)	Ca ($x10^3$)	Ti ($x10^3$)	Fe ($x10^4$)
		Total Elements ($kg\ ha^{-1}$)						
Ho 1	A_{11}	10.4	10.0	4.09	2.22	11.8	4.42	3.88
	A_{12}	17.1	17.2	6.79	3.62	21.6	7.49	6.70
	C*	23.4	19.7	9.42	5.64	26.6	8.09	8.47
I(y) 1	O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	A	3.65	3.70	1.40	0.70	3.48	1.59	1.72
	AB	6.72	7.04	2.71	1.44	6.63	3.24	2.83
	B_2	11.2	11.0	4.28	2.27	10.9	4.74	4.68
	B_3	12.2	11.0	4.71	2.55	12.7	5.70	4.57
	C*	46.1	35.1	16.5	8.28	55.9	16.2	15.7
I(o) 1	OA	0.27	0.39	0.17	0.07	0.65	0.20	0.18
	A	1.43	2.41	1.09	0.44	2.52	1.37	1.09
	B_{21}	4.88	8.27	3.66	1.62	7.95	4.35	3.73
	B_{22}	11.3	14.3	5.99	2.76	14.0	7.17	5.90
	C_{11}	11.8	11.2	4.77	2.47	12.5	4.97	4.80
	C_{12}*	17.8	13.9	6.55	3.62	18.0	7.13	6.59
I(w) 1	OA	1.83	2.66	1.41	0.47	3.32	1.83	0.55
	A	3.49	7.38	3.93	1.39	7.29	5.39	1.20
	A_{2g}	3.12	5.08	2.20	0.97	4.30	3.06	1.17
	B_{21}	19.9	18.3	7.62	3.79	16.9	10.5	8.33
	B_{22}	13.4	13.5	5.26	2.73	11.3	7.53	5.73
	C_{11}	2.16	2.18	1.03	0.49	2.49	0.99	0.69
	C_{12}	-	-	-	-	-	-	-

TABLE 26. cont.

Soil and Horizon		Total Elements				(kg ha^{-1})		
		Mg	Al	Si	K	Ca	Ti	Fe
		(x10^3)	(x10^4)	(x10^5)	(x10^4)	(x10^3)	(x10^3)	(x10^4)
Ah 1	A	0.99	2.06	1.03	0.41	2.13	1.52	1.19
	AB	1.82	3.75	1.90	0.69	4.06	2.78	2.05
	B_{21}	4.12	7.24	3.07	1.36	5.91	4.39	3.45
	B_{22}	10.6	13.7	5.84	3.02	11.0	7.58	6.23
	B_3	14.0	15.9	6.35	3.71	14.0	8.35	6.99
	C_{11}	16.1	15.6	6.45	3.79	15.1	8.33	6.65
	C_{12}	-	-	-	-	-	-	-
Ku 1	A	0.68	1.86	2.64	0.34	0.80	2.94	0.38
	A_2G	0.96	3.00	4.05	0.51	1.15	4.60	0.45
	G	4.75	12.3	11.4	1.82	4.75	14.5	1.65
	B_hG	2.01	4.89	4.88	0.82	2.24	6.39	0.70
	B_2G	0.64	1.67	1.94	0.27	0.92	2.03	0.25
	B_3G	2.65	7.14	8.59	1.24	3.46	9.36	1.32
	C	-	-	-	-	-	-	-
Ok 1	A	0.70	0.71	4.48	0.06	1.30	3.69	0.24
	AG	0.24	0.93	3.54	0.08	0.71	2.90	0.19
	G	1.09	3.37	8.01	0.40	1.63	7.61	0.53
	B_2G	1.65	5.62	14.5	0.60	2.31	14.2	1.85
	B_3G	1.86	4.78	8.10	0.56	1.12	9.11	0.58
	C*	2.67	6.52	8.65	1.39	1.44	8.20	0.98

* To a depth of 0.76 m.

TABLE 27. TOTAL Mg, Al, Si, K, Ca, Ti and Fe - Chronosequence.

(Volume-weight data; >2 mm material: calculated from Tables 6 and 23).

Soil and Horizon		Total Elements Mg ($x10^3$)	Al ($x10^4$)	Si ($x10^5$)	K ($x10^4$)	(kg ha^{-1}) Ca ($x10^3$)	Ti ($x10^3$)	Fe ($x10^4$)
Ho 1	C*	55.3	36.1	16.5	10.8	80.0	24.2	15.8
I(y) 1	C*	6.97	4.00	2.07	1.18	9.25	3.08	1.68
I(o) 1	C_{11}	2.94	1.14	0.66	0.39	3.45	1.27	0.66
	C_{12}*	27.5	16.6	7.36	5.20	36.5	10.7	7.14
I(w) 1	C_{11}	4.71	4.67	2.39	1.45	6.31	2.96	1.66

* To a depth of 0.76 m.

TABLE 28. SUMMARY OF TOTAL Mg, Al, Si, K, Ca, Ti AND Fe - Chronosequence. (To a depth of 0.38 m).

Soil	Total Weight ($kg\ ha^{-1}$)							% of Total Weight						
	Mg ($x10^3$)	Al ($x10^4$)	Si ($x10^5$)	K ($x10^4$)	Ca ($x10^3$)	Ti ($x10^3$)	Fe ($x10^4$)	Mg	Al	Si	K	Ca	Ti	Fe
Ho 1	27.5	27.3	10.9	5.84	33.4	11.9	10.6	1.72	17.1	68.1	3.65	2.09	0.74	6.62
I(y) 1	27.7	27.2	10.7	5.69	27.4	12.4	11.5	1.75	17.2	67.7	3.60	1.73	0.78	7.27
I(o) 1	15.2	22.0	9.50	4.24	21.8	11.4	9.51	1.12	16.2	70.1	3.13	1.61	0.84	7.01
I(w) 1	8.44	15.1	7.54	2.83	14.9	10.3	2.92	0.85	15.2	75.7	2.85	1.50	1.03	2.93
Ah 1	7.26	17.4	7.84	3.41	15.6	11.1	8.66	0.66	15.6	70.5	3.06	1.40	1.00	7.78
Ku 1	4.57	12.5	13.8	1.97	4.89	16.5	1.85	0.29	7.97	88.0	1.26	0.31	1.05	1.18
Ok 1	2.54	6.77	20.6	0.73	4.37	18.7	1.54	0.17	3.11	94.7	0.33	0.20	0.86	0.71

TABLE 29. SUMMARY OF TOTAL Mg, Al, Si, K, Ca, Ti AND Fe - Chronosequence (To a depth of 0.76 m).

Soil		Total Weight (kg ha^{-1})							% of Total Weight						
		Mg ($x10^3$)	Al ($x10^4$)	Si ($x10^5$)	K ($x10^4$)	Ca ($x10^3$)	Ti ($x10^3$)	Fe ($x10^4$)	Mg	Al	Si	K	Ca	Ti	Fe
Ho 1	of < 2 mm	50.9	46.9	20.3	11.5	60.0	20.0	19.1	1.73	16.0	69.1	3.92	2.04	0.68	6.51
	of > 2 mm	55.3	36.1	16.5	10.8	80.0	24.2	15.8							
	Σ < + > 2 mm	106.2	83.0	36.8	22.3	140.0	44.2	34.9	1.98	15.4	68.5	4.15	2.60	0.82	6.50
	Adjusted Total ●	75.0	67.3	30.0	17.3	87.5	28.4	27.8	1.74	15.6	69.5	4.01	2.03	0.66	6.44
I(y) 1	of < 2 mm	79.9	67.8	29.6	15.2	89.6	31.5	29.5	1.86	15.8	69.1	3.55	2.09	0.73	6.88
	of > 2 mm	7.0	4.0	2.1	1.2	9.3	3.08	1.7							
	Σ < + > 2 mm	86.9	71.8	31.7	16.4	98.9	34.6	31.2	1.90	15.7	69.1	3.58	2.16	0.75	6.81
	Adjusted Total ●	83.2	70.3	30.8	15.8	93.8	32.6	30.6	1.87	15.8	69.1	3.54	2.10	0.73	6.86
I(o) 1	of < 2 mm	47.5	50.5	22.2	11.0	55.6	25.2	22.3	1.49	15.8	69.7	3.45	1.74	0.79	7.00
	of > 2 mm	30.4	17.7	8.0	5.6	40.0	12.0	7.8							
	Σ < + > 2 mm	77.9	68.2	30.2	16.6	95.6	37.2	30.1	1.78	15.6	69.0	3.79	2.18	0.85	6.87
	Adjusted Total ●	61.7	61.7	27.4	13.9	69.7	30.9	27.5	1.57	15.7	69.7	3.53	1.77	0.79	6.99
I(w) 1*	of < 2 mm	41.7	46.9	20.4	9.35	43.1	28.3	17.0	1.44	16.3	70.7	3.24	1.49	0.98	5.89
Ah 1*	of < 2 mm	42.2	53.1	22.5	11.7	47.2	30.2	24.3	1.29	16.3	69.0	3.59	1.45	0.93	7.45
Ku 1*	of < 2 mm	11.7	30.9	33.5	5.00	13.3	39.8	4.75	0.31	8.08	87.6	1.31	0.35	1.04	1.24
Ok 1*	of < 2 mm	8.21	21.9	47.3	3.08	8.51	45.7	4.36	0.16	4.31	93.0	0.61	0.17	0.90	0.86

● Assumes < 2 mm material fills volume actually occupied by > 2 mm.

* Only < 2 mm material present to 0.76 m.

TABLE 30. ANNUAL LOSSES OF TOTAL ELEMENTS DURING VARIOUS PERIODS OF SOIL DEVELOPMENT - Chronosequence.

(To a constant depth of 0.38 m).

Period	Annual Losses													
	Mg	Al	Si	K	Ca	Ti	Fe	Mg	Al	Si	K	Ca	Ti	Fe
	($kg\ ha^{-1} \times 10^{-1}$)							(As % of amount remaining at beginning of period $\times 10^{-3}$)						
I(y) 1 to I(o) 1	63	260	600	73	28	5	100	23	9.6	5.6	13	10	3.9	8.7
I(o) 1 to Ah 1	40	230	600	42	31	1.5	43	26	11	5.6	9.8	14	1.3	4.5
Ah 1 to Ku 1	0.52	9.4	-115*	2.8	2.1	-1.0	13	0.72	0.54	-1.5	0.81	1.3	-0.94	1.5
Ku 1 to Ok 1	0.34	9.6	-113	2.1	0.09	-0.37	0.52	0.74	0.77	-0.82	1.1	0.18	-0.22	0.28
I(y)1 to Ok 1	2.2	18	-85	4.3	2.0	-0.54	8.6	0.78	0.65	-0.80	0.75	0.73	-0.44	0.75
I(y)1 to I(w) 1	96	600	1580	140	63	11	430	35	22	15	25	23	8.5	37

* Negative sign indicates a gain.

TABLE 31. **MOLAR ELEMENTAL RATIOS - Chronosequence.**
(Calculated from the data in Table 28).

Ratio	Soil						
	Ho 1	I(y) 1	I(o) 1	I(w) 1	Ah 1	Ku 1	Ok 1
Si/Mg	35	34	54	77	93	261	701
Si/Al	3.8	3.7	4.1	4.8	4.3	11	29
Si/K	26	26	31	37	32	97	393
Si/Ca	47	56	63	73	71	402	672
Si/Ti	157	147	142	124	121	143	188
Si/Fe	21	19	20	51	18	149	264
Al/Mg	9.0	8.9	13	16	22	25	24
Al/K	6.8	6.9	7.5	7.7	7.4	9.2	13
Al/Ca	12	15	15	15	17	38	23
Al/Ti	41	42	34	26	28	14	6.4
Al/Fe	5.3	4.9	4.8	11	4.2	14	9.1
Fe/Mg	1.7	1.8	2.7	1.5	5.2	1.8	2.6
Fe/K	1.3	1.4	1.6	0.72	1.8	0.66	1.5
Fe/Ca	2.3	3.0	3.1	1.4	4.0	2.7	2.5
Fe/Ti	7.6	8.0	7.2	2.4	6.7	0.96	0.70
K/Mg	1.3	1.3	1.7	2.1	2.9	2.7	1.8
K/Ca	1.8	2.1	2.0	2.0	2.2	4.1	1.7
K/Ti	6.0	5.6	4.6	3.4	3.8	1.5	0.48
Ca/Mg	0.73	0.60	0.87	1.1	1.3	0.65	1.0
Ca/Ti	3.8	2.6	2.3	1.7	1.7	0.36	0.28
Mg/Ti	4.6	4.4	2.6	1.6	1.3	0.55	0.28

TABLE 32. 'CORRECTED' VALUES FOR TOTAL Mg, Al, Si, K, Ca, Ti, AND Fe - Chronosequence.

(Calculated from data in Tables 6, 22 and 28).

(A) Assumed:

(i) Si constant Ah 1 to Ok 1
(ii) Ti constant PM to Ah 1

(B) Assumed:

(i) Constant annual loss Ti (0.038 kg ha^{-1})
(ii) Parent material values from Section (A)

Soil	Total Weight (kg ha^{-1}) (A)							(B)						
	Mg ($x10^3$)	Al ($x10^4$)	Si ($x10^5$)	K ($x10^4$)	Ca ($x10^3$)	Ti ($x10^3$)	Fe ($x10^4$)	Mg ($x10^3$)	Al ($x10^4$)	Si ($x10^5$)	K ($x10^4$)	Ca ($x10^3$)	Ti ($x10^3$)	Fe ($x10^4$)
Parent Material (Ho 1, C)	34.3	28.8	13.8	8.31	39.0	11.9	12.4	34.4	28.9	13.8	8.34	39.1	11.9	12.4
Ho 1	27.5	27.2	10.9	5.84	33.4	11.9	10.6	27.5	27.2	10.9	5.84	33.4	11.9	10.6
I(y) 1	26.6	26.1	10.3	5.46	26.3	11.9	10.9	25.5	25.0	9.87	5.23	25.2	11.4	10.4
I(o) 1	15.8	22.9	9.90	4.44	22.7	11.9	9.94	15.0	21.8	9.42	4.23	21.6	11.3	9.46
I(w) 1	9.74	17.4	8.72	3.27	17.2	11.9	3.37	9.27	16.6	8.30	3.11	16.4	11.3	3.21
Ah 1	7.78	18.6	8.39	3.65	16.7	11.9	9.29	7.36	17.6	7.93	3.45	15.8	11.2	8.78
Ku 1	2.78	7.62	8.39	1.20	2.97	10.0	1.12	2.57	7.06	7.77	1.11	2.75	9.26	1.04
Ok 1	1.03	2.76	8.39	0.30	1.78	7.62	0.63	0.94	2.52	7.67	0.27	1.63	6.97	0.58

TABLE 33. 'CORRECTED' ANNUAL LOSSES OF TOTAL ELEMENTS DURING VARIOUS PERIODS OF SOIL DEVELOPMENT - Chronosequence.

(Calculated from data in Section (B) of Table 32).

Period	Annual Losses													
	Mg	Al	Si	K	Ca	Ti	Fe	Mg	Al	Si	K	Ca	Ti	Fe
	($kg\ ha^{-1} \times 10^{-1}$)							(As % of amount remaining at beginning of period $\times 10^{-3}$)						
I(y) 1 to I(o) 1	52	160	225	50	18	0.38	47	21	6.4	2.3	9.6	7.1	0.33	4.5
I(o) 1 to Ah 1	38	210	745	39	29	0.38	34	26	9.6	7.9	9.2	13.4	0.34	3.6
Ah 1 to Ku 1	0.92	20	3.1	4.5	2.5	0.38	15	1.3	1.2	0.04	1.3	1.6	0.34	1.7
Ku 1 to Ok 1	0.59	7.6	1.7	1.4	0.19	0.38	0.77	2.3	1.1	0.02	1.3	0.68	0.41	0.74
I(y) 1 to Ok 1	2.1	19	19	4.3	2.0	0.38	8.5	0.83	0.78	0.19	0.82	0.81	0.34	0.81
I(y) 1 to I(w) 1	81	420	785	106	44	0.38	360	32	17	8.0	20	17	0.33	35

TABLE 34. QUANTITATIVE EVALUATION OF CHANGES OCCURRING DURING SOIL DEVELOPMENT - Chronosequence.

(Following Barshad, 1964).

Soil and Horizon	Ho 1			I(y) 1					I(o) 1					
	A_{11}	A_{12}	C●	A	AB	B_2	B_3	C●	OA	A	B_{21}	B_{22}	C_{11}	C_{12}●
Present volume (cm^3)*	18.0	20.0	1.0	7.0	9.0	13.0	12.0	1.0	3.0	7.0	15.0	17.0	13.0	1.0
Bulk density (g/cm^3)*	0.79	1.13	1.57	0.76	1.02	1.10	1.25	1.66	0.36	0.60	0.86	1.17	1.28	1.66
Weight Ti ($gx10^{-2}$)*	4.42	7.49	0.433	1.59	3.24	4.74	5.70	0.542	0.204	1.37	4.35	7.17	5.59	0.588
Present weight soil (g)*	14.22	22.60	1.57	5.32	9.18	14.30	15.00	1.66	1.08	4.20	12.90	19.89	16.64	1.66
Present weight >2 µm (g)*	12.64	20.79	1.52	4.36	7.53	12.58	13.65	1.61	0.90	3.32	11.35	18.90	16.14	1.61
Present weight <2 µm (g)*	1.56	1.81	0.047	0.96	1.65	1.72	1.35	0.050	0.18	0.88	1.55	1.00	0.50	0.050
Original weight >2 µm (g)*	15.55	26.35	1.52	5.59	11.40	16.68	20.04	1.91	0.72	4.82	15.31	25.22	19.66	2.07
Original weight <2 µm (g)*	0.48	0.82	0.047	0.17	0.35	0.52	0.62	0.059	0.02	0.15	0.47	0.78	0.61	0.064
Loss of >2 µm fraction due to soil formation (g)*	2.91	5.56	0	1.23	3.87	4.10	6.39	0.30	-0.19	1.50	3.96	6.32	3.52	0.46
Clay formed (g)*	0.71	1.36	0	0.31	0.98	1.03	1.61	0.075	-	0.18	0.48	0.76	0.42	0.055
Total clay in absence of migration or destruction (g)*	1.19	2.18	0.047	0.48	1.33	1.55	2.23	0.134	0.02	0.33	0.95	1.54	1.03	0.119
Loss or gain of clay due to migration or destruction (g)*	+0.37	-0.37	0	+0.48	+0.32	+0.17	-0.88	-0.075	+0.16	+0.55	+0.60	-0.55	-0.53	-0.069
Weight parent material (PM) (g)*	16.03	27.17	1.57	5.76	11.75	17.20	20.66	1.97	0.74	4.97	15.78	26.00	20.27	2.13
Original volume PM (cm^3)*	10.2	17.3	1.00	3.7	7.5	11.0	13.2	1.25	0.5	3.2	10.1	16.6	12.9	1.36
Change in volume PM (cm^3)*	+ 7.8	+ 2.7	0	+3.3	+1.5	+2.1	-1.2	-0.3	+2.5	+3.8	+5.0	+0.4	+0.1	-0.4
Relative clay formation (g/100 g >2 µm PM)	4.6	5.2	0	5.6	8.6	6.2	8.0	3.9	-	3.8	3.1	3.0	2.2	2.7
Relative clay loss or gain (g/100 cm^3 PM)	+3.6	-2.1	0	+12.9	+4.3	+1.5	-6.7	-6.0	+ 33	+ 17	+6.0	-3.3	-4.1	-4.0
Relative volume change (cm^3/100 cm^3 PM)	+ 76	+ 16	0	+ 91	+ 20	+ 19	-8.8	- 20	+538	+120	+ 49	+2.7	+0.7	- 27

Soil and Horizon	I(w) 1							Ah 1						
	OA	A	A_{2g}	B_{21}	B_{22}	C_{11}	C_{12} ●	A	AB	B_{21}	B_{22}	B_3	C_{11}	C_{12} ●
Present volume (cm^3)*	13.0	17.0	8.0	23.0	15.0	5.0	1.0	8.0	10.0	14.0	19.0	15.0	15.0	1.0
Bulk density (g/cm^3)*	0.50	0.79	0.96	1.10	1.16	1.37	1.25	0.54	0.69	0.77	1.00	1.43	1.43	1.56
Weight Ti ($gx10^{-2}$)*	1.83	5.39	3.06	10.5	7.53	2.20	0.554	1.52	2.78	4.39	7.58	8.35	8.33	0.631
Present weight soil (g)*	6.50	13.43	7.68	25.30	17.40	6.85	1.25	4.32	6.90	10.78	19.00	21.45	21.45	1.56
Present weight >2 µm (g)*	5.69	11.01	6.60	23.40	16.36	6.64	1.20	3.30	5.73	9.09	16.34	18.02	20.48	1.51
Present weight <2 µm (g)*	0.81	2.42	1.08	1.90	1.04	0.21	0.050	1.02	1.17	1.69	2.66	3.43	0.97	0.047
Original weight >2 µm (g)*	6.44	18.96	10.76	37.04	26.48	7.74	1.95	5.35	9.78	15.44	26.67	29.36	29.30	2.22
Original weight <2 µm (g)*	0.20	0.59	0.33	1.15	0.82	0.24	0.060	0.17	0.30	0.48	0.82	0.91	0.91	0.067
Loss of >2 µm fraction due to soil formation (g)*	0.75	7.95	4.16	13.64	10.12	1.10	0.75	2.05	4.05	6.35	10.33	11.34	8.82	0.71
Clay formed (g)*	0.08	0.85	0.45	1.46	1.09	0.12	0.081	0.34	0.68	1.07	1.73	1.90	1.48	0.119
Total clay in absence of migration or destruction (g)*	0.28	1.44	0.78	2.61	1.91	0.36	0.141	0.51	0.98	1.54	2.56	2.81	2.39	0.188
Loss or gain of clay due to migration or destruction (g)*	+0.53	+0.98	+0.30	-0.71	-0.86	-0.15	-0.091	+0.51	+0.19	+0.15	+0.10	+0.62	-1.42	-0.141
Weight parent material (g)*	6.64	19.55	11.09	38.19	27.30	7.98	2.01	5.52	10.08	15.92	27.49	30.27	30.2	2.29
Original volume PM(cm^3)*	4.2	12.5	7.1	24.3	17.4	5.1	1.28	3.5	6.4	10.1	17.5	19.3	19.2	1.46
Change in volume PM (cm^3)*	+8.8	+4.6	+0.9	-1.3	-2.4	-0.1	-0.3	+4.5	+3.6	+3.9	+1.5	-4.3	-4.2	-0.5
Relative clay formation (g/100 g >2 µm PM)	1.3	4.5	4.1	4.0	4.1	1.5	4.1	6.4	7.0	6.9	6.5	6.5	5.1	5.4
Relative clay loss or gain (g/100 cm^3 PM)	+12.6	+7.9	+4.2	-2.9	-5.0	-3.0	-7.1	+14.4	+3.0	+1.5	+0.6	+3.2	-7.4	-9.7
Relative volume change (cm^3/100 cm^3 PM)	+207	+36	+13	-5.4	-13.7	-1.6	-22	+ 127	+ 56	+ 38	+8.5	- 22	- 22	- 32

TABLE 34. cont.

Soil and Horizon	Ku 1							Ok 1					
	A	A_2G	G	B_hG	B_2G	B_3G	C●	A	AG	G	B_2G	B_3G	C●
Present volume (cm^3)*	15.0	10.0	21.0	11.0	4.0	15.0	1.0	14.0	6.0	12.0	19.0	11.0	1.0
Bulk density (g/cm^3)*	0.48	1.04	1.42	1.21	1.21	1.41	1.32	0.83	1.41	1.55	1.81	1.73	1.50
Weight Ti ($gx10^{-2}$)*	2.94	4.60	14.5	6.39	2.03	9.36	0.502	3.69	2.90	7.61	14.2	9.11	0.586
Present weight soil (g)*	7.20	10.40	29.82	13.31	4.84	21.15	1.32	11.62	8.46	18.60	34.39	19.03	1.50
Present weight >2 µm (g)*	6.12	9.10	24.60	9.85	4.26	16.92	1.11	11.04	7.70	17.11	30.95	16.84	1.38
Present weight <2 µm (g)*	1.08	1.30	5.22	3.46	0.58	4.23	0.21	0.58	0.76	1.49	3.44	2.19	0.12
Original weight>2 µm (g)*	10.34	16.17	51.01	22.48	7.14	32.18	1.77	12.98	10.20	26.77	49.94	32.04	2.06
Original weight <2 µm (g)*	0.32	0.50	1.58	0.70	0.22	1.00	0.055	0.40	0.32	0.83	1.54	0.99	0.064
Loss of >2 µm fraction due to soil formation (g)*	4.22	7.07	26.41	12.63	2.88	15.26	0.66	1.94	2.50	9.66	18.99	15.20	0.68
Clay formed (g)*	0.72	1.20	4.48	2.14	0.49	2.59	0.111	0.18	0.23	0.88	1.72	1.38	0.062
Total clay in absence of migration or destruction (g)*	1.04	1.70	6.05	2.84	0.71	3.58	0.166	0.58	0.54	1.70	3.27	2.37	0.125
Loss or gain of clay due to migration or destruction (g)*	+0.05	-0.40	-0.83	+0.63	-0.13	+0.65	+0.045	+0.004	+0.22	-0.22	+0.17	-0.18	-0.005
Weight parent material (g)*	10.66	16.67	52.59	23.18	7.36	33.18	1.82	13.38	10.52	27.60	51.48	33.03	2.12
Original volume PM (cm^3)*	6.8	10.6	33.5	14.8	4.7	21.1	1.2	8.5	6.7	17.6	32.8	21.0	1.4
Change in volume PM (cm^3)*	+8.2	-0.6	-12.5	-3.8	-0.7	-6.1	-0.2	+5.5	-0.7	-5.6	-13.8	-10.0	-0.4
Relative clay formation (g/100 g >2 µm PM)	6.9	7.4	8.8	9.5	6.8	8.0	6.3	1.4	2.2	3.3	3.5	4.3	3.0
Relative clay loss or gain (g/100 cm3 PM)	+0.7	-3.8	-2.5	+4.2	-2.7	+3.1	+0.4	+0.05	+3.3	-1.2	+0.5	-0.9	-0.4
Relative volume change (cm^3/100 cm^3PM)	+ 121	-5.8	- 37	- 26	- 15	- 29	- 14	+ 64	- 10	- 32	- 42	- 48	- 26

PM of all soils assumed to be <2 mm fraction from C horizon of Ho 1.
* per horizon/cm^2 of surface. ● values expressed/cm of horizon.

TABLE 35. PERCENTAGE OF ELEMENTS INITIALLY PRESENT IN A WEIGHT OF PARENT MATERIAL (EQUAL TO THAT FROM WHICH UNIT SOIL VOLUME TO 0.38 m AT Ho 1 HAS FORMED) REMAINING AT VARIOUS STAGES OF SOIL DEVELOPMENT.

(Calculated from data in Tables 22 and 34).

Soil	Element Mg	Al	Si (% remaining)	K	Ca	Ti	Fe	Depth Containing Similar Weight of PM/cm^2 of Surface (m)
PM (Ho 1, C)	100	100	100	100	100	100	100	0.275
Ho 1	80	94	79	70	86	100	87	0.380
I(y) 1	77	91	75	66	67	100	89	0.369
I(o) 1	47	80	72	53	58	100	80	0.392
Ah 1	33	65	62	45	43	100	77	0.401
Ku 1	9	30	74	17	9	100	11	0.313
Ok 1	5	14	99	5	8	100	7	0.284
I (w) 1	34	62	63	41	45	100	35	0.416

TABLE 36. OXALATE - EXTRACTABLE Al AND Fe - Chronosequence.

Soil and Horizon		Al (%)	Fe (%)	Al ($kg\ ha^{-1} \times 10^3$)	Fe ($kg\ ha^{-1} \times 10^3$)
Ho 1	A_{11}	0.25	0.50	3.11	6.13
	A_{12}	0.24	0.45	5.00	9.38
	C*	0.11	0.28	3.18	8.09
	Total to: 0.38 m			8.11	15.5
	0.76 m			11.3	23.6
I(y) 1	O	0.99	0.91	-	-
	A	0.63	0.89	2.70	3.82
	AB	0.62	0.80	5.01	6.48
	B_2	0.54	0.71	7.07	9.36
	B_3	0.48	0.48	6.80	6.40
	C*	0.17	0.29	8.33	14.2
	Total to: 0.38 m			18.2	22.9
	0.76 m			29.9	40.3
I(o) 1	OA	1.22	1.15	0.61	0.57
	A	1.05	1.20	3.25	3.73
	B_{21}	1.21	1.23	12.8	13.0
	B_{22}	1.24	0.99	22.2	16.5
	C_{11}	0.64	0.38	9.92	5.89
	C_{12}*	0.25	0.29	4.95	5.74
	Total to: 0.38 m			33.6	30.0
	0.76 m			53.7	45.4
I(o) 2	A_2	0.76	1.26	-	-

TABLE 36. cont.

Soil and Horizon		Al (%)	Fe (%)	Al (kg ha^{-1} x 10^3)	Fe (kg ha^{-1} x 10^3)
I(w) 1	OA	0.41	0.58	1.57	2.22
	A	0.55	0.14	5.83	1.48
	A_{2g}	1.01	0.29	6.29	1.80
	B_{21}	1.07	0.88	25.1	20.6
	B_{22}	0.76	0.73	13.1	11.7
	C_{11}	0.35	0.22	1.05	0.66
	C_{12}	0.52	0.35	-	-
	Total to: 0.38 m			13.7	5.50
	0.76 m			52.9	38.5
Ah 1	A	0.76	1.81	2.22	5.27
	AB	0.99	1.96	5.29	10.5
	B_{21}	1.51	1.69	13.5	15.2
	B_{22}	1.50	1.54	25.4	25.9
	B_3	1.19	0.80	23.1	15.5
	C_{11}	0.69	0.54	13.7	10.7
	C_{12}	0.44	0.50	-	-
	Total to: 0.38 m			29.1	39.1
	0.76 m			78.6	79.5

TABLE 36. cont.

Soil and Horizon		Al (%)	Fe (%)	Al ($kg\ ha^{-1} \times 10^3$)	Fe ($kg\ ha^{-1} \times 10^3$)
Ku 1	A	0.13	0.10	0.80	0.61
	A_2G	0.12	0.04	1.14	0.38
	G	0.21	0.02	5.90	0.56
	B_hG	0.37	0.03	4.40	0.36
	B_2G	0.25	0.03	1.15	0.14
	B_3G	0.33	0.02	6.71	0.41
	C	0.39	0.11	-	-
	Total to: 0.38 m			5.59	1.34
	0.76 m			20.1	2.46
Ok 1	A	0.02	0.00	0.18	0.00
	AG	0.03	0.00	0.20	0.00
	G	0.03	0.00	0.51	0.00
	B_2G	0.07	0.05	2.31	1.65
	B_3G	0.09	0.05	1.72	0.67
	C*	0.10	0.08	2.05	1.64
	Total to: 0.38 m			2.66	0.52
	0.76 m			6.97	3.96

*To a depth of 0.76 m.

TABLE 37. OXALATE - EXTRACTABLE Al AND Fe - Transect 1.

Soil and Horizon		Extracted Al (%)	Extracted Fe (%)	Proportion of Total Elements Extracted Al (%)	Proportion of Total Elements Extracted Fe (%)
Ah 1	A	0.76	1.81	11	44
	AB	0.99	1.96	14	51
	B_{21}	1.51	1.69	19	44
Ah 2	A	0.82	1.66	13	54
	AB	1.17	2.00	16	63
	B_{21}	2.42	1.82	28	48
Ah 3	A	0.66	1.46	12	53
	AB	0.86	2.49	15	72
	B_{21}	2.73	2.06	31	55
Ah 4	OA	0.62	1.62	10	49
	A_2	1.20	2.29	18	61
	B_{21}	2.50	2.12	29	55
Ah 5	A_{21}	0.15	0.06	3	8
	A_{22}	0.85	0.88	9	39
	B_{21}	3.00	2.16	35	51

TABLE 38. OXALATE - EXTRACTABLE Al AND Fe - Transect 2.

Soil and Horizon		Extracted Al (%)	Extracted Fe (%)	Proportion of Total Elements Extracted Al (%)	Proportion of Total Elements Extracted Fe (%)
Ah 6	O	1.10	1.22	-	-
	A_2	0.62	1.48	10	51
	B_{21}	1.38	2.10	20	55
Ah 7	O	1.52	0.99	28	29
	A	1.18	1.82	15	49
	B_{21}	1.92	1.43	22	41
Ah 1	A	0.76	1.81	11	44
	AB	0.99	1.96	14	51
	B_{21}	1.51	1.69	19	44
Ah 8	A	0.99	2.02	18	64
	B_1	2.22	2.64	26	58
	B_{21}	2.15	1.62	25	44
Ah 9	OA	0.84	1.79	15	57
	AB	1.26	2.46	20	60
	B_{21}	1.78	1.68	22	45

TABLE 39. PYROPHOSPHATE - EXTRACTABLE Al AND Fe - Chronosequence.

Soil and Horizon		Al (%)	Fe (%)	Al (kg ha^{-1} x 10^3)	Fe (kg ha^{-1} x 10^3)
Ho 1	A_{11}	0.30	0.73	3.61	9.00
	A_{12}	0.22	0.62	4.65	11.9
	C*	0.11	0.08	3.18	2.31
	Total to:	0.38 m		8.26	20.9
		0.76 m		11.4	23.2
I(y) 1	O	0.44	0.68	n.d.	n.d.
	A	0.58	1.15	2.52	4.94
	AB	0.60	0.95	4.93	7.73
	B_2	0.49	0.73	6.40	9.59
	B_3	0.36	0.48	5.04	6.44
	C*	0.06	0.08	2.94	3.92
	Total to:	0.38 m		16.4	25.5
		0.76 m		21.8	32.6
I(o) 1	OA	1.09	1.46	0.54	0.73
	A	1.20	2.01	3.74	6.23
	B_{21}	1.11	1.33	11.8	14.1
	B_{22}	0.83	0.86	14.9	14.3
	C_{11}	0.32	0.20	4.96	3.10
	C_{12}*	0.11	0.07	2.18	1.39
	Total to:	0.38 m		27.5	32.0
		0.76 m		38.1	39.9
I(o) 2	A_2	0.67	0.62	-	-

TABLE 39. cont.

Soil and Horizon		Al (%)	Fe (%)	Al (kg ha^{-1} x 10^3)	Fe (kg ha^{-1} x 10^3)
I(w) 1	OA	0.67	0.62	2.58	2.35
	A	0.72	0.18	7.60	1.89
	A_{2g}	1.09	0.35	6.80	2.19
	B_{21}	0.66	0.63	15.4	14.8
	B_{22}	0.46	0.73	7.56	11.9
	C_{11}	0.19	0.45	0.57	1.35
	C_{12}	0.25	0.39	-	-
	Total to: 0.38 m			17.0	6.43
	0.76 m			39.9	33.1
Ah 1	A	1.51	1.91	4.41	8.23
	AB	1.95	2.73	10.4	14.6
	B_{21}	1.78	1.67	16.0	15.0
	B_{22}	0.88	0.56	14.8	9.47
	B_3	0.85	0.47	16.4	9.09
	C_{11}	0.81	0.45	16.2	8.98
	C_{12}	0.42	0.10	-	-
	Total to: 0.38 m			35.5	40.8
	0.76 m			72.8	62.4

TABLE 39. cont.

Soil and Horizon		Al (%)	Fe	Al (kg ha^{-1}	Fe x 10^3)
Ku 1	A	0.13	0.12	0.82	0.74
	A_2G	0.10	0.06	0.99	0.55
	G	0.18	0.03	5.17	0.76
	B_hG	0.54	0.07	6.41	0.81
	B_2G	0.51	0.00	2.34	0.00
	B_3G	0.49	0.29	10.0	5.86
	C	0.64	0.36	-	-
	Total to:	0.38 m		5.01	1.76
		0.76 m		25.7	8.72
Ok 1	A	0.05	0.18	0.47	2.14
	AG	0.08	0.08	0.63	0.67
	G	0.11	0.13	1.92	2.44
	B_2G	0.29	0.27	9.61	8.97
	B_3G	0.26	0.12	4.78	1.66
	C*	0.41	0.15	8.41	3.08
	Total to:	0.38 m		6.05	8.08
		0.76 m		25.8	19.0

* To a depth of 0.76 m.

TABLE 40. PYROPHOSPHATE - EXTRACTABLE Al AND Fe - Transect 1.

Soil and Horizon		Extracted Al (%)	Extracted Fe (%)	Proportion of Total Elements Extracted Al (%)	Proportion of Total Elements Extracted Fe (%)
Ah 1	A	1.51	1.91	21	69
	AB	1.95	2.73	28	71
	B_{21}	1.78	1.67	22	43
Ah 2	A	0.82	2.15	13	70
	AB	1.23	2.27	16	71
	B_{21}	1.23	1.31	14	35
Ah 3	A	0.65	1.72	12	62
	AB	1.13	2.56	19	74
	B_{21}	2.03	1.91	23	51
Ah 4	OA	1.17	1.81	19	55
	A_2	1.46	2.76	22	73
	B_{21}	1.84	1.72	22	45
Ah 5	A_{21}	0.17	0.08	3	10
	A_{22}	0.73	1.15	12	51
	B_{21}	2.33	1.94	27	46

TABLE 41. PYROPHOSPHATE - EXTRACTABLE Al AND Fe - Transect 2.

Soil and Horizon		Extracted Al (%)	Extracted Fe (%)	Proportion of Total Elements Extracted Al (%)	Proportion of Total Elements Extracted Fe (%)
Ah 6	O	1.46	0.16	-	-
	A_2	0.57	1.87	10	64
	B_{21}	2.09	2.22	30	58
Ah 7	O	1.26	1.03	23	30
	A	1.17	2.18	15	59
	B_{21}	1.83	1.68	21	48
Ah 1	A	1.51	1.91	21	69
	AB	1.95	2.73	28	71
	B_{21}	1.78	1.67	22	43
Ah 8	A	1.10	2.31	20	42
	B_1	2.88	3.38	34	74
	B_{21}	1.32	1.50	16	41
Ah 9	OA	1.01	2.26	17	72
	AB	1.66	3.13	26	76
	B_{21}	1.44	1.42	18	38

TABLE 42. FIELDES AND PERROTT TEST AND PHOSPHATE RETENTION - Transect 1.

Soil and Horizon		Fieldes and Perrott Test (pH developed after 30 minutes) < 2 mm	< 2 µm	Phosphate Retention (%)
Ah 1	A	7.7	10.5	98
	AB	9.7	11.4	94
	B_{21}	11.1	11.5	98
Ah 2	A	7.3	8.1	70
	AB	8.3	9.0	85
	B_{21}	11.2	11.5	97
Ah 3	A	7.2	7.5	68
	AB	7.8	8.0	79
	B_{21}	11.2	11.5	97
Ah 4	OA	6.8	6.8	43
	A_2	8.1	8.7	87
	B_{21}	11.2	11.5	98
Ah 5	A_{21}	7.0	6.9	12
	A_{22}	7.2	7.4	58
	B_{21}	11.3	11.5	98

TABLE 43. FIELDES AND PERROTT TEST AND PHOSPHATE RETENTION - Transect 2.

Soil and Horizon		Fieldes and Perrott Test < 2 mm (pH developed after 30 minutes)	< 2 µm	Phosphate Retention (%)
Ah 6	O	5.6	5.8	0
	A_2	6.3	6.6	12
	B_{21}	10.9	11.5	93
Ah 7	O	6.0	6.0	0
	A	7.2	7.7	69
	B_{21}	11.1	11.5	95
Ah 1	A	7.7	10.5	98
	AB	9.7	11.4	94
	B_{21}	11.1	11.5	98
Ah 8	A	7.6	8.1	76
	B_1	11.0	11.4	97
	B_{21}	11.2	11.5	98
Ah 9	OA	6.9	7.4	49
	AB	8.6	9.7	86
	B_{21}	11.1	11.5	97

TABLE 44. CHEMICAL PROPERTIES OF VARIOUS WATER-DISPERSED SIZE SEPARATES FROM THE B HORIZON OF A TAUPO SANDY SILT.

Property \ Soil, Horizon and Particle size	Taupo Sandy Silt B Horizon <0.2 µm	Taupo Sandy Silt B Horizon 0.2-2 µm	Taupo Sandy Silt B Horizon 2-53 µm	Whole Soil
Moisture loss (%)	15.5	11.2	n.d.	2.16
Loss on Ignition (%)	43.9	28.8	n.d.	6.40
Total Al (%)	25.4	14.7	6.43	7.84
Total Si (%)	17.5	26.4	29.8	29.7
Total K (%)	0.14	0.78	1.87	1.75
Total Fe (%)	7.93	5.80	2.17	3.44
SiO_2/Al_2O_3 (molar)	1.32	3.46	8.91	7.28
$Al_2O_3/Al_2O_3 + SiO_2$ (%)	56.2	32.9	16.0	18.9
Oxalate-extractable Al (%)	24.7	12.0	0.16	1.50
Oxalate-extractable Fe (%)	4.09	3.15	0.10	0.78
Pyrophosphate-extractable Al (%)	4.05	2.08	0.09	0.44
Pyrophosphate-extractable Fe (%)	3.60	1.76	0.15	0.28
Oxalate-Al as % of Total Al	97	82	2.5	19
Oxalate-Fe as % of Total Fe	52	54	4.6	23
Pyrophosphate-Al as % of Total Al	16	14	1.4	5.6
Pyrophosphate-Fe as % of Total Fe	45	30	6.9	8.1
Phosphate Retention (%)	100	99	10	56
2 min. Fieldes and Perrott Test (pH)	11.2	11.2	7.4	10.4
30 min. Fieldes and Perrott Test (pH)	11.5	11.4	7.4	10.5

TABLE 45. CHEMICAL PROPERTIES OF VARIOUS WATER-DISPERSED SIZE SEPARATES FROM THE C HORIZON OF A TAUPO SANDY SILT.

Property / Soil, Horizon and Particle Size	Taupo Sandy Silt C Horizon <0.2 µm	0.2-2 µm	2-53 µm	Whole Soil
Moisture loss (%)	17.5	3.50	n.d.	0.96
Loss on Ignition (%)	27.7	5.51	n.d.	3.01
Total Al (%)	21.7	7.65	6.75	7.13
Total Si (%)	21.6	31.8	34.7	34.3
Total K (%)	0.41	1.70	1.89	1.63
Total Fe (%)	5.96	2.28	2.15	2.63
SiO_2/Al_2O_3 (molar)	1.92	7.76	9.89	9.25
$Al_2O_3/Al_2O_3 + SiO_2$ (%)	47.0	17.1	14.6	15.5
Oxalate-extractable Al (%)	19.6	1.43	0.18	0.48
Oxalate-extractable Fe (%)	5.21	0.86	0.11	0.57
Pyrophosphate - extractable Al (%)	1.38	0.31	0.09	0.15
Pyrophosphate-extractable Fe (%)	0.41	0.08	0.00	0.08
Oxalate-Al as % of Total Al	90	19	2.7	6.7
Oxalate-Fe as % of Total Fe	87	38	5.1	22
Pyrophosphate-Al as % of Total Al	6.4	4.1	1.3	2.1
Pyrophosphate-Fe as % of Total Fe	6.9	3.5	0.0	3.0
Phosphate Retention (%)	99	68	9	25
2 min. Fieldes and Perrott Test (pH)	10.9	10.1	7.4	9.0
30 min. Fieldes and Perrott Test (pH)	11.2	10.5	7.4	9.2

TABLE 46. CHEMICAL PROPERTIES OF WATER-DISPERSED < 2 μm FRACTION OF THREE SELECTED HORIZONS FROM CHRONOSEQUENCE.

Property \ Soil, Horizon and Particle Size	Ah 1		Ok 1
	B_{21}	C_{12}	G
Total Al (%)	19.4	20.5	9.82
Total Si (%)	17.1	17.5	30.6
Total K (%)	0.97	1.12	1.88
Total Fe (%)	14.5	14.5	0.22
SiO_2/Al_2O_3 (molar)	1.70	1.65	5.99
$Al_2O_3/Al_2O_3 + SiO_2$ (%)	50.0	50.8	22.1
Oxalate-extractable Al (%)	9.68	11.7	0.14
Oxalate-extractable Fe (%)	8.51	6.22	0.13
Pyrophosphate-extractable Al (%)	4.33	2.65	1.63
Pyrophosphate-extractable Fe (%)	5.11	1.36	0.18
Oxalate-Al as % of Total Al	50	57	1.4
Oxalate-Fe as % of Total Fe	59	43	59
Pyrophosphate-Al as % of Total Al	22	13	17
Pyrophosphate-Fe as % of Total Fe	35	9.4	82
Phosphate Retention (%)	100	100	29
2 min. Fieldes and Perrott Test (pH)	11.3	11.4	7.3
30 min. Fieldes and Perrott Test (pH)	11.5	11.6	7.3

TABLE 47. RATIOS OF % OXALATE- AND % PYROPHOSPHATE-EXTRACTABLE Al AND Fe TO % CLAY, AND INDEX OF ACCUMULATION OF PRECIPITATED AMORPHOUS MATERIAL - Chronosequence.

Soil and Horizon		Oxalate-extractable		Pyrophosphate-extractable			Index*
		% Al / % Clay	% Fe / % Clay	% Al / % Clay	% Fe / % Clay	%(Al+Fe) / % Clay	
Ho 1	A_{11}	0.036	0.071	0.043	0.104	0.15	
	A_{12}	0.048	0.090	0.044	0.124	0.16	
	C	0.026	0.065	0.026	0.019	0.05	
I(y) 1	O	-	-	-	-	-	
	A	0.045	0.063	0.054	0.082	0.14	
	AB	0.053	0.069	0.052	0.082	0.13	
	B_2	0.063	0.083	0.057	0.085	0.14	
	B_3	0.084	0.084	0.063	0.084	0.15	
	C	0.085	0.145	0.030	0.040	0.07	
I(o) 1	OA	0.074	0.070	0.066	0.089	0.16	
	A	0.078	0.089	0.089	0.149	0.24	114
	B_{21}	0.097	0.098	0.089	0.106	0.20	124
	B_{22}	0.127	0.101	0.085	0.088	0.17	
	C_{11}	0.178	0.106	0.089	0.056	0.15	
	C_{12}	0.074	0.085	0.032	0.021	0.05	
I(w) 1	OA	0.033	0.046	0.053	0.049	0.10	
	A	0.045	0.011	0.059	0.015	0.07	
	A_{2g}	0.080	0.023	0.087	0.028	0.12	
	B_{21}	0.119	0.098	0.073	0.070	0.14	
	B_{22}	0.104	0.100	0.063	0.100	0.16	
	C_{11}	0.206	0.129	0.112	0.265	0.38	11
	C_{12}	0.179	0.121	0.086	0.134	0.22	-

* As defined by United States Department of Agriculture (1970). In this study CEC was measured at pH 7.0, not at 8.2. Index calculated only for those horizons where ratio of pyrophosphate-extractable Al + Fe to clay content meets requirements for spodic horizons.

TABLE 47. cont.

Soil and Horizon		Oxalate-extractable % Al / % Clay	Oxalate-extractable % Fe / % Clay	Pyrophosphate-extractable % Al / % Clay	Pyrophosphate-extractable % Fe / % Clay	Pyrophosphate-extractable %(Al+Fe) / % Clay	Index*
Ah 1	A	0.044	0.105	0.087	0.110	0.20	182
	AB	0.058	0.115	0.115	0.161	0.28	113
	B_{21}	0.096	0.108	0.113	0.106	0.22	17
	B_{22}	0.096	0.099	0.056	0.036	0.09	
	B_3	0.092	0.062	0.065	0.036	0.10	
	C_{11}	0.076	0.059	0.089	0.049	0.14	
	C_{12}	0.169	0.192	0.162	0.038	0.20	-
Ku 1	A	0.011	0.009	0.011	0.011	0.02	
	A_2G	0.010	0.003	0.008	0.005	0.01	
	G	0.011	0.001	0.009	0.002	0.01	
	B_hG	0.018	0.001	0.026	0.003	0.03	
	B_2G	0.021	0.003	0.044	0.000	0.04	
	B_3G	0.027	0.002	0.040	0.024	0.06	
	C	0.038	0.011	0.062	0.035	0.10	
Ok 1	A	0.005	0.000	0.011	0.041	0.05	
	AG	0.005	0.000	0.014	0.014	0.03	
	G	0.004	0.000	0.013	0.016	0.03	
	B_2G	0.009	0.006	0.037	0.034	0.07	
	B_3G	0.008	0.004	0.023	0.011	0.03	
	C	0.010	0.008	0.041	0.015	0.05	

TABLE 48. RATIOS OF % OXALATE - AND % PYROPHOSPHATE - EXTRACTABLE Al AND Fe TO % CLAY, AND INDEX OF ACCUMULATION OF PRECIPITATED AMORPHOUS MATERIAL - Transect 1.

Soil and Horizon		Oxalate-extractable % Al / % Clay	Oxalate-extractable % Fe / % Clay	Pyrophosphate-extractable % Al / % Clay	Pyrophosphate-extractable % Fe / % Clay	Pyrophosphate-extractable %(Al+Fe) / % Clay	Index*
Ah 1	A	0.044	0.105	0.087	0.110	0.20	182
	AB	0.058	0.115	0.115	0.161	0.28	113
	B_{21}	0.096	0.108	0.113	0.106	0.22	17
Ah 2	A	0.055	0.111	0.055	0.144	0.20	156
	AB	0.075	0.128	0.079	0.146	0.23	240
	B_{21}	0.114	0.085	0.058	0.062	0.12	
Ah 3	A	0.044	0.097	0.043	0.115	0.16	
	AB	0.052	0.151	0.068	0.155	0.22	285
	B_{21}	0.116	0.087	0.086	0.081	0.17	94
Ah 4	OA	0.038	0.100	0.072	0.112	0.18	342
	A_2	0.072	0.137	0.087	0.165	0.25	463
	B_{21}	0.109	0.092	0.080	0.075	0.16	63
Ah 5	A_{21}	0.011	0.004	0.013	0.006	0.02	130
	A_{22}	0.045	0.047	0.039	0.061	0.10	147
	B_{21}	0.155	0.111	0.120	0.100	0.22	96

* As defined by United States Department of Agriculture (1970). In this study CEC was measured at pH 7.0, not at 8.2. Index calculated only for those horizons where ratio of pyrophosphate-extractable Al + Fe to clay content meets requirements for spodic horizons.

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TABLE 49. RATIOS OF % OXALATE - AND % PYROPHOSPHATE - EXTRACTABLE Al AND Fe TO % CLAY, AND INDEX OF ACCUMULATION OF PRECIPITATED AMORPHOUS MATERIAL - Transect 2.

Soil and Horizon		Oxalate-extractable % Al / % Clay	% Fe / % Clay	Pyrophosphate-extractable % Al / % Clay	% Fe / % Clay	%(Al+Fe) / % Clay	Index*
Ah 6	O	0.041	0.045	0.054	0.006	0.06	
	A_2	0.032	0.077	0.030	0.097	0.13	
	B_{21}	0.077	0.117	0.116	0.123	0.24	146
Ah 7	O	0.084	0.055	0.070	0.057	0.13	
	A	0.072	0.117	0.072	0.134	0.21	350
	B_{21}	0.110	0.082	0.105	0.096	0.20	-
Ah 1	A	0.044	0.105	0.087	0.110	0.20	182
	AB	0.058	0.115	0.115	0.161	0.28	113
	B_{21}	0.096	0.108	0.113	0.106	0.22	17
Ah 8	A	0.058	0.117	0.064	0.134	0.20	259
	B_1	0.099	0.118	0.129	0.151	0.28	173
	B_{21}	0.091	0.069	0.056	0.064	0.12	
Ah 9	OA	0.052	0.110	0.062	0.139	0.20	475
	AB	0.060	0.117	0.079	0.149	0.23	277
	B_{21}	0.082	0.078	0.067	0.066	0.13	

* As defined by United States Department of Agriculture (1970). In this study CEC was measured at pH 7.0, not at 8.2. Index calculated only for those horizons where ratio of pyrophosphate-extractable Al + Fe to clay content meets requirements for spodic horizons.

TABLE 50. RATIO OF OXALATE- TO PYROPHOSPHATE-EXTRACTABLE Al AND Fe - Chronosequence.

Soil	Al		Fe	
	To 0.38 m	To 0.76 m	To 0.38 m	To 0.76 m
Ho 1	0.98	0.99	0.74	1.02
I(y) 1	1.11	1.37	0.90	1.24
I(o) 1	1.22	1.41	0.94	1.14
I(w) 1	0.81	1.33	0.86	1.16
Ah 1	0.82	1.08	0.96	1.27
Ku 1	1.12	0.78	0.76	0.28
Ok 1	0.81	0.27	0.06	0.21

TABLE 51. MINERALOGY OF THE SAND FRACTION (177 - 125 μm).

