

GEOLOGICAL SURVEY OF CANADA



COMMISSION GÉOLOGIQUE DU CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES

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AIRBORNE GAMMA RAY SPECTROMETER
SURVEY

SASKATCHEWAN

1989

HARDY STUDY AREA



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GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA
OTTAWA

AIRBORNE GAMMA RAY SPECTROMETER SURVEY

HARDY, SASKATCHEWAN

GSC OPEN FILE No. 2223

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Mineral Resources Division
Geological Survey of Canada

In 1989 the Geological Survey of Canada conducted airborne geophysical surveys in the Willow Bunch Lake area of southern Saskatchewan in order to demonstrate the usefulness of airborne gamma ray spectrometry in distinguishing soil types and mapping surficial geology. In addition to gamma ray data, VLF-EM and total field magnetic data were also recorded.

Two areas, each approximately 25 km by 30 km, were surveyed; one area located over the town of Hardy (Open File 2223), the other area located south of Radville and centred about Freda Lake-Cecilia Lake (Open File 2208).

Data Presentation

This booklet contains colour contour maps of exposure rate, potassium, equivalent uranium and equivalent thorium concentrations and the eU/eTh, eU/K and eTh/K ratios. Also included are a ternary radioelement map, total field magnetic and VLF-EM maps. The scale of these maps, 1:126,720 (2 miles = 1 inch) was chosen to correspond to a surficial geology map of the region (J.G. Ellis, D.F. Acton and H.C. Moss, 1967, The Soils of the Willow Bunch Lake Map Area, 72H Saskatchewan, Saskatchewan Institute of Pedology, Publication S2).

Stacked profiles for each flight line, also in the booklet, show the VLF quadrature and total field components, magnetic total field, gamma radiation exposure rate, potassium, equivalent uranium and equivalent thorium concentrations, eU/eTh, eU/K and eTh/K ratios, and terrain clearance.

Instrumentation

All data were sampled at 1 second intervals. The airborne gamma ray measurements were made using a 256 channel spectrometer, with twelve 102x102x406 mm NaI(Tl) detectors, flown at a mean terrain clearance of 125 m at 190 km/h and a flight line spacing of 800 metres.

Potassium is measured directly from the 1.46 MeV gamma ray photons emitted by ⁴⁰K, whereas uranium and thorium are measured

indirectly from gamma ray photons emitted by daughter products in their decay chains. Uranium is monitored by means of gamma ray photons at approximately 1.76 MeV from ²¹⁴Bi, and thorium, from 2.62 MeV photons emitted by ²⁰⁸Tl. The energy windows used are as follows:

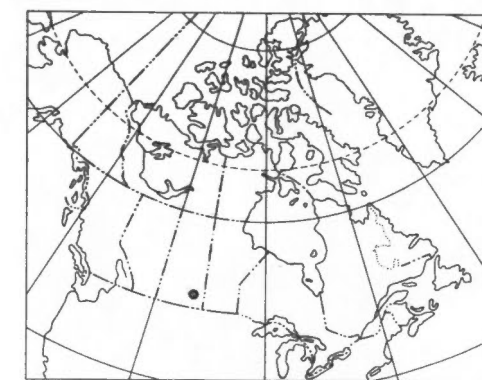
Potassium	⁴⁰ K	1.36-1.56 MeV
Uranium	²¹⁴ Bi	1.66-1.86 MeV
Thorium	²⁰⁸ Tl	2.41-2.81 MeV

Uranium, thorium and potassium counts have been corrected for dead time, ambient temperature changes, background radiation, spectral scattering and deviations of terrain clearance from the planned survey altitude. The data presented represent an average surface concentration which is influenced by varying amounts of outcrop, overburden, vegetation, soil moisture and surface waters.

Factors for converting the airborne measurements to concentrations were determined by relating the airborne count rates to the known ground concentrations of a test strip in the Ottawa area. The factors used to convert the airborne measurements to ground concentrations are:

1% K	91.0 cps
1 ppm eU	9.1 cps
1 ppm eTh	7.0 cps

The exposure rate, in micro Roentgens per hour has been computed from the measured concentrations of potassium, uranium and thorium (Grasty, R.L., Carson, J.M., Charbonneau, B.W. and Holman, P.B., 1984, Natural Background Radiation in Canada, Geol. Surv. Can., Bull. 360). To compare these data with earlier total count maps expressed in Units of Radioelement concentrations (Ur), the conversion factors is $1\mu R/h=1.67 Ur$.

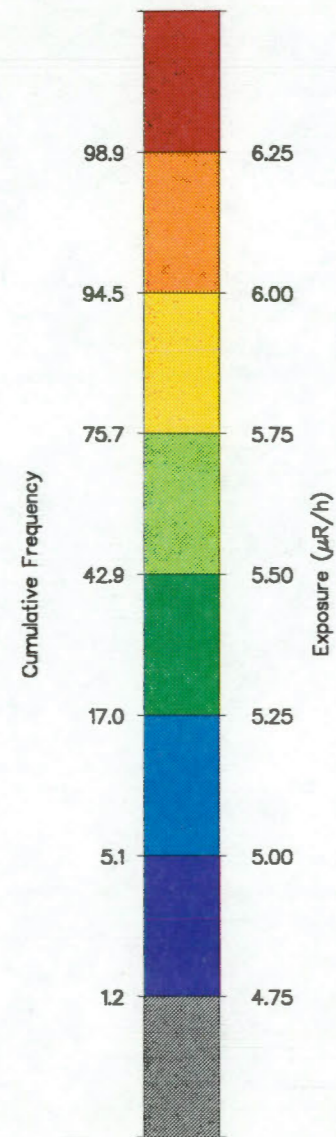


INDEX MAP

EXPOSURE ($\mu\text{R}/\text{H}$)


Hardy Survey, Saskatchewan, 1989

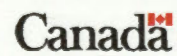
Reference map: Soil map of the
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Saskatchewan, NTS 72H east half.

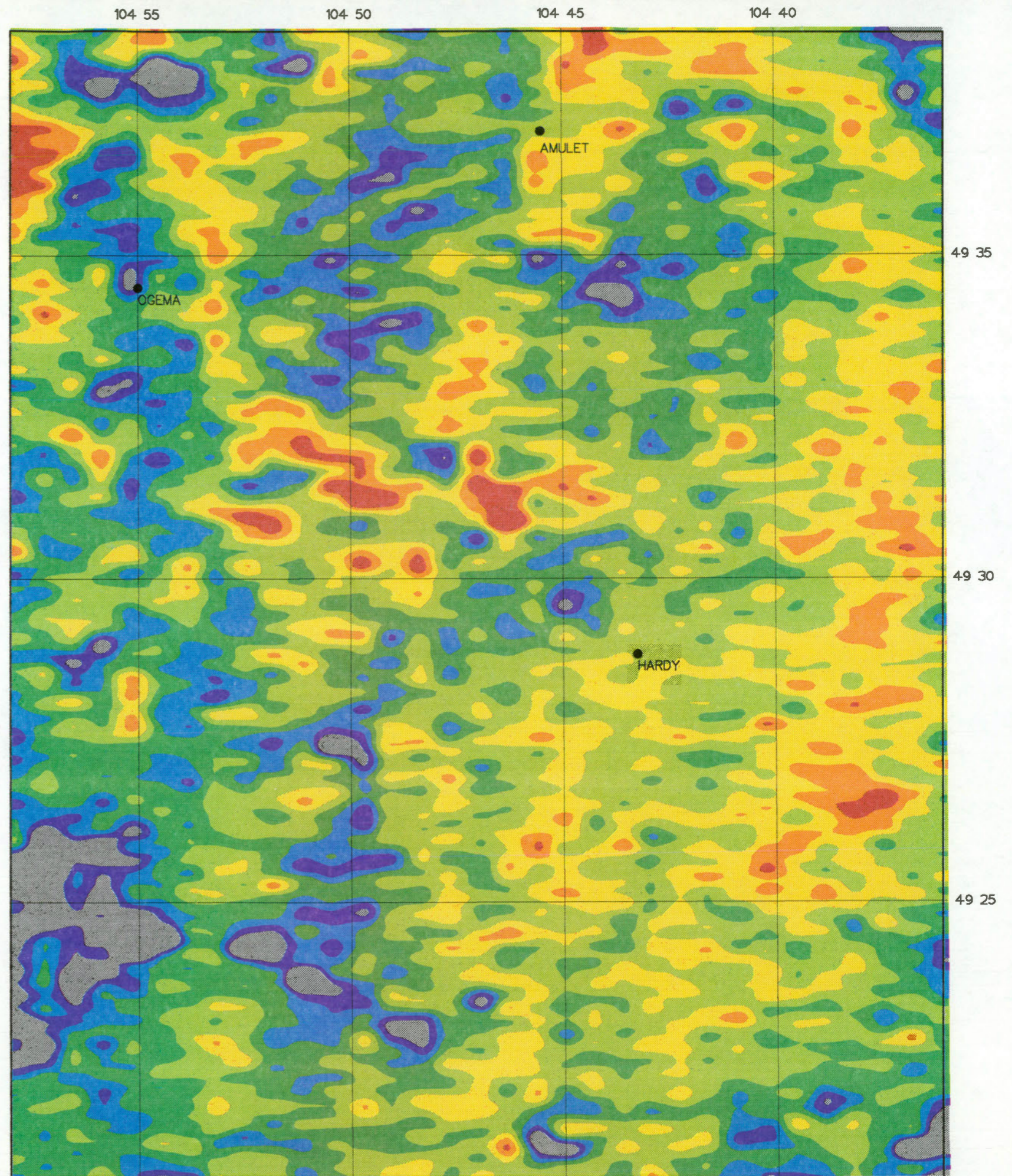


Scale = 1:126 720
Line spacing = 800 metres

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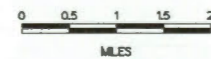
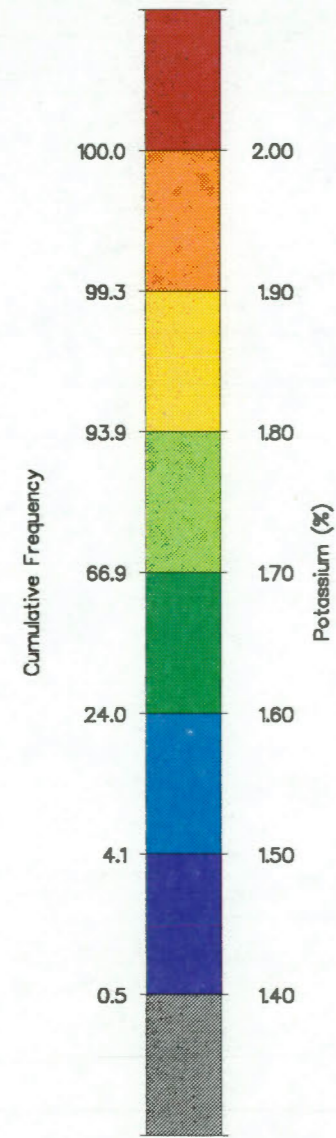




POTASSIUM (%)

Hardy Survey, Saskatchewan, 1989

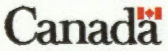
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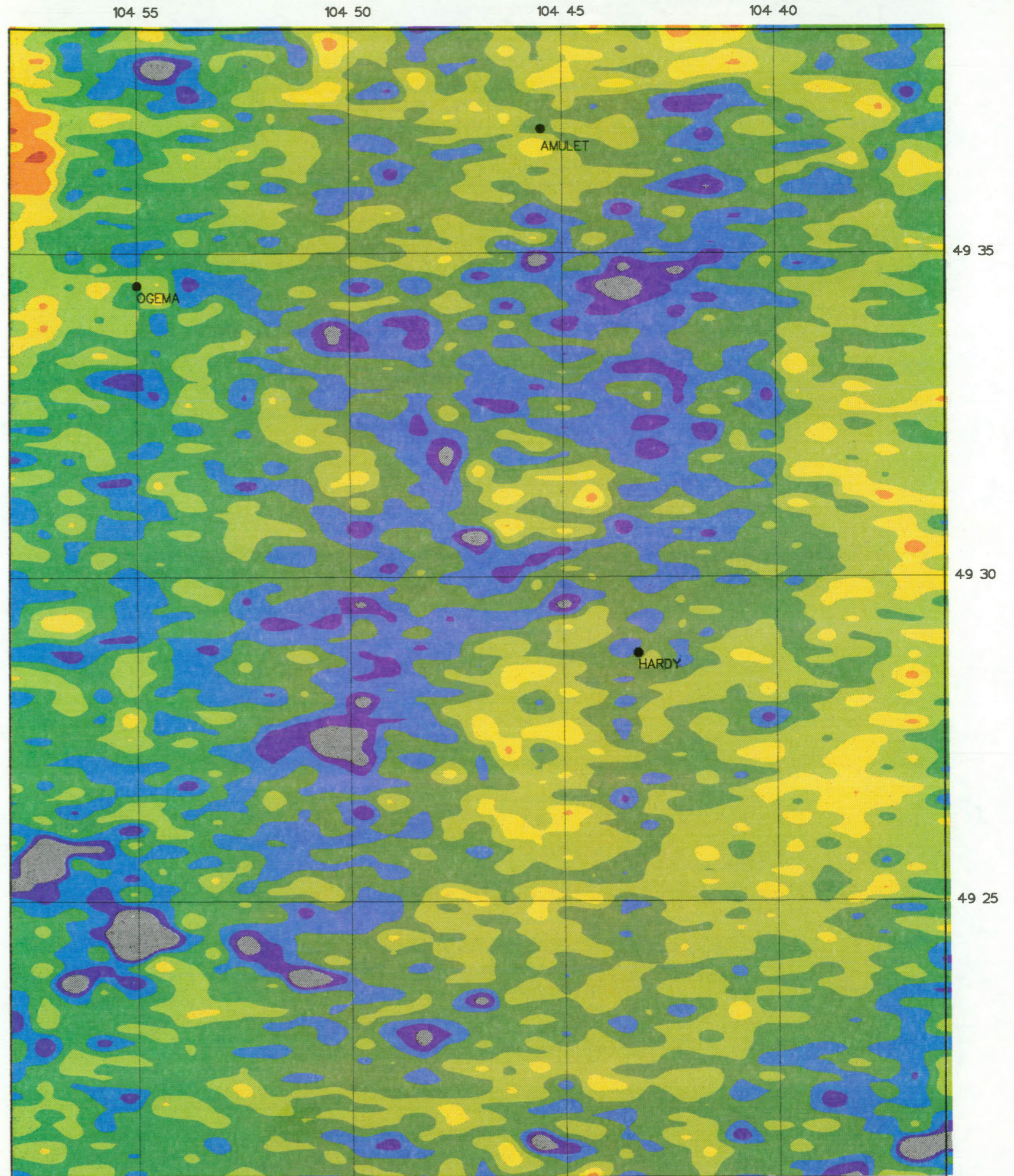


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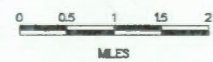
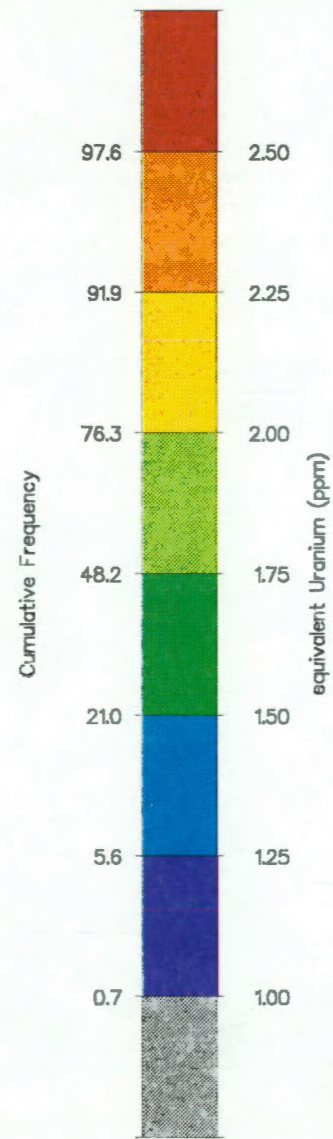




EQUIVALENT URANIUM (PPM)

Hardy Survey, Saskatchewan, 1989

Reference map: Soil map of the
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Saskatchewan, NTS 72H east half.



Scale = 1:126 720
Line spacing = 800 metres

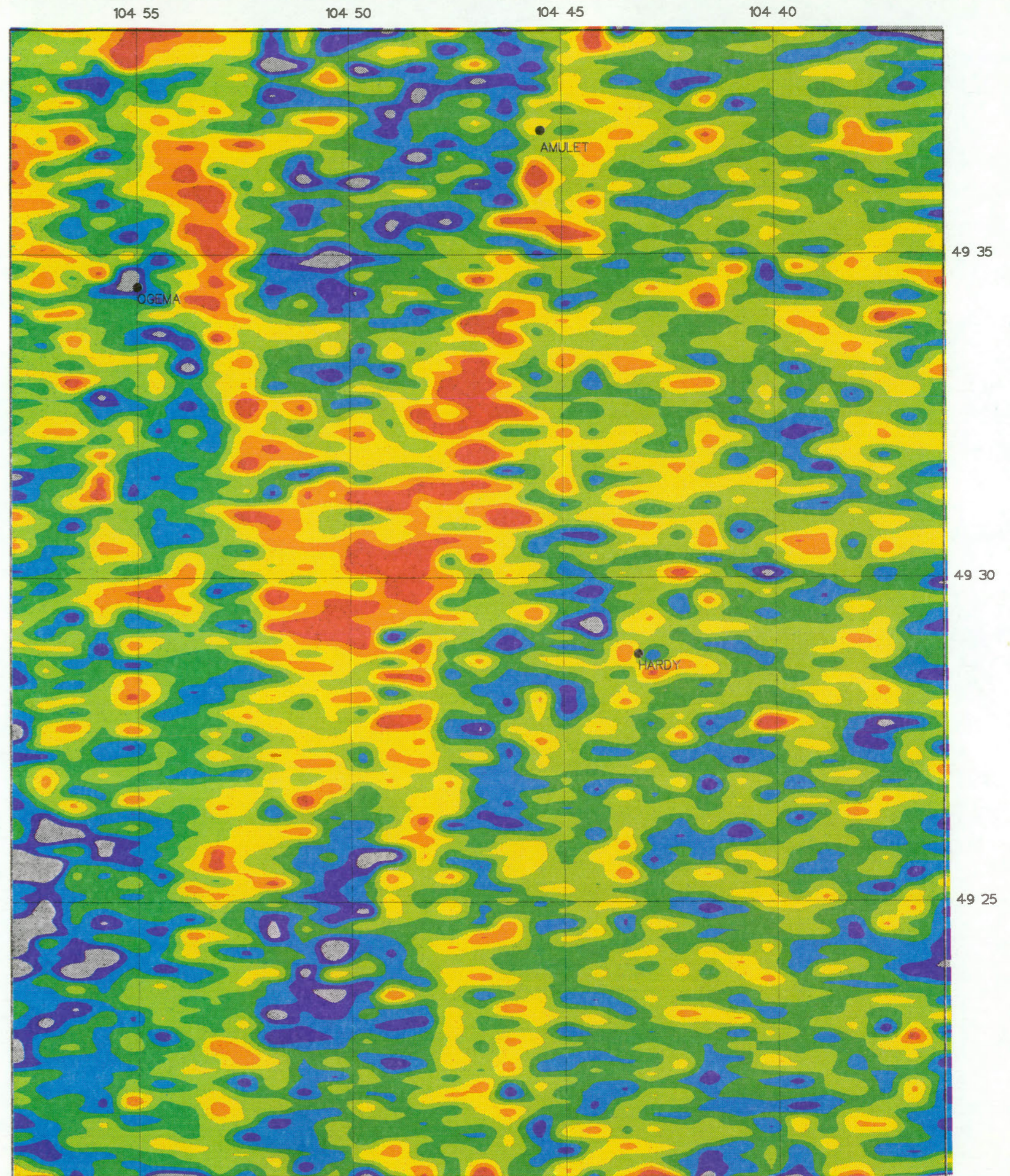
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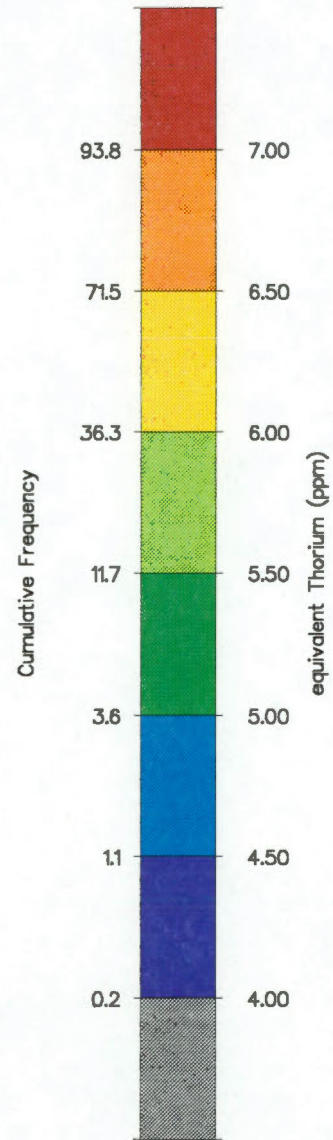
Canada



EQUIVALENT THORIUM (PPM)

Hardy Survey, Saskatchewan, 1989

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Scale = 1:126 720
Line spacing = 800 metres

