

This document was produced  
by scanning the original publication.

Ce document est le produit d'une  
numérisation par balayage  
de la publication originale.

GEOLOGICAL SURVEY OF CANADA



COMMISSION GÉOLOGIQUE DU CANADA

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

AIRBORNE GAMMA RAY SPECTROMETER  
SURVEY

SASKATCHEWAN

1989

FREDA LAKE AND HARDY  
STUDY AREAS



Energy, Mines and  
Resources Canada

Énergie, Mines et  
Ressources Canada

Canada

OPEN FILE  
DOSSIER PUBLIC  
**2208**

GEOLOGICAL SURVEY OF CANADA  
COMMISSION GÉOLOGIQUE DU CANADA  
OTTAWA

## AIRBORNE GAMMA RAY SPECTROMETER SURVEY

2

FREDA LAKE, SASKATCHEWAN

GSC OPEN FILE No. 2208

R.J. Hetu and P.B. Holman  
Airborne Geophysics Section  
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  $^{40}\text{K}$ , 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 approximatley 1.76 MeV from  $^{214}\text{Bi}$ , and thorium, from 2.62 MeV photons emitted by  $^{208}\text{Tl}$ . The energy windows used are as follows:

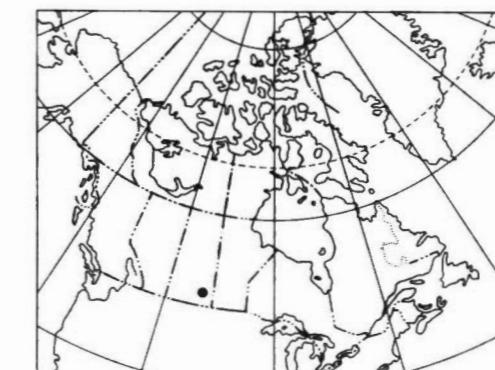
Potassium	$^{40}\text{K}$	1.36-1.56 MeV
Uranium	$^{214}\text{Bi}$	1.66-1.86 MeV
Thorium	$^{208}\text{Tl}$	2.41-2.81 MeV

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

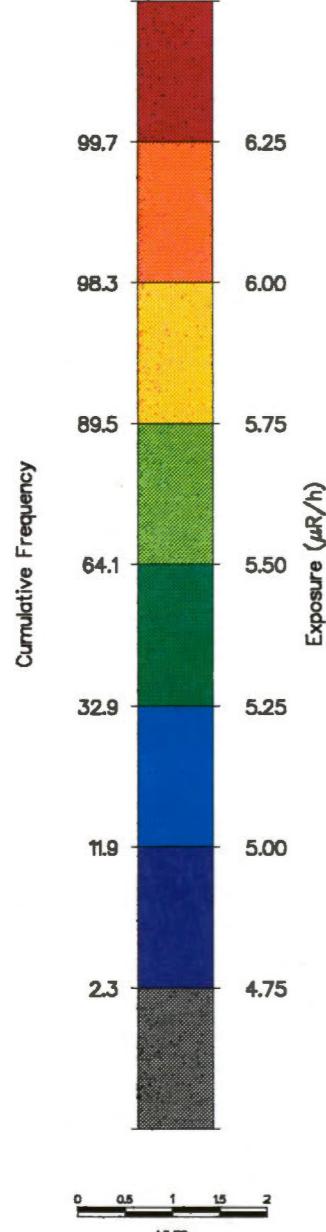
The exposure rate, in micro Roentgens per hour has been computed from the measured concentrations of potassium, uranium and thorium (Grasty, R.L., Carson, J.M., Charbonneau, B.W. and Holman, P.B., 1984, Natural Background Radiation in Canada, Geol. Surv. Can., Bull. 360). To compare these data with earlier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



INDEX MAP

## Freda Lake Survey, Saskatchewan, 1989

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



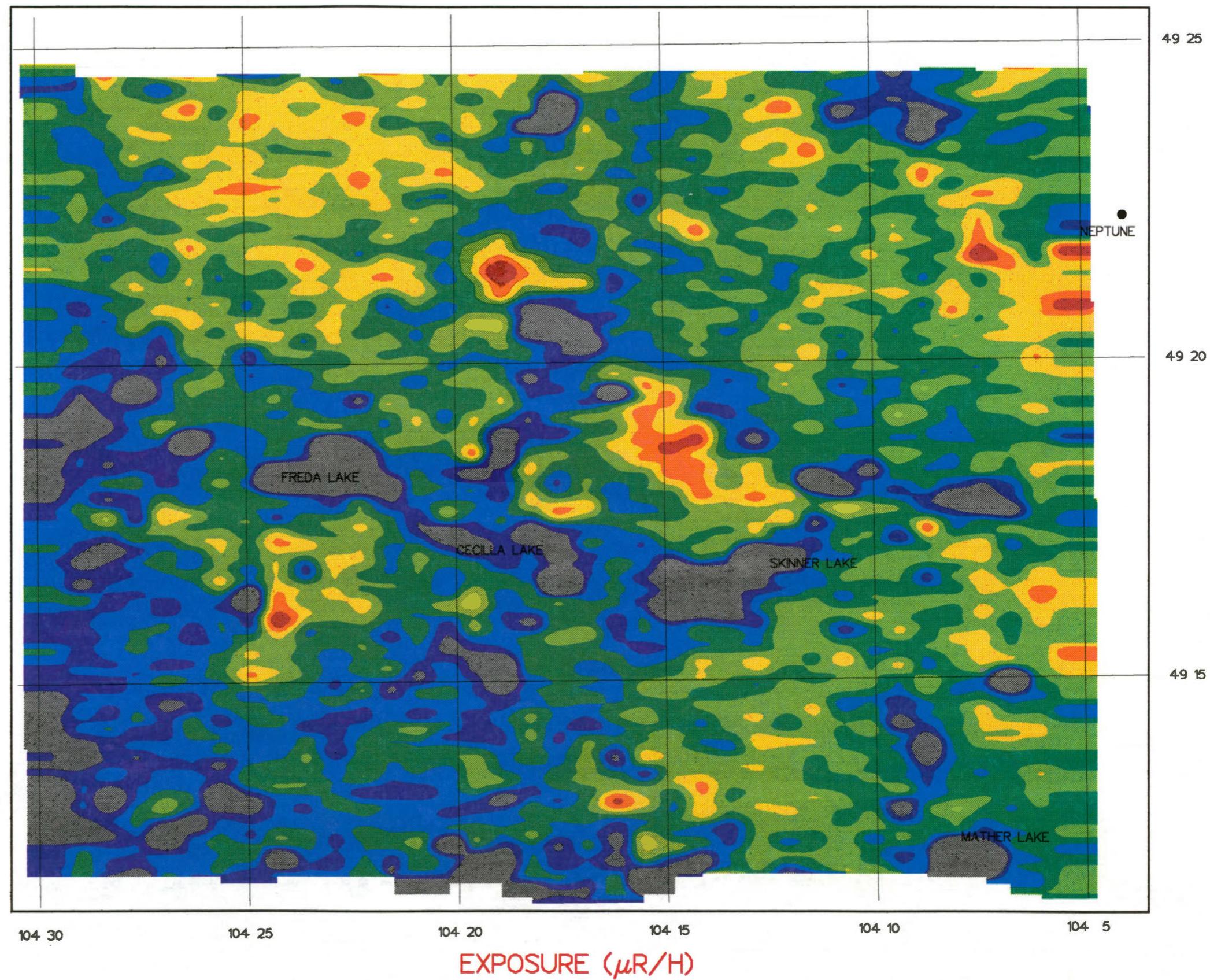
Scale = 1:126 720  
Line spacing = 800 metres

Survey flown, compiled and funded by  
Airborne Geophysics Section  
Mineral Resources Division  
Geological Survey of Canada



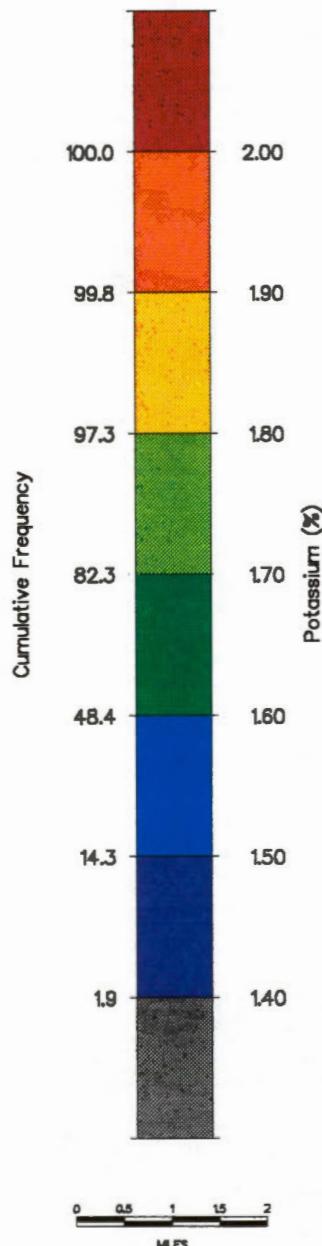
Energie, Mines et Ressources Canada

Canada



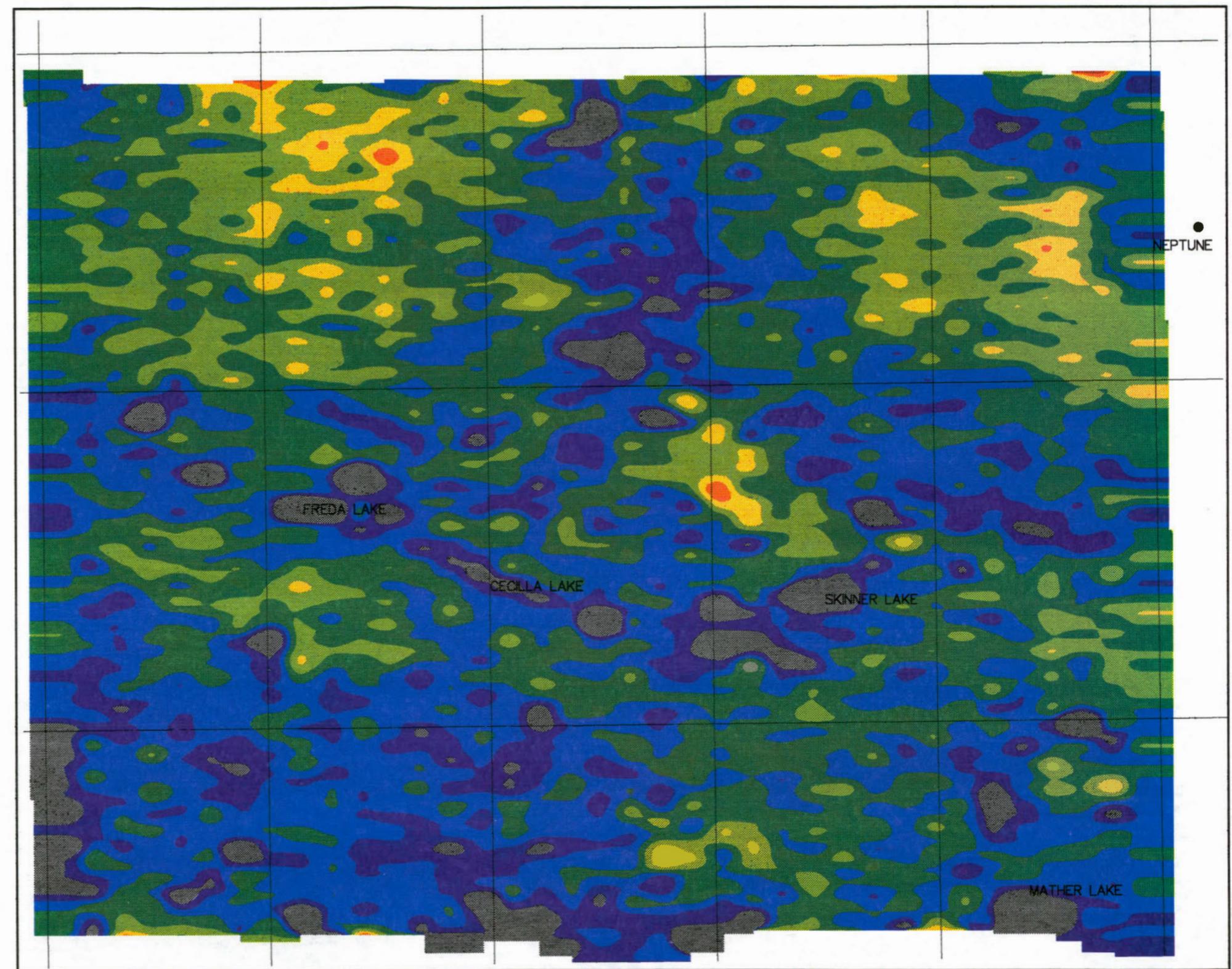
## Freda Lake Survey, Saskatchewan, 1989

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



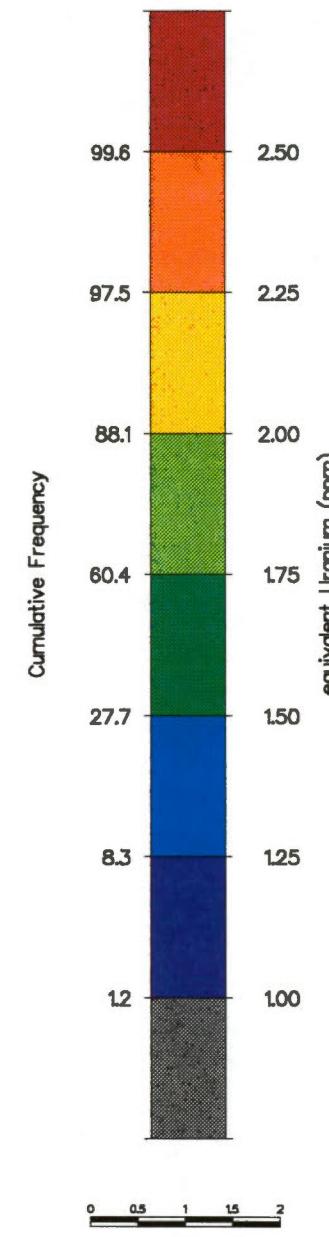
Scale = 1:126 720  
Line spacing = 800 metres

Survey flown, compiled and funded by  
Airborne Geophysics Section  
Mineral Resources Division  
Geological Survey of Canada



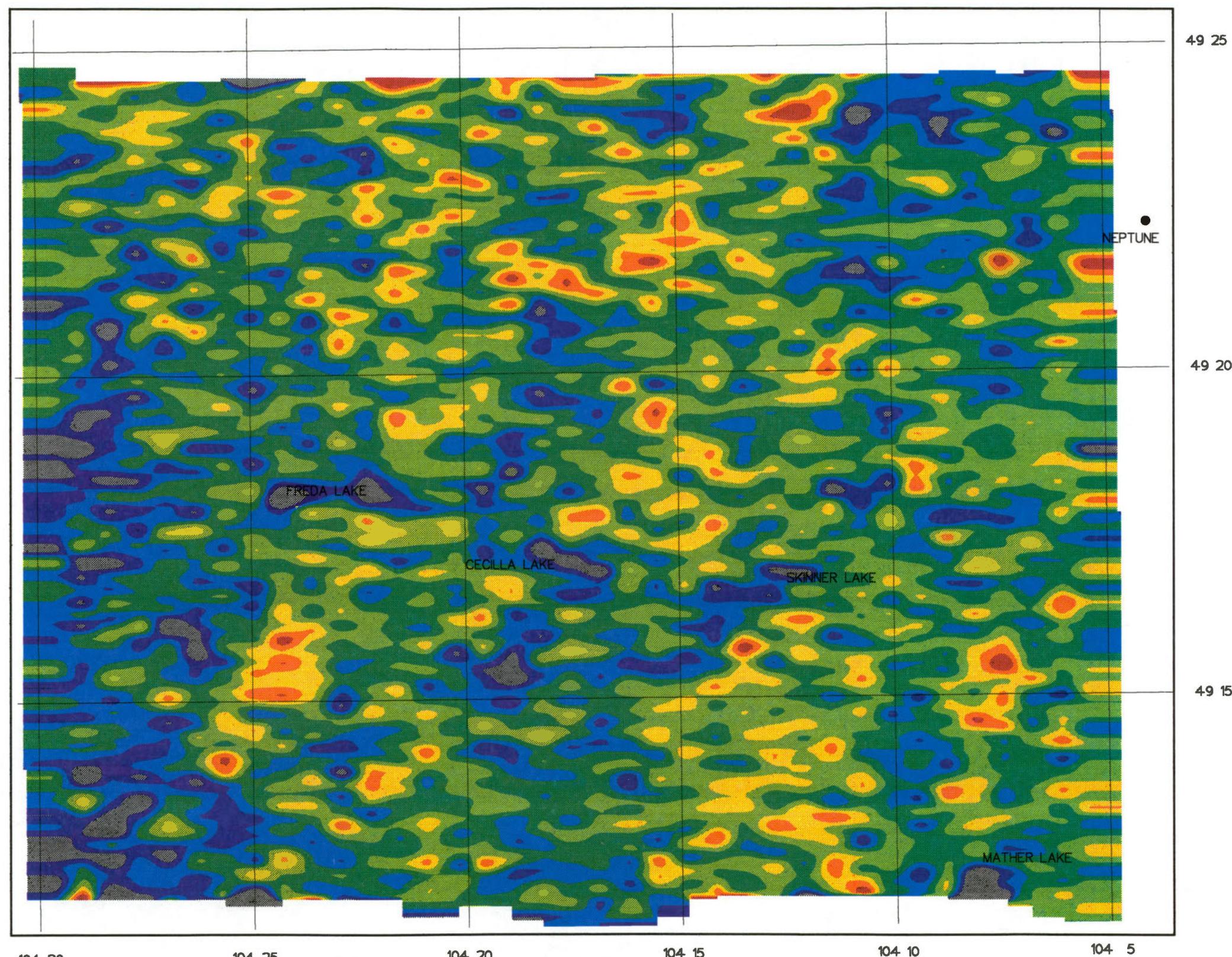
## Freda Lake Survey, Saskatchewan, 1989

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



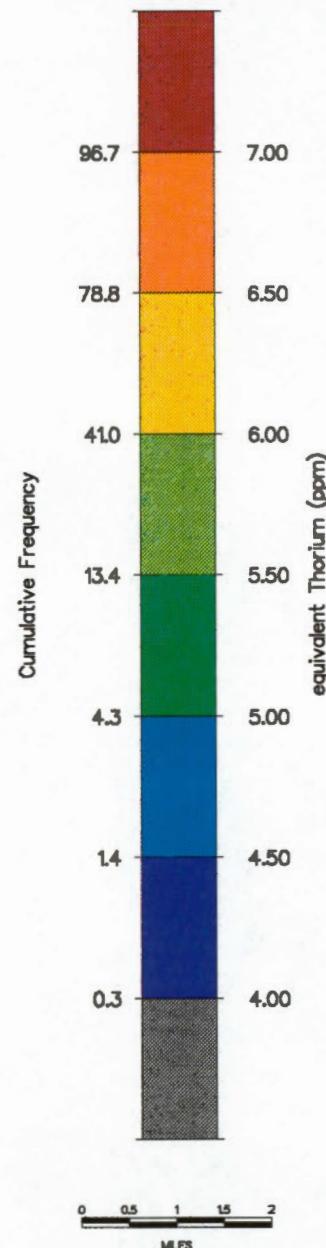
Scale = 1:126 720  
Line spacing = 800 metres

Survey flown, compiled and funded by  
Airborne Geophysics Section  
Mineral Resources Division  
Geological Survey of Canada



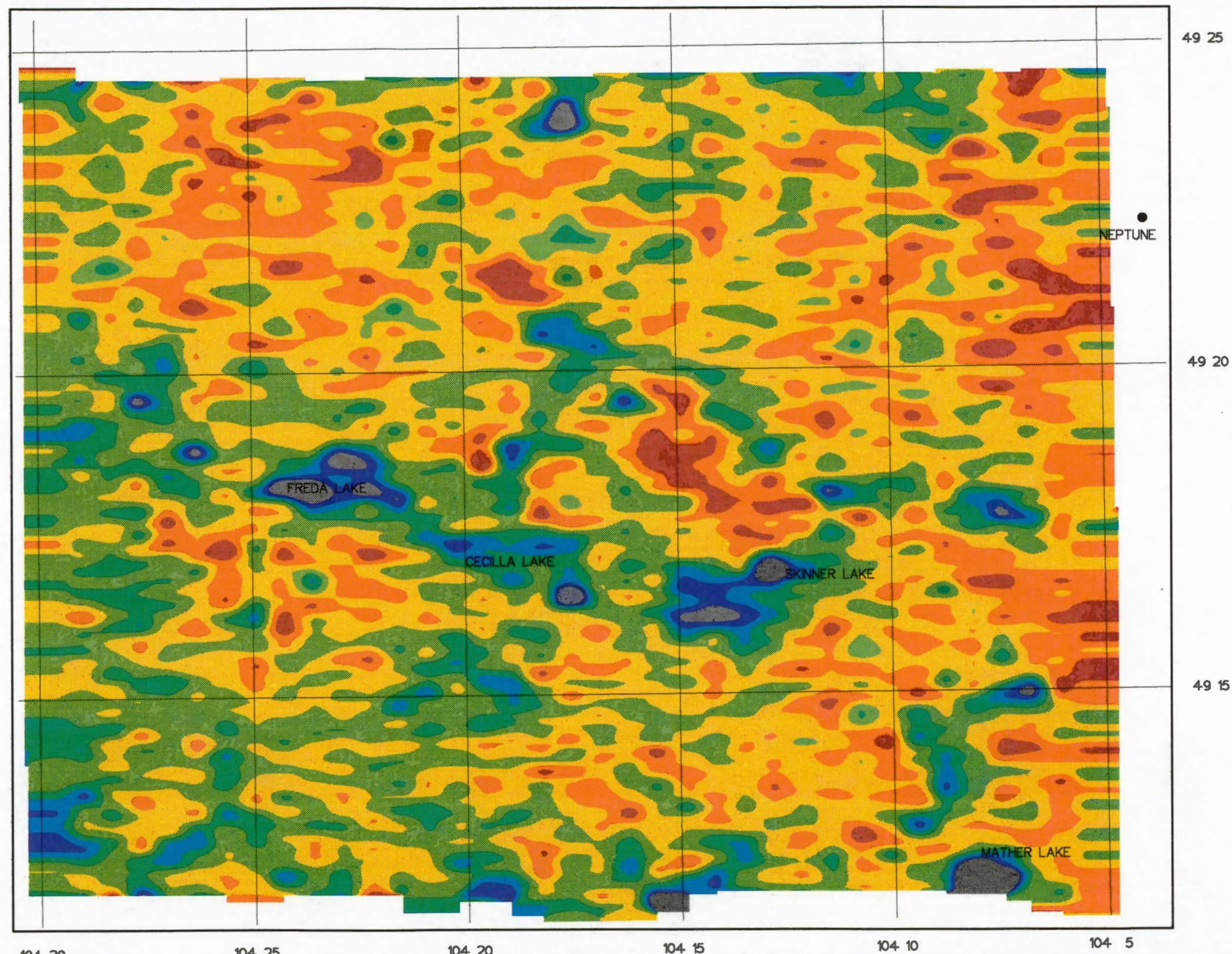
## Freda Lake Survey, Saskatchewan, 1989

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



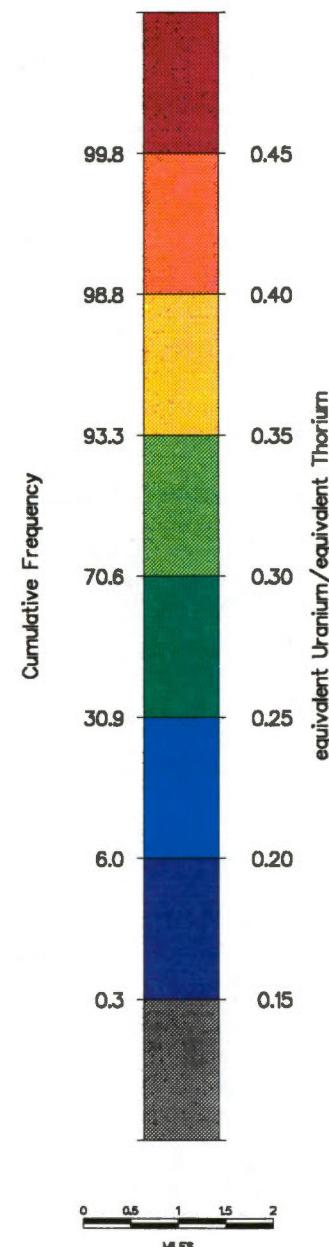
Scale = 1:126 720  
Line spacing = 800 metres

