

# GEOLOGICAL SURVEY OF FINLAND RADIOCARBON MEASUREMENTS VI

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In September 1970, the laboratory moved into new premises on the ground floor of a new building. The measuring room is constructed of low radioactive limestone concrete and is lined with grounded copper plate. Air conditioning insures a working temperature of  $20 \pm 1^\circ\text{C}$  and a relative humidity of 40%.

The dating system has 3 copper-walled proportional counters. The iron shield, fashioned out of a 29cm cannon barrel, has 2 sections 190cm long and walls 30cm thick. The total weight is ca 15 tons. Counter 1 has been described previously (Heikkinen, 1971) but subsequently was transferred into a section of the cannon barrel. Counters 2 and 3 are in the other barrel. The proportional counters are shielded by 1.5 to 4cm of selected lead and a ring of 21 cosmic ray Geiger counters (Model HZ-100, Zentralwerkstadt, Göttingen). 2.5cm paraffin wax containing 10% boric acid are between the long sides of the counters and the 30cm-thick iron shield.

Detailed description of the counters are as follows:

Counter	Effective vol ml	Pressure torr	Working voltage	Baromet- ric effect cpm/10 mb	Back- ground B, cpm	Modern carbon A, cpm	Fig of merit A/ $\sqrt{B}$
C-1	570	1524	5100	0.03	1.15	7.02	6.55
C-2	1040	2032	5100	0.04	2.00	17.92	12.67
C-3	1335	2286	5200	0.09	3.25	25.50	14.14

CO<sub>2</sub> is still used as counter gas at a pressure of (1524, 2032 or 2286) mm Hg at a detector temperature of 20°C. Samples are measured for the first time 4 weeks after combustion of the sample and purification of the CO<sub>2</sub>. The counting period is 2400 min and is repeated after ca 2 weeks with another counter. Some samples are measured with the third counter. Alternating counting sample/background was applied to sample Su-153, total counting time: 20,000 min.

All dates are calculated both in years BP (before AD 1950) and in AD/BC scale. Calculations are based on 95% of the isotopically corrected activity of the NBS oxalic acid standard, and on half-life of 5568 yr. Corrections for deviations from the normal <sup>13</sup>C/<sup>12</sup>C ratios ( $\delta^{13}\text{C} = -25.0\text{‰}$  in the PDB scale) have been made for most of the samples.  $\delta^{13}\text{C}$  values quoted are relative to the PDB standard.

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## SAMPLE DESCRIPTIONS

## I. GEOLOGIC SAMPLES

*Finland*

- Su-134. Lammi, S Finland** **3600  $\pm$  100**  
**1650 BC**  
Peat, taken with piston corer, depth 2.40 to 2.60m, alt 90m, surface alt of Lake Lovojärvi 108.2m (61°05' N, 25° 02' E). Coll by E Kukkonen and R Tynni. *Comment:* according to pollen analysis, horizon represents spread of *Picea* (Kukkonen, 1972; Tynni, 1972).
- Su-135. Lammi, S Finland** **8550  $\pm$  100**  
**6600 BC**  
Sulfidic dy from same lake as Su-134, taken with piston corer, depth 3.50 to 3.70m. Coll by E Kukkonen and R Tynni. *Comment:* according to pollen analysis horizon represents Boreal period (Kukkonen, 1972; Tynni, 1972).
- Su-136. Janakkala, Central Finland** **7460  $\pm$  200**  
**5510 BC**  
Conifer wood taken with piston sampler, depth 2.18 to 2.20m, surface alt 106.8m, Käkilamminsuo bog (60° 57' N, 24° 42' E). Coll 1969 by V E Valovirta. *Comment:* pollen analysis indicates Atlantic period.
- Su-137. Renko, Central Finland** **8810  $\pm$  100**  
**6860 BC**  
Detritus gyttja taken with piston sampler, depth 4.90 to 4.95m, surface alt 114.0m Kakarinlampi lake (60° 54' N, 24° 13' E). Coll 1969 by V E Valovirta. *Comment:* pollen analysis shows Boreal period.
- Su-138. Renko, Central Finland** **8490  $\pm$  150**  
**6540 BC**  
Detritus gyttja taken with piston sampler, depth 4.90 to 4.95m, surface alt 114.0m Kakarinlampi lake (60° 54' N, 24° 13' E). Coll by V E Valovirta. *Comment:* pollen analysis shows Boreal period.
- Su-139. Renko, Central Finland** **8940  $\pm$  110**  
**6990 BC**  
Detritus gyttja taken with piston sampler, depth 5.85 to 5.90m, surface alt 110.2m, Valkealammensuo bog (60° 48' N, 24° 26' E). Coll 1969 by V E Valovirta. *Comment:* pollen analysis indicates transition from Pre-Boreal to Boreal period.

**Könkäänlampi series, Inari, N Finland**

Samples from various levels of paludificating shore of Könkäänlampi (68° 43' N, 27° 52' E), surface alt 146.6m. Coll 1969 to 1971 with piston sampler and subm 1971 by E Lappalainen.

**Su-140. Könkäänlampi 1** **1660 ± 110**  
**AD 290**  
 $\delta^{13}C = -29.1\text{‰}$

Gyttja (detritus) at depth 1.91 to 2.00m in peat layer. Pollen analysis: *Pinus* 78%, *Alnus* 3%.