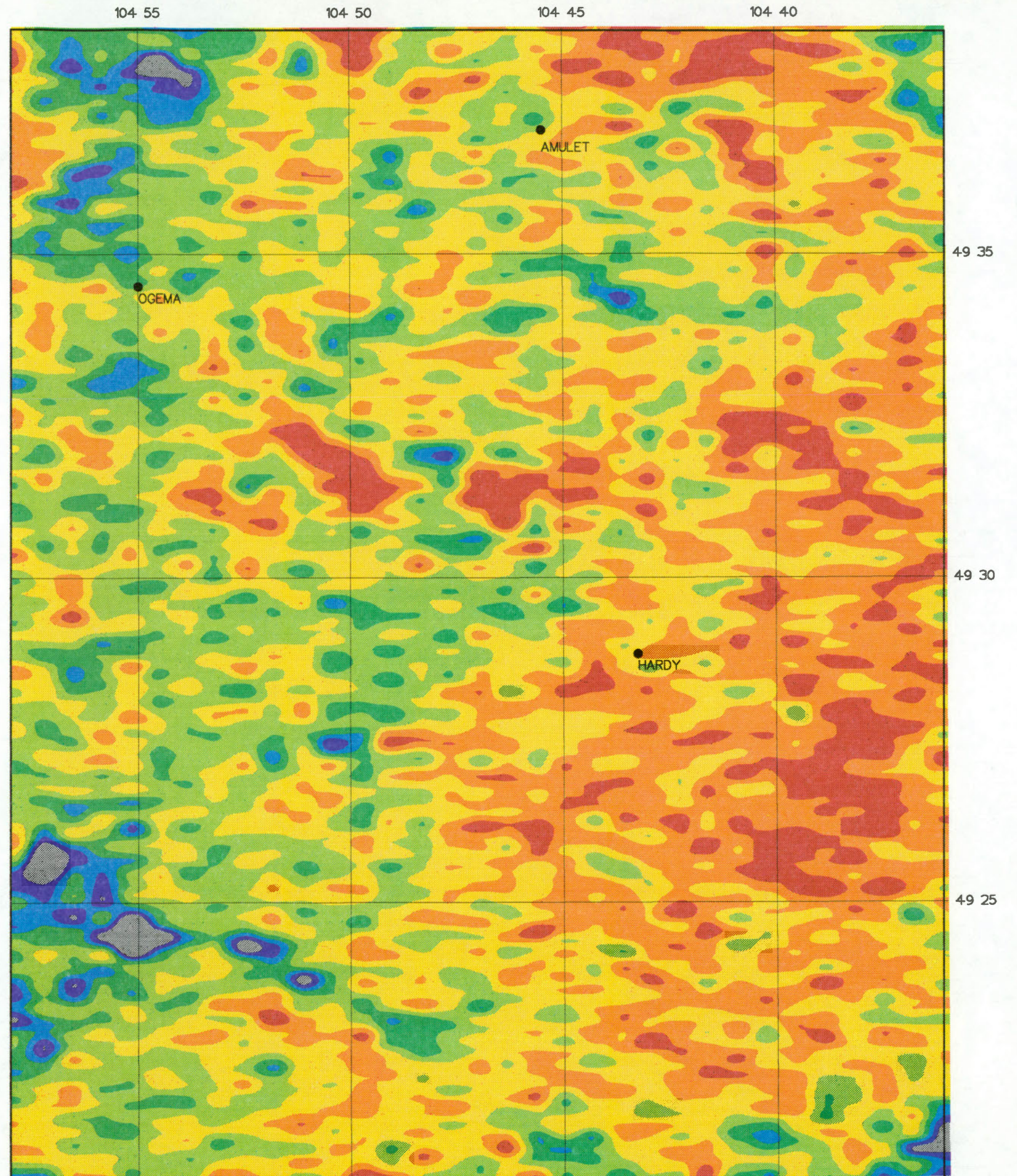
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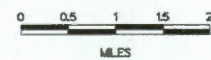
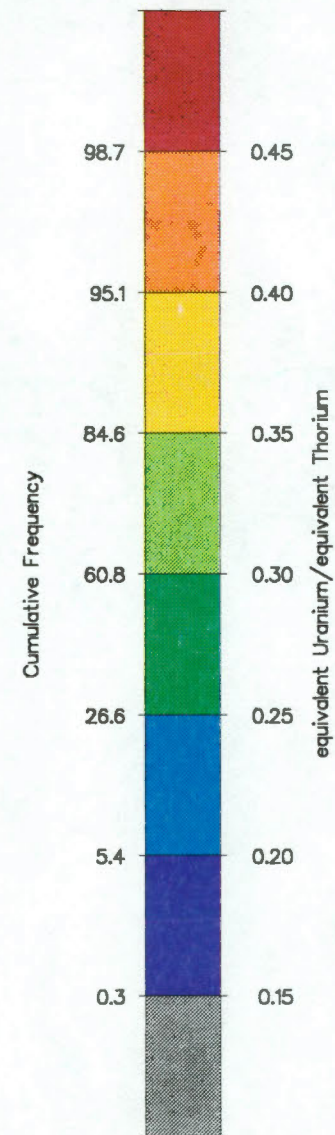
Canada



EQUIVALENT URANIUM/EQUIVALENT THORIUM

Hardy Survey, Saskatchewan, 1989

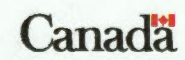
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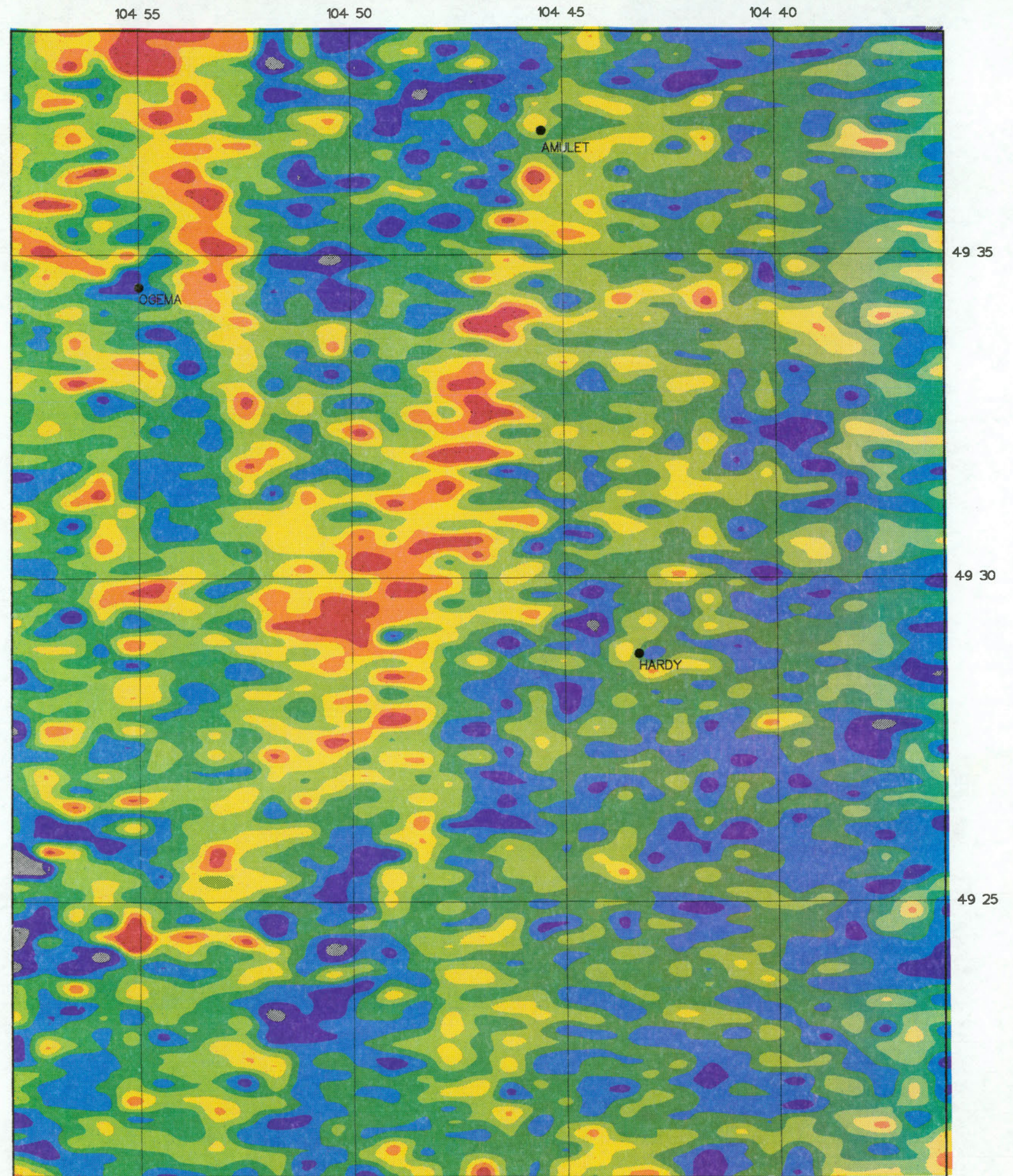


Scale = 1:126 720
Line spacing = 800 metres

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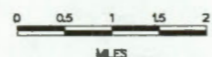
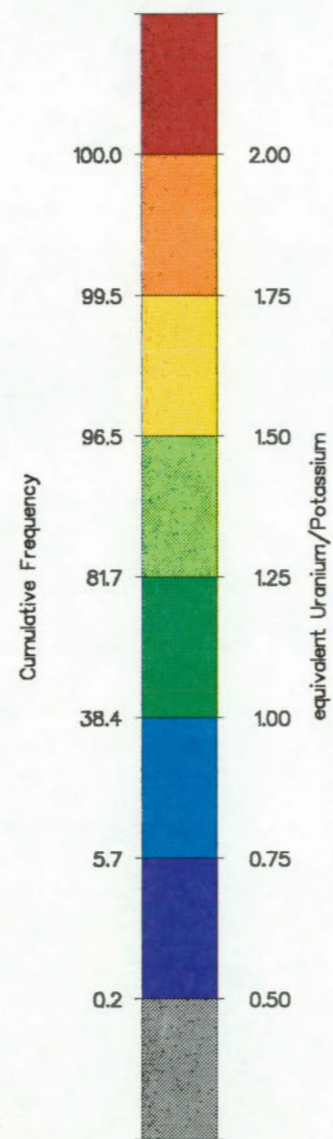




EQUIVALENT URANIUM/POTASSIUM


Hardy Survey, Saskatchewan, 1989

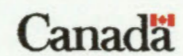
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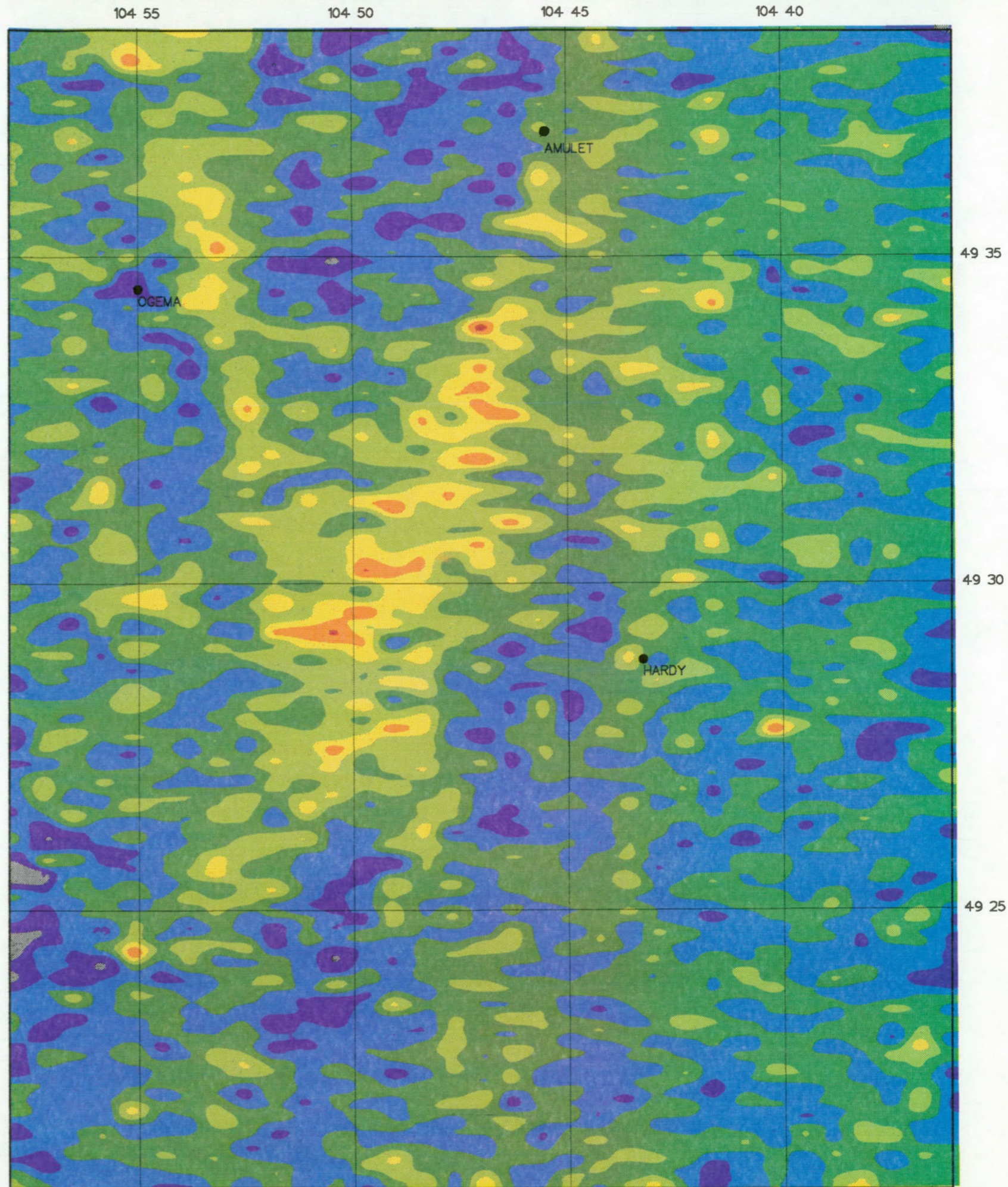


Scale = 1:126 720
Line spacing = 800 metres

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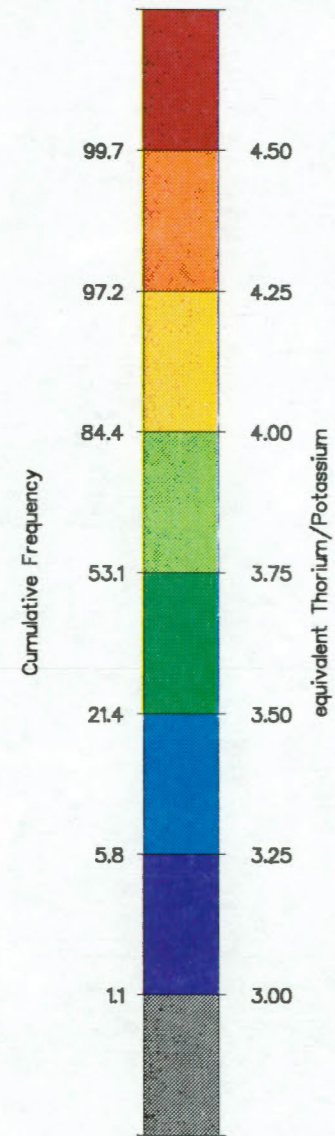




EQUIVALENT THORIUM/POTASSIUM


Hardy Survey, Saskatchewan, 1989

Reference map: Soil map of the
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Saskatchewan, NTS 72H east half.



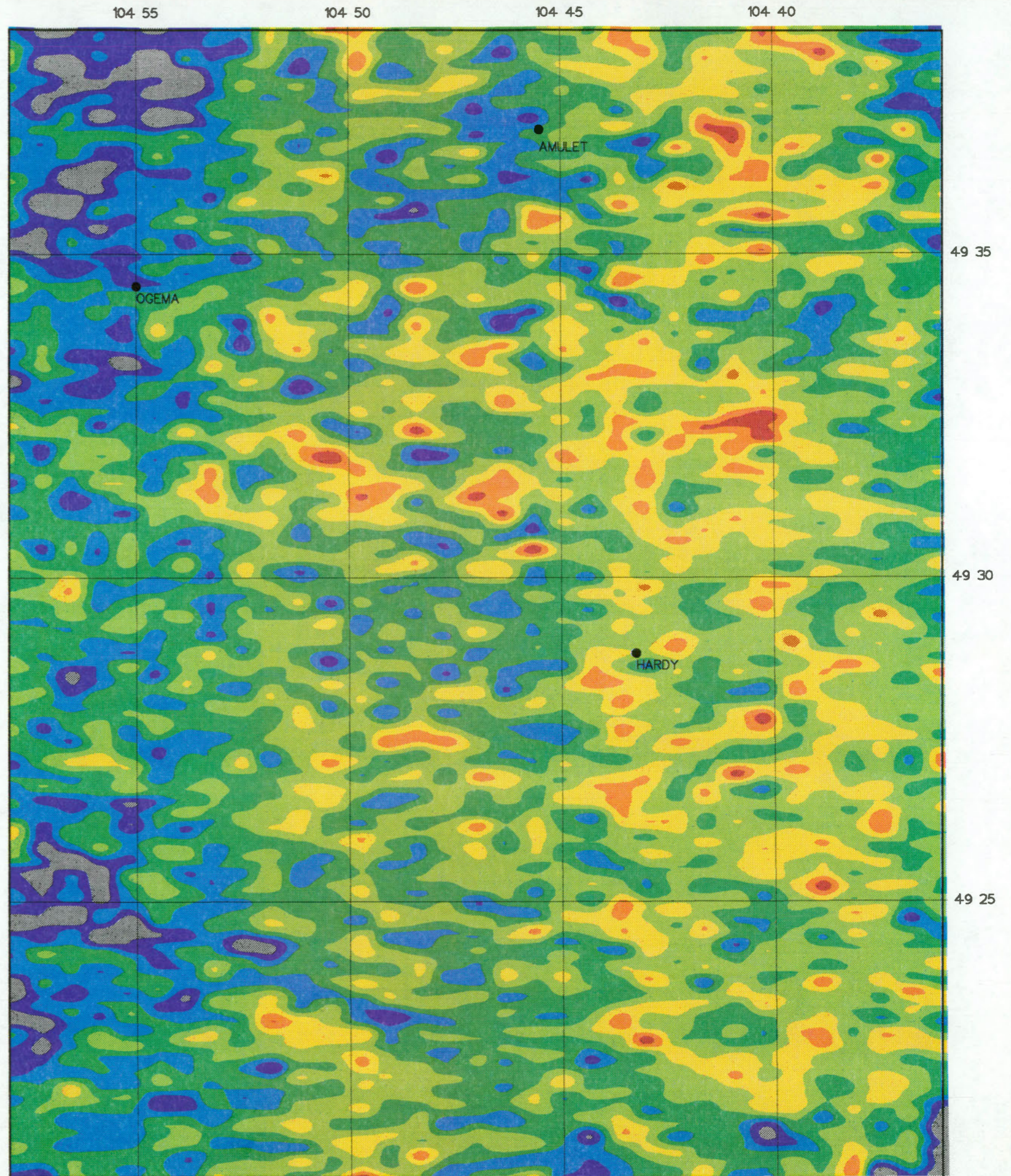
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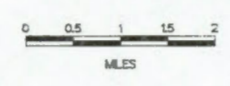
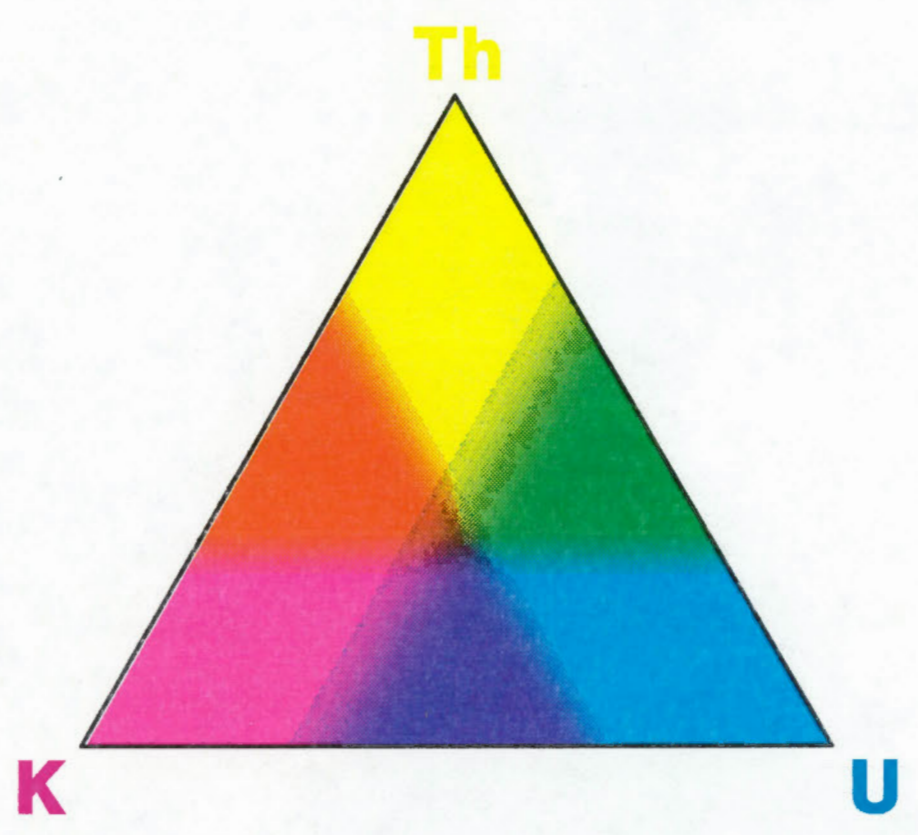




TERNARY RADIOELEMENT MAP


Hardy Survey, Saskatchewan, 1989


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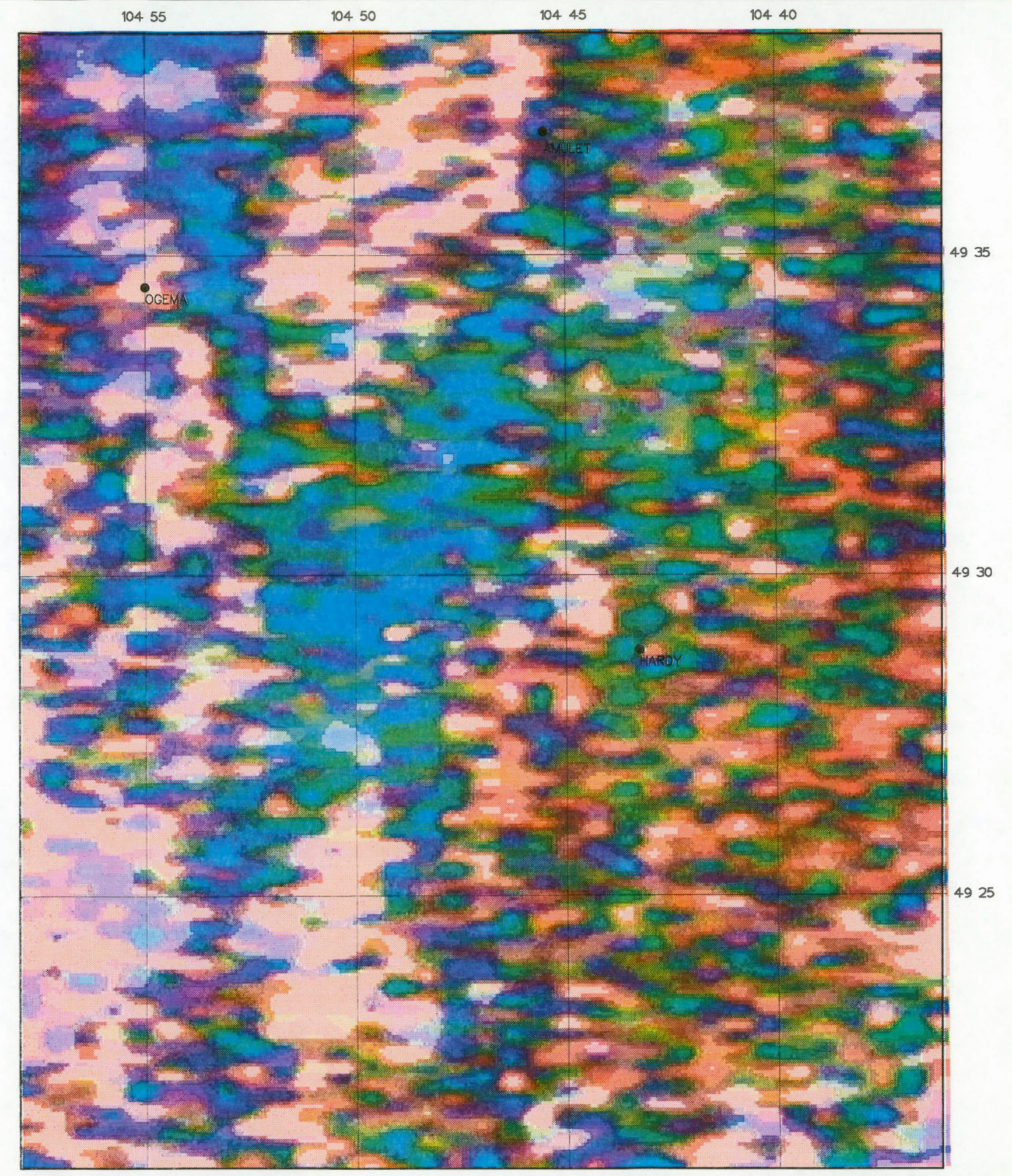


Scale = 1:126 720
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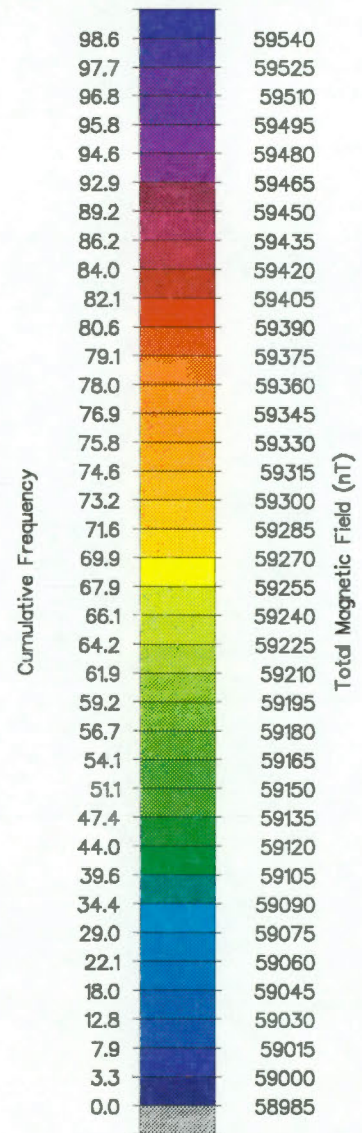




TOTAL MAGNETIC FIELD (nT)


Hardy Survey, Saskatchewan, 1989

Reference map: Soil map of the
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Saskatchewan, NTS 72H east half.