SAMPLE	Proportion of Sand Fraction in 177-125 μm Range	Proportion of Magnetic Minerals in 177-125 μm Fraction	Quartz	Feldspar	Mica	Chlorite	Garnet	Ilmenite	Horn-blende	Rutile	Zircon	Unidentifiable Strongly Weathered Grains (Includes Sericitic Residues)	Quartz/Feldspar Ratio
	(%)	(%)	(%)										
Ho 1, C	3	38	22	34	8	6	<1	2	1	n.o.	<1	24	0.6
I(y) 1, C	24	25	26	40	8	3	<1	*	<1	<1	<1	22	0.7
I(o) 1, C	12	35	34	27	13	4	<1	<1	n.o.	n.o.	n.o.	22	1.3
I(w) 1, C	21	33	27	32	9	5	1	*	n.o.	n.o.	n.o.	26	0.8
Ah 1, C_{11}	20	28	28	35	12	3	<1	<1	<1	n.o.	n.o.	22	0.8
Ku 1, A	20	5	60	5	<1	<1	<1	<1	<1	n.o.	n.o.	33	1.2
Ku 1, C	21	3	56	27	<1	<1	<1	<1	<1	n.o.	n.o.	16	2.1
Ok 1, A	17	17	30	3	<1	n.o.	<1	n.o.	n.o.	n.o.	n.o.	66	10
Ok 1, C	12	3	58	13	<1	n.o.	<1	<1	n.o.	n.o.	n.o.	29	4.5

n.o. not observed; * observed only as inclusions.

TABLE 52. QUARTZ (100) / PLAGIOCLASE (002) INTENSITY RATIO FOR THE SILT FRACTION (20 - 2 μm) - Chronosequence.

Soil and Horizon		Ratio
Ho 1	A_{11}	1.21
	A_{12}	1.22
	C	1.35
I(y) 1	A	1.42
	AB	1.24
	B_2	1.21
	B_3	1.25
	C	0.98
I(o) 1	A	1.42
	B_{21}	1.40
	B_{22}	1.39
	C_{11}	1.07
	C_{12}	1.05
Ah 1	A	1.81
	AB	1.38
	B_{21}	1.30
	B_{22}	1.18
	B_3	1.14
	C_{11}	1.05
	C_{12}	0.84
Ku 1	A	11.3
	A_2G	10.0
	G	10.5
	B_hG	11.5
	B_2G	11.1
	B_3G	11.5
	C	8.0
Ok 1	A	117
	AG	110
	G	67
	B_2G	85
	B_3G	82
	C	51

TABLE 53. MINERALOGY OF THE FINE (< 0.2 µm) CLAY FRACTION - Chronosequence.

Soil and Horizon		Phyllosilicates									Other Minerals			
		*Int.Mo	I	Ch	I-Ch	I-V	V	P-Ch	Mo	K	G	Q	F	A
		(Weighted peak-area "percentages")									(%)●	I/I_M■	P=present	
Ho 1	A_{11}	-	47	13	-	-	22	2	2	14	1.5	-	-	-
	A_{12}	-	48	11	-	-	17	7	1	16	1.9	-	P	-
	C	-	63	13	-	-	8	8	-	8	n.d.	8	P	-
I(y)1	O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	A	-	5	16	3	-	63	-	-	11	1.0	-	-	-
	AB	-	7	10	-	-	34	33	-	17	1.4	-	-	-
	B_2	-	11	10	-	-	32	31	-	16	1.9	-	-	-
	B_3	-	17	10	-	-	26	27	-	21	2.3	-	-	-
	C	-	36	14	-	-	15	19	-	17	3.3	-	-	-
I(o) 1	OA	83	-	5	-	-	-	-	-	13	0.1	-	P	-
	A	-	-	7	-	-	49	30	-	14	0.3	-	-	-
	B_{21}	-	-	4	-	-	37	45	-	14	0.8	-	-	-
	B_{22}	-	-	3	-	-	17	57	-	22	1.5	-	-	-
	C_{11}	-	20	16	-	-	15	31	-	18	1.9	-	-	-
	C_{12}	-	38	12	-	-	22	20	-	8	2.2	-	P	-
I(o) 2	A_2	-	-	-	-	-	-	-	85	15	0.1	-	-	-
I(w) 1	OA	85	-	-	-	-	-	-	-	15	0	-	-	-
	A	-	-	-	-	-	57	31	-	12	0.5	-	-	-
	A_{2g}	-	-	6	-	-	39	42	-	13	1.0	-	-	-
	B_{21}	-	5	14	-	-	18	44	-	19	3.2	-	-	-
	B_{22}	-	6	15	-	-	17	44	-	18	4.8	-	-	-
	C_{11}	-	25	13	-	-	8	38	-	16	3.8	-	-	-
	C_{12}	-	25	23	-	-	4	30	-	18	5.1	-	-	-

TABLE 53. cont.

Soil and Horizon		Phyllosilicates									Other Minerals			
		*Int.Mo	I	Ch	I-Ch	I-V	V	P-Ch	Mo	K	G	Q	F	A
		(Weighted peak-area "percentages")									(%)●	I/I_M■	P=present	
Ah 1	A	-	-	4	-	-	80	-	-	16	0.4	-	-	-
	AB	-	-	4	-	-	47	39	-	10	0.7	-	-	-
	B_{21}	-	-	13	-	-	22	51	-	14	1.3	-	-	-
	B_{22}	-	-	23	11	-	6	47	-	13	2.5	-	-	-
	B_3	-	-	27	25	-	-	24	-	12	2.9	-	-	-
	C_{11}	-	-	26	26	-	-	36	-	12	2.2	-	-	-
	C_{12}	-	37	11	-	-	-	39	-	13	2.2	-	-	-
Ku 1	A	88	-	-	-	-	-	-	-	12	0	-	-	-
	A_2G	87	-	-	-	-	-	-	-	13	0	-	-	-
	G	82	-	-	-	-	-	-	-	18	0.1	-	-	-
	B_hG	82	-	-	-	-	-	-	-	18	0.3	-	-	-
	B_2G	-	9	-	-	7	48	4	-	32	0.6	-	-	-
	B_3G	-	-	-	24	-	32	12	-	32	0.6	-	-	-
	C	-	-	-	35	-	23	15	-	27	0.5	-	-	-
Ok 1	A	93	-	-	-	-	-	-	-	7	0	6	-	-
	AG	88	-	-	-	-	-	-	-	12	0	6	-	-
	G	74	-	-	-	-	-	-	-	26	0.2	6	-	-
	B_2G	-	34	-	-	31	8	1	-	25	0.1	4	-	-
	B_3G	-	17	-	-	38	13	2	-	30	0.3	-	-	-
	C	-	11	-	-	39	9	13	-	28	0.4	-	-	-

* I, mica (illite); Ch, chlorite; V, vermiculite; P-Ch, pedogenic chlorite; Mo, montmorillonite; K, kaolinite; G, gibbsite; Q, quartz; F, feldspar; A, amphibole; Int., interstratified.

● Of air-dried weight, of peroxidised and deferrated samples.

■ Intensity is given as a percentage of the maximum quartz intensity obtained - that from the 0.2 - 2 µm fraction from the A horizon of Ok 1.

In the above table a dash indicates that the mineral was not identified by X-ray diffraction.

TABLE 54. MINERALOGY OF THE COARSE (0.2 - 2 μm) CLAY FRACTION - Chronosequence.

Soil and Horizon		Phyllosilicates									Other Minerals			
		*Int.Mo	I	Ch	I-Ch	I-V	V	P-Ch	Mo	K	G	Q	F	A
		(Weighted peak-area "percentages")									(%)●	I/I_M■	P=present	
Ho 1	A_{11}	-	54	16	5	-	8	2	1	14	0.7	12	-	P
	A_{12}	-	47	14	3	5	11	3	-	16	0.8	12	P	P
	C	-	56	17	-	4	7	4	-	12	0.3	19	P	P
I(y) 1	O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	A	-	16	28	5	13	19	5	-	15	0.3	7	P	P
	AB	-	15	28	6	-	16	22	-	13	0.4	6	P	P
	B_2	-	13	13	-	-	27	40	-	8	0.6	6	P	P
	B_3	-	29	22	-	-	15	20	-	14	0.7	9	P	P
	C	-	34	15	12	-	18	9	-	12	0.7	8	P	P
I(o) 1	OA	75	-	17	-	-	-	-	-	8	0.1	10	P	P
	A	-	-	19	4	-	46	14	-	18	0.1	6	P	P
	B_{21}	-	-	29	-	-	24	35	-	12	0.3	7	P	P
	B_{22}	-	6	24	-	-	17	39	-	14	0.7	8	P	P
	C_{11}	-	40	22	-	-	8	16	-	14	1.5	7	P	P
	C_{12}	-	49	20	-	-	9	11	-	11	1.2	9	P	P
I(o) 2	A_2	-	-	12	-	-	-	-	67	21	0.1	8	P	P
I(w) 1	OA	79	-	2	-	-	-	-	-	19	0	10	P	P
	A	-	16	12	-	-	51	7	-	14	0.1	10	P	P
	A_{2g}	-	7	20	-	-	38	25	-	10	0.3	8	P	P
	B_{21}	-	18	33	-	-	8	28	-	13	1.8	8	P	P
	B_{22}	-	22	26	-	-	16	24	-	13	2.2	11	P	P
	C_{11}	-	50	18	-	-	12	12	-	9	1.5	14	P	P
	C_{12}	-	45	22	-	-	10	11	-	12	1.2	11	P	P

TABLE 54. cont.

Soil and Horizon		Phyllosilicates									Other Minerals			
		*Int.Mo	I	Ch	I-Ch	I-V	V	P-Ch	Mo	K	G	Q	F	A
		(Weighted peak-area "percentages")									(%)●	I/I_M■	P=present	
Ah 1	A	-	-	15	-	-	61	11	-	12	0.3	10	P	P
	AB	-	-	5	-	-	51	35	-	10	0.4	13	P	P
	B_{21}	-	-	17	-	-	19	50	-	14	1.2	10	P	P
	B_{22}	-	-	36	9	-	16	23	-	16	4.4	10	P	P
	B_3	-	12	29	10	-	11	22	-	17	5.5	9	P	P
	C_{11}	-	14	33	13	-	7	18	-	16	4.2	8	P	P
	C_{12}	-	38	17	8	-	12	9	-	16	3.7	7	P	P
Ku 1	A	82	-	-	-	-	-	-	-	17	0.1	33	P	-
	A_2G	77	12	-	-	-	-	-	-	13	0.1	38	P	-
	G	90	-	-	-	-	-	-	-	10	0.3	32	P	-
	B_hG	87	-	-	-	-	-	-	-	13	0.5	33	P	-
	B_2G	-	12	-	18	10	27	10	-	23	0.8	44	P	-
	B_3G	-	7	-	19	-	21	25	-	28	0.7	50	P	-
	C	-	27	-	17	8	19	14	-	16	0.8	41	P	-
Ok 1	A	56	-	-	-	-	-	-	-	44	0	100	P	-
	AG	13	48	-	-	-	7	-	7	26	0	71	-	-
	G	78	-	-	-	-	-	-	-	22	0.2	58	P	-
	B_2G	-	37	-	16	20	4	3	-	20	0	67	P	-
	B_3G	-	24	-	19	12	10	9	-	26	0.2	48	P	-
	C	-	29	4	17	3	7	12	-	28	0.2	40	P	-

*, ●, and ■; refer to key at foot of Table 53.

TABLE 55. "WEIGHT" OF CLAY-SIZED (< 2 μm) PHYLLOSILICATE MINERALS PER KILOGRAM OF INORGANIC MATERIAL < 2 mm - Chronosequence.

Soil and Horizon		Mineral (g)								
		*Int.Mo	I	Ch	I-Ch	I-V	V	P-Ch	Mo	K
Ho 1	A_{11}	-	36	10	2	-	8	1	1	10
	A_{12}	-	24	7	1	2	6	2	0.2	8
	C	-	4	1	-	0.2	0.5	0.4	-	0.7
I(y) 1	O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	A	-	18	35	6	13	45	5	-	20
	AB	-	14	26	5	-	25	30	-	17
	B_2	-	11	10	-	-	25	32	-	9
	B_3	-	14	11	-	-	10	13	-	10
	C	-	7	3	2	-	3	2	-	3
I(o) 1	OA	130	-	17	-	-	-	-	-	18
	A	-	-	19	3	-	64	28	-	22
	B_{21}	-	-	24	-	-	36	49	-	16
	B_{22}	-	3	15	-	-	17	46	-	17
	C_{11}	-	11	7	-	-	4	8	-	6
	C_{12}	-	14	5	-	-	6	6	-	3
I(w) 1	OA	103	-	1	-	-	-	-	-	22
	A	-	12	9	-	-	65	19	-	16
	A_{2g}	-	5	18	-	-	48	40	-	14
	B_{21}	-	12	24	-	-	10	30	-	14
	B_{22}	-	12	16	-	-	12	22	-	11
	C_{11}	-	7	3	-	-	2	4	-	2
	C_{12}	-	11	6	-	-	2	5	-	4

TABLE 55. cont.

Soil and Horizon		Mineral								
		*Int.Mo	I	Ch	I-Ch (g)	I-V	V	P-Ch	Mo	K
Ah 1	A	-	-	18	-	-	120	11	-	24
	AB	-	-	8	-	-	84	32	-	17
	B_{21}	-	-	24	-	-	32	79	-	22
	B_{22}	-	-	47	15	-	18	53	-	23
	B_3	-	9	37	15	-	8	30	-	19
	C_{11}	-	5	24	16	-	3	23	-	11
	C_{12}	-	10	4	1	-	2	6	-	4
Ku 1	A	96	-	-	-	-	-	-	-	18
	A_2G	99	10	-	-	-	-	-	-	16
	G	112	-	-	-	-	-	-	-	27
	B_hG	165	-	-	-	-	-	-	-	42
	B_2G	-	13	-	16	31	20	7	-	31
	B_3G	-	5	-	25	-	31	24	-	36
	C	-	16	-	26	16	22	15	-	22
Ok 1	A	26	-	-	-	-	-	-	-	18
	AG	14	23	-	-	-	3	-	3	14
	G	64	-	-	-	-	-	-	-	19
	B_2G	-	28	-	9	19	4	2	-	18
	B_3G	-	24	-	13	26	13	7	-	31
	C	-	21	2	10	18	8	12	-	28

*; refer to key at foot of Table 53.

TABLE 56. MINERALOGY OF THE FINE (< 0.2 μm) CLAY FRACTION - Transect 1.

Soil and Horizon		Phyllosilicates									Other Minerals			
		*Int.Mo	I	Ch	I-Ch	I-V	V	P-Ch	Mo	K	G	Q	F	A
		(Weighted peak-area "percentages")									(%)●	I/I_M■	P=present	
Ah 1	A	-	-	4	-	-	80	-	-	16	0.4	-	-	-
	AB	-	-	4	-	-	47	39	-	10	0.7	-	-	-
	B_{21}	-	-	13	-	-	22	51	-	14	1.3	-	-	-
Ah 2	A	82	-	-	-	-	-	-	-	18	n.d.	-	-	-
	AB	-	-	-	-	-	84	-	-	16	n.d.	-	-	-
	B_{21}	-	-	14	-	-	21	49	-	16	n.d.	-	-	-
Ah 3	A	81	-	-	-	-	-	-	-	19	n.d.	-	-	-
	AB	-	-	-	-	-	85	-	-	15	n.d.	-	-	-
	B_{21}	-	-	16	-	-	24	45	-	14	n.d.	-	-	-
Ah 4	OA	-	-	-	-	-	-	-	91	9	n.d.	-	-	-
	A_2	-	-	-	-	-	84	-	-	16	n.d.	-	-	-
	B_{21}	-	-	-	-	-	16	74	-	10	n.d.	-	-	-
Ah 5	A_{21}	-	-	-	-	-	-	-	88	12	0	-	-	-
	A_{22}	-	-	-	-	-	-	-	82	18	0	-	-	-
	B_{21}	-	-	2	-	-	-	80	-	18	1.3	-	-	-

*, ●, and ■; refer to key at foot of Table 53.

TABLE 57. MINERALOGY OF THE COARSE (0.2-2 μm) CLAY FRACTION - Transect 1.

Soil and Horizon		Phyllosilicates (Weighted peak-area "percentages")									Other Minerals			
		*Int.Mo	I	Ch	I-Ch	I-V	V	P-Ch	Mo	K	G● (%)	Q■ I/I_M	F	A (P=present)
Ah 1	A	-	-	15	-	-	61	11	-	12	0.3	10	P	P
	AB	-	-	5	-	-	51	35	-	10	0.4	13	P	P
	B_{21}	-	-	17	-	-	19	50	-	14	1.2	10	P	P
Ah 2	A	82	-	2	-	-	-	-	-	16	n.d.	15	P	P
	AB	-	39	9	-	22	15	-	1	15	n.d.	15	P	P
	B_{21}	-	10	25	-	-	33	17	-	15	n.d.	12	P	P
Ah 3	A	87	-	-	-	-	-	-	-	13	n.d.	21	P	P
	AB	88	-	-	-	-	-	-	-	12	n.d.	23	P	P
	B_{21}	-	-	35	-	-	33	18	-	14	n.d.	12	P	P
Ah 4	OA	-	-	-	-	-	-	-	93	7	n.d.	18	P	P
	A_2	-	-	12	-	43	27	3	-	15	n.d.	18	P	P
	B_{21}	-	-	23	-	-	34	27	-	16	n.d.	12	P	P
Ah 5	A_{21}	-	-	-	-	-	-	-	88	17	0.03	22	P	P
	A_{22}	-	-	3	-	-	-	-	78	19	0	17	P	P
	B_{21}	-	-	14	4	-	41	30	-	11	0.8	14	P	P

*, ●, and ■; refer to key at foot of Table 53.

TABLE 58. MINERALOGY OF THE FINE (< 0.2 μm) CLAY FRACTION - Transect 2.

Soil and Horizon		Phyllosilicates (Weighted peak-area "percentages")									Other Minerals			
		*Int.Mo	I	Ch	I-Ch	I-V	V	P-Ch	Mo	K	G (%)●	Q I/I_M■	F P=present	A
Ah 6	O ▼										n.d.			
	A_2	-	-	-	-	-	-	-	86	14	n.d.	-	-	-
	B_{21}	-	-	4	-	-	21	58	-	17	n.d.	-	-	-
Ah 7	O ▼										n.d.			
	A	83	-	-	-	-	-	-	-	17	n.d.	-	-	-
	B_{21}	-	-	-	-	-	39	45	-	16	n.d.	-	-	-
Ah 1	A	-	-	4	-	-	80	-	-	16	0.4	-	-	-
	AB	-	-	4	-	-	47	39	-	10	0.7	-	-	-
	B_{21}	-	-	13	-	-	22	51	-	14	1.3	-	-	-
Ah 8	A	-	-	-	-	-	83	-	-	17	n.d.	-	-	-
	B_1	-	-	-	-	-	28	56	-	16	n.d.	-	-	-
	B_2	-	-	8	-	-	-	78	-	14	n.d.	-	-	-
Ah 9	OA	86	-	-	-	-	-	-	-	14	n.d.	-	-	-
	AB	-	-	3	-	-	70	14	-	13	n.d.	-	-	-
	B_2	-	-	-	-	-	26	56	-	18	n.d.	-	-	-

*, ●, and ■; refer to key at foot of Table 53.

▼ <2 μm fraction only determined. Data given in Table 59.

TABLE 59. MINERALOGY OF THE COARSE (0.2 - 2 µm) CLAY FRACTION-Transect 2.

Soil and Horizon		Phyllosilicates									Other Minerals			
		*Int.Mo	I	Ch	I-Ch	I-V	V	P-Ch	Mo	K	G (%)●	Q I/I$_M$■	F	A
		(Weighted peak-area "percentages")											P=presen	
Ah 6	O ▼	-	-	-	-	-	-	-	74	26	n.d.	9	-	P
	A_2	-	-	-	-	-	-	-	72	28	n.d.	17	P	P
	B_{21}	-	-	16	-	-	41	33	-	10	n.d.	16	P	P
Ah 7	O ▼	78	-	-	-	-	-	-	-	22	n.d.	12	-	P
	A	86	-	4	-	-	-	-	-	10	n.d.	14	P	P
	B_{21}	-	-	15	-	-	51	23	-	11	n.d.	12	P	P
Ah 1	A	-	-	15	-	-	61	11	-	12	0.3	10	P	P
	AB	-	-	5	-	-	51	35	-	10	0.4	13	P	P
	B_{21}	-	-	17	-	-	19	50	-	14	1.2	10	P	P
Ah 8	A	-	-	-	-	36	48	-	-	16	n.d.	21	P	P
	B_1	-	-	8	-	-	-	82	-	10	n.d.	14	P	P
	B_2	-	-	20	-	-	-	71	-	9	n.d.	12	P	P
Ah 9	OA	90	-	-	-	-	-	-	-	10	n.d.	17	-	P
	AB	-	-	11	-	28	46	-	-	15	n.d.	15	P	P
	B_{21}	-	-	27	-	-	42	19	-	13	n.d.	13	P	P

*, ●, and ■; refer to key at foot of Table 53.

▼ Values refer to < 2 µm fraction.

TABLE 60. EMPIRICAL MEASURE OF MONTMORILLONITE CRYSTALLINITY. (After Biscaye, 1965).

Soil and Horizon		Ratio of the 1.8 nm peak height (p) to the depth of the "valley" (v) on the low-angle side of the peak.	
		(v/p), <0.2 µm Fraction	(v/p), 0.2-2.0 µm Fraction
Ho 4,	A_2	0.55	0.77
I(o) 2,	A_2	0.72	0.71
I(w) 1,	OA	0.59	0.63
Ah 2,	A	0.58	0.69
Ah 3,	A	0.56	0.50
Ah 4,	OA	0.70	0.76
Ah 5,	A_{21}	0.89	0.91
	A_{22}	0.84	0.88
Ah 6,	OA	-	0.73*
	A_2	0.71	0.75
Ah 7,	A	0.54	0.60
Ah 9,	OA	0.56	0.58
Ah 10,	A_2	0.75	0.83
Ah 11,	A_2	0.81	0.85
Ah 12,	A_2	0.83	0.79
Ah 13,	A_2	0.80	0.80
Ah 14,	A_2	0.83	0.82
Ah 15,	A_2	0.80	0.81
Ah 16,	A_2	0.77	0.73
Ah 17,	A_2	0.78	0.76
Ah 18,	A_2	0.84	0.85
Ah 19,	A	0.63 †	0.66 †
Ah 20,	A_2	0.70	0.76
Ku 1,	A	0.47	0.48
	A_2G	0.45	0.53
	G	0.43	0.63
	B_hG	0.38	0.29
Ok 1	A	0.17	-
	AG	0.17	0.43

* Clay (<2 µm) not subdivided into fine and coarse fractions.
† Peak at 1.5 - 1.6 nm.

TABLE 61. MINERALOGY OF THE CLAY FRACTIONS OF SURFACE HORIZONS COLLECTED WITHIN FIVE METRES OF LIVING BEECH TREES, OR DECAYING BEECH STUMPS AND LOGS.

Soil and Horizon	Particle Size (μm)	Phyllosilicates (Weighted peak-area "percentages") Int.Mo*	I	Ch	I-Ch	I-V	V	P-Ch	Mo	K	Other Minerals Q I/I_M■	G (P = present)	F	A
Ho 2, A	<0.2	43	23	21	-	-	-	-	-	13	-	P	-	-
	0.2-2	-	27	28	-	-	29	-	-	16	15	P	P	P
Ho 3, A	<0.2	-	-	17	-	73	-	-	-	10	-	-	-	-
	0.2-2	-	34	30	-	13	12	-	-	11	12	P	P	P
Ho 4, A_2	<0.2	82	-	-	-	-	-	-	-	18	-	-	-	-
	0.2-2	-	-	15	-	-	-	-	65	20	15	-	P	P
Ho 5, A_2	<0.2	74	-	3	-	-	-	-	-	23	-	-	-	-
	0.2-2	57	8	22	-	-	-	-	-	13	19	-	P	P
Ah 10, A_2	<0.2	-	-	-	-	-	-	-	89	11	-	-	-	-
	0.2-2	-	-	-	-	-	-	-	86	14	21	-	P	P
Ah 11, A_2	<0.2	-	-	-	-	-	-	-	92	8	-	-	-	-
	0.2-2	-	-	-	-	-	-	-	80	20	20	-	P	P
Ah 12, A_2	<0.2	-	-	-	-	-	-	-	86	14	-	-	P	-
	0.2-2	-	-	-	-	-	-	-	86	14	20	-	P	P
Ah 13, A_2	<0.2	-	-	-	-	-	-	-	90	10	-	-	P	-
	0.2-2	-	-	-	-	-	-	-	76	24	18	-	P	P
Ah 14, A_2	<0.2	-	-	-	-	-	-	-	94	6	-	-	-	-
	0.2-2	-	-	-	-	-	-	-	86	14	18	-	P	P
Ah 15, A_2	<0.2	-	-	-	-	-	-	-	86	14	-	-	-	-
	0.2-2	-	-	-	-	-	-	-	82	18	23	-	P	P
Ah 16, A_2	<0.2	-	-	-	-	-	-	-	84	16	13	-	-	-
	0.2-2	-	-	-	-	-	-	-	89	11	44	-	P	P
Ah 17, A_2	<0.2	-	-	-	-	-	-	-	85	15	-	-	-	-
	0.2-2	-	-	-	-	-	-	-	79	21	25	-	P	P
Ah 18, A_2	<0.2	-	-	-	-	-	-	-	85	15	6	-	-	-
	0.2-2	-	-	-	-	-	-	-	85	15	36	-	P	P
Ah 19, A	<0.2	84	-	-	-	-	-	-	-	16	-	-	-	-
	0.2-2	85	-	-	-	-	-	-	-	13	39	-	P	P
Ah 20, A_2	<0.2	-	-	-	-	-	-	-	86	14	-	-	-	-
	0.2-2	-	-	-	-	-	-	-	82	18	29	-	P	P

* and ■; refer to key at foot of Table 53.

TABLE 62. WEIGHT OF GIBBSITE AND PROPORTION OF TOTAL Al AS GIBBSITE - Chronosequence.

Soil and Horizon		Weight Gibbsite per kg of Inorganic Material < 2 mm[■] as fine clay	as coarse clay	Weight of Clay-sized Gibbsite in Soil	Proportion of Total Soil Al as Clay-sized Gibbsite	Proportion of Gibbsite in Water-dispersed < 2 μm Clay
		($g \times 10^{-1}$)		($kg\ ha^{-1}\ horizon^{-1} \times 10^{2}$)	($\% \times 10^{-1}$)	(%)
Ho 1	A_{11}	2.9	3.2	7.6	2.6	0.4
	A_{12}	2.9	2.7	11.6	2.3	0.6
	C	n.d.	0.1	-	-	0.6
I(y) 1	O	n.d.	n.d.	-	-	n.d.
	A	4.0	3.2	3.1	2.9	0.5
	AB	5.4	3.4	7.1	3.5	0.7
	B_2	5.1	3.4	11.3	3.5	0.7
	B_3	3.9	2.8	9.6	3.0	1.1
	C*	0.2	0.9	6.0	0.6	1.2
I(o) 1	OA	0.9	0.6	0.1	0.6	0.1
	A	1.5	0.9	0.7	1.1	0.3
	B_{21}	3.8	2.0	6.2	2.6	0.6
	B_{22}	6.0	3.9	17.8	4.3	1.0
	C_{11}	2.8	3.2	9.5	2.6	1.5
	C_{12}*	4.9	1.4	14.5	2.1	1.9
I(w) 1	OA	0	0	0	0	0.2
	A	2.3	0.1	3.5	1.6	0.2
	A_{2g}	4.6	0.3	4.1	2.8	0.6
	B_{21}	10.2	1.8	48.0	9.0	1.9
	B_{22}	11.5	2.2	36.2	9.3	2.6
	C_{11}	2.3	1.5	2.6	1.9	1.8
	C_{12}	4.6	1.2	-	3.4	2.2

TABLE 62. cont.

Soil and Horizon		Weight Gibbsite per kg of Inorganic Material <2 mm■ as fine clay	as coarse clay	Weight of Clay-sized Gibbsite in Soil	Proportion of Total Soil Al as Clay-sized Gibbsite	Proportion of Gibbsite in Water-dispersed <2 μm Clay
		(g x 10^{-1})		(kg ha^{-1} $horizon^{-1}$ x 10^2)	(% x 10^{-1})	(%)
Ah 1	A	3.1	3.1	1.8	3.0	0.4
	AB	4.8	4.2	4.8	4.5	0.7
	B_{21}	8.9	10.8	17.7	8.4	1.1
	B_{22}	18.3	36.9	92.9	23.4	2.8
	B_3	16.7	39.9	109.8	23.8	3.4
	C_{11}	9.6	19.5	57.8	8.5	2.4
	C_{12}	2.9	4.8	-	3.6	2.5
Ku 1	A	0	0.9	0.6	1.0	0.1
	A_2G	0	1.1	1.1	1.2	0.1
	G	1.0	3.0	11.1	3.1	0.2
	B_hG	2.5	5.1	9.0	6.4	0.3
	B_2G	3.0	5.2	3.7	7.7	0.6
	B_3G	3.1	4.8	16.0	7.8	0.6
	C	2.1	4.5	-	5.4	0.5
Ok 1	A	n.d.	0	0	0	0
	AG	0	0	0	0	0
	G	0.5	0.9	2.5	2.5	0.1
	B_2G	0.2	0	0.5	0.3	0.3
	B_3G	1.2	1.2	4.5	3.2	0.3
	C*	1.5	1.3	5.7	3.0	0.4

* To 0.76 m.

■ Calculated from data in Tables 7, 53 and 54.

TABLE 63. X-RAY DIFFRACTION DATA FOR RESIDUES FROM SOIL, ROCK AND MUSCOVITE SAMPLES FOLLOWING 24 HOUR DIGESTION WITH 48% HF.

Clay (< 2 μm) from Ok 1, B_3G		Granite		Obsidian		Basalt		Muscovite	
d(nm)*	I/I_1	d(nm)	I/I_1	d(nm)	I/I_1	d(nm)	I/I_1	d(nm)	I/I_1
0.582	100	0.584	100	0.584	100	0.584	100	0.581	100
0.303	41	0.303	52	0.303	58	0.304	55	0.302	74
0.290	65	0.291	77	0.291	100	0.292	100	0.289	100
0.249	7	0.252	8	0.252	4	0.251	5	0.250	5
0.231	15	0.231	19	0.231	28	0.232	25	0.230	22
0.205	17	0.205	17	0.205	20	0.206	15	0.204	30
0.193	20	0.193	27	0.193	35	0.194	28	0.193	35
0.177	33	0.177	45	0.177	54	0.178	50	0.177	50
0.169	13	0.169	4	0.170	4	0.170	5	0.169	9
		0.159	6	0.159	6	0.160	4	0.159	6
0.151	17	0.151	16	0.151	21	0.152	16	0.151	15

* Values for anatase, rutile, zircon, Na_2SiF_6 and K_2SiF_6 have been omitted.

TABLE 64. X-RAY DIFFRACTION DATA FOR SOME PLUMBOGUMMITE MINERALS AND COMPLEX FLUORIDES.

$NaMgAlF_6$		$Ca_{0.5}MgAlF_6$		$KMgAlF_6$		Crandallite (16-162)*		Gorceixite (19-535)*	
d(nm)	I/I_1	d(nm)	I/I_1	d(nm)	I/I_1	d(nm)	I/I_1	d(nm)	I/I_1
0.584	100	0.582	100	0.576	79	0.575	35	0.573	90
						0.353	35	0.352	80
0.303	53	0.303	54	0.300	100	0.297	100	0.2978	100
0.291	79	0.291	86	0.288	31	0.288	10		
						0.273	14		
0.251	3	0.251	7	0.249	13			0.2475	20
								0.2449	30
0.231	25	0.231	29	0.228	15	0.221	25	0.2271	50
						0.218	45	0.2215	60
0.205	19	0.205	24	0.203	8	0.215	10	0.2021	30
								0.2013	30
0.193	30	0.193	30	0.191	25	0.1917	12	0.1905	70
						0.1900	30		
0.177	51	0.178	63	0.176	30			0.1756	60
0.170	5	0.170	5	0.168	5			0.1675	20
0.159	7	0.159	6	0.157	5				
0.151	17	0.151	21	0.151	8				

*Card reference to the Powder Diffraction File, published by the Joint Committee on Powder Diffraction Standards.

TABLE 65. CONCENTRATION OF P IN RESIDUES FROM <2 µm FRACTION OF A KAITERITERI HILL SOIL FOLLOWING VARIOUS HF TREATMENTS.

HF Concentration (%)	20	20	20	20	48
Duration of digestion	2 min	2 hr	15 hr	24 hr	24 hr
Weight of residue (mg)	51	24	22	20	11
Percentage of P in residue	0.82	1.54	0.35	0.16	0.11
Percentage of total P in residue	98	86	18	7	3

(Total P in this clay fraction was 0.043%).

TABLE 66. X-RAY DIFFRACTION DATA FOR RESIDUES FROM <2 μm FRACTION OF A KAITERITERI HILL SOIL FOLLOWING VARIOUS HF TREATMENTS.

20% HF, 2 min		20% HF, 2 hr		20% HF, 24 hr		48% HF, 24 hr		Mineral Species*
d(nm)	I/I_1	d(nm)	I/I_1	d(nm)	I/I_1	d(nm)	I/I_1	
				0.582	100	0.582	100	F
0.573	41	0.573	75	0.573	●			Pg
0.497	10							Go
0.451	44							Clay (110)
0.436	23							?
0.426	20							Q
0.418	63							Go
0.352	80	0.351	92	0.351	36	0.351	35	Pg, An
				0.325	20	0.325	20	Ru
0.336	100							Q
				0.303	56	0.303	66	F
0.296	62	0.296	100	0.296	28			Pg
				0.290	88	0.290	78	F
0.280	17							?
0.270	22	0.270	32					Pg,Go
0.258	33							Go
		0.252	29					Pg
						0.249	13	F, Ru
0.244	40							Go
				0.230	24	0.230	22	F
		0.221	23					Pg
0.219	11	0.218	32					Pg
				0.205	24	0.205	28	F
0.190	21	0.190	46					Pg
				0.193	36	0.193	28	F
				0.177	48	0.177	56	F
0.175	14	0.175	25					Pg

* F, fluoride; Pg, plumbogummite mineral; Go, goethite; Q, quartz; An, anatase; Ru, rutile.

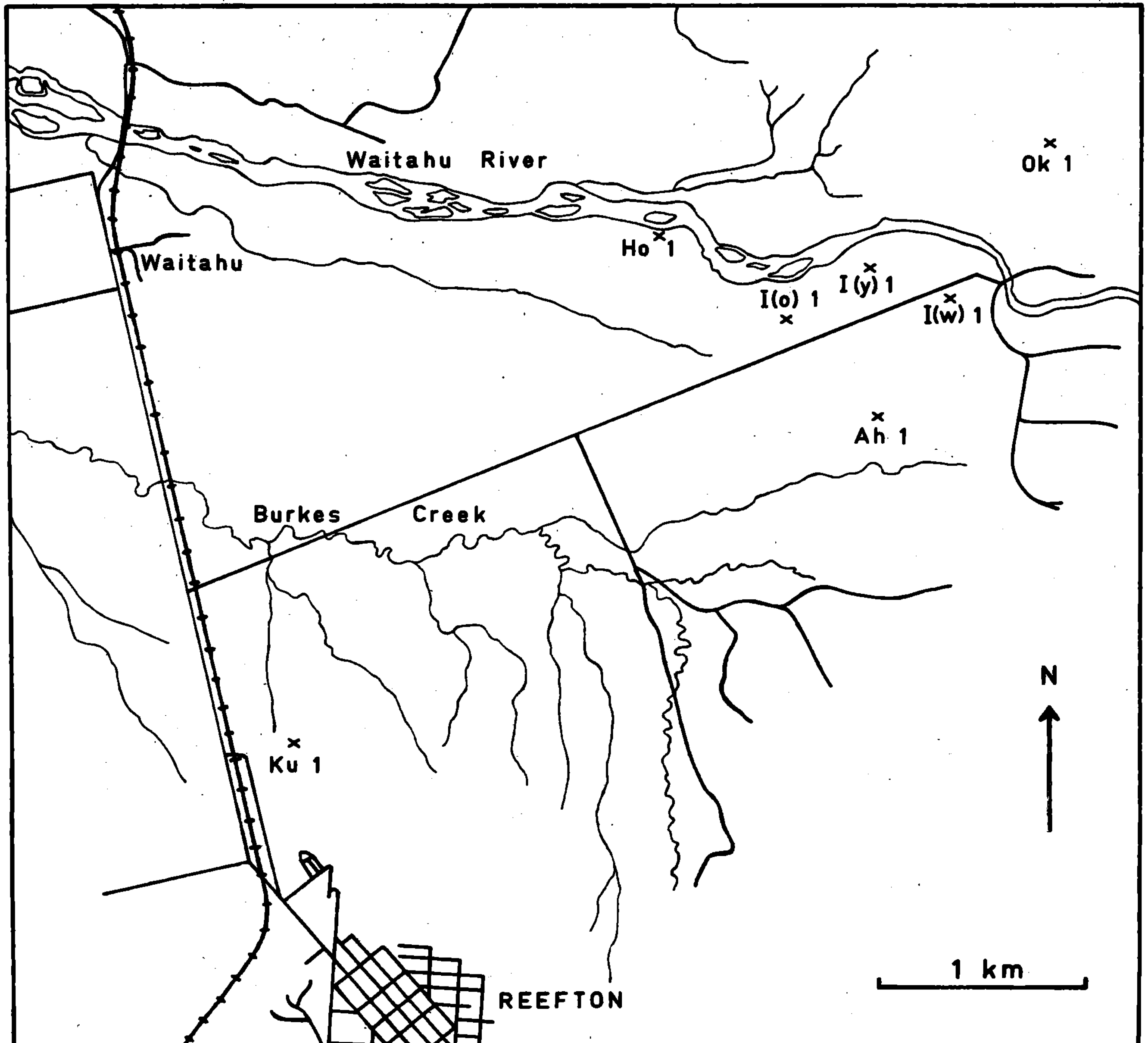


FIGURE 1: MAP OF THE STUDY AREA SHOWING LOCATIONS OF SAMPLING SITES.

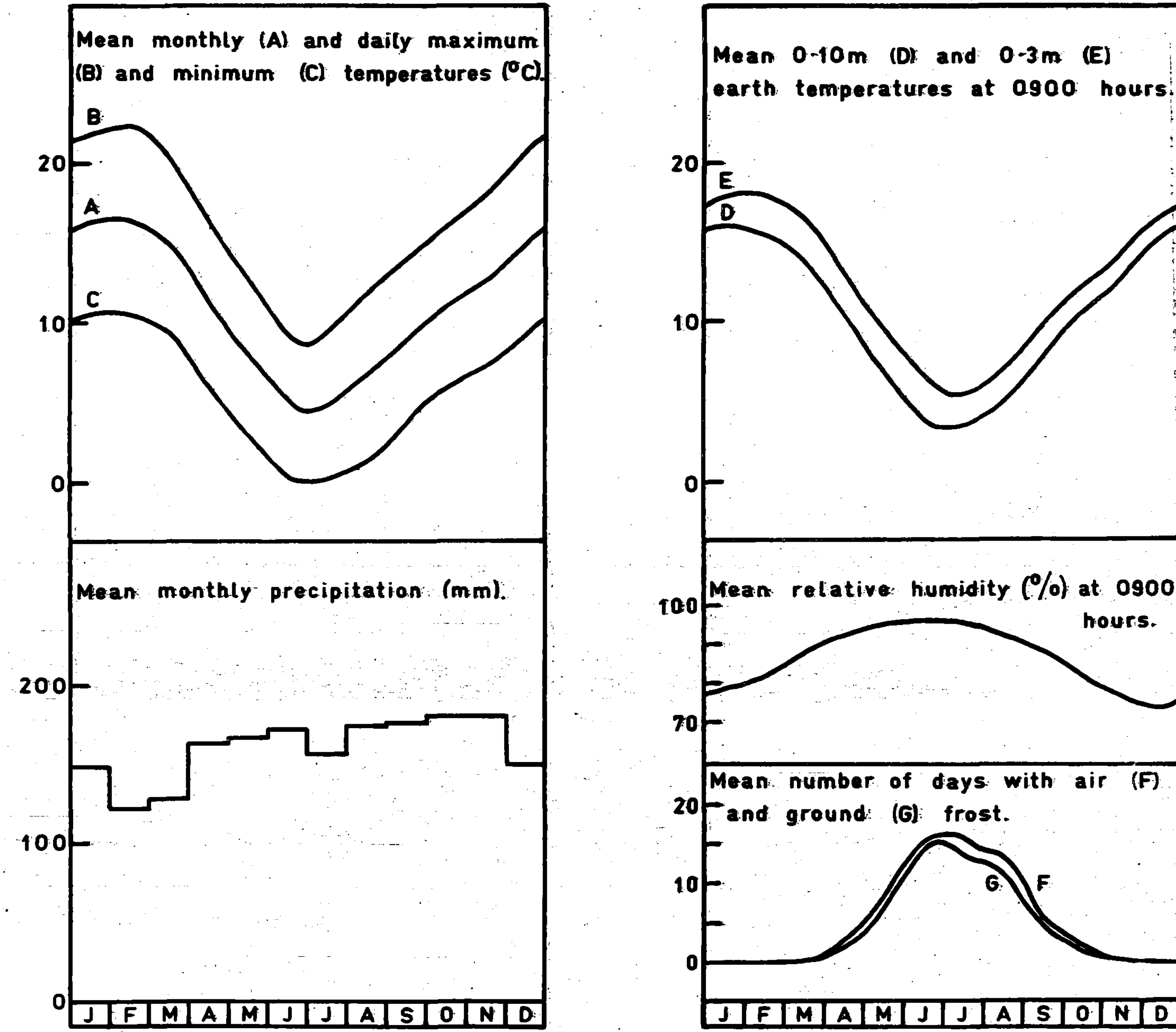


FIGURE 2: CLIMATIC DATA FOR REEFTON.

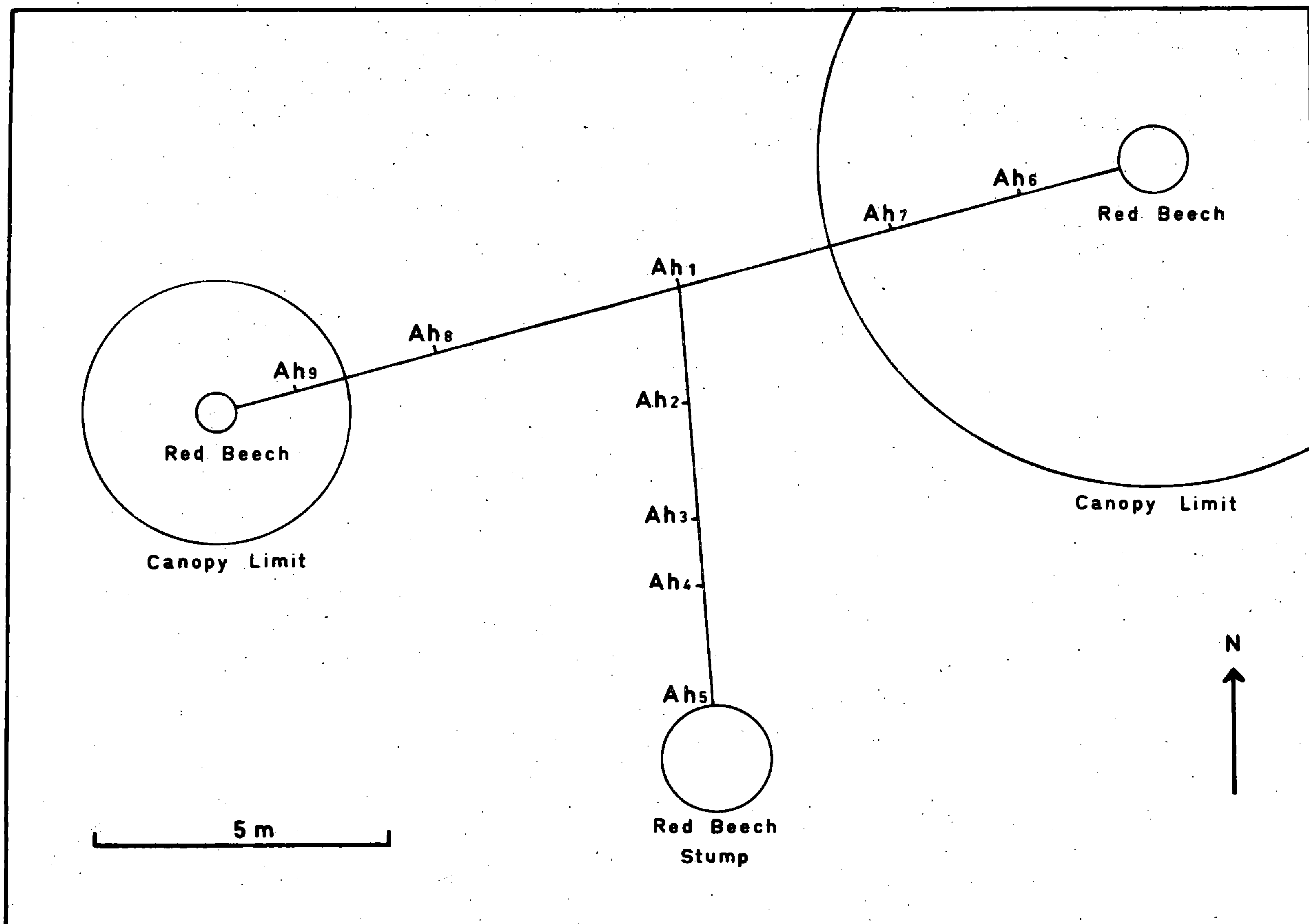


FIGURE 3: LOCATION OF SAMPLING SITES ALONG THE TWO AHAURA TRANSECTS.

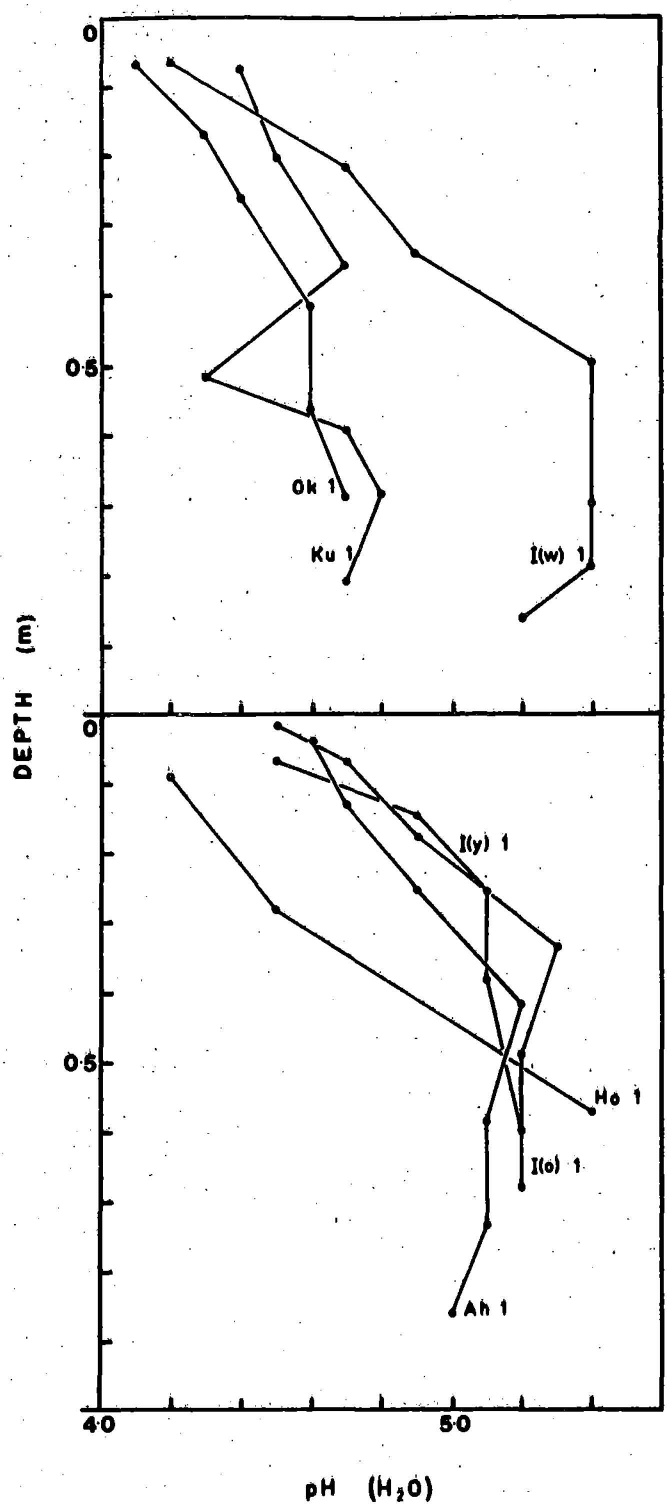


FIGURE 4: SOIL pH DEPTH FUNCTIONS - Chronosequence.

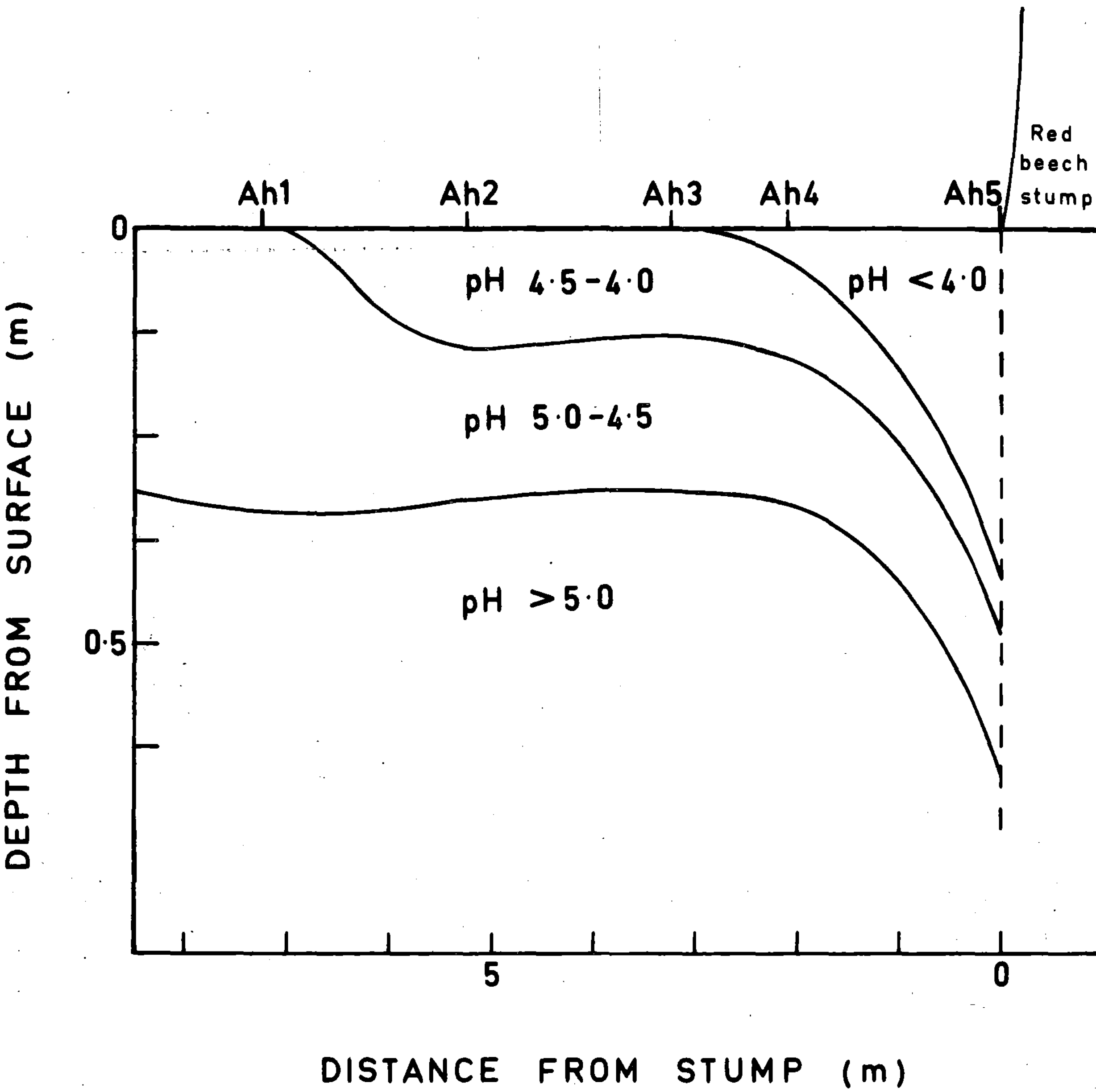


FIGURE 5: SOIL pH DEPTH FUNCTIONS - Transect 1.