**Su-141. Könkäänlampi 2** **2360 ± 130**  
**410 BC**  
 $\delta^{13}C = -26.8\text{‰}$

Gyttja (detritus) at depth 2.65 to 2.75m in peat layer. Pollen analysis: *Pinus* 59%, *Betula* 40%, *Alnus* 1%.

**Su-142. Könkäänlampi 3** **3990 ± 100**  
**2040 BC**  
 $\delta^{13}C = -26.0\text{‰}$

Gyttja (detritus) from depth 3.92 to 4.03m in peat layer. Pollen analysis: *Pinus* 53%, *Betula* 37%, *Alnus* 9%, *Picea* 1%.

**Su-143. Könkäänlampi 4** **5100 ± 100**  
**3150 BC**  
 $\delta^{13}C = -28.1\text{‰}$

Gyttja (detritus) from depth 4.85 to 4.95m. Pollen analysis: *Pinus* 55%, *Betula* 43%, *Alnus* 2%.

**Su-204. Könkäänlampi 5** **9680 ± 400**  
**7730 BC**  
 $\delta^{13}C = -31.4\text{‰}$

Gyttja from depth 6.90 to 7.00m. Pollen analysis: *Betula* 95%, *Pinus* 4%, *Picea* 1%.

**Hanhijänkä series, Inari, N Finland**

Samples from various levels in Hanhijänkä bog (69° 09' N, 27° 08' E), surface alt 164.5m. Coll with piston sampler 1969 and subm 1971 by E Lappalainen.

**Su-161. Hanhijänkä 1** **2950 ± 130**  
**1000 BC**

Peat (*Carex-Bryales*) from depth 1.93 to 1.97m. Sample represents overgrowth of basin. Pollen analysis: *Betula* 36%, *Pinus* 64%.

**Su-162. Hanhijänkä 2** **4280 ± 100**  
**2330 BC**

Peat (*Bryales-Carex*) from depth 2.70 to 2.74m. From upper part of peat in ooze layer. Pollen analysis: *Betula* 71%, *Pinus* 28%, *Alnus* 1%.

**Su-163. Hanhijänkä 3****9730 ± 150****7780 BC**

Coarse detritus ooze from depth 4.30 to 4.36m from bottom of ooze layer. Pollen analysis: *Betula* 90%, *Pinus* 8%, *Picea* 2%.

**Su-144. Hanhijänkä 4****4940 ± 150****2990 BC** $\delta^{13}C = -24.7\text{‰}$ 

Peat (*Bryales-Carex*) from depth 2.87 to 2.96m. From lower part of peat in same ooze layer as sample Su-162. Pollen analysis: *Betula* 50%, *Pinus* 48%, *Alnus* 2%.

**Su-145. Jyväskylä, Central Finland****8980 ± 150****7030 BC**

Gyttja sampled with piston drill, depth 4.3m, surface alt 157m, Vuorilampi 1 bog, (62° 15' N, 25° 48' E). Coll 1969 by R Repo and R Tynni. *Comment*: according to pollen analysis, horizon corresponds to Pre-Boreal period.

**Su-146. Jyväskylä, Central Finland****8590 ± 100****6640 BC**

Peat, piston drilled, depth 3.5m, surface alt 181m, Vuorilampi 2, a small bog, (62° 13' N, 25° 42' E). Coll 1969 by R Repo and R Tynni. *Comment*: according to pollen analysis horizon corresponds to Boreal period. Profile description: Repo and Tynni (1971, p 199).

**Su-147. Joensuu, E Finland****8000 ± 100****6050 BC**

Peat layer in sand deposit, from depth 1.5m, surface alt 81m, (62° 37' N, 29° 45' E). Coll 1954 by R Repo. *Comment*: peat buried by Ancient Saimaa transgression.

**Su-148. Pornainen, S Finland****3820 ± 110****1870 BC**

Gyttja, taken with piston drill, depth 3.60 to 3.70m, surface alt 46.0m, Valkjärvi lake, (60° 29' N, 25° 26' E). Coll by R Tynni and V Saarinen. *Comment*: according to pollen analysis, horizon represents late phase of Sub-Boreal period.

**Su-149. Utsjoki, N Finland****2830 ± 90****880 BC** $\delta^{13}C = -26.6\text{‰}$ 

Wood peat from top of end moraine, lower part of peat layer, depth 0.6m from summit of Tsaraioaivi fell, alt ca 348m, (69° 46' N, 28° 15' E). Coll 1970 by Heikki Hirvas.

**Su-150. Utsjoki, N Finland****105 ± 50****AD 1845** $\delta^{13}C = -22.9\text{‰}$ 

Twig peat from same site as Su-149. Depth 0.05m. Coll 1970 by Heikki Hirvas.

**Su-151. Luumäki, S Finland** **3670 ± 80**  
**1720 BC**  
 $\delta^{13}C = -25.2\text{‰}$

Coarse detritus gyttja with *Sphagnum* remains taken with piston sampler, depth 1.58 to 1.62m, surface alt 76.2m Paijainniemensuo bog (60° 58' N, 24° 51' E). Coll 1970 by V E Valovirta. *Comment*: pollen analysis shows latter half of Sub-Boreal period.