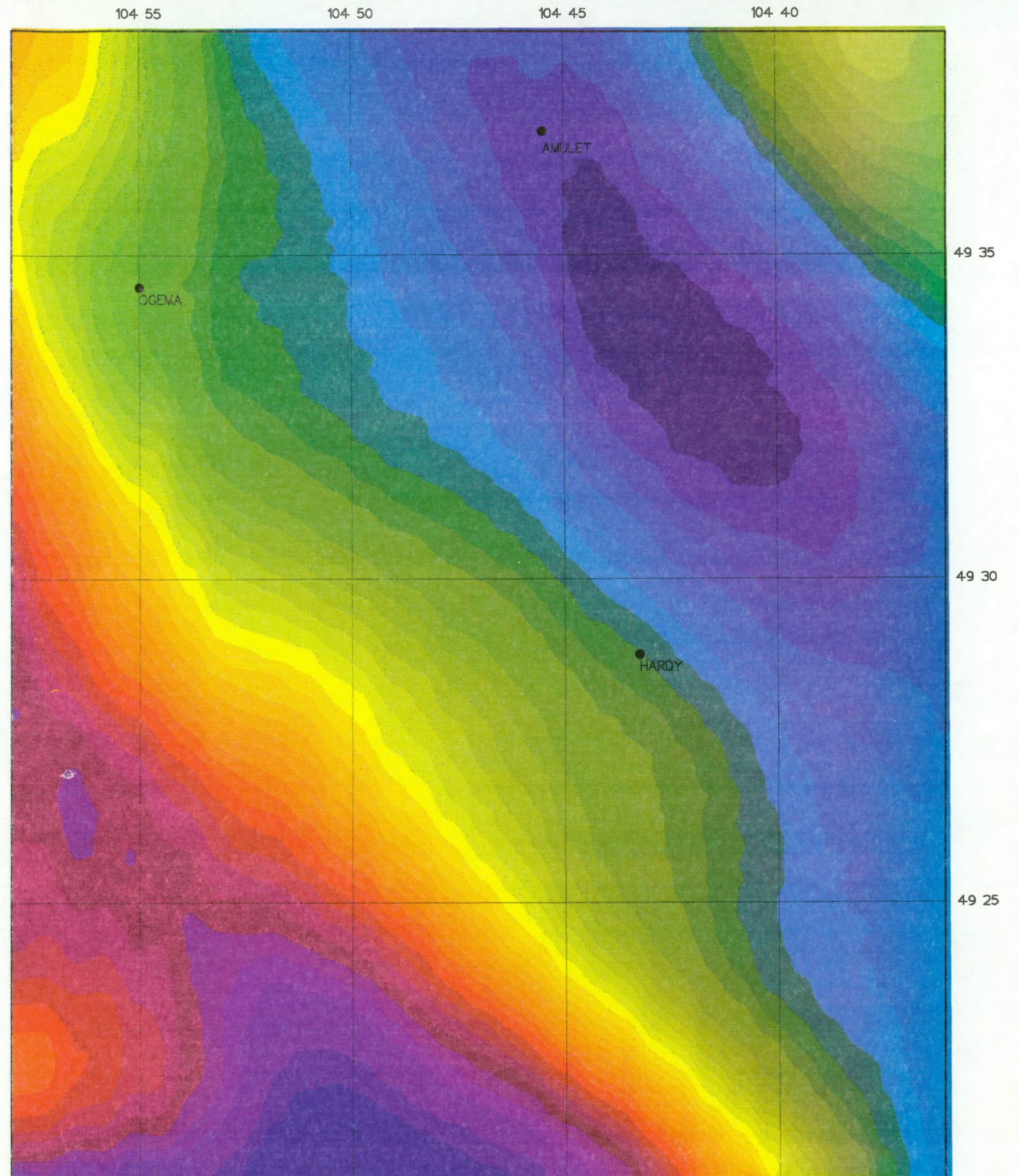


Scale = 1:126 720
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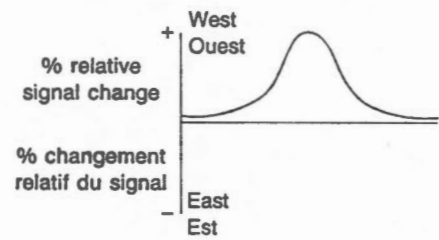




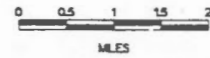
Hardy Survey, Saskatchewan, 1989

Reference map: Soil map of the
Willow Bunch Lake sheet
Saskatchewan, NTS 72H east half.

Total field VLF response Réponse VLF du champ total



Vertical scale 50% / cm
Échelle verticale 50% / cm



Scale = 1:126 720
Line spacing = 800 metres

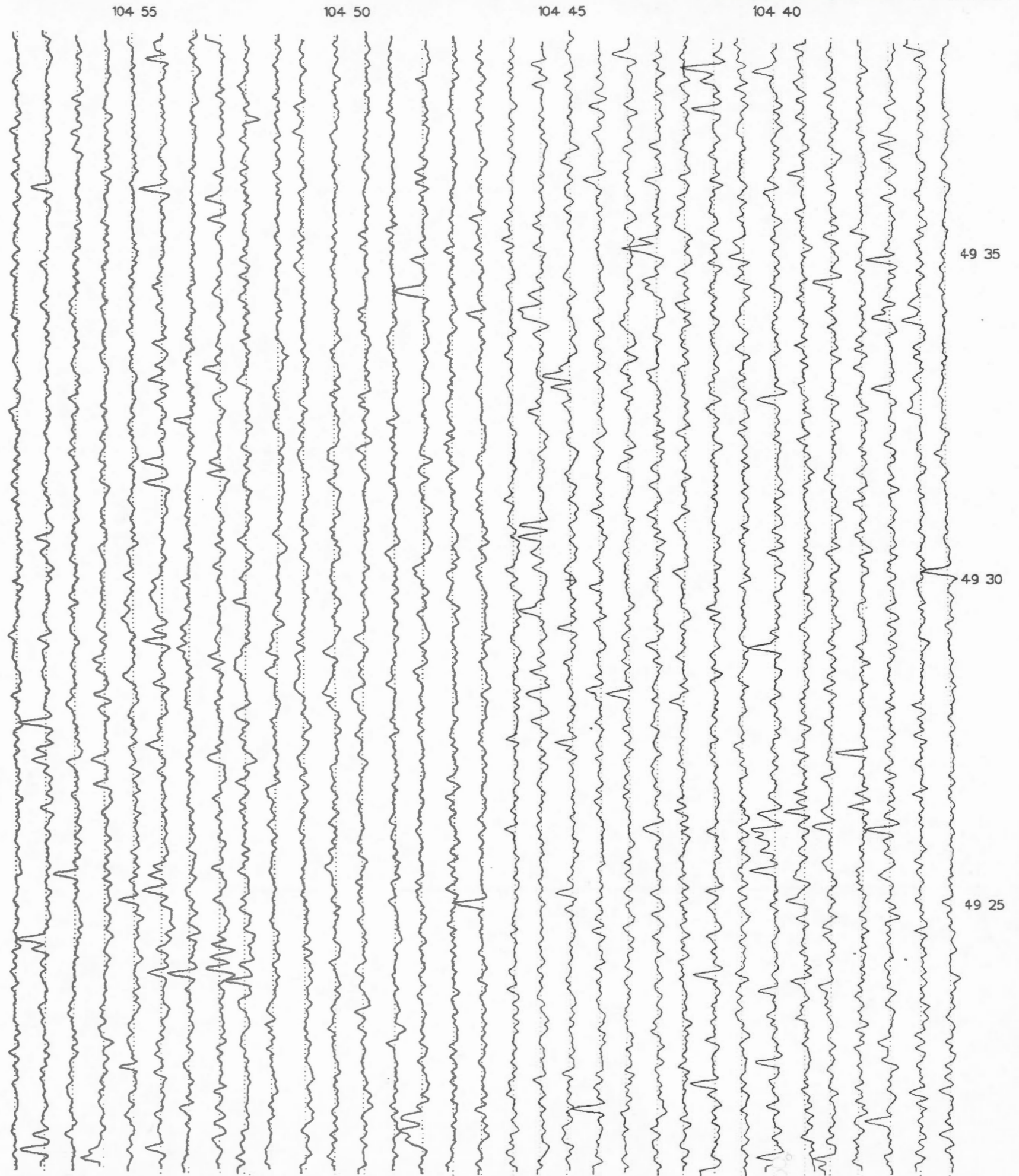
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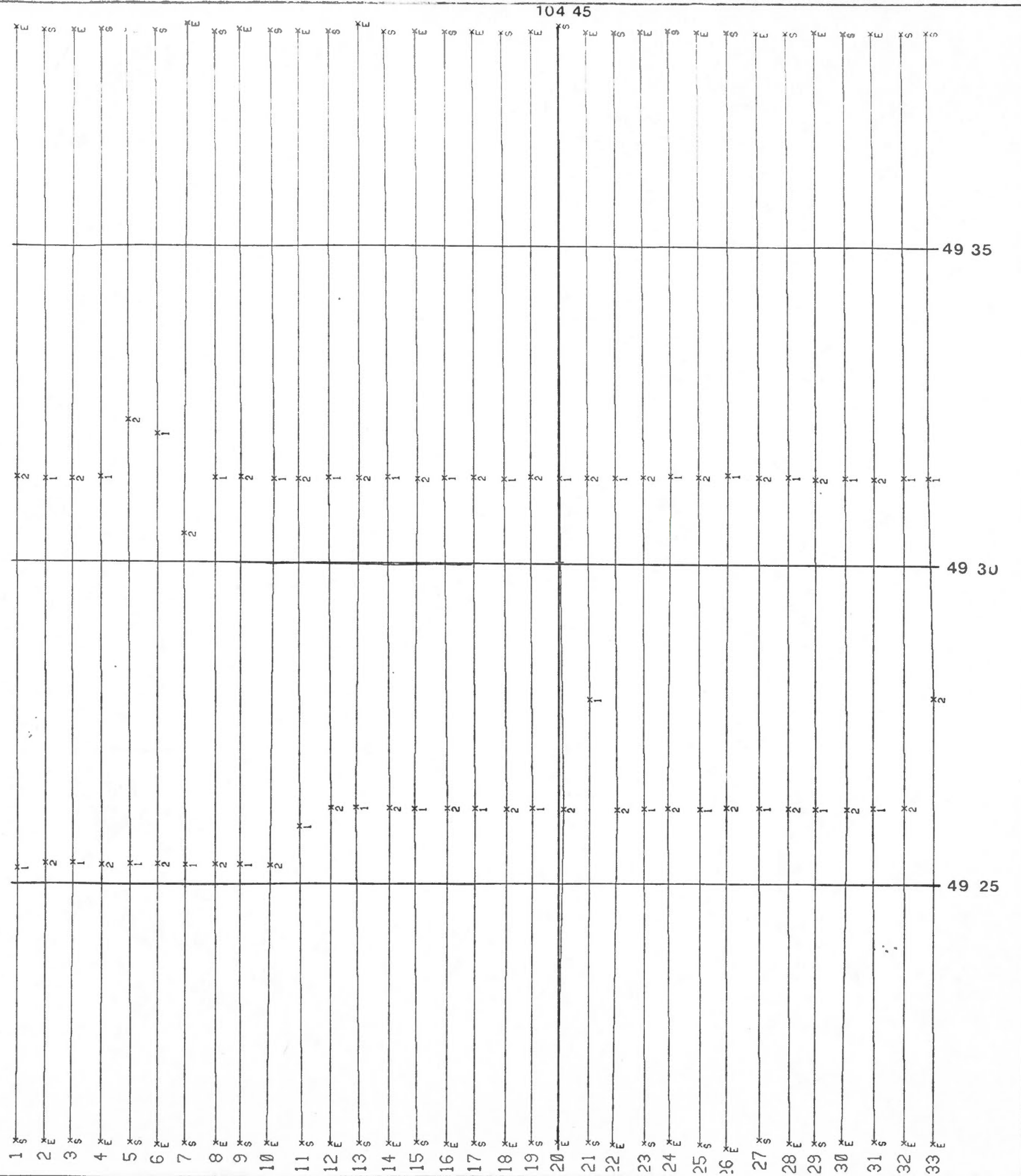
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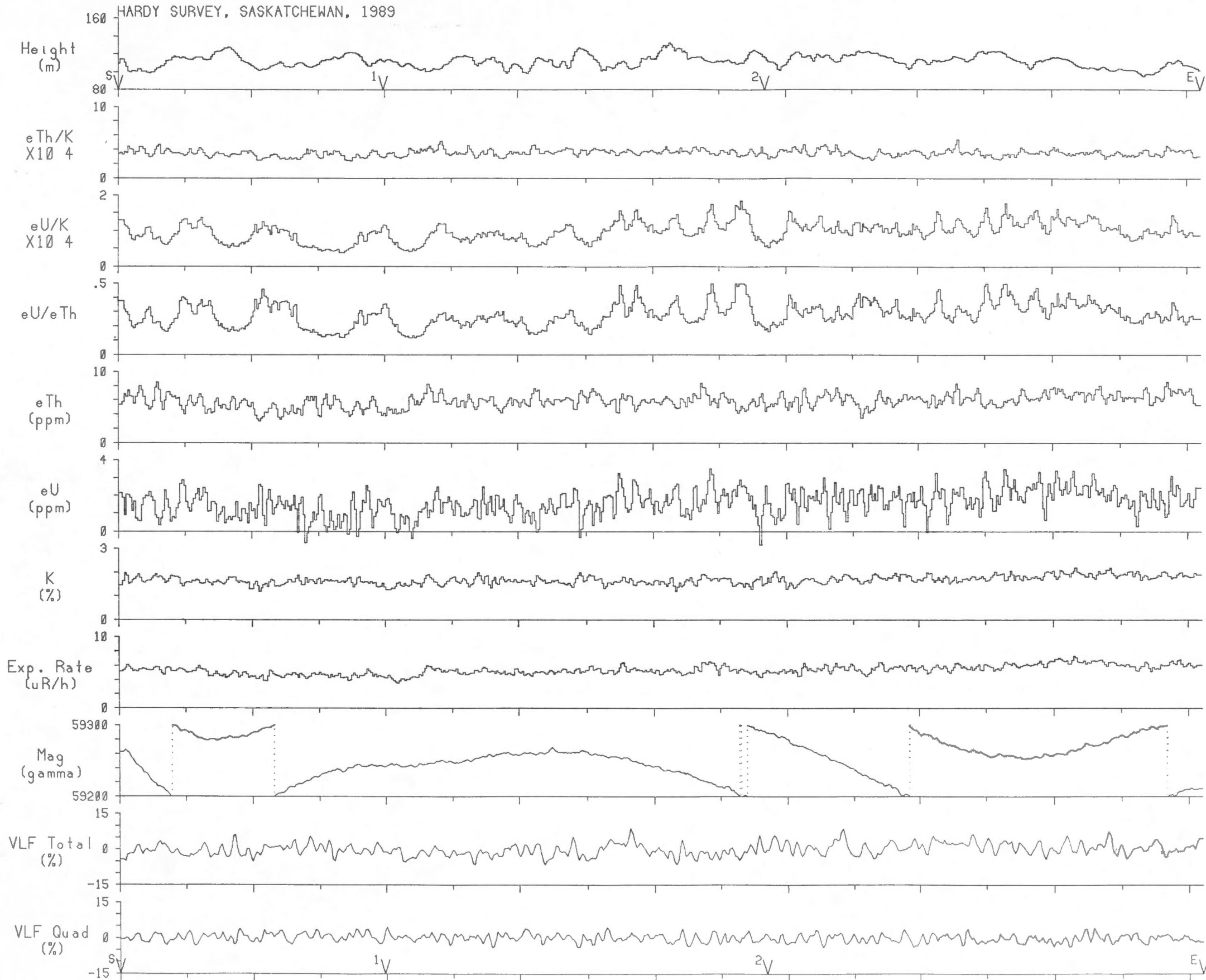
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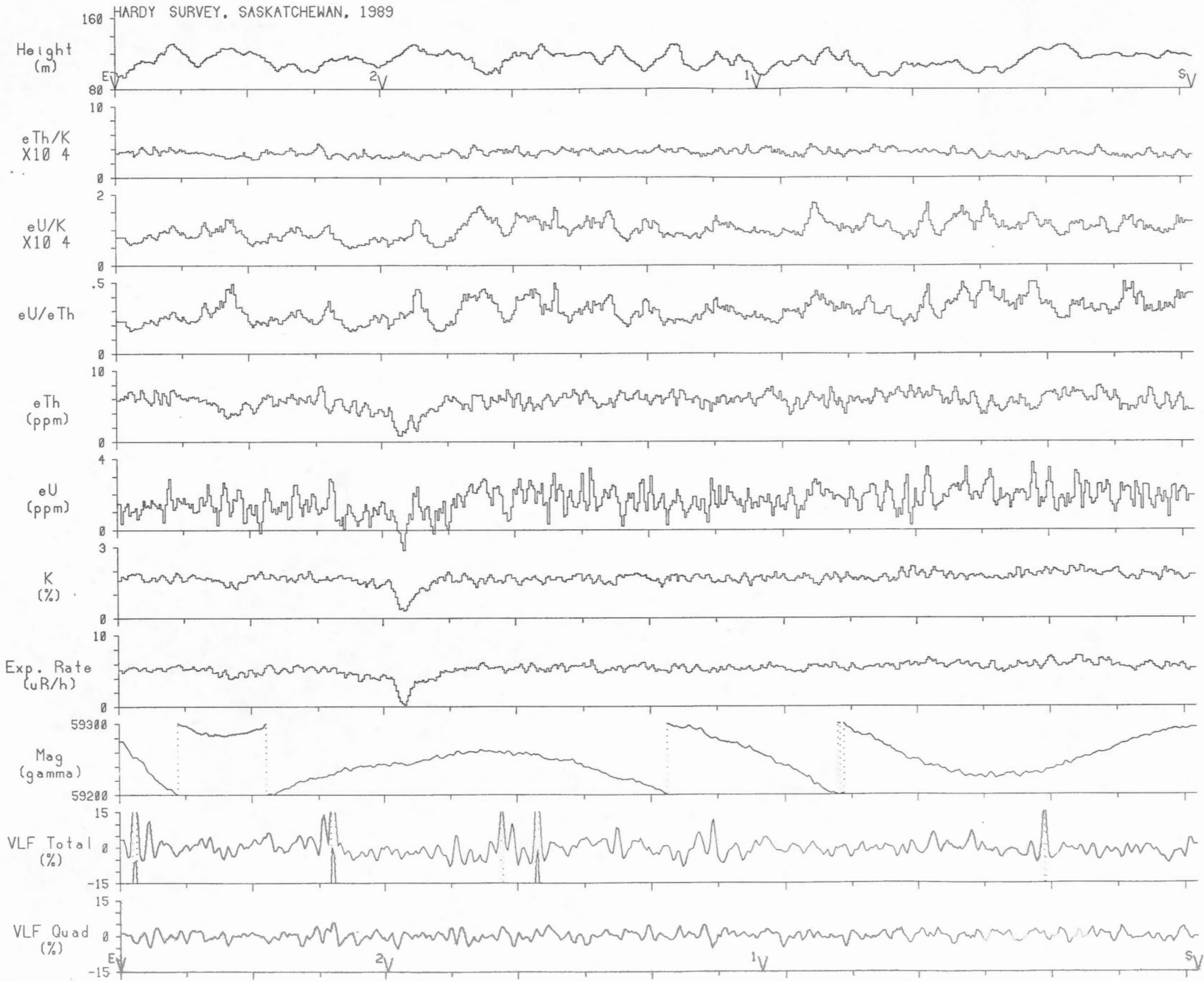