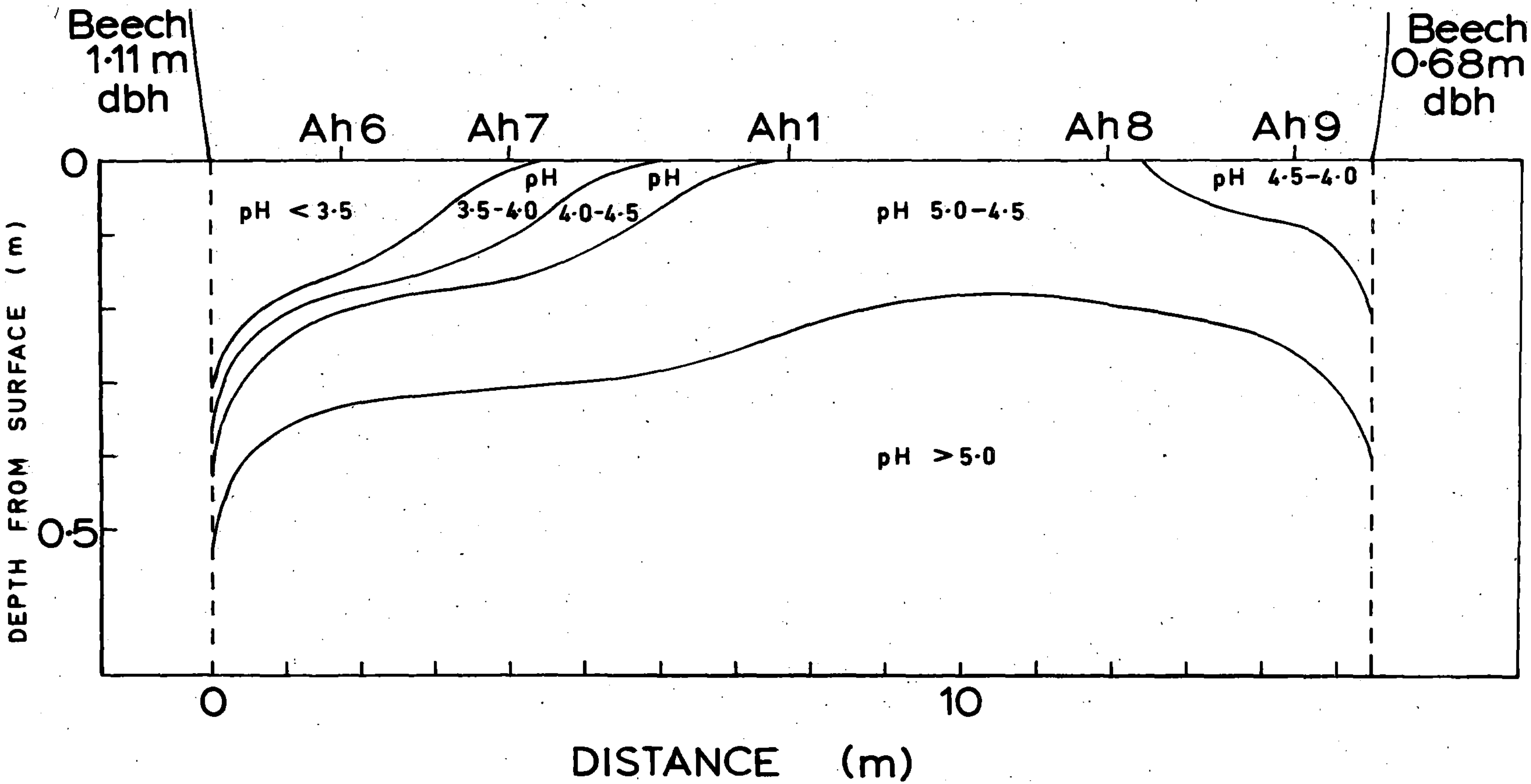


FIGURE 6: SOIL pH DEPTH FUNCTIONS - Transect 2.

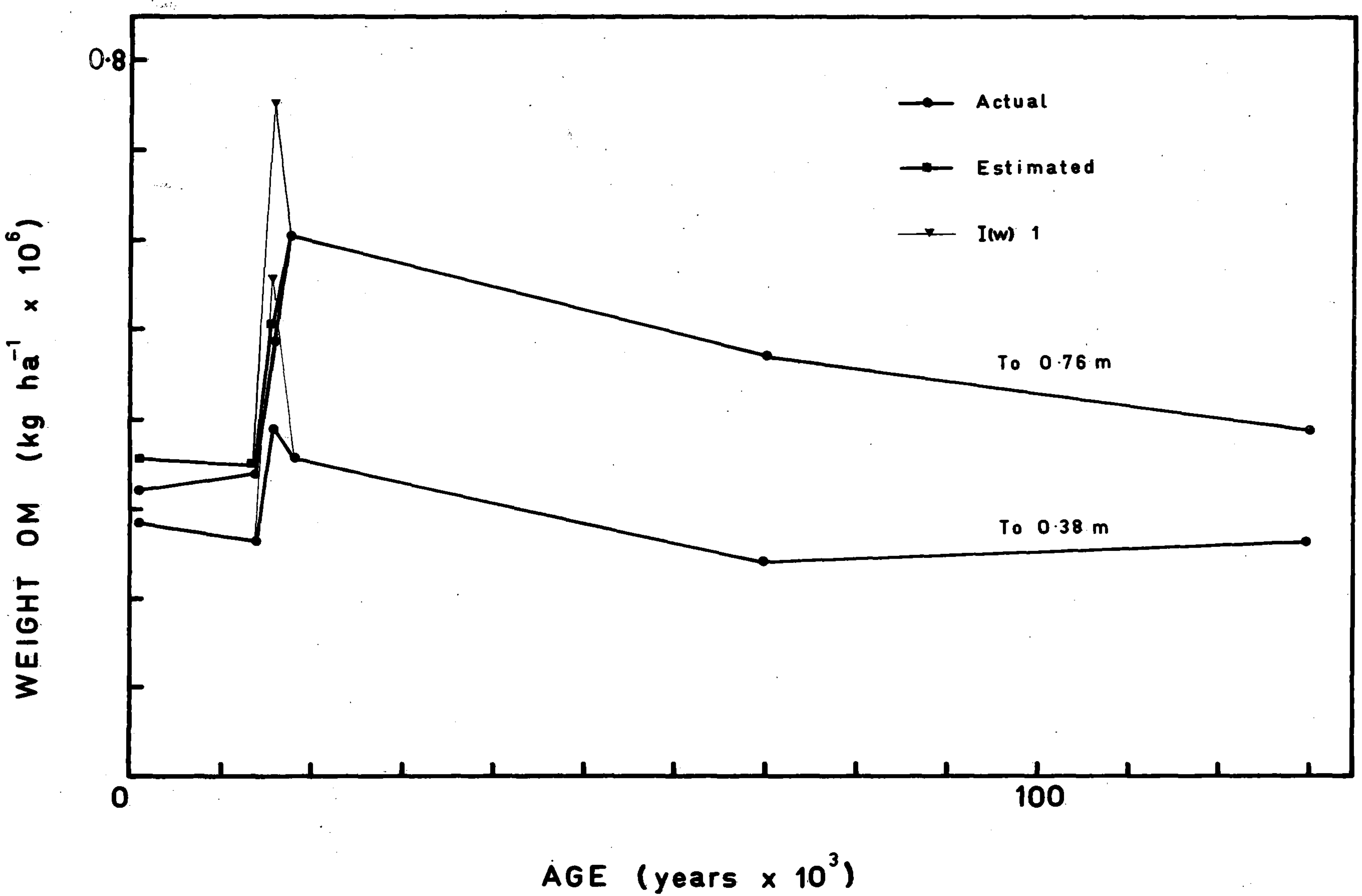


FIGURE 7: ACCUMULATION OF SOIL ORGANIC MATTER - Chronosequence.

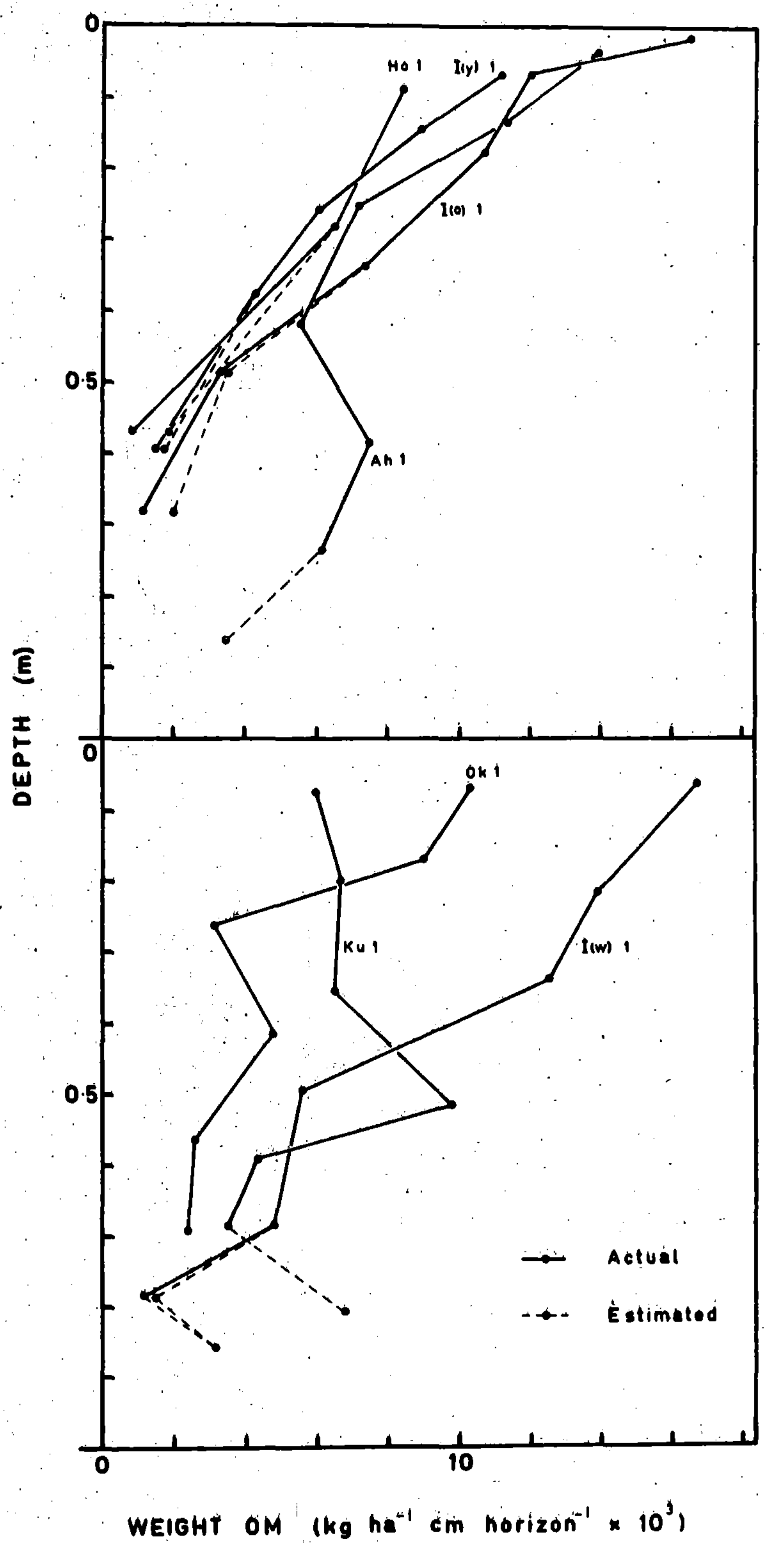


FIGURE 8: SOIL ORGANIC MATTER DEPTH FUNCTIONS - Chronosequence.

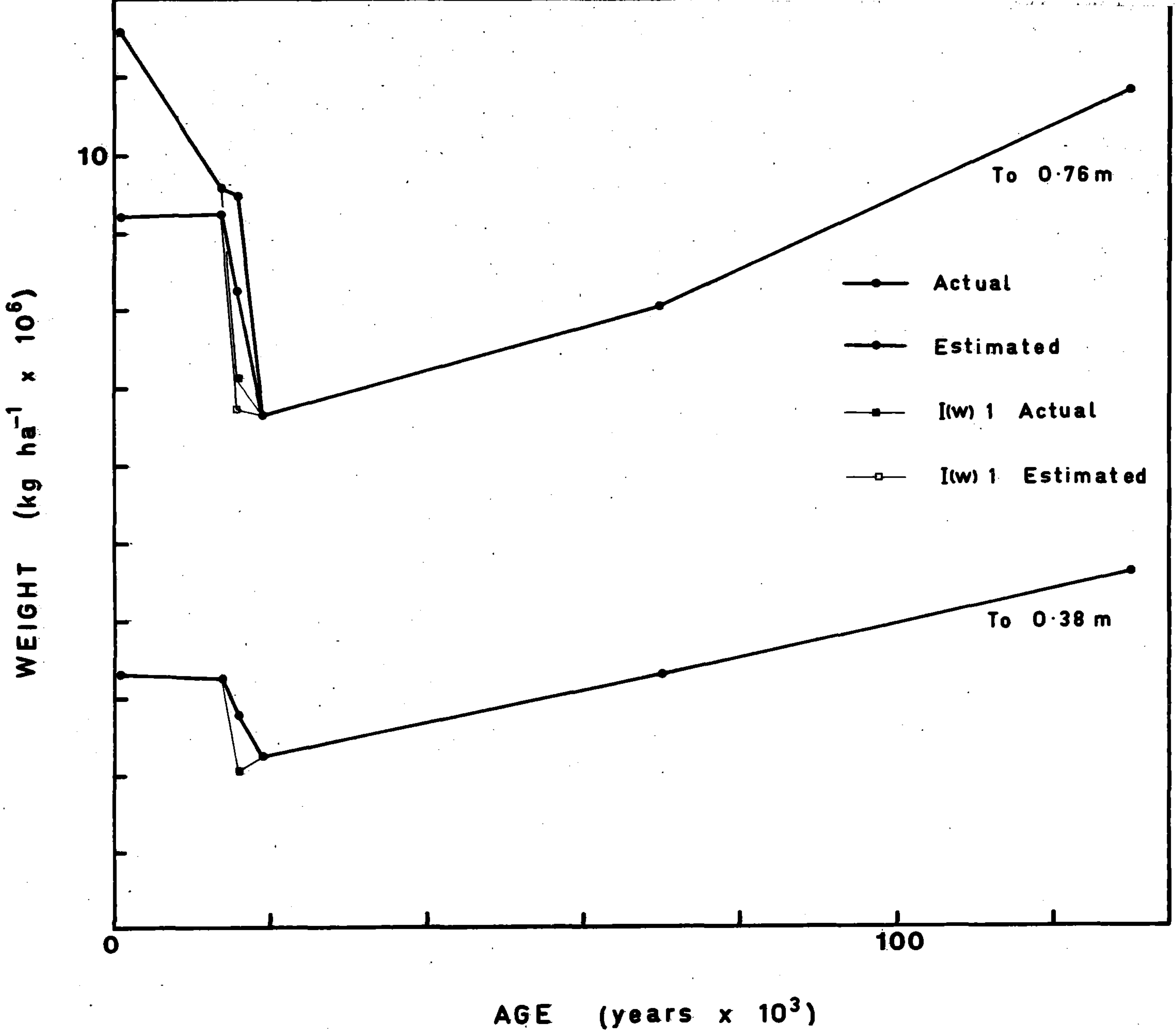


FIGURE 9: WEIGHTS OF INORGANIC MATERIAL IN CONSTANT SOIL VOLUME - Chronosequence.

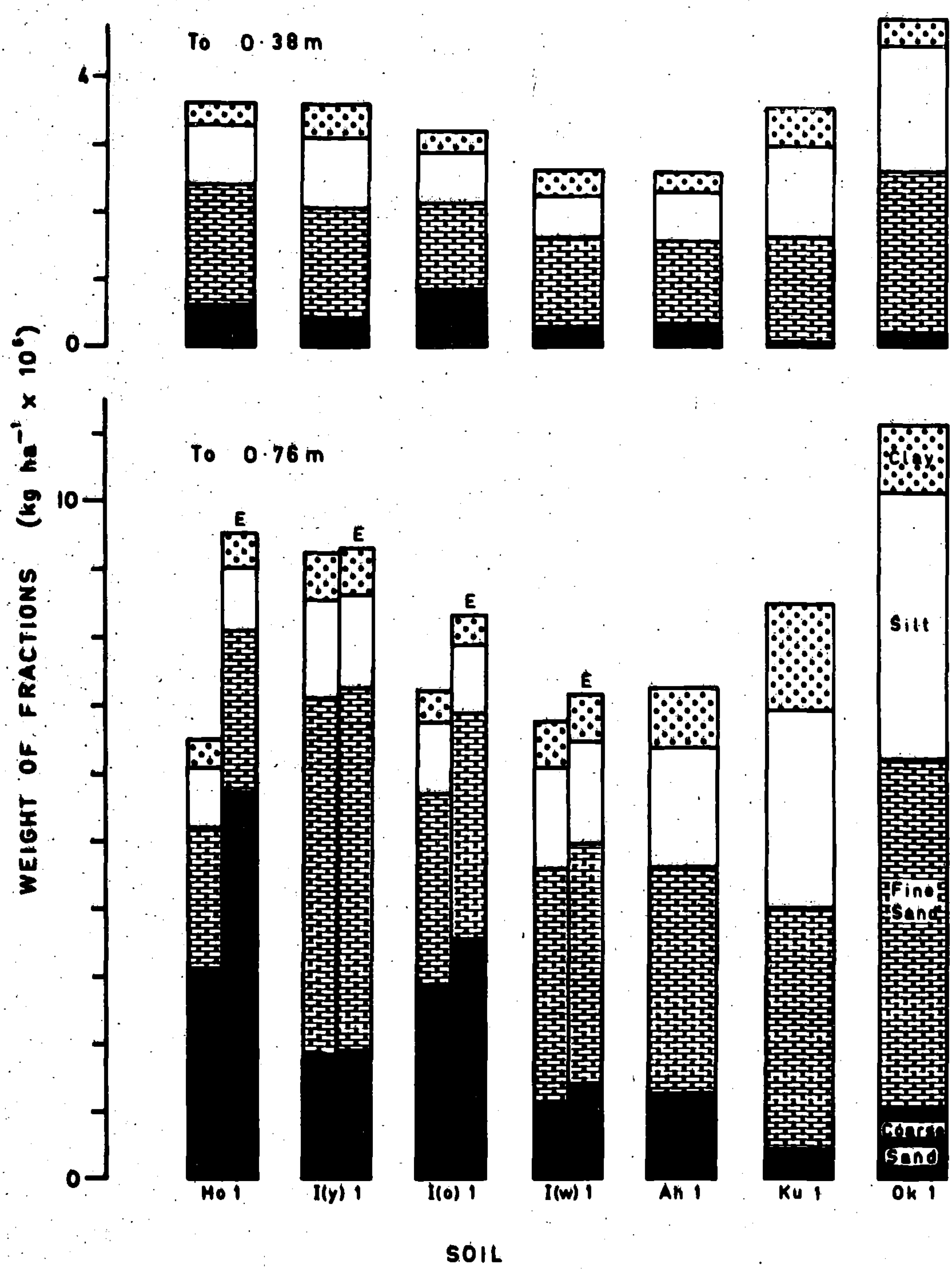


FIGURE 10: VOLUME-WEIGHTS OF SAND, SILT AND CLAY - Chronosequence.

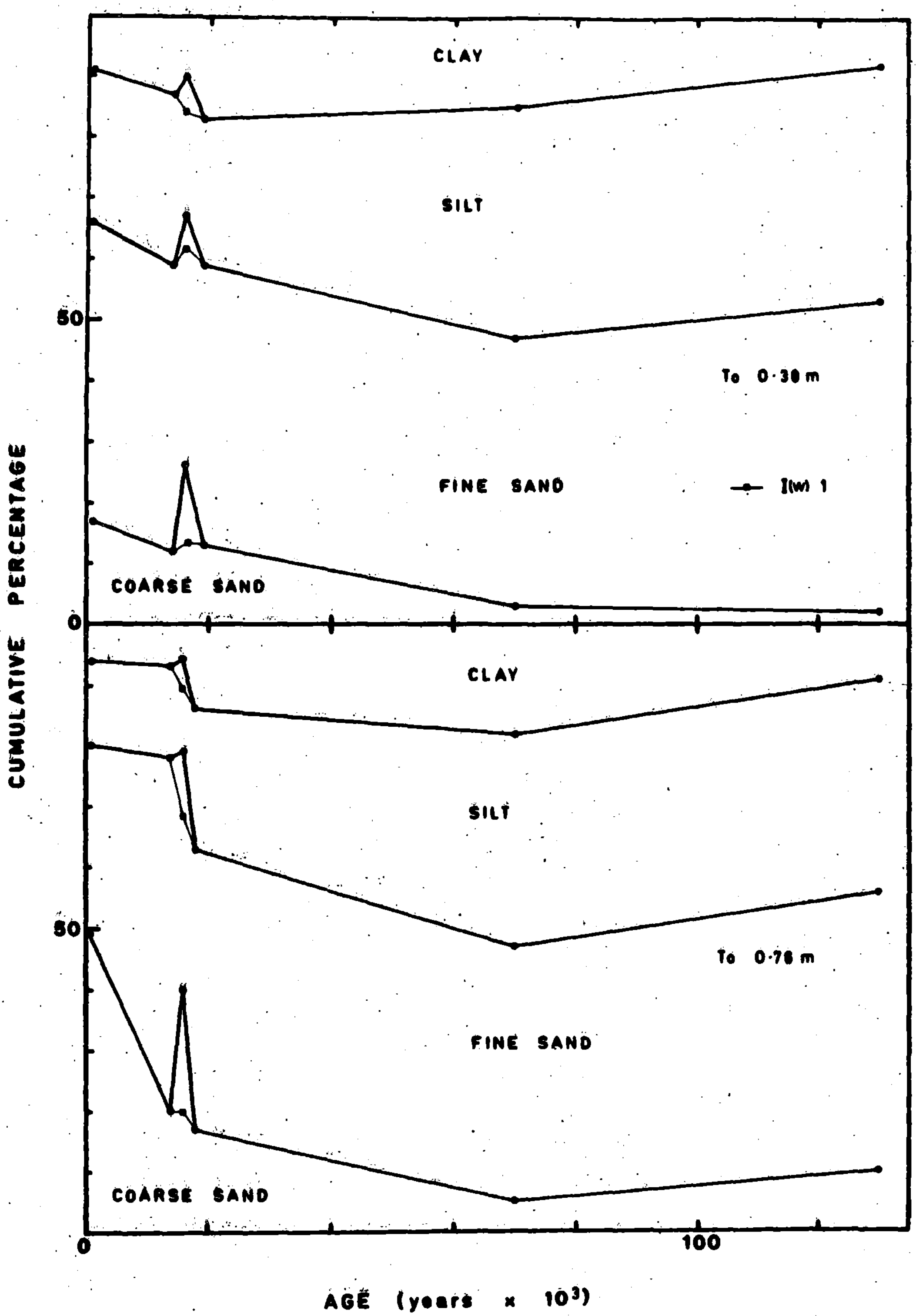


FIGURE 11: CHANGE IN % COMPOSITION OF <2 mm MATERIAL WITH TIME.

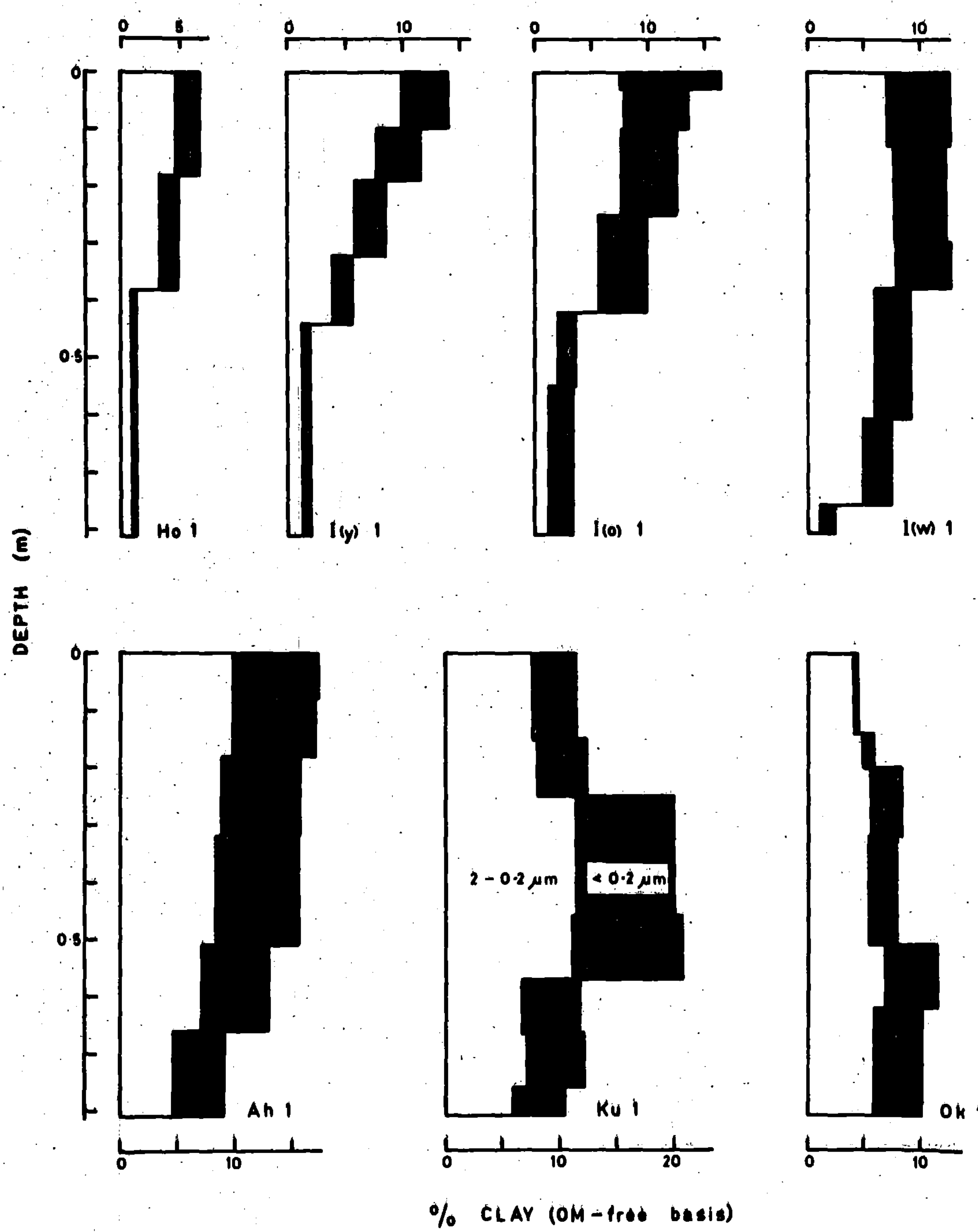
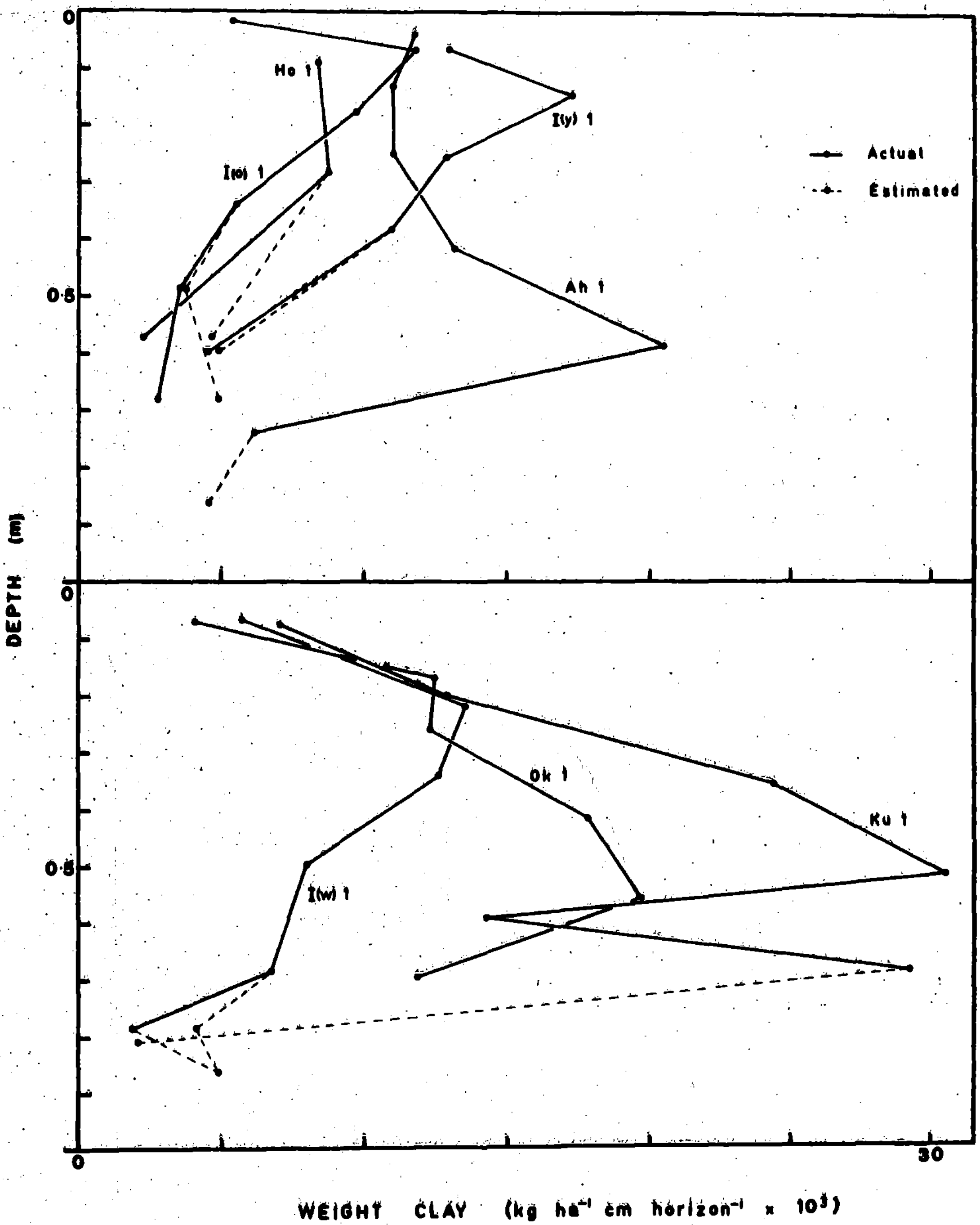
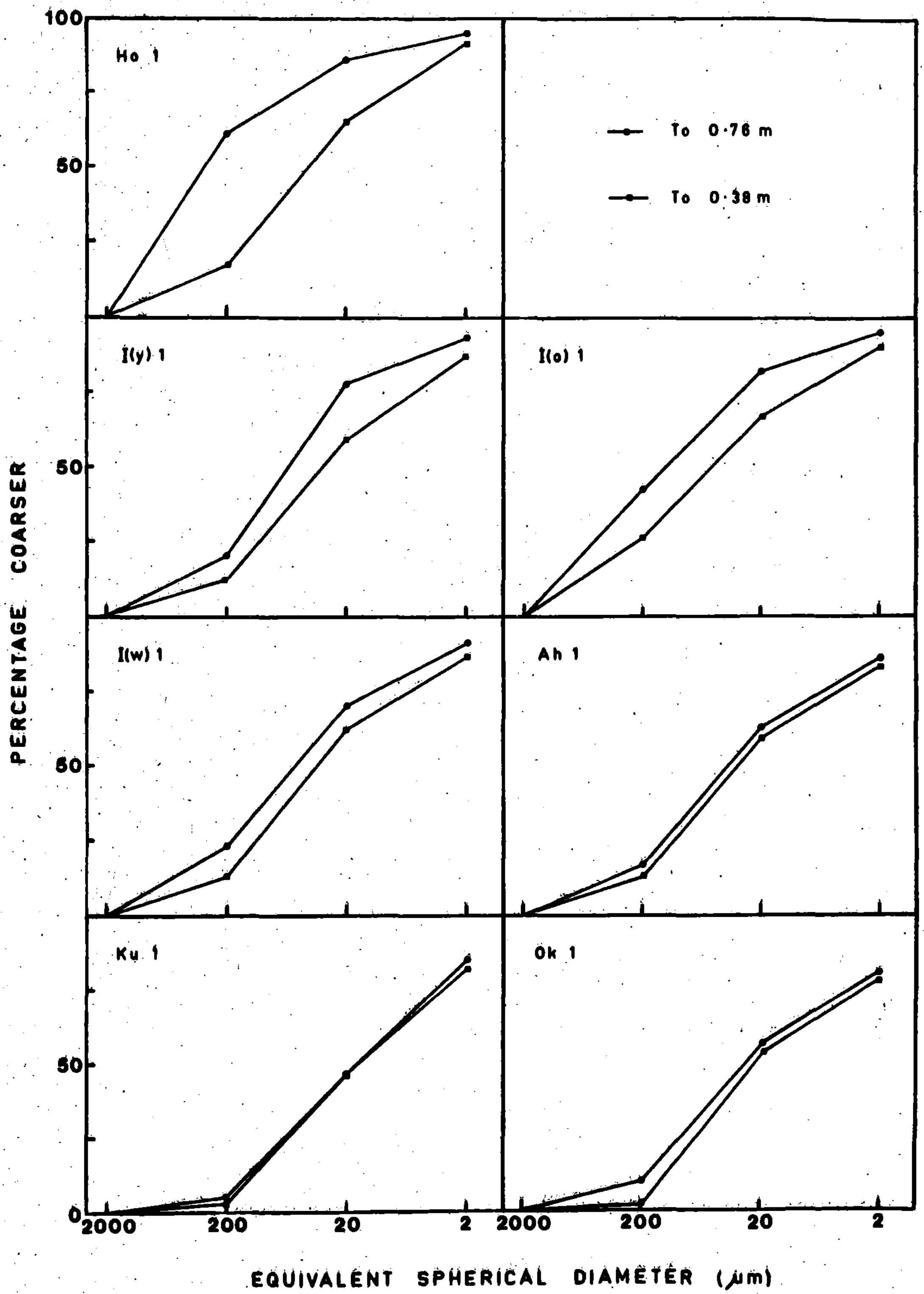


FIGURE 12: CLAY DEPTH FUNCTIONS (% BASIS) - Chronosequence.



URE 13: CLAY DEPTH FUNCTIONS (VOLUME-WEIGHT BASIS) - Chronosequence.



IGURE 14: SUMMATION PERCENTAGES OF <2mm FRACTION - Chronosequence.

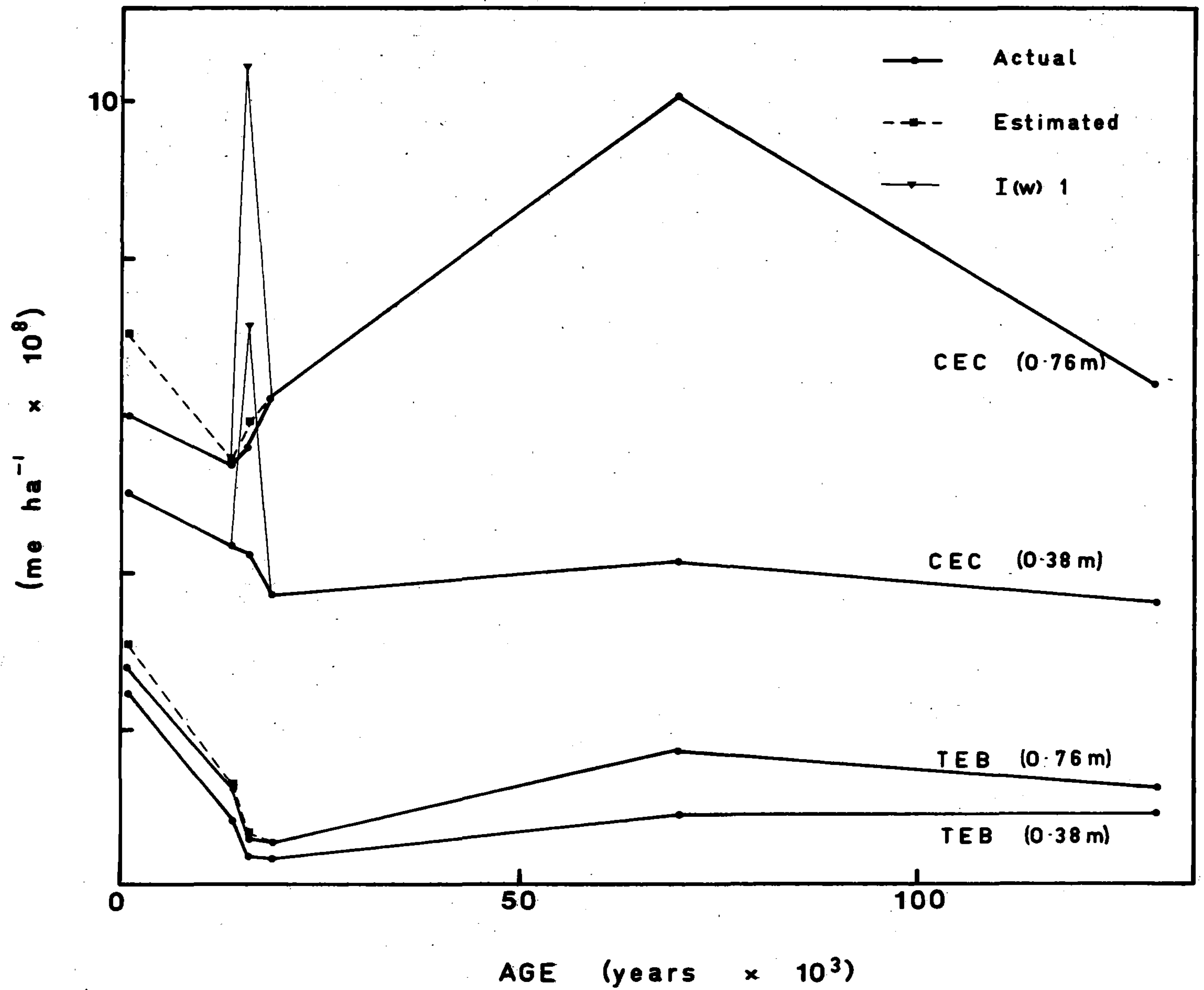
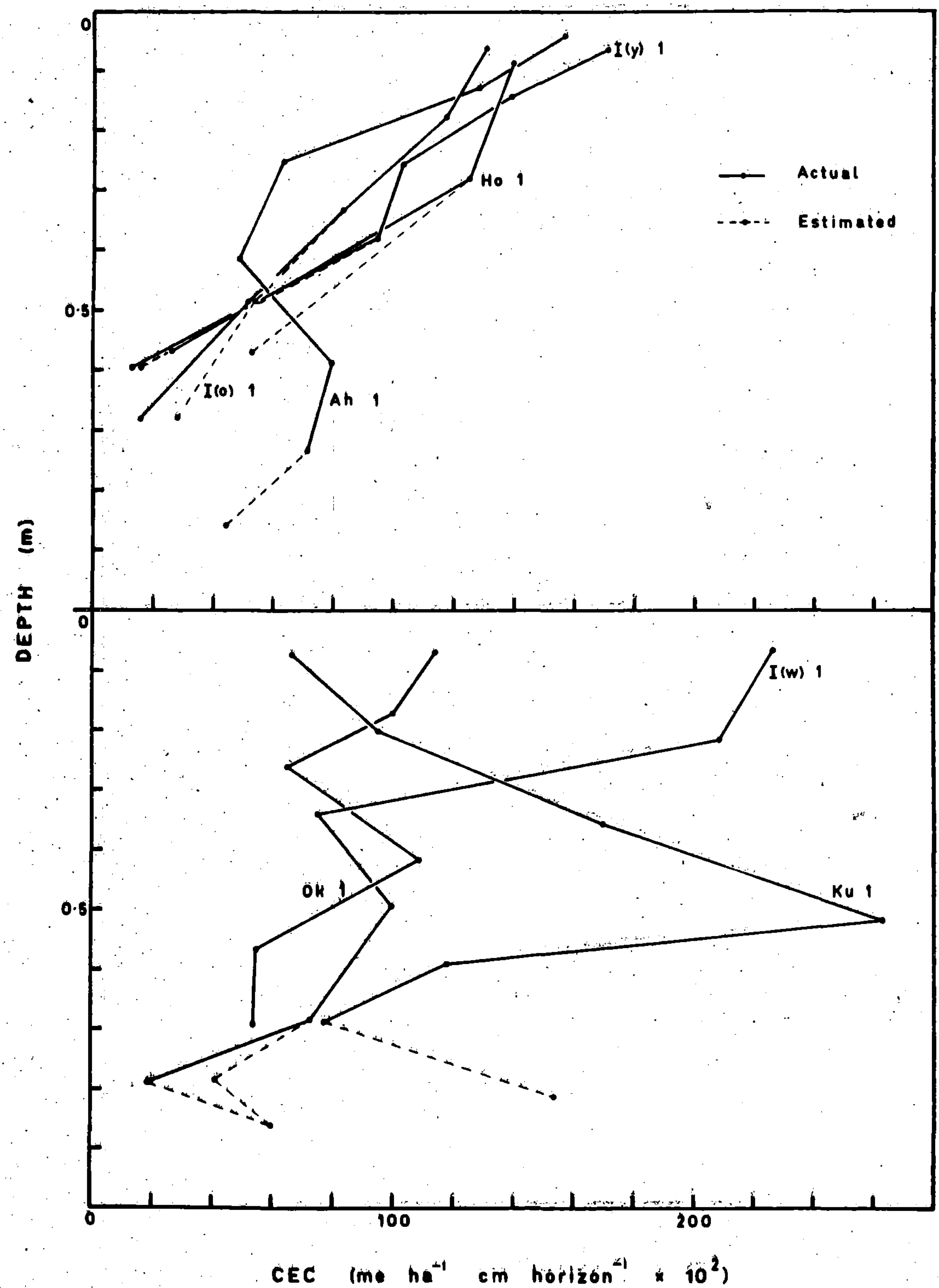


FIGURE 15: VARIATION IN CEC AND TEB WITH TIME.



<u>FIGURE 16</u>: CEC DEPTH FUNCTIONS - Chronosequence.

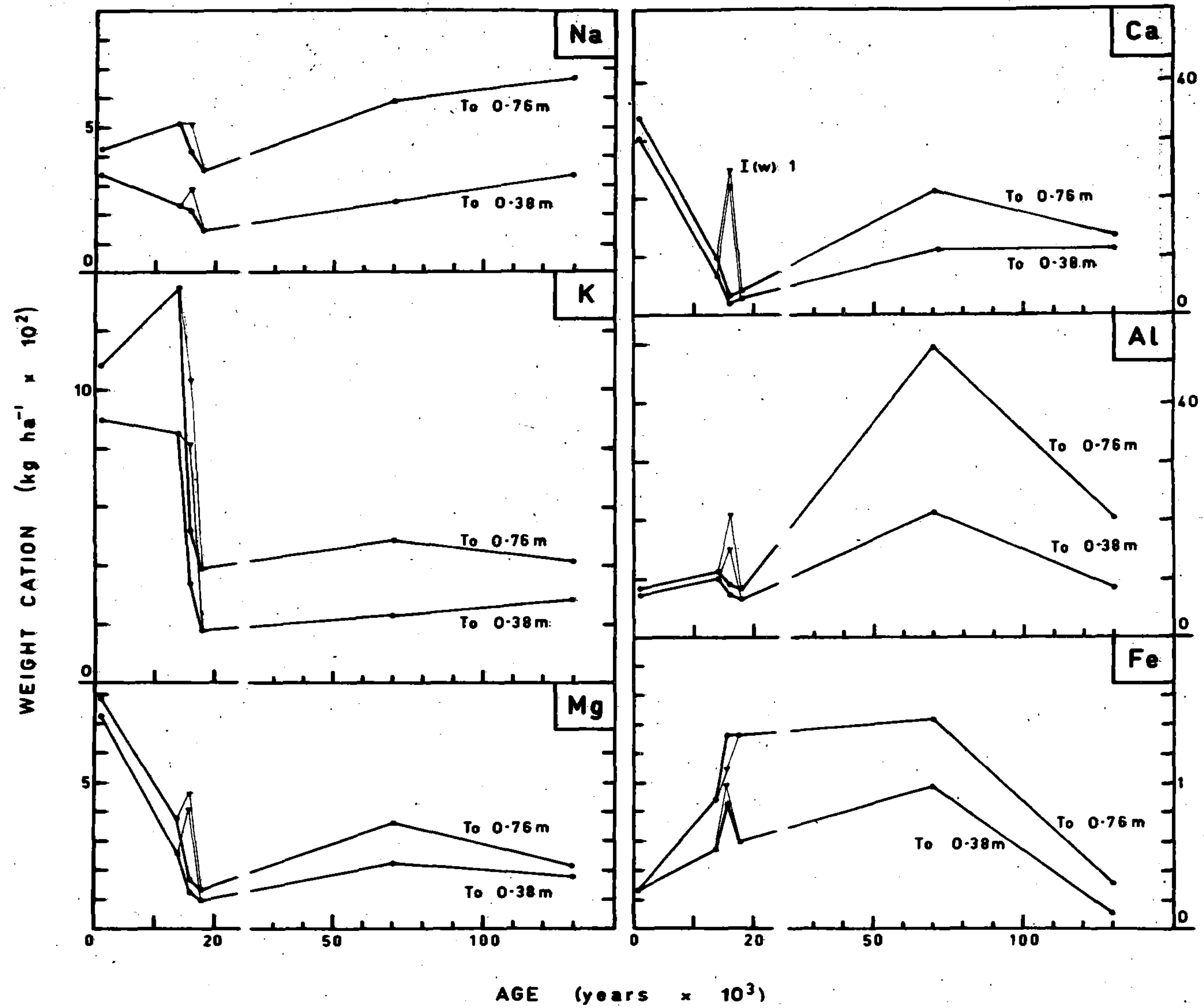


FIGURE 17: VARIATION IN EXCHANGEABLE CATIONS WITH TIME.

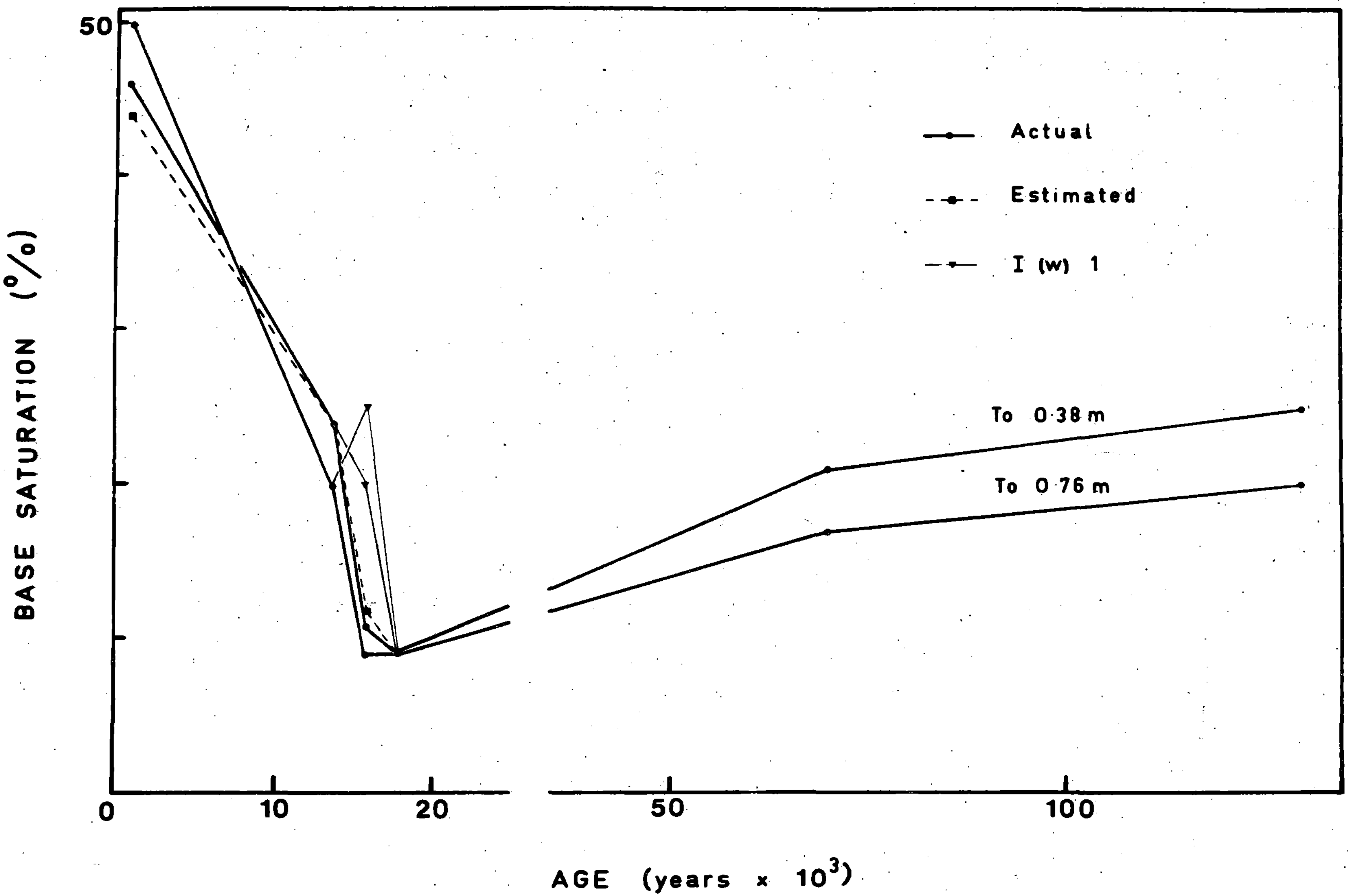


FIGURE 18: VARIATION IN BASE SATURATION WITH TIME.

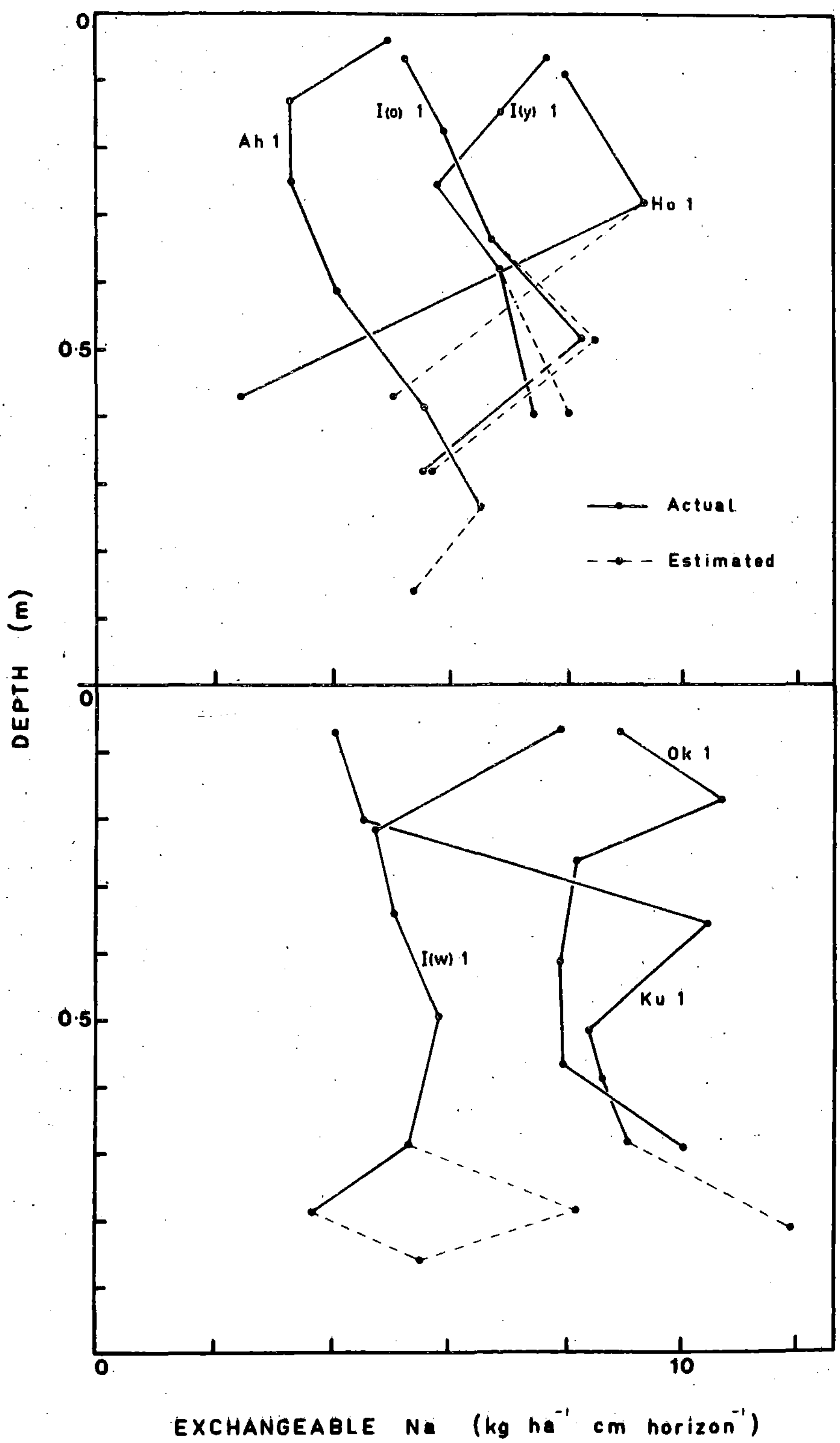


FIGURE 19: EXCHANGEABLE Na DEPTH FUNCTIONS - Chronosequence.