**Su-153. Sodankylä, N Finland** **42,000 ± 2000**  
**40,050 BC**  
 $\delta^{13}C = -24.2\text{‰}$

Fragments of wood and charcoal from paleosol horizon, depth 2.40m, 1.5km NE of Vuotso village (68° 05.5' N, 27° 09.2' E). Paleosol horizon is in lowermost part of till bed underlain by sorted and till-like material. Coll 1971 by Raimo Kujansuu. *Comment*: occurrence has been described by Kujansuu (1972).  $^{14}C$  age and stratigraphic position place paleosol horizon in Peräpohjola interstadial stage (Korpela, 1962; 1969).

**Kuoshnaoivi series, Inari, N Finland**

Samples from various levels in bog near Kuoshnaoivi fell (69° 23' N, 28° 20' E), at +124.6m. Coll with piston sampler and subm 1970 by E Lappalainen.

**Su-164. Kuoshnaoivi 1** **9300 ± 160**  
**7350 BC**

Gyttja (detritus) from depth 3.82 to 3.89m above mineral bottom. Pollen analysis: *Betula* maximum.

**Su-165. Kuoshnaoivi 2** **4840 ± 100**  
**2890 BC**

Peat (*Bryalis-Carex*) at depth 2.66 to 2.74m. Peat representing overgrowth of basin. Pollen analysis: *Pinus* 72%, *Betula* 28%.

**Su-166. Inari, N Finland** **8950 ± 100**  
**7000 BC**

Wood and peat taken with piston sampler, depth 3.17 to 3.20m, surface alt 203.0m, Sammuttijänkä palsa bog (69° 20' N, 27° 15' E). Coll 1970 by V E Valovirta. *Comment*: pollen analysis shows middle of Pre-Boreal period, Zone IV.

**Su-167. Inari, N Finland** **8740 ± 120**  
**6790 BC**

Same site as Su-166. Peat taken with piston sampler, depth 1.55 to 1.60m, surface alt 203.0m. Coll 1970 by V E Valovirta. *Comment*: pollen analysis shows late Pre-Boreal period.

**Su-168. Vihti, S Finland** **6570 ± 135**  
**4620 BC**

*Sphagnum-Carex* peat taken with piston sampler, depth 5.90 to 5.94m, Hurrinsuo bog (60° 19' N, 24° 21' E). Coll 1971 by V E Valovirta. *Comment*: pollen analysis shows Atlantic period.

**Su-169. Vihti, S Finland** **5930 ± 160**  
**3980 BC**

Wood and peat taken with piston sampler, depth 5.20 to 5.24m, surface alt 50.0m, same site as Su-168. Coll 1971 by V E Valovirta. *Comment:* pollen analysis shows transition from Atlantic to Sub-Boreal period.

**Su-170. Teuva, W Finland** **4350 ± 90**  
**2400 BC**  
 $\delta^{13}C = -29.1\text{‰}$

Wood and peat taken with piston sampler, depth 3.10 to 3.15m, surface alt 79.0m, Varisneva bog (62° 32' N, 21° 40' E). Coll 1971 by V E Valovirta. *Comment:* pollen analysis shows Sub-Boreal period.

**Su-171. Teuva, W Finland** **6370 ± 100**  
**4420 BC**

*Phragmites* peat taken with piston sampler, depth 3.95 to 4.00m, surface alt 97.0m, Lammasneva bog (62° 32' N, 21° 59' E). Coll 1971 by V E Valovirta. *Comment:* pollen analysis indicates early part of Atlantic period.

**Su-172. Vihti, S Finland** **5600 ± 80**  
**3650 BC**  
 $\delta^{13}C = -26.3\text{‰}$

Peat taken with piston sampler, depth 3.80 to 3.84m, surface alt 42.0m, Pehkusuo bog (60° 25' N, 24° 21' E). Coll 1971 by V E Valovirta. *Comment:* pollen analysis indicates Atlantic period.

**Su-173. Vihti, S Finland** **7900 ± 180**  
**5950 BC**

Coarse detritus gyttja and wood taken with piston sampler, depth 5.70 to 5.74m, surface alt 104.0m, Ahvenlampi lake (60° 29' N, 24° 25' E). Coll 1971 by V E Valovirta. *Comment:* pollen analysis shows transition from Boreal to Atlantic.

**Su-174. Vihti, S Finland** **4515 ± 100**  
**2565 BC**

*Phragmites* peat taken with piston sampler, depth 2.30 to 2.35m, surface alt 45.0m, Arosuo bog (60° 25' N, 24° 14' E). Coll 1971 by V E Valovirta. *Comment:* pollen analysis shows end of Atlantic period.

**Su-175. Kauhajoki, W Finland** **8020 ± 80**  
**6070 BC**  
 $\delta^{13}C = -26.0\text{‰}$

*Equisetum* peat taken with piston sampler, depth 2.65 to 2.70m, surface alt 150.0m, Matolamminsuo bog (62° 26' N, 22° 32' E). Coll 1971 by V E Valovirta. *Comment:* pollen analysis shows transition from Boreal to Atlantic period.