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Line 1 2 km Scale 1:126720

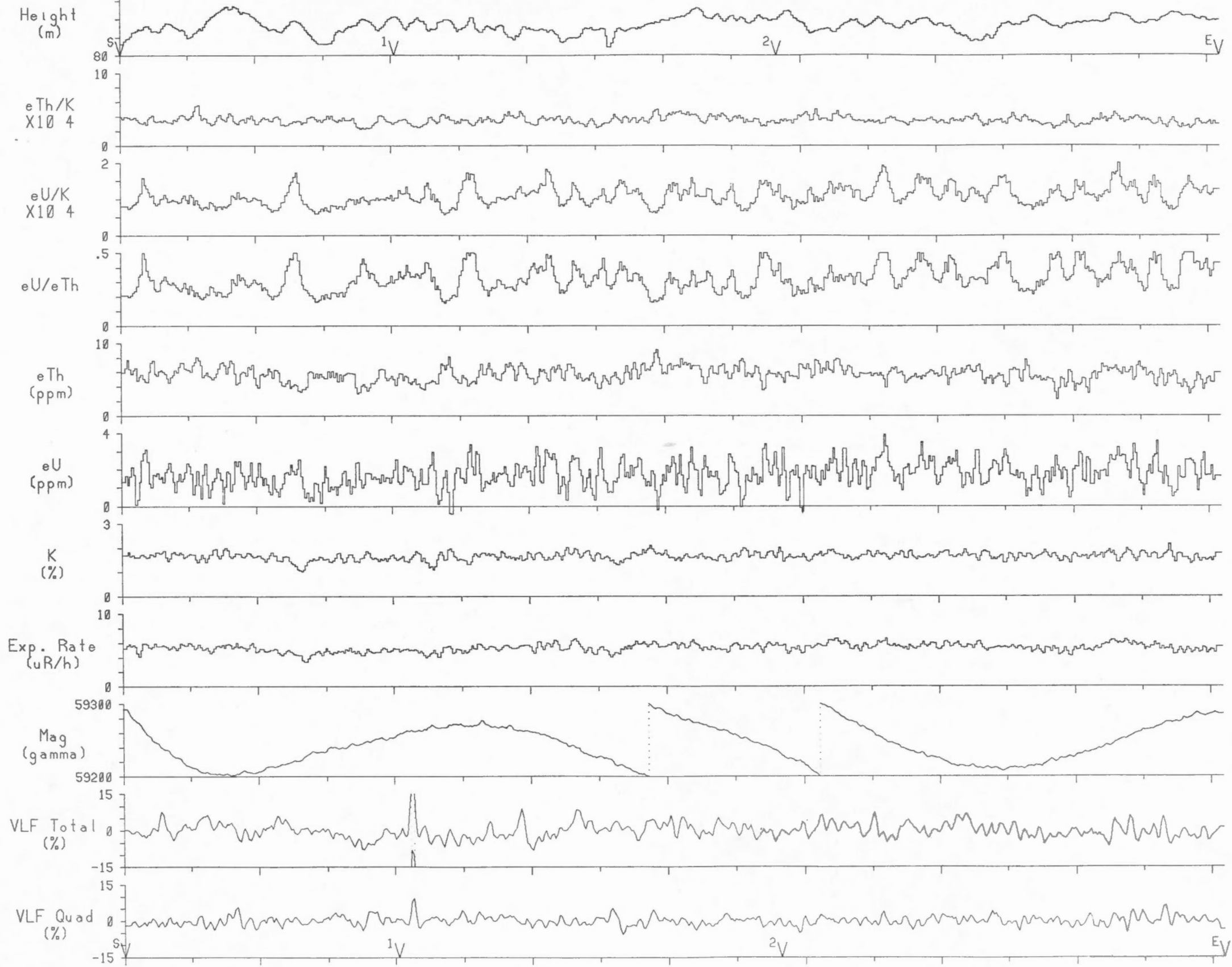
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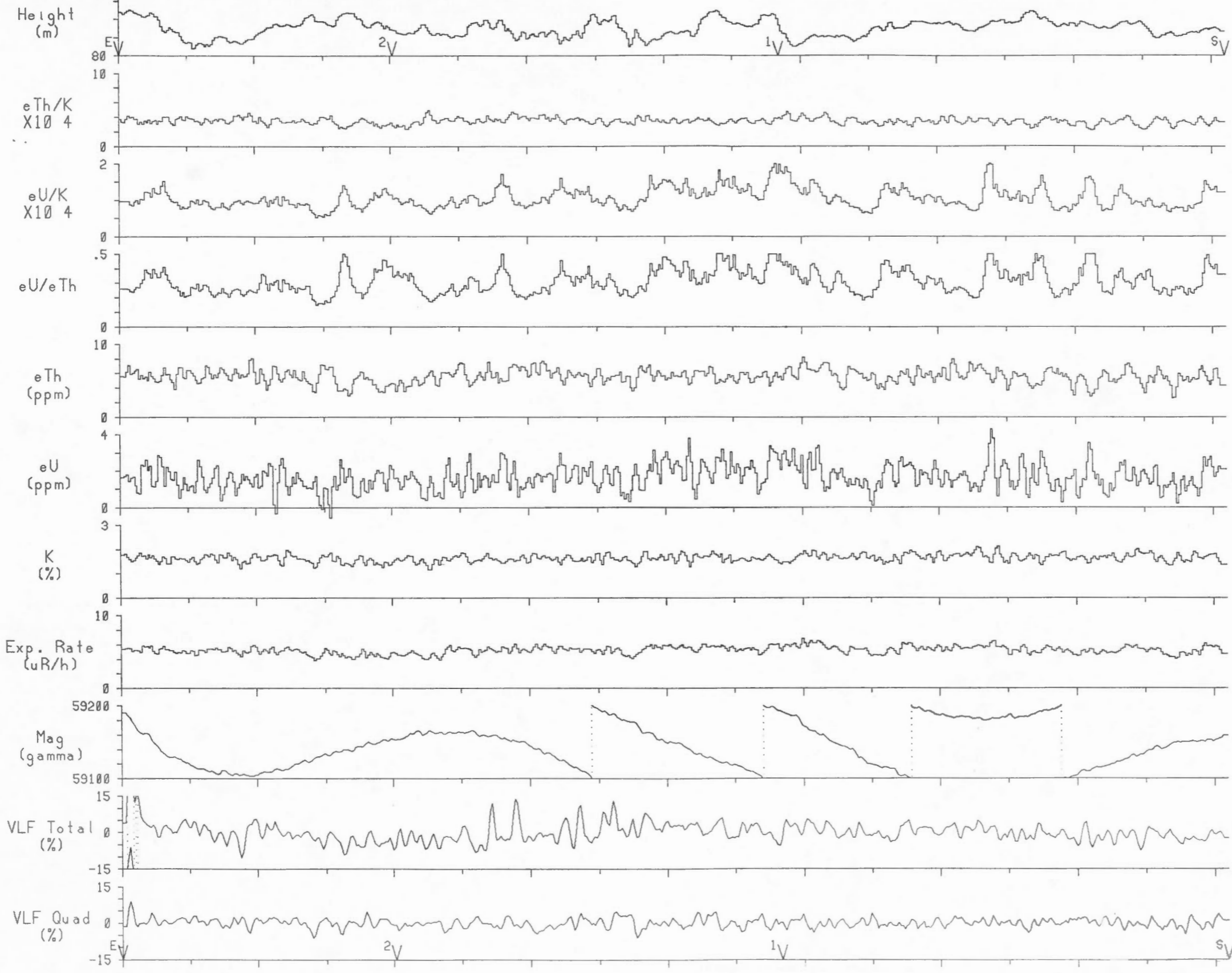
Line 2 2 km Scale 1:126720

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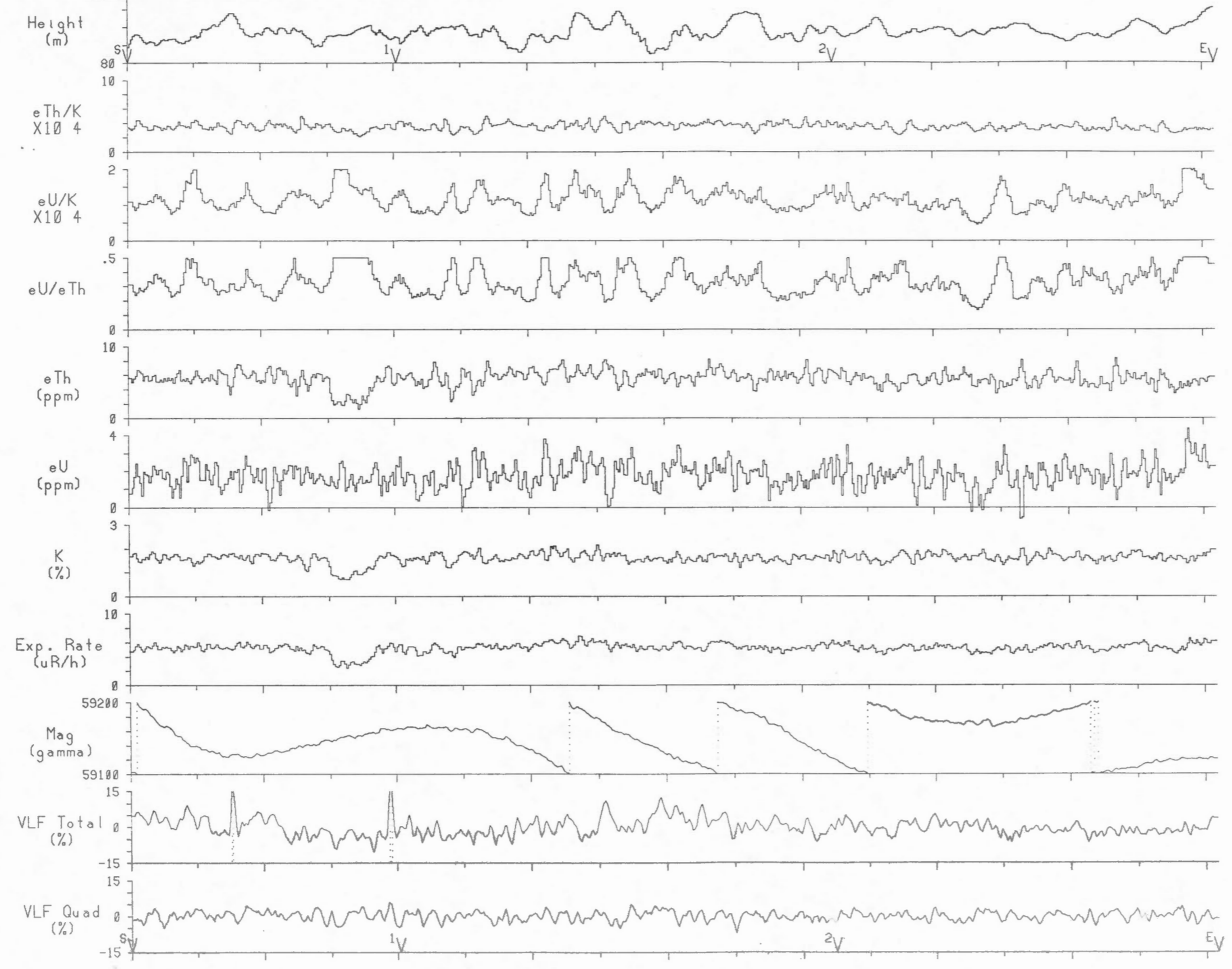


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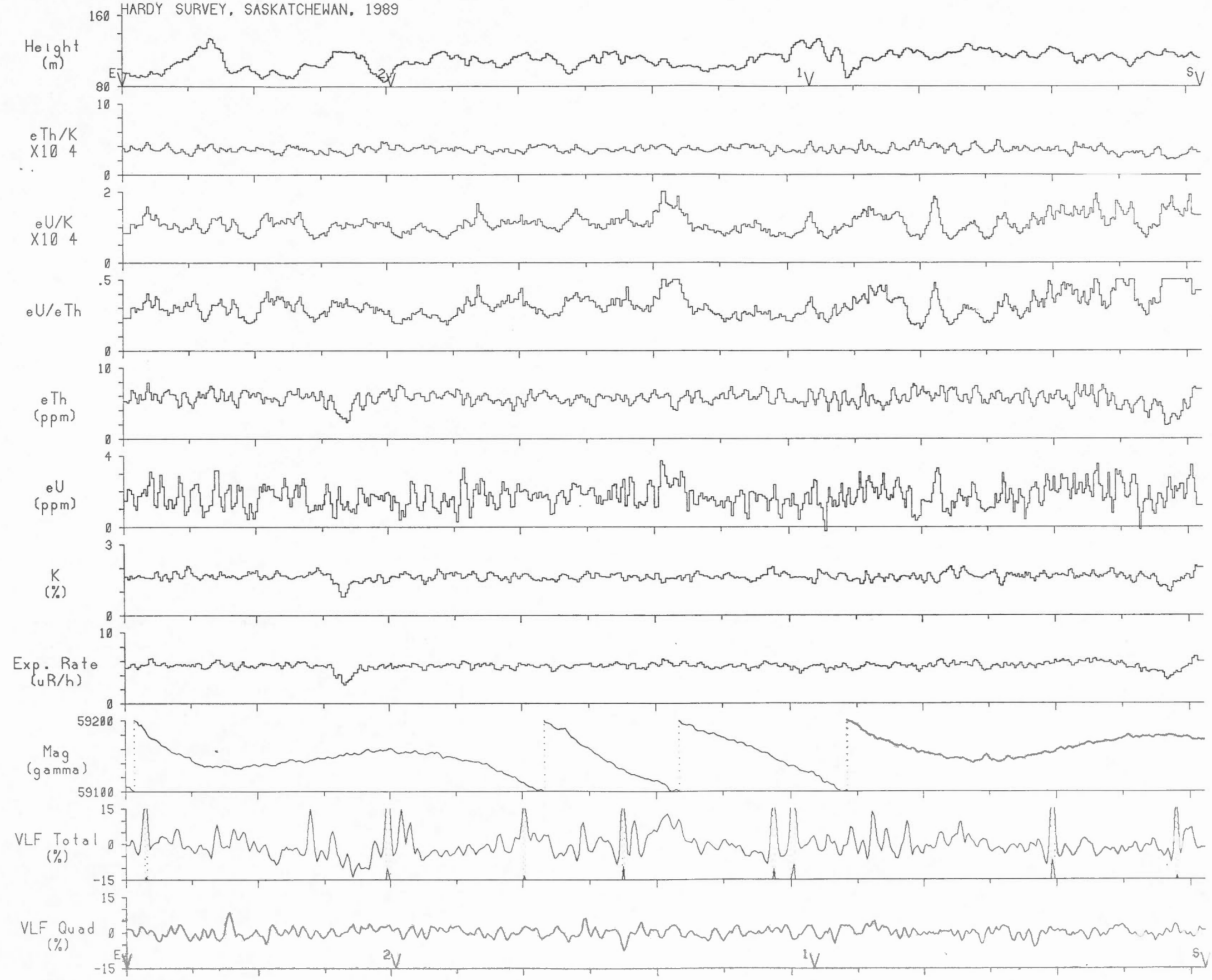
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HARDY SURVEY, SASKATCHEWAN, 1989