Survey flown, compiled and funded by  
Airborne Geophysics Section  
Mineral Resources Division  
Geological Survey of Canada



## Freda Lake Survey, Saskatchewan, 1989

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



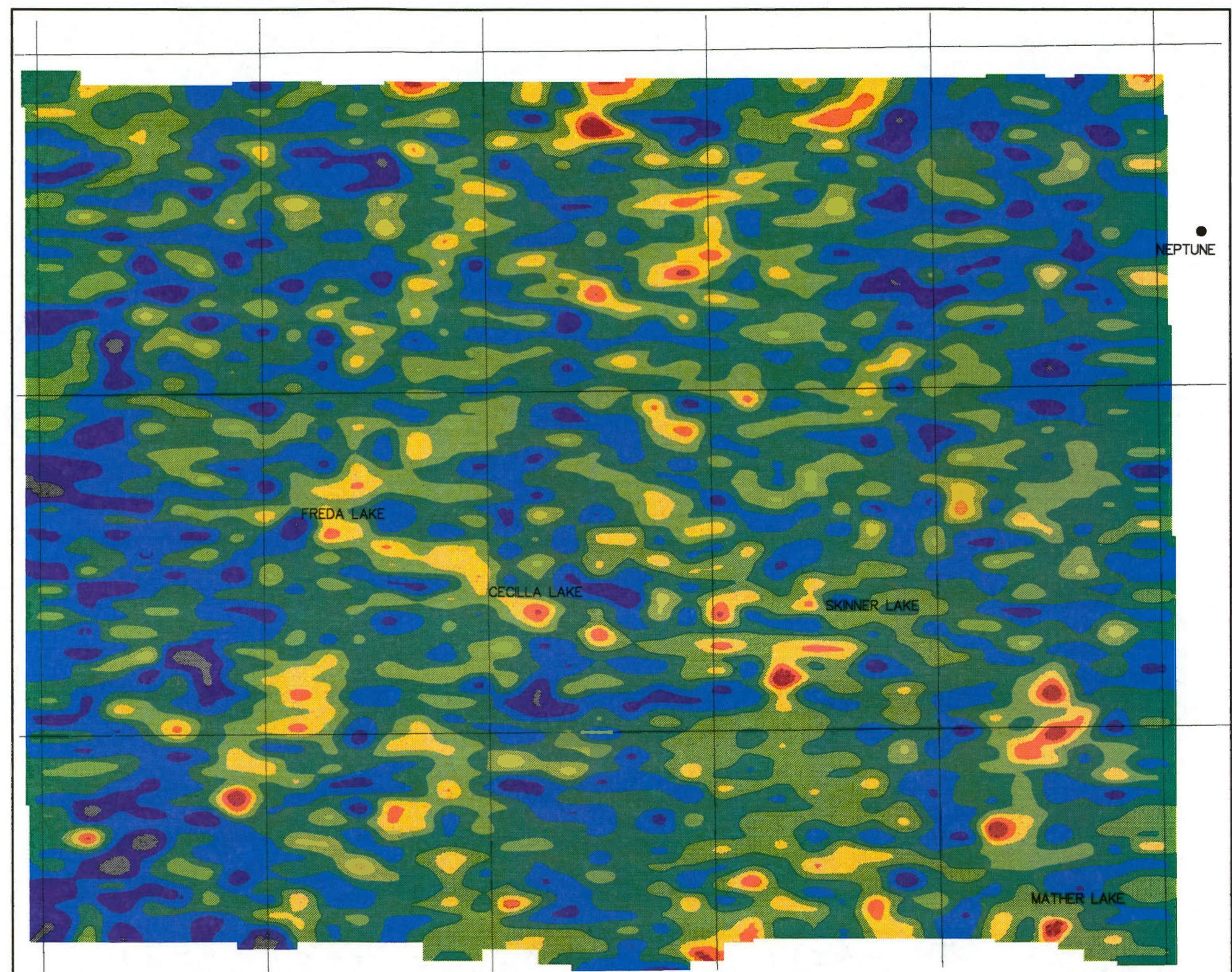
Scale = 1:126 720  
Line spacing = 800 metres

Survey flown, compiled and funded by  
Airborne Geophysics Section  
Mineral Resources Division  
Geological Survey of Canada



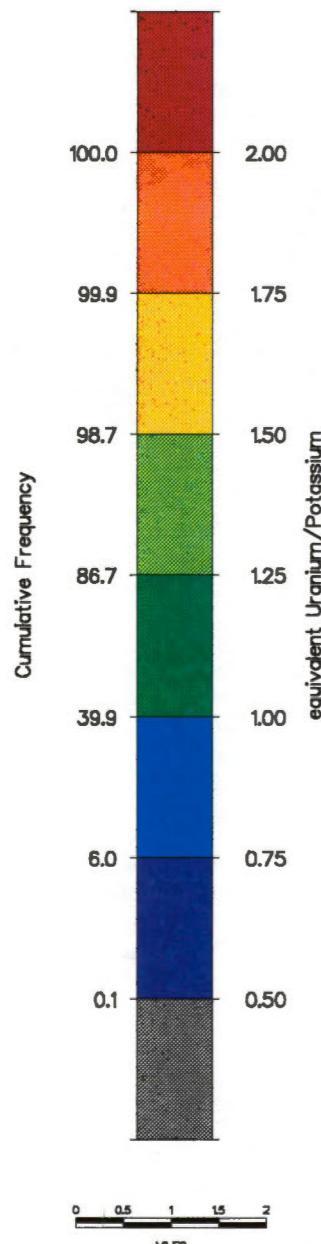
Energy, Mines and  
Resources Canada

Canada



## Freda Lake Survey, Saskatchewan, 1989

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



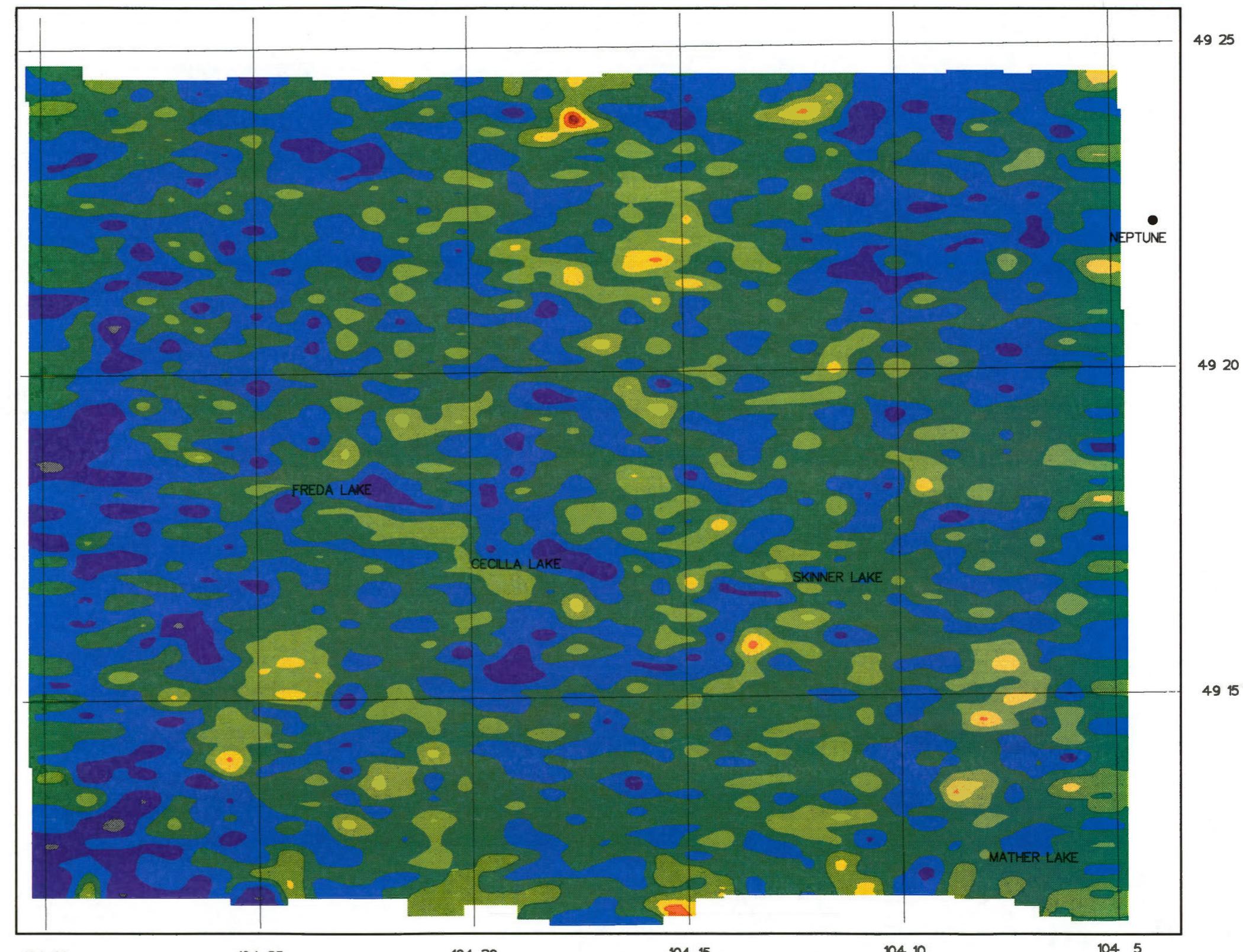
Scale = 1:126 720  
Line spacing = 800 metres

Survey flown, compiled and funded by  
Airborne Geophysics Section  
Mineral Resources Division  
Geological Survey of Canada



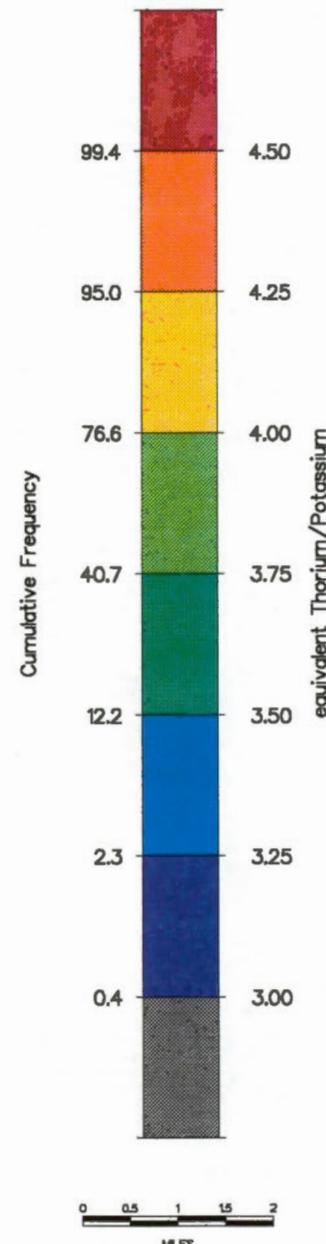
Energie, Mines et Ressources Canada

Canada



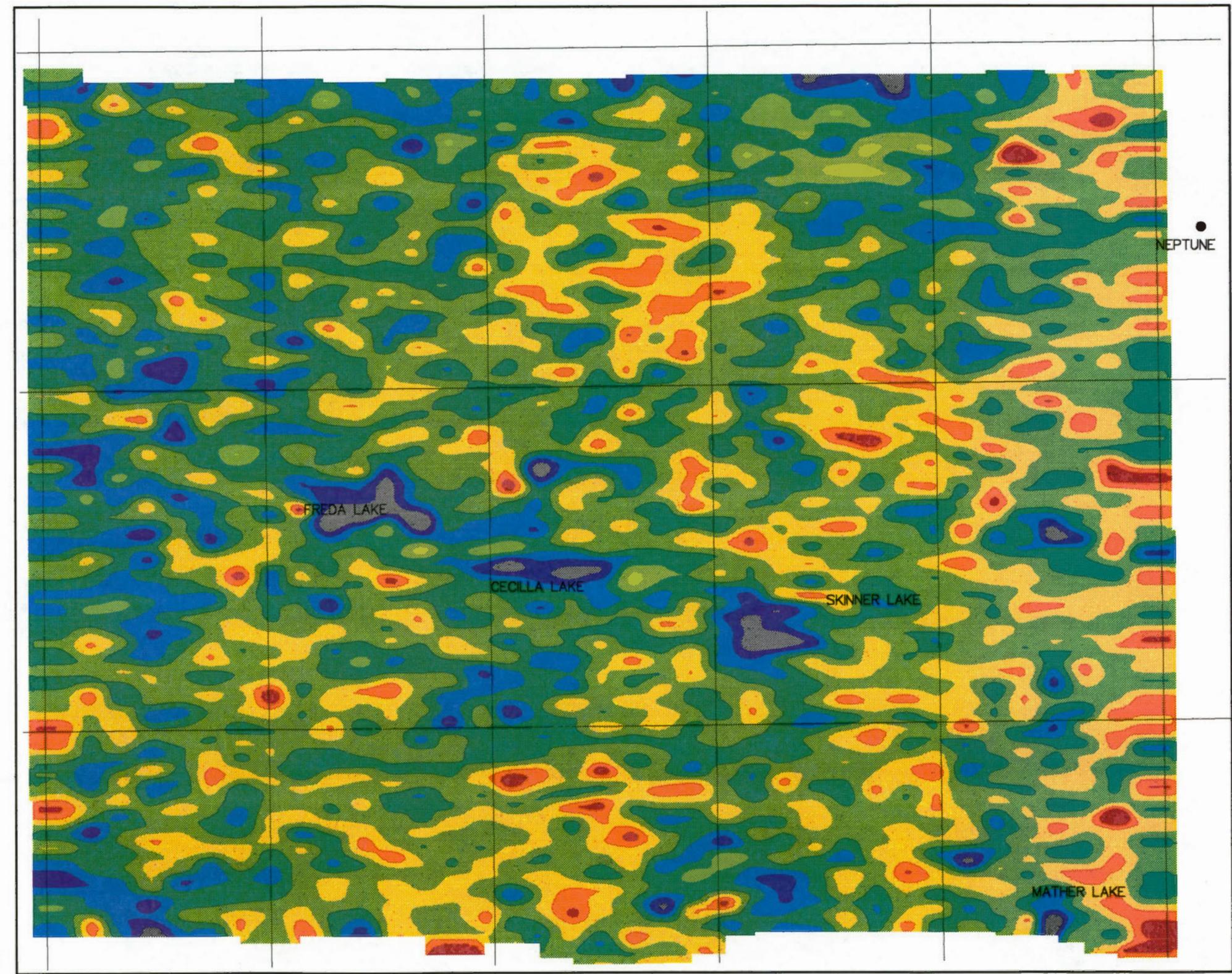
## Freda Lake Survey, Saskatchewan, 1989

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



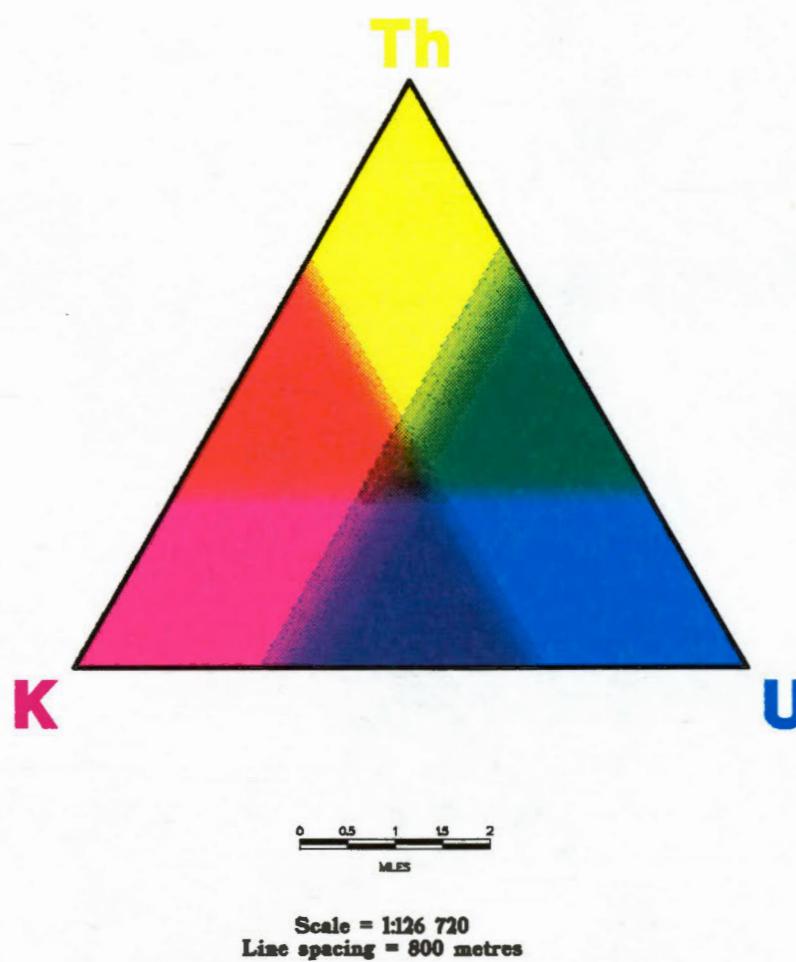
Scale = 1:126 720  
Line spacing = 800 metres

Survey flown, compiled and funded by  
Airborne Geophysics Section  
Mineral Resources Division  
Geological Survey of Canada



## Freda Lake Survey, Saskatchewan, 1989

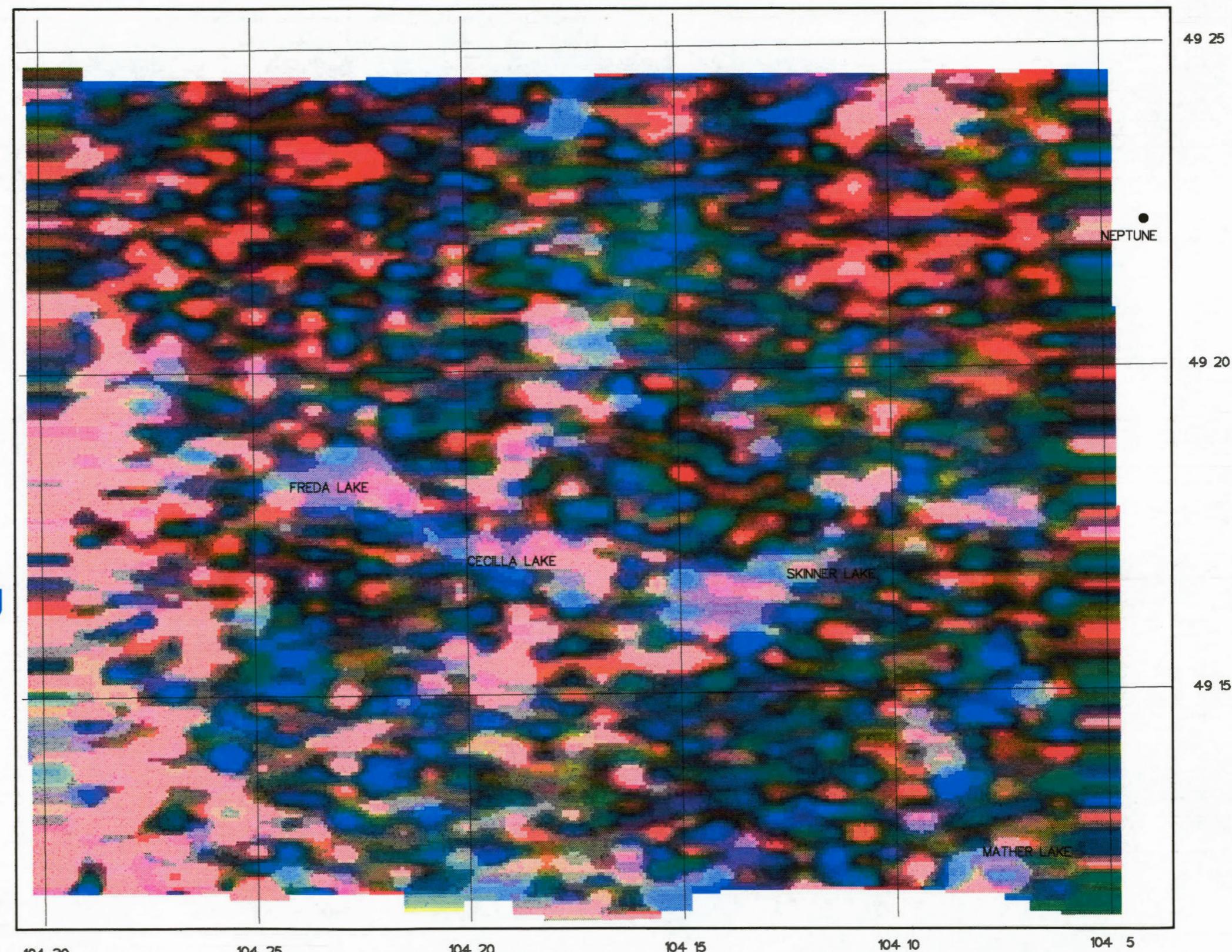
Reference map: Soil map of the  
Willow Bunch Lake sheet  
Saskatchewan, NTS 72H east half.



Survey flown, compiled and funded by  
Airborne Geophysics Section  
Mineral Resources Division  
Geological Survey of Canada

Energy, Mines and  
Resources Canada

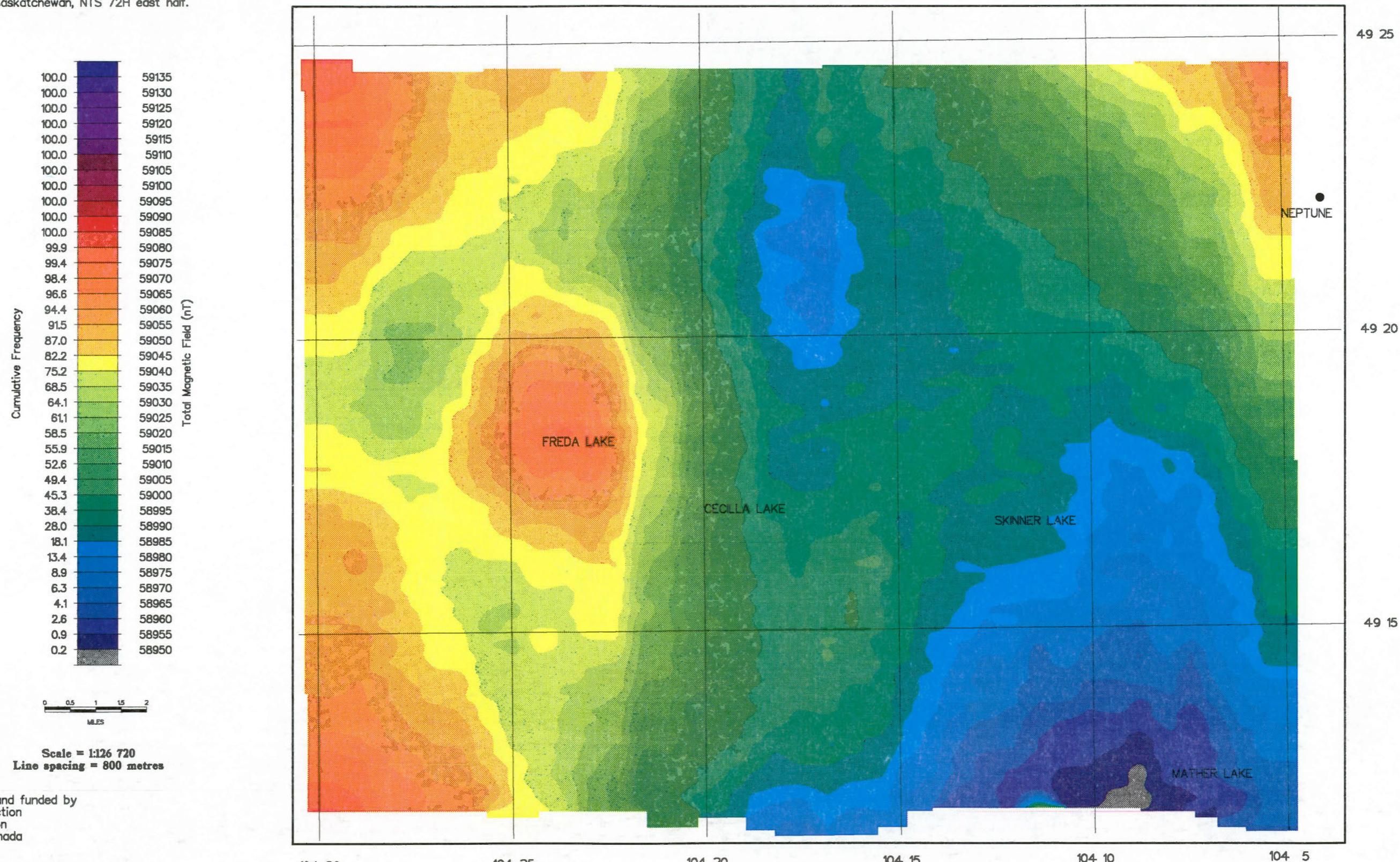
Energie, Mines et  
Ressources Canada



TERNARY RADIOELEMENT MAP

## Freda Lake Survey, Saskatchewan, 1989

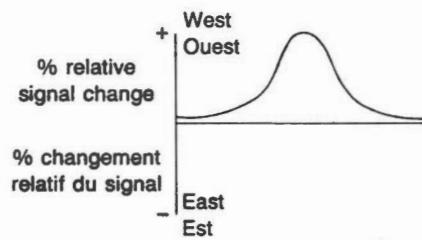
Reference map: Soil map of the  
Willow Bunch Lake sheet  
Saskatchewan, NTS 72H east half.