**4965 ± 100**  
**3015 BC**

**Su-176. Ähtäri, Central Finland**

Wood and peat taken with piston sampler, depth 2.60 to 2.65m, surface alt 146.0m, Apurinneva bog (62° 29' N, 23° 55' E). Coll 1971 by V E Valovirta. *Comment*: pollen analysis shows end of Atlantic period.

**6030 ± 100**  
**4080 BC**

**Su-177. Jalasjärvi, W Finland**

Wood and peat taken with piston sampler, depth 4.00 to 4.05m, surface alt 91.0m, Ojajärvensuo bog (62° 34' N, 22° 54' E). Coll 1971 by V E Valovirta. *Comment*: pollen analysis shows middle of Atlantic period.

**8070 ± 100**  
**6120 BC**

**Su-178. Alavus, W Finland**

*Equisetum* peat taken with piston sampler, depth 3.75 to 3.80m, surface alt 116.0m, Lylyneva bog (62° 35' N, 23° 26' E). Coll 1971 by V E Valovirta. *Comment*: pollen analysis shows Boreal period.

**Viherperänkeidas bog series, Kankaanpää, W Finland**

Wood and peat from hand-dug sec, surface alt 115.0m, Viherperänkeidas bog (61° 40' N, 23° 02' E). Coll 1971 by V E Valovirta. *Comment*: comparison between wood and peat ages.

**1610 ± 100**  
**AD 340**

**Su-179. Pine wood, depth 1.50m**

**1770 ± 100**  
**AD 180**

**Su-180. *Carex-sphagnum* peat, depth 1.50m**

**1370 ± 100**  
**AD 580**

**Su-181. Pine wood, depth 0.60m**

**1420 ± 100**  
**AD 530**

**Su-182. *Sphagnum* peat, depth 0.60m**

**2090 ± 100**  
**140 BC**

**Su-183. Pine wood, depth 0.70m**

**1980 ± 100**  
**30 BC**

**Su-184. Pine wood-*sphagnum* peat, depth 0.70m**

**Aitoneva bog series, Kihniö, W Finland**

Wood and peat from hand-dug sec, surface alt 162.0m Aitoneva bog (62° 10' N, 23° 20' E). Coll 1971 by V E Valovirta. *Comment*: comparison between wood and peat ages.

**280 ± 100**  
**AD 1670**

**Su-185. Pine wood, depth 0.7m**

**60 ± 100**  
**AD 1890**

**Su-186. Wood-*sphagnum* peat, depth 0.6m**

- Su-187. Wood-sphagnum peat, depth 0.8m**  $540 \pm 140$   
AD 1410
- Su-188. Pine wood, depth 1.5m**  $3220 \pm 100$   
1270 BC
- Su-189. Wood-sphagnum peat, depth 1.5m**  $2810 \pm 100$   
860 BC
- Su-190. Pine wood, depth 2.0m**  $4960 \pm 100$   
3010 BC
- Su-191. Eriophorum-Carex-Sphagnum peat, depth 2.0m**  $4600 \pm 150$   
2650 BC
- Su-205. Janakkala, Central Finland**  $4820 \pm 100$   
2870 BC  
*Sphagnum-Carex* peat taken with piston sampler, depth 4.11 to 4.15m, surface alt 117.0m, Niinisolonsuo bog (60° 47' N, 24° 30' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows transition from Atlantic to Sub-Boreal period.
- Su-206. Janakkala, Central Finland**  $7100 \pm 80$   
5150 BC  
 $\delta^{13}C = -26.3\text{‰}$   
Peat taken with piston sampler, depth 4.76 to 4.80m, surface alt 117.0m, Terrinsuo bog (60° 47' N, 24° 31' E). Coll 1972 by V E Valovirta. *Comment:* beginning of Atlantic period.
- Su-207. Kalvola, Central Finland**  $1830 \pm 50$   
AD 120  
 $\delta^{13}C = -24.3\text{‰}$   
Peat taken with piston sampler, depth 3.30 to 3.35m, surface alt 137.1m, Matolammensuo bog I (60° 57' N, 24° 02' E). Coll 1972 by V E Valovirta. *Comment:* Sub-Atlantic period.
- Su-208. Kalvola, Central Finland**  $8670 \pm 120$   
6720 BC  
 $\delta^{13}C = -28.1\text{‰}$   
Same site as Su-207. Peat taken with piston sampler, depth 2.93 to 2.98m. Coll 1972 by V E Valovirta. *Comment:* pollen analysis indicates Boreal period.
- Su-209. Kalvola, Central Finland**  $1690 \pm 120$   
AD 260  
 $\delta^{13}C = -30.5\text{‰}$   
Peat taken with piston sampler, depth 3.16 to 3.20m, surface alt 134.6m, Rastaslampi (60° 59' N, 24° 05' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows Sub-Atlantic period.



**Su-210. Kalvola, Central Finland****5220 ± 80****3270 BC** $\delta^{13}C = -28.6\text{‰}$ 

Same site as Su-209. Peat taken with piston sampler, depth 3.16 to 3.20m. Coll 1972 by V E Valovirta. *Comment*: pollen analysis shows end of Atlantic period.