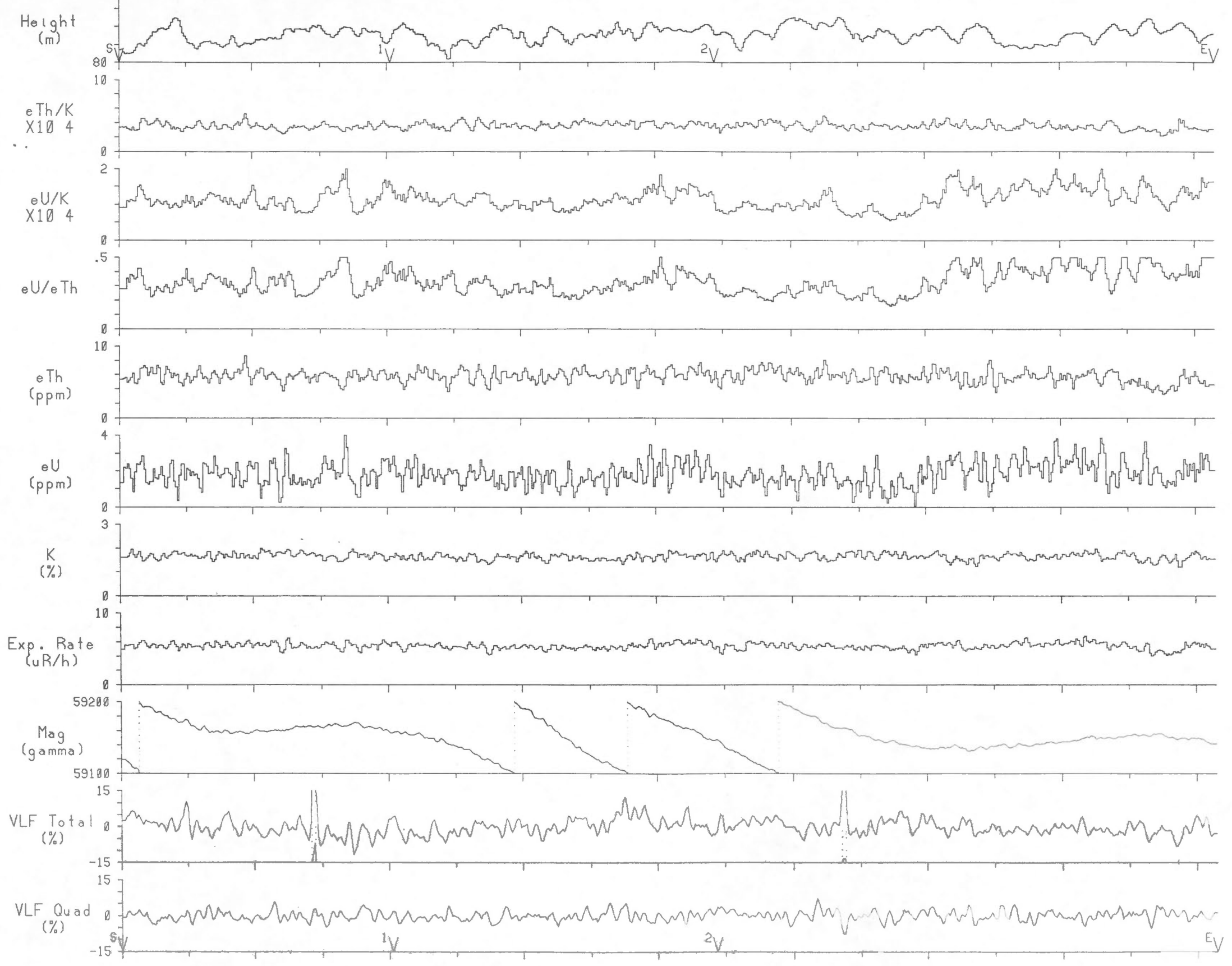


Line 5 2 km Scale 1:126720

HARDY SURVEY, SASKATCHEWAN, 1989



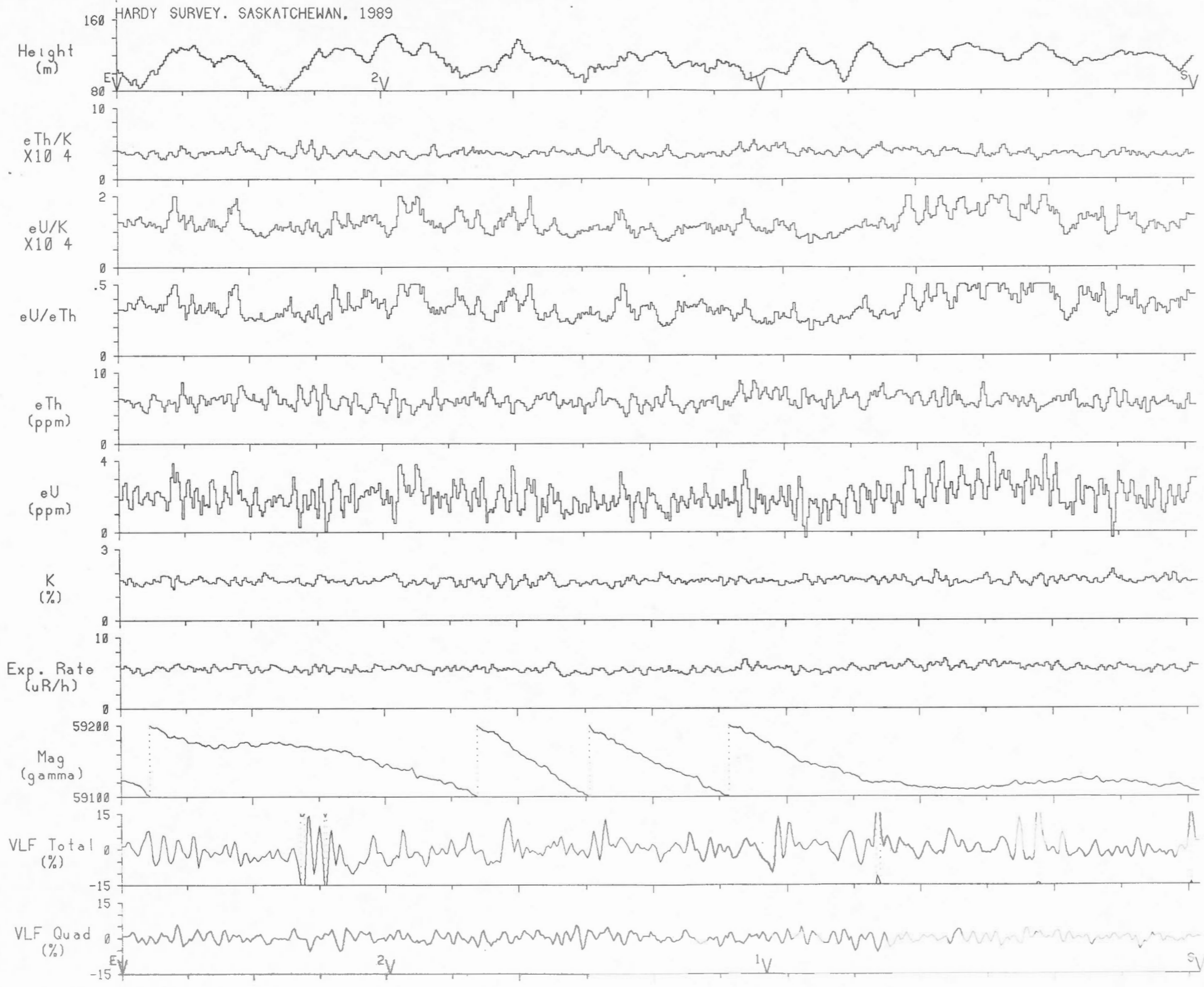
HARDY SURVEY, SASKATCHEWAN, 1989



Line 7 2 km Scale 1:126720

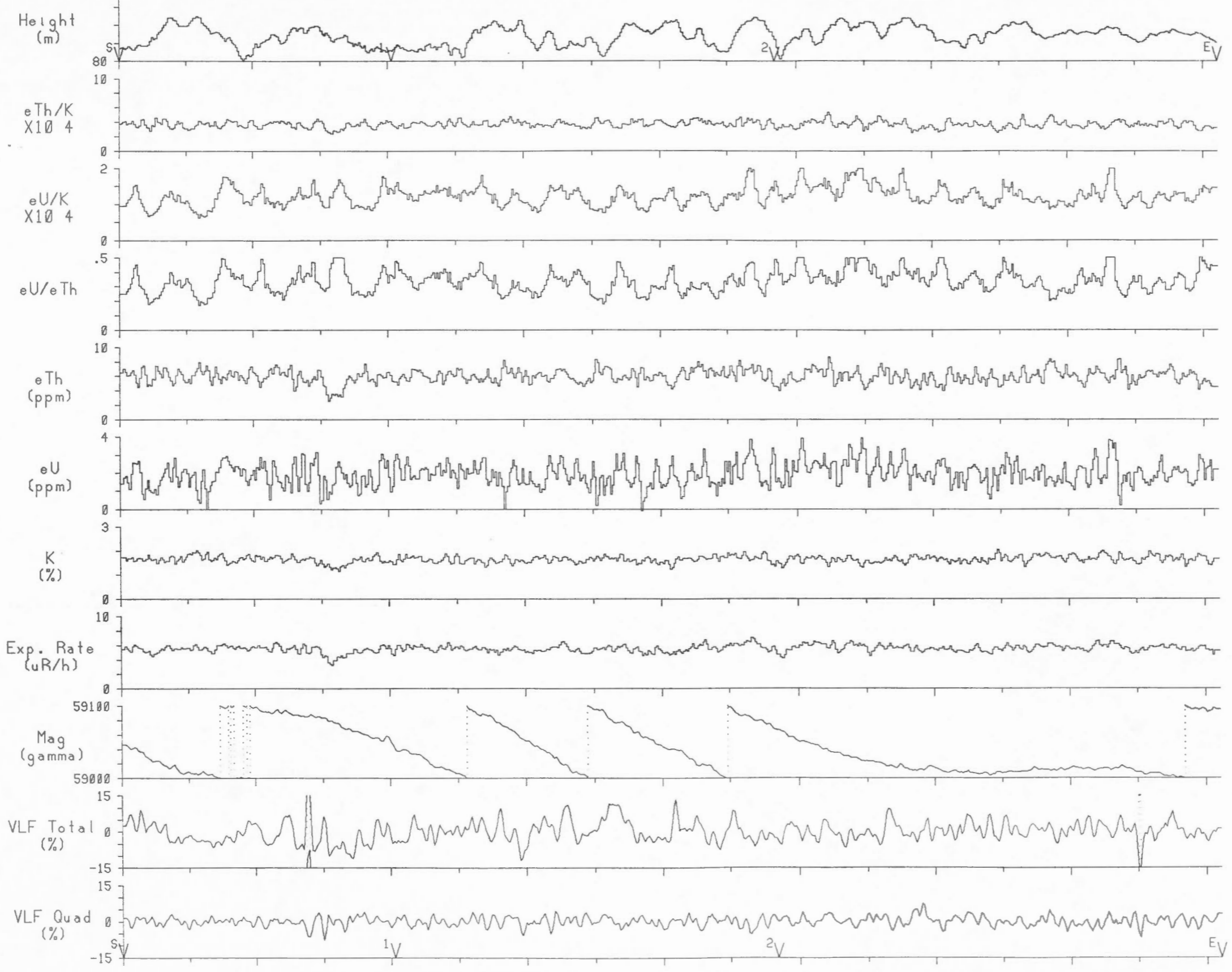
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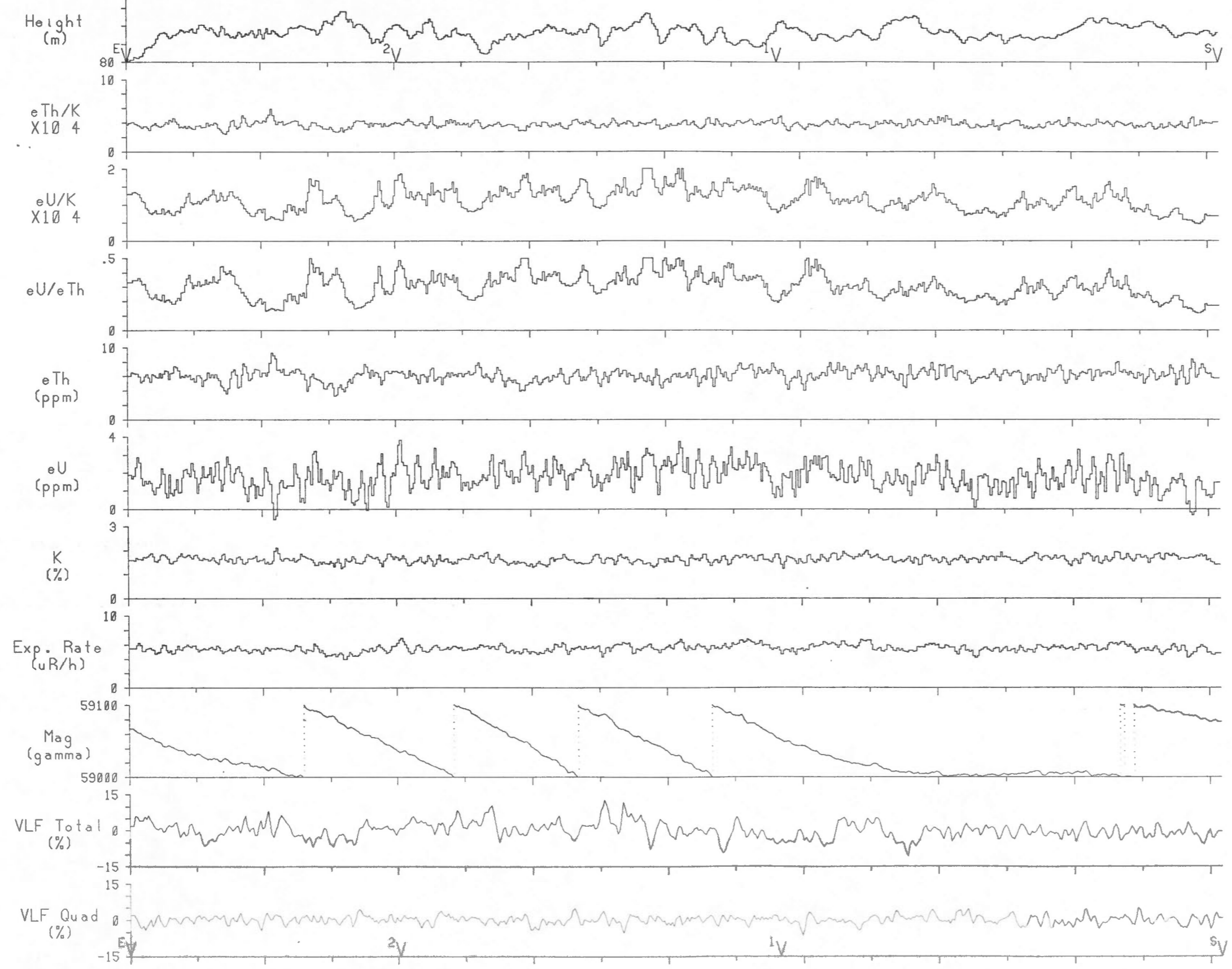


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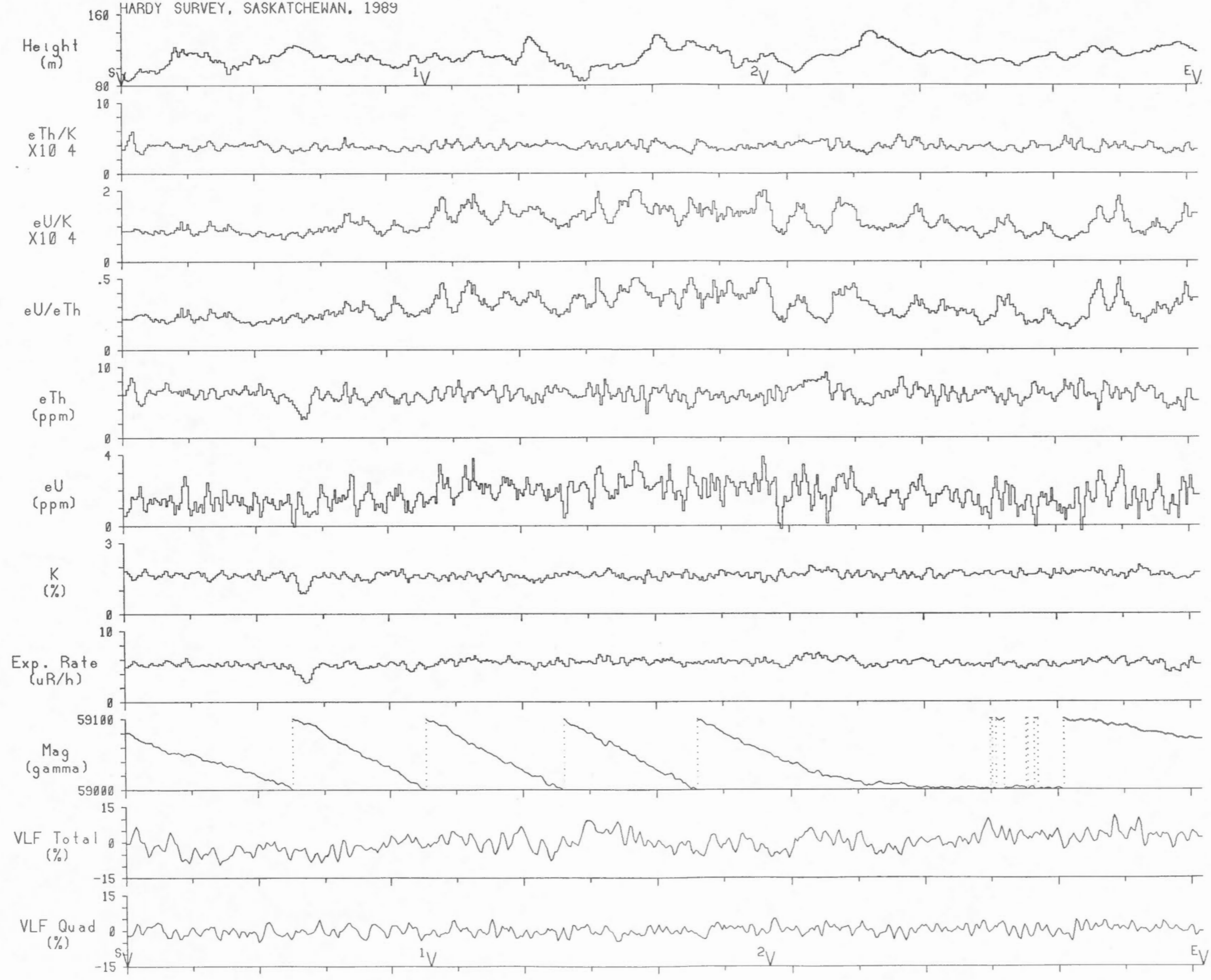
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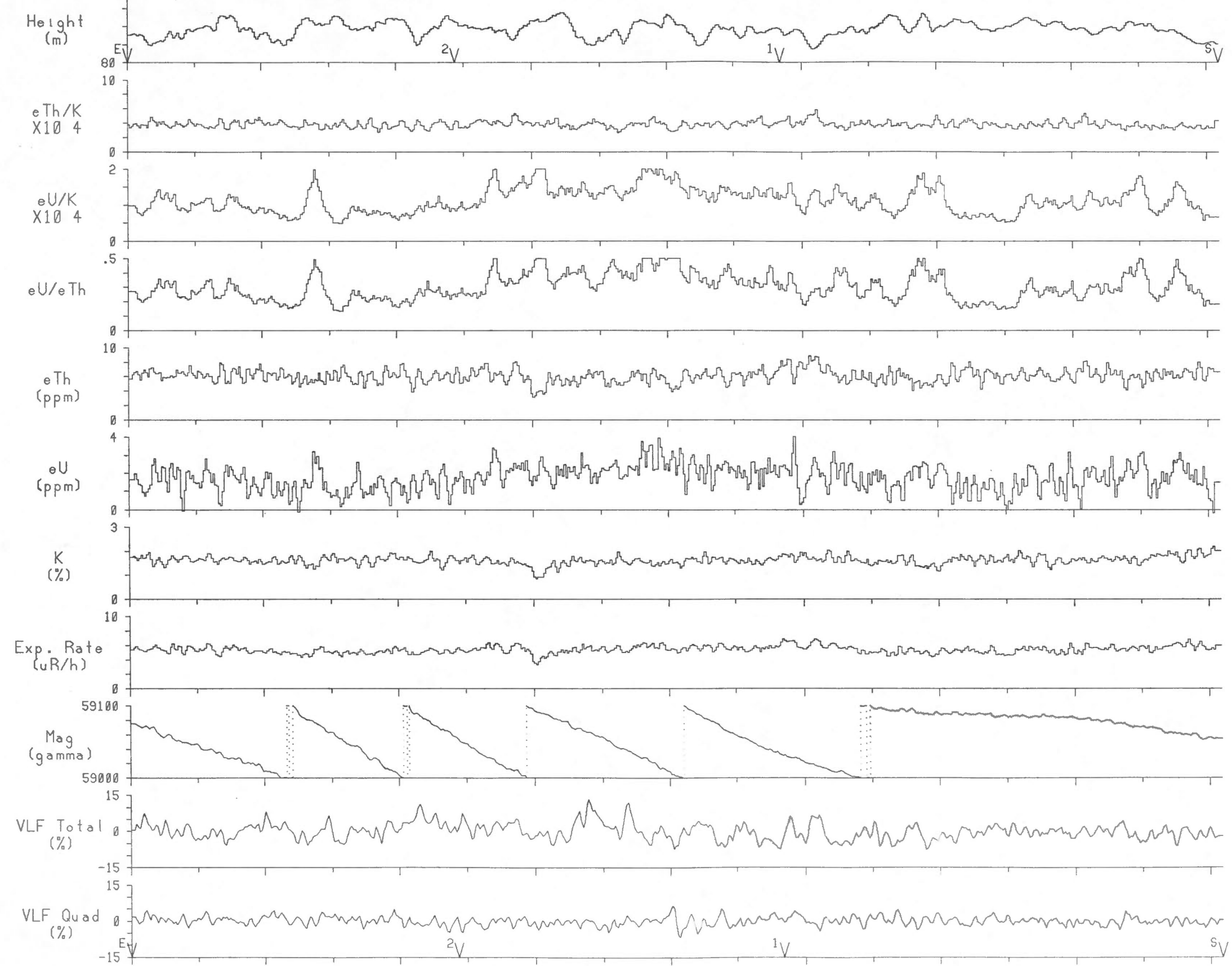
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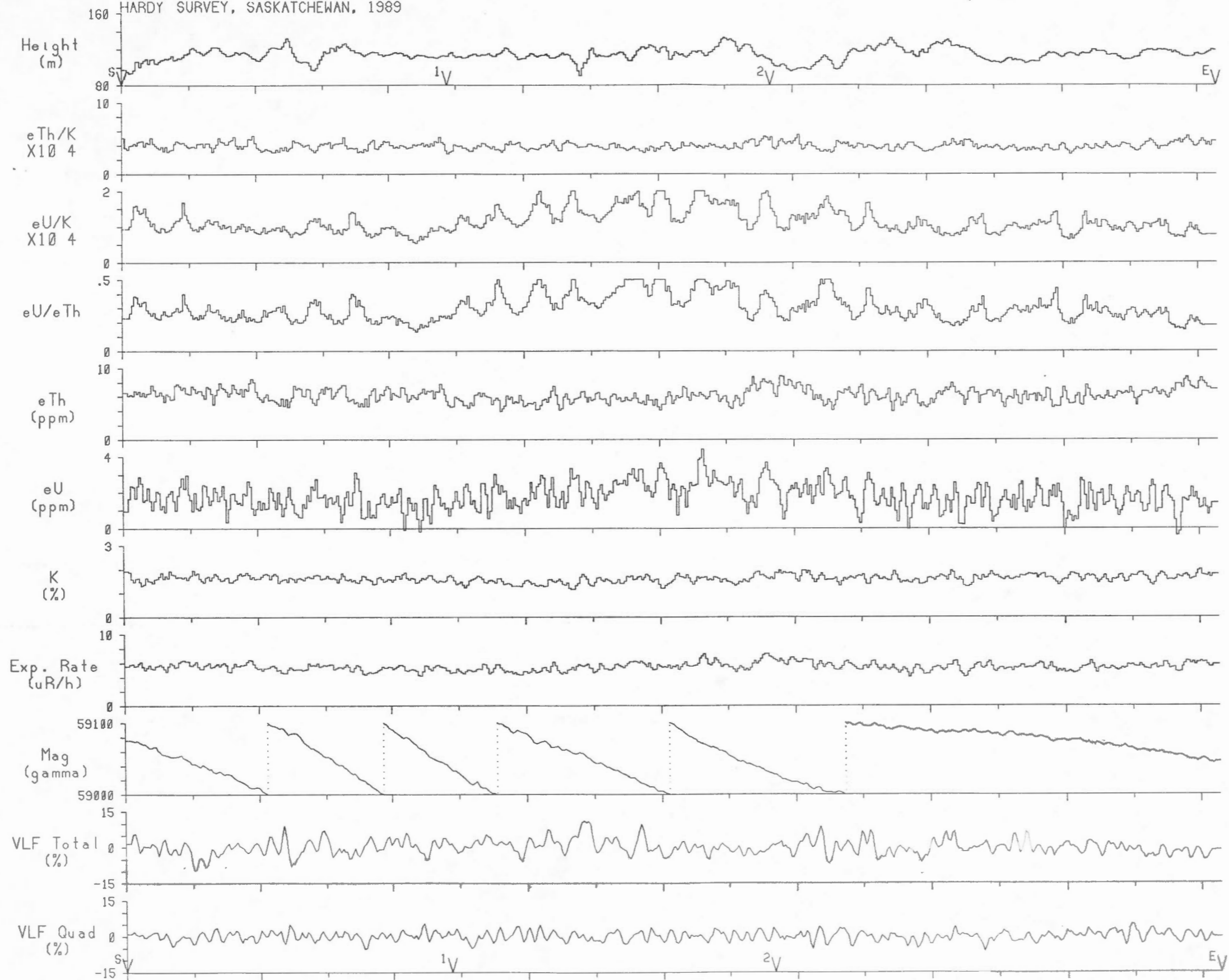
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HARDY SURVEY, SASKATCHEWAN, 1989



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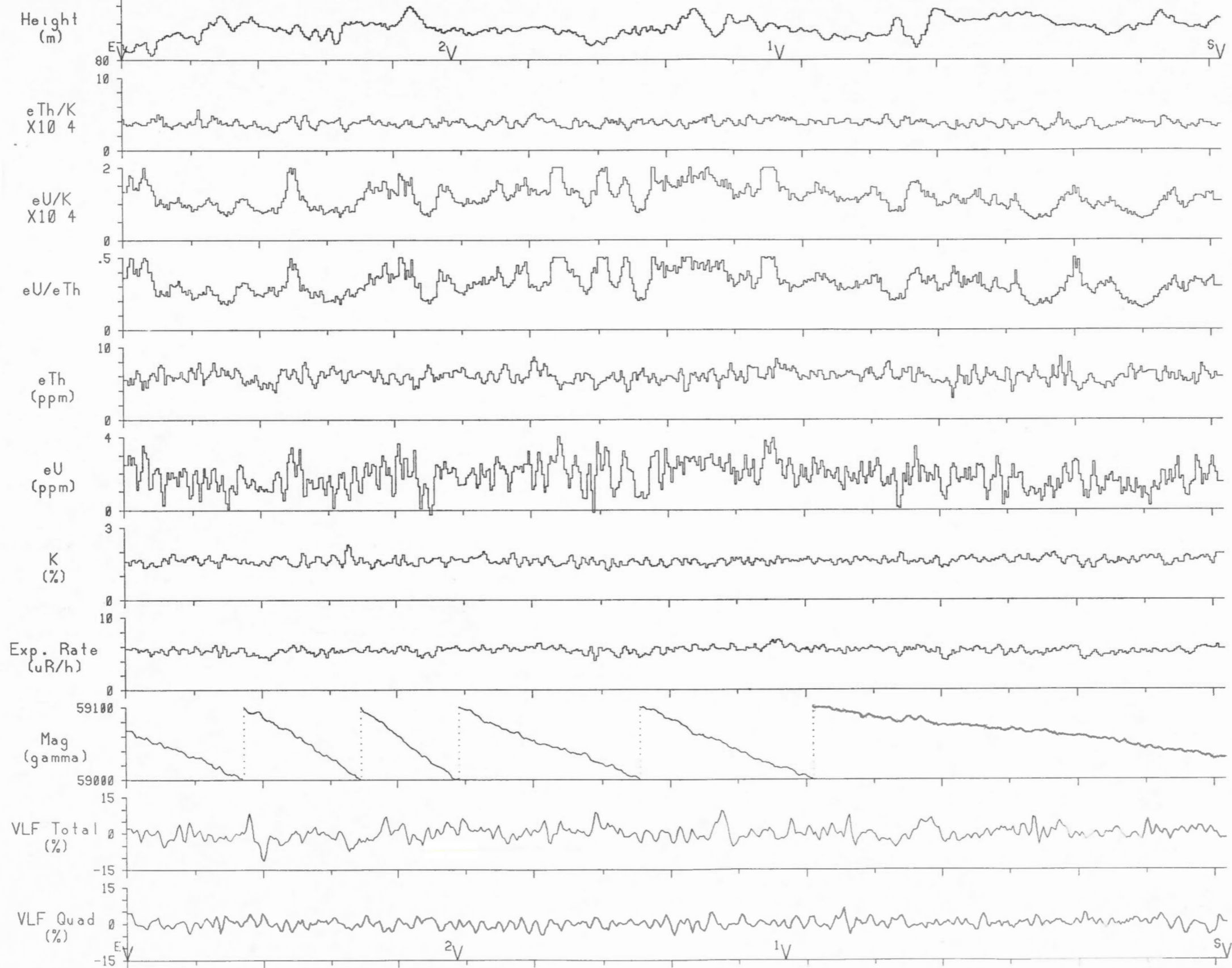


Line 13

2 km

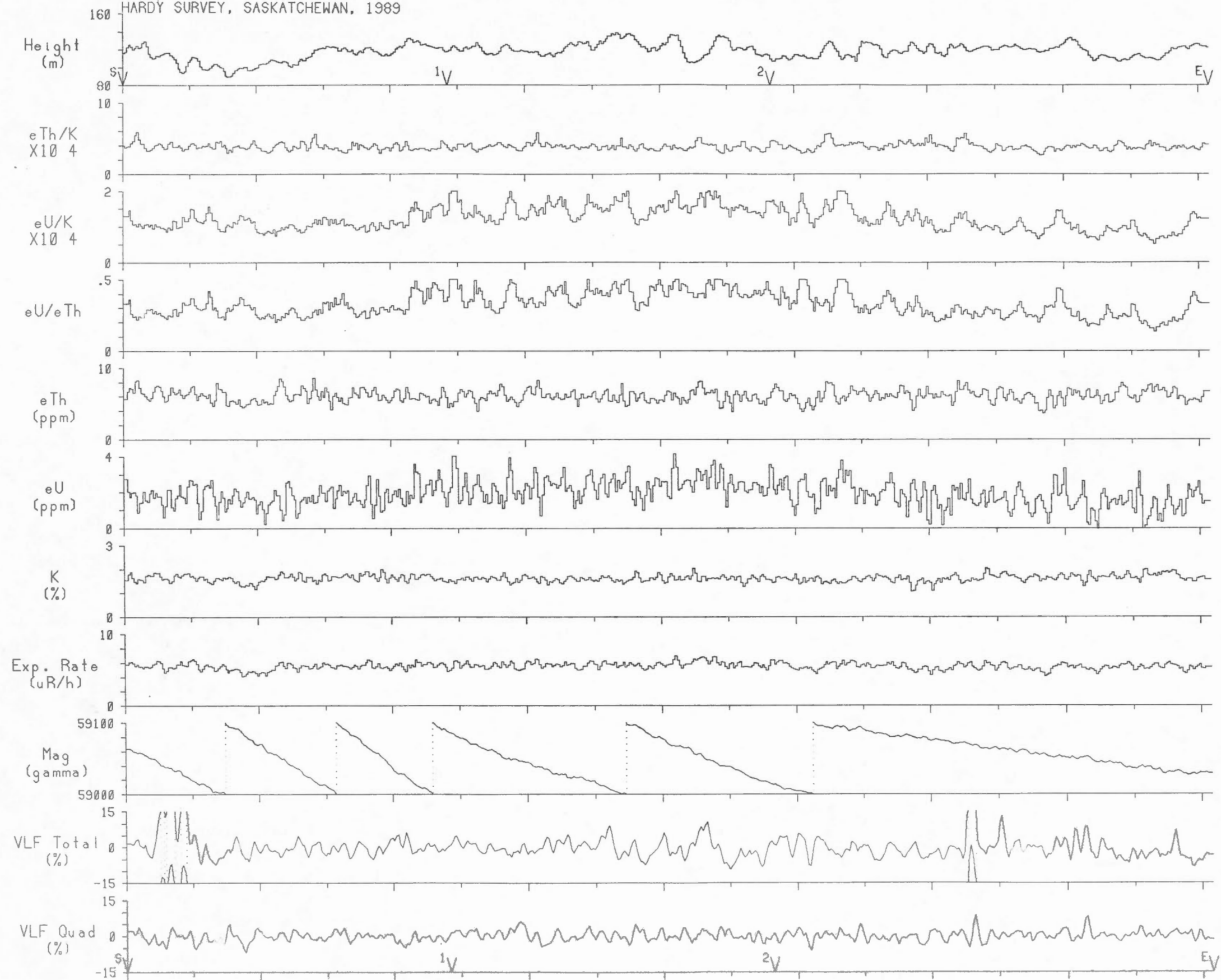
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HARDY SURVEY, SASKATCHEWAN, 1989