# Freda Lake 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

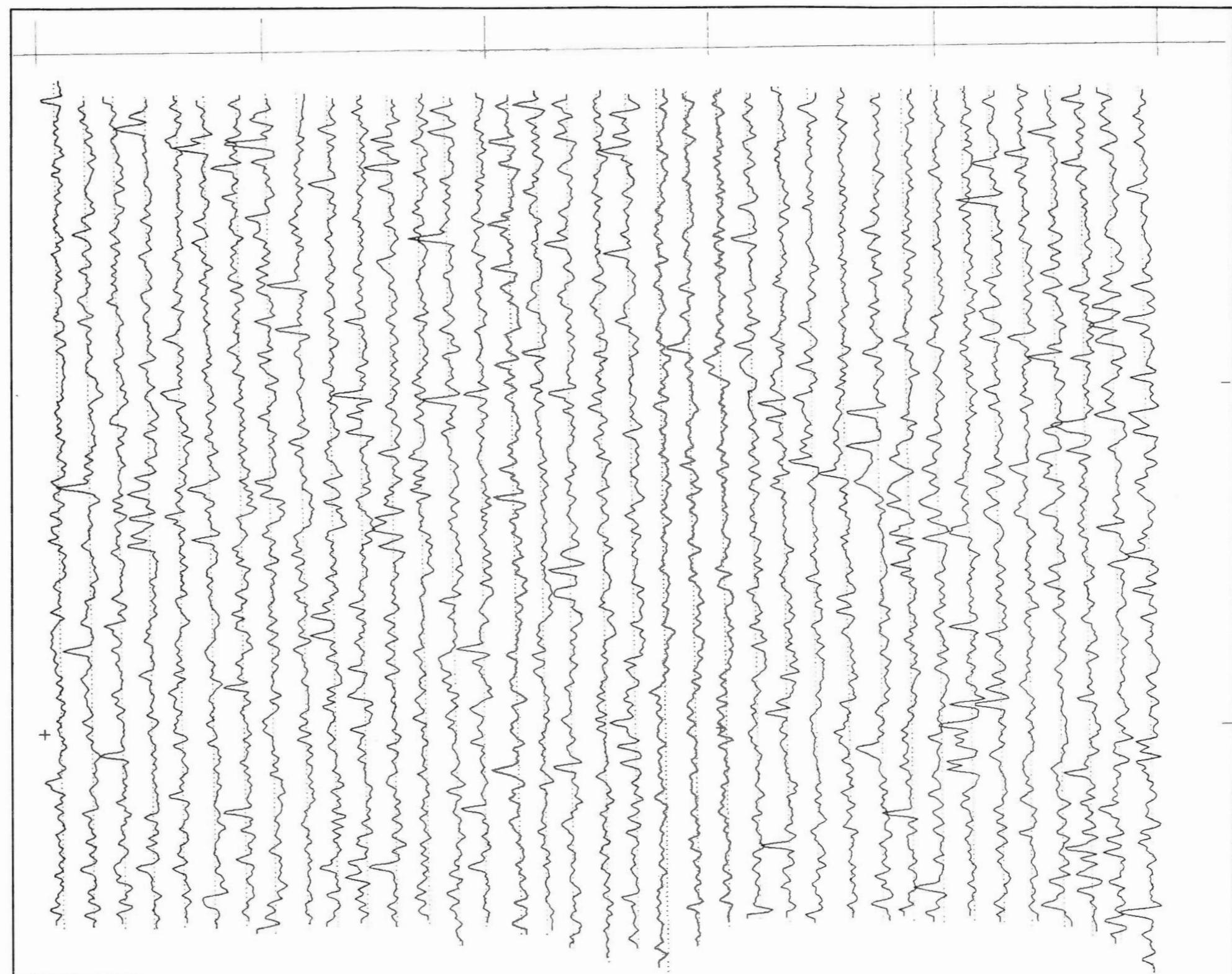


Vertical scale 50% / cm  
Échelle verticale 50% / cm



Scale = 1:126 720  
Line spacing = 800 metres

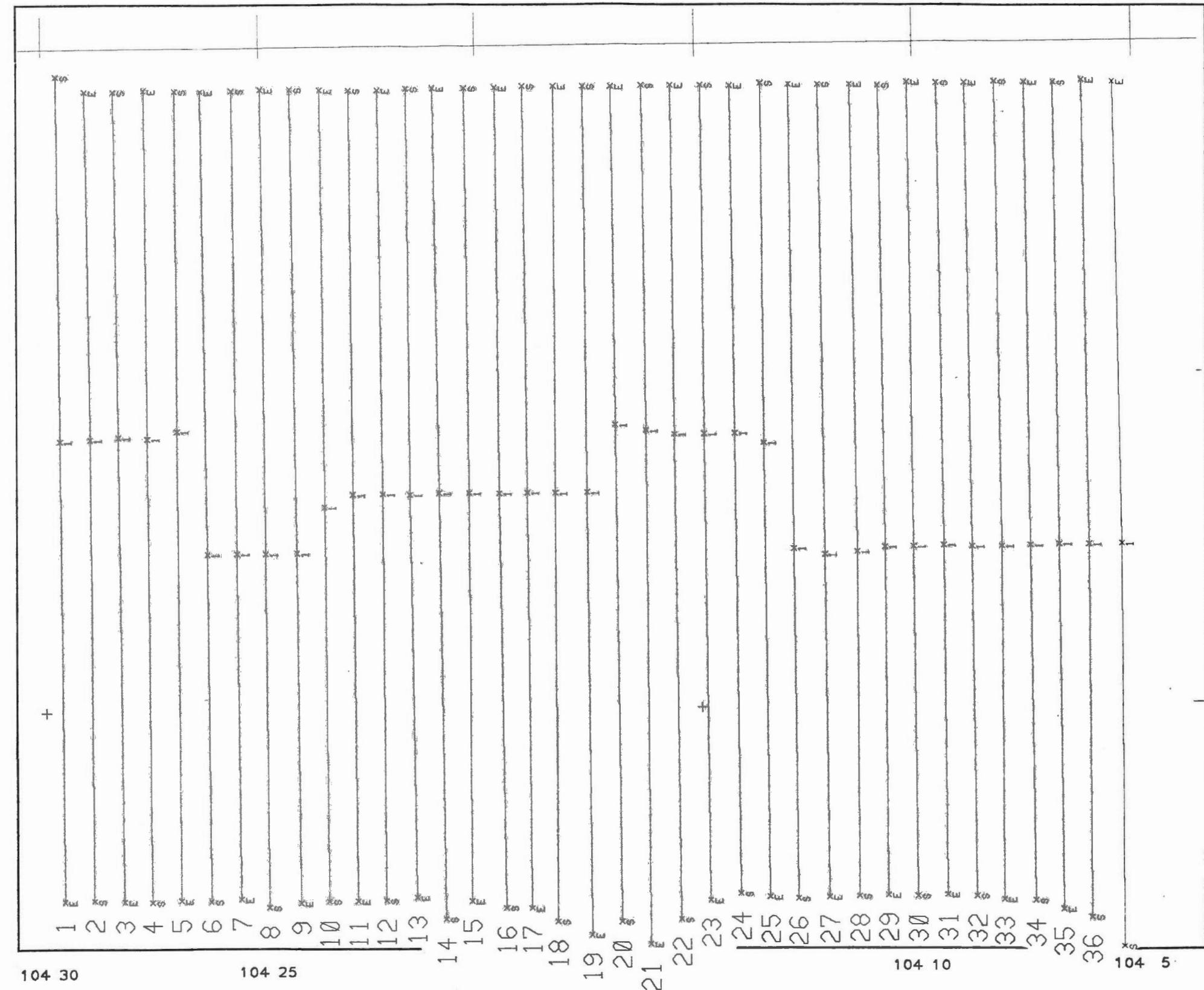
Survey flown, compiled and funded by  
Airborne Geophysics Section  
Mineral Resources Division  
Geological Survey of Canada



## Freda Lake Survey, Saskatchewan, 1989

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

49 25



A horizontal scale bar representing distance in miles. It features five numerical tick marks at 0, 0.5, 1, 1.5, and 2. The word "MILES" is centered below the scale.

Scale = 1:126 720  
Line spacing = 800 metres

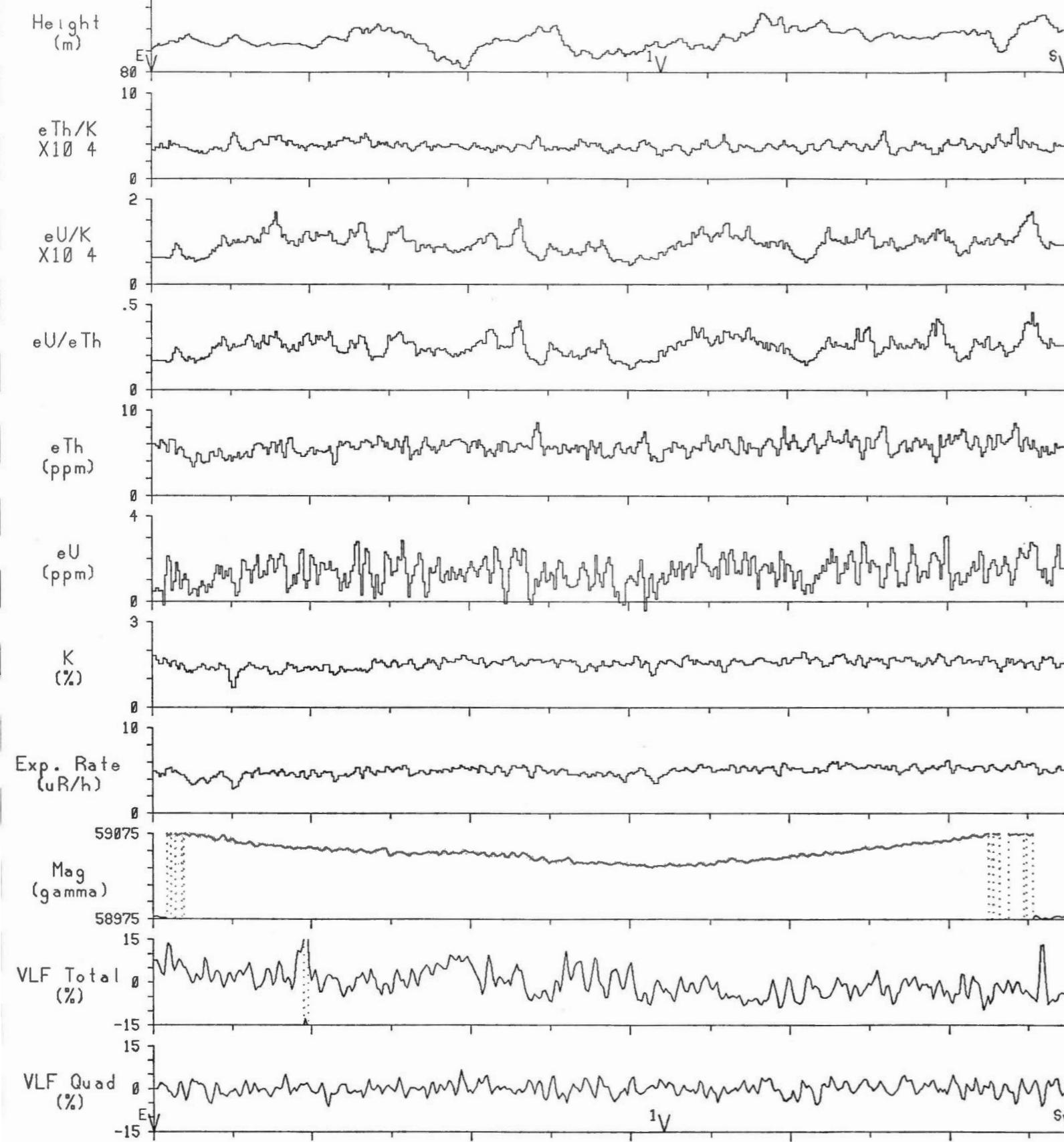
Survey flown, compiled and funded by  
Airborne Geophysics Section  
Mineral Resources Division  
Geological Survey of Canada



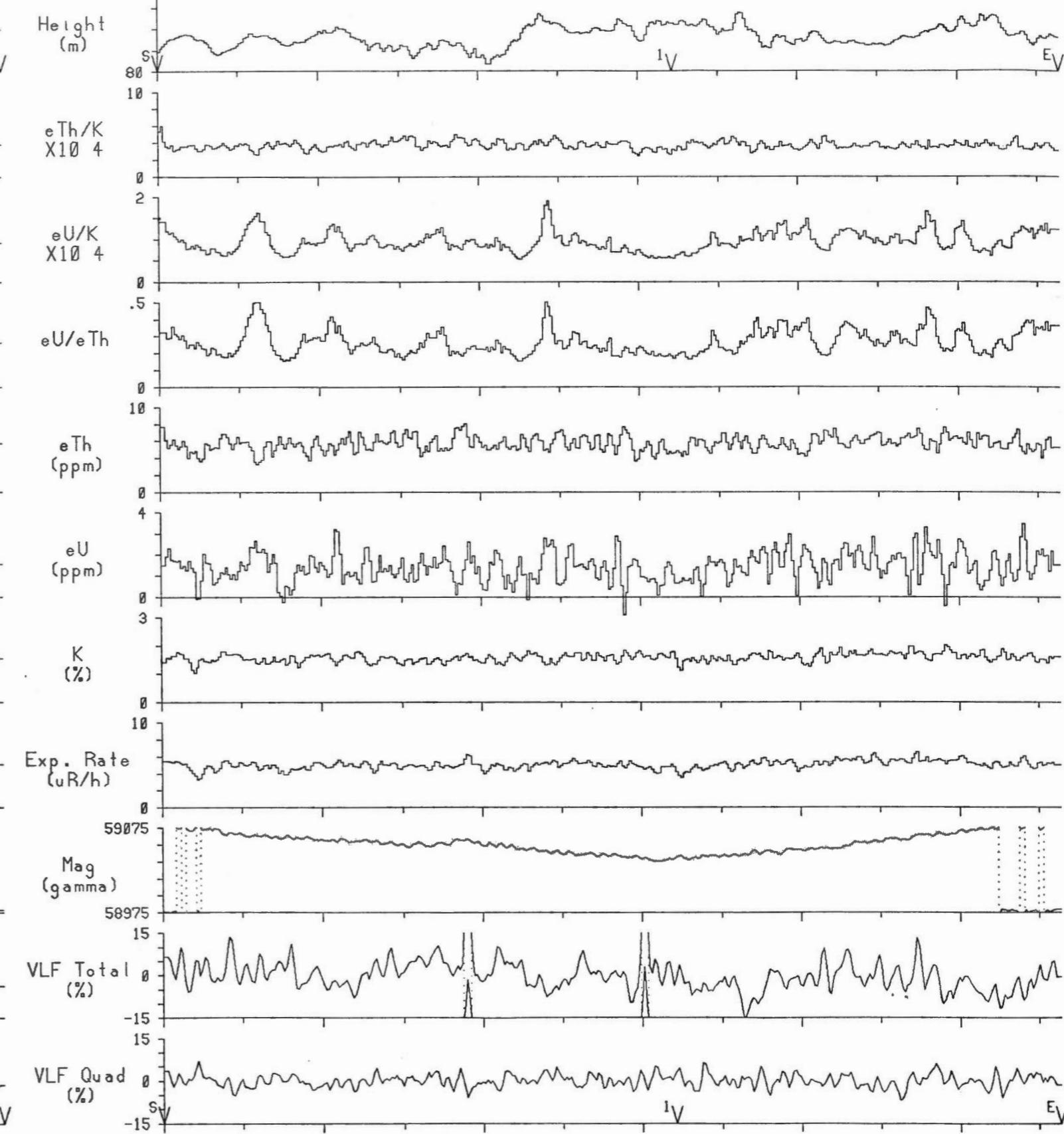
## **Energy, Mines and Resources Canada**

Canadä

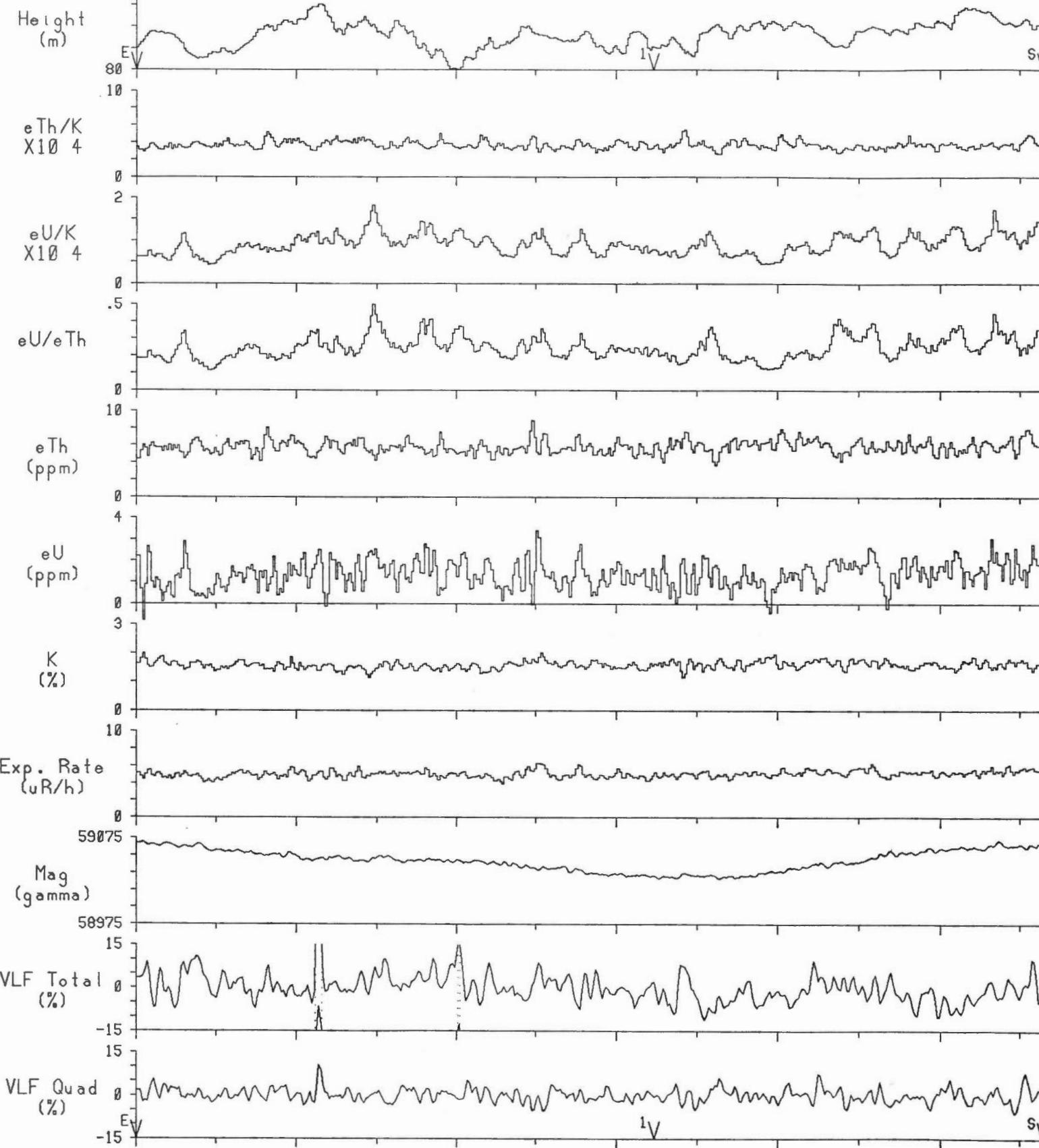
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



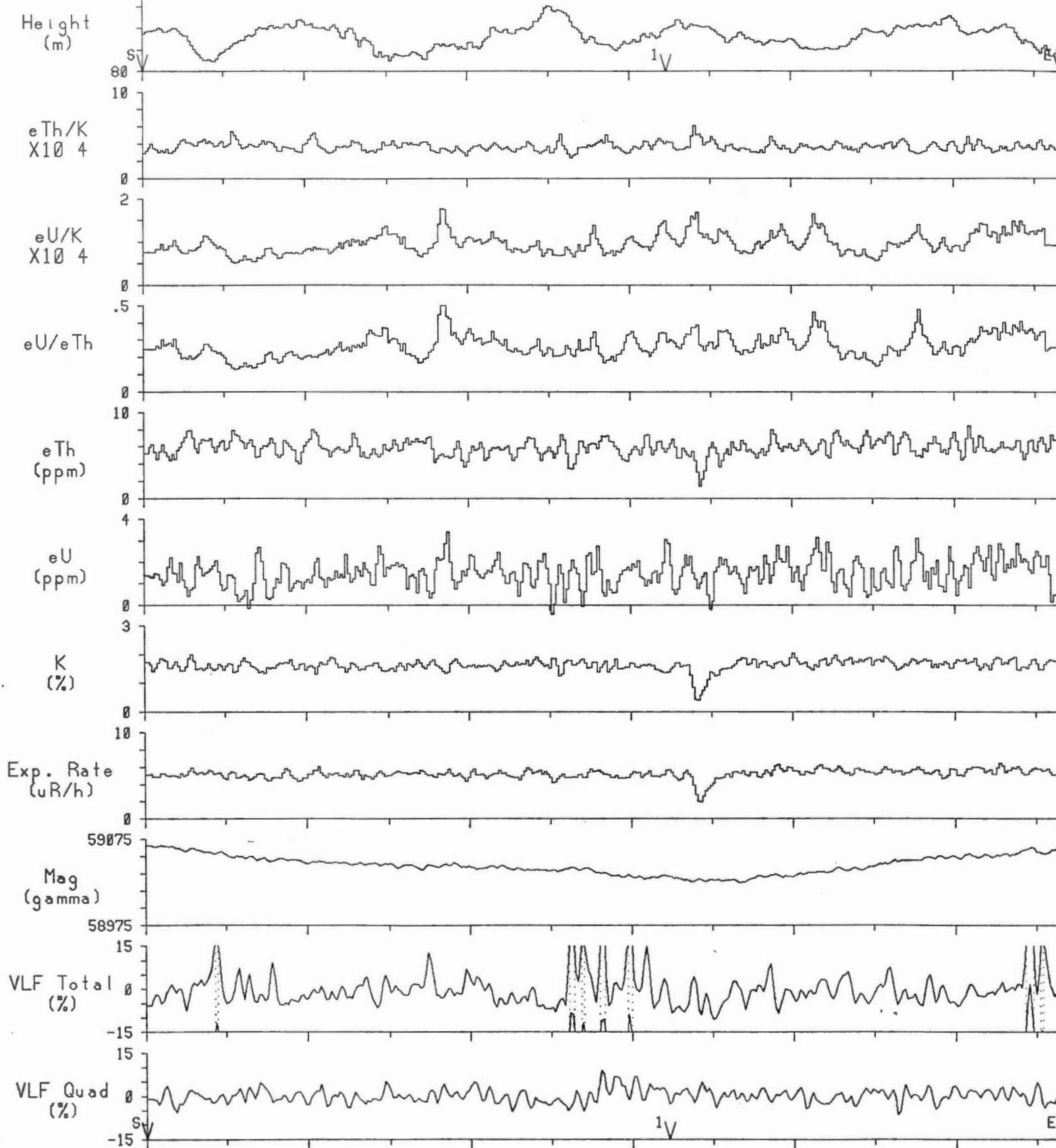
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