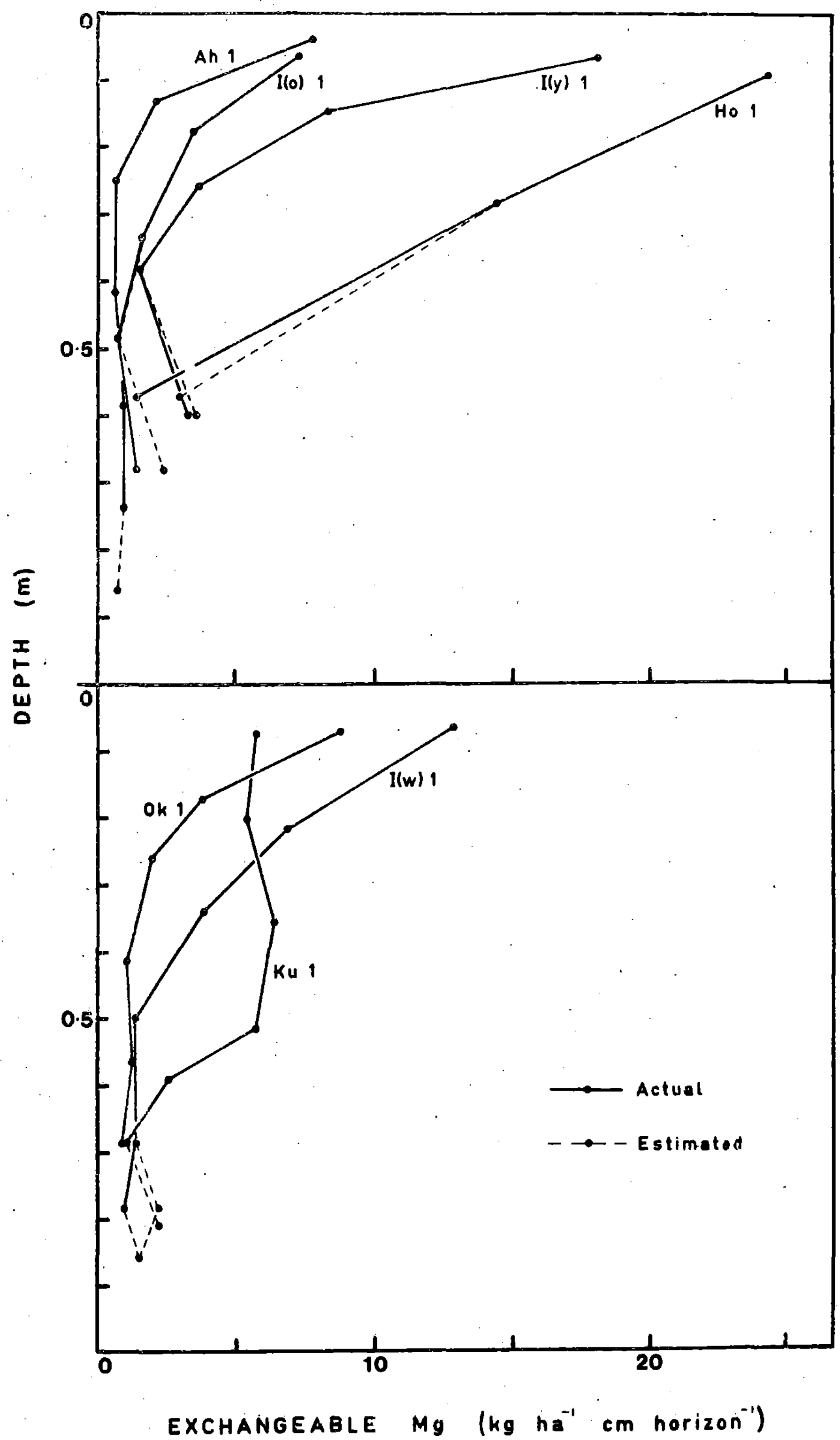


FIGURE 20: EXCHANGEABLE Mg DEPTH FUNCTIONS - Chronosequence.

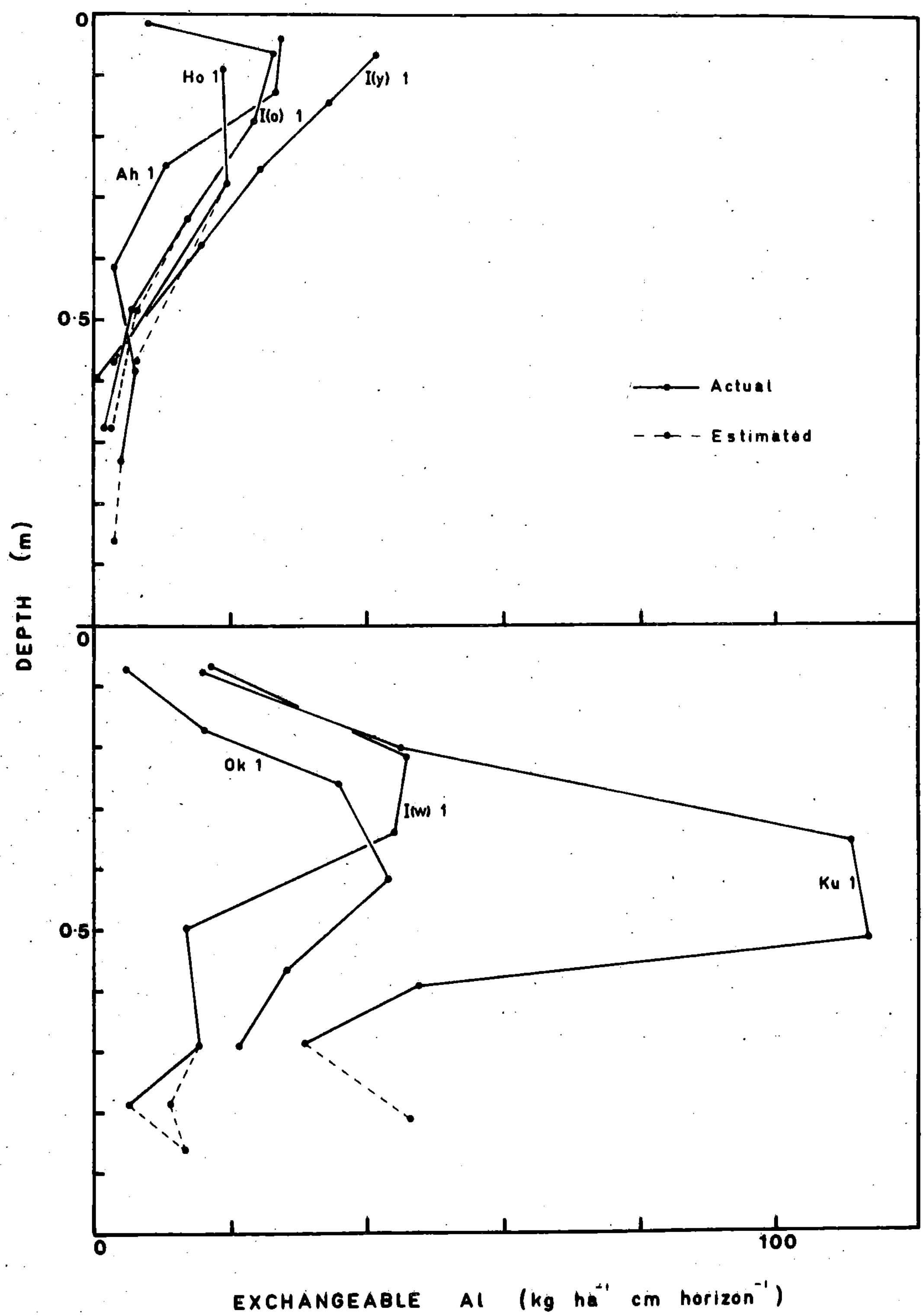


FIGURE 21: EXCHANGEABLE Al DEPTH FUNCTIONS - Chronosequence.

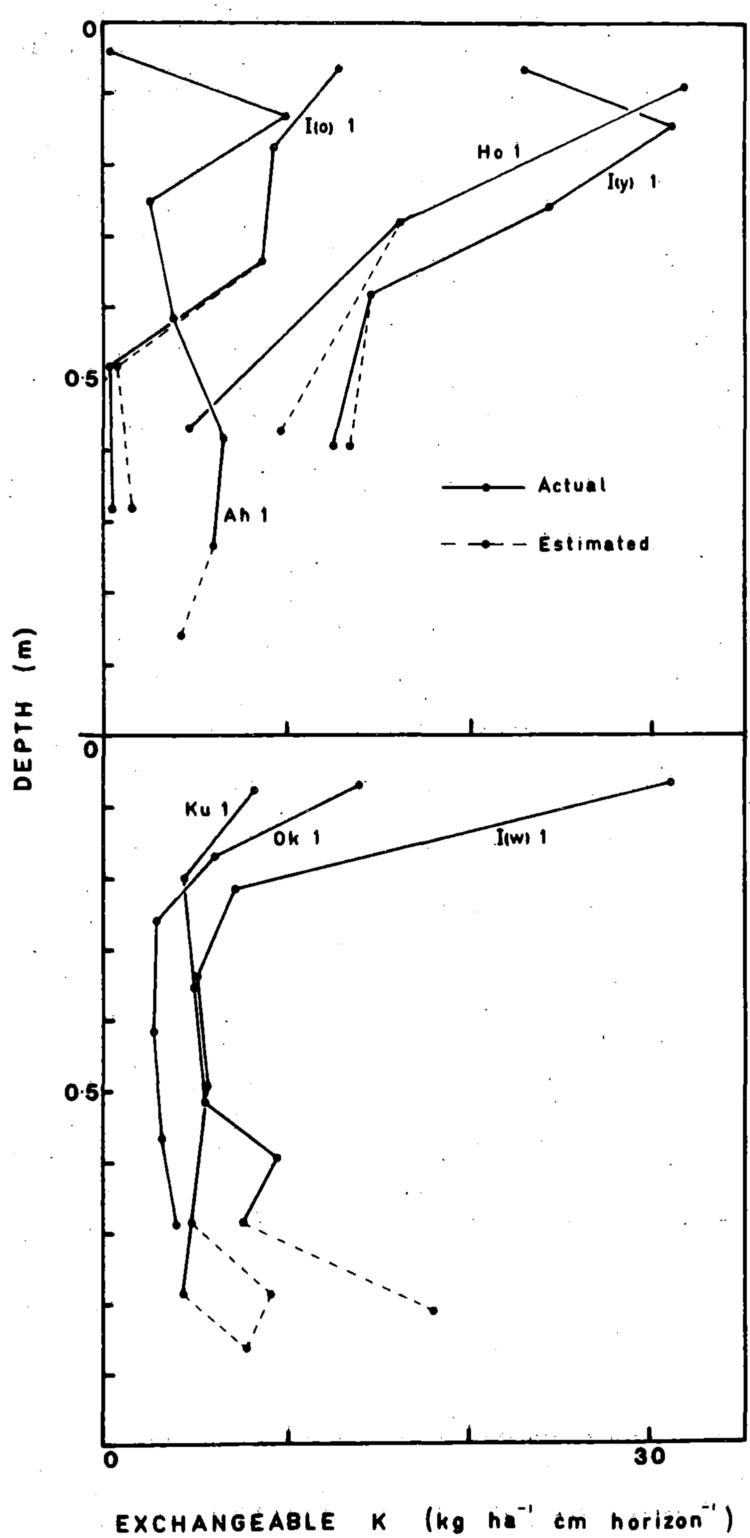


FIGURE 22: EXCHANGEABLE K DEPTH FUNCTIONS - Chronosequence.

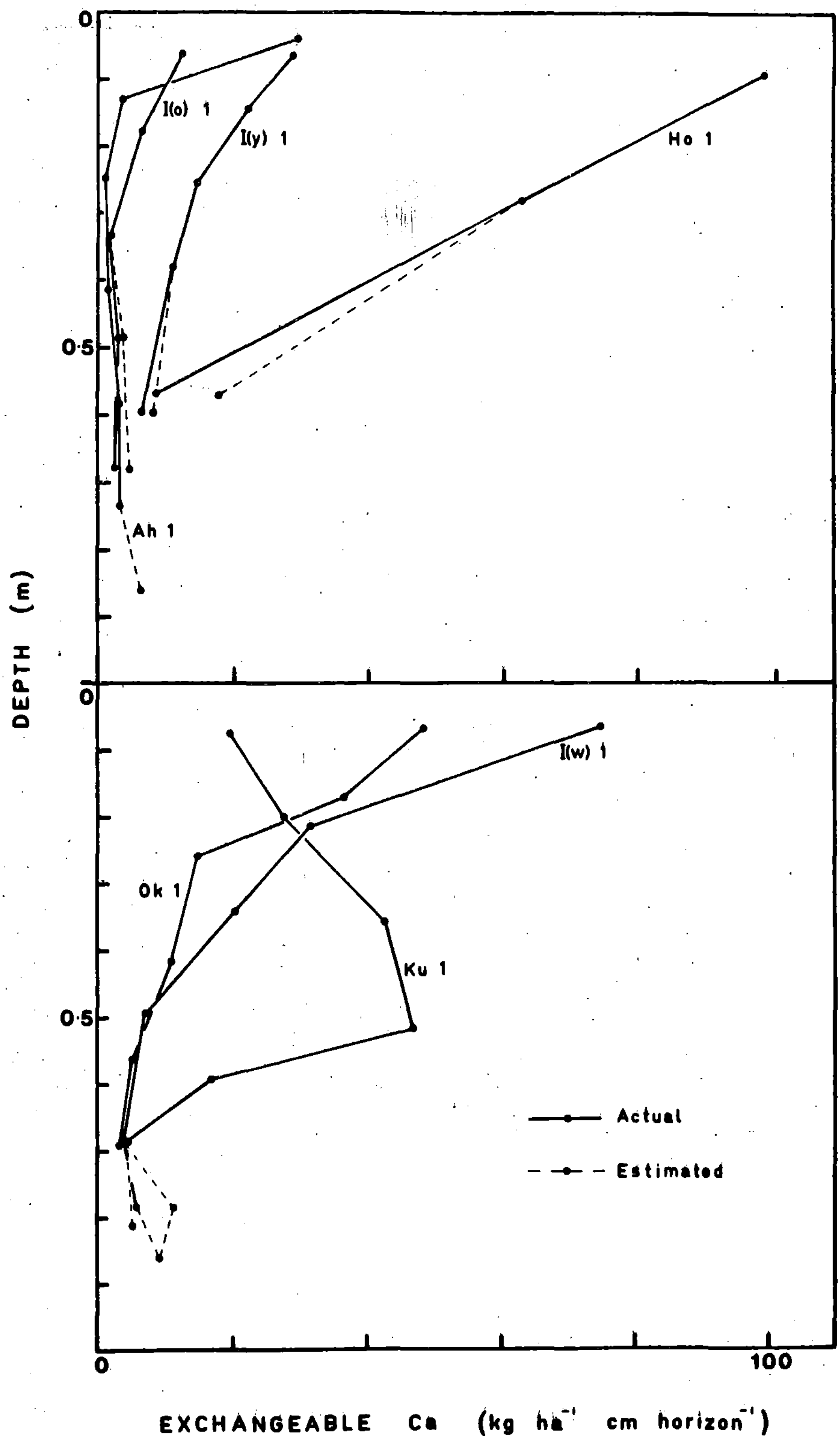
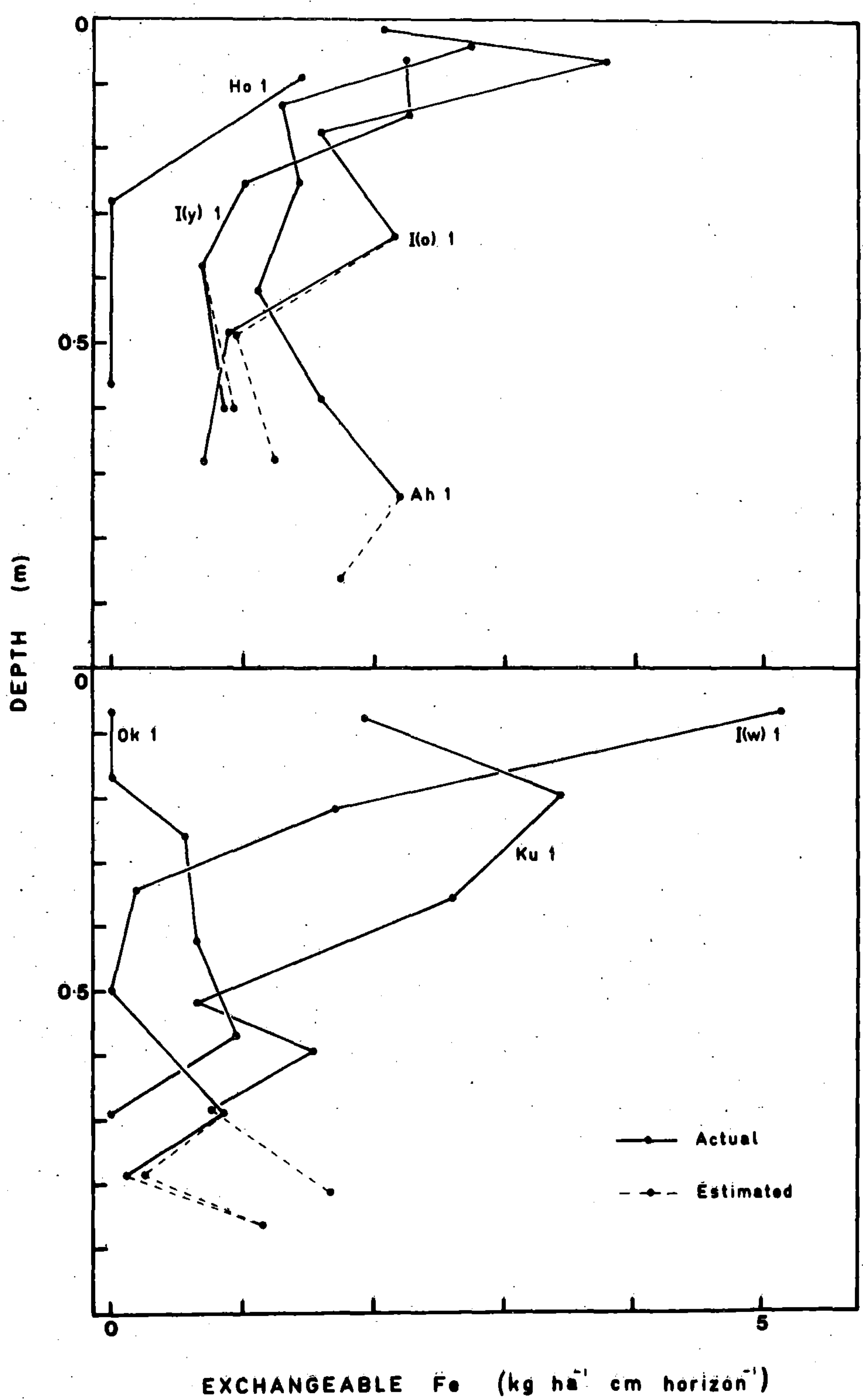


FIGURE 23: EXCHANGEABLE Ca DEPTH FUNCTIONS - Chronosequence.



<u>FIGURE 24:</u> EXCHANGEABLE Fe DEPTH FUNCTIONS - Chronosequence.

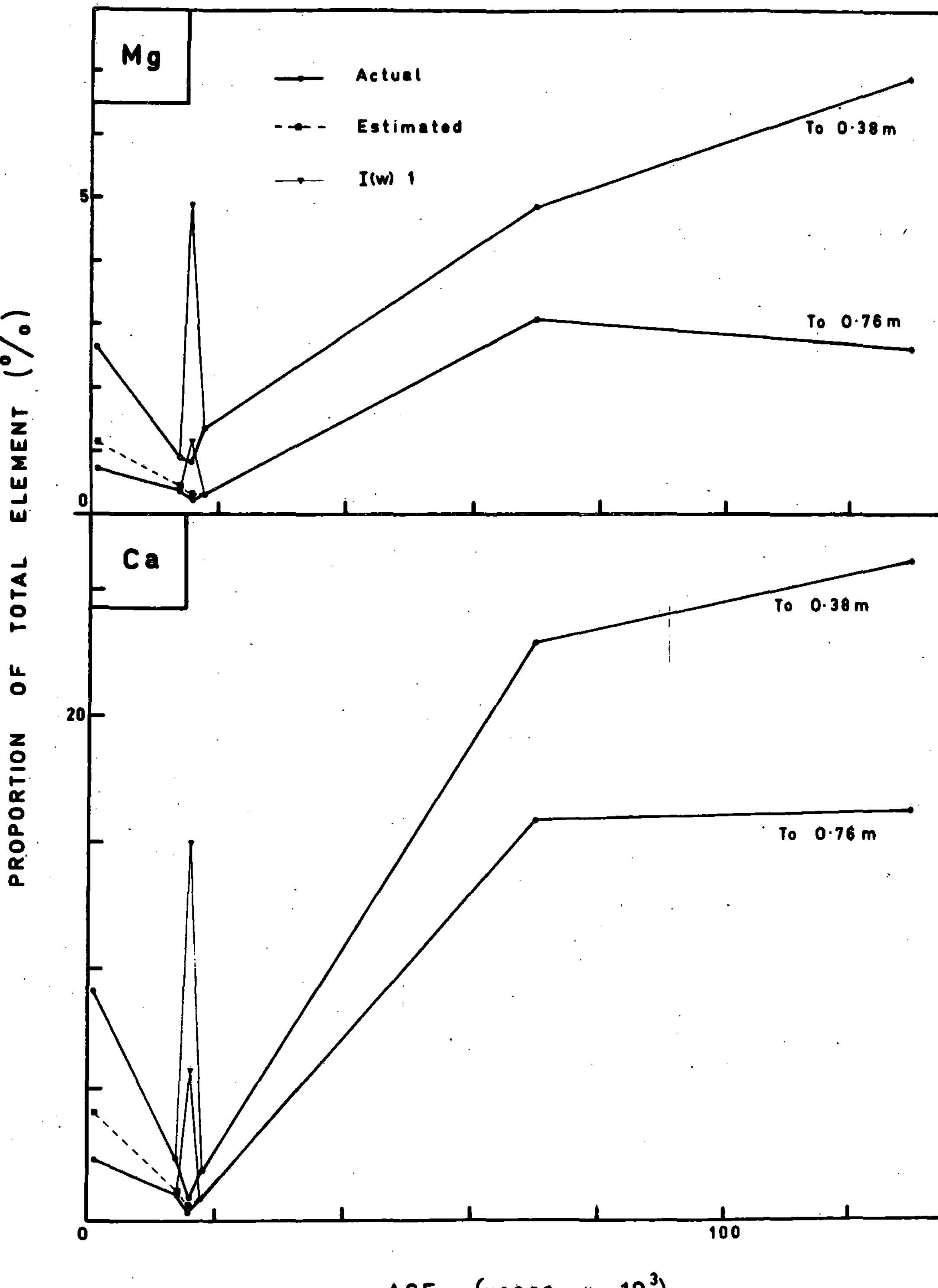
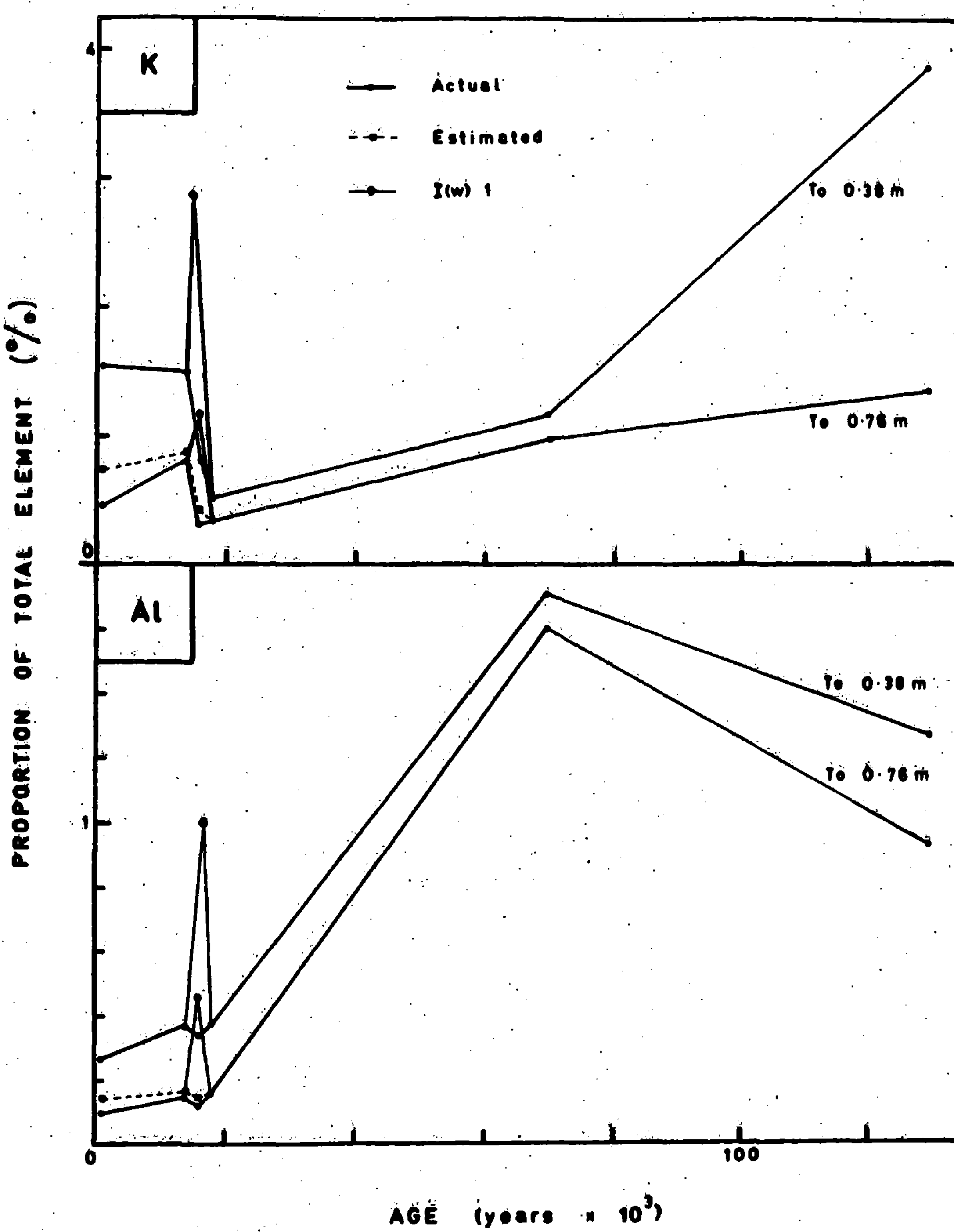


FIGURE 25: PROPORTIONS OF TOTAL Mg AND Ca PRESENT IN EXCHANGEABLE FORMS - Chronosequence.



<u>FIGURE 26</u>: PROPORTIONS OF TOTAL K AND Al PRESENT IN EXCHANGEABLE FORMS - Chronosequence.

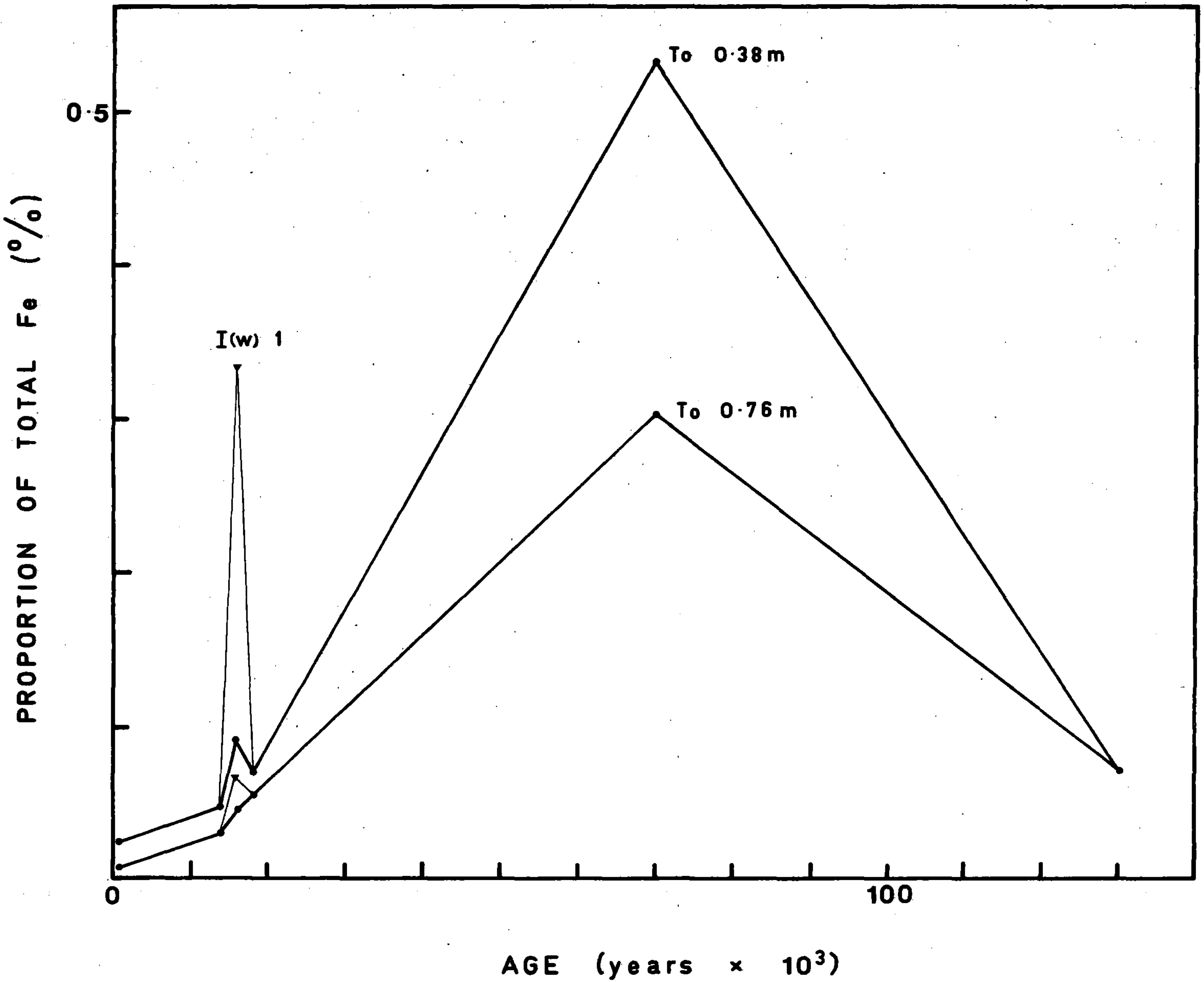


FIGURE 27: PROPORTION OF TOTAL Fe PRESENT IN EXCHANGEABLE FORMS - Chronosequence.

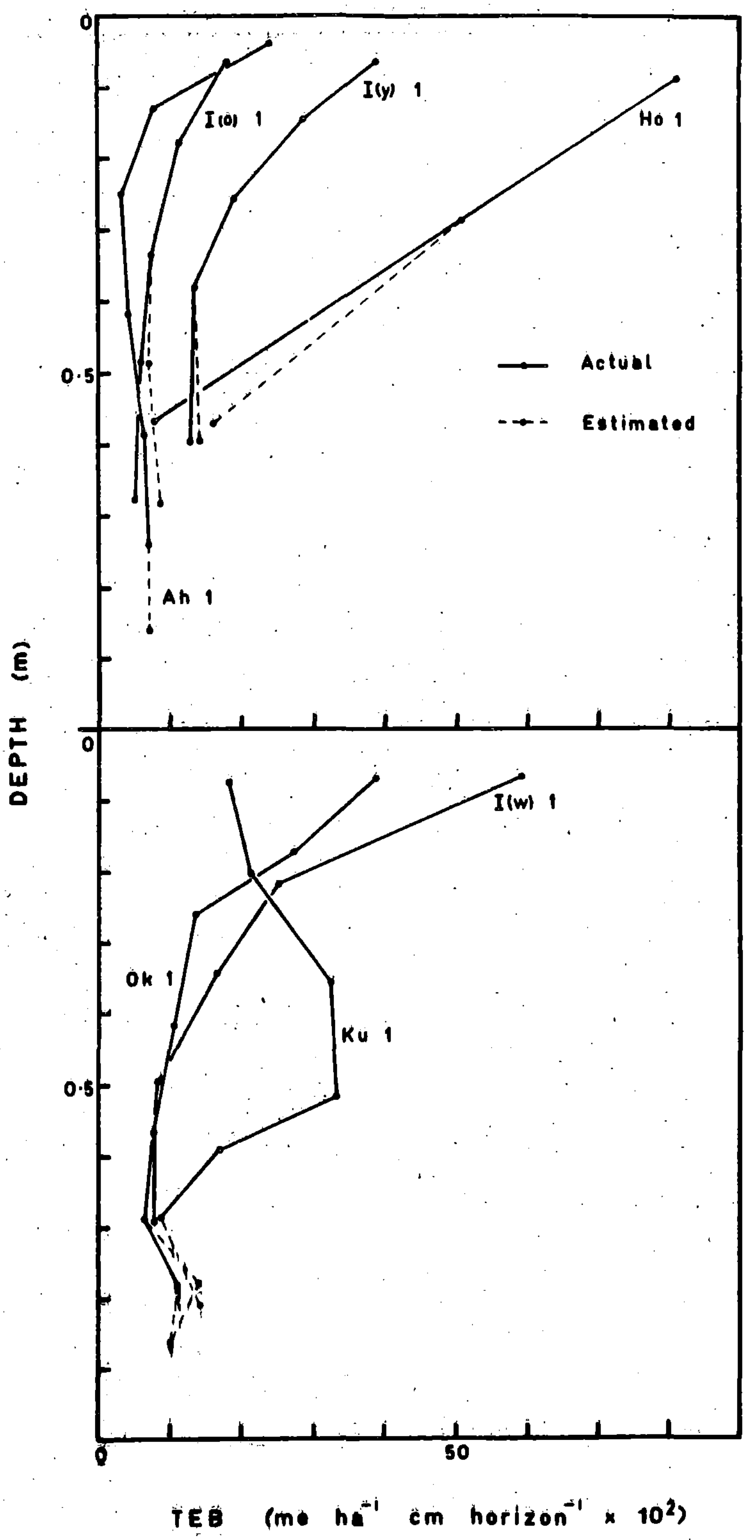


FIGURE 28: TEB DEPTH FUNCTIONS - Chronosequence.

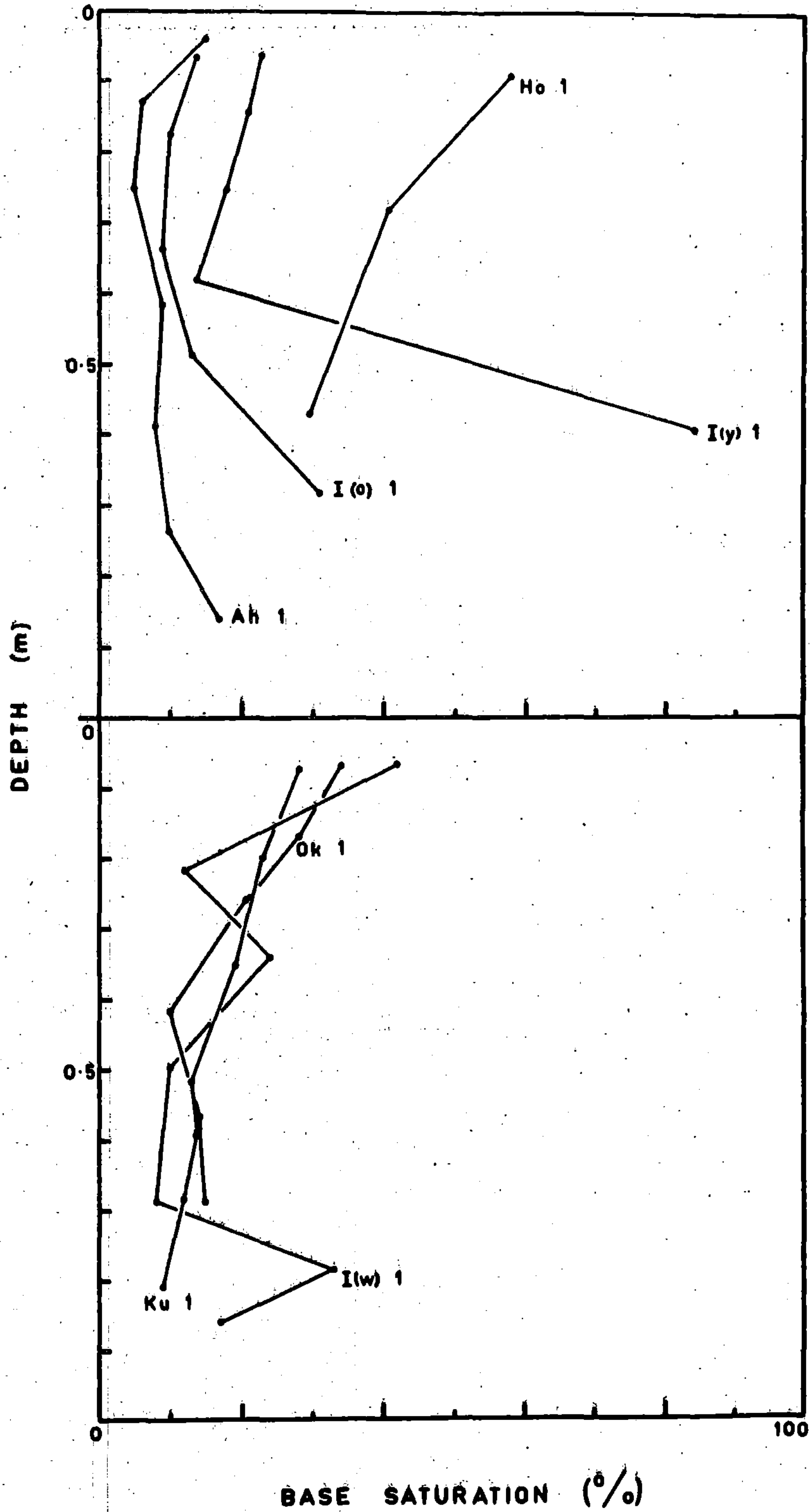


FIGURE 29: BASE SATURATION DEPTH FUNCTIONS - Chronosequence.

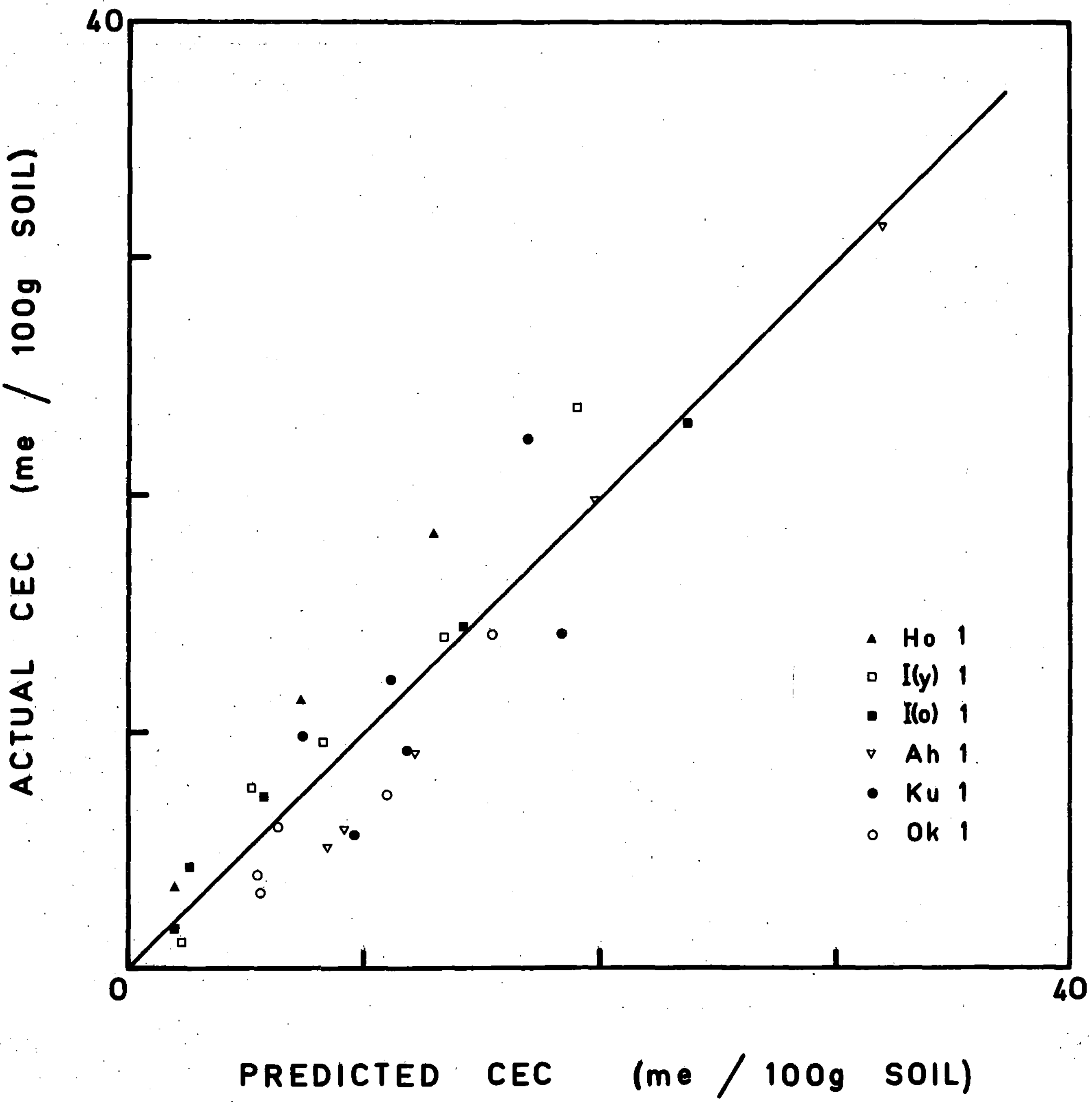


FIGURE 30: SCATTER DIAGRAM SHOWING THE PREDICTABILITY OF CEC BASED ON THE REGRESSION EQUATION RELATING CEC TO % OXIDISABLE CARBON AND % CLAY - Chronosequence.

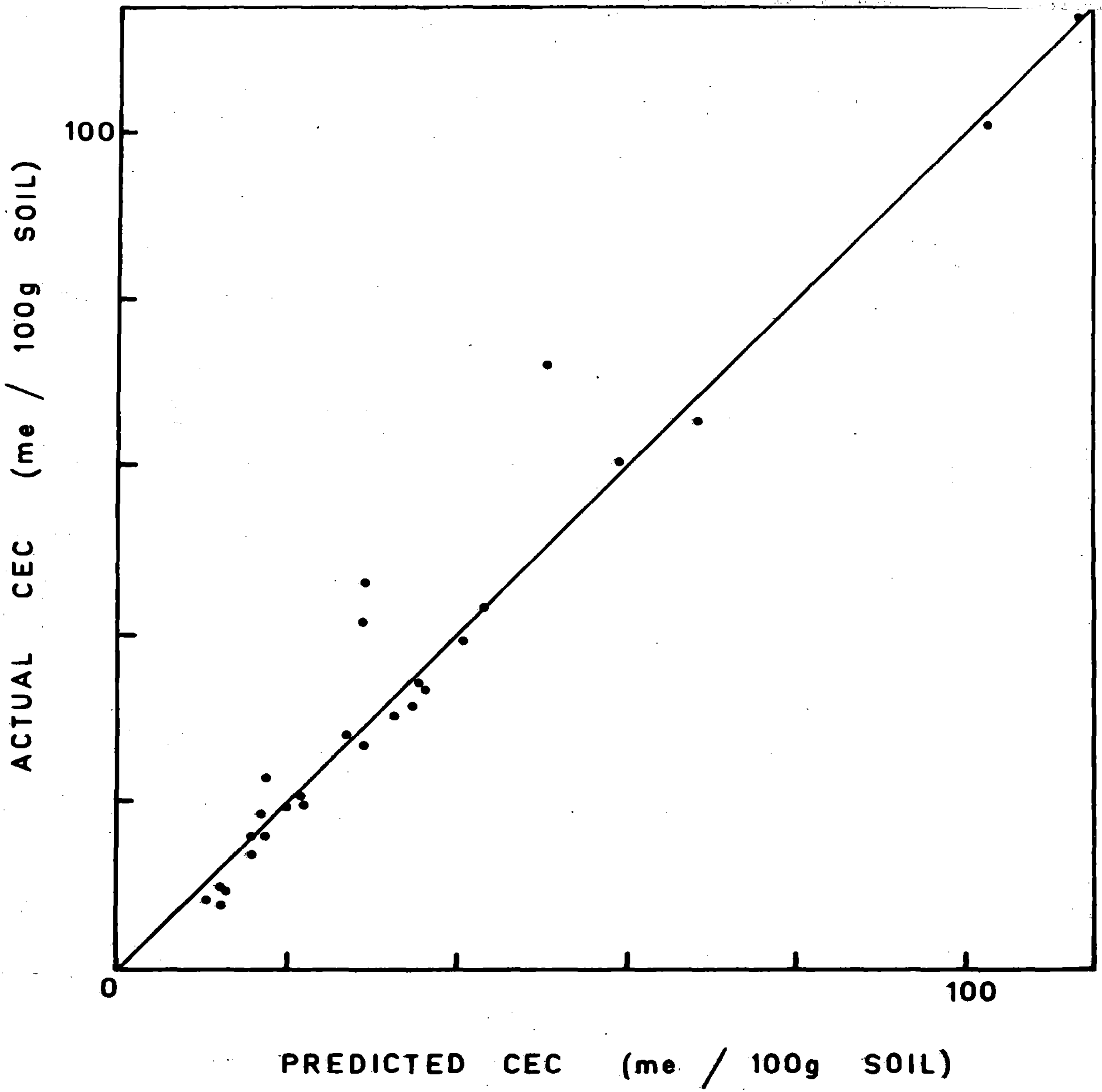


FIGURE 31: SCATTER DIAGRAM SHOWING THE PREDICTABILITY OF CEC BASED ON THE REGRESSION EQUATION RELATING CEC TO % LOSS-ON-IGNITION AND % CLAY - Transects.

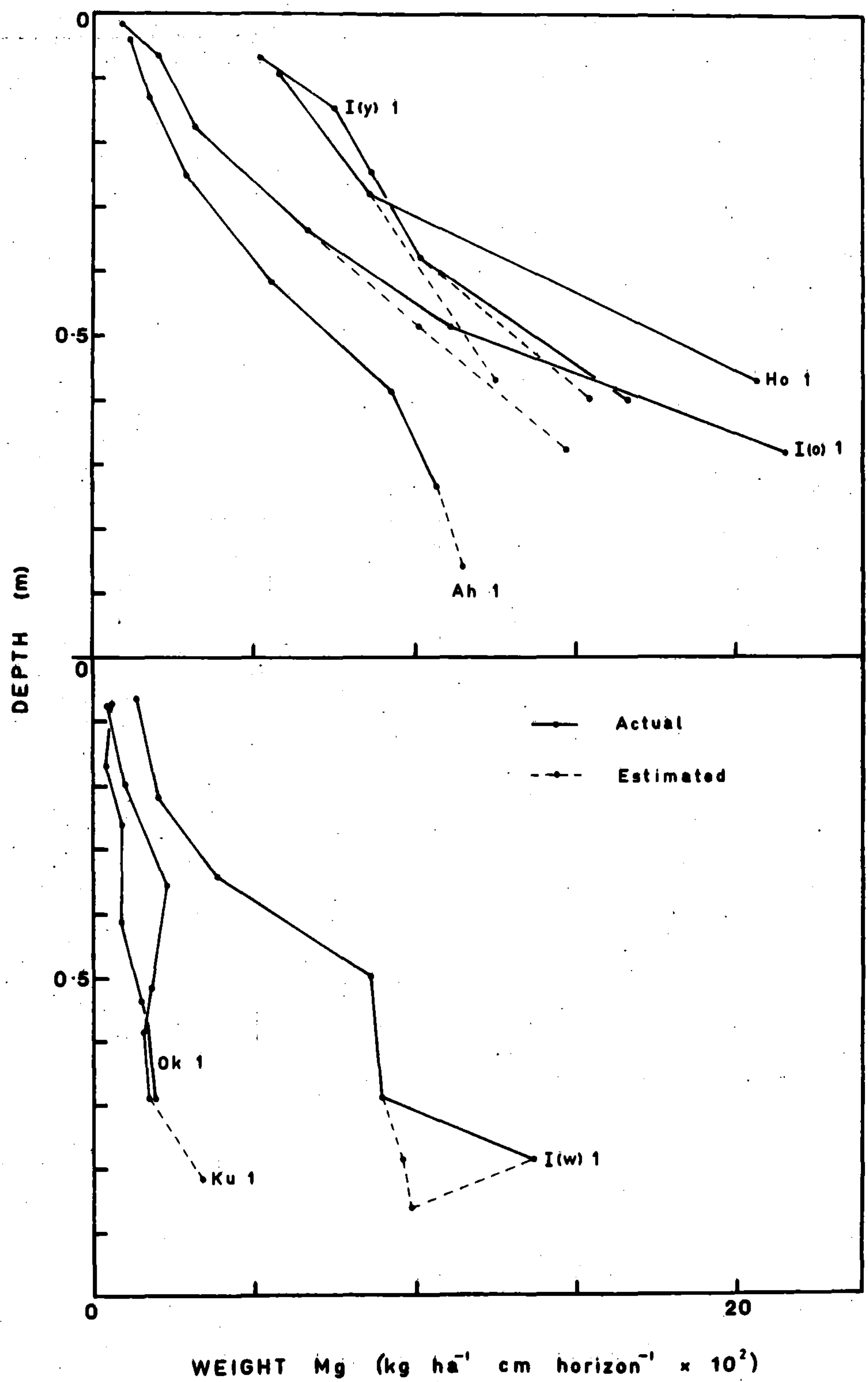


FIGURE 32: TOTAL Mg DEPTH FUNCTIONS - Chronosequence.

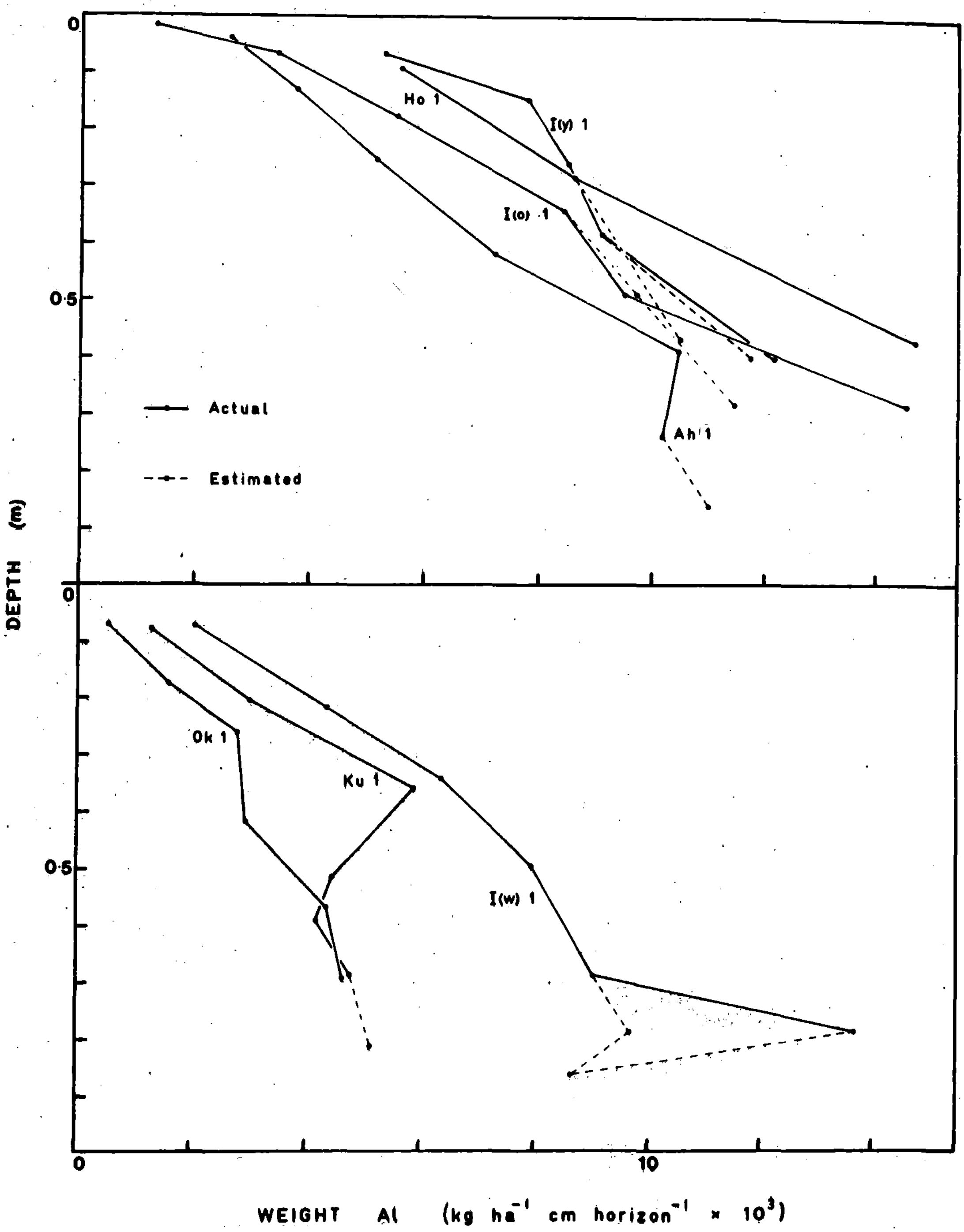


FIGURE 33: TOTAL Al DEPTH FUNCTIONS - Chronosequence.