**Su-211. Kalvola, Central Finland****7870 ± 100****5920 BC** $\delta^{13}C = -27.8\text{‰}$ 

Same site as Su-209 and Su-210. Peat taken with piston sampler, depth 1.95 to 2.00m. Coll by V E Valovirta. *Comment*: pollen analysis shows Boreal period.

**Su-212. Hattula, Central Finland****5770 ± 150****3820 BC** $\delta^{13}C = -22.7\text{‰}$ 

Peat taken with piston sampler, depth 3.31 to 3.35m, surface alt 121.5m lake Ylinen Savijärvi (61° 00' N, 24° 15' E). Coll 1972 by V E Valovirta. *Comment*: pollen analysis shows middle of Atlantic period.

**Su-213. Hattula, Central Finland****5730 ± 70****3780 BC** $\delta^{13}C = -26.3\text{‰}$ 

Same site as Su-212. Peat taken with piston sampler depth 2.51 to 2.55m. Coll 1972 by V E Valovirta. *Comment*: pollen analysis shows middle of Atlantic period.

**Pormestarinsuo bog series, Renko, Central Finland**

Peat series from Pormestarinsuo bog (60° 58' N, 24° 18' E) taken with piston sampler. Coll 1972 by V E Valovirta.

**Su-217. Depth 2.70 to 2.75m****7900 ± 170****5950 BC** $\delta^{13}C = -27.2\text{‰}$ 

Beginning of Atlantic period.

**Su-218. Depth 3.12 to 3.17m****8970 ± 50****7020 BC** $\delta^{13}C = -29.3\text{‰}$ 

End of Pre-Boreal period.

**Su-219. Janakkala, Central Finland****1490 ± 50****AD 460** $\delta^{13}C = -24.8\text{‰}$ 

Wood and peat taken with piston sampler, depth 1.13 to 1.18m, surface alt 80.8m, Röyhynsuo bog (60° 51' N, 24° 40' E). Coll 1972 by V E Valovirta. *Comment*: pollen analysis shows Sub-Atlantic period.

**Su-220. Janakkala, Central Finland** **3100 ± 60**  
**1150 BC**  
 $\delta^{13}C = -25.4\text{‰}$

Wood and peat taken with piston sampler, depth 2.45 to 2.50m, same site as Su-219. *Comment:* pollen analysis shows Sub-Boreal period.

**Su-221. Janakkala, Central Finland** **4730 ± 50**  
**2780 BC**  
 $\delta^{13}C = -25.1\text{‰}$

*Equisetum-Scheuchzeria-Sphagnum* peat taken with piston sampler, depth 3.95 to 4.00m. Same site as Su-220 and Su-219. *Comment:* pollen analysis shows transition from Atlantic to Sub-Boreal period.

**Su-222. Janakkala, Central Finland** **5790 ± 50**  
**3840 BC**  
 $\delta^{13}C = -26.5\text{‰}$

Telmatic peat taken with piston sampler, depth 4.75 to 4.80m. Same site as Su-219-221. *Comment:* pollen analysis shows Atlantic period.

**Su-225. Muurame, Central Finland** **7920 ± 65**  
**5970 BC**  
 $\delta^{13}C = -31.0\text{‰}$

Peat taken with piston sampler, depth 2.00 to 2.05m, surface alt 99.0m, Tyynelänsuo bog (62° 09' N, 25° 36' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis indicates beginning of Atlantic period.

**Su-226. Toivakka, Central Finland** **8960 ± 50**  
**7010 BC**  
 $\delta^{13}C = -31.9\text{‰}$

Fine detritus ooze taken with piston sampler, Raatosuo bog (62° 12' N, 26° 02' E), depth 5.75 to 5.80m, surface alt 141m. Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows middle of Pre-Boreal period.

**Su-227. Toivakka, Central Finland** **8970 ± 50**  
**7020 BC**  
 $\delta^{13}C = -28.6\text{‰}$

Peat taken with piston sampler, depth 4.65 to 4.70m, surface alt 129.0m, Sammakkosuo bog (62° 13' N, 26° 05' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows middle of Pre-Boreal period.

**Su-228. Toivakka, Central Finland** **6600 ± 50**  
**4650 BC**  
 $\delta^{13}C = -30.4\text{‰}$

Peat taken with piston sampler, depth 4.22 to 4.27m, surface alt 123.5m Antinlammensuo bog (62° 13' N, 26° 13' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows early Atlantic period.