3°

HARDY SURVEY, SASKATCHEWAN, 1989



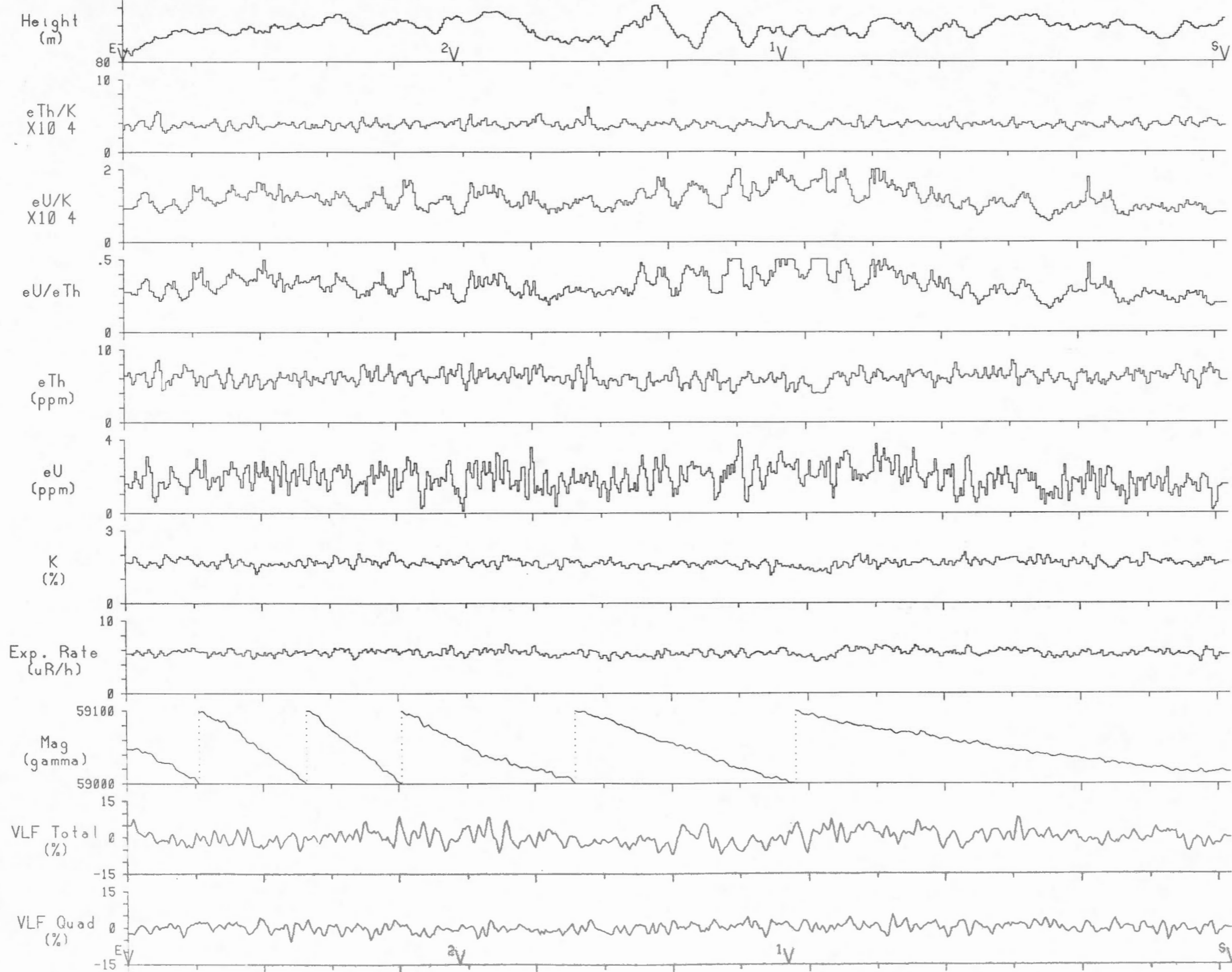
Line 15

2 km

Scale 1:126720

8

HARDY SURVEY, SASKATCHEWAN, 1989

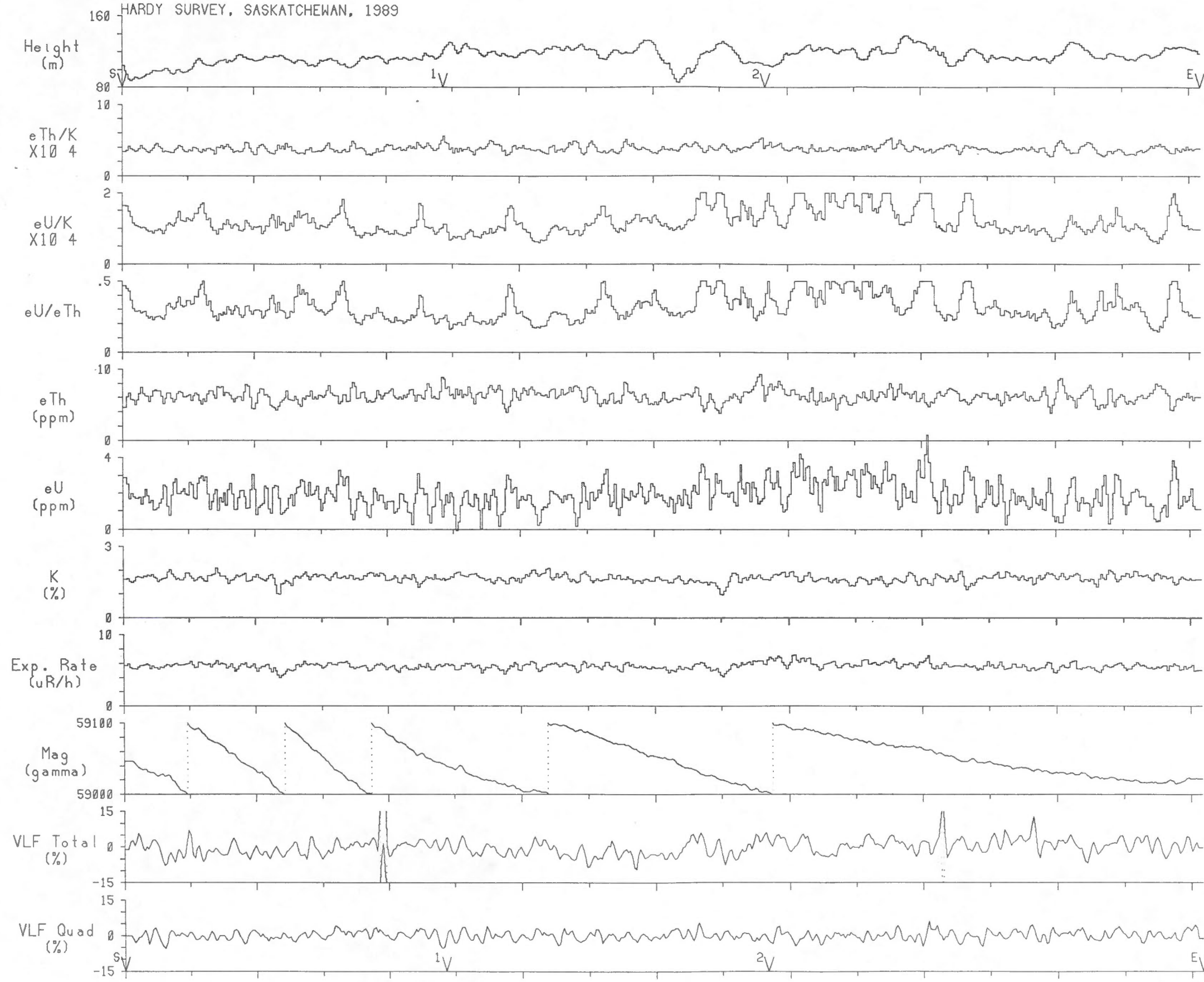


Line 16

2 km

Scale 1:126720

HARDY SURVEY, SASKATCHEWAN, 1989



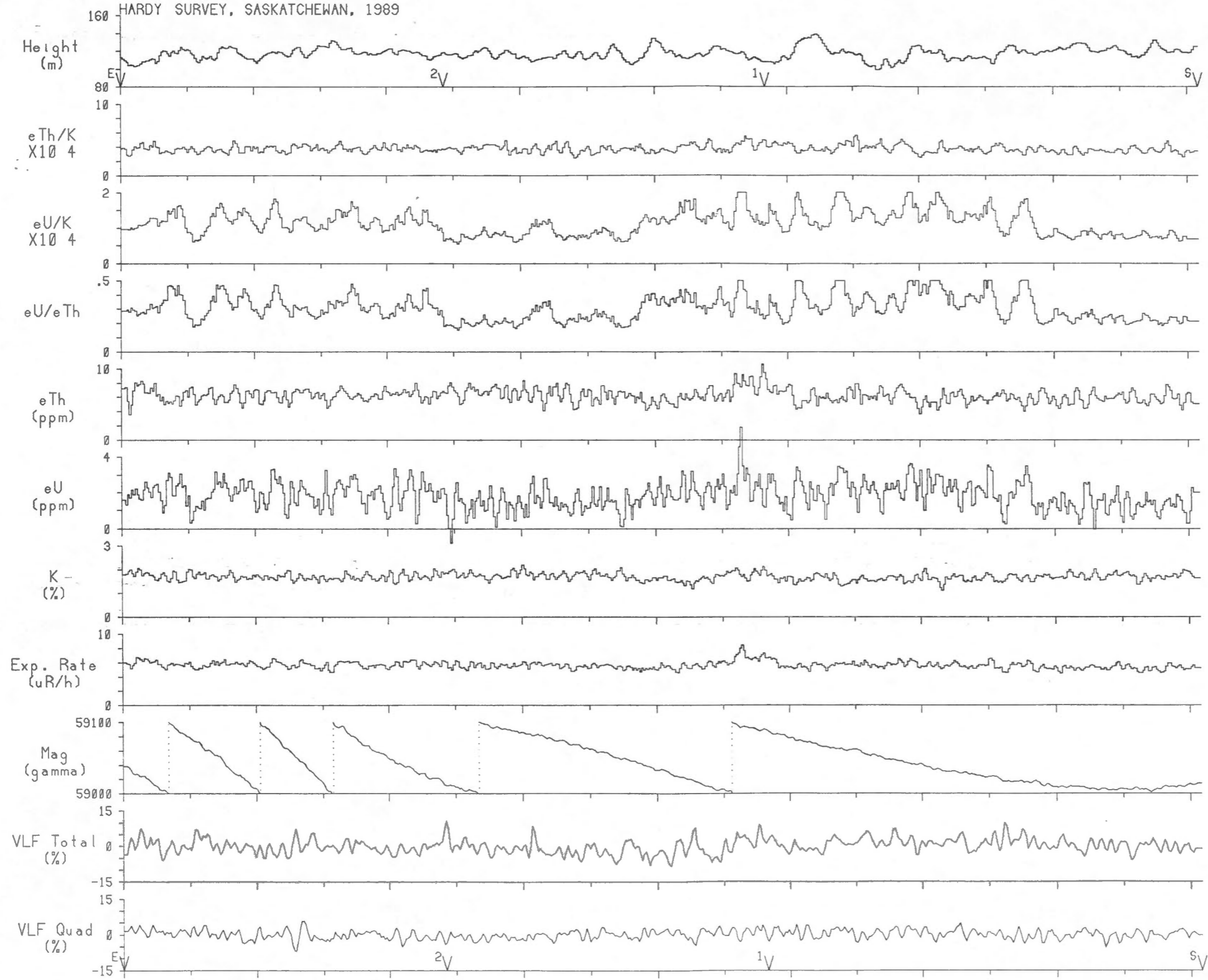
Line 17

2 km

Scale 1:126720

80

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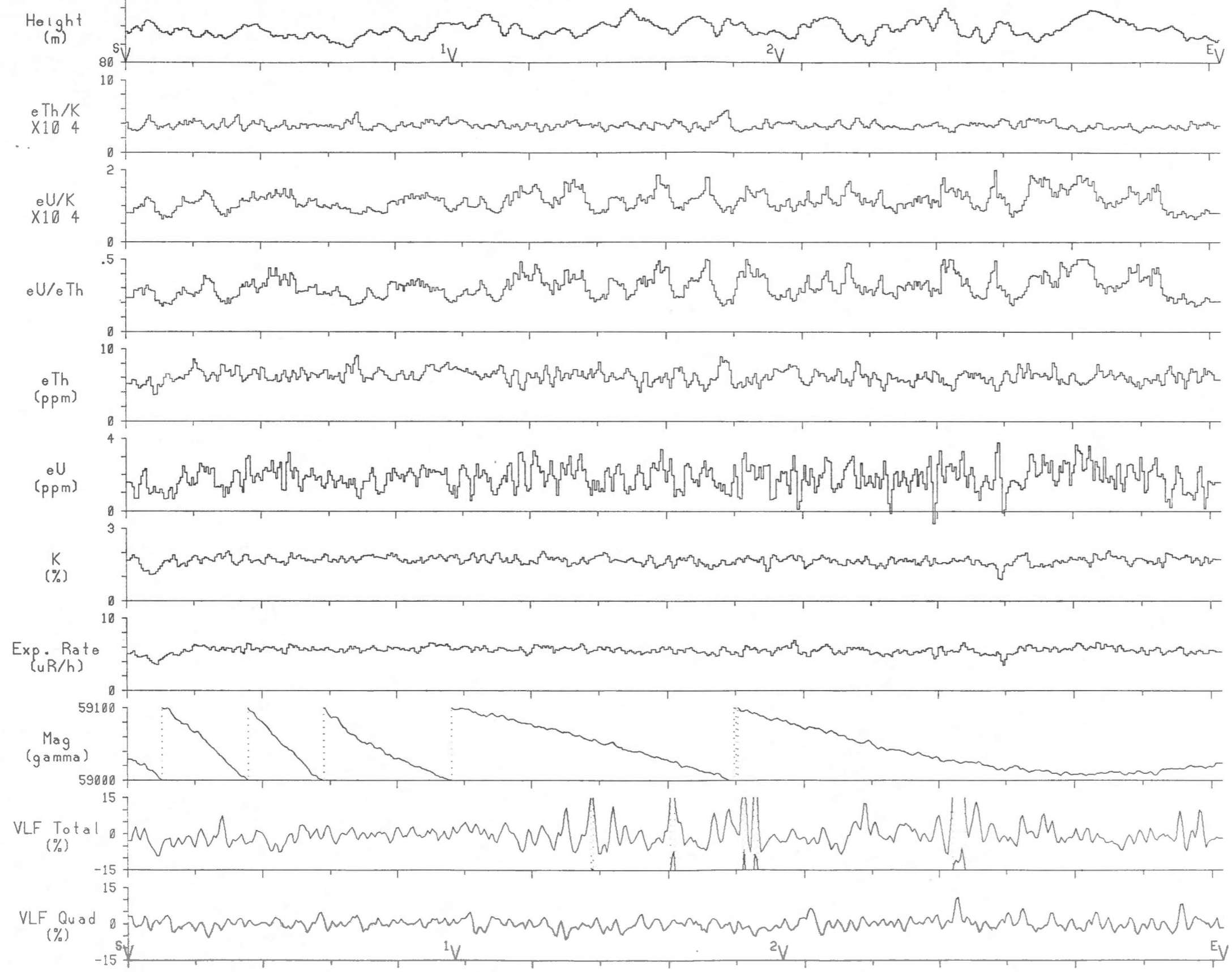
Line 18

2 km

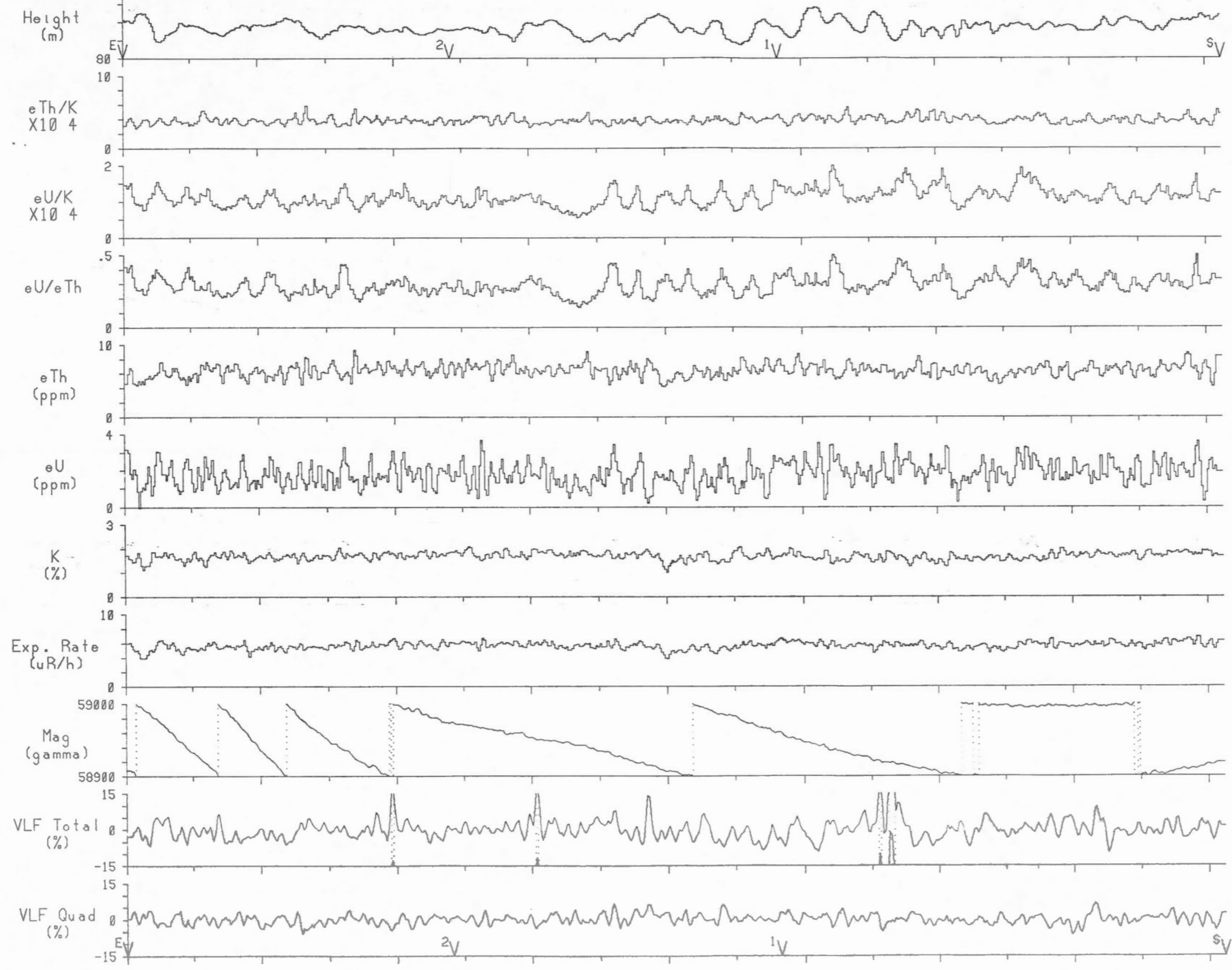
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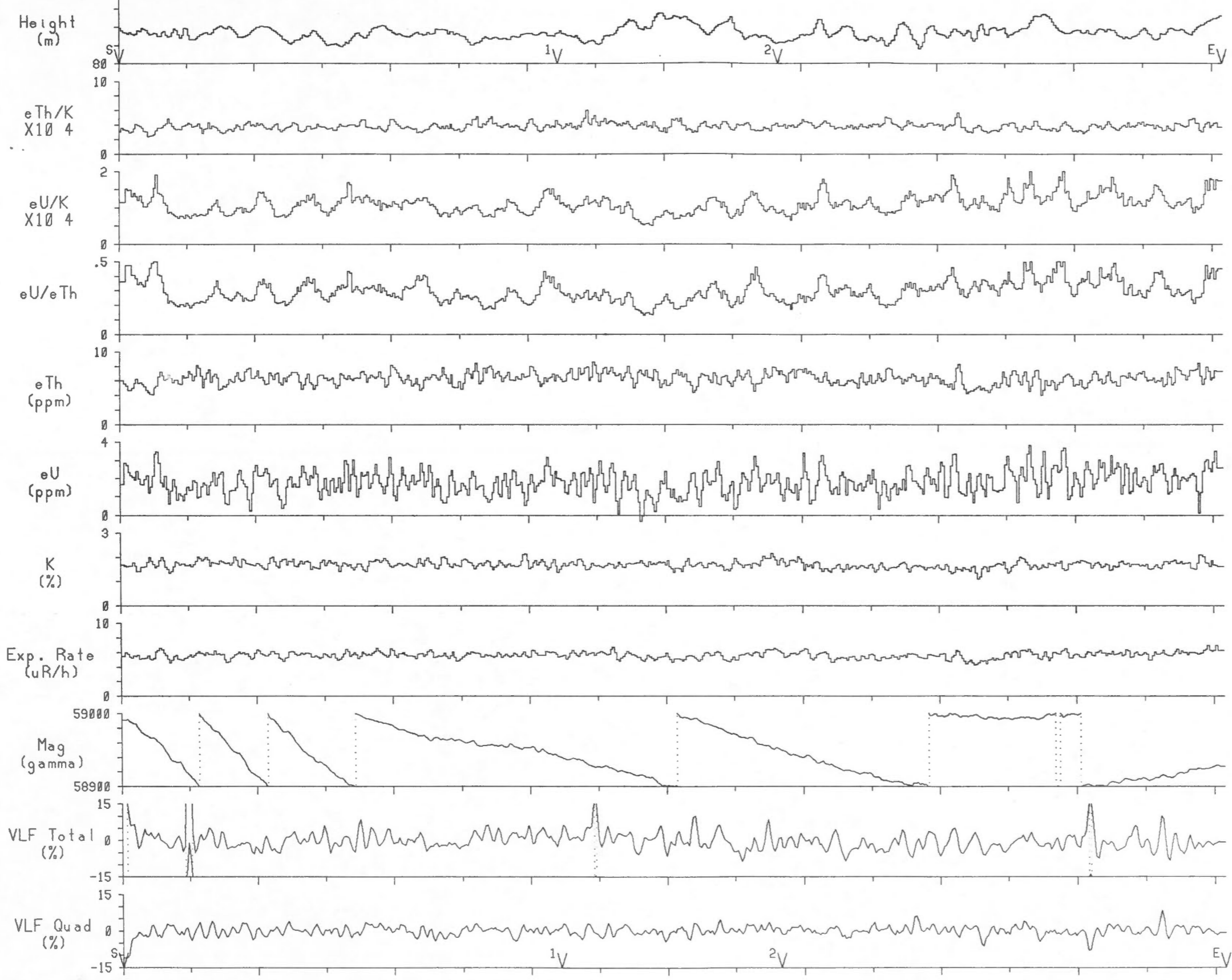