Line 3      2 km

Scale 1:126720

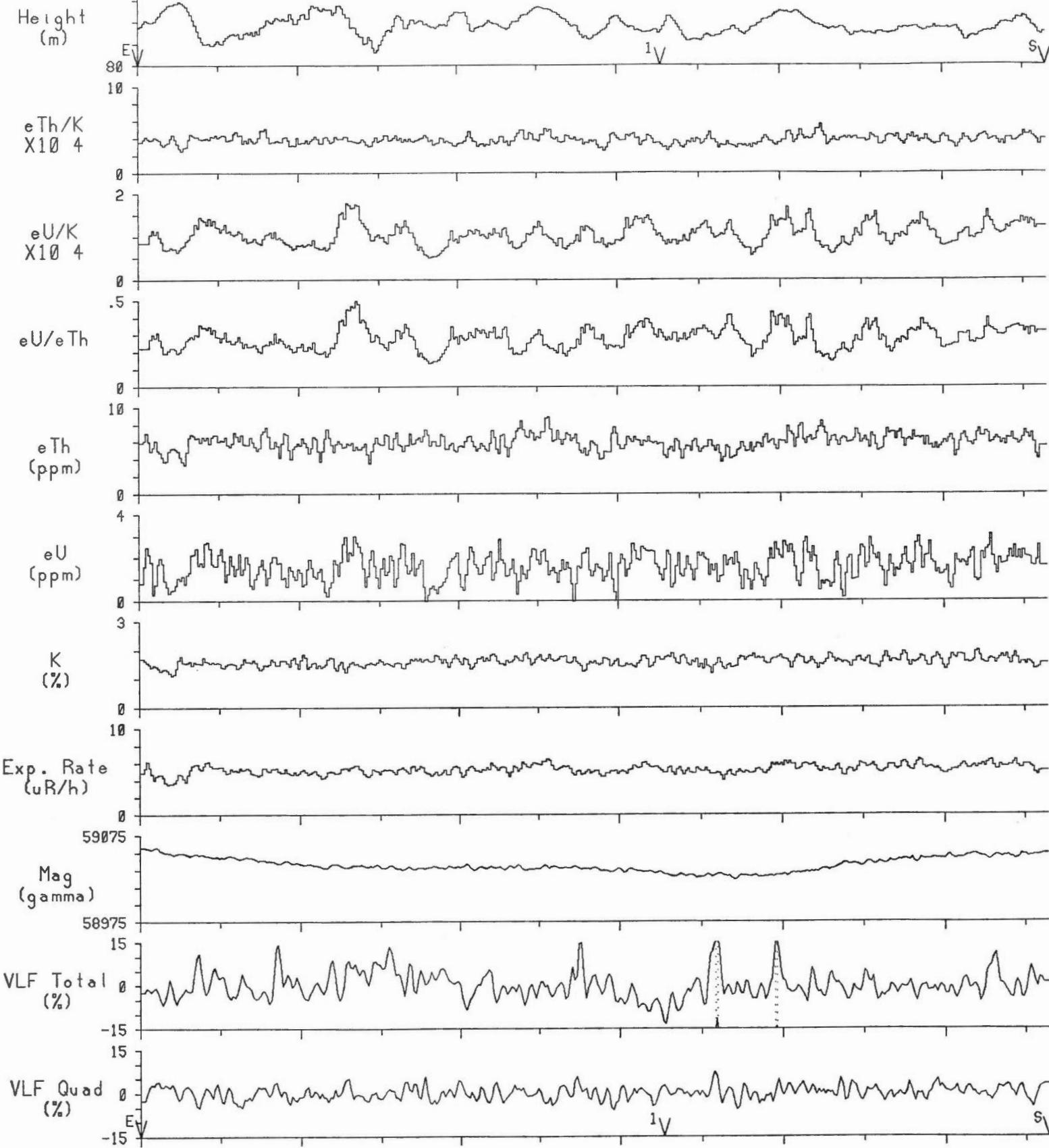
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



Line 4      2 km

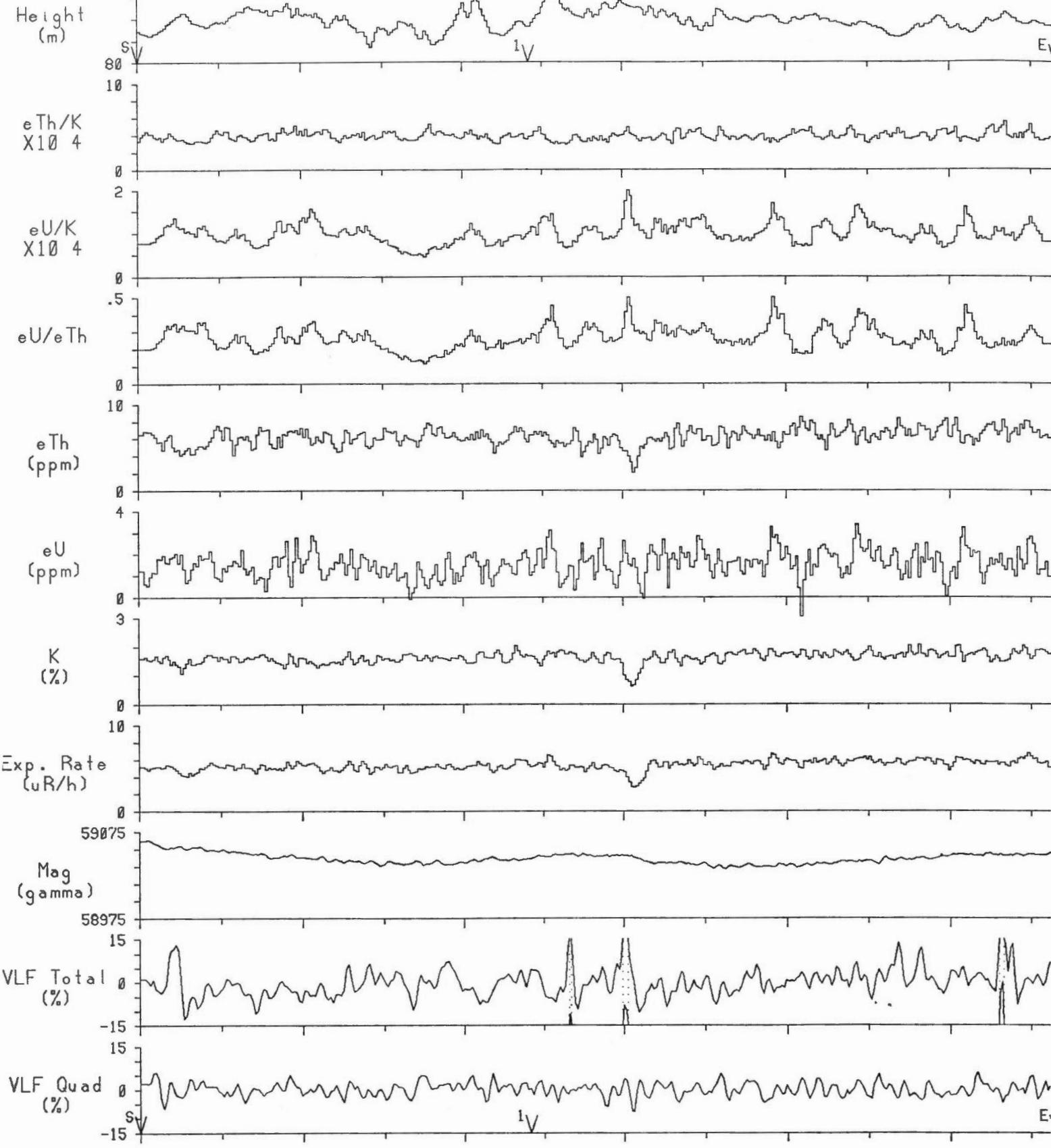
Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



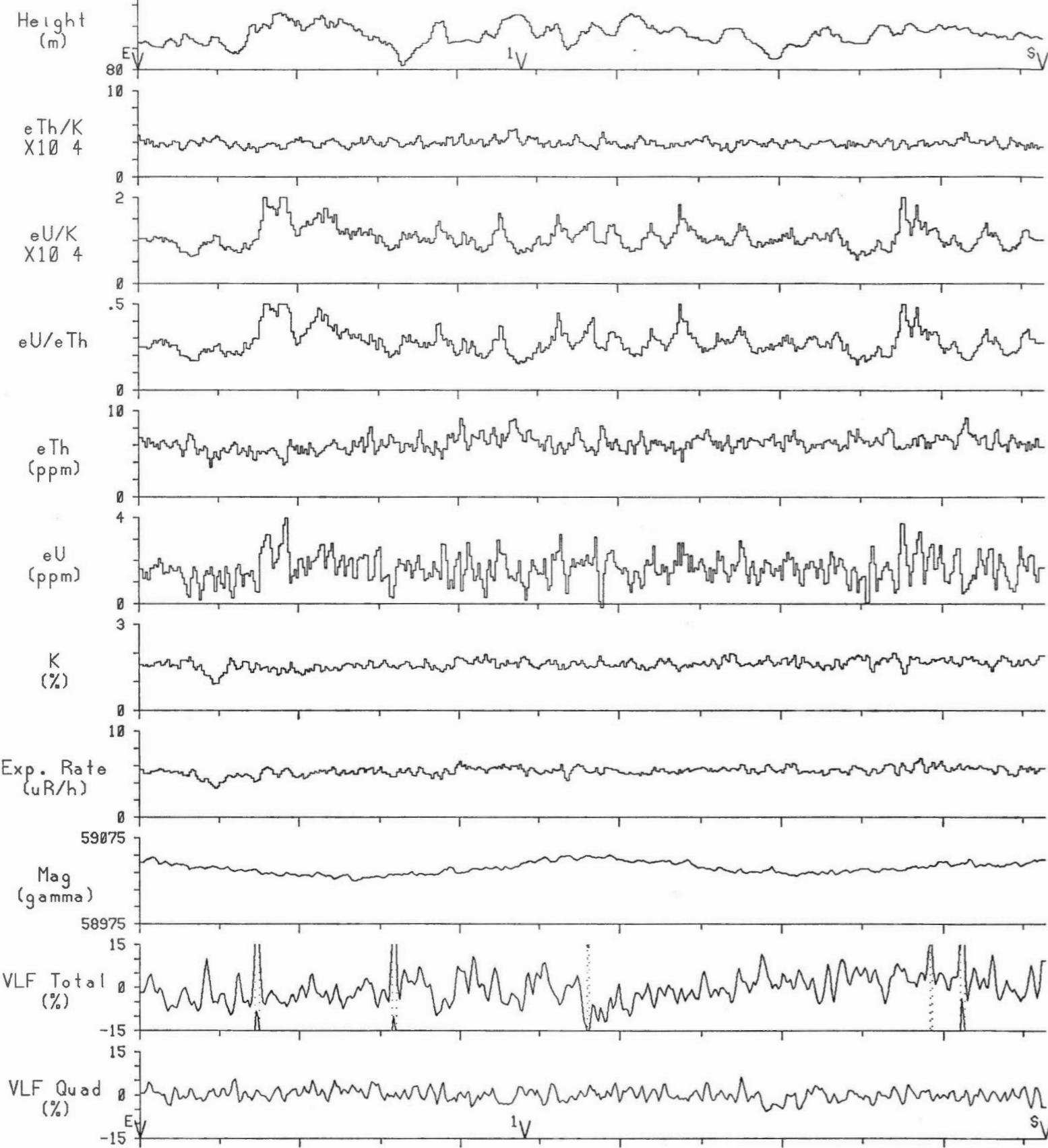
Line 5      2 km      Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



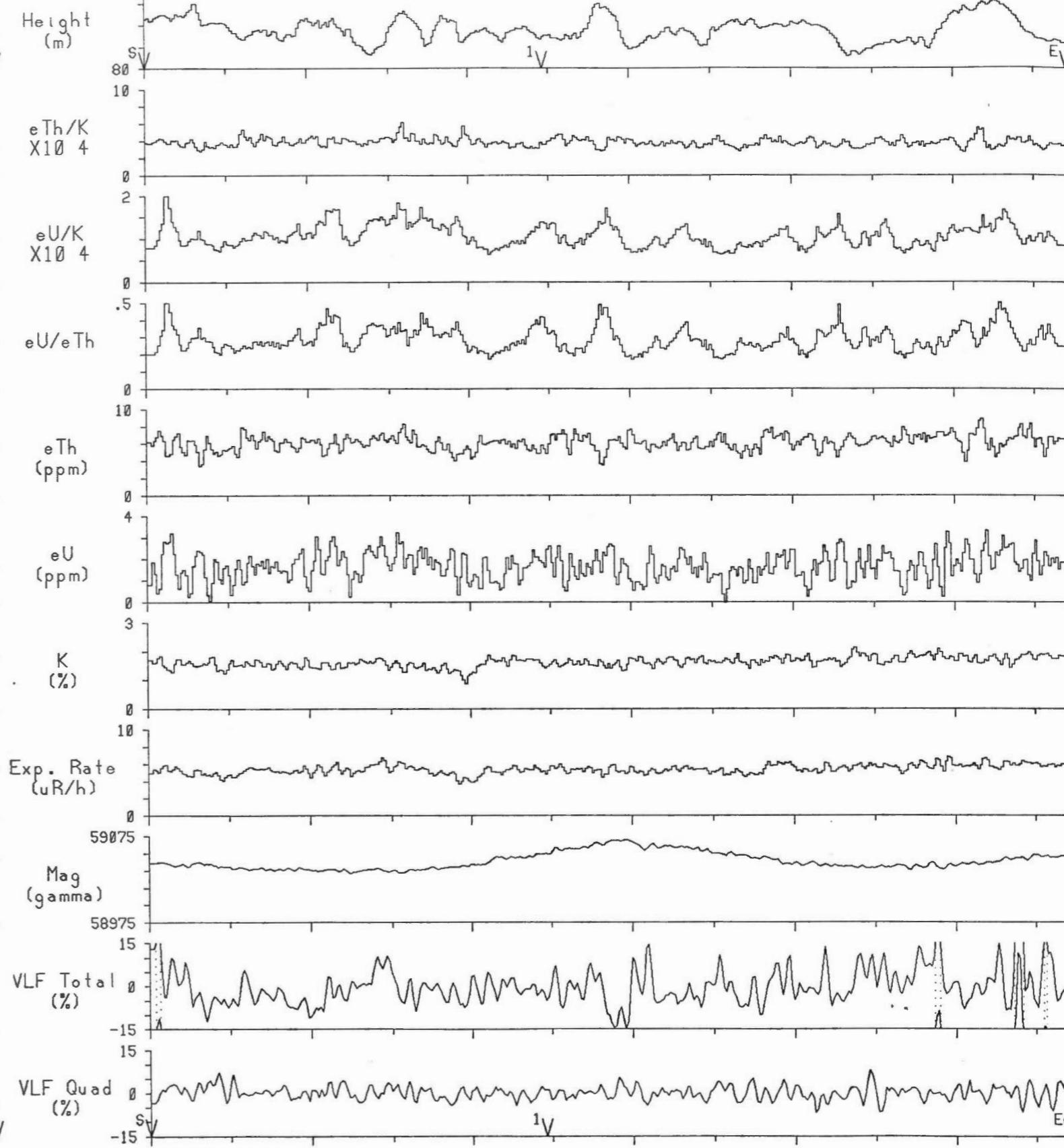
Line 6      2 km      Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



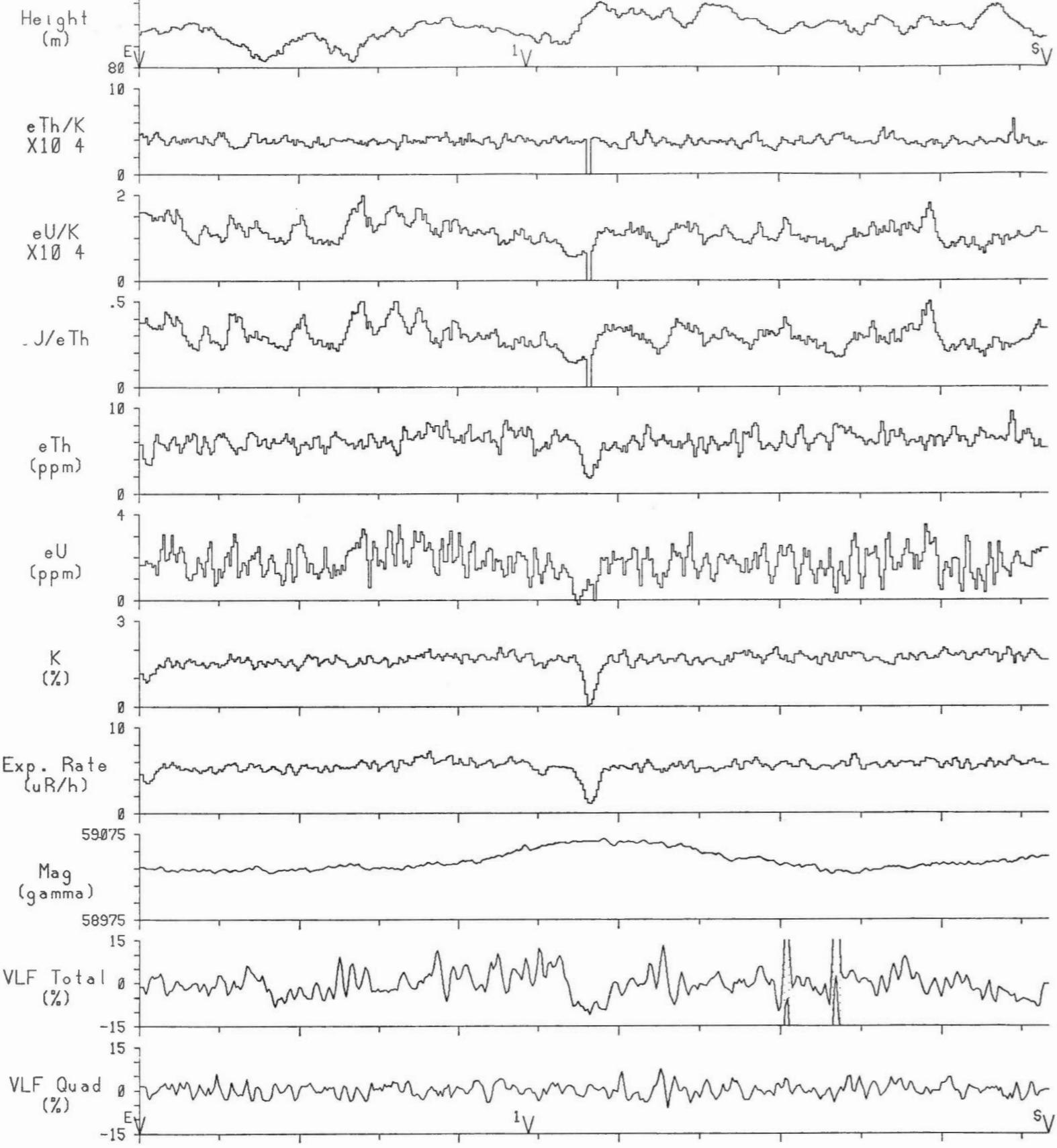
Line 7      2 km      Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



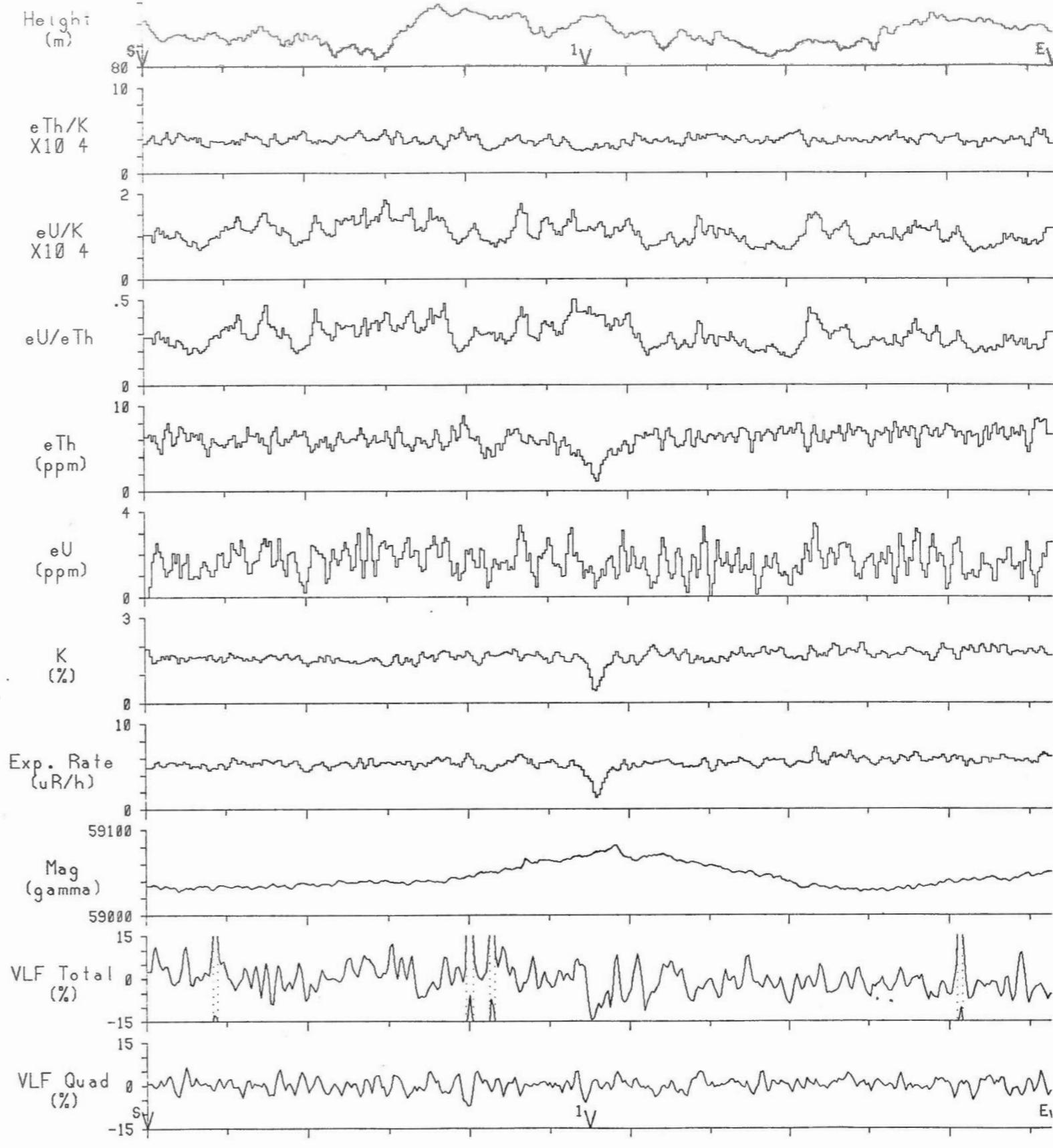
Line 8      2 km      Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