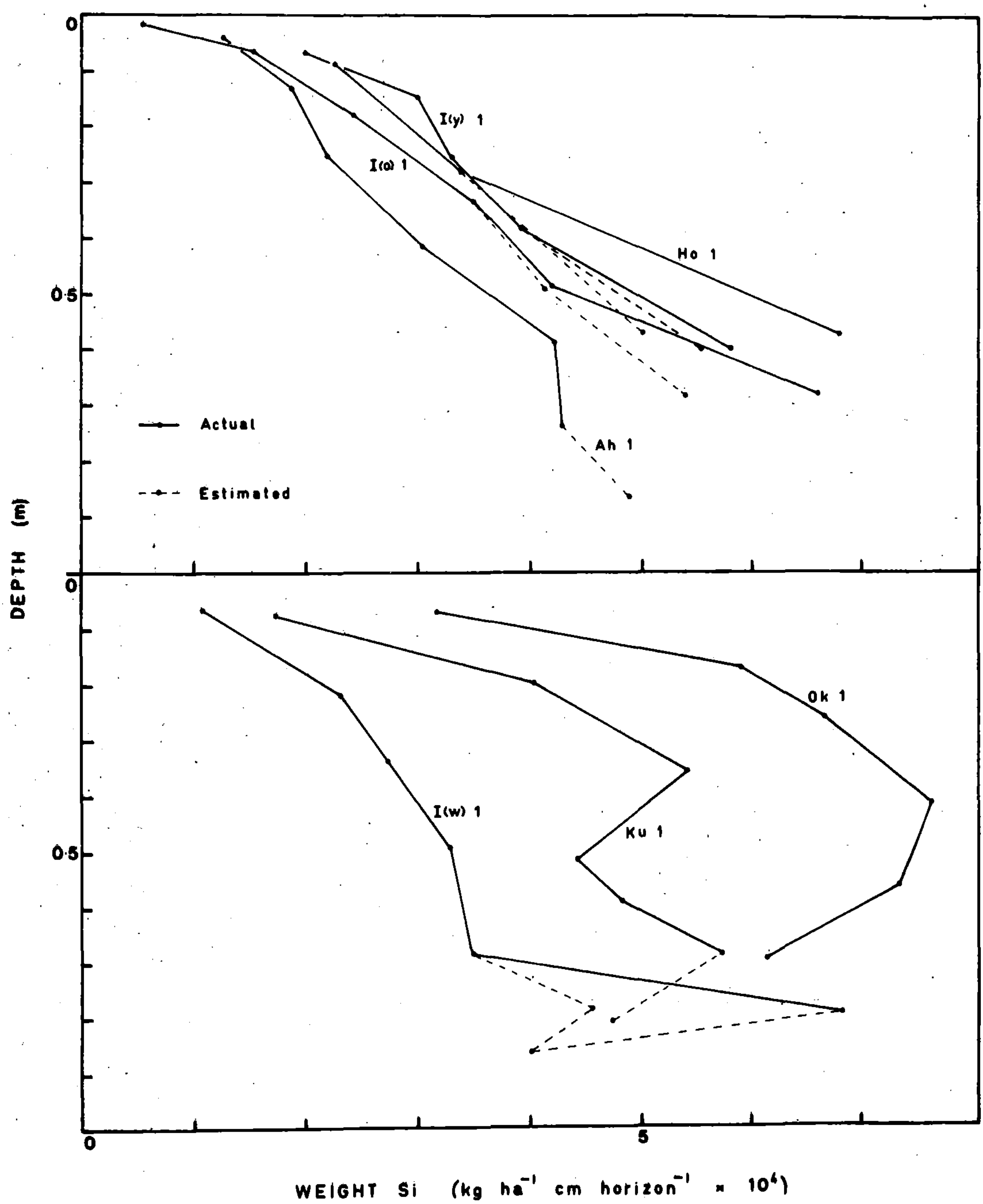


FIGURE 34: TOTAL Si DEPTH FUNCTIONS - Chronosequence.

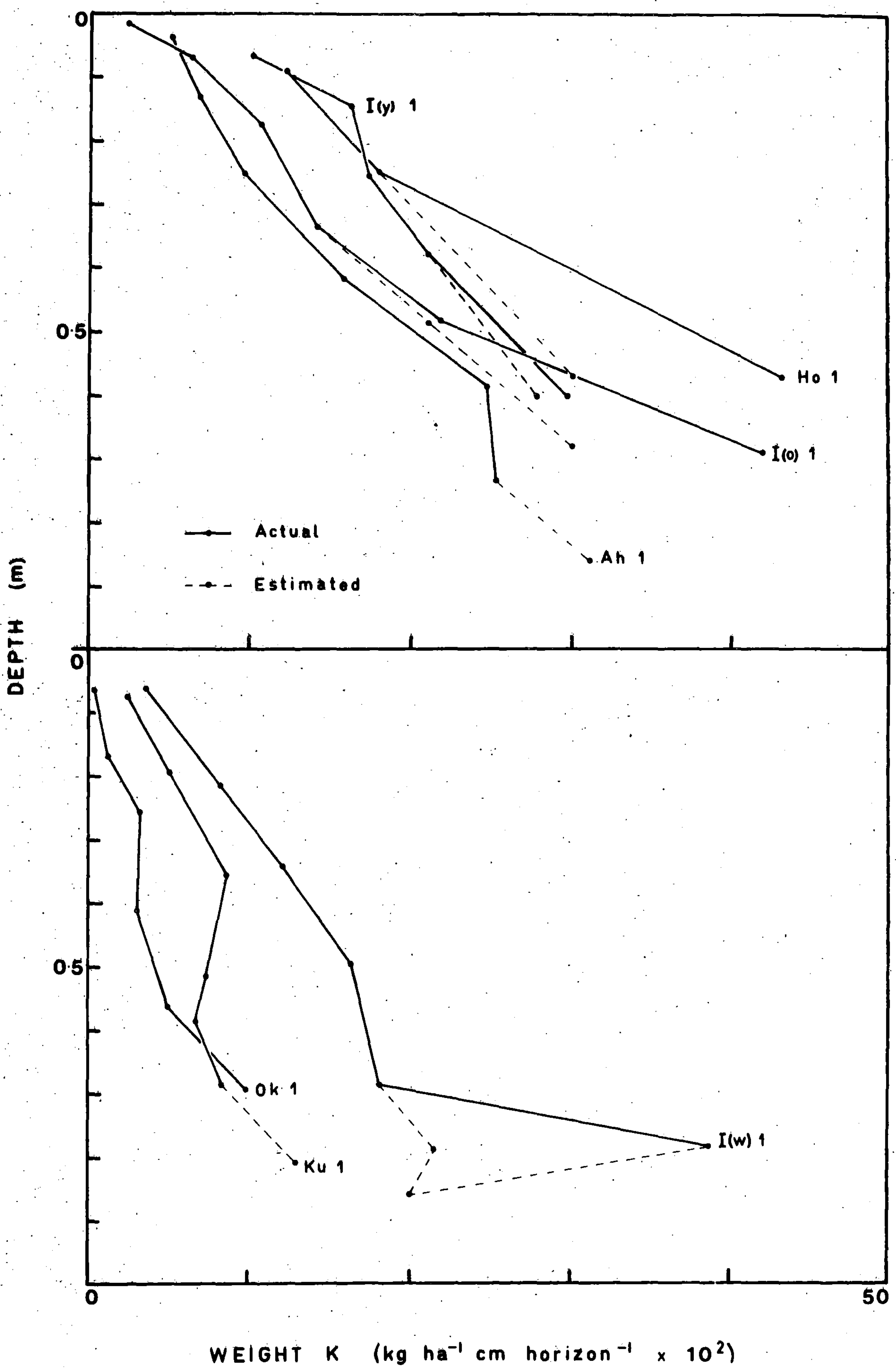


FIGURE 35: TOTAL K DEPTH FUNCTIONS - Chronosequence.

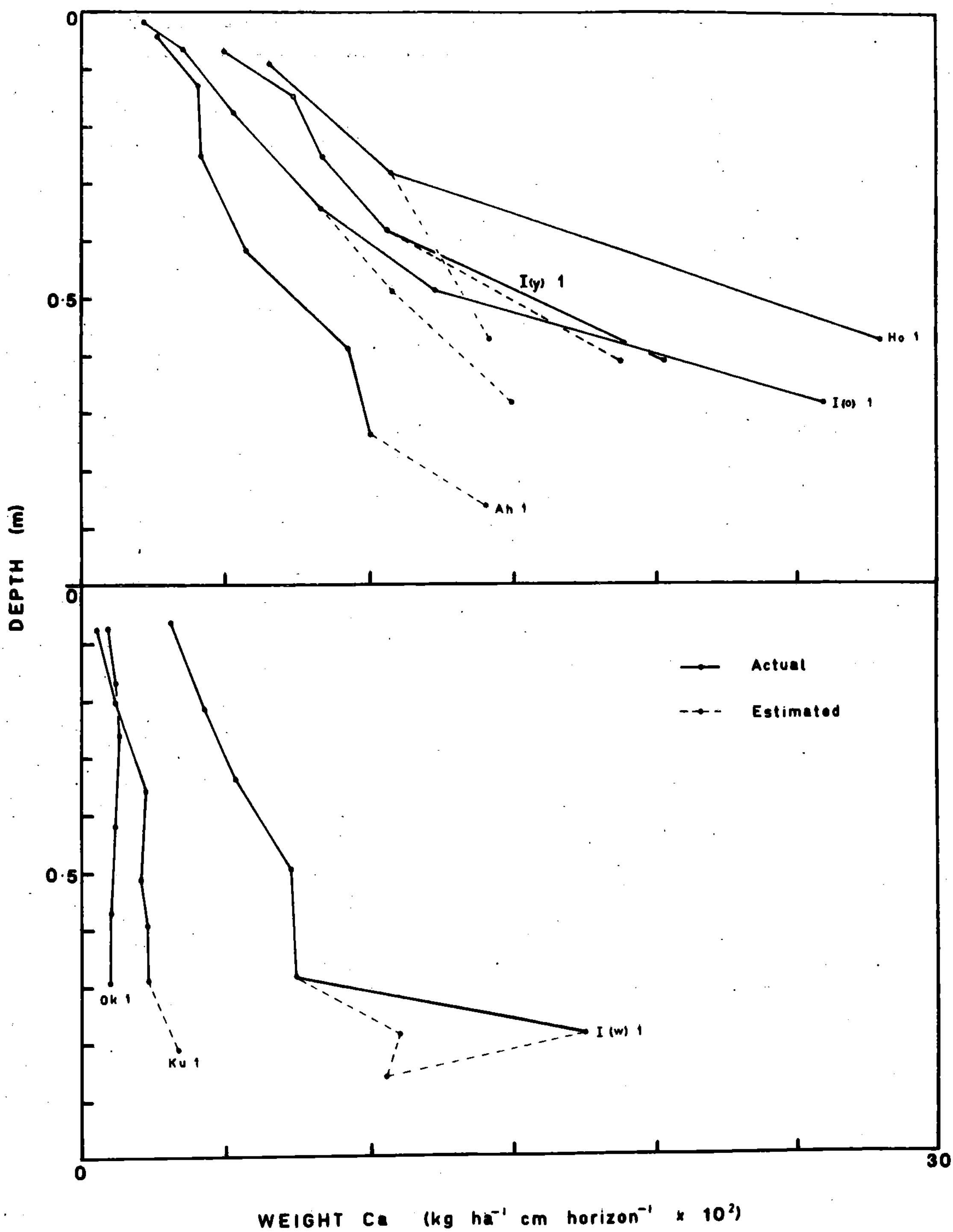


FIGURE 36: TOTAL Ca DEPTH FUNCTIONS - Chronosequence.

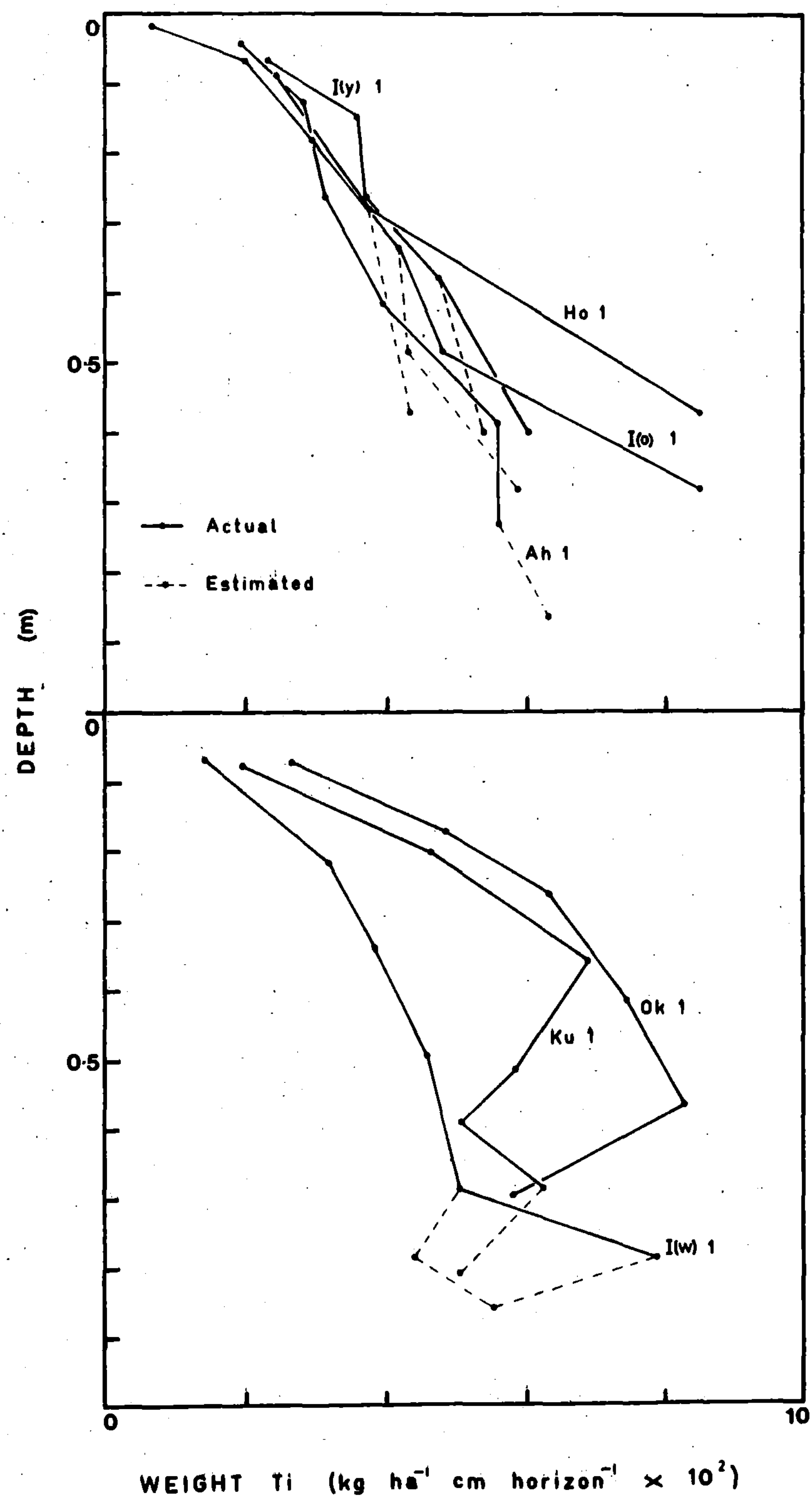


FIGURE 37: TOTAL Ti DEPTH FUNCTIONS - Chronosequence.

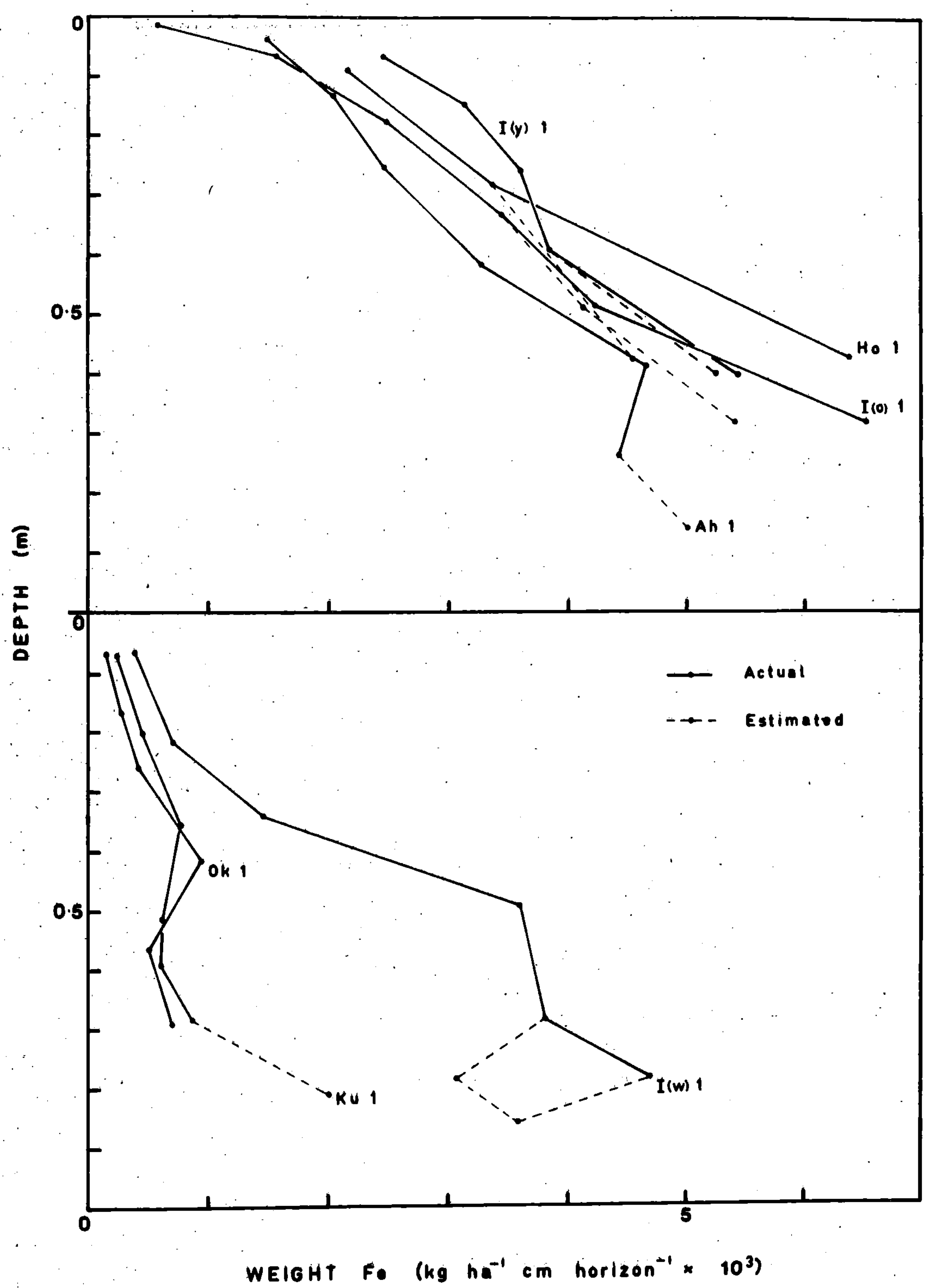


FIGURE 38: TOTAL Fe DEPTH FUNCTIONS - Chronosequence.

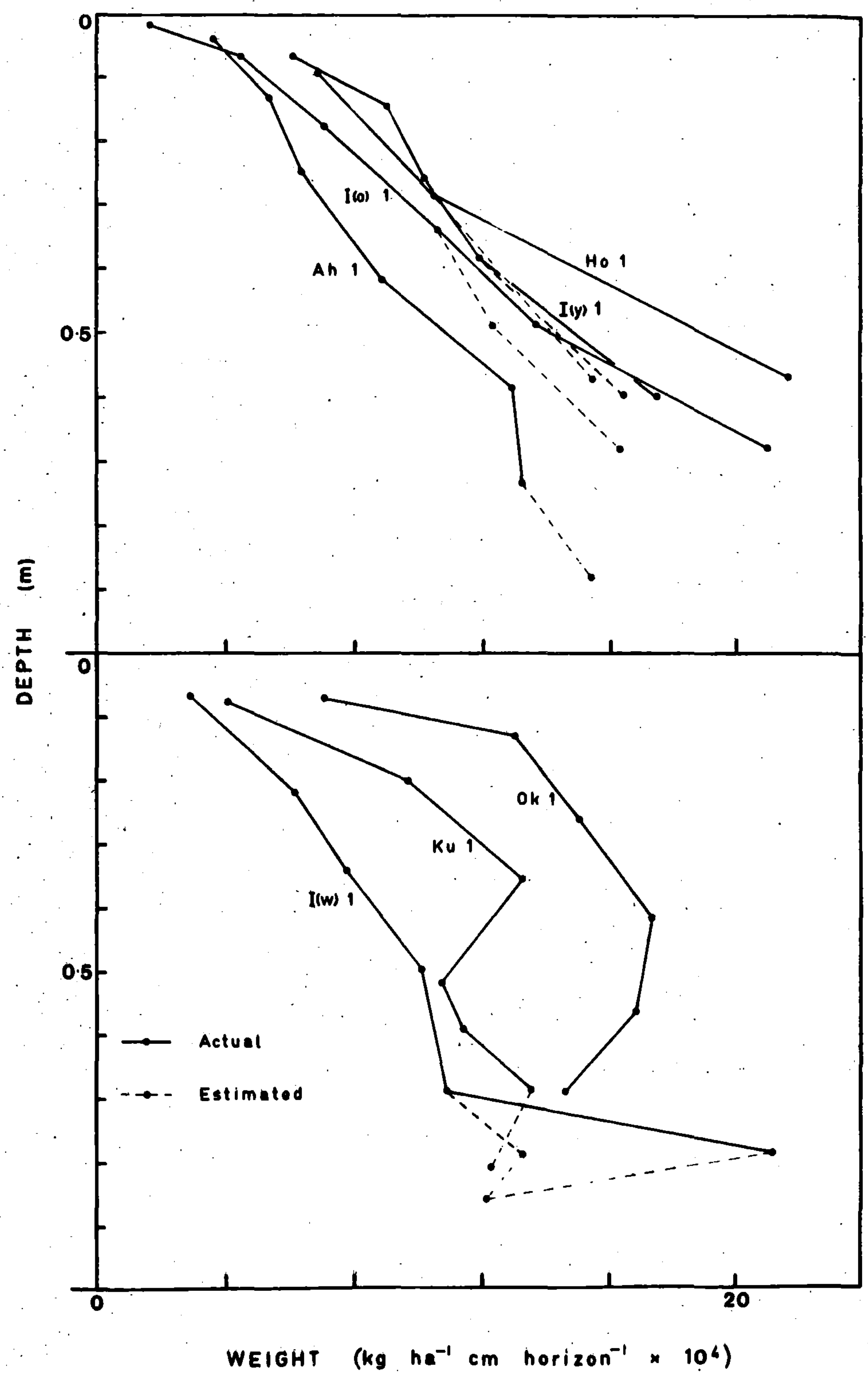


FIGURE 39: INORGANIC MATERIAL DEPTH FUNCTIONS - Chronosequence.

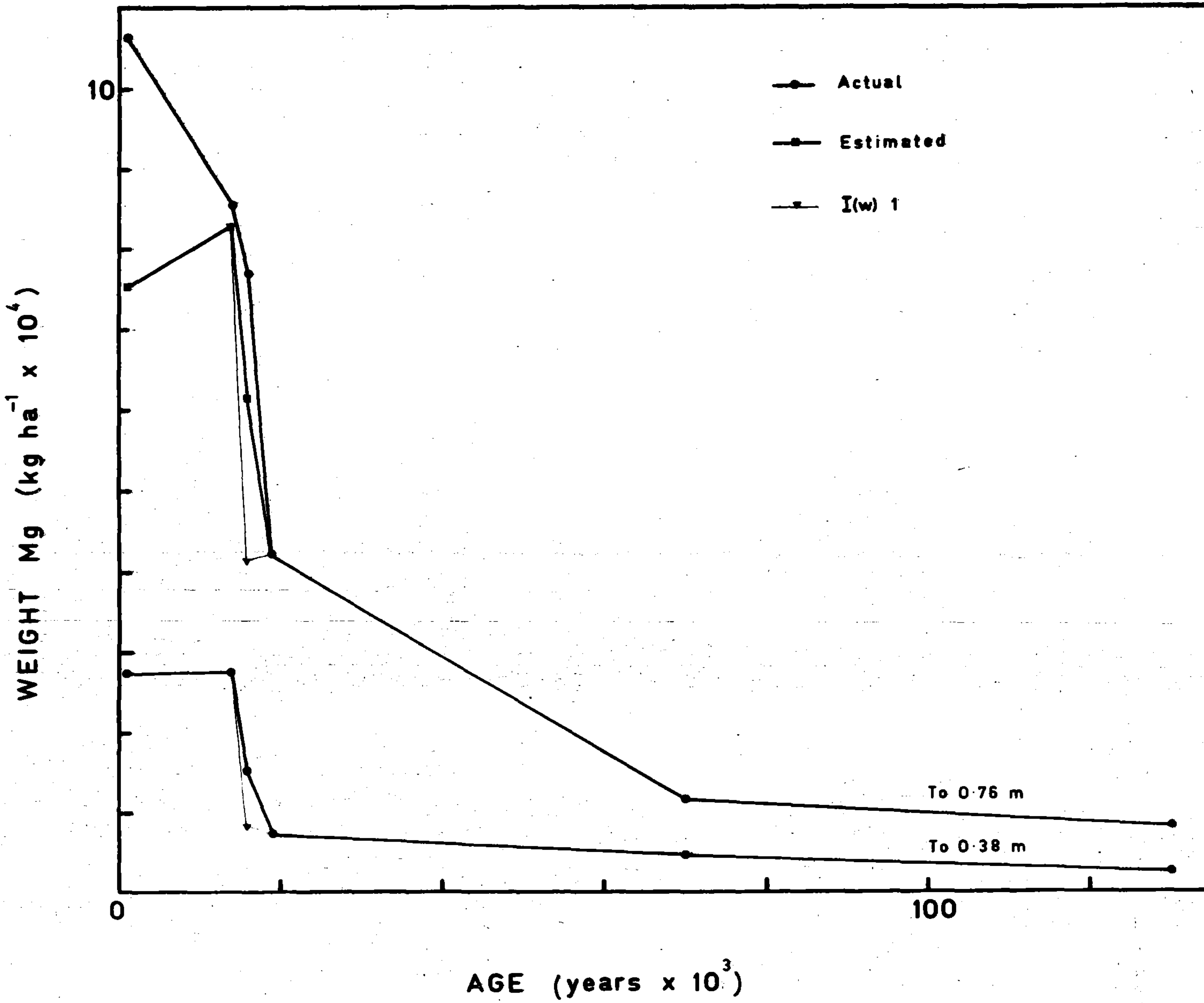


FIGURE 40: VARIATION IN TOTAL Mg WITH TIME.

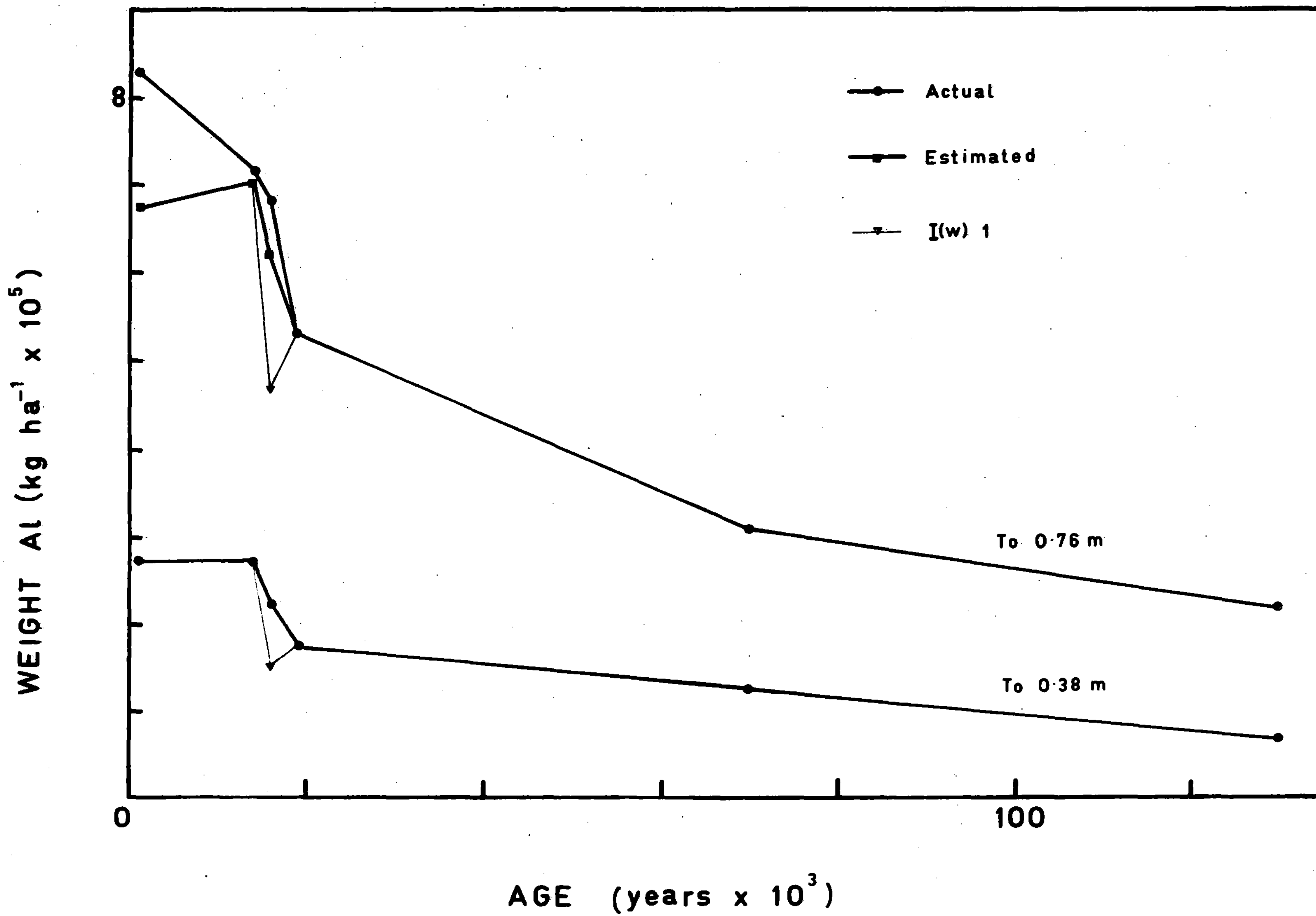


FIGURE 41: VARIATION IN TOTAL Al WITH TIME.

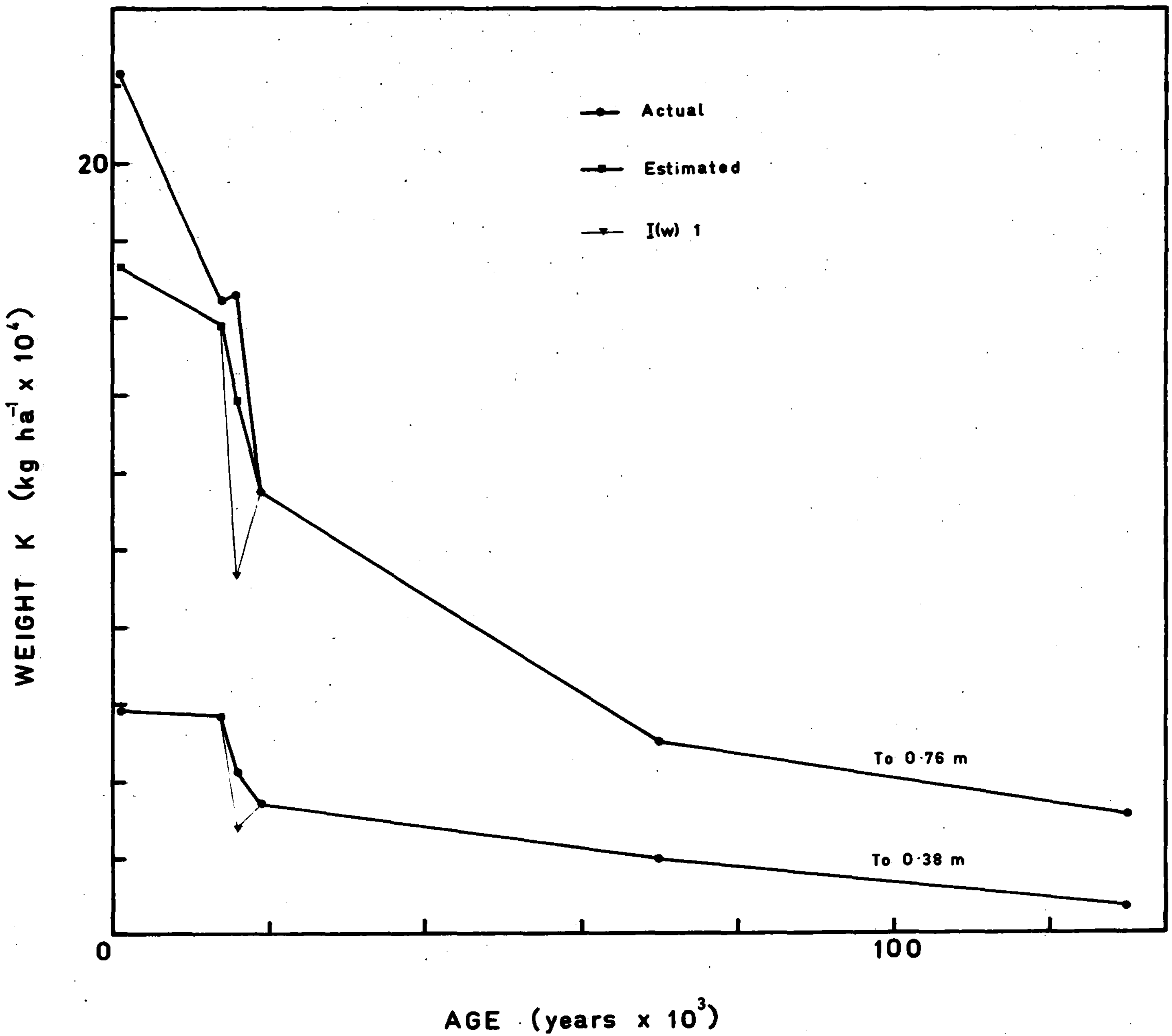


FIGURE 42: VARIATION IN TOTAL K WITH TIME.

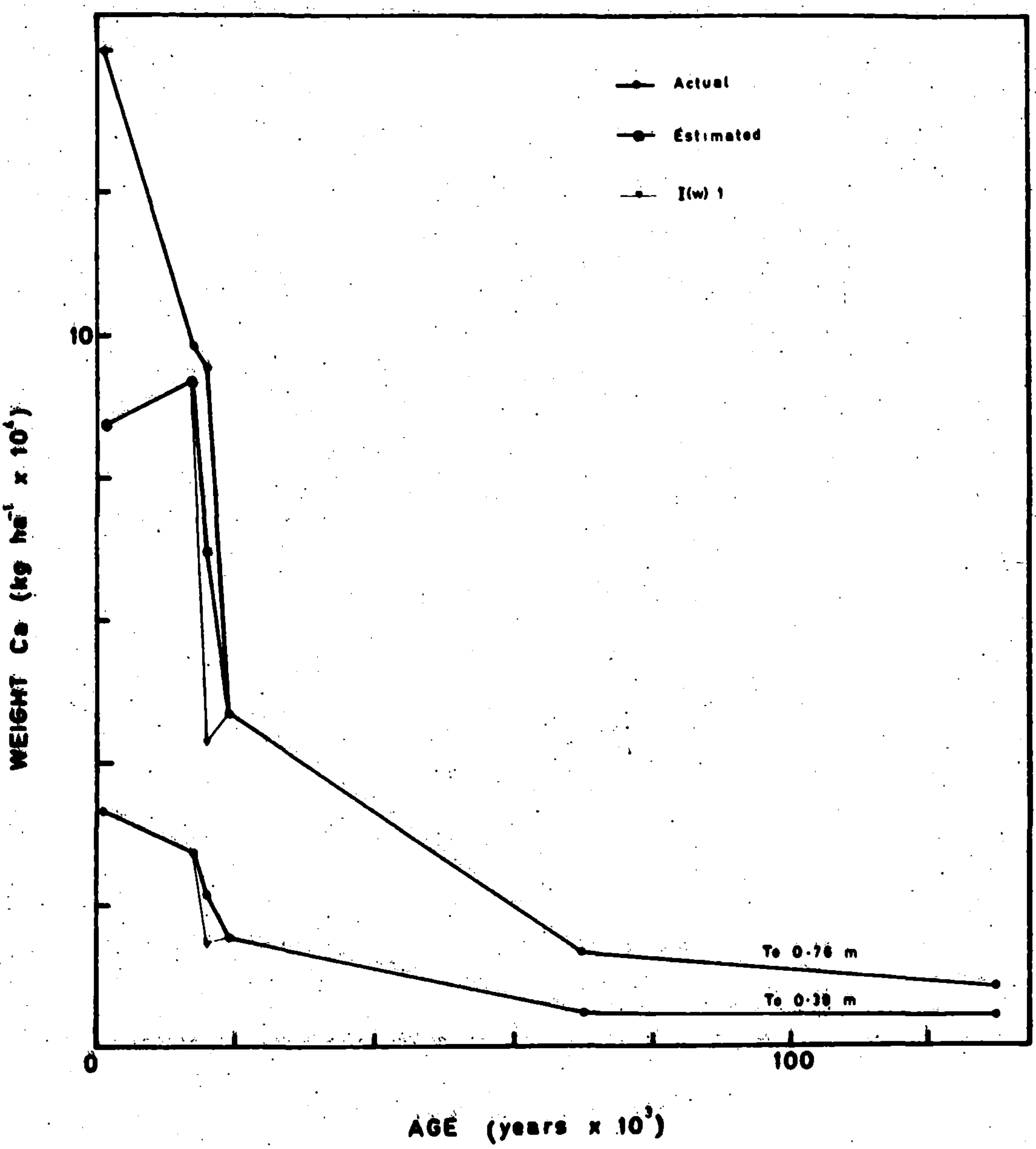


FIGURE 43: VARIATION IN TOTAL Ca WITH TIME.

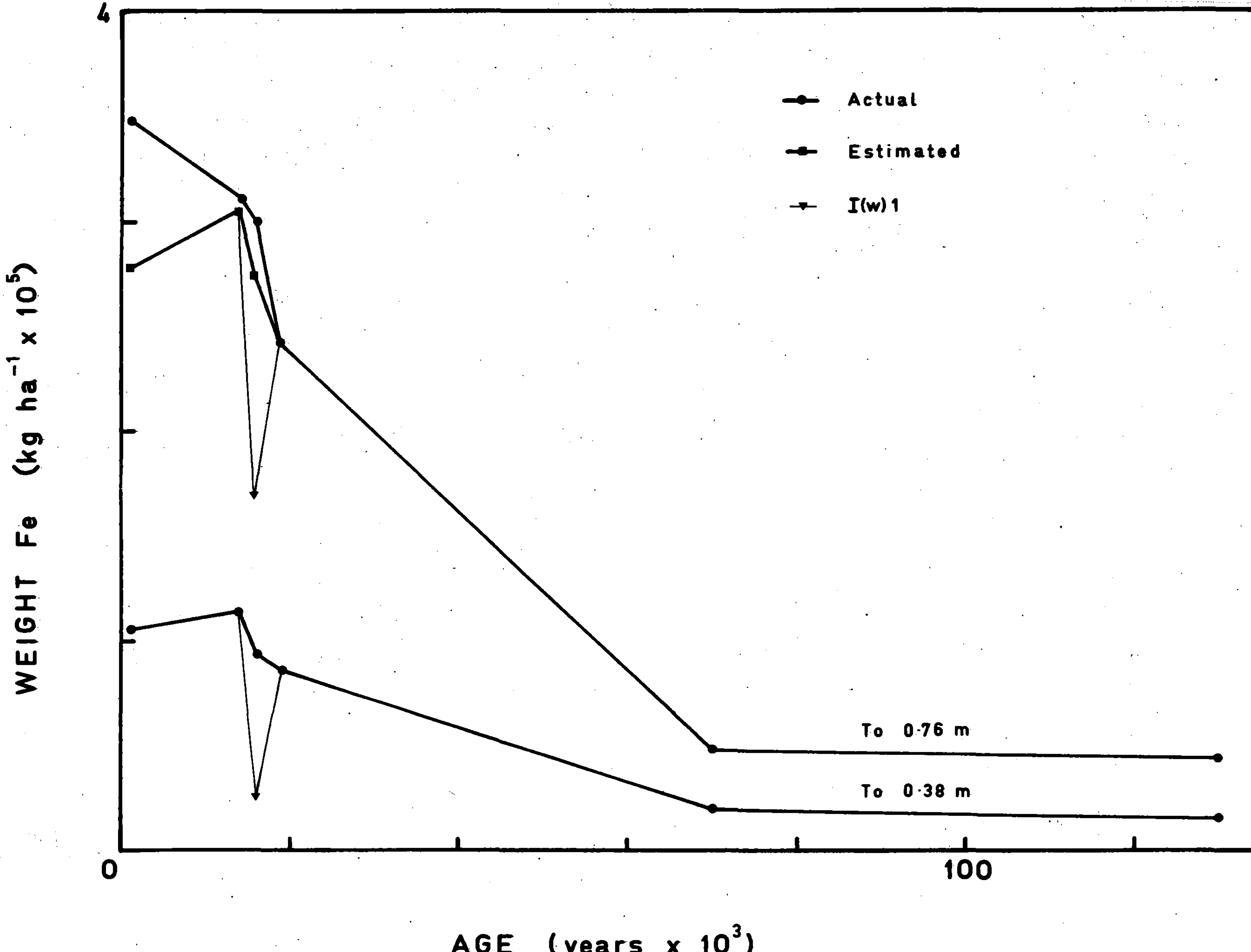


FIGURE 44: VARIATION IN TOTAL Fe WITH TIME.

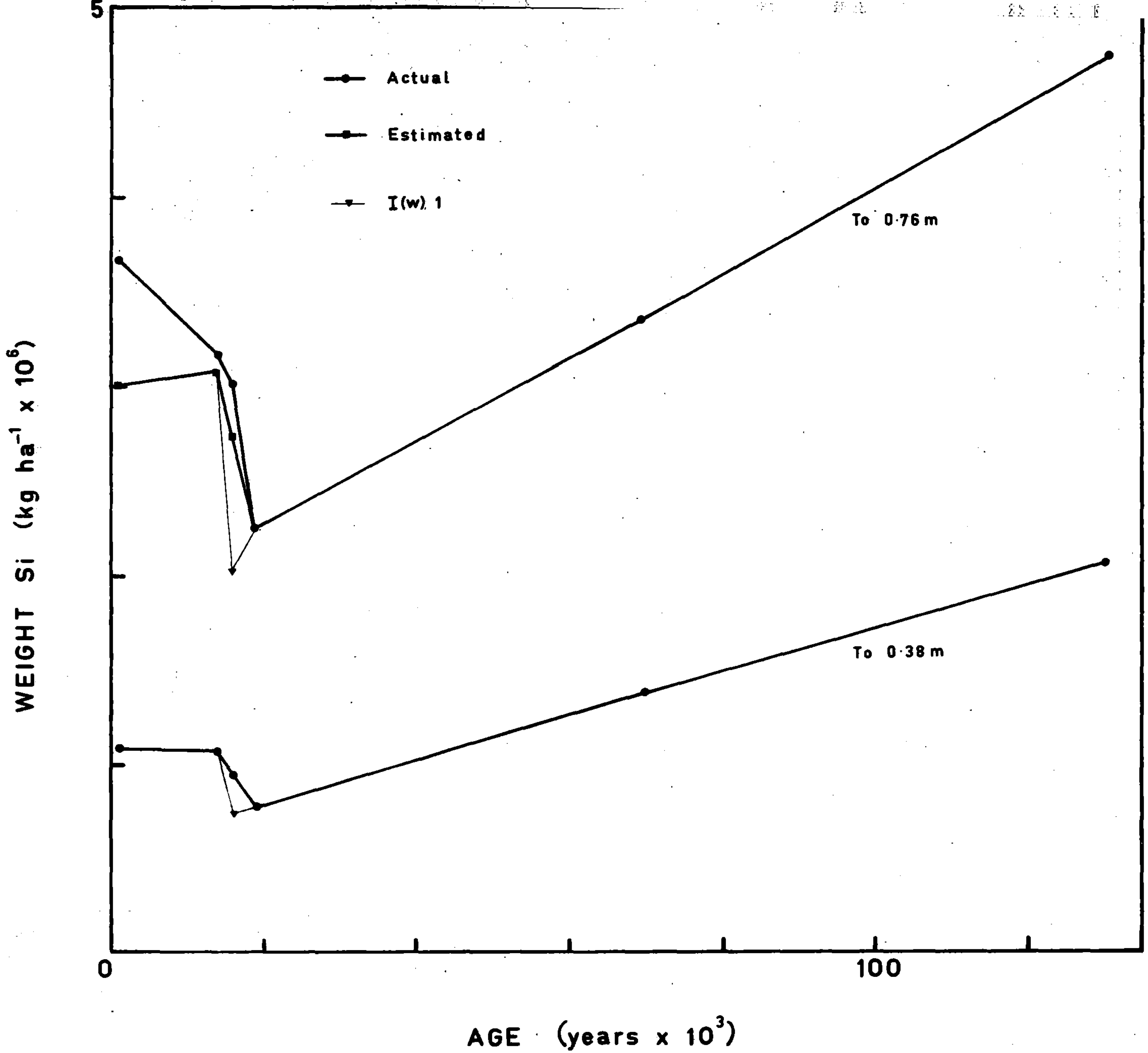


FIGURE 45: VARIATION IN TOTAL Si WITH TIME.

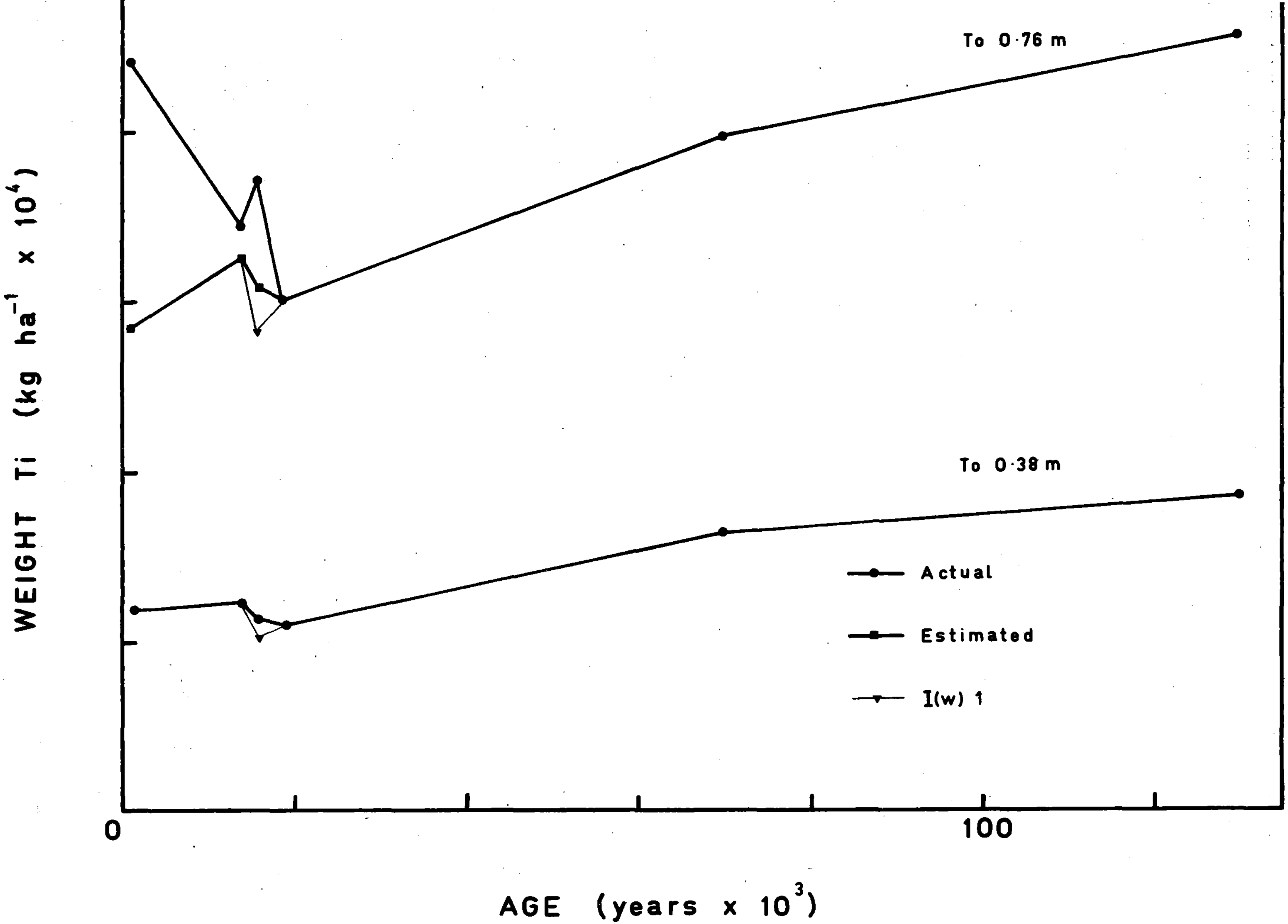


FIGURE 46: VARIATION IN TOTAL Ti WITH TIME.

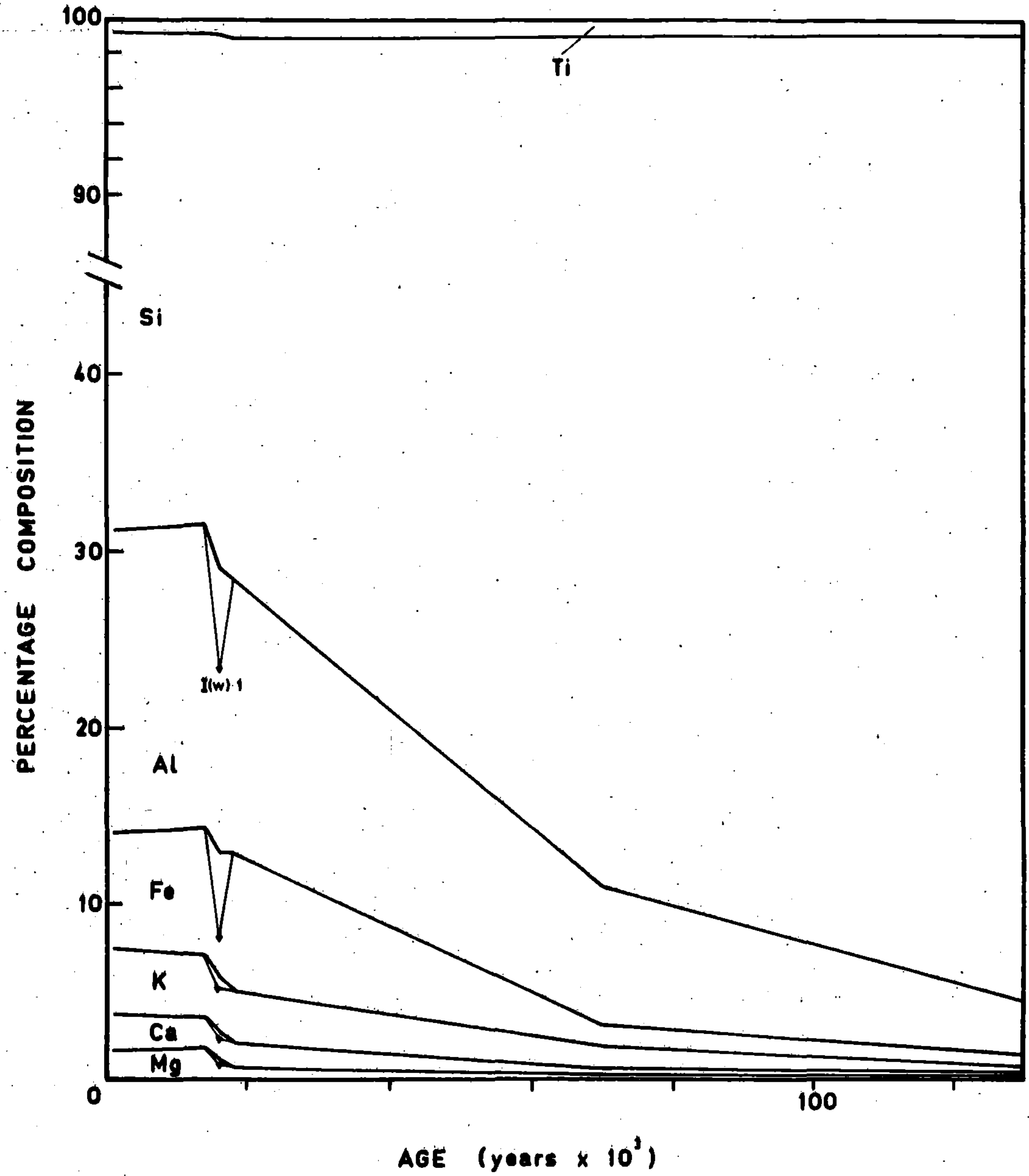


FIGURE 47: CHANGES IN ELEMENTAL % COMPOSITION WITH TIME.