- 8010 ± 50**  
**6060 BC**  
 $\delta^{13}C = -31.0\text{‰}$
- Su-229. Jyväskylä, Central Finland**
- Peat taken with piston sampler, depth 5.00 to 5.05m, surface alt 184.0m Mörkölammensuo bog (62° 20' N, 25° 32' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows Boreal period.
- 7730 ± 50**  
**5780 BC**  
 $\delta^{13}C = -25.7\text{‰}$
- Su-230. Pylkönmäki, Central Finland**
- Phragmites-Sphagnum* peat taken with piston sampler, depth 3.95 to 4.00m, surface alt 205.0m Kiesmisuo bog (62° 41' N, 24° 39' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows beginning of Atlantic period.
- 7860 ± 50**  
**5910 BC**  
 $\delta^{13}C = -25.7\text{‰}$
- Su-231. Lehtimäki, Central Finland**
- Phragmites-Sphagnum* peat taken with piston sampler, depth 7.50 to 7.55m, Kuohukonto bog (62° 47' N, 23° 51' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows transition from Boreal to Atlantic period.
- 3210 ± 90**  
**1260 BC**  
 $\delta^{13}C = -26.6\text{‰}$
- Su-251. Tenhola, S Finland**
- Wood taken with piston sampler, depth 4.90 to 4.95m, surface alt 20.2m Hjortronmossen bog (59° 58' N, 23° 21' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows latter half of Sub-Boreal period.
- 3070 ± 150**  
**1120 BC**  
 $\delta^{13}C = -23.6\text{‰}$
- Su-252. Pohja, S Finland**
- Phragmites* peat taken with piston sampler, depth 3.16 to 3.20m, surface alt 17.0m Östermossen bog (60° 02' N, 23° 35' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows end of Sub-Boreal period.
- 7340 ± 100**  
**5390 BC**  
 $\delta^{13}C = -26.6\text{‰}$
- Su-253. Karjaa, S Finland**
- Peat taken with piston sampler, depth 3.97 to 4.02m, surface alt 42.0m Varvarinsuo bog (62° 07' N, 20° 49' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows early part of Atlantic period.
- 3860 ± 110**  
**1910 BC**  
 $\delta^{13}C = -28.1\text{‰}$
- Su-254. Karjaa, S Finland**
- Peat taken with piston sampler, depth 4.06 to 4.10m, surface alt 33.0m, Mossabölemossen bog (60° 07' N, 23° 50' E). Coll 1972 by V E

Valovirta. *Comment:* pollen analysis shows latter half of Sub-Boreal period.

**Su-255. Karjalohja, S Finland** **5390 ± 70**  
**3440 BC**  
 $\delta^{13}C = -27.5\text{‰}$

Peat taken with piston sampler, depth 4.90 to 4.94m, surface alt 54.8m Pehkusuo bog (60° 12' N, 23° 38' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows Atlantic period.

**Su-256. Karjalohja, S Finland** **2470 ± 60**  
**520 BC**  
 $\delta^{13}C = -27.2\text{‰}$

Peat taken with piston sampler, depth 3.40 to 3.44m, surface alt 86.4m Kakarinlammensuo bog (60° 15' N, 23° 40' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows beginning of Sub-Atlantic period.

**Su-257. Kisko, S Finland** **3490 ± 90**  
**1540 BC**  
 $\delta^{13}C = -27.5\text{‰}$

Peat taken with piston sampler, depth 4.80 to 4.85m, surface alt 46.0m Haikassuo I bog (60° 14' N, 23° 21' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows Sub-Boreal period.

**Su-258. Kisko, S Finland** **3550 ± 90**  
**1600 BC**  
 $\delta^{13}C = -28.7\text{‰}$

Same site as Su-257. Peat taken with piston sampler, depth 4.03 to 4.08m. *Comment:* Sub-Boreal period.

**Su-259. Janakkala, Central Finland** **6490 ± 100**  
**4540 BC**  
 $\delta^{13}C = -27.8\text{‰}$

Wood and peat taken with piston sampler, depth 4.82 to 4.86m, surface alt 81.0m Röyhynsuo bog (60° 52' N, 24° 40' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows early part of Atlantic period.

**Su-260. Kalvola, Central Finland** **4540 ± 100**  
**2590 BC**  
 $\delta^{13}C = -29.3\text{‰}$

Peat taken with piston sampler, depth 4.10 to 4.15m, surface alt 137.5m Matolammensuo bog (60° 57' N, 21° 02' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows Sub-Boreal period.

**Su-261. Kalvola, Central Finland** **1510 ± 50**  
**AD 440**  
 $\delta^{13}C = -26.3\text{‰}$

Peat taken with piston sampler, depth 3.22 to 3.27m, surface alt 135.0m Rastaslammensuo bog (60° 59' N, 25° 05' E). Coll 1972 by V E Valovirta. *Comment:* pollen analysis shows Sub-Atlantic period.

**2250 ± 70**  
**300 BC**  
 $\delta^{13}C = -26.9\text{‰}$

**Su-192. Kuru, SW Finland**

Wood (*Salix* spp and *Betula* spp) from bog under peat 1m thick in Kuru (61° 59' N, 23° 24' E). Wood bore clear marks of gnawing by beaver (*Castor fiber* L) (Lappalainen and Lahti, 1973).

**Angeli series, Inari, N Finland**

Two samples containing plant remnants from bottom of basin. The stratigraphic site is overlain by 4m ooze overlain by 3.60m peat (69° 57' N, 25° 42' E), alt 205m. Coll with piston sampler and subm 1971 by E Lappalainen.

**8490 ± 100**  
**6540 BC**

**Su-194. Angeli**

Undisintegrated remnants of following plants: *Mnium cuspidatum*, *Drepanocladus* spp, *Betula tortuosa* and *Salix Lapponum*. Coll at depth 7.93 to 7.98m. Pollen analysis: *Betula* 78%, *Pinus* 21%, *Alnus* 1%. Sample location near shift of *Betula/Pinus*.