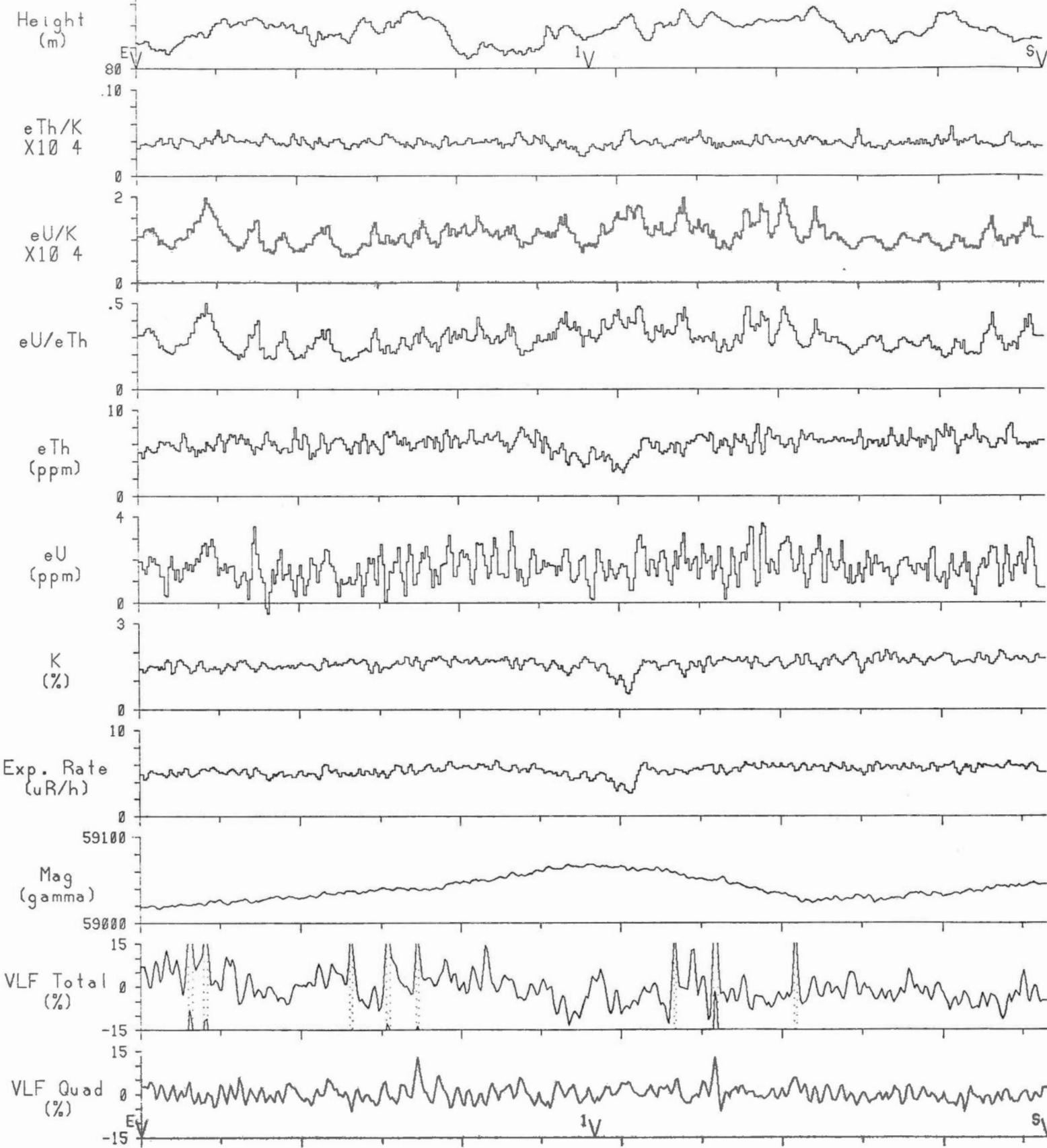
Line 9      2 km      Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8

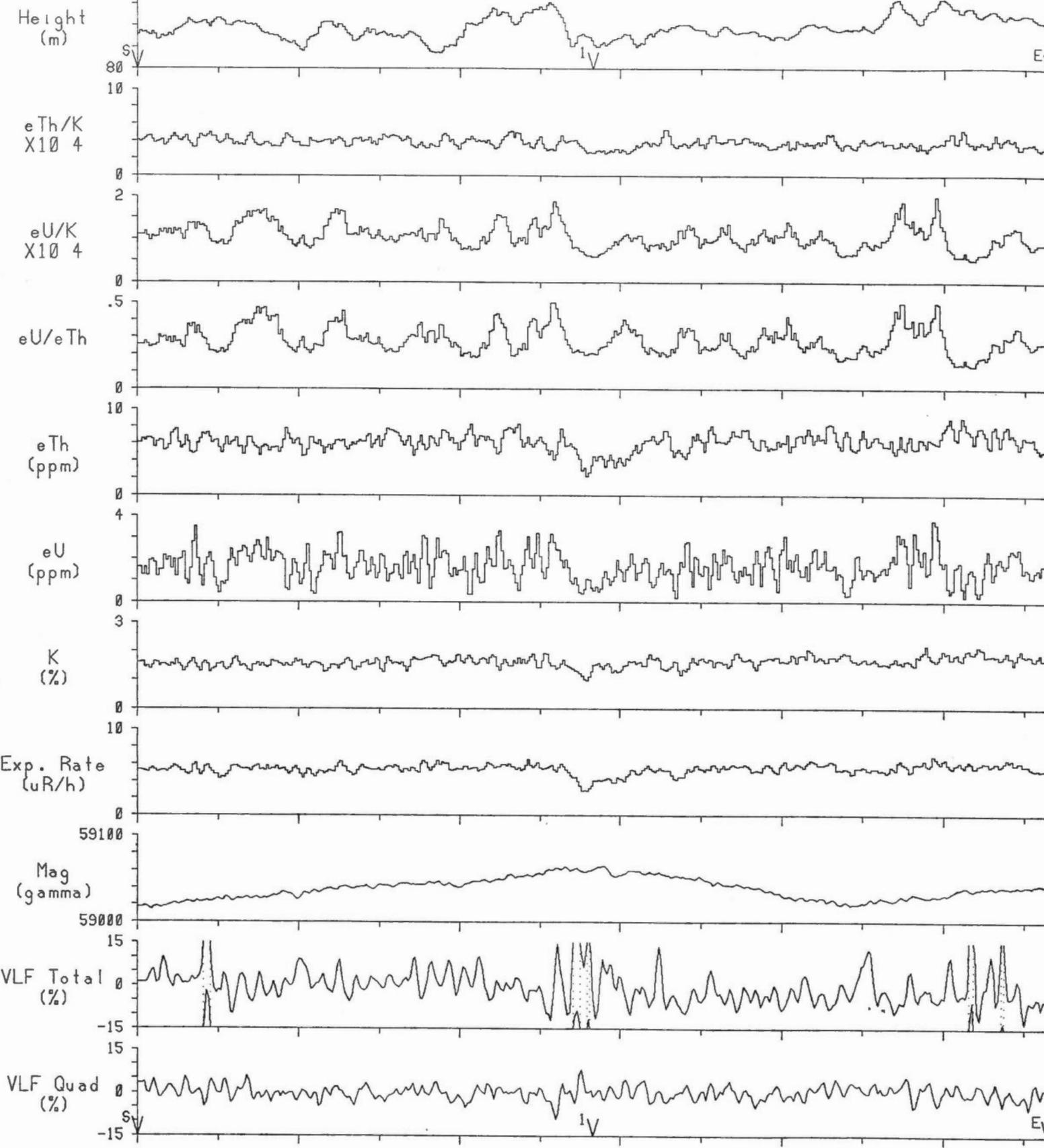


Line 10      2 km      Scale 1:126720

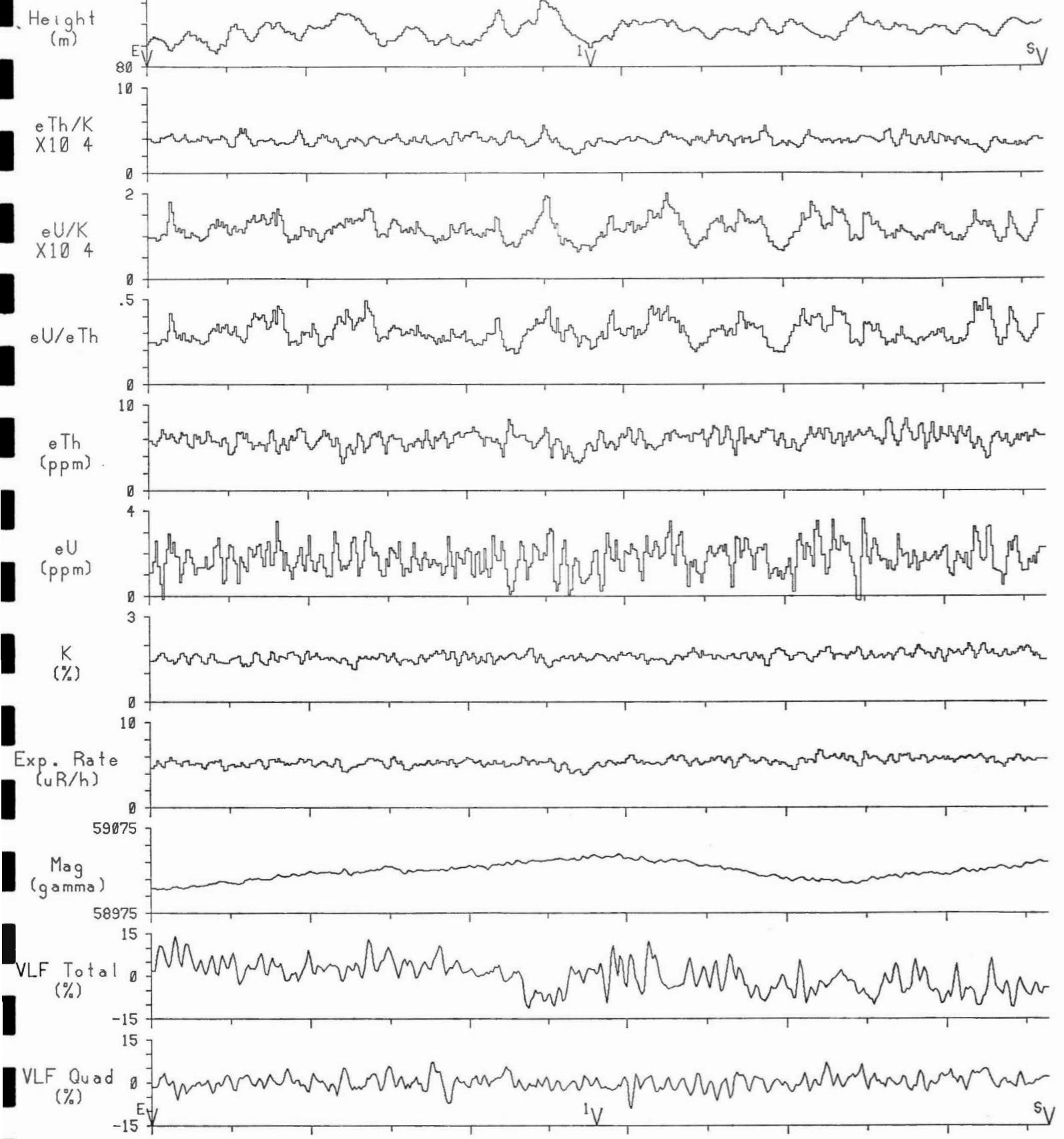
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8

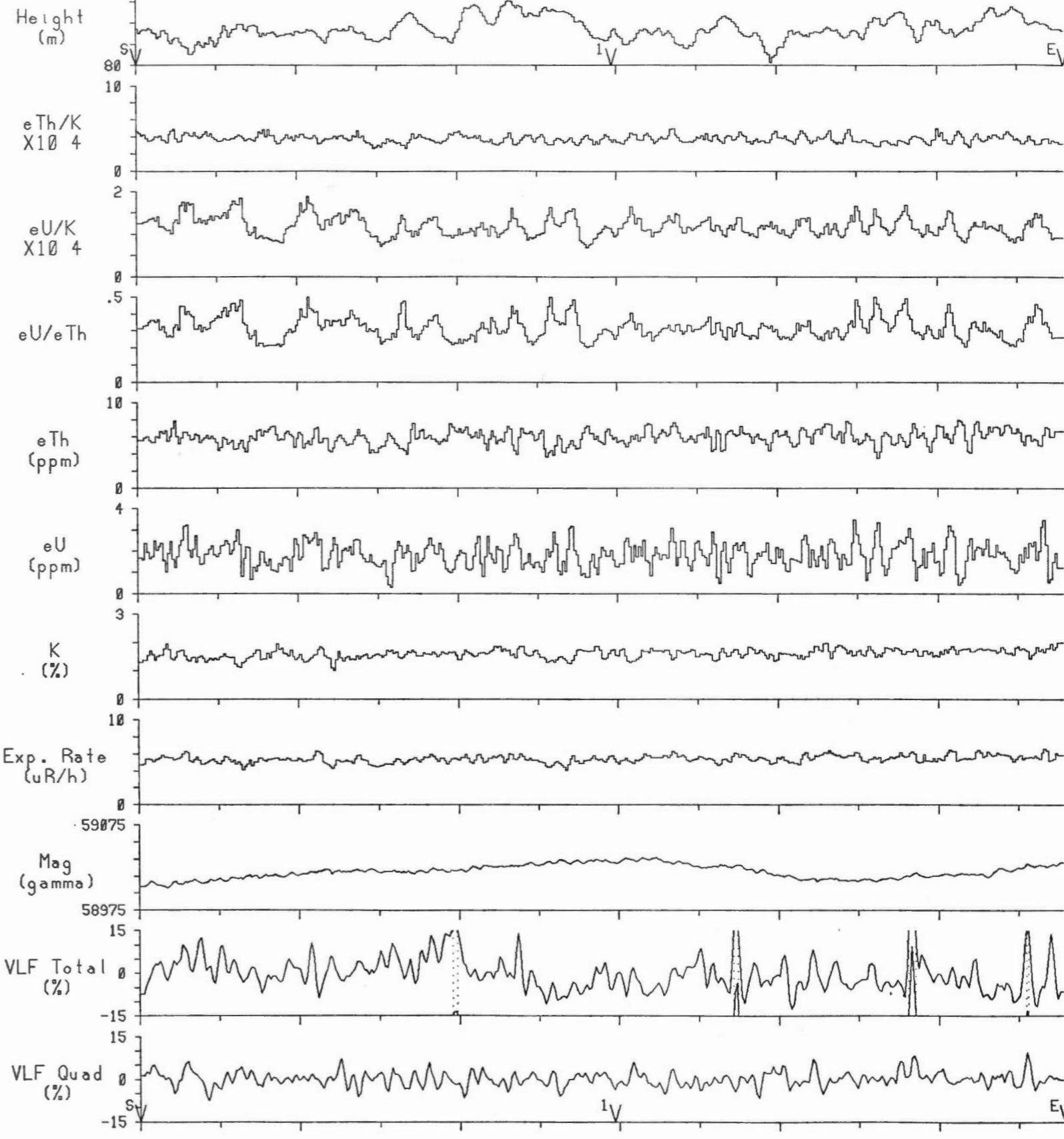


Line 13

2 km

Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8

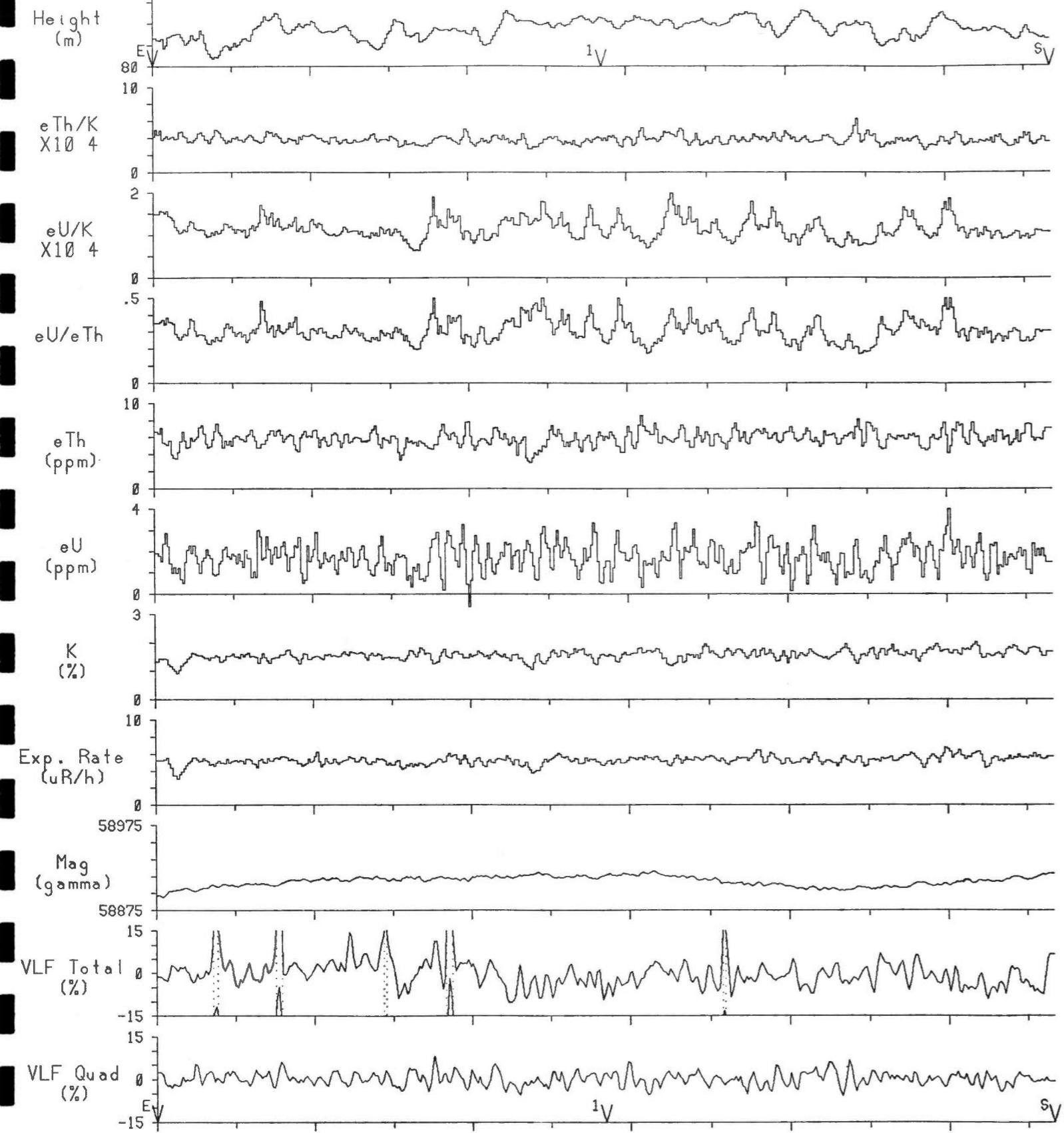


Line 14

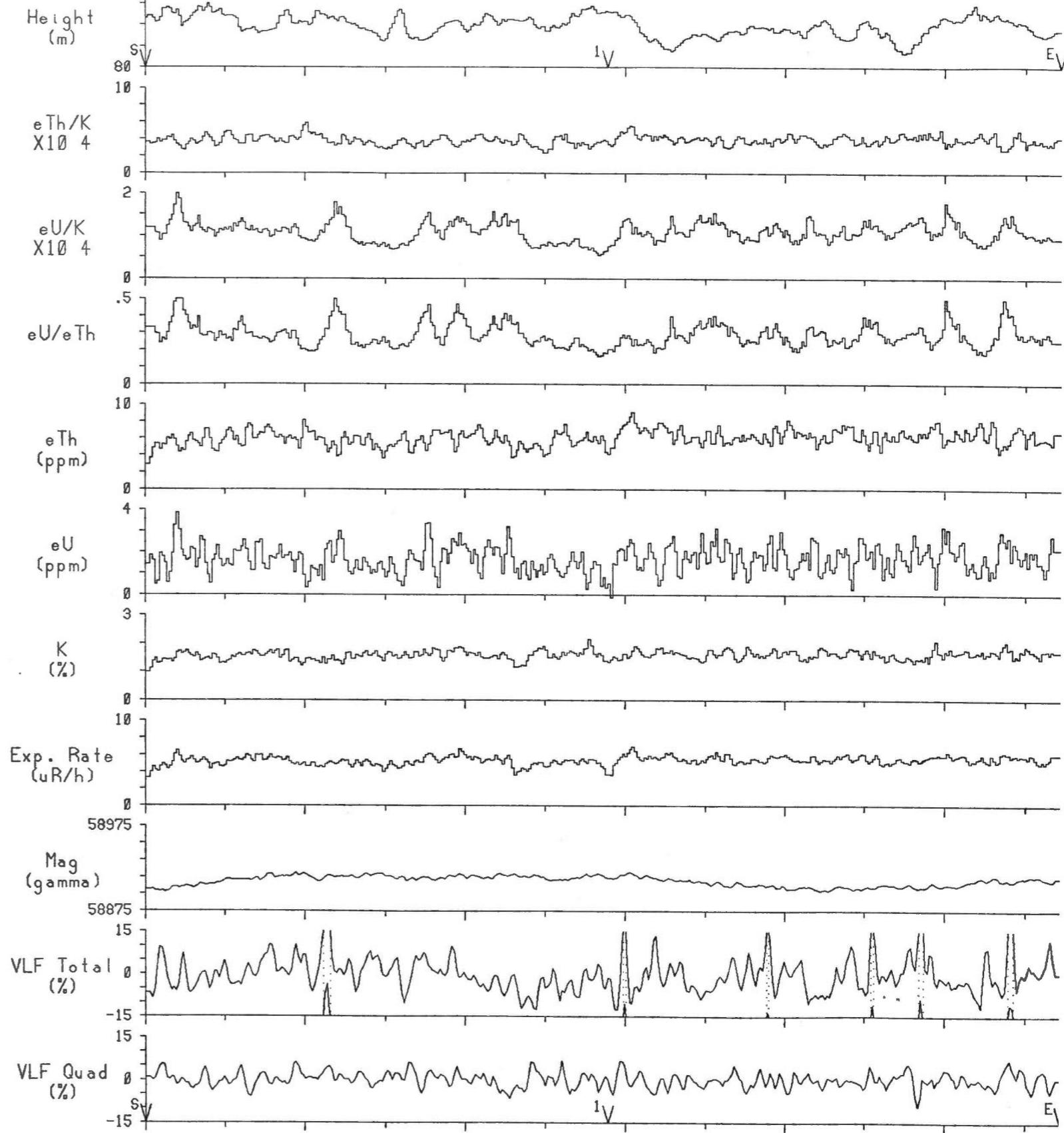
2 km

Scale 1:126720

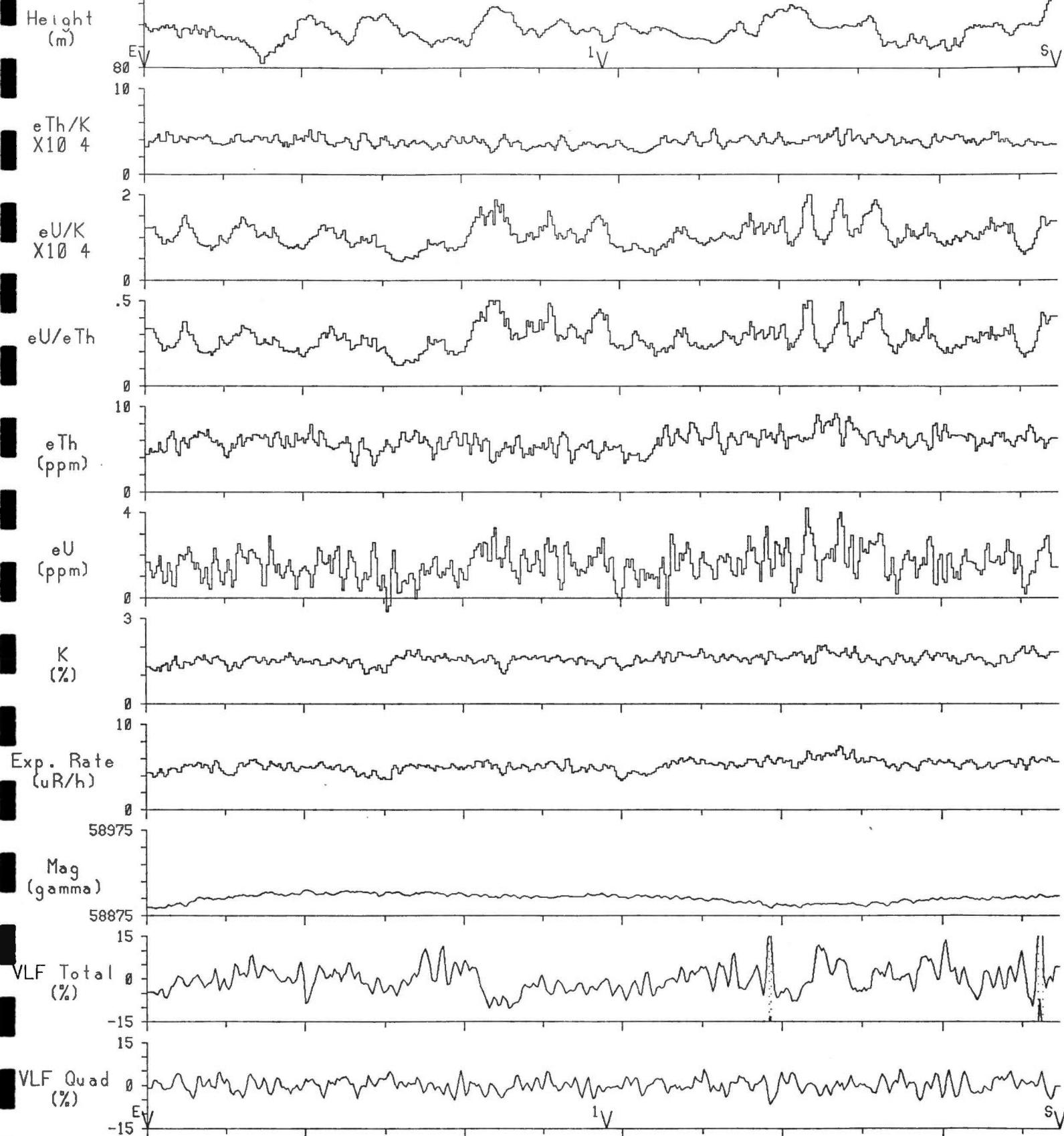
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8