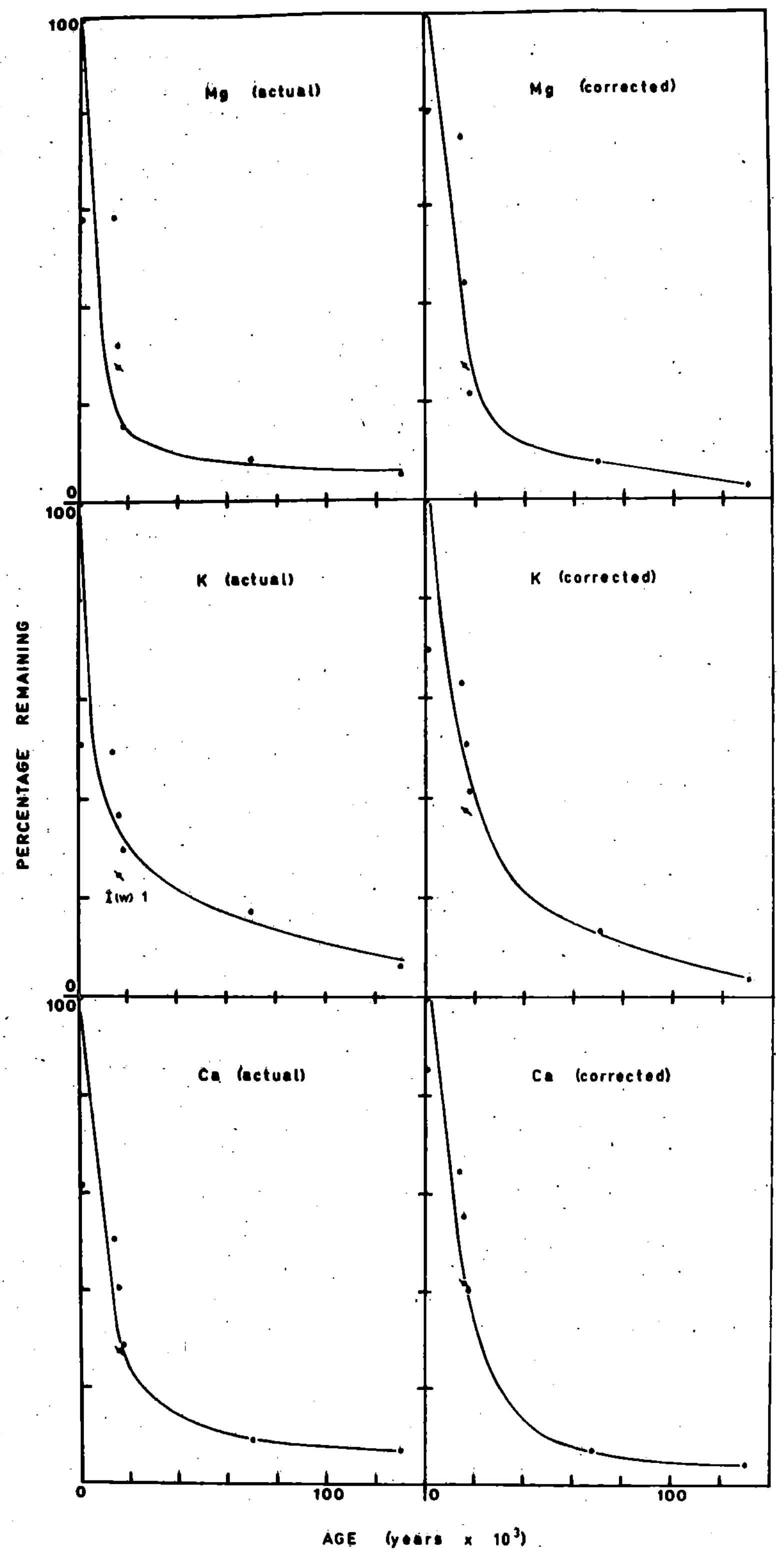


FIGURE 48: LOSS OF TOTAL Mg, K AND Ca WITH TIME.

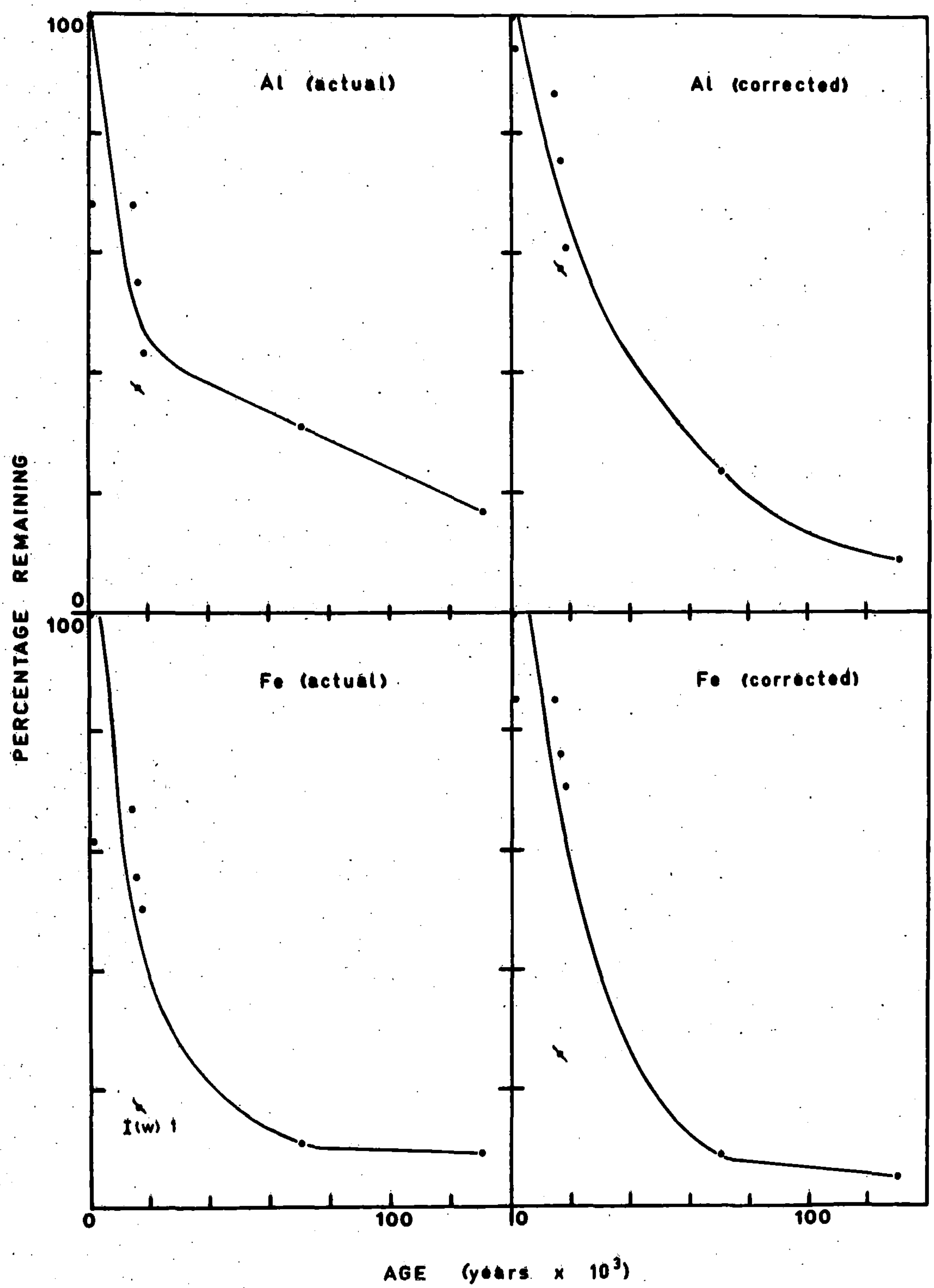


FIGURE 49: LOSS OF TOTAL Al AND Fe WITH TIME.

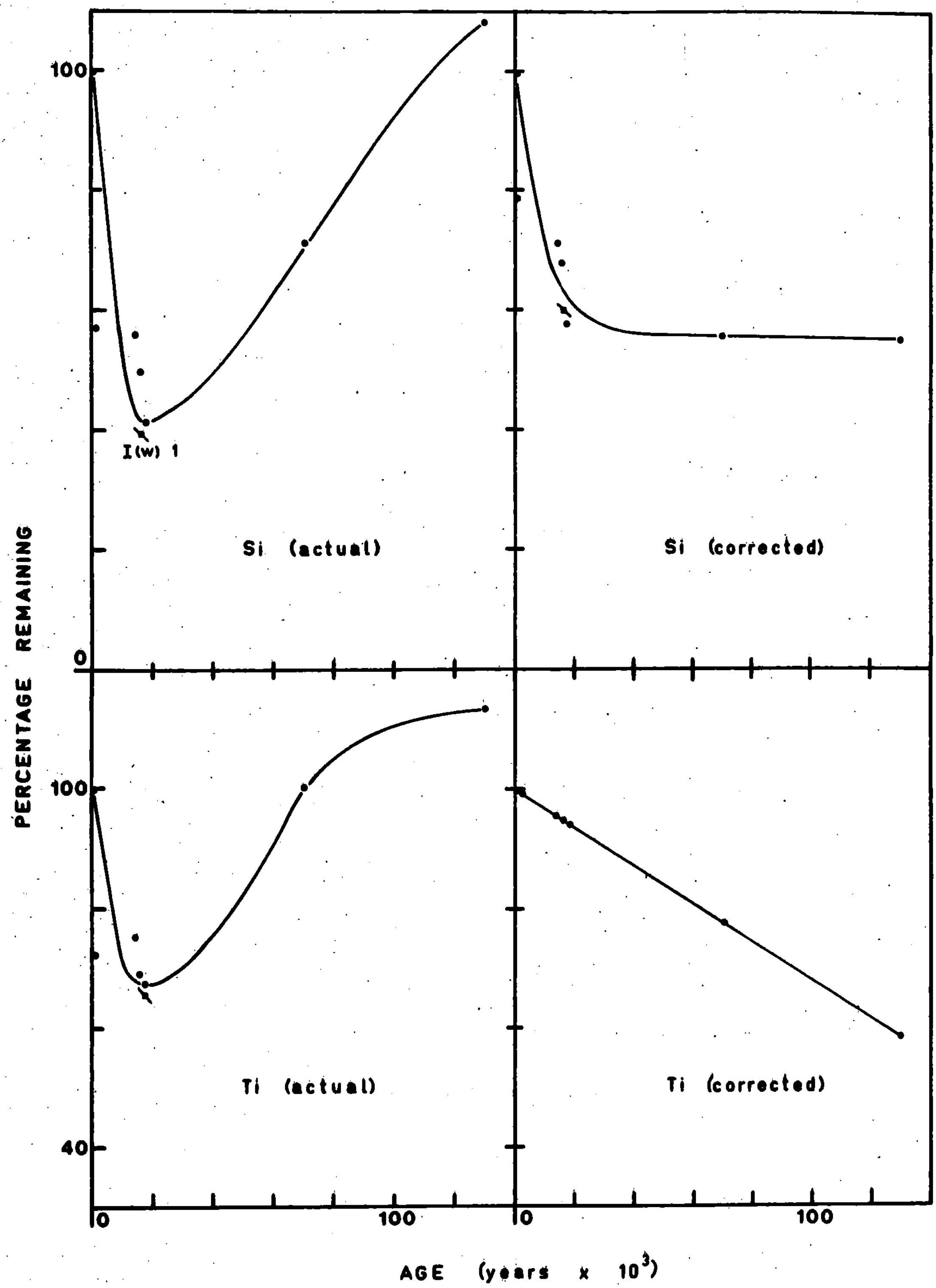


FIGURE 50: LOSS OF TOTAL Si AND Ti WITH TIME.

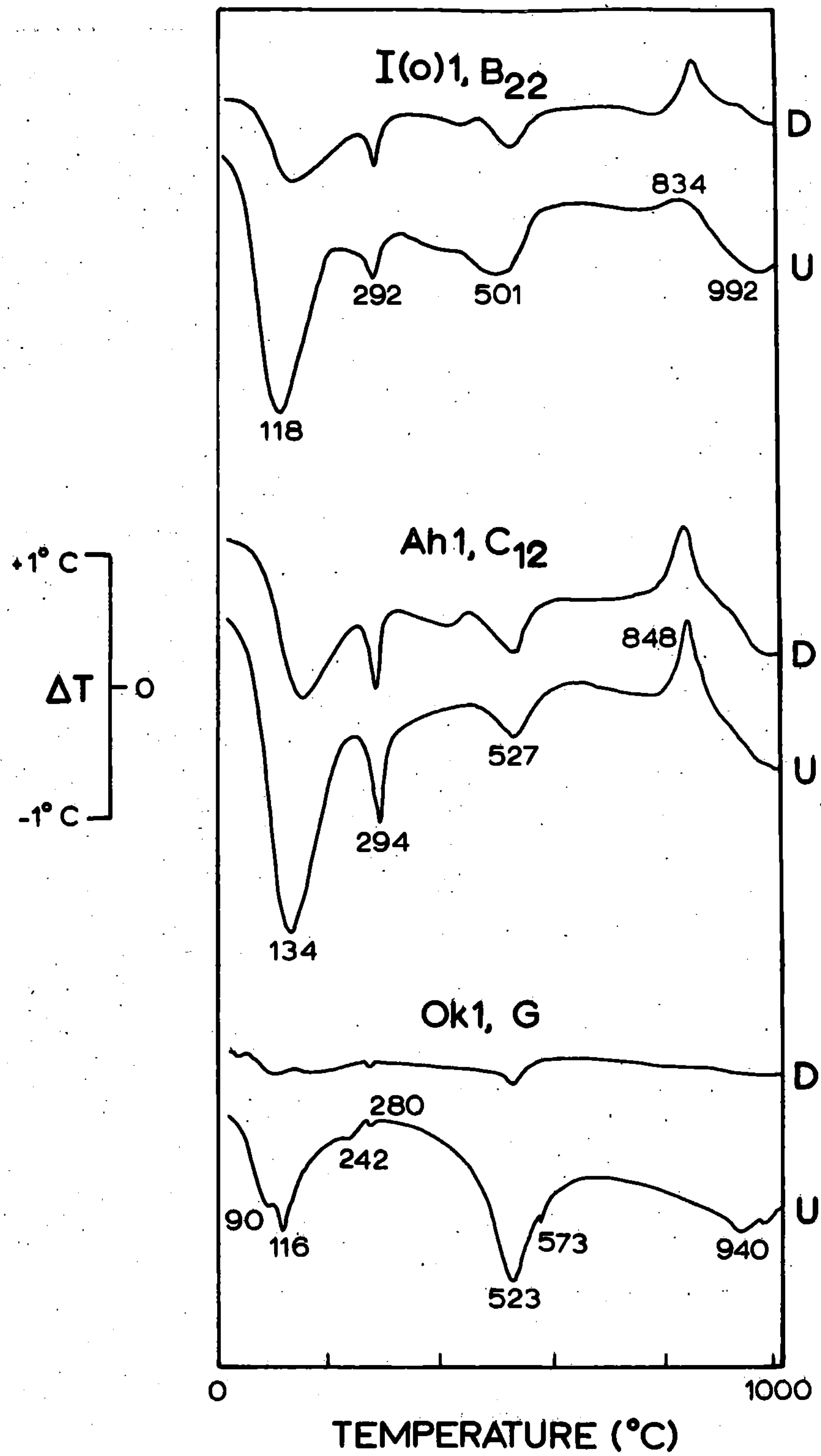


FIGURE 51: USE OF DIFFERENTIAL DTA TO DETERMINE MATERIAL EXTRACTED BY TREATMENT WITH 0.85 MOLAR NaF FOR 2 MINUTES.

(D, differential DTA; U, untreated sample).

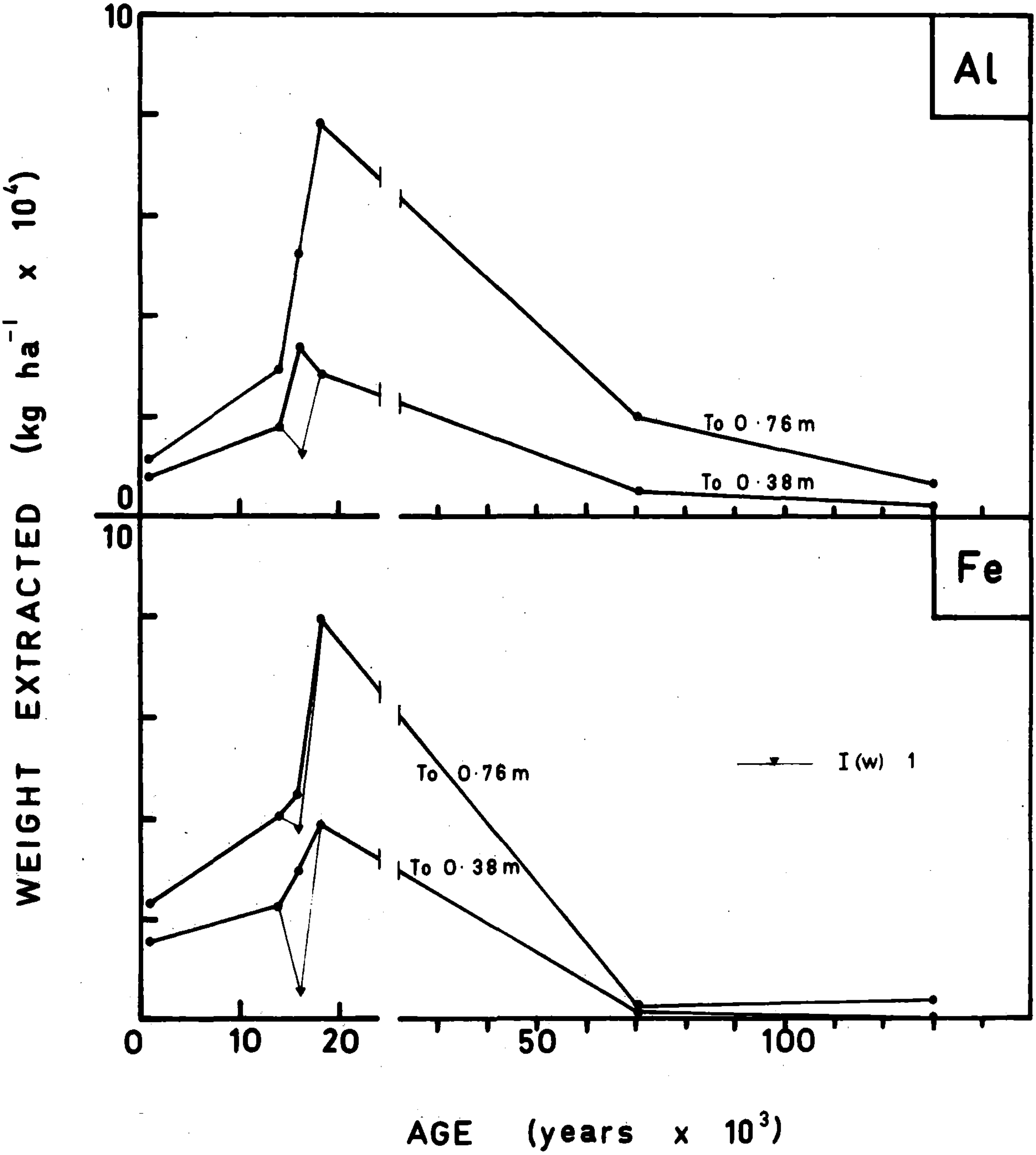


FIGURE 52: VARIATION IN OXALATE-EXTRACTABLE Al AND Fe WITH TIME.

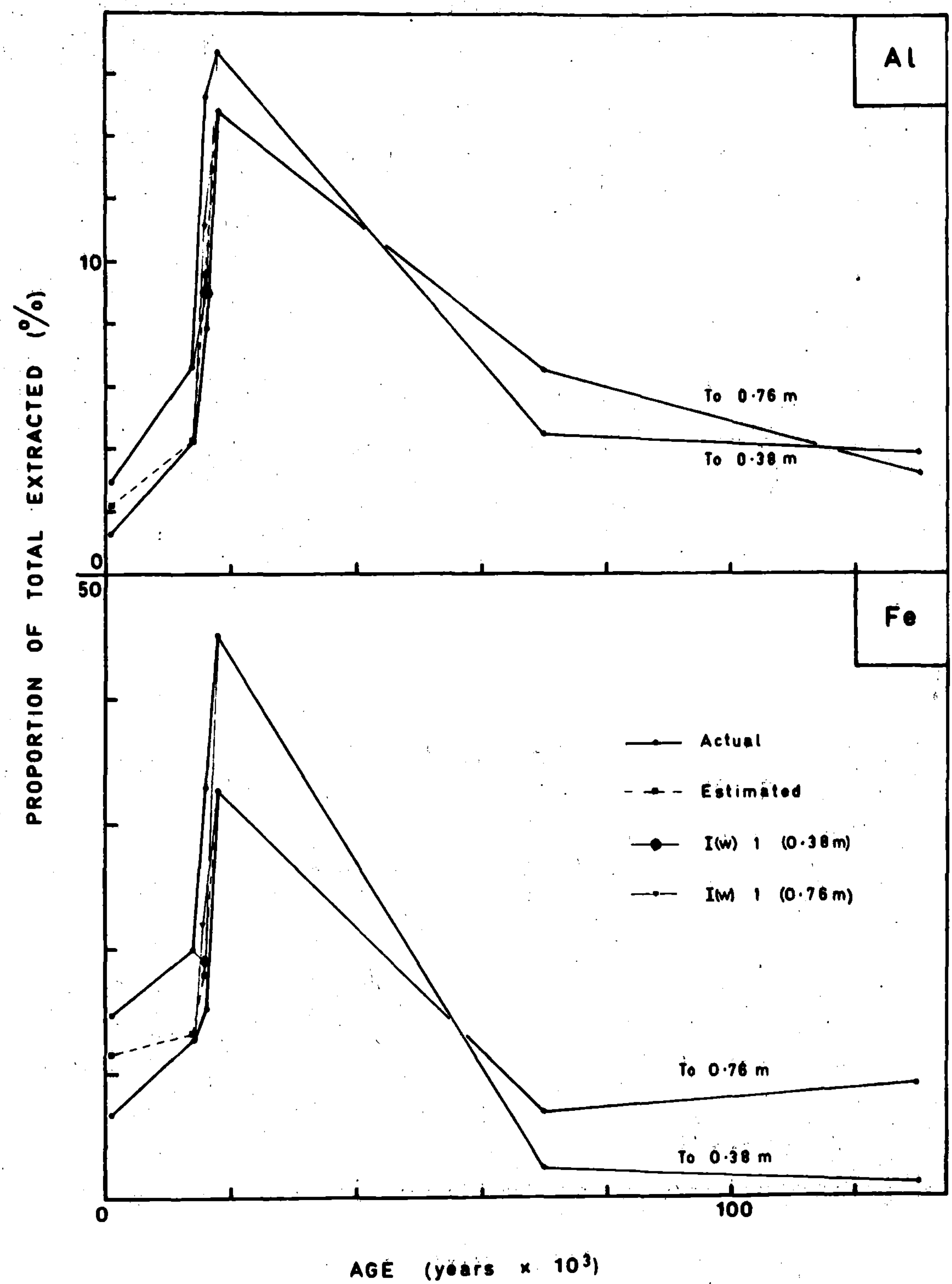


FIGURE 53: VARIATION IN % OF TOTAL Al AND Fe THAT IS OXALATE-EXTRACTABLE WITH TIME.

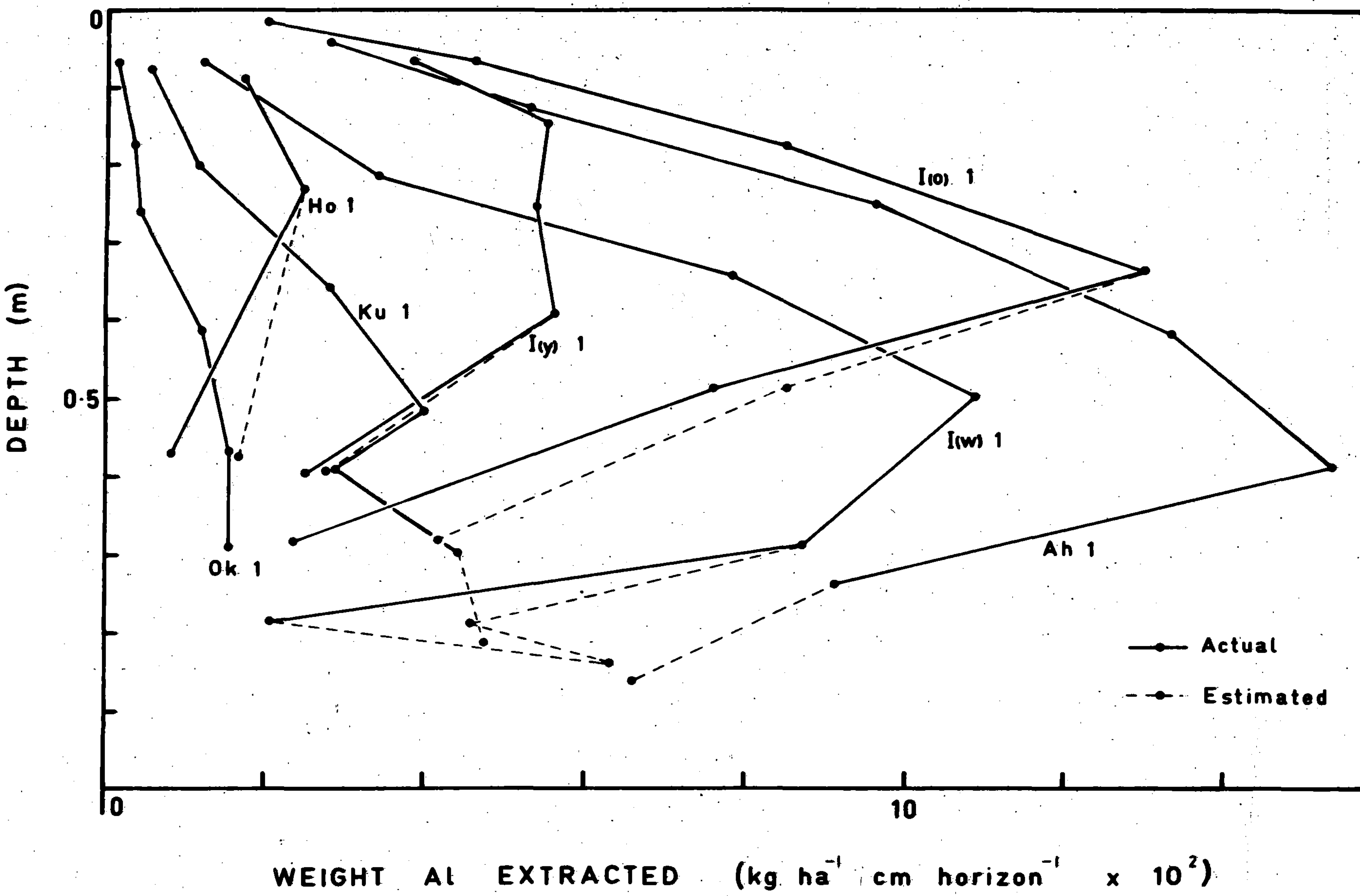


FIGURE 54: OXALATE-EXTRACTABLE Al DEPTH FUNCTIONS - Chronosequence.

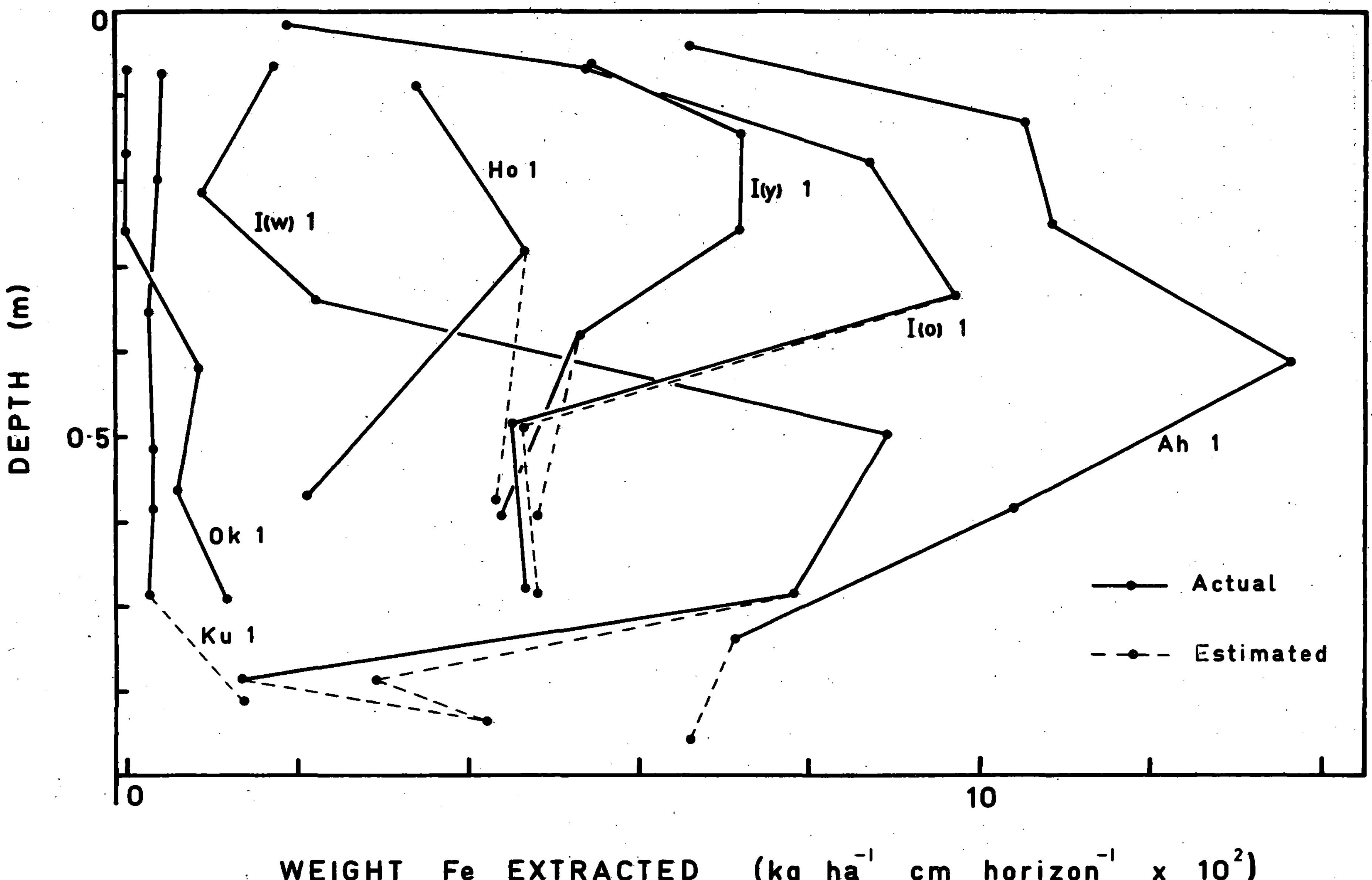


FIGURE 55: OXALATE-EXTRACTABLE Fe DEPTH FUNCTIONS - Chronosequence.

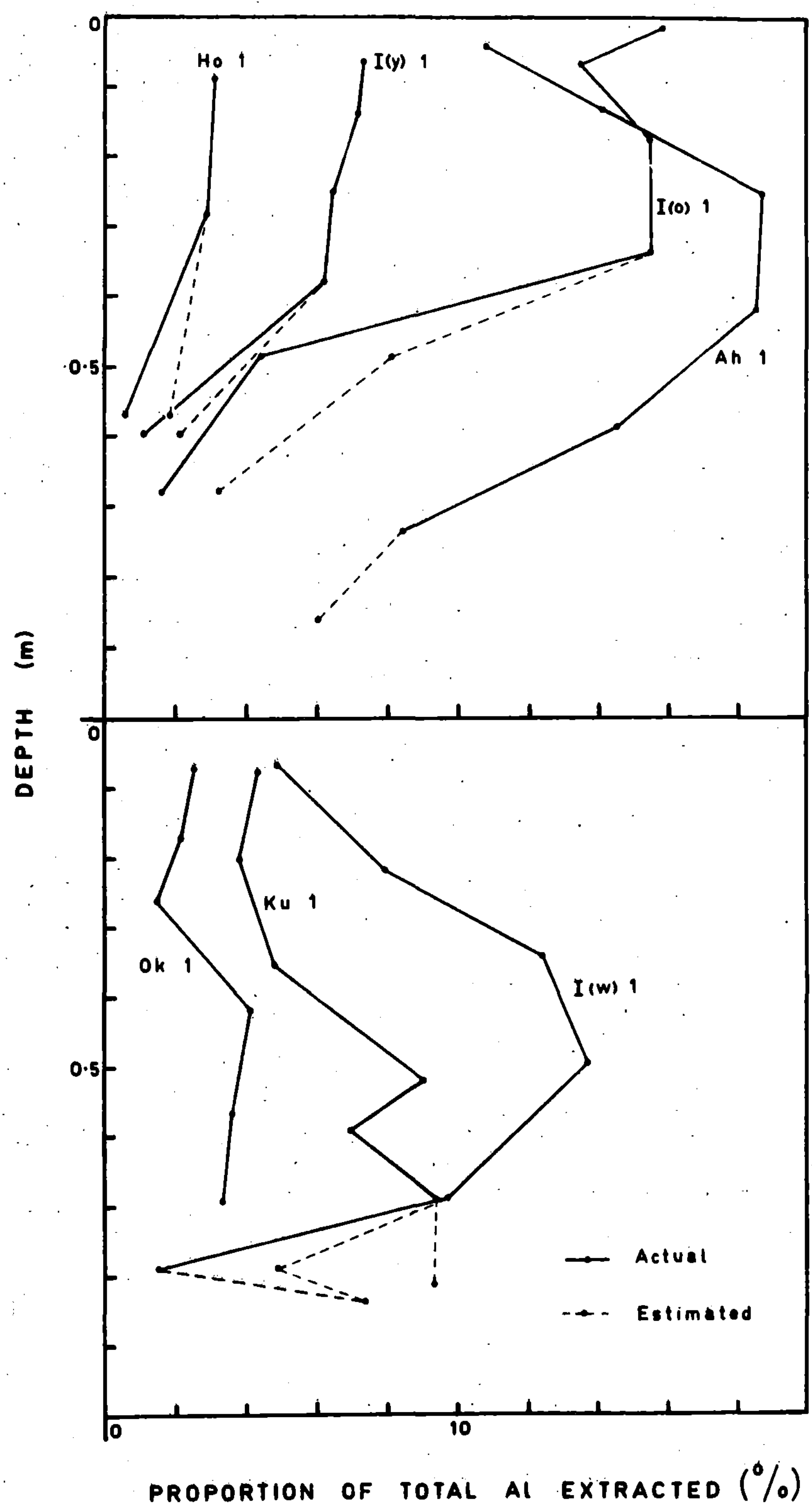


FIGURE 56: DEPTH FUNCTIONS OF % OF TOTAL Al THAT IS OXALATE-EXTRACTABLE - Chronosequence.

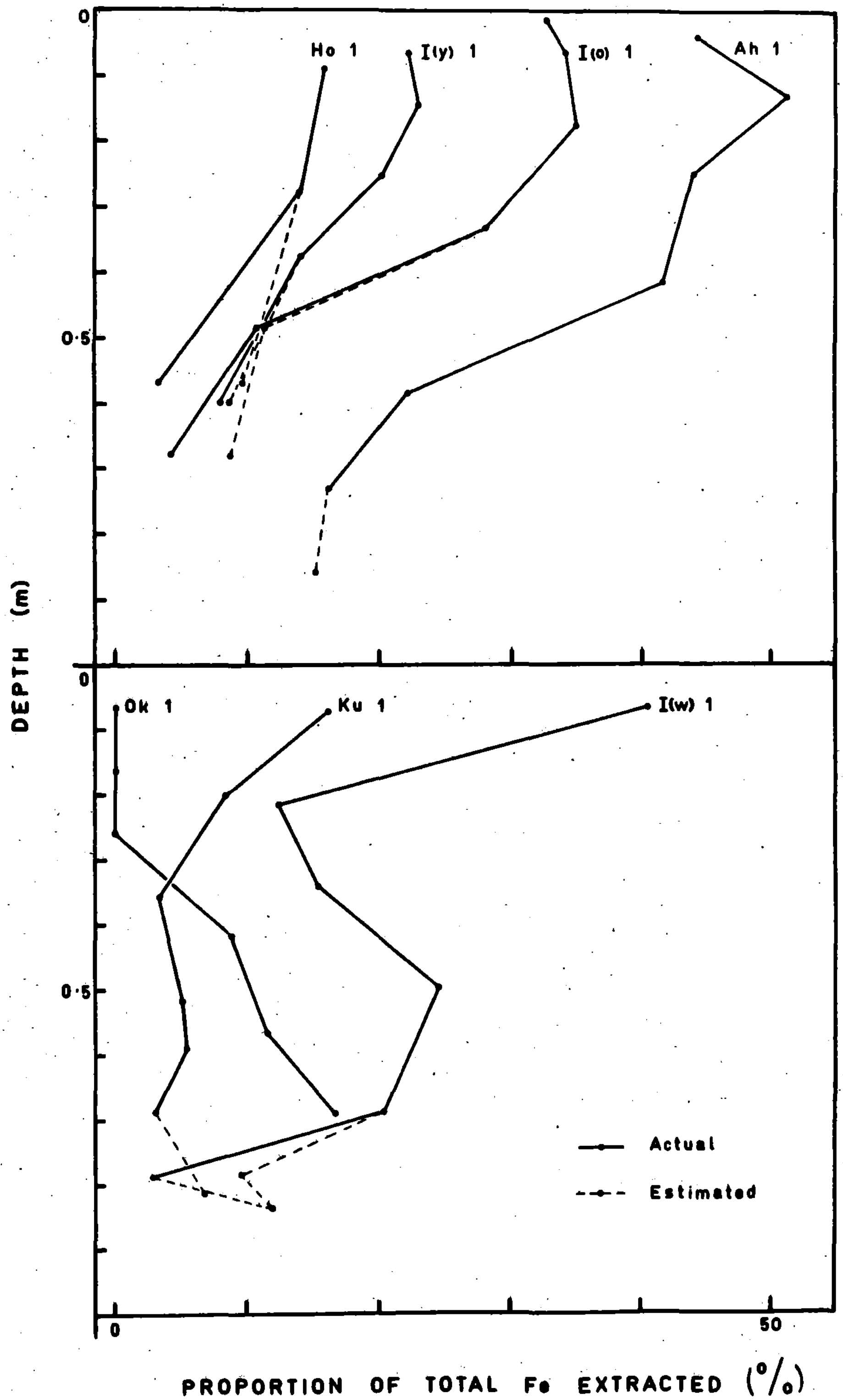


FIGURE 57: DEPTH FUNCTIONS OF % OF TOTAL Fe THAT IS OXALATE-EXTRACTABLE - Chronosequence.

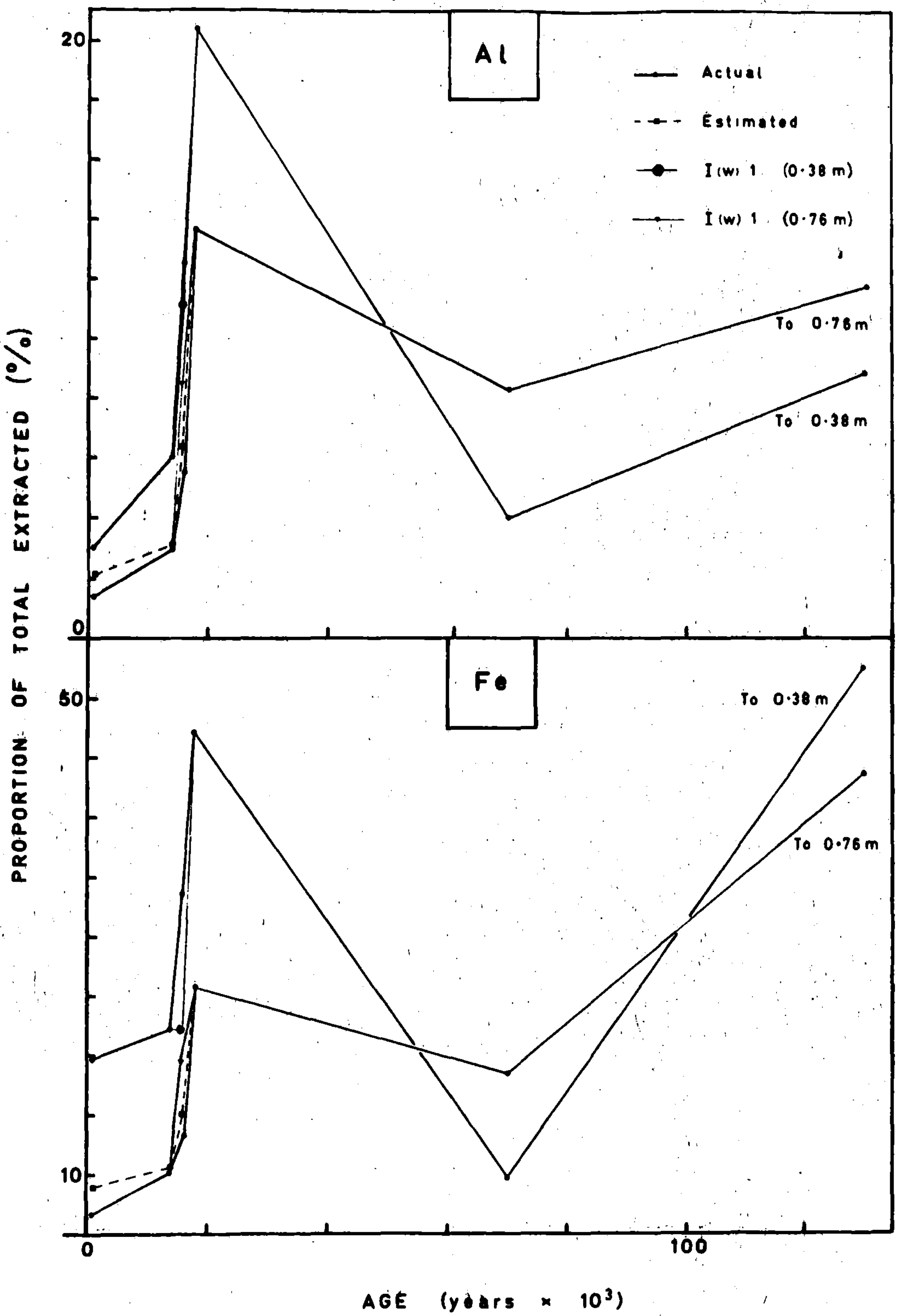


FIGURE 59: VARIATION IN % OF TOTAL Al AND Fe THAT IS PYROPHOSPHATE-EXTRACTABLE WITH TIME.

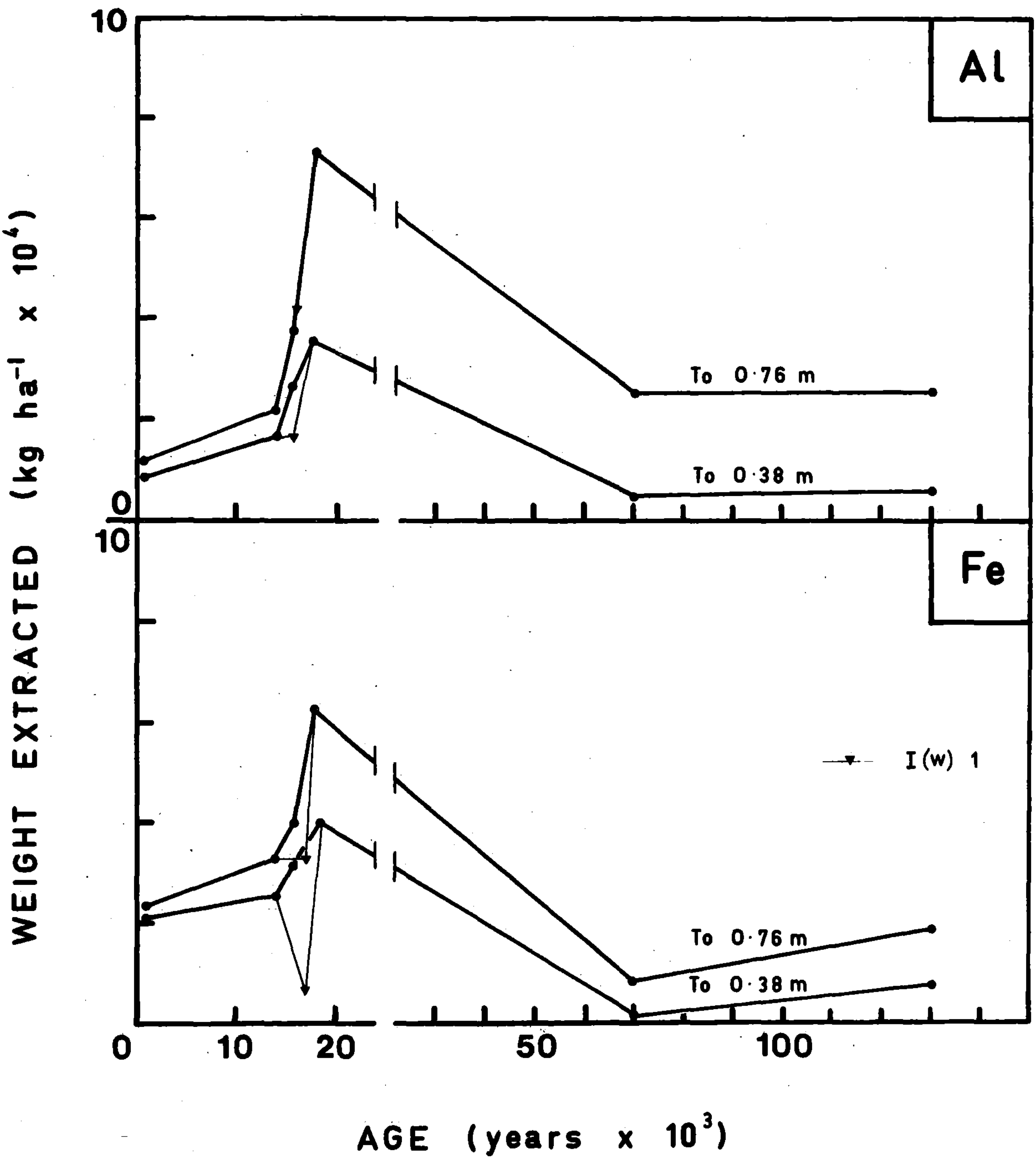


FIGURE 58: VARIATION IN PYROPHOSPHATE-EXTRACTABLE Al AND Fe WITH TIME.

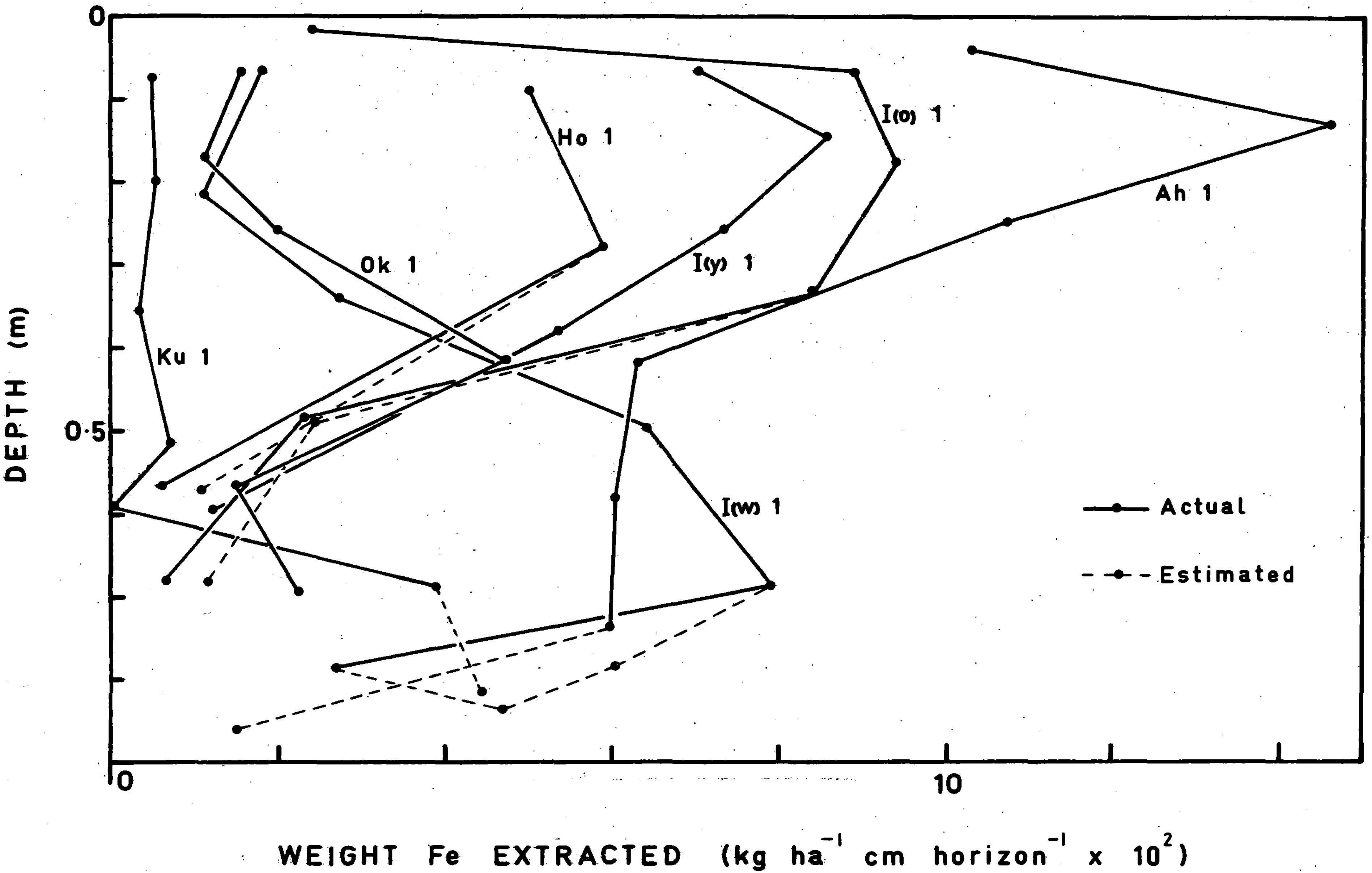


FIGURE 60: PYROPHOSPHATE-EXTRACTABLE Fe DEPTH FUNCTIONS - Chronosequence.

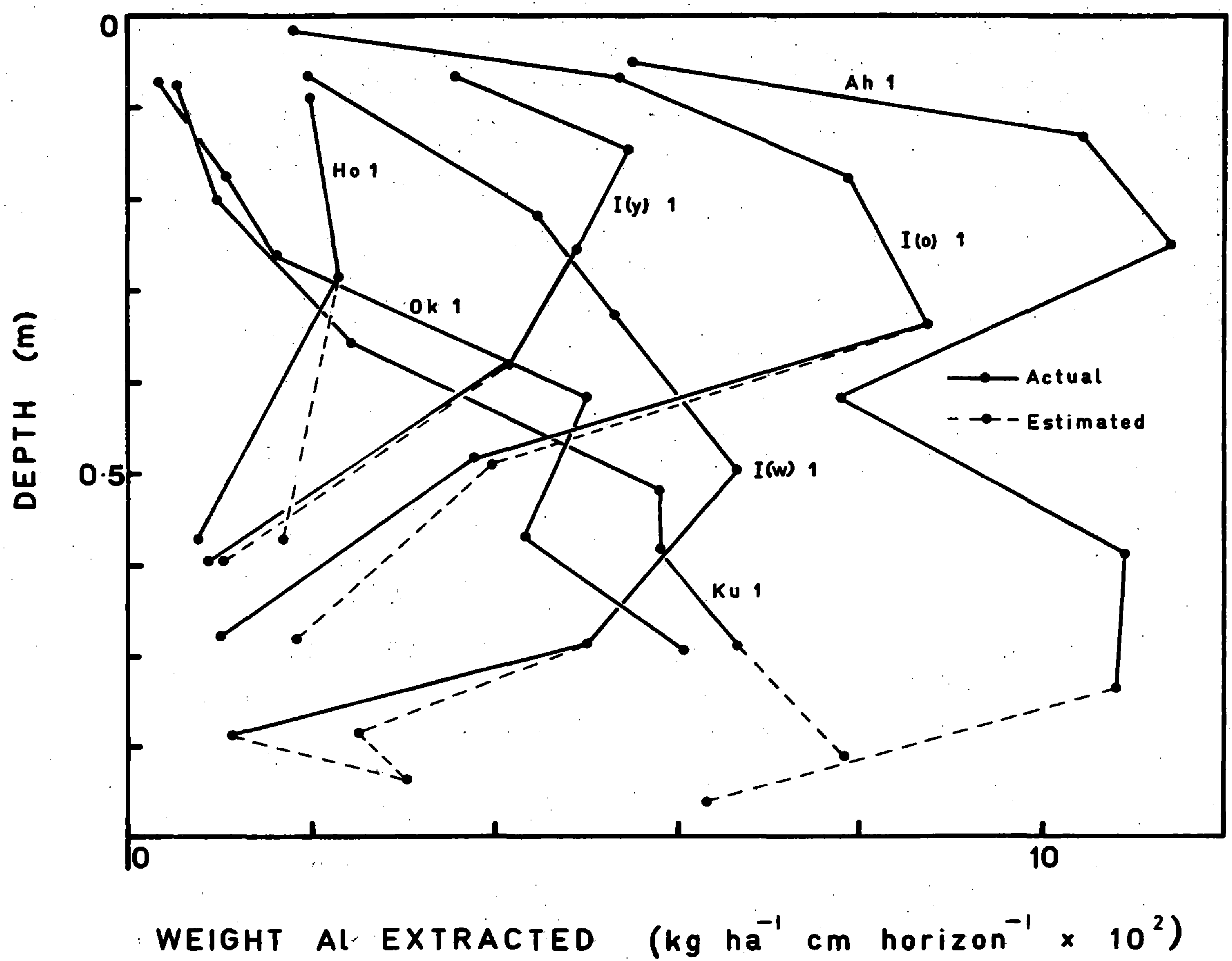


FIGURE 61: PYROPHOSPHATE-EXTRACTABLE Al DEPTH FUNCTIONS - Chronosequence.