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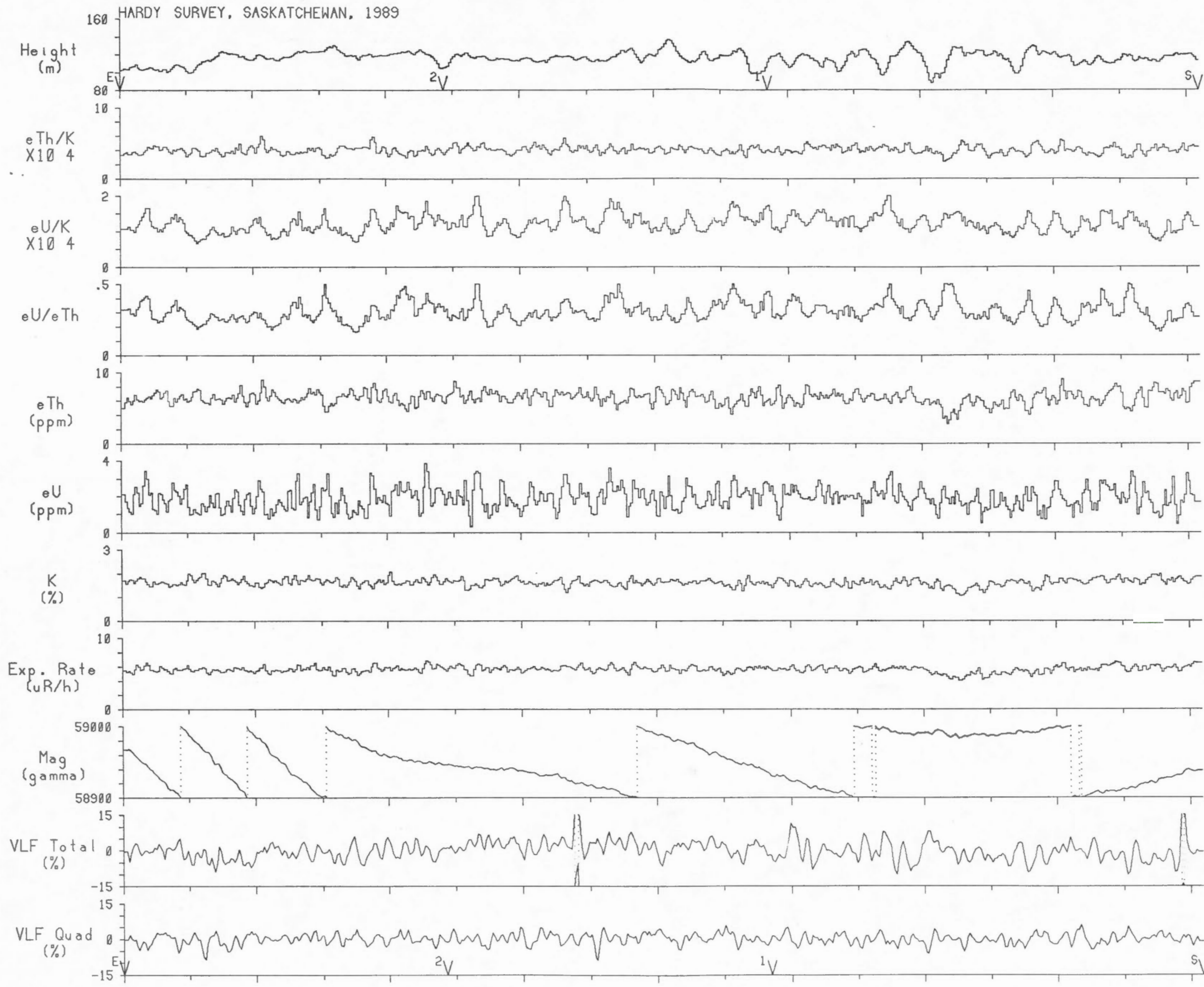
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Scale 1:126720

HARDY SURVEY, SASKATCHEWAN, 1989



HARDY SURVEY, SASKATCHEWAN, 1989

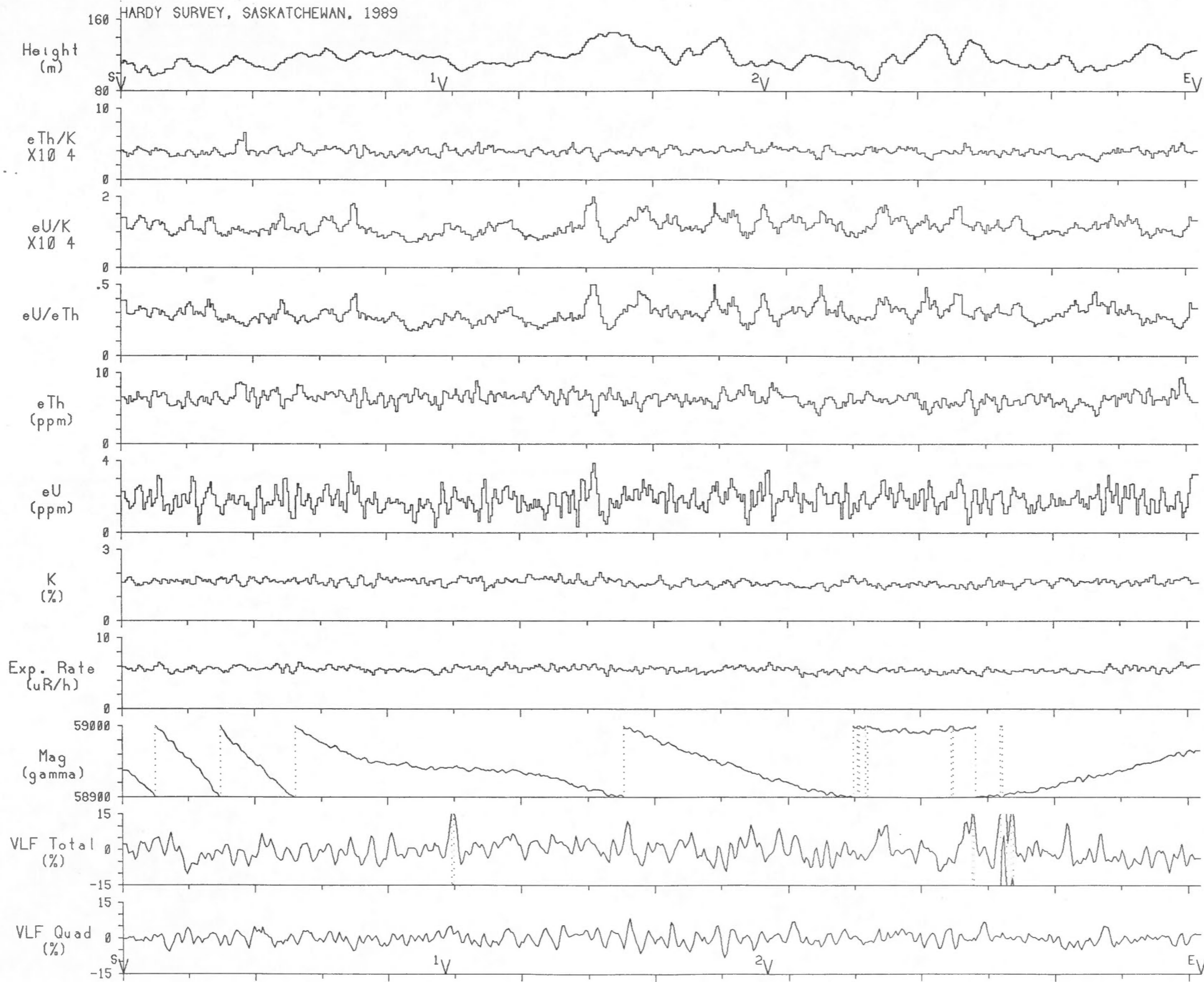


Line 22

2 km

Scale 1:126720

HARDY SURVEY, SASKATCHEWAN, 1989

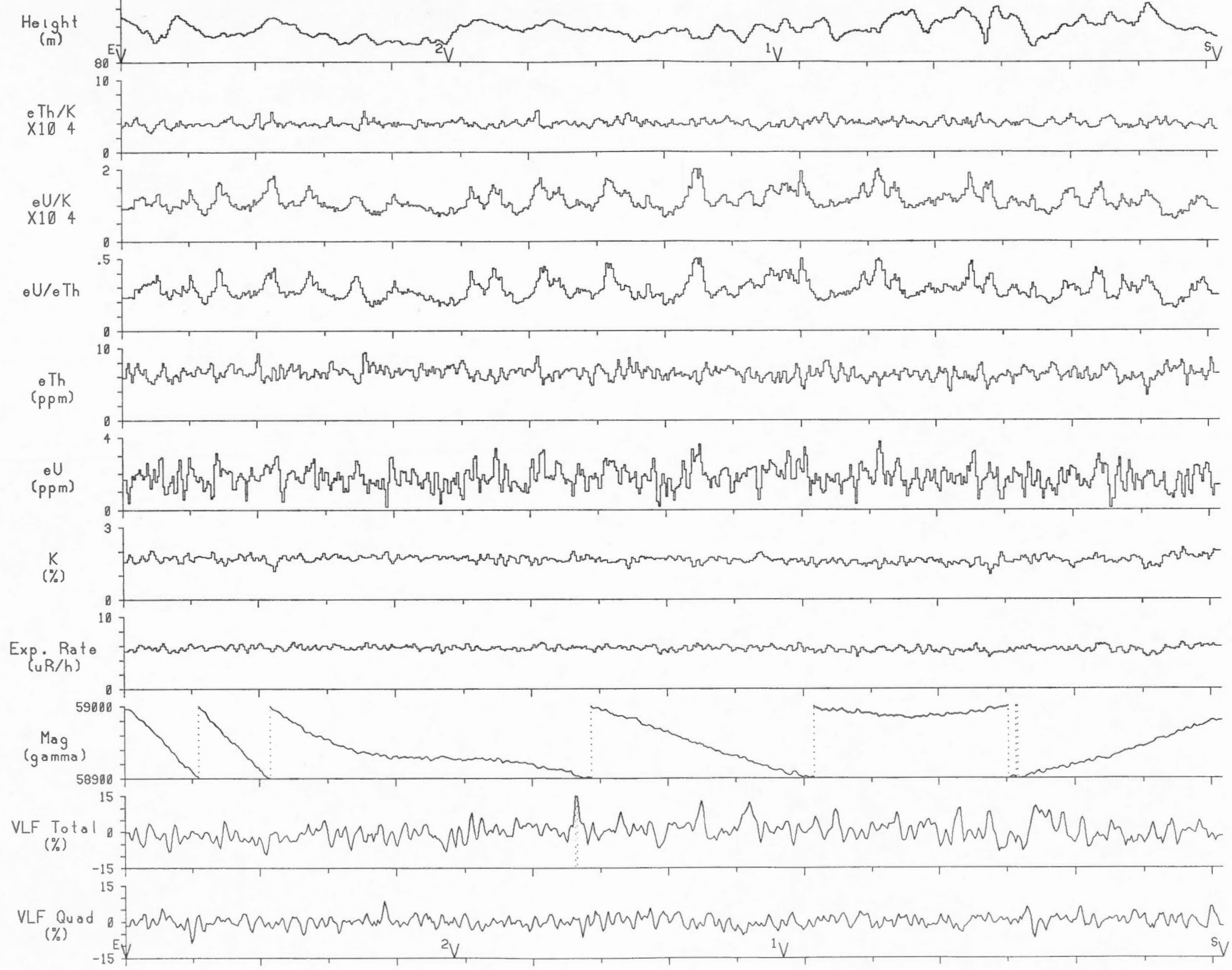


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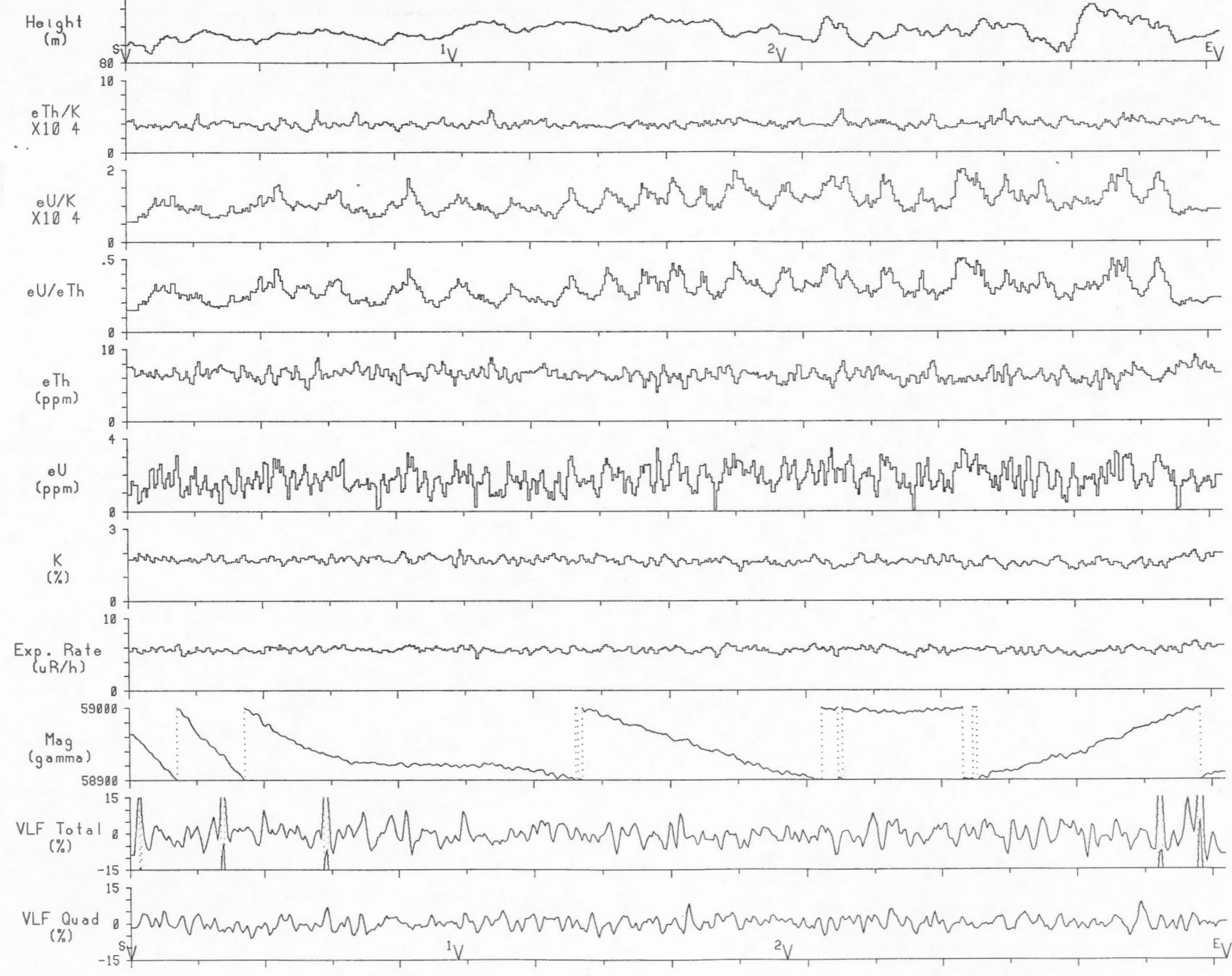
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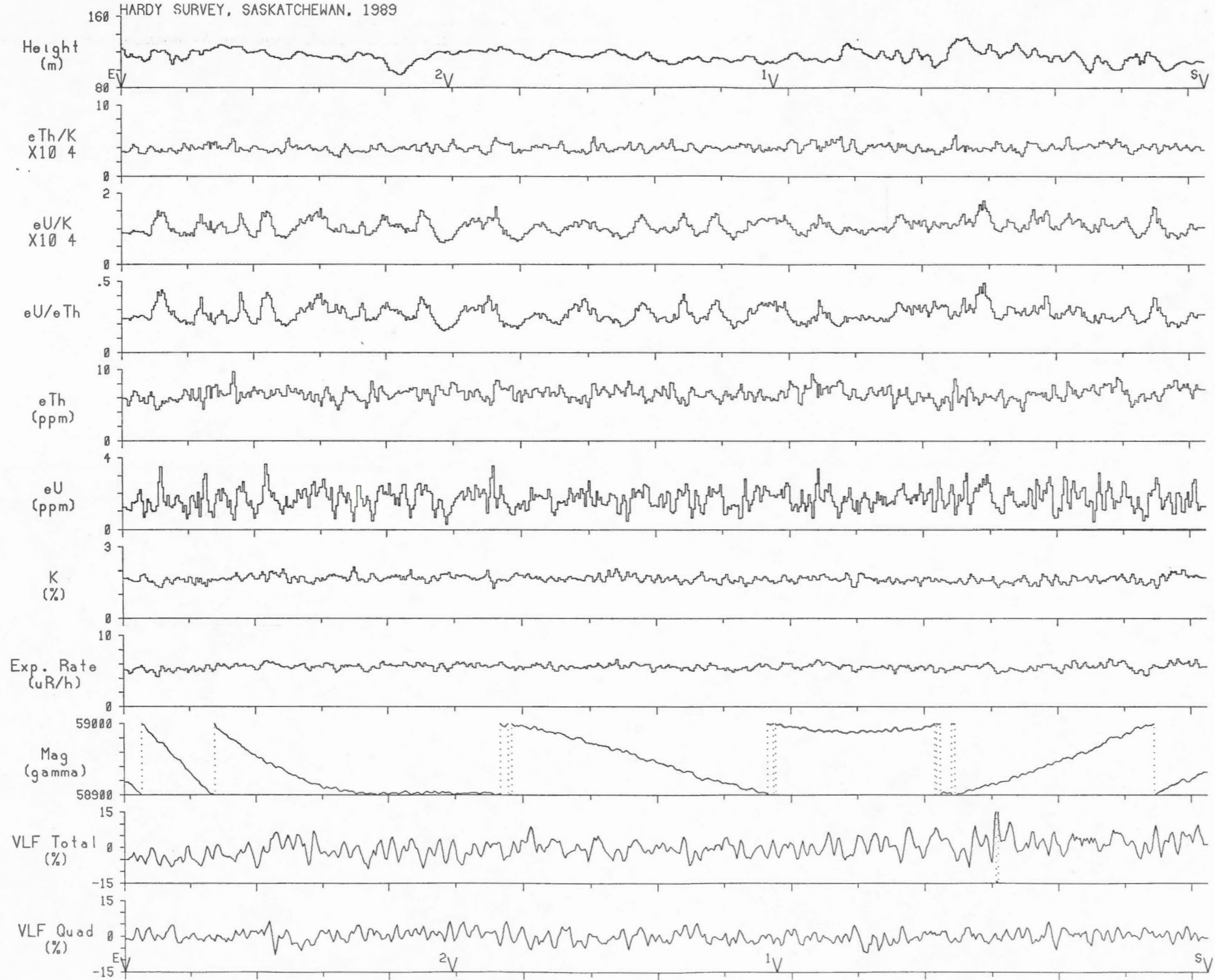


HARDY SURVEY, SASKATCHEWAN, 1989



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HARDY SURVEY, SASKATCHEWAN, 1989