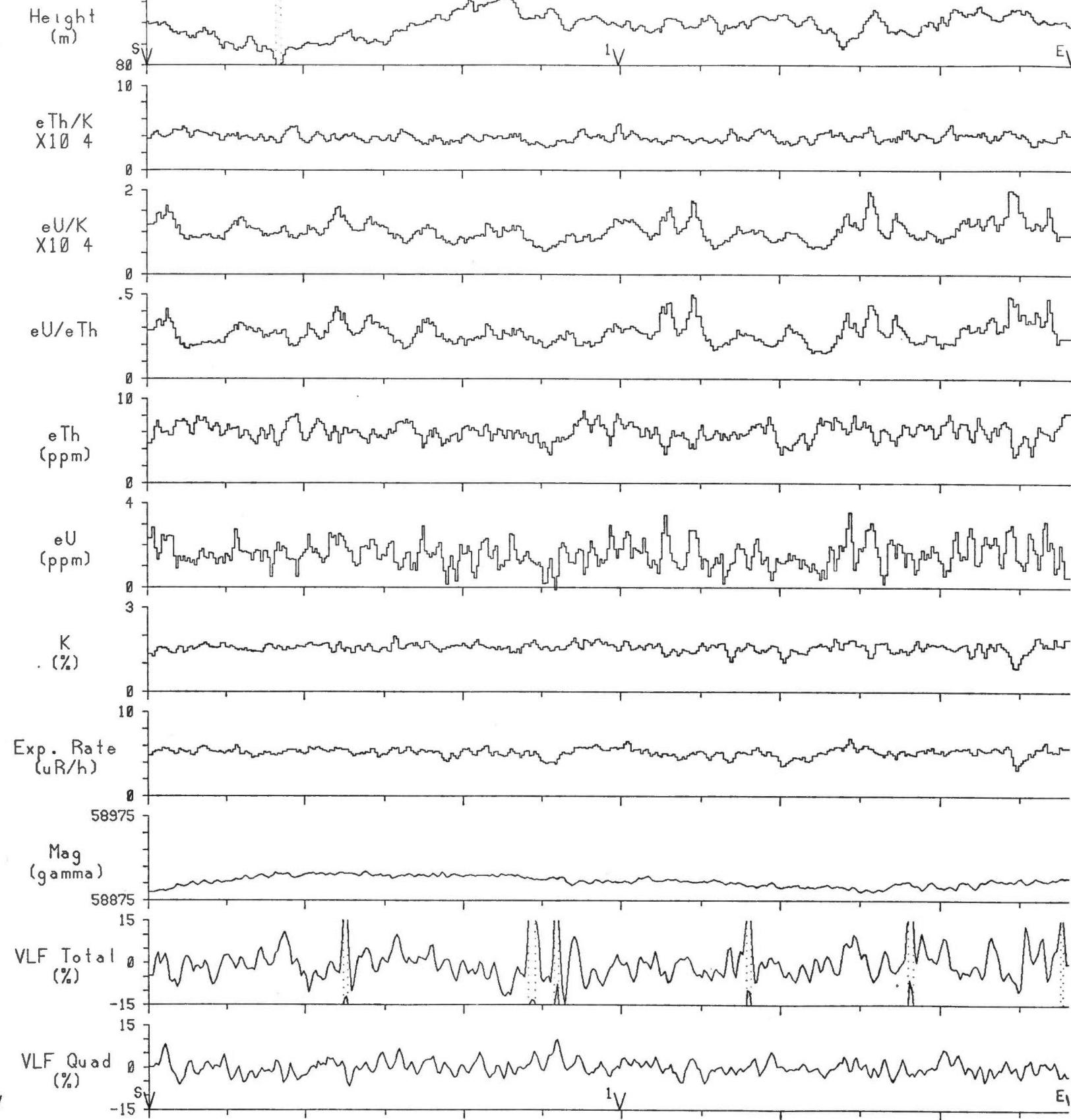


FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



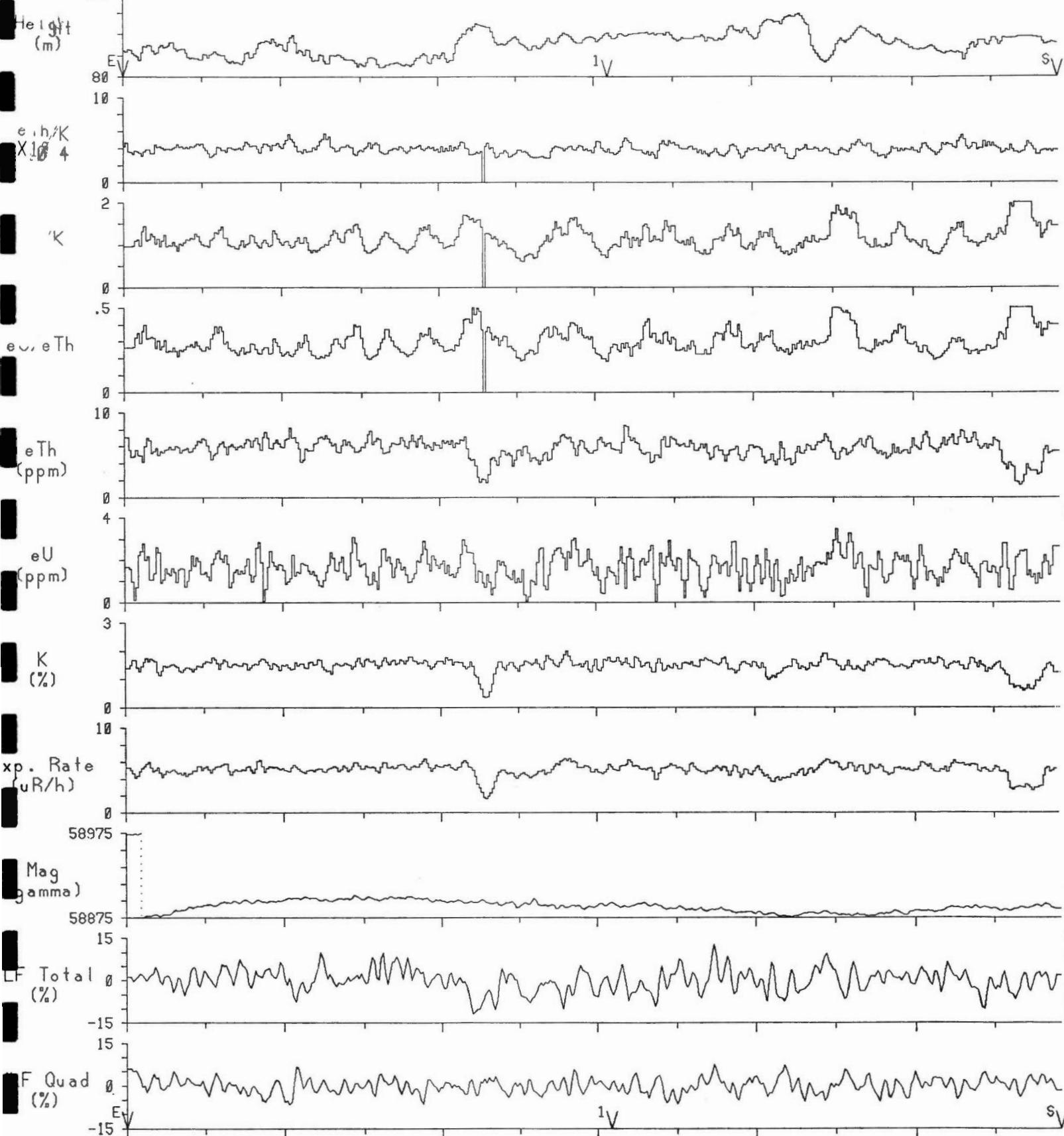
Line 17      2 km      Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



Line 18      2 km      Scale 1:126720

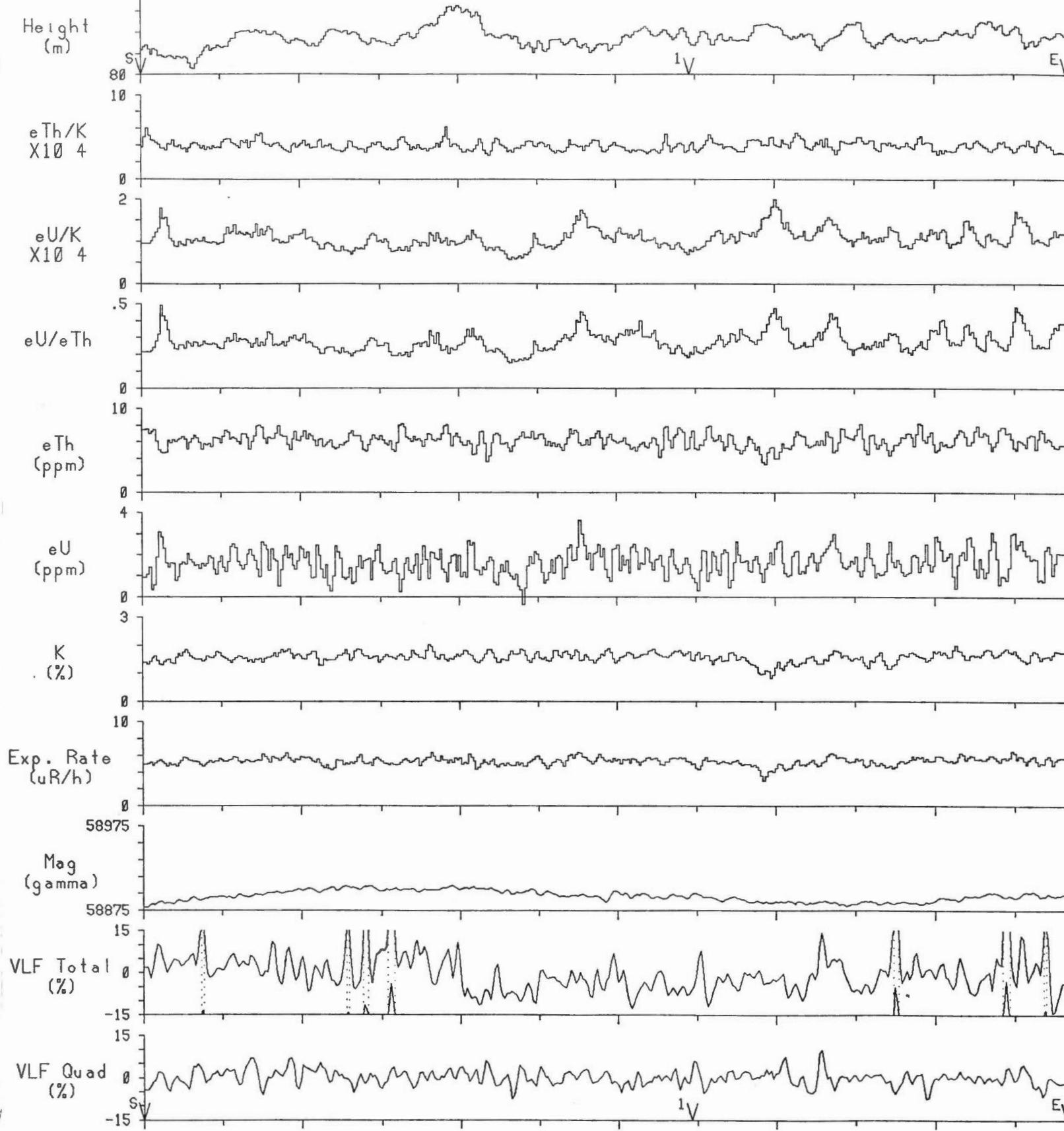
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



Line 19      2 km

Scale 1:126720

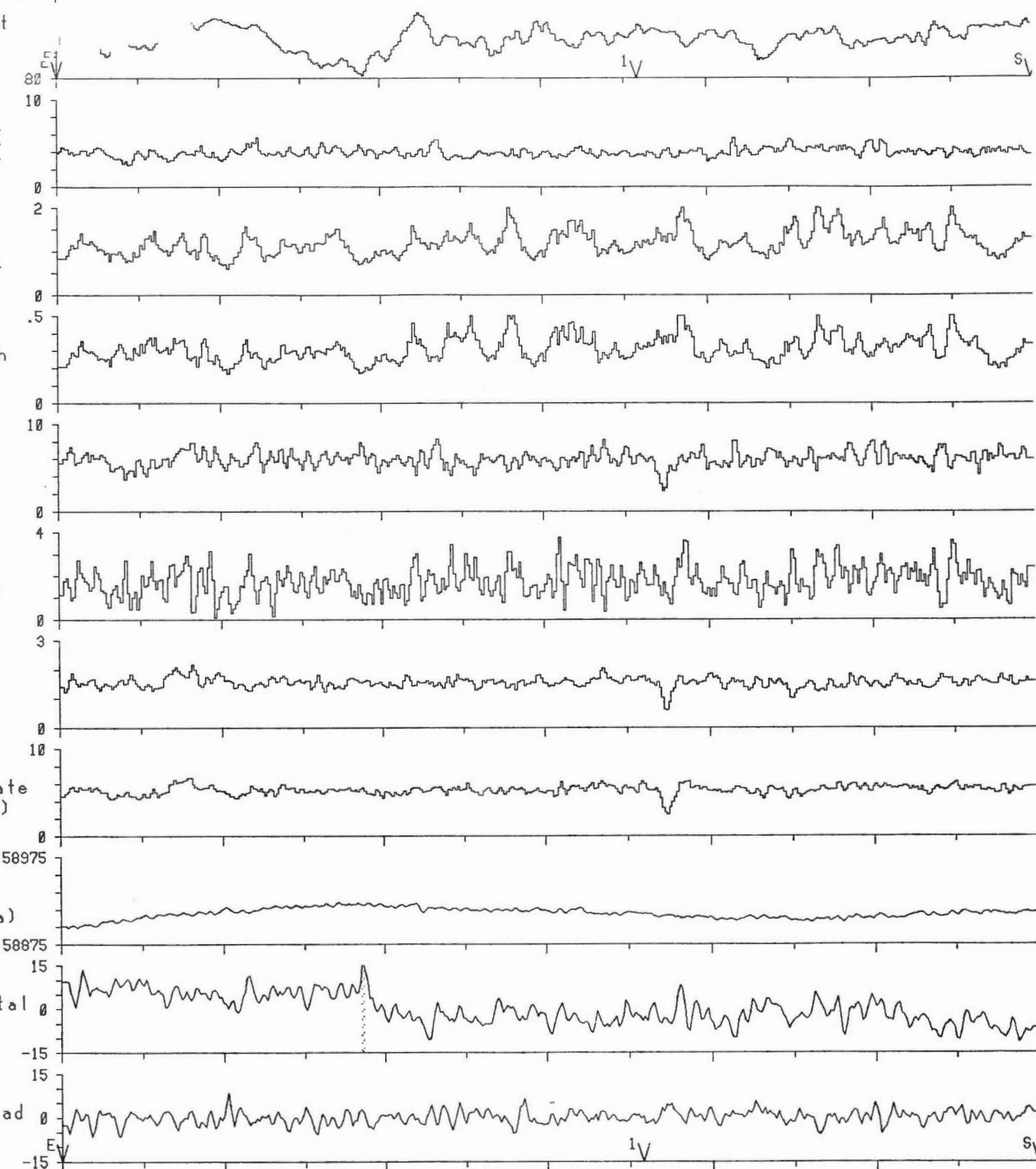
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



Line 20      2 km

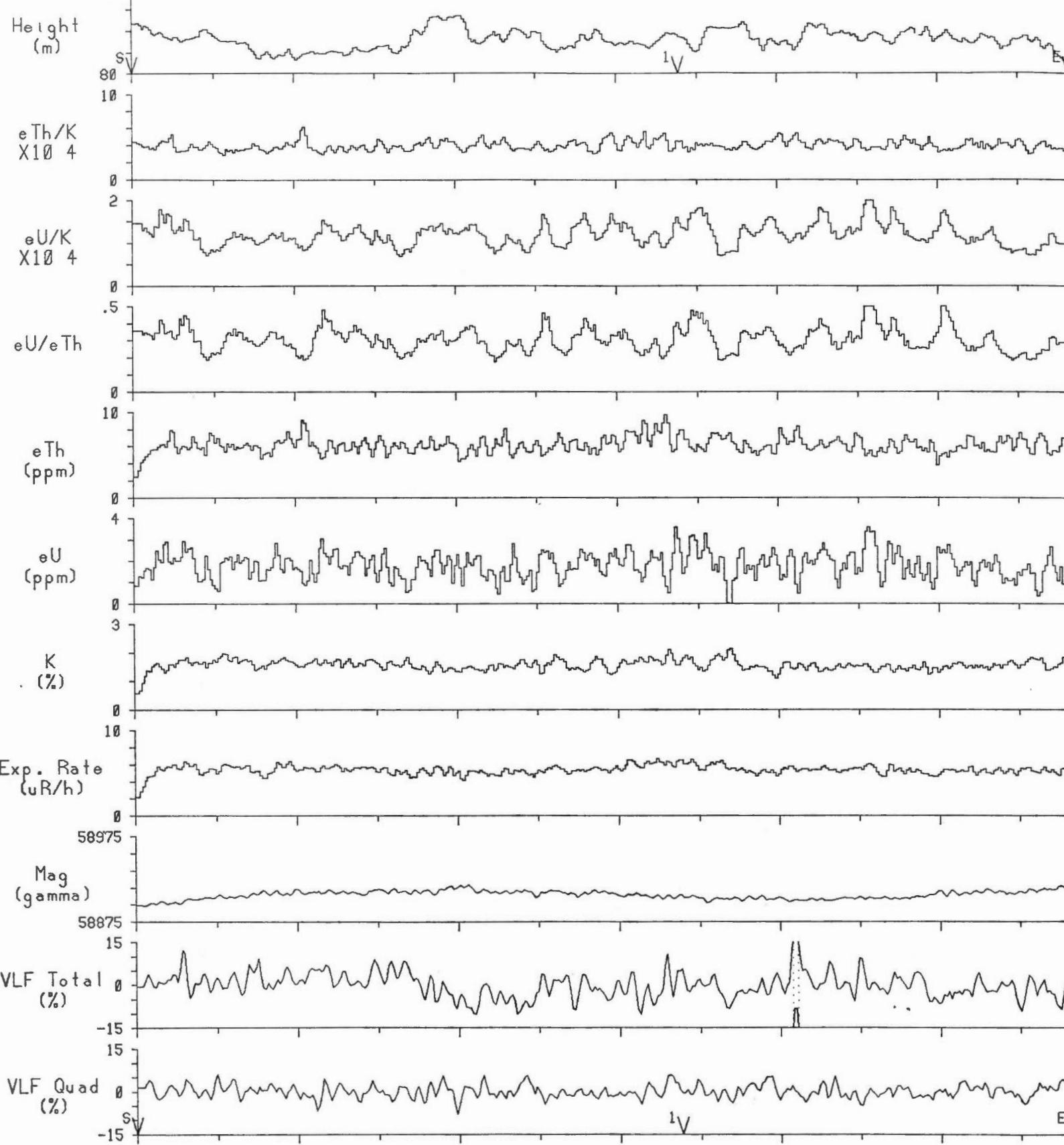
Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



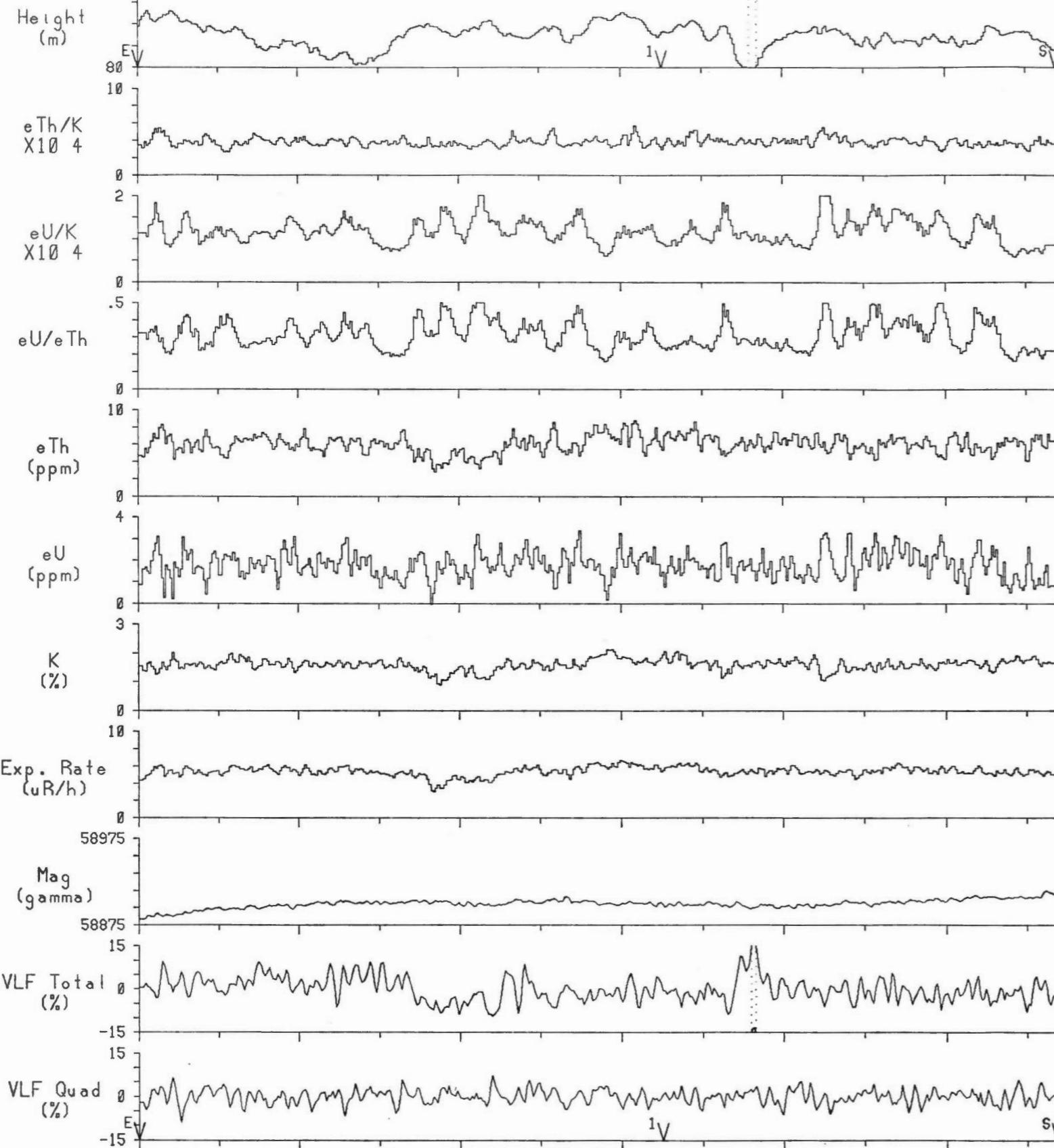
Line 21      2 km      Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



