

SEISMICITY NEAR SASKATOON, SASKATCHEWAN,  
AND ITS POSSIBLE RELATIONSHIP TO POTASH MINING

by

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SEISMOLOGICAL SERVICE OF CANADA

INTERNAL REPORT # 80-3

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March 1980

## A Summary of Seismic Activity

Three earthquakes felt over small areas centered about 10 km west of Saskatoon near the Cory Potash mine have occurred since November, 1979. Epicentres, origin times and magnitudes are listed in Table 1. These are unique events in this area of Saskatchewan, however, it should be noted that events of this size could not have been detected by the Canadian Seismograph Network until the mid-1960's.

A plot of all known seismicity in Saskatchewan is shown in Fig.1. The largest earthquake, magnitude  $5\frac{1}{2}$  in 1909, was widely felt over central Canada and the north-central United States. The events near Bengough in 1972, Radville in 1976, and Esterhazy in 1976 and 1978 were all strongly felt over small areas. For more information see Horner and Hasegawa (1978).

TABLE 1

## Epicentral parameters and magnitudes

DATE	H-TIME (U.T.)*			LATITUDE **	LONGITUDE **	MAGNITUDE *
	h	m	s	N	W	$m_b$ (Lg)
18 NOV 1979	23	02	13.	52° 06'	106° 55'	3.0
29 FEB 1980	19	41	41.	52° 07'	106° 56'	2.4
18 MAR 1980	00	31	51.	52° 05'	106° 54'	2.8

\* preliminary estimates that will be revised as more data are received.

\*\* represents the approximate center of the felt area (see Fig.2.)

## Intensity Distribution

Isoseismal maps for the Feb.29 and Mar.18 earthquakes are shown in Fig.2. They were compiled from extensive interviews in the felt areas by Dr. Don Gendzwill, Geology Dept., University of Saskatchewan at Saskatoon and R.B. Horner. Both events were felt over areas of about 150 km<sup>2</sup>. The radii of perceptibility were about 7 km. Maximum intensities were generally IV with effects described as if the furnace had exploded or a heavy vehicle had struck the house. The duration of shaking was short, no more than 2 or 3 seconds. People near the center of the felt area were frightened, dishes and pictures rattled, however there was no damage. At one location for the Feb.29 earthquake (marked as "5" in Fig.2) some small knickknacks were overturned and there was evidence of a fresh crack in a plaster wall. One noticeable difference in the isoseismals is a relative shift of about 5 km, suggesting a similar shift in epicentral location.

Only the March 18 event was felt underground in the Cory Potash mine. Workers in the machine shop thought it had been struck by a vehicle. Others felt a light vibration and a sensation described as "a rush of air", perhaps from an interruption in the air circulation system. The effects would appear to be similar to a roof collapse, however no evidence for a collapse or any damage was found. Interviews with the miners did not indicate any alarm. The apparent shift in epicentre location probably explains why the February 29 earthquake was not felt underground.

Few intensity data are available for the November 18, 1979, earthquake. Localities where it was reported felt are marked by "N" in Fig.2. The effects were similar to the latter two events, although not as strong. The epicentre would appear to lie between the other two.

## Aftershock Investigations

Two EPB portable seismographs were deployed in the epicentral region of the March 18 event; the first on the afternoon of March 19 and the second on the afternoon of March 21 (see Fig.2). Several very low magnitude events were observed in the first few days of operation. S-P intervals appeared to be less than a few tenths of a second and would suggest a focus in the 2 km thick sedimentary sequence above the precambrian basement. A third seismograph (on order by Gendzwill) will be placed underground in the potash mine.

## Media Coverage

The uniqueness of these earthquakes near Saskatoon and their spatial association with the potash mine has created considerable interest among both the public and officials of the Potash Corporation of Saskatchewan (PCS). Gendzwill has been interviewed numerous times by the Press (see Appendix), radio and television.

On March 21, 1980, in Saskatoon, Gendzwill and Horner met with officials of PCS (Don