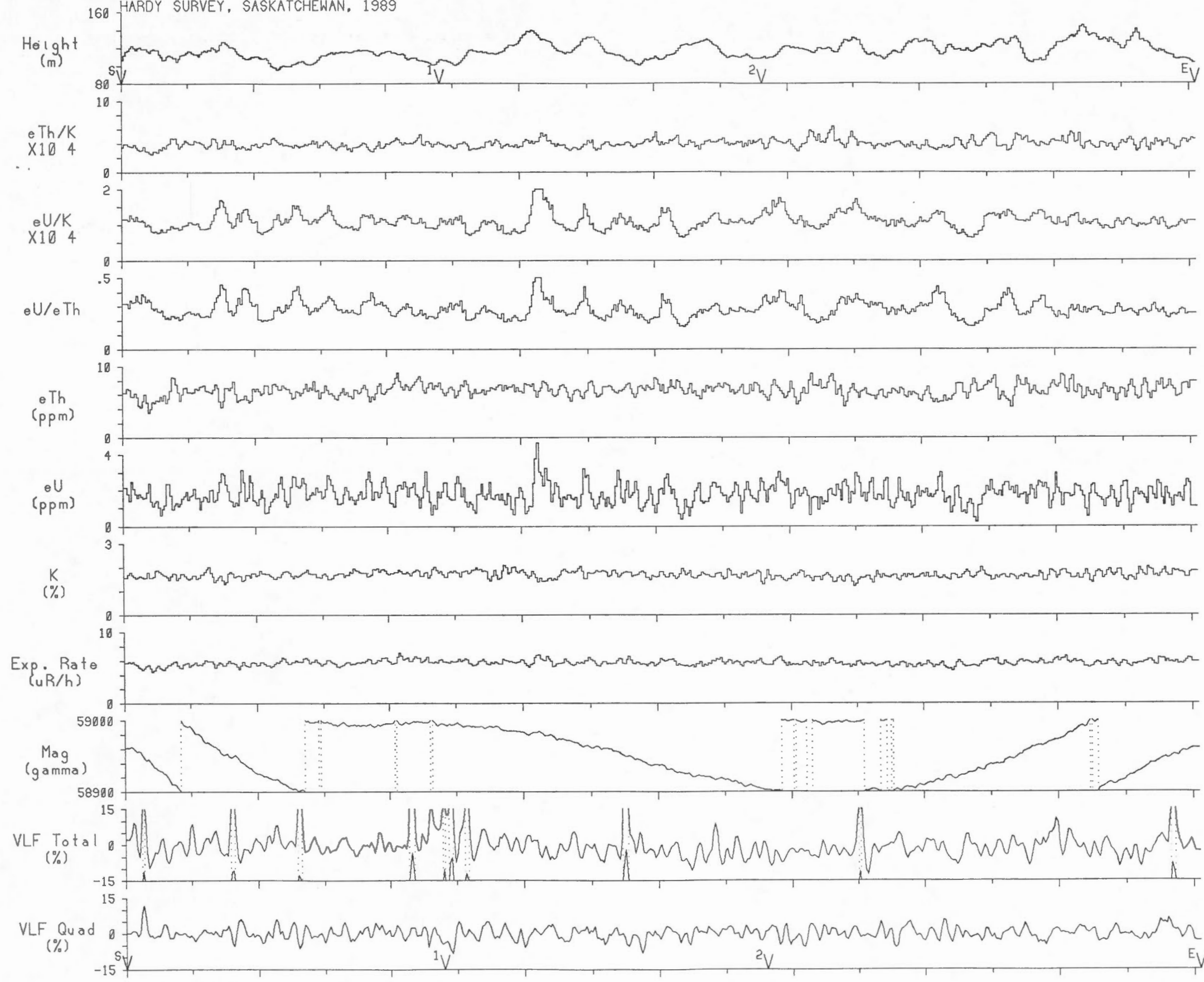
Line 26

2 km

Scale 1:126720

8°

HARDY SURVEY, SASKATCHEWAN, 1989



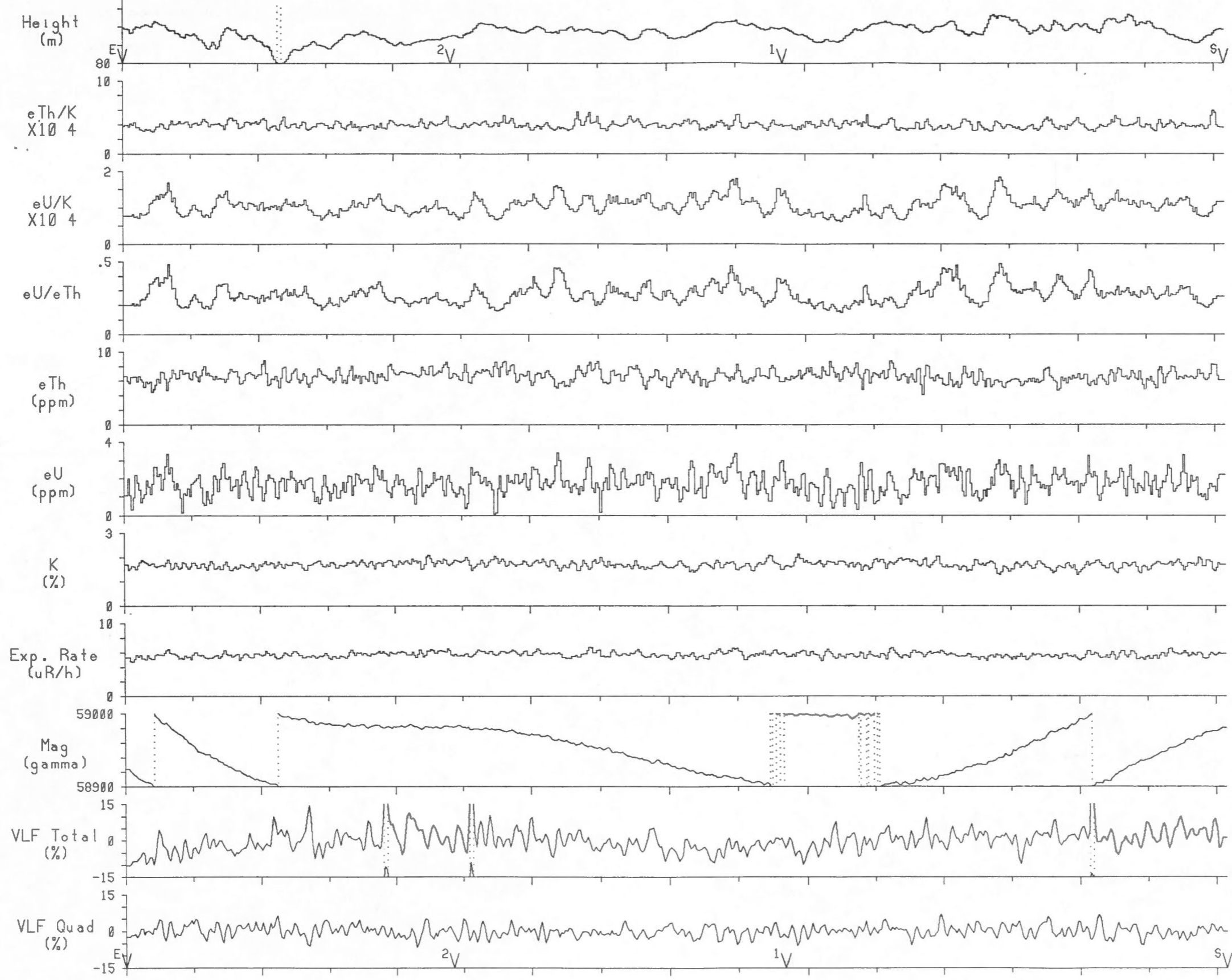
Line 27

2 km

Scale 1:126720

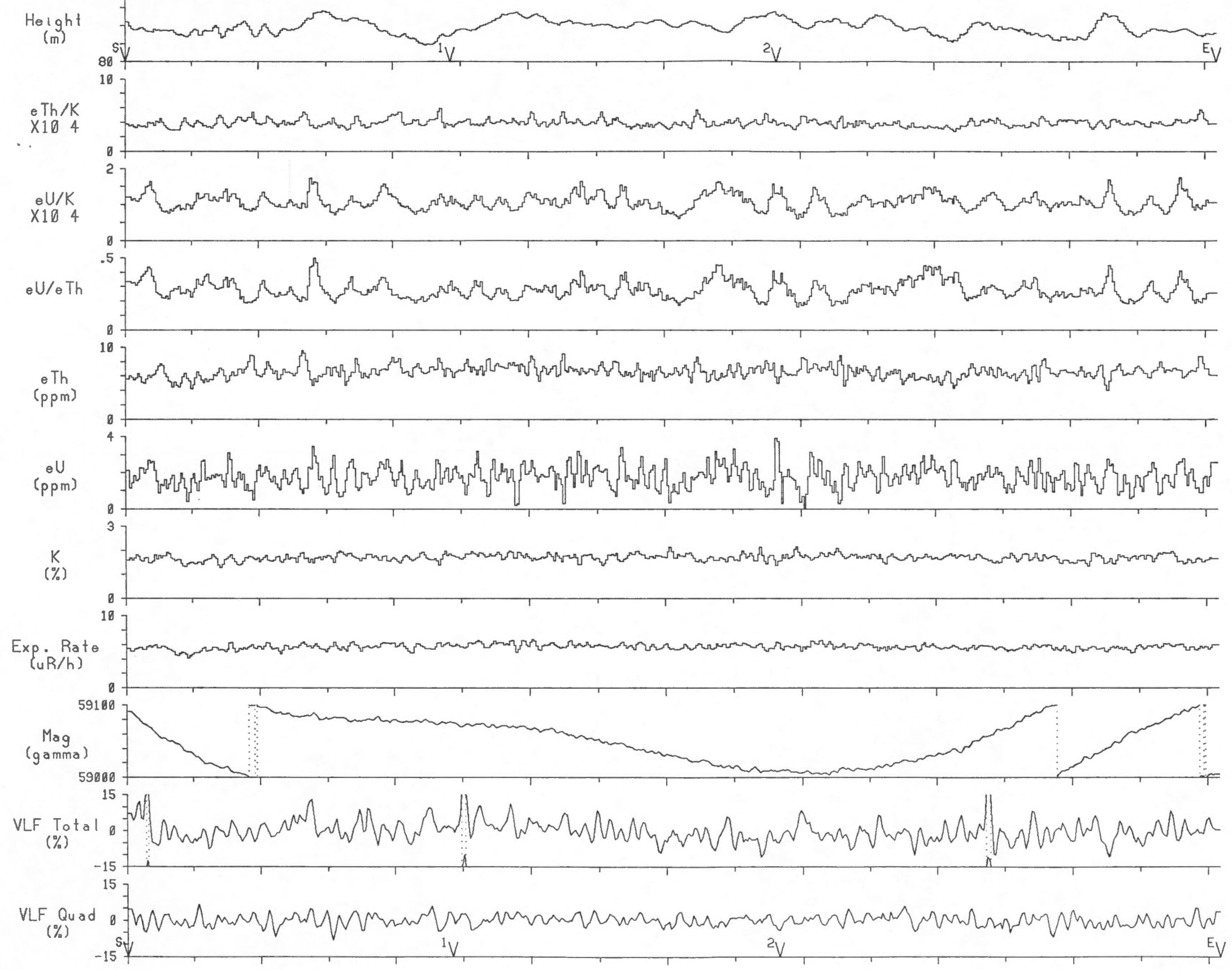
004

HARDY SURVEY, SASKATCHEWAN, 1989



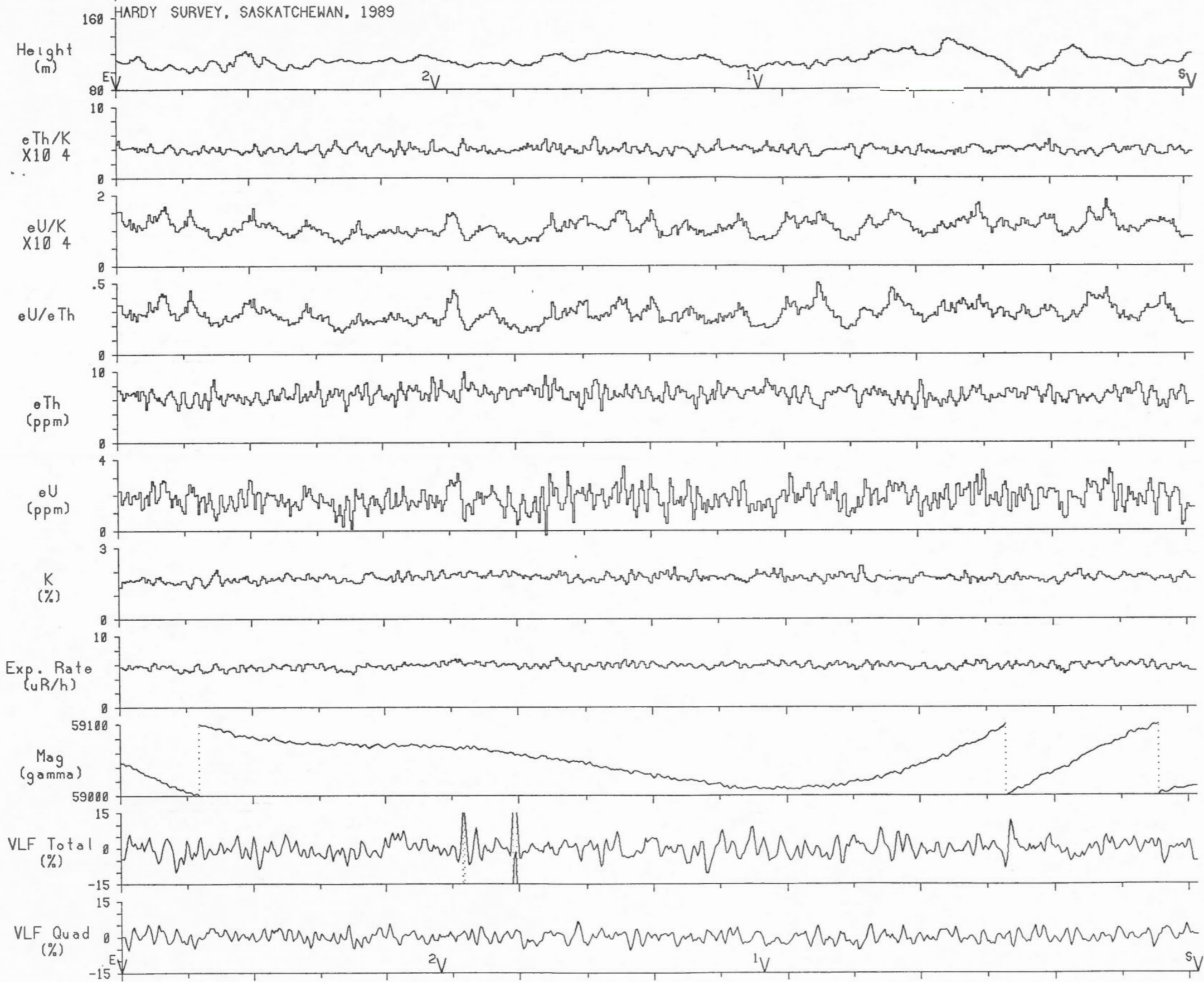
86

HARDY SURVEY, SASKATCHEWAN, 1989



80

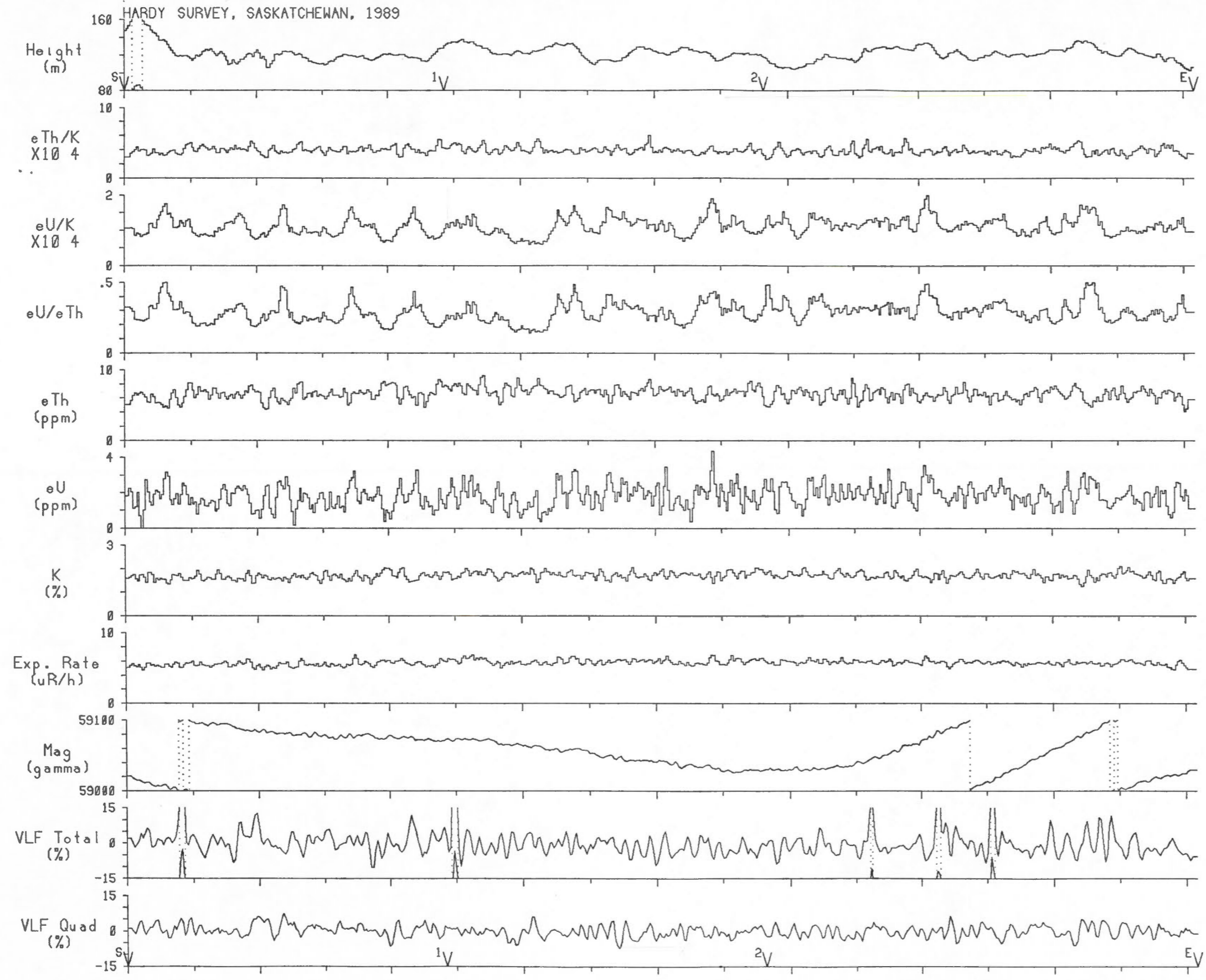
HARDY SURVEY, SASKATCHEWAN, 1989



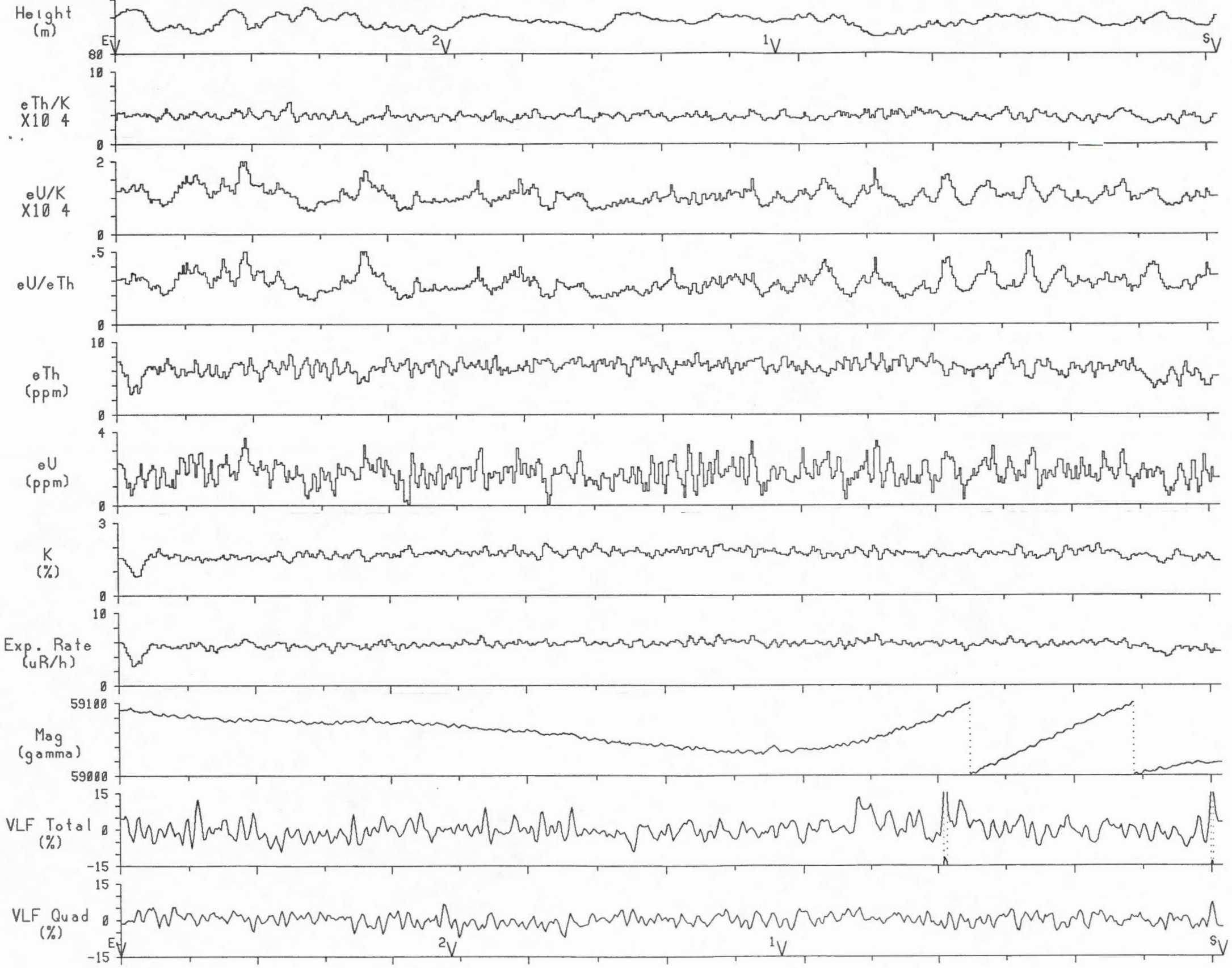
Line 30 2 km Scale 1:126720

8°

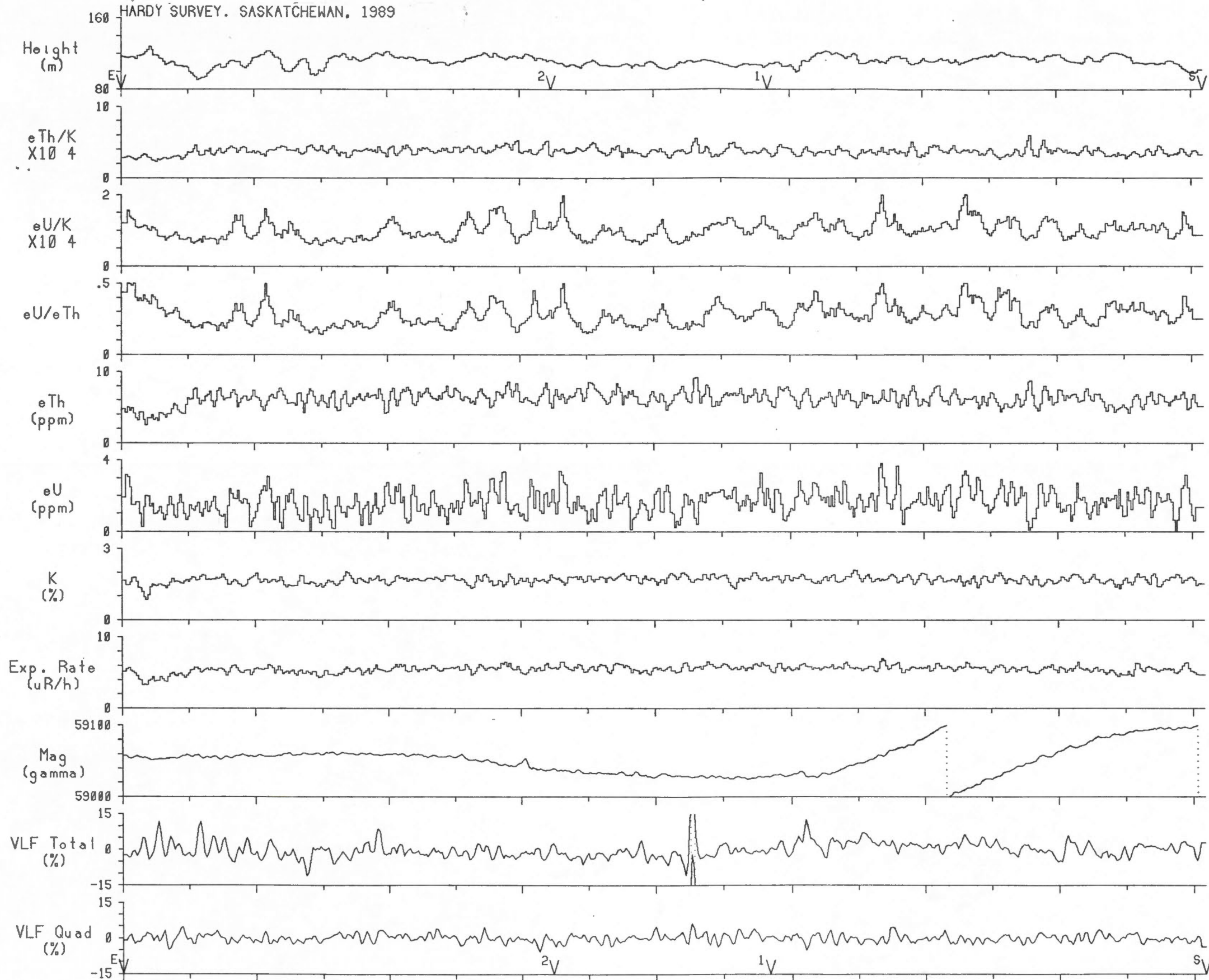
HARDY SURVEY, SASKATCHEWAN, 1989



HARDY SURVEY, SASKATCHEWAN, 1989



HARDY SURVEY. SASKATCHEWAN, 1989



86