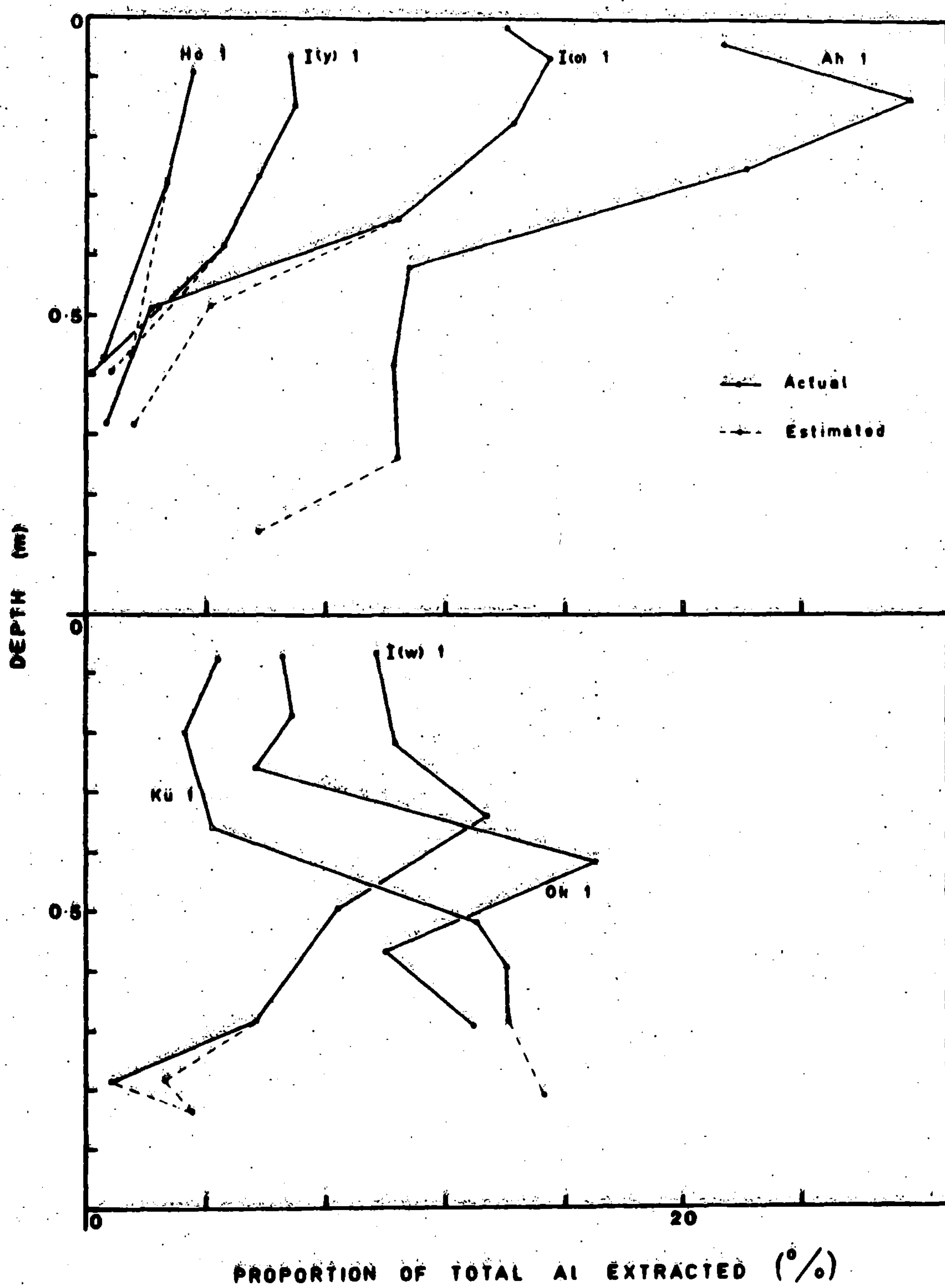


FIGURE 62: DEPTH FUNCTIONS OF % OF TOTAL Al THAT IS PYROPHOSPHATE-EXTRACTABLE - Chronosequence.

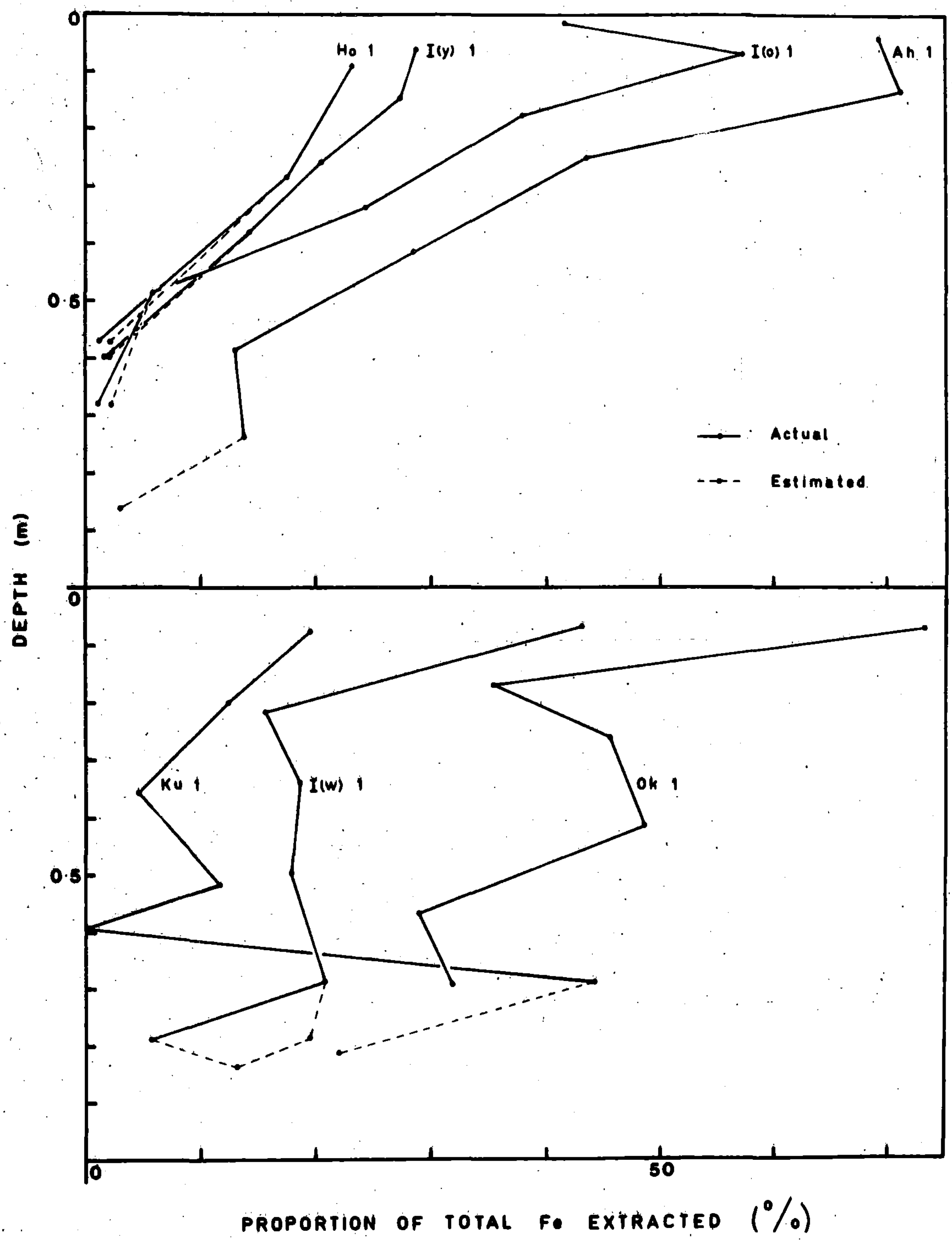


FIGURE 63: DEPTH FUNCTIONS OF % OF TOTAL Fe THAT IS PYROPHOSPHATE-EXTRACTABLE - Chronosequence.

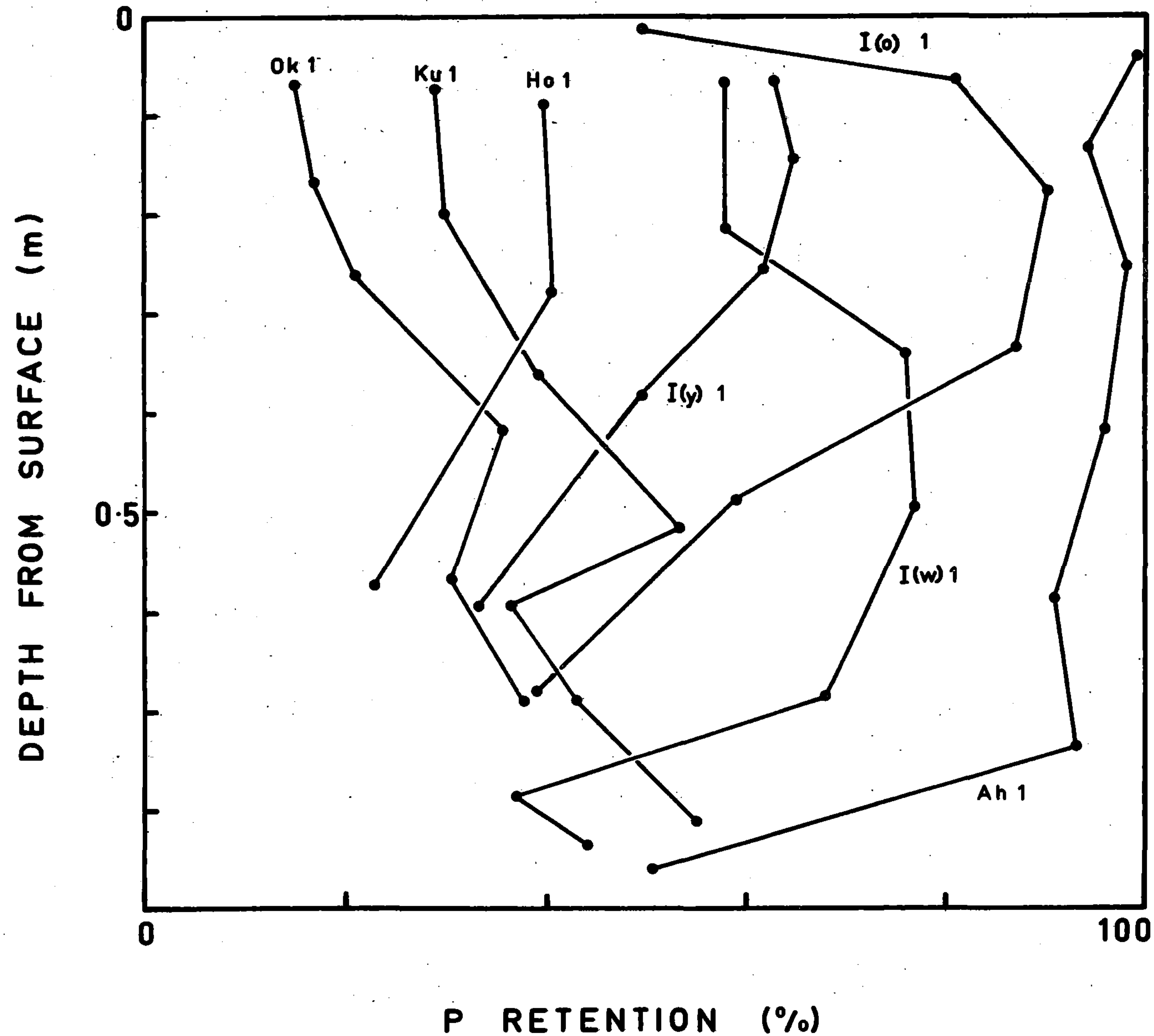


FIGURE 64: PHOSPHATE RETENTION DEPTH FUNCTIONS - Chronosequence.

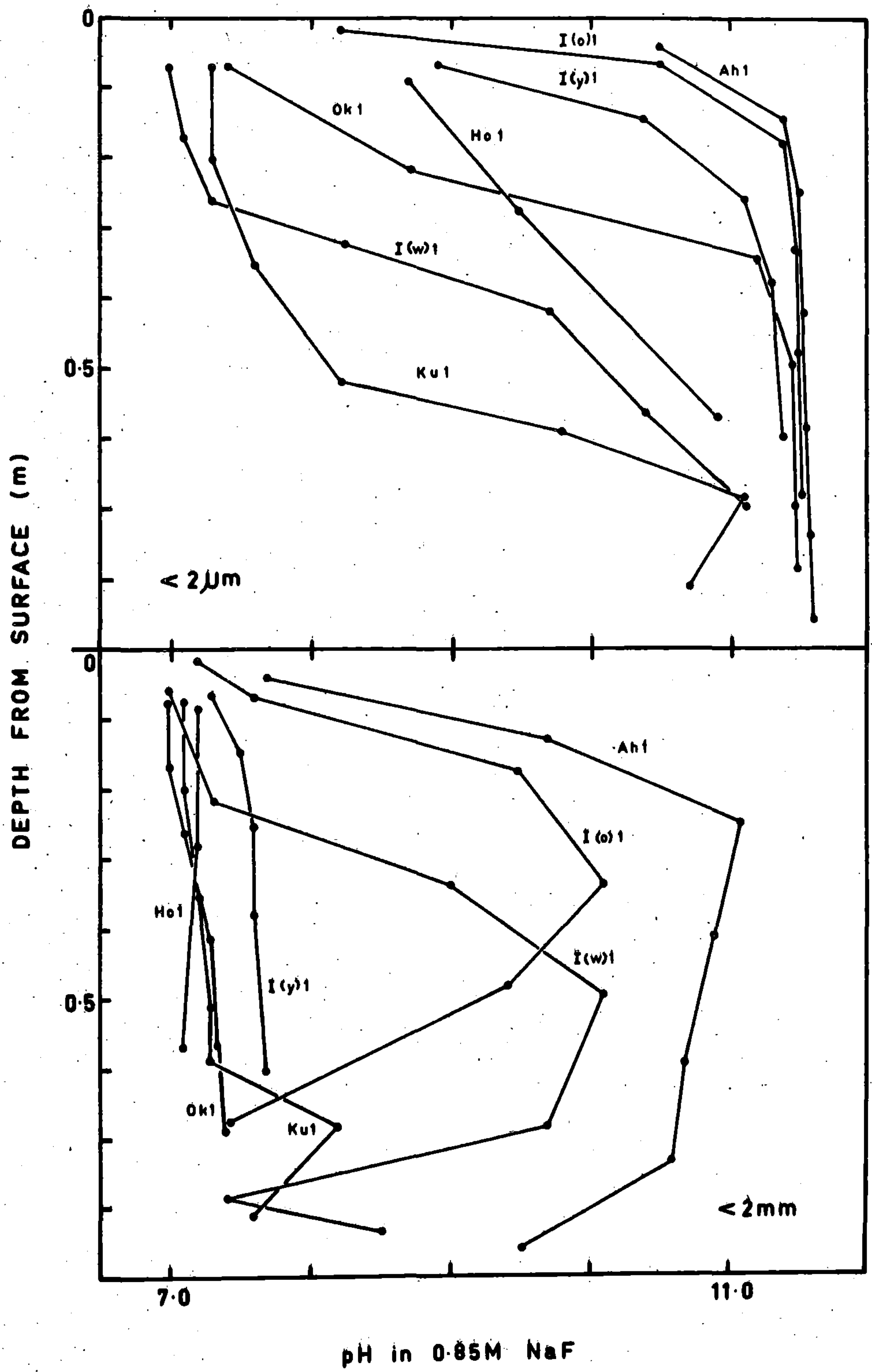


FIGURE 65: FIELDES AND PERROTT TEST DEPTH FUNCTIONS - Chronosequence.

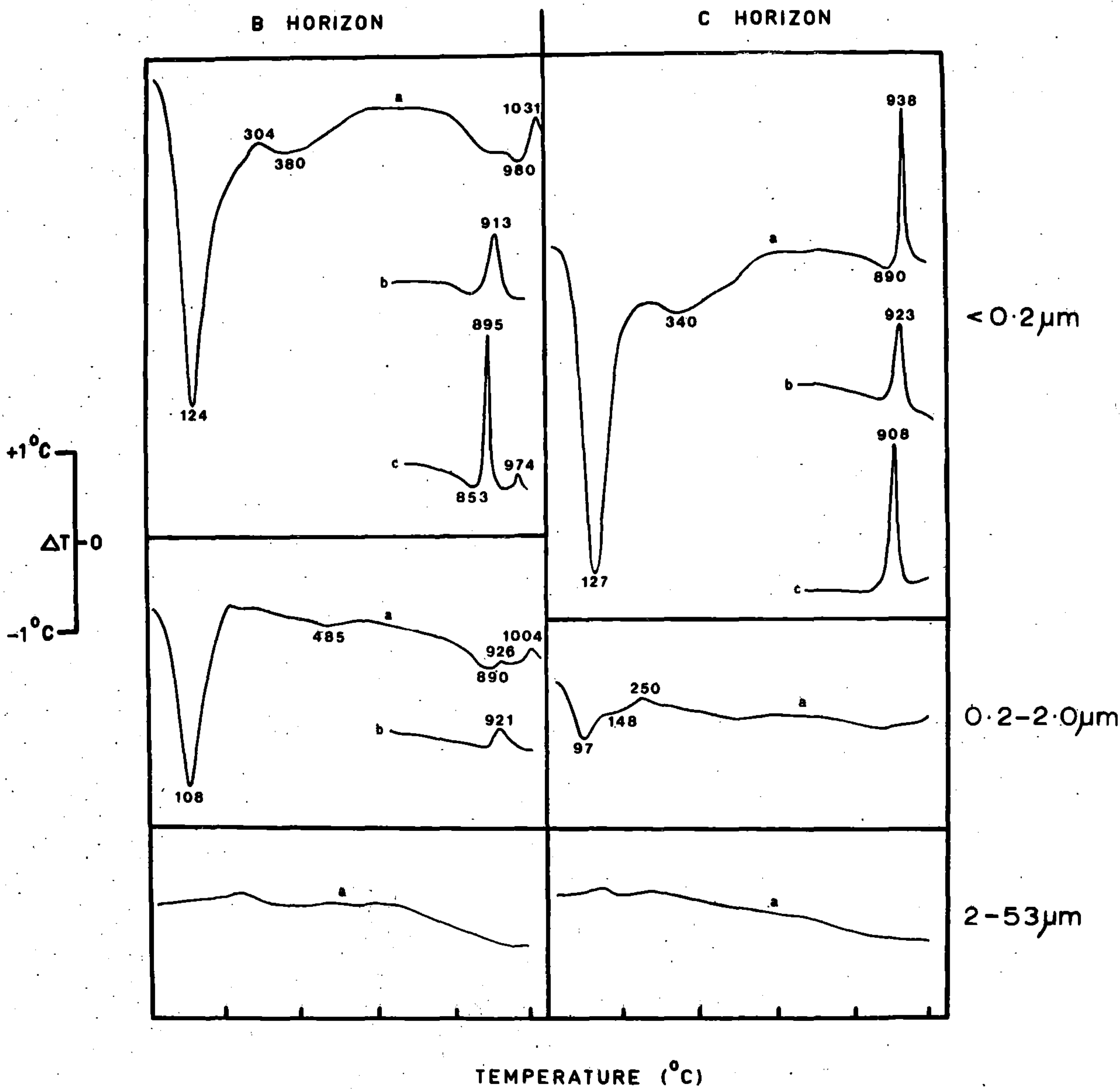


FIGURE 66: DIFFERENTIAL THERMOGRAMS FOR TAUPO SANDY SILT.

(a, nitrogen atmosphere; b, oxygen atmosphere; c, organic matter destroyed by heating to 600°C in air, cooled, 10 mg charcoal added and reheated to 1000°C in nitrogen atmosphere).

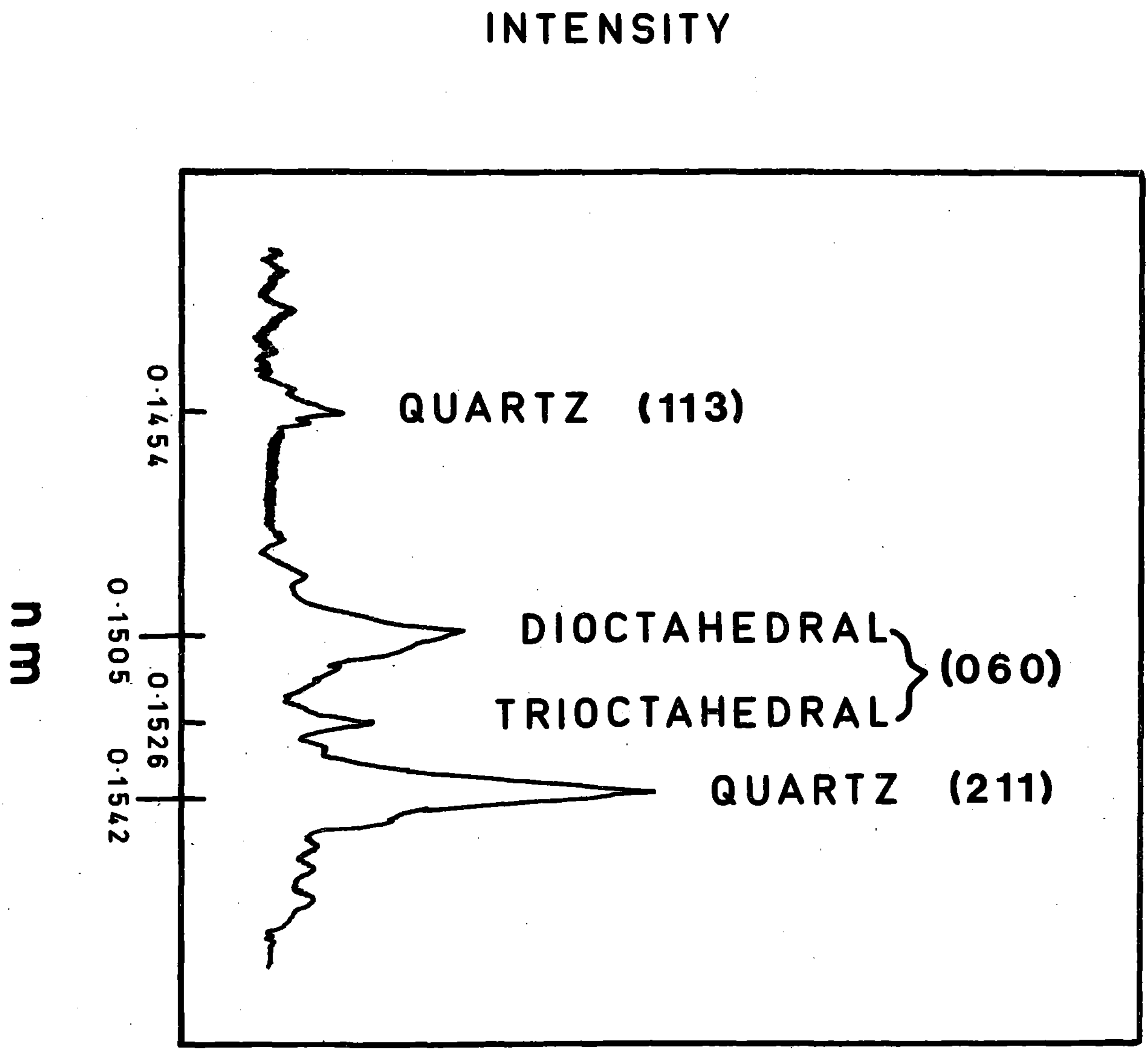


FIGURE 67: X-RAY DIFFRACTOGRAM OF (060) SPACINGS FROM SILT FRACTION OF C HORIZON OF Ho 1.

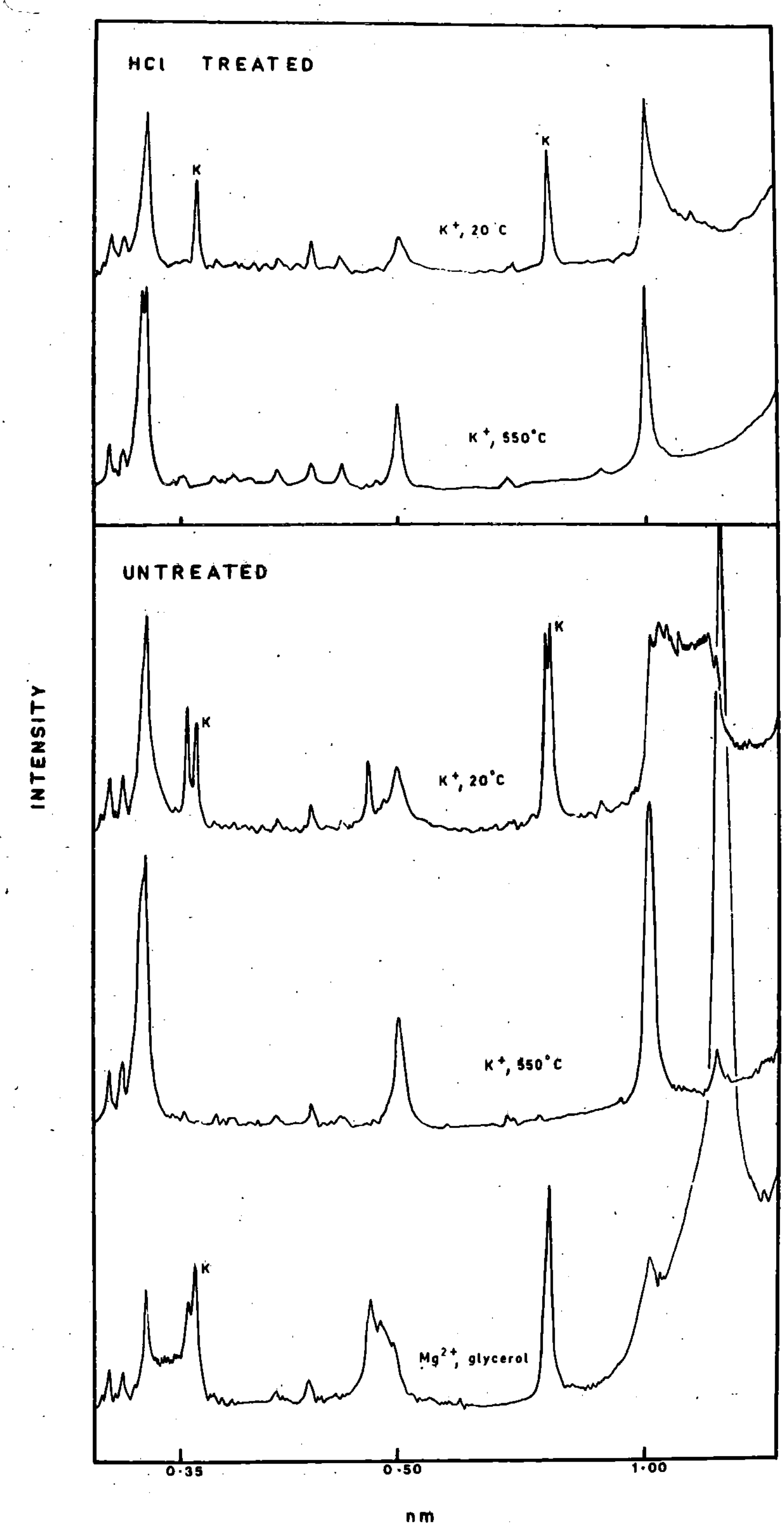


FIGURE 68: USE OF HCl DIGESTION TO CONFIRM PRESENCE OF KAOLINITE.

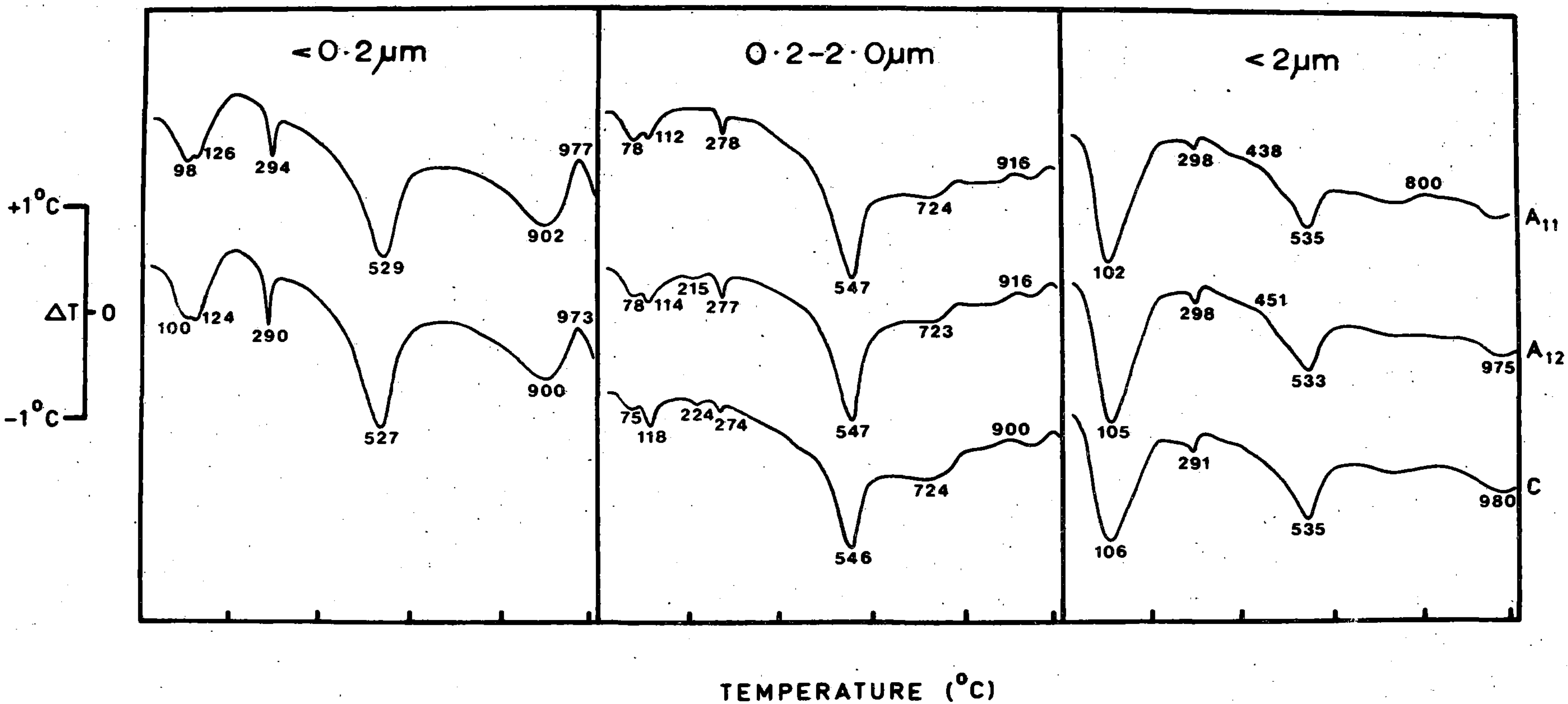


FIGURE 69: DIFFERENTIAL THERMOGRAMS FOR Ho 1.

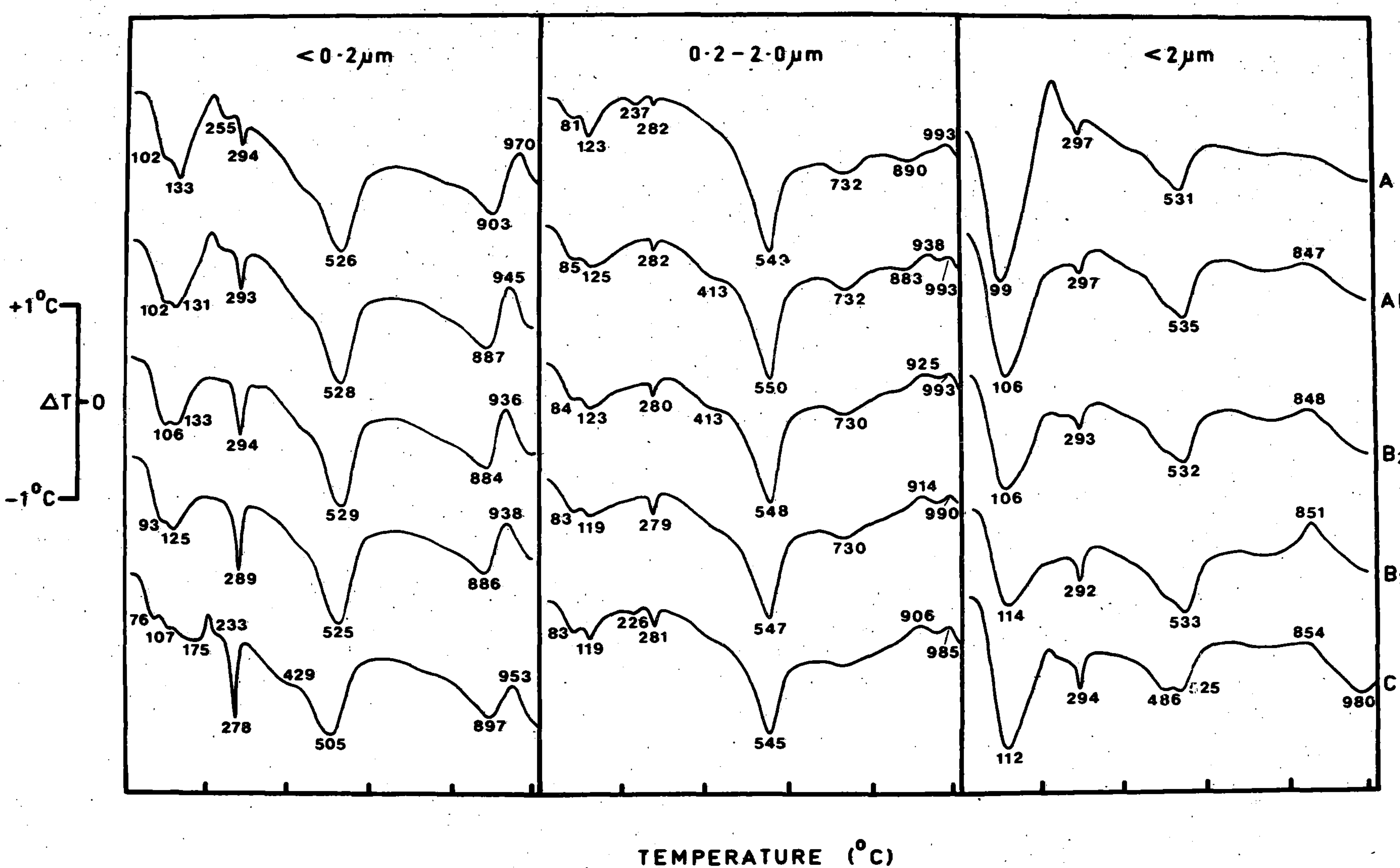


FIGURE 70: DIFFERENTIAL THERMOGRAMS FOR I(y) 1.

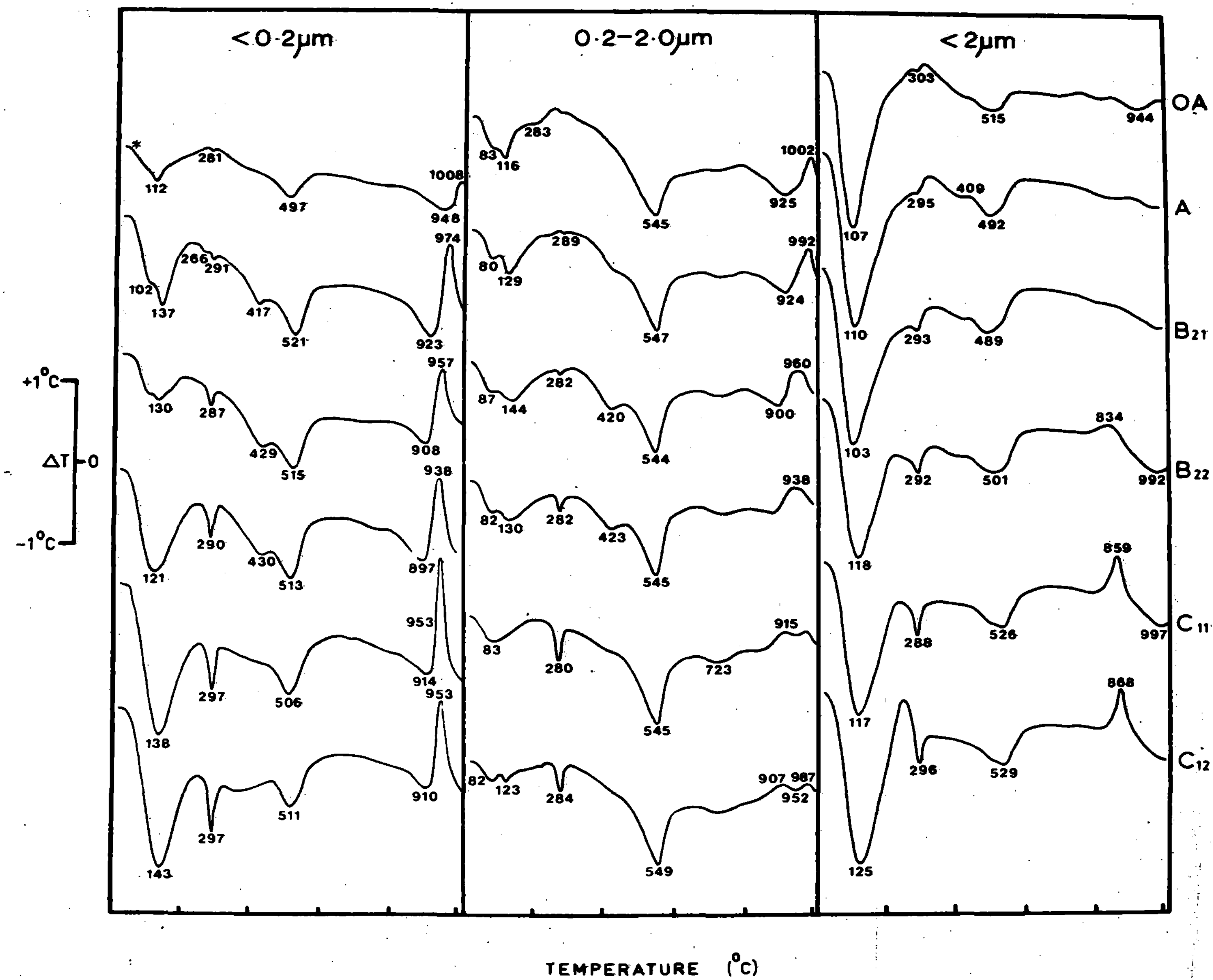


FIGURE 71: DIFFERENTIAL THERMOGRAMS FOR I(o) 1.

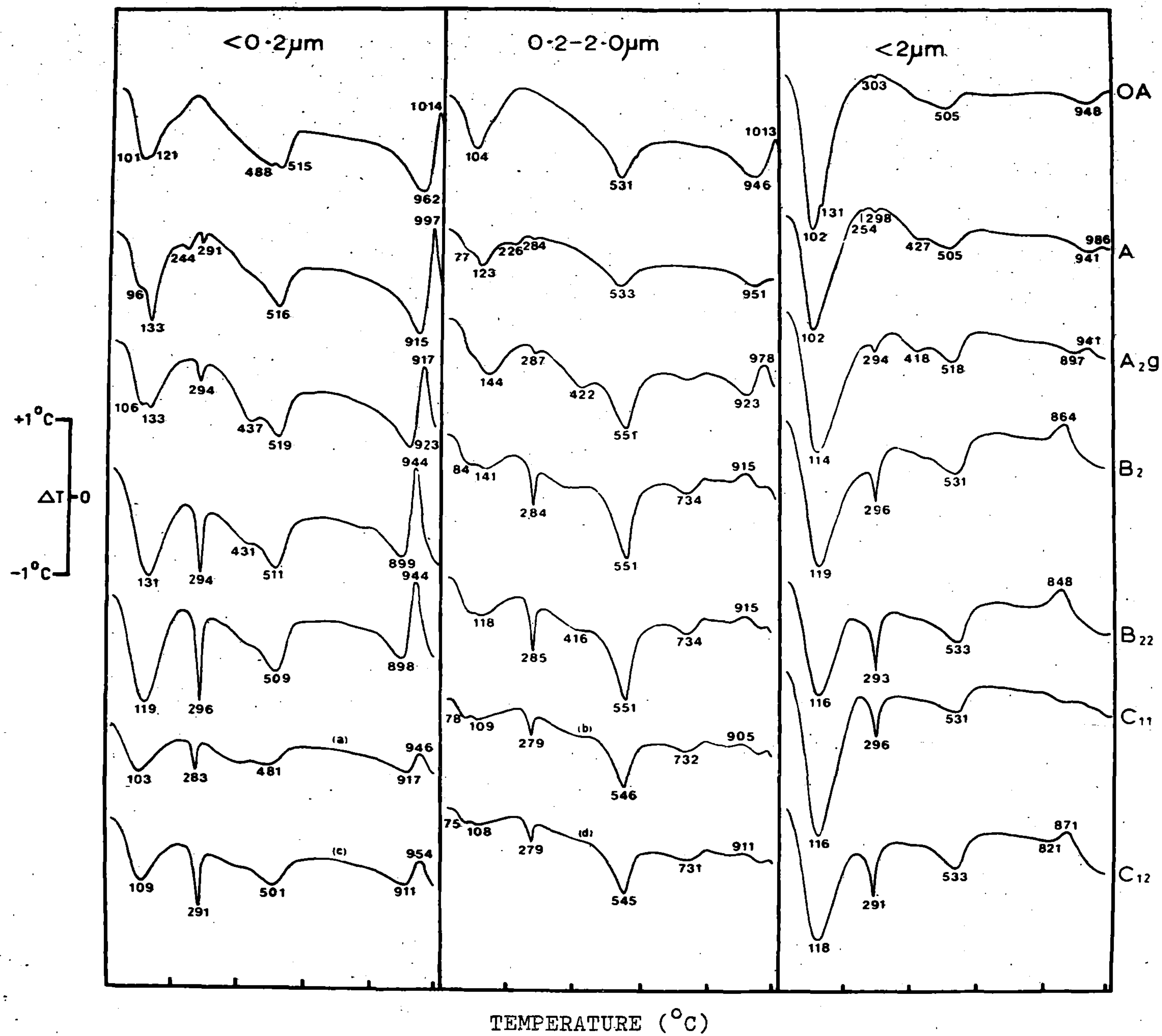


FIGURE 72: DIFFERENTIAL THERMOGRAMS FOR I(w) 1.
((a), (b), (c) and (d) indicate sample weights of 26, 60, 40 and 62 mg, respectively).

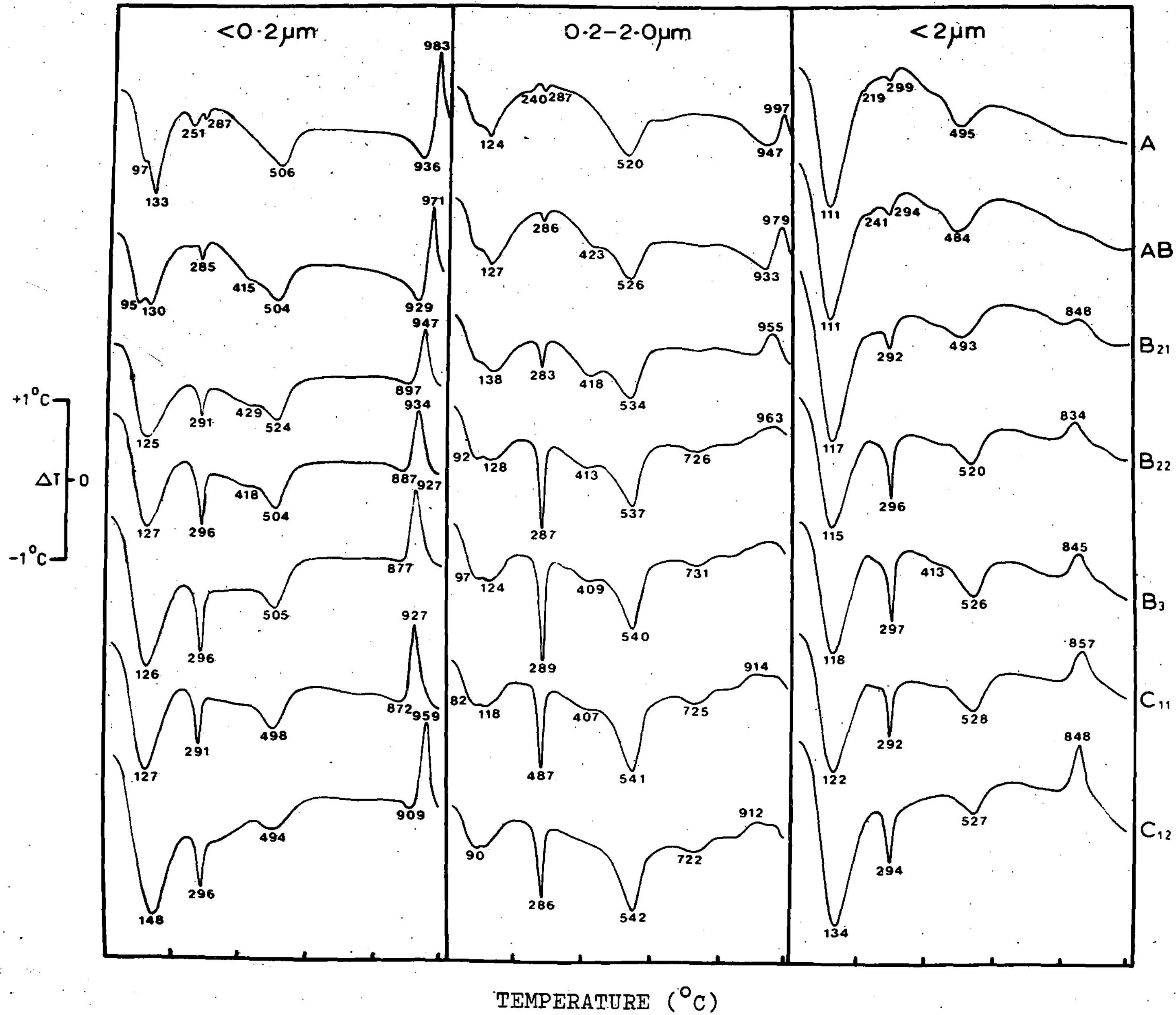


FIGURE 73: DIFFERENTIAL THERMOGRAMS FOR Ah 1.

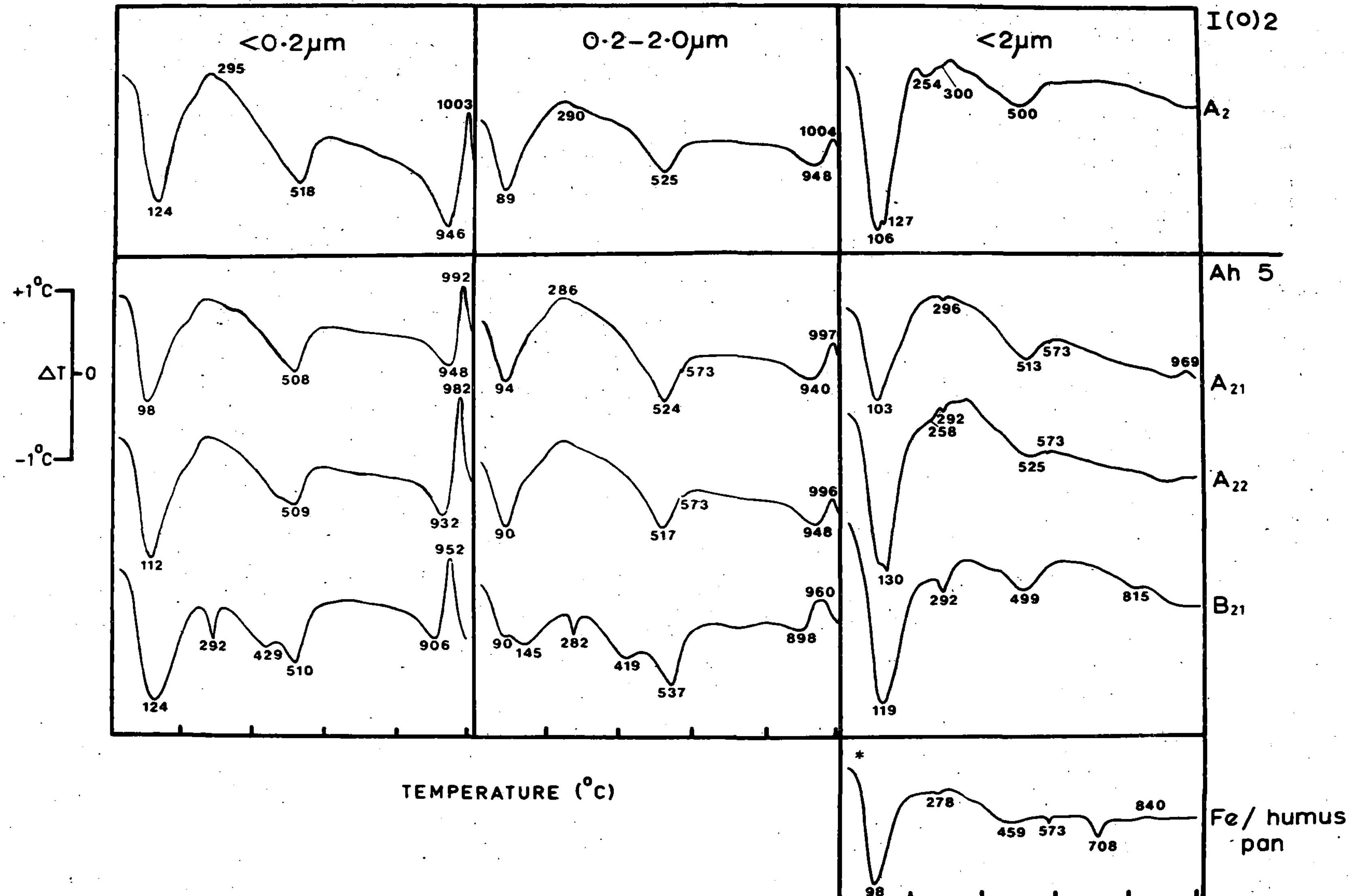


FIGURE 74: DIFFERENTIAL THERMOGRAMS FOR I(o) 2 AND Ah 5.
(* Sample Wt 50 mg).

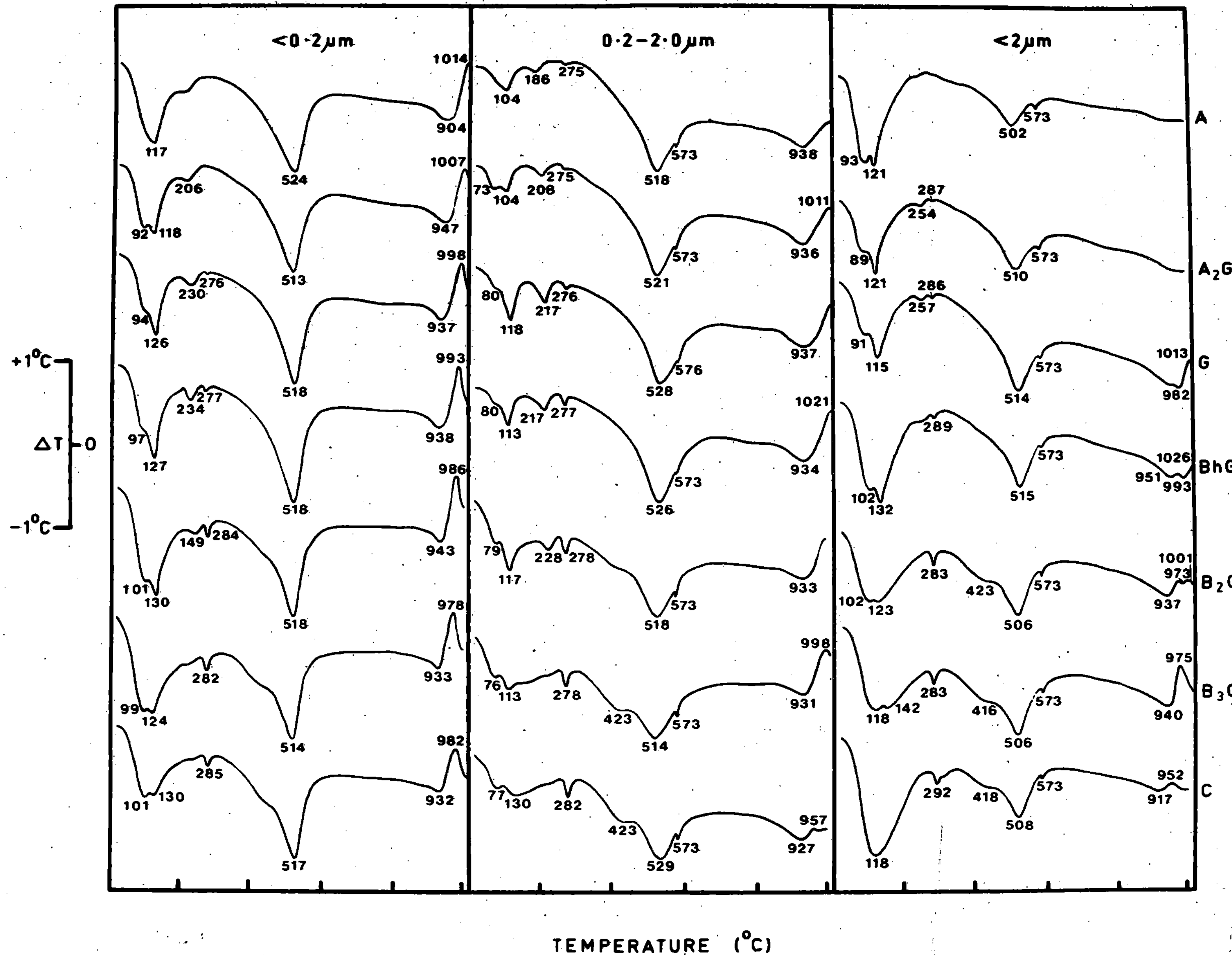


FIGURE 75: DIFFERENTIAL THERMOGRAMS FOR Ku 1.