Line 22      2 km      Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8

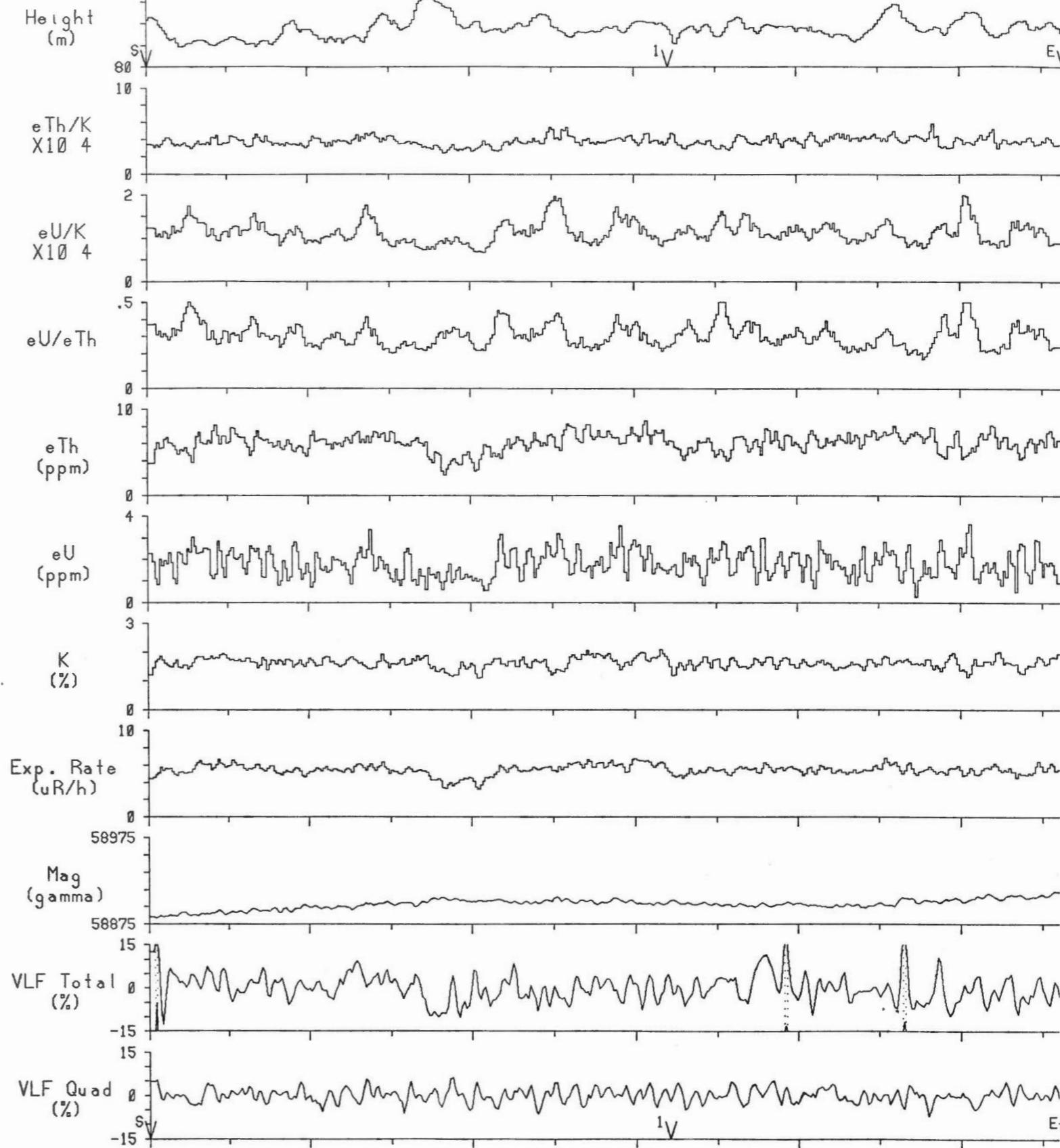


Line 23

2 km

Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8

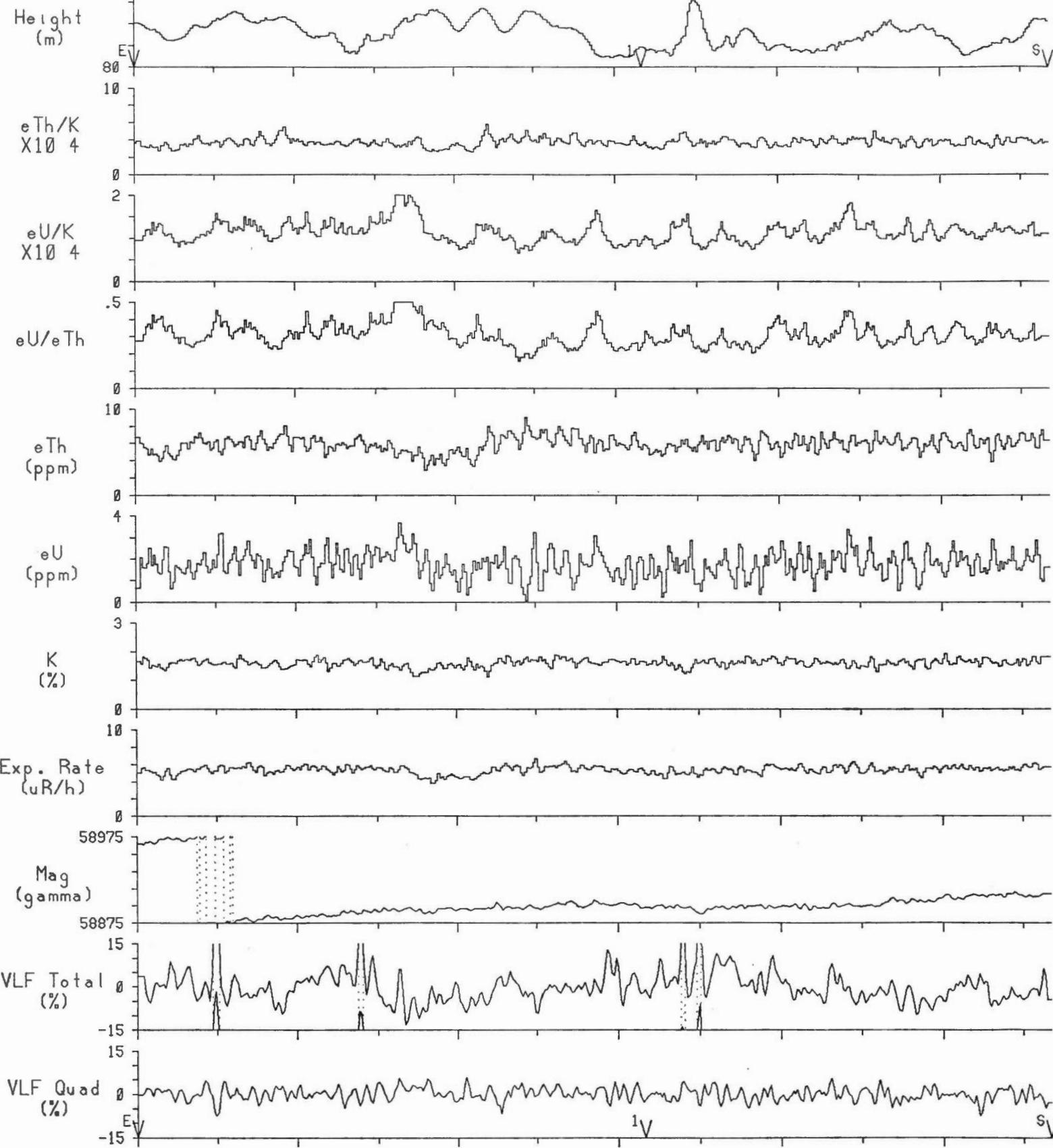


Line 24

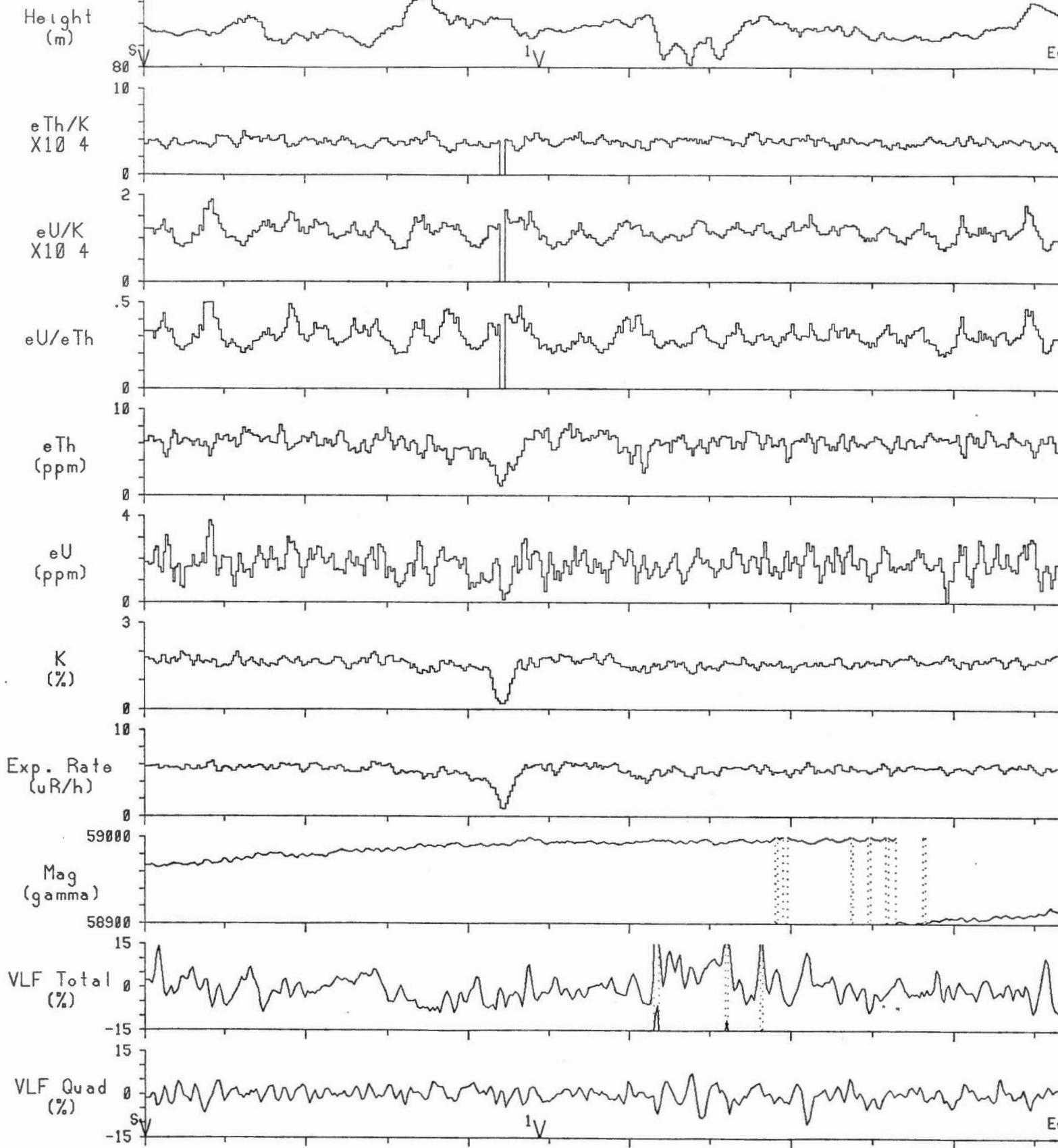
2 km

Scale 1:126720

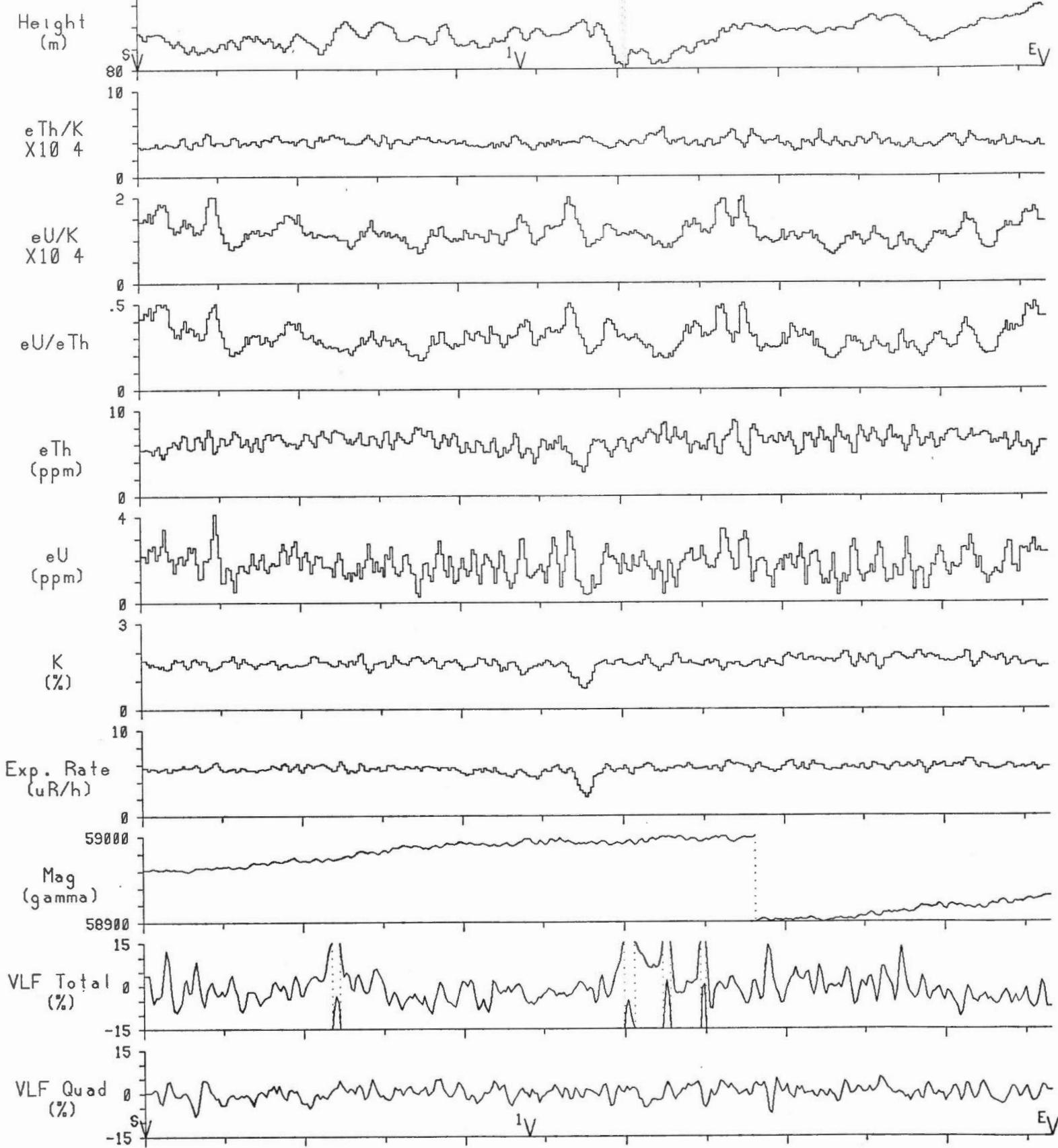
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8

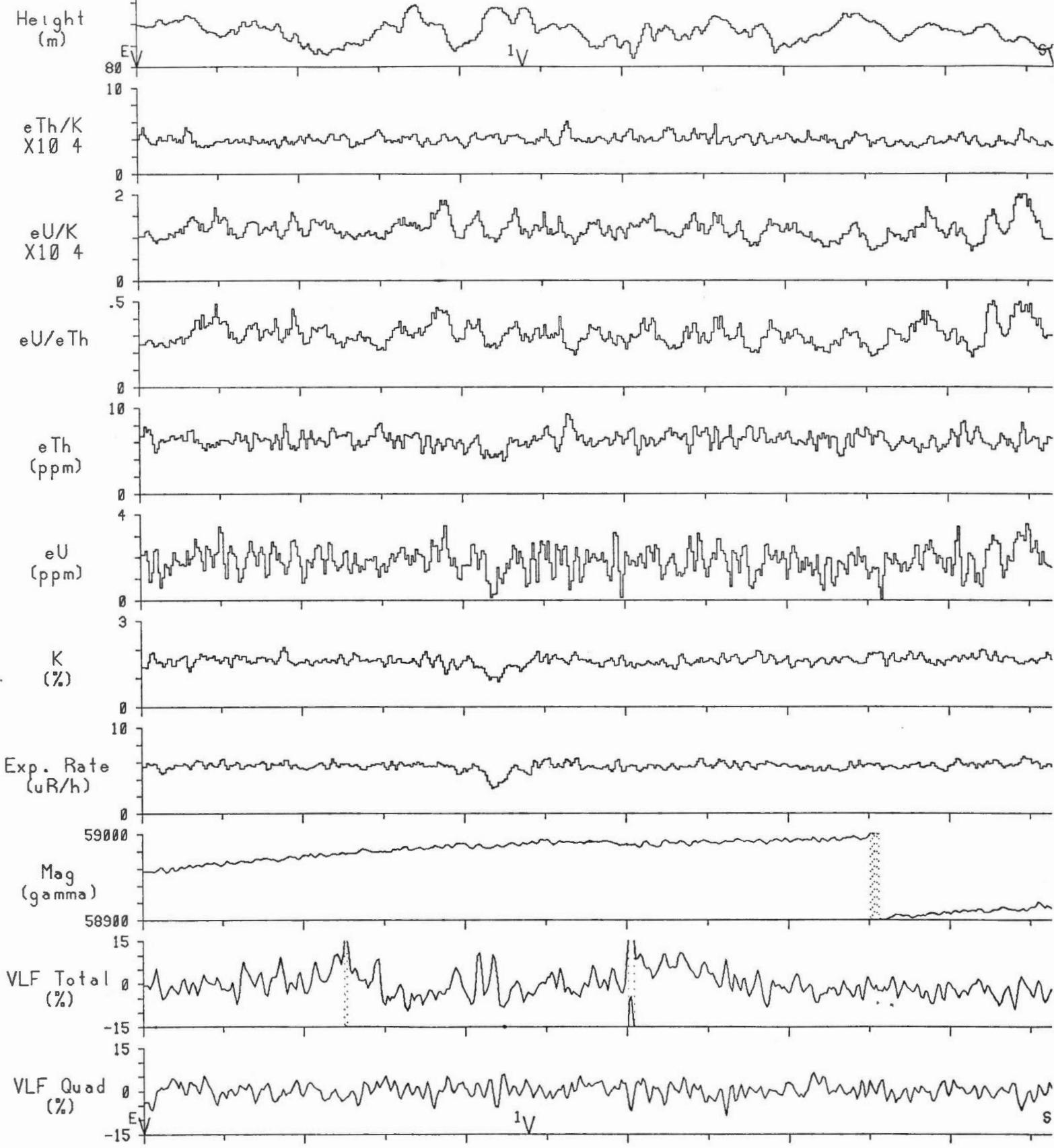


Line 28

2 km

Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8

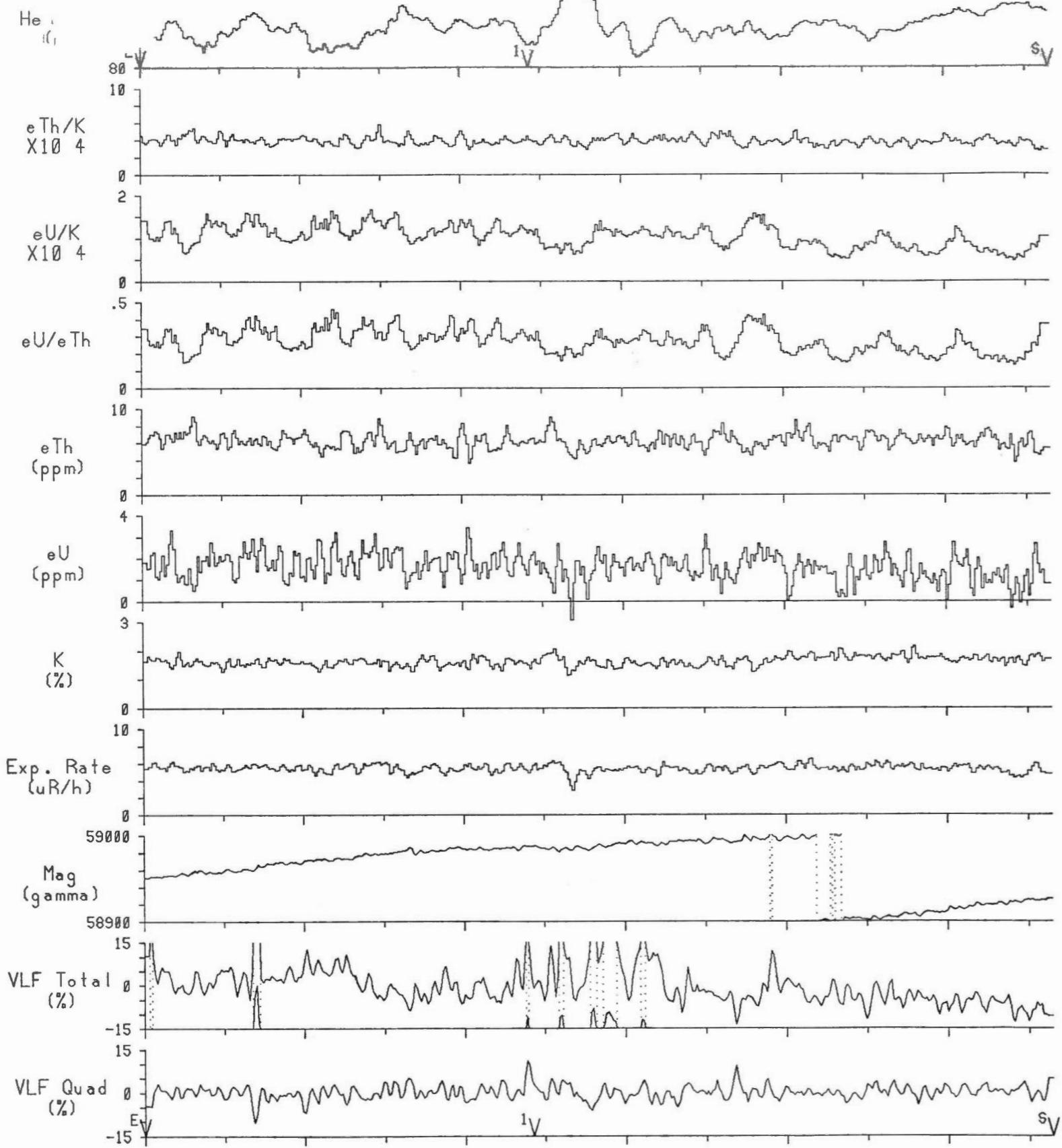


Line 27

2 km

Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8

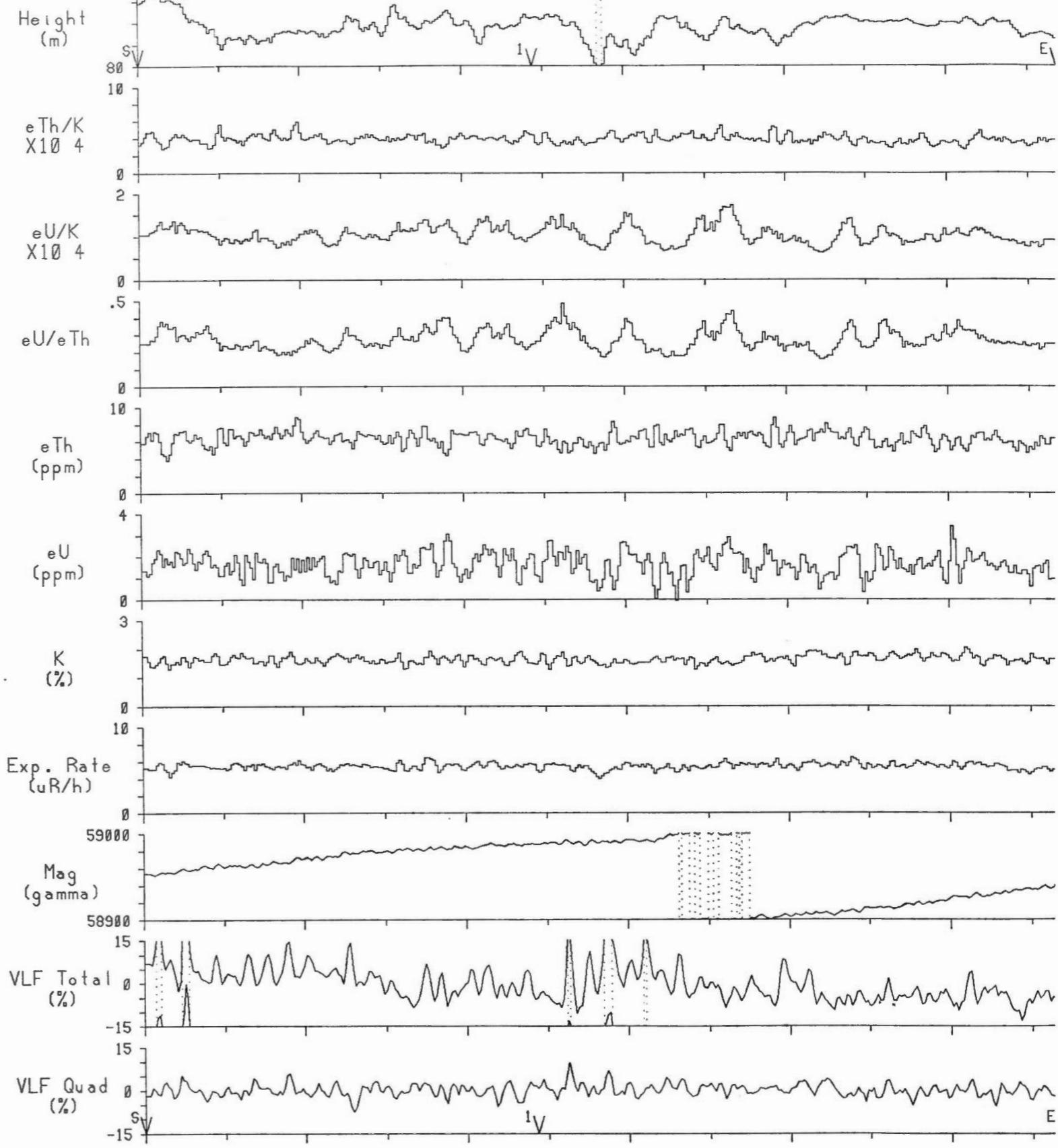


Line 29

2 km

Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8

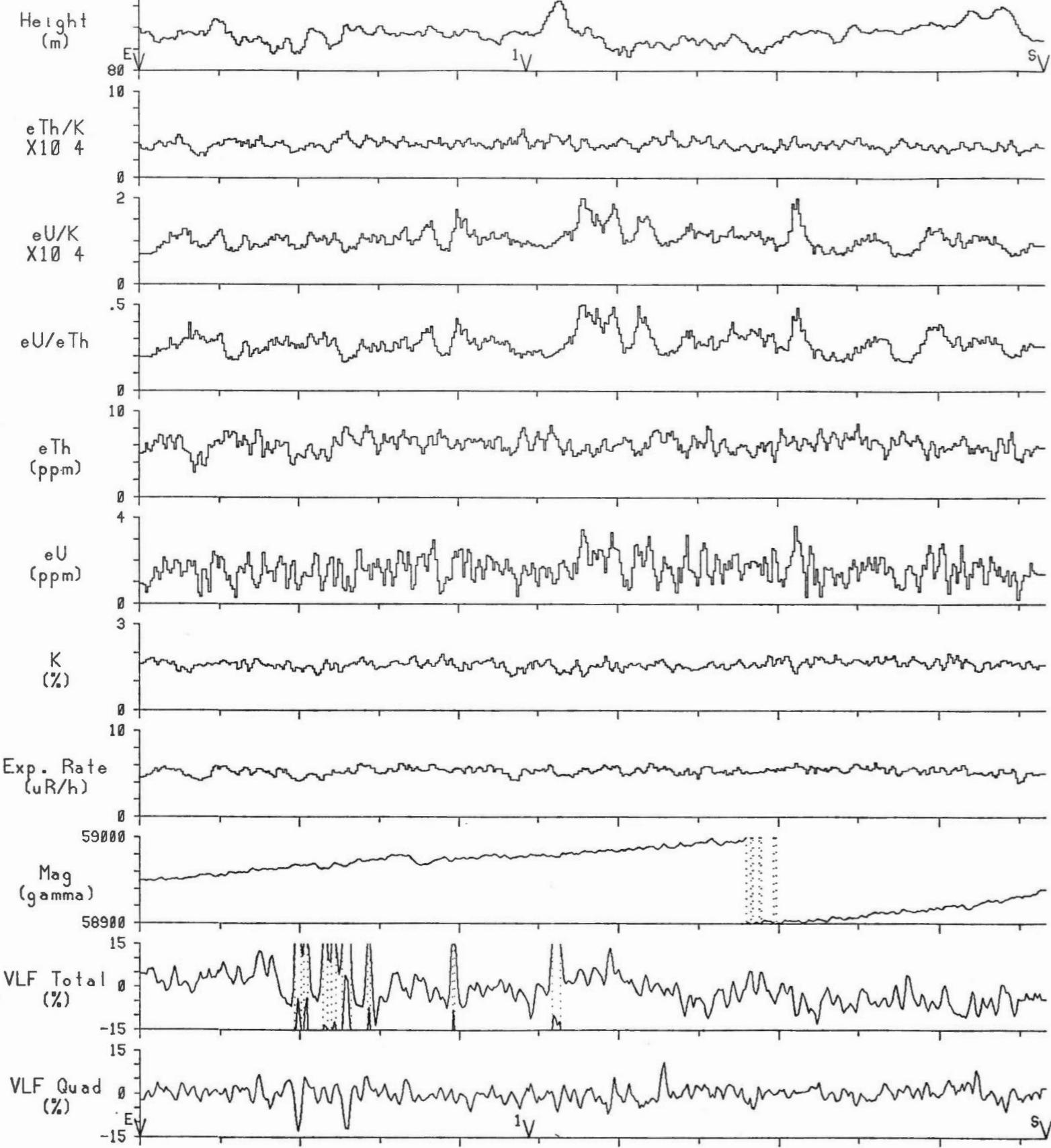


Line 30

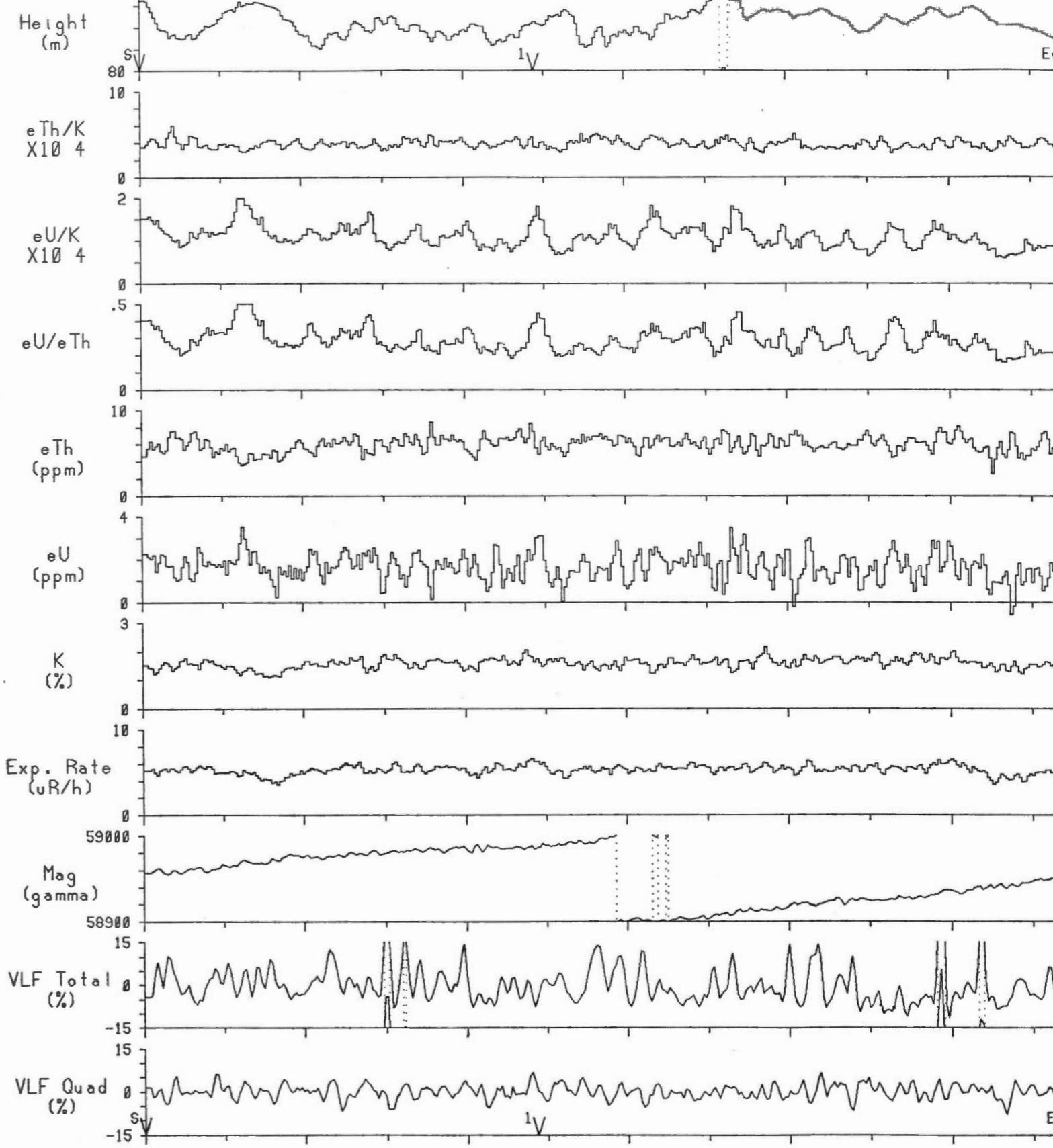
2 km

Scale 1:126720

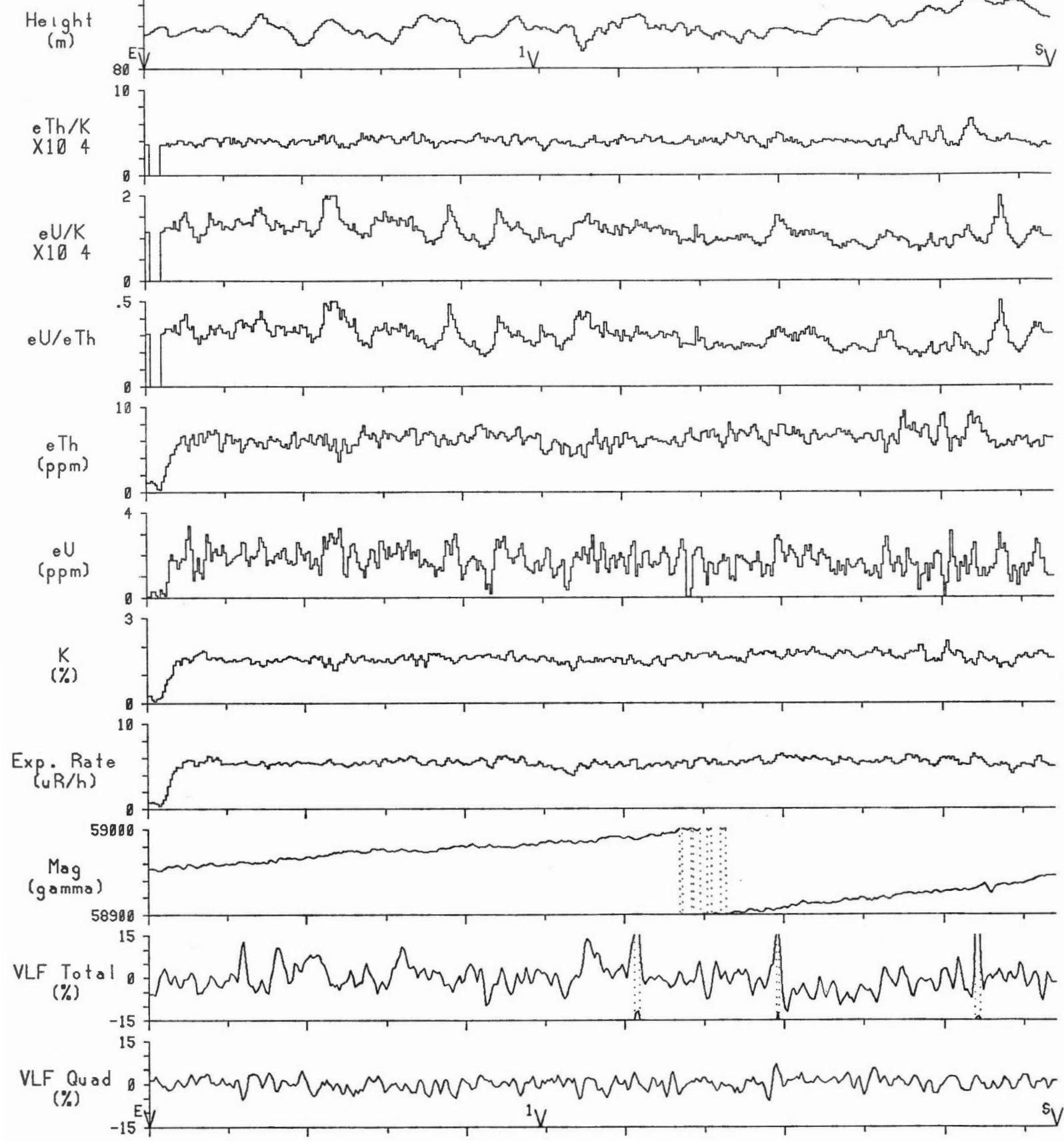
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



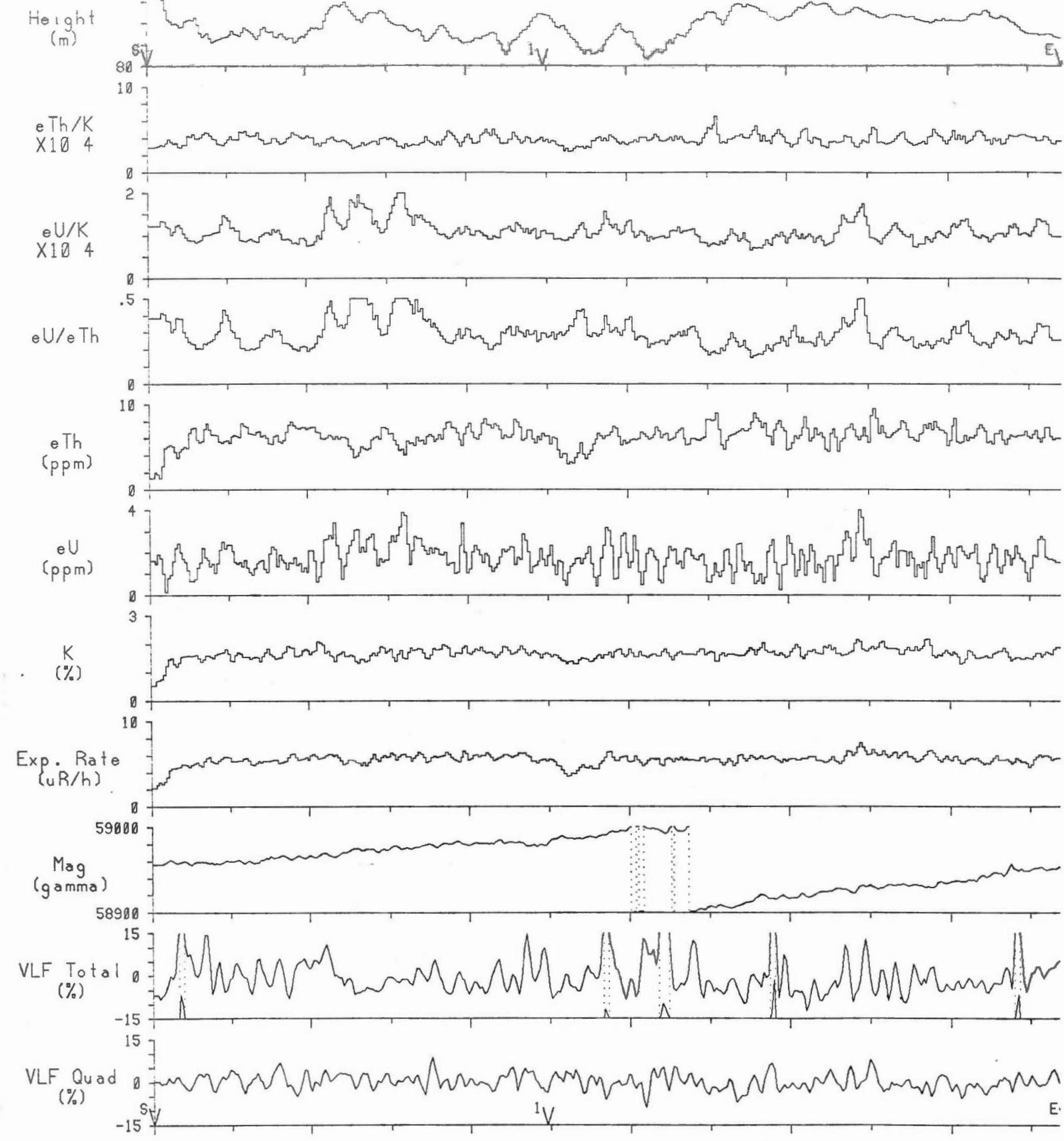
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



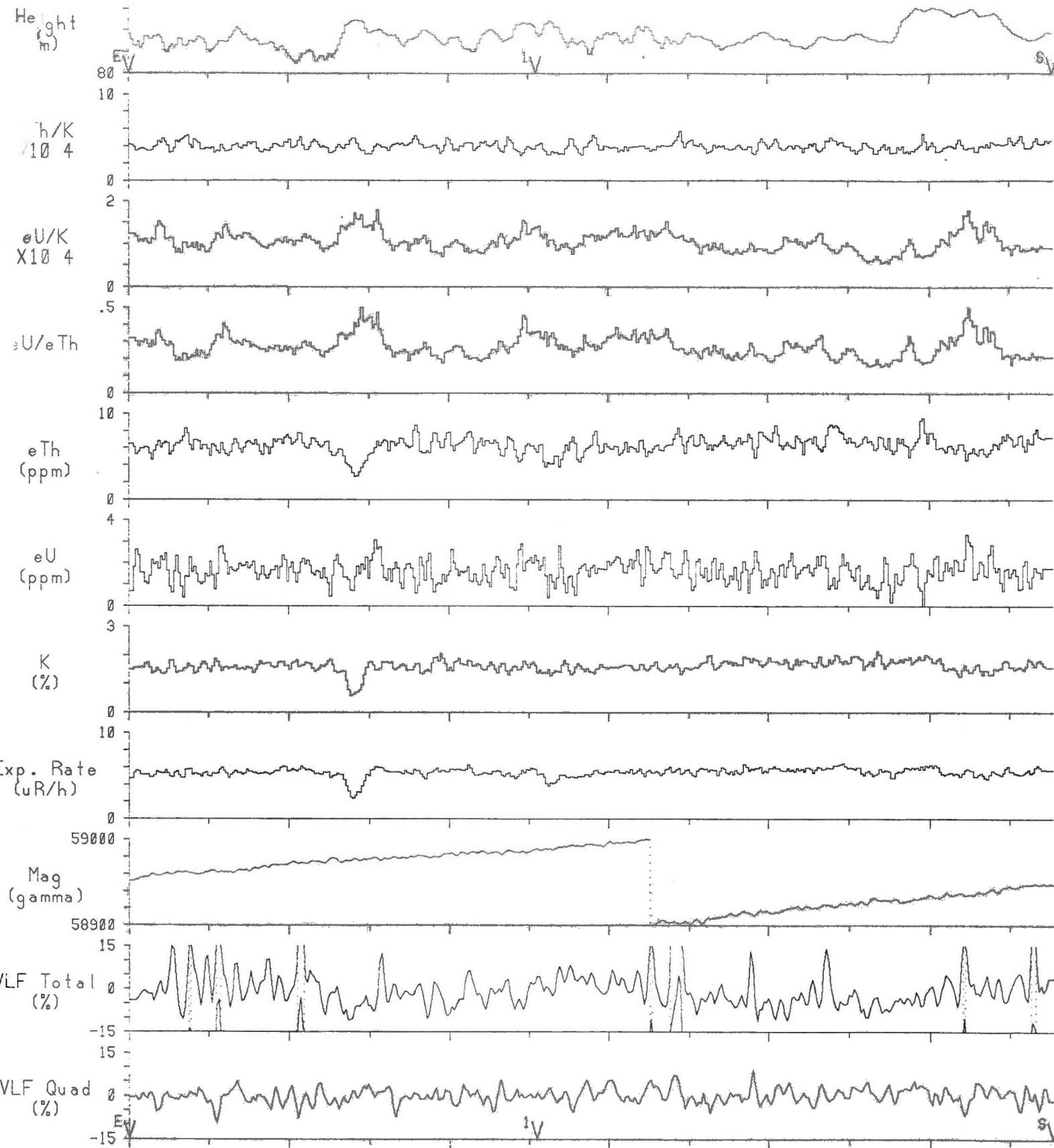
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



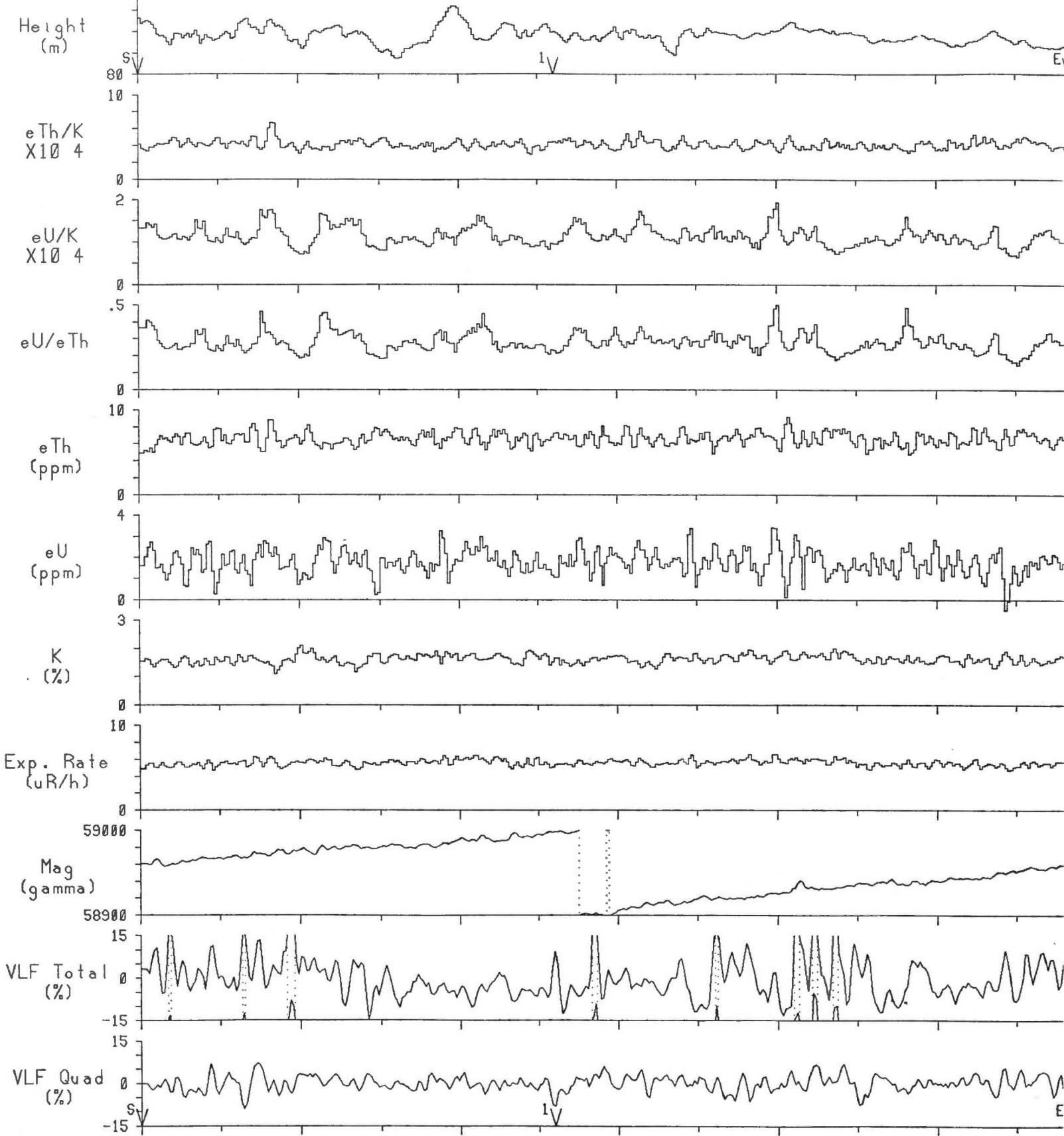
FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



Line 35      2 km

Scale 1:126720

FRED LAKE SURVEY, SASKATCHEWAN, 1989  
RADVILLE, SASKATCHEWAN, 1989 72H/8



Line 36      2 km

Scale 1:126720