**8080 ± 100**  
**6130 BC**  
 $\delta^{13}C = -29.3\text{‰}$

**Su-193. Angeli**

Twigs from above preceding sample, depth 7.86 to 7.91m.

**Parvavuoma series, Kittilä, N Finland**

Samples from Parvavuoma bog (67° 37' N, 25° 00' E), surface alt 179.7m, from bottom of paludificated channel eroded by glacial melt waters. Coll with piston sampler 1971 and subm 1972 by E Lappalainen.

**10,600 ± 200**  
**8650 BC**  
 $\delta^{13}C = -28.7\text{‰}$

**Su-202. Parvavuoma 3**

Gyttja (detritus) from depth 6.98 to 7.07m. *Comment* (EL): previous dates of same pollen analytic horizon 10,820 ± 270 BP (I-1660) and 11,000 ± 130 BP (T-825). Sample belongs to younger Dryas period (Lappalainen, 1970; 1972b, c).

**9710 ± 100**  
**7760 BC**  
 $\delta^{13}C = -28.7\text{‰}$

**Su-203. Parvavuoma 4**

Gyttja (detritus) at depth 6.75 to 6.84m.

**3350 ± 100**  
**1400 BC**

**Su-195. Salla, N Finland**

Detritus gyttja from hand-dug sec, depth 0.45 to 0.55m, surface alt 257m, bog E of Mujuvaarankangas (67° 33' N, 29° 22' E). Coll 1971 by H Hirvas and R Tynni. *Comment*: pollen analysis places horizon in Pre-Boreal period, but sediment contains older and younger organic matter including some diatoms from Tertiary period.

**Su-214. Ylitornio, N Finland** **4780 ± 150**  
**2830 BC**  
 $\delta^{13}\text{C} = -27.2\text{‰}$

Wood from sandy shallow-water sediment, depth 2m, surface alt 49m, Tornio R valley (66° 17' N, 23° 40' E). Coll 1971 by Sakari Leskelä. *Comment*: allochthonous material deposited in Litorina Sea.

#### Sedimentation rate series, Central Finnish lakes

**Su-223. Mäntyharju, Central Finland** **4900 ± 80**  
**2950 BC**  
 $\delta^{13}\text{C} = -28.9\text{‰}$

Lake sediment containing humus taken with sediment sampler 25cm below bottom and 32m below surface of Lahnavesi, a lake in Mäntyharju, surface alt 80m (61° 29' N, 26° 41' E). Coll 1972 and subm by Matti Miekko-oja. *Comment*: date shows connection points between sediment of Lahnavesi in the Mäntyharju watercourse and drying of the channel between this watercourse and Lake Saimaa, and confirms date of break of Vuoksenniska (Saarnisto, 1970).

**Su-224. Mäntyharju, Central Finland** **7260 ± 80**  
**5310 BC**  
 $\delta^{13}\text{C} = -28.8\text{‰}$

Lake sediment containing humus taken with sediment sampler 40cm below bottom and 32m below surface of Lahnavesi lake, surface alt 80m (61° 29' N, 26° 41' E). Coll 1972 by Matti Miekko-oja. *Comment*: date indicates beginning of flow of humus to Lahnavesi.

#### II. NATURAL GAS SAMPLES

Gas samples were coll 1971 by Aulis Heikkinen (Su-155-158) and 1972 (Su-200) from gases dissolved in ground water. He used 10l gas collecting bottles filled with sealing fluid, the opening of the bottle placed face down in a dish containing the same liquid. The sealing fluid was a saturated sodium sulphate solution whose pH was slightly decreased with sulphuric acid. The gas released displaced the corresponding volume of fluid. A little fluid was left in the bottle and the stopper was put on under the solution. The sampling bottles were then sent stopper downwards to the laboratory for treatment.

According to the gas chromatographic analyses, the gases are composed mainly of methane, nitrogen, and oxygen. Before combustion of methane into CO<sub>2</sub>, the gas was washed with sodium hydroxide. The age obtained from methane was that of the organic matter that produced methane through fermentation from bacterial activity (Heikkinen, 1972; 1973).

**Su-197. Loppi**  $\delta^{14}\text{C} = +541 \pm 7\text{‰}$   
 $\Delta^{14}\text{C} = +547 \pm 7\text{‰}$   
 $\delta^{13}\text{C} = -26.9\text{‰}$

Leaves (*Carex vesicaria*), coll Aug 29, 1971.

**Su-198. Loppi**  $\delta^{14}\text{C} = +542 \pm 12\text{‰}$   
 $\Delta^{14}\text{C} = +539 \pm 12\text{‰}$   
 $\delta^{13}\text{C} = -23.6\text{‰}$

Leaves (*Phragmites communis*), coll Aug 29, 1971.

**Su-155. Tyrnävä, W Finland** **5600 ± 80**  
**3650 BC**  
 $\delta^{13}C = -60.1\text{‰}$

Methane from a well on the Lassila farm (64° 46.4' N, 25° 36.5' E). The gas is expelled from ground water flowing at depth ca 10 to 14m in sand between clay sediments containing organic matter (Hyypä, 1935).