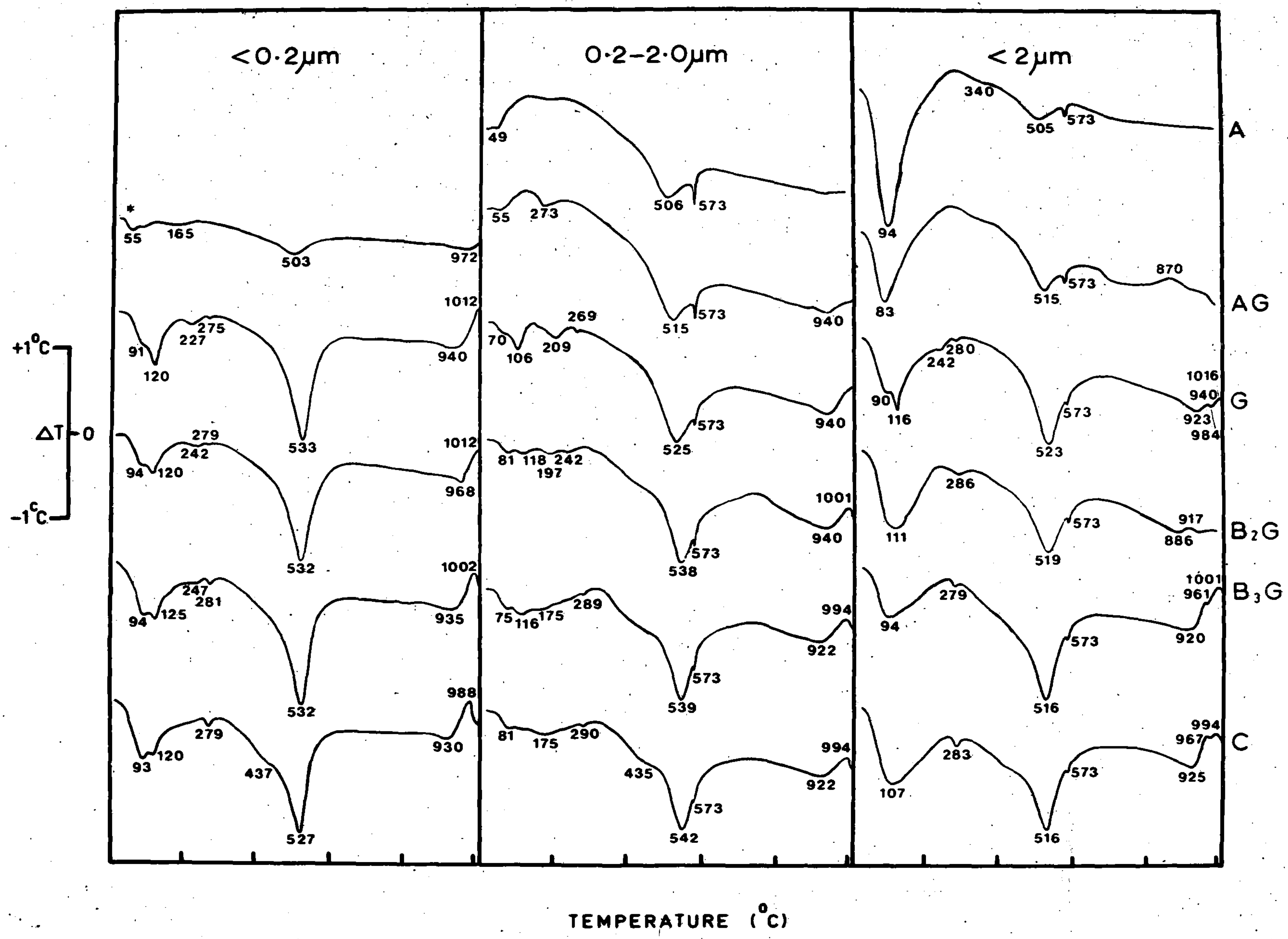


FIGURE 76: DIFFERENTIAL THERMOGRAMS FOR Ok 1.
(* Sample Wt 30 mg).

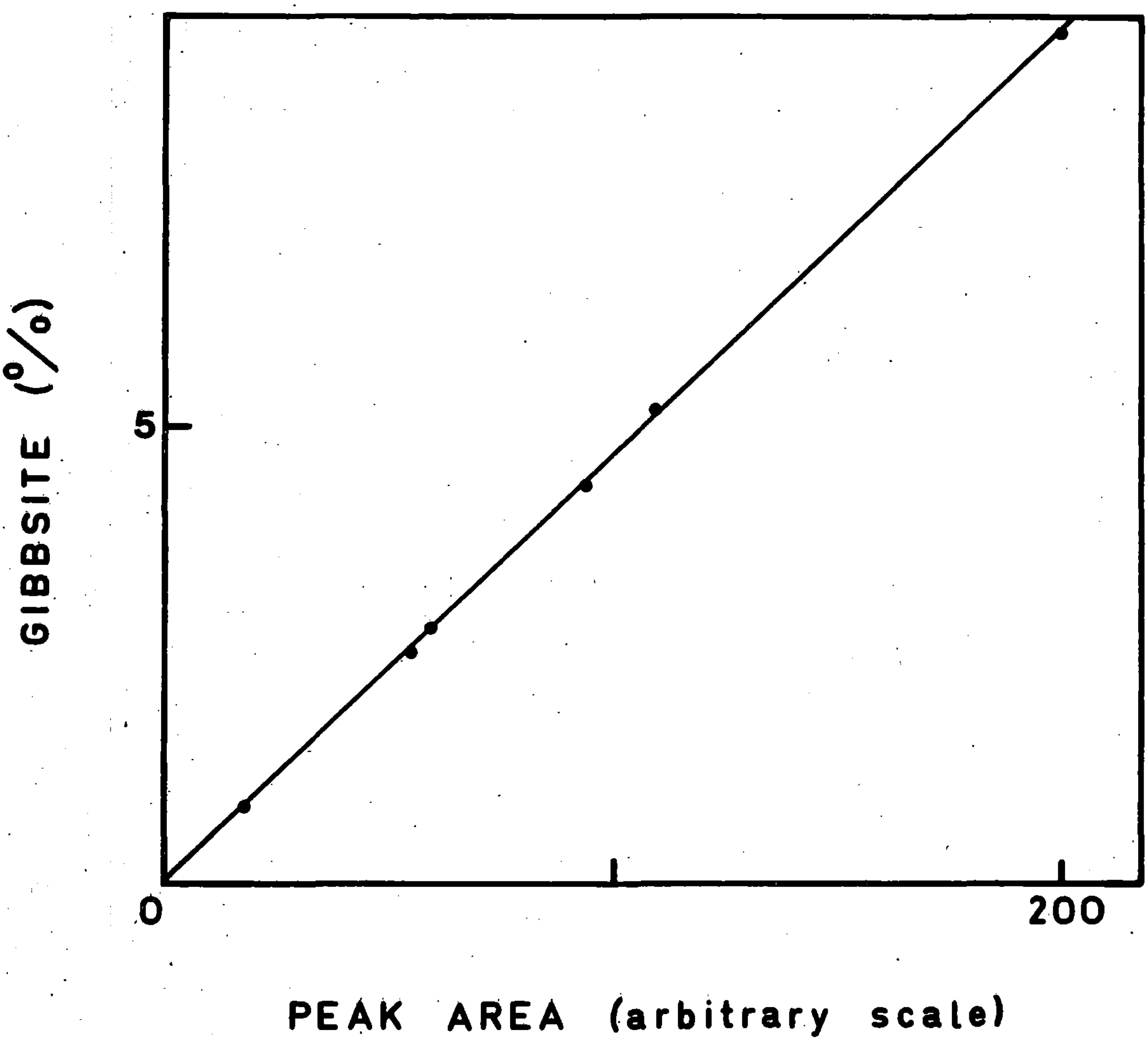


FIGURE 77: STANDARD CURVE USED FOR GIBBSITE DETERMINATION.

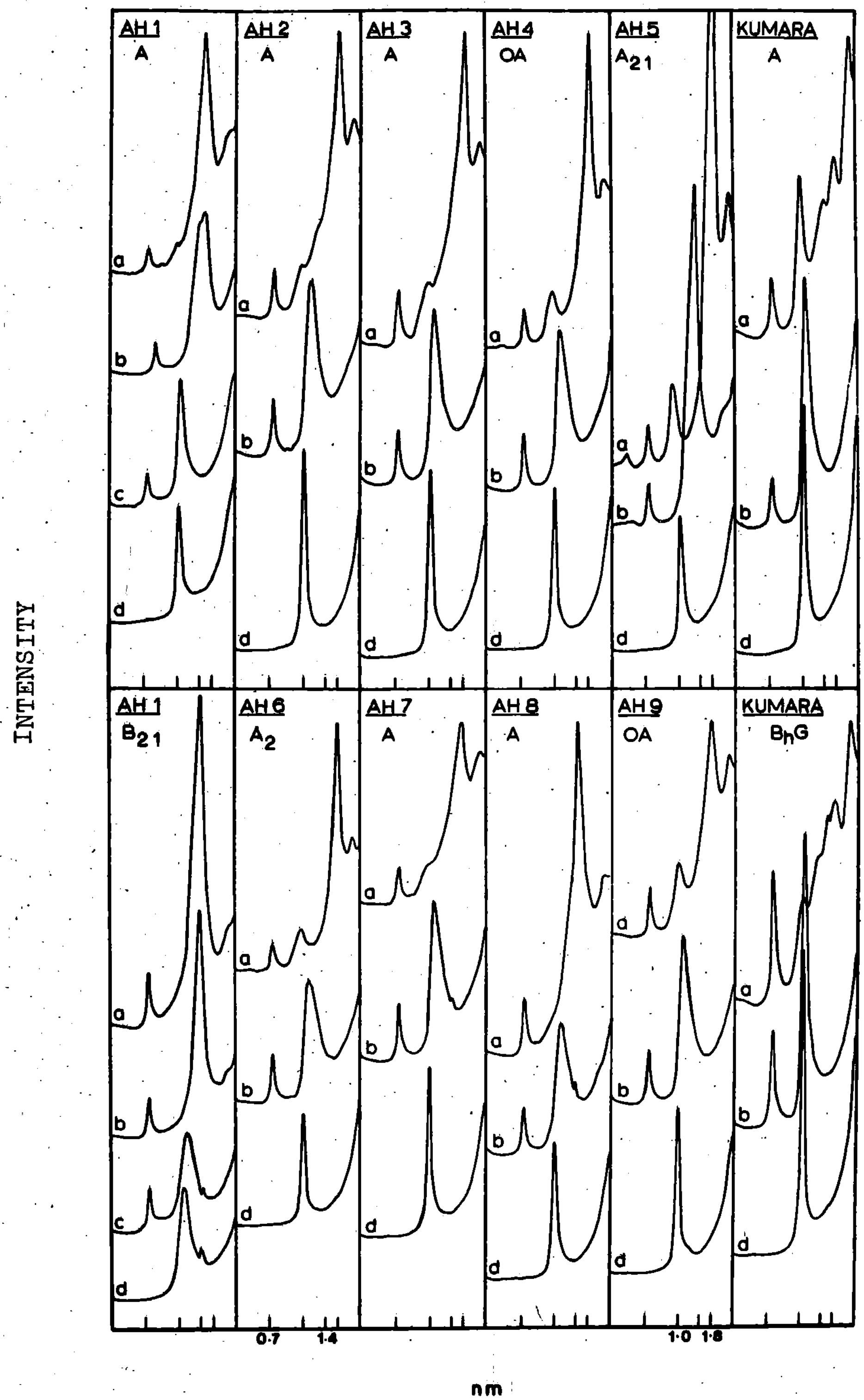


FIGURE 78: X-RAY DIFFRACTOGRAMS OF < 0.2μm FRACTION FROM SELECTED SOIL HORIZONS.

(Mg-saturated/glycerol (a); K-saturated, 20°C (b), 350°C (c), 550°C (d)).

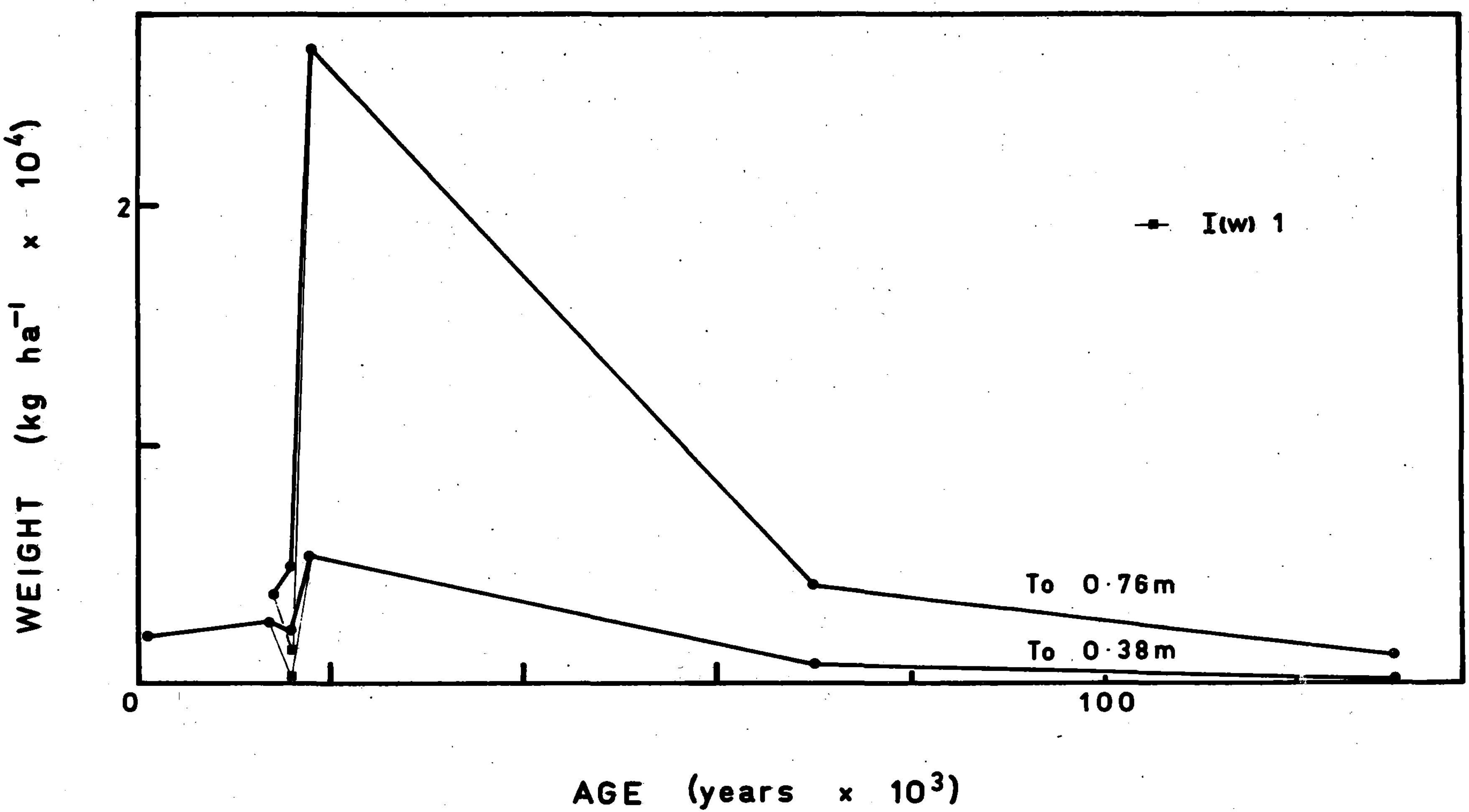


FIGURE 79: VARIATION OF GIBBSITE WITH TIME.

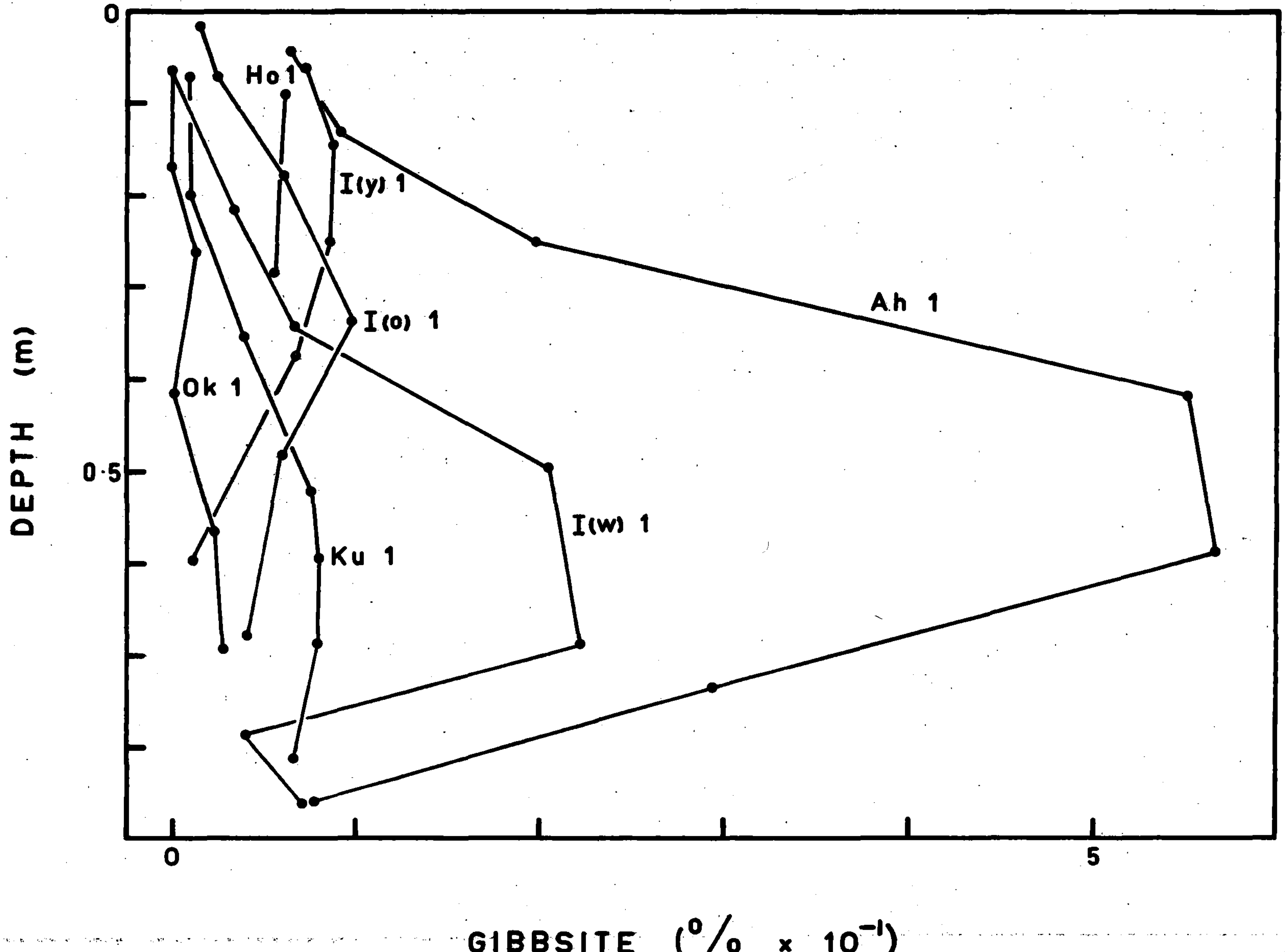


FIGURE 80: GIBBSITE DEPTH FUNCTIONS - Chronosequence.

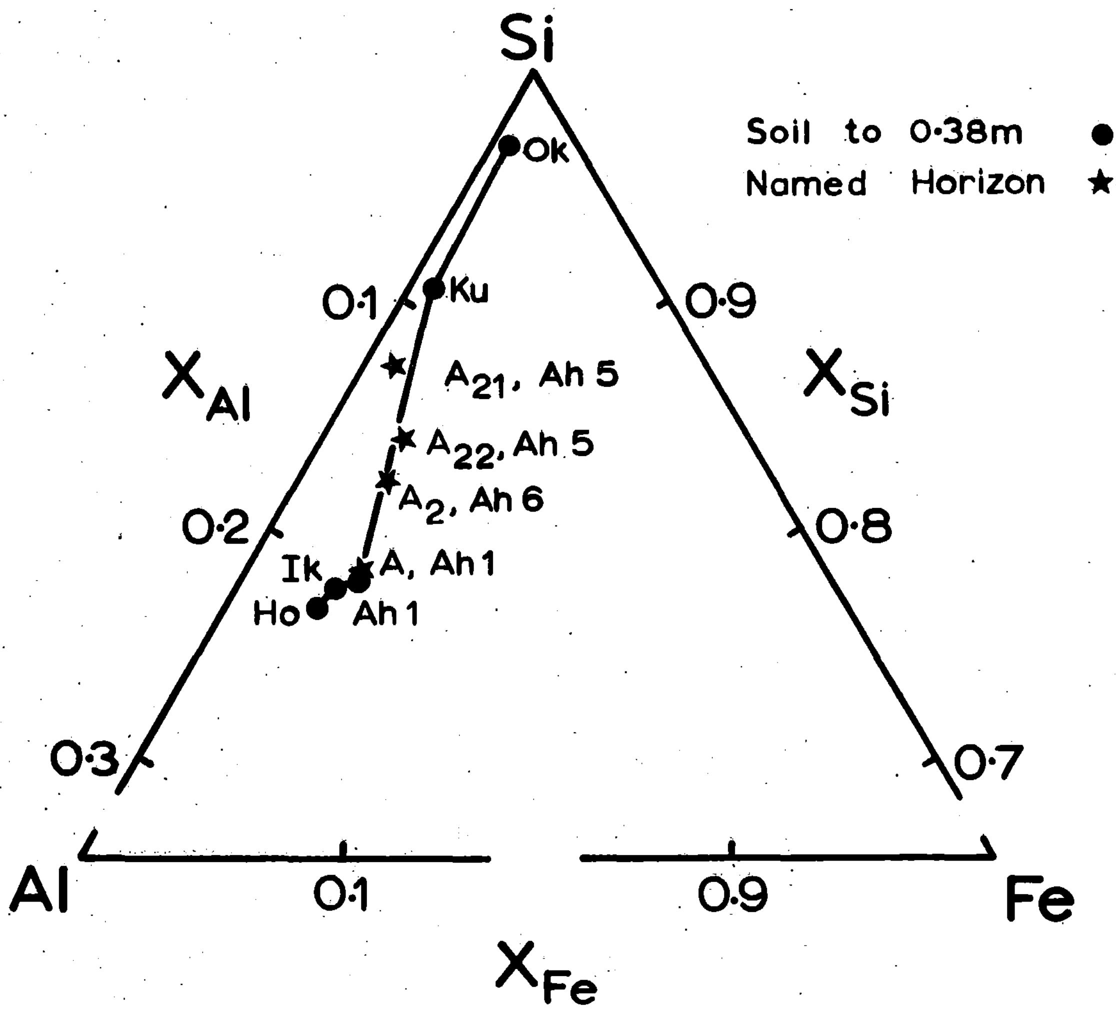


FIGURE 81: TRIANGULAR DIAGRAM ILLUSTRATING DEPLETION OF Al AND Fe RELATIVE TO Si - Chronosequence.

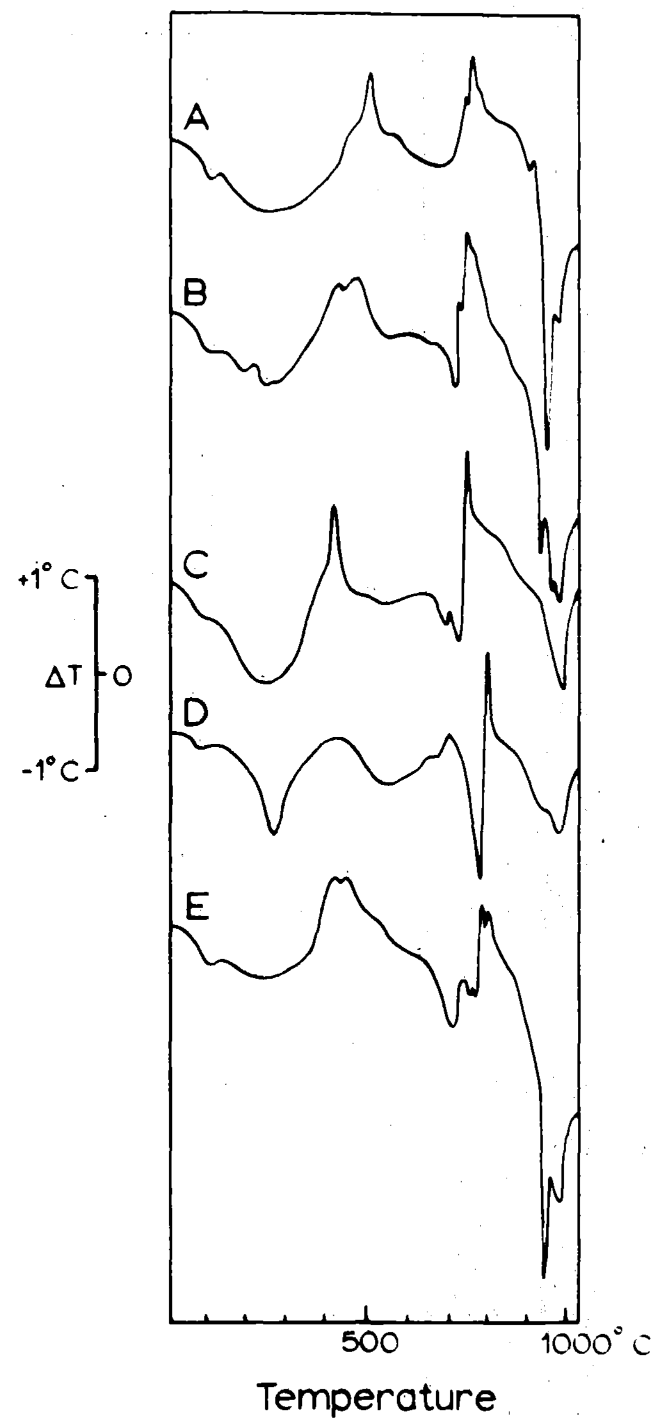


FIGURE 82: DIFFERENTIAL THERMOGRAMS OF SOME COMPLEX FLUORIDES. (A, $Ca_{0.5}MgAlF_6$; B, $(Na_{0.5}Ca_{0.25})MgAlF_6$; C, $NaMgAlF_6$; D, $KMgAlF_6$; E, basalt residue following 24-hour digestion with 48% HF).

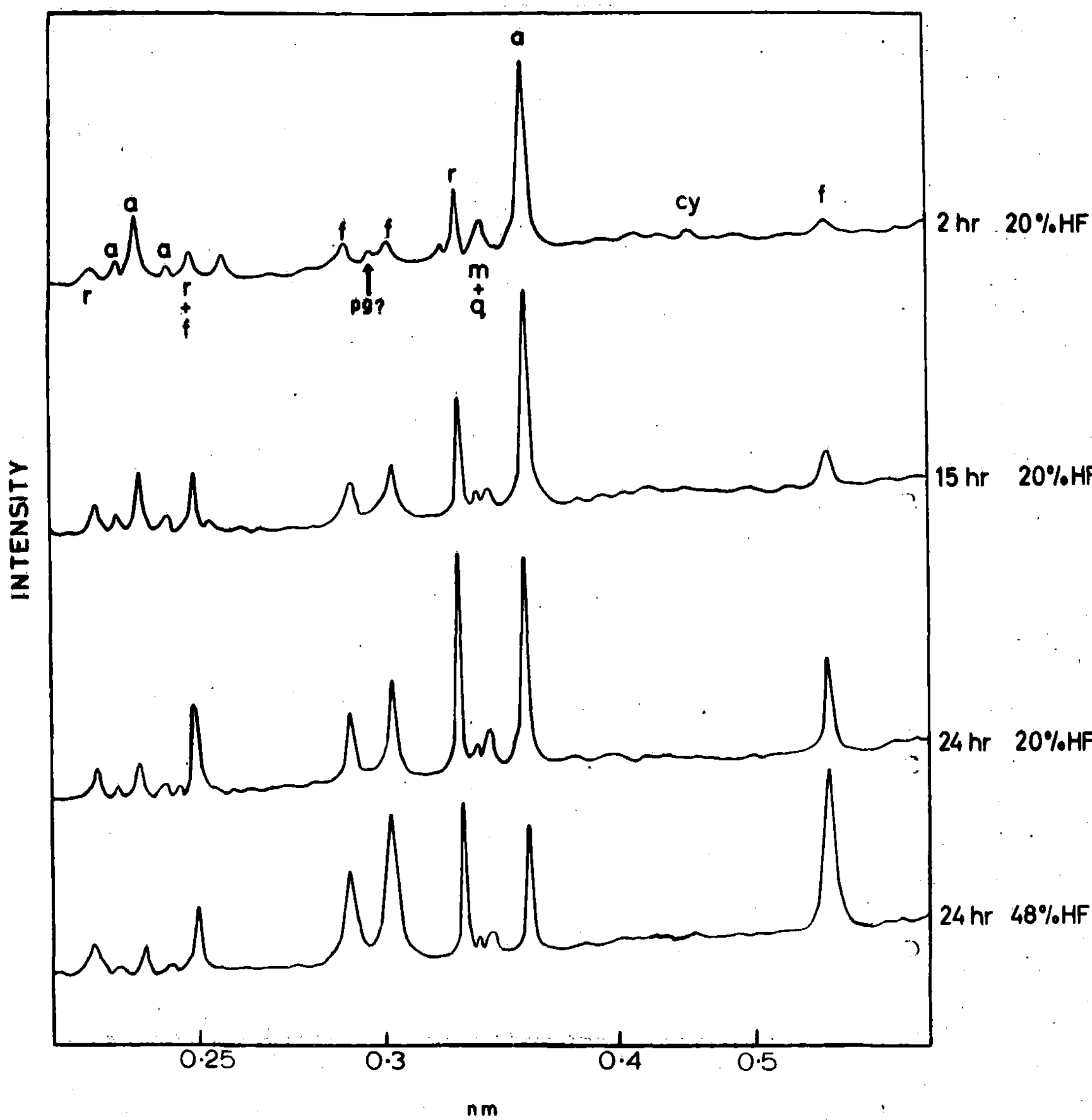


FIGURE 83: X-RAY DIFFRACTOGRAMS OF RESIDUES FROM < 2µm FRACTION OF THE B_3G HORIZON OF Ok 1 FOLLOWING HF DIGESTION.

(a, anatase; cy, clay (110); f, complex magnesium aluminium fluoride precipitated during digestion; m, mica; pg, mineral of the plumbogummite group; q, quartz; r, rutile).

APPENDIX I

LIST OF PLANT NAMES

COMMON NAME	SCIENTIFIC NAME
American beech	*Fagus grandifolia*
Blackberry	*Rubus fruticosus*
Bog pine	*Dacrydium bidwillii*
Bracken fern	*Pteridium aquilinum* var. *esculentum*
Buttercup	*Ranunculus* sp.
Cocksfoot	*Dactylis glomerata*
Coprosma	*Coprosma crassifolia*
Gorse	*Ulex europaeus*
Hall's totara	*Podocarpus hallii*
Hard beech	*Nothofagus truncata*
Kahikatea	*Podocarpus dacrydioides*
Kamahi	*Weinmannia racemosa*
Manuka	*Leptospermum scoparium*
Matai	*Podocarpus spicatus*
Miro	*Podocarpus ferrugineus*
Mountain beech	*Nothofagus solandri* var. *cliffortioides*
Pepper tree	*Pseudowintera colorata*
Pink pine	*Dacrydium biforme*
Quintinia	*Quintinia acutifolia*
Red beech	*Nothofagus fusca*
Rimu	*Dacrydium cupressinum*
Rush	*Juncus* spp.
Sedge	*Carex* spp.
Silver beech	*Nothofagus menziesii*
Silver pine	*Dacrydium colensoi*
Sphagnum moss	*Sphagnum fulcatum*
Toa toa	*Phyllocladus alpinus*
Totara	*Podocarpus totara*
Tussock	*Chionochloa* spp.
Umbrella fern	*Gleichenia circinata*
Yellow-silver pine	*Dacrydium intermedium*

APPENDIX II

PROFILE DESCRIPTIONS OF SOILS OF THE REEFTON CHRONOSEQUENCE

Note: Soil profiles are described using terms defined in "Soil Survey Method" (Taylor and Pohlen, 1962). Soil colour notation is that of "Munsell Soil Colour Charts" (1954). All grid references refer to N.Z.M.S. Sheet S. 38.

Profile: Ho 1 (Hokitika sandy loam, site 1).

Location: 100 m south of Waitahu River, 10.5 km east of main Reefton - Inangahua road. (S.38/344337).

Topography: Flat. Highest part of floodplain.

Site Vegetation: Grass and buttercup. 8 m from edge of red beech dominated forest remnant.

Altitude: 190 m **Estimated annual rainfall:** 1920 mm.

Profile:

A_{11} 18 cm — dark brown (10YR 3/4) sandy loam; friable; weakly developed fine granular and crumb structure, grading downwards to fine and medium nutty; no stones; abundant grass and numerous tree roots; diffuse smooth boundary,

A_{12} 20 cm — dark brown (7.5YR 4/3) loamy sand; friable; moderately developed fine and medium nutty structure; few grass or tree roots; distinct, slightly wavy boundary,

C on — white (7.5Y 8/1) to grey (5Y 6/1) sandy gravel; loose; structureless; no roots.

Parent Material: Silty alluvium over gravels from granite (dominant) and indurated sandstone.

Native Vegetation: Red and silver beech, totara, matai, and kahikitea.

Profile: I(y) 1 (Ikamatua silt loam, younger variant, site 1).

Location: 250 m north of road to Dauntless mine, 3.4 km east of its intersection with main Reefton-Inangahua road. (S. 38/351332).

Topography: Flat river terrace, 4 m above floodplain. Site located 8 m from terrace edge.

Site Vegetation: Forest remnant: red beech (0.5 - 0.6 m, d.b.h.), coprosma and pepper tree. Many fallen logs.

Altitude: 194 m **Estimated annual rainfall:** 1920 mm.

Profile:

O	3 cm	very dark brown (5YR 4/3) partly decomposed litter of red beech leaves and twigs; distinct boundary,
A	7 cm	dark brown (10YR 4/3) to very dark brown (10YR 2/3) silt loam; very friable; weakly developed medium and fine nutty structure; many roots; indistinct boundary,
AB	9 cm	dark yellowish brown (10YR 4/4) silt loam; friable; moderately developed medium nutty structure; few roots; indistinct boundary,

B_2	13 cm	yellowish brown (10YR 5/4) fine sandy loam; friable; weakly developed medium and fine nutty structure; very few roots; diffuse boundary,
B_3	12 cm	yellowish brown (10YR 5/5) loamy sand; friable; very weakly developed medium nutty structure; few mica flakes; very few roots; distinct to sharp boundary,
C	on	dark yellowish brown (10YR 4/4) sandy gravel; loose; structureless; abundant mica, quartz and rock fragments; many medium stones, dominantly granite with some indurated sandstone; no roots.

Parent Material: Silty alluvium over gravels from granite (dominant) and indurated sandstone.

Native Vegetation: Red beech (dominant), kamahi, quintinia, rimu, matai and kahikitea.

Profile: I(o) 1 (Ikamatua fine sandy loam, older variant, site 1).

Location: 140 m north of road to Dauntless mine, 3.1 km east of its intersection with main Reefton-Inangahua road. (S. 38/355334).

Topography: Flat river terrace. Separated from site I(y) 1 by minor terrace scarp.

Site Vegetation: Forest remnant: dominant red beech (0.5-0.7 m, d.b.h.), some silver beech, pepper tree. Many fallen logs.

Altitude: 198 m **Estimated annual rainfall:** 1920 mm.

Profile:

OA	3 cm	dark reddish brown (5YR 3/2) peaty loam with much decomposed litter of beech leaves and twigs; distinct boundary,
A	7 cm	dark brown (8.5YR 3/4) fine sandy loam; very friable; moderately developed medium and fine granular and fine and very fine crumb structures; many roots; distinct boundary,
B_{21}	15 cm	strong brown (7.5YR 5/6) sandy loam; very friable; moderately developed coarse and medium granular and fine and very fine crumb structures, with patches of medium nutty structure surrounding roots; few roots; indistinct boundary,
B_{22}	17 cm	yellowish brown (10YR 5/7) loamy sand; very friable; weakly developed medium and fine nutty structure; few roots; distinct boundary,
C_{11}	13 cm	olive brown (1Y 4/4) gravelly sand; loose; structureless; few medium and small stones of granite and indurated sandstone; no roots; distinct boundary,
C_{12}	on	white (N8) to very dark greyish brown (2.5Y 3/2) sandy gravel; loose; structureless; few small stones of granite and indurated sandstone; no roots.

Parent Material: Silty alluvium over gravels from granite (dominant) and indurated sandstone.

Native Vegetation: Red beech (dominant), kamahi, quintinia, rimu, matai and kahikitea.

Profile: I(w) 1 (Ikamatua fine sandy loam, wetter variant, site 1).

Location: 50 m south of road to Dauntless mine, 3.9 km east of its intersection with main Reefton-Inangahua road. (S. 38/361333).

Topography: Flat. Lower-lying area of river terrace.

Site Vegetation: Manuka scrub, grass.

Altitude: 197 m   **Estimated annual rainfall**: 1920 mm.

Profile:

OA	13 cm	dark reddish brown (5YR 2/3) humose sandy loam; very friable; weakly developed fine nutty structure, breaking into moderately developed medium and fine granular and fine and very fine crumb; many roots; distinct, wavy boundary,
A	17 cm	dark reddish brown (5YR 2/4) fine sandy loam; friable; weakly developed coarse to fine nutty structure grading to fine and very fine granular and crumb; few roots; indistinct boundary,
A_{2g}	8 cm	dark brown (7.5YR 4/2) to dark yellowish brown (10YR 4/4) and dark reddish brown (5YR 2/4) sandy loam; friable; moderately developed coarse to very fine nutty structure; few roots and worm casts; sharp wavy boundary,
B_{fe}	0.2 cm	iron pan; dark reddish brown (5YR 2/2); hard; sharp wavy boundary,

B_{21}	23 cm	light yellowish brown (10YR 6/4) loamy sand; some iron and humus staining in root channels; very friable; moderately developed coarse and medium granular and fine and very fine crumb structures; few roots; indistinct boundary,
B_{22}	15 cm	brownish yellow (10YR 6/6) loamy sand; friable; weakly developed coarse to very fine nutty, and fine and very fine crumb and granular structures; rare roots; distinct boundary,
C_{11}	5 cm	light yellowish grey (7.5Y 8) to dark brown (10YR 3/3) stony, sandy gravel; loose; structureless; no roots; distinct boundary,
C_{12}	on	light olive brown (2.5Y 5/4) gravelly sand; loose; structureless; few small stones of granite and indurated sandstone; no roots.

Parent Material: Silty alluvium over gravels from granite (dominant) and indurated sandstone.

Native Vegetation: Red beech (dominant), matai, kahikitea, kamahi, quintinia, rimu.

Profile: Ah 1 (Ahaura silt loam, site 1).

Location: 480 m south of road to Dauntless mine, 3.5 km east of its intersection with main Reefton-Inangahua road. (S. 38/355326).

Topography: Flat glacial outwash terrace. Free-draining site in slightly lower part of terrace.

Site Vegetation:		Forest remnant: dominant red beech (0.6-1.1 m, d.b.h.) with some silver beech. Many stumps, fallen logs and litter mounds. Some grass. Recently opened to stock.
Altitude: 210 m		**Estimated annual rainfall:** 1920 mm.

Profile:

A	8 cm	brown to dark brown (7.5YR 4/4) silt loam; very friable; moderately developed medium and fine nutty structure (surface) grading downwards to moderately developed medium and fine granular and crumb; many roots at surface, few fragments of beech litter on surface; indistinct boundary,
AB	10 cm	brown to dark brown (7.5YR 4/4) and yellowish brown (10YR 5/8) sandy loam; very friable; moderately developed medium and fine granular, and fine and very fine crumb structures; few roots; distinct boundary,
B_{21}	14 cm	brownish yellow (10YR 6/8) sandy loam; very friable; moderately developed coarse to fine granular and fine and very fine crumb structures; few roots; diffuse boundary,
B_{22}	19 cm	brownish yellow (10YR 7/8) sandy loam; very friable; ultimate structure is fine and very fine crumb; some tendency to form coarser aggregates that are either nuts or blocks; very few roots; indistinct boundary,

B_3	15 cm	brownish yellow (9YR 6/6) sandy loam; very friable; massive; breaks to indefinite crumb-like structures; very few roots; distinct boundary,
C_{11}	15 cm	yellowish brown (9YR 5/6) loamy sand; massive; slightly coherent, breaking to indefinite crumb-like structures; very few roots; sharp boundary,
C_{12}	on	light olive brown (3.5Y 5/6) sandy gravel; loose; structureless; few small to large stones of granite (dominant) and indurated sandstone.

Parent Material: Silty alluvium over gravels from granite (dominant) and indurated sandstone.

Native Vegetation: Red beech (dominant), rimu, kamahi, quintinia, matai and kahikitea.

Profile: Ku 1 (Kumara silt loam, site 1).

Location: 300 m north-east of Reefton railway station. (S. 38/322306).

Topography: Flat, intermediate level, glacial outwash terrace.

Site Vegetation: Manuka scrub, moss, sedges, grass.

Altitude: 250 m — **Estimated annual rainfall:** 1920 mm.

Profile:

A	15 cm	brown to dark brown (7.5YR 4/2) silt loam; slightly plastic; non sticky; structureless; many roots; distinct boundary,

A_2G	10 cm	light brownish grey (10YR 6/2) heavy silt loam; slightly plastic; moderately sticky; massive; moderately coherent; few roots; indistinct boundary,
G	21 cm	light grey (7.5Y 7/1) and dark greyish brown (10YR 4/2) silt loam; plastic; moderately sticky; massive; coherent; few roots; distinct boundary,
B_hG	11 cm	dark brown (7.5YR 3/4) and light grey (7.5Y 7/1) heavy silt loam; slightly plastic; moderately sticky; weakly developed very fine nutty structure; many roots; distinct boundary,
B_2G	4 cm	light grey (7.5Y 7/2) silt loam with dark reddish brown (5YR 2/2) stains along cracks and root channels; slightly plastic; slightly sticky; very weakly developed coarse blocky structure with nutty structure near cracks and some thin platy structure at bottom of horizon; many roots (in patches); distinct boundary,
B_3G	15 cm	light grey (7.5Y 7/1) silt loam; non plastic; non sticky; massive; moderately coherent; few roots; distinct boundary,
C	on	dark yellowish brown (10YR 3/4) gritty silt among weathering granite stones up to 20 cm in diameter; massive; very hard; few roots.

<u>Parent Material</u>: Silty alluvium (or loess?) over gravels from granite (dominant) and indurated sandstone.

Native Vegetation:	Silver pine and mountain beech (dominant), stunted rimu, kamahi and quintinia, and some toa toa, pink pine and yellow-silver pine.
Profile:	Ok 1 (Okarito loamy sand site 1).
Location:	600 m north-west of Waitahu Dam. (S. 38/364340).
Topography:	Slightly undulating high level glacial outwash terrace. Site is 40 m from edge of terrace, and is slightly higher than the main terrace surface.
Site Vegetation:	Manuka scrub, bracken fern, umbrella fern, grass, occasional orchids.
Altitude: 390 m	**Estimated annual rainfall**: 1920 mm.

Profile:

A	14 cm	dark reddish brown (6YR 3/3) loamy sand; non plastic; non sticky; weakly developed medium and fine nutty structure; few roots; distinct boundary,
AG	6 cm	dark greyish brown (10YR 4/2) spotted with light grey (7.5Y 6/1) silt loam; firm; massive; moderately coherent; very few roots; distinct boundary,
G	12 cm	grey (5Y 6/1) silt loam; extremely firm; massive; very coherent; very few roots; patchy boundary,
B_2G	19 cm	light grey (6Y 7/1), orange (10YR 6/6) and brown (10YR 3/3) silt loam; very dark brown (7.5YR 2/3) stains on faces of major vertical cracks and of some prisms; very few roots; distinct boundary,

B_3G	11 cm	light grey (8.5Y 7/1) silt loam; few strong brown (7.5YR 5/8) mottles; very firm; massive; moderately coherent; no roots; distinct boundary,
C	on	grey (7.5Y 6/1) gritty silt loam; very firm; massive; moderately coherent; many weathered granite stones; no roots.

Parent Material: Silty alluvium (or loess?) over gravels from granite (dominant) and indurated sandstone.

Native Vegetation: Stunted forest or scrub of manuka, bog pine, pink pine, yellow-silver pine and mountain beech.

APPENDIX III

PROFILE DESCRIPTIONS OF UPPER HORIZONS OF TRANSECT SOILS, AND OF THE A_2 HORIZON OF I(o) 2.

Note: Site characters for profiles Ah 2 - Ah 9, and for I(o) 2 are similar to those listed in Appendix I for profile Ah 1 and I(o) 1, respectively.

Profile:	Ah 2 (Ahaura fine sandy loam, site 2).
A 6 cm	dark brown (7.5YR 3/4) fine sandy loam; very friable; moderately developed medium and fine nutty structure (surface) grading downward to moderately developed medium and fine granular and fine and very fine crumb; root mat at surface; indistinct boundary,
AB 12 cm	dark brown (7.5YR 3/4) with a few patches of reddish yellow (10YR 6/8) fine sandy loam; very friable; strong to moderately developed medium to very fine nutty, and moderately developed medium and fine granular, and fine and very fine crumb structures; few roots; distinct boundary,
B_{21} 14 cm	strong brown (7.5YR 5/8) fine sandy loam; very friable; moderately developed coarse to fine granular, and fine and very fine crumb structures; some deposition of iron oxides on faces of peds; no roots; diffuse boundary,

Profile:	Ah 3 (Ahaura fine sandy loam, site 3).
A 7 cm	dark reddish brown (5YR 3/2) fine sandy loam; very friable; moderately developed fine nutty structure grading downwards to moderately developed medium and fine granular and fine and very fine crumb; many roots; indistinct boundary,
AB 11 cm	dark reddish brown (5YR 3/2) fine sandy loam; very friable; moderately developed medium and fine nutty structure and moderately developed medium and fine granular, and fine and very fine crumb; many roots; distinct boundary,
B_{21} 14 cm	strong brown (7.5YR 5/8) silt loam; very friable; moderately developed medium and fine nutty structure, and moderately developed coarse to fine granular and fine and very fine crumb; very few roots; diffuse boundary,

Profile:	Ah 4 (Ahaura fine sandy loam, site 4).
OA 6 cm	dark reddish brown (5YR 3/3) peaty fine sandy loam; very friable; weakly developed fine nutty structure breaking to moderately developed medium and fine granular, and fine and very fine crumb; abundant decomposing beech leaves; many roots; distinct boundary,
A_2 14 cm	strong brown (7.5YR 4/6) and dark reddish brown (5YR 2/3) silt loam; very friable; moderately to strongly dveloped medium and fine nutty structure, and medium and fine granular and fine and very fine crumb; many roots; distinct boundary,

B_{21}	15 cm	strong brown (10YR 5/6) silt loam; iron oxide staining on the faces of many peds; very friable; strongly developed medium and fine nutty structure, breaking to fine and very fine granular and crumb; few roots; diffuse boundary,

Profile: Ah 5 (Ahaura fine sany loam, site 5).

A_{21}	8 cm	dark reddish brown (5YR 2/4) peaty fine sandy loam; friable; moderately developed medium and fine nutty, granular and crumb structures; few roots; distinct wavy boundary,
A_{22}	4 cm	dark reddish brown (5YR 2/3) silt loam; friable; moderately developed medium and fine nutty and fine and very fine crumb structures; few roots; sharp wavy boundary,
$B_{h,fe}$	0.4 cm	humus/iron pan: dark reddish brown (5YR 2/2); hard; sharp wavy boundary,
B_{21}	16 cm	yellowish brown (10YR 5/6) silt loam; very friable; weakly developed medium and fine nutty structure breaking to fine and very fine granular; rare roots; diffuse boundary,

Profile: Ah 6 (Ahaura silt loam, site 6).

O	9 cm	dark red (2.5YR 3/6) partly decomposed moroid litter of red beech leaves and twigs; many roots; distinct boundary,

A_2	6 cm	dark reddish brown (2.5 YR 2/4) peaty silt loam; very friable; moderately developed medium and fine nutty structure breaking to moderately developed medium and fine granular, and fine and very fine crumb; many roots; distinct boundary,
B_{21}	14 cm	strong brown (7.5YR 5/6) fine sandy loam; very friable; weakly developed medium and fine nutty structure breaking to moderately developed coarse to fine granular, and fine and very fine crumb; few roots; diffuse boundary,

<u>Profile</u>: Ah 7 (Ahaura fine sandy loam, site 7).

O	5 cm	dark reddish brown (5YR 3/3) partly decomposed moroid litter of red beech leaves and twigs; many roots; distinct boundary,
A	10 cm	very dark brown (7.5YR 2/3) to strong brown (7.5YR 4/6) slightly peaty fine sandy loam; very friable; moderately to strongly developed medium and fine nutty structure breaking to moderately developed fine and very fine granular, and medium to very fine crumb; many roots; distinct boundary,
B_{21}	15 cm	yellowish brown (10YR 5/6) fine sandy loam; very friable; moderately developed medium and fine nutty structure breaking to coarse to fine granular, and fine and very fine crumb; few roots; diffuse boundary,

Profile:		Ah 8 (Ahaura silt loam, site 8).
A	12 cm	dark brown (7.5YR 3/4) silt loam; very friable; moderately to strongly developed medium and fine nutty structure (surface) grading downward to moderately developed medium to very fine granular, and fine and very fine crumb; many roots; distinct boundary,
B_1	18 cm	strong brown (7.5YR 4/6) silt loam; very friable; moderately developed medium and fine nutty structure breaking into medium and fine granular, and fine and very fine crumb; few roots; distinct boundary,
B_{21}	15 cm	brownish yellow (10YR 6/6) silt loam; very friable; breaks ultimately into fine and very fine crumb structures; some tendency to form coarser aggregates that are either nuts or blocks; very few roots; diffuse boundary,

Profile:		Ah 9 (Ahaura silt loam, site 9).
OA	9 cm	dark reddish brown (5YR 2/3) slightly peaty silt loam; very friable; weakly developed fine nutty structure breaking to moderately developed medium and fine granular and fine and very fine crumb; many decomposing red beech leaves and twigs; many roots; distinct boundary,
AB	17 cm	dark brown (7.5YR 4/4) silt loam; very friable; moderately to strongly developed medium and fine nutty structure breaking to medium and fine granular and fine and very fine crumb; few roots; distinct boundary,

B_{21} 16 cm brownish yellow (10YR 6/6) silt loam; very friable; breaks ultimately into fine and very fine crumb structure; some tendency to form coarser aggregates that are either nuts or blocks; very few roots; diffuse boundary,

Profile: I(o) 2 (Ikamatua fine sandy loam, older variant, site 2).

A_2 9 cm dark brown (7.5YR 3/4) peaty fine sandy loam; very friable; weakly developed medium to very fine nutty structure breaking to fine and very fine granular and crumb; few roots; distinct boundary.

ADDENDUM

Since this thesis was completed, further work including the application of the test devised by Greene-Kelly (1953)[1] has confirmed that the smectite group mineral that dominates the clay fractions of the A_2 horizons at Ah 5, and referred to as montmorillonite in the text, belongs to the beidellite-nontronite series. It is likely that the smectite minerals identified at other sites also belong to this series. The products formed from muscovite, the dominant mineral present in the parent material of the soils, are more likely to approach the beidellite end of the series.

Sokolova, Targul'yan and Shostak (1971)[2] and Belousova, Sokolova and Tyapkina (1973)[3] have found highly aluminous minerals of the montmorillonite (smectite) group, in which the layer charge arose in the tetrahedral positions, in the A_2 horizons of Al-Fe-humic podzolic soils. They have identified these minerals as beidellites. It is considered that more detailed examination of the smectite minerals found in the A_2 horizons of podzols from other areas will lead to further reports of the presence of minerals of the beidellite-nontronite series. Such studies may help to elucidate the conditions of formation of the minerals concerned.

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1 GREEN-KELLY, R. 1953. The identification of montmorillonoids in clays. J. Soil. Sci. 4: 233-237.

2 SOKOLOVA, T.A., TARGUL'YAN, V.O., & SHOSTAK, R.V. 1971. Description of a swelling mineral from the A_2 horizons of podzolic Al-Fe-humic soils. Pochvovedeniye 7: 129-137.

3 BELOUSOVA, N.I., SOKOLOVA, T.A., & TYAPKINA, N.A. 1973. Profile differentiation of clay minerals in Al-Fe-podzolic soils on granite. Pochvovedeniye 11: 116-132.