**Su-156. Tyrnävä, W Finland** **5350 ± 80**  
**3400 BC**  
 $\delta^{13}C = -57.4\text{‰}$

Methane from Uusilaanila well (64° 46.5' N, 25° 36.5' E). Depth of well 52m. Gas emerges at depth ca 19m.

**Su-157. Tyrnävä, W Finland** **5670 ± 100**  
**3720 BC**  
 $\delta^{13}C = -63.8\text{‰}$

Methane from a well on the Ala-Laanila farm (64° 46.5' N, 25° 36.2' E). Depth of well 50m. Gas emerges at depth ca 20m.

**Su-158. Muhos, W Finland** **5790 ± 90**  
**3840 BC**  
 $\delta^{13}C = -60.4\text{‰}$

Methane from natural gas at base of channel cut by Rovastinoja (64° 49' N, 25° 59' E). Depth of channel is ca 10m. *Comment* (Su-156-158): mean age of initial material from which the gases derive is 5600 yr according to the Libby value and 5770 yr according to half-life value of  $5730 \pm 40$ . In Baltic Sea history, this age corresponds to Litorina Sea stage (L II), when the site formed the bottom of a deep and calm bay. Anaerobic methane bacteria produce gases which derive from organisms deposited in that bay (Heikkinen, 1972).

**Su-200. Leppävirta, Central Finland** **8420 ± 200**  
**6470 BC**  
 $\delta^{13}C = -40.8\text{‰}$

Methane from the Kotalahti mine (62° 34.5' N, 27° 36' E), from 600m level from a drill hole descending 600 to 700m from surface. *Comment*: present-day mining area was under Ancylus lake when organic matter was deposited (Heikkinen, 1973).

### III. GEOCHEMICAL SAMPLES

Leaves from birch trees and annual plants from Pitkälampi bog (60° 43' N, 24° 12' E), Loppi, S Finland, +110m. Samples grew on paludifying shore of oligotrophic pond. They were cleaned and washed with distilled water; coll Aug 1971 and June 1972 by Aulis Heikkinen.

#### Loppi series

**Su-196. Loppi**  $\delta^{14}C = +547 \pm 12\text{‰}$   
 $\Delta^{14}C = +546 \pm 12\text{‰}$   
 $\delta^{13}C = -24.7\text{‰}$

Leaves (*Carex lasiocarpa*), coll Aug 29, 1971.

**UB-703. Ballymacdermot Cairn, Sample 9** **975 ± 70**  
**AD 975**  
 $\delta^{13}C = -25.3\text{‰}$

Charcoal from among stones and soil overlying pre-cairn soil in Cutting 9. *Comment*: as for Sample 8 (UB-700).

**UB-702. Ballymacdermot Cairn, Sample 10** **6925 ± 95**  
**4975 BC**  
 $\delta^{13}C = -25.1\text{‰}$

<b>Su-197. Loppi</b>	$\delta^{14}\text{C} = +541 \pm 7\text{‰}$ $\Delta^{14}\text{C} = +547 \pm 7\text{‰}$ $\delta^{13}\text{C} = -26.9\text{‰}$
Leaves ( <i>Carex vesicaria</i> ), coll Aug 29, 1971.	
<b>Su-198. Loppi</b>	$\delta^{14}\text{C} = +542 \pm 12\text{‰}$ $\Delta^{14}\text{C} = +539 \pm 12\text{‰}$ $\delta^{13}\text{C} = -23.6\text{‰}$
Leaves ( <i>Phragmites communis</i> ), coll Aug 29, 1971.	
<b>Su-199. Loppi</b>	$\delta^{14}\text{C} = +534 \pm 14\text{‰}$ $\Delta^{14}\text{C} = +533 \pm 14\text{‰}$ $\delta^{13}\text{C} = -24.8\text{‰}$
Leaves ( <i>Betula odorata</i> ), col Aug 29, 1971.	
<b>Su-232. Loppi</b>	$\delta^{14}\text{C} = +499 \pm 4\text{‰}$ $\Delta^{14}\text{C} = +507 \pm 4\text{‰}$ $\delta^{13}\text{C} = -27.7\text{‰}$
Leaves ( <i>Carex lasiocarpa</i> ), coll June 15, 1972.	
<b>Su-233. Loppi</b>	$\delta^{14}\text{C} = +511 \pm 4\text{‰}$ $\Delta^{14}\text{C} = +515 \pm 4\text{‰}$ $\delta^{13}\text{C} = -26.3\text{‰}$
Leaves ( <i>Carex vesicaria</i> ), coll June 15, 1972.	
<b>Su-234. Loppi</b>	$\delta^{14}\text{C} = +522 \pm 13\text{‰}$ $\Delta^{14}\text{C} = +516 \pm 13\text{‰}$ $\delta^{13}\text{C} = -22.9\text{‰}$
Leaves ( <i>Phragmites communis</i> ), coll June 15, 1972.	
<b>Su-235. Loppi</b>	$\delta^{14}\text{C} = +484 \pm 6\text{‰}$ $\Delta^{14}\text{C} = +497 \pm 6\text{‰}$ $\delta^{13}\text{C} = -29.5\text{‰}$
Leaves ( <i>Betula odorata</i> ), coll June 15, 1972.	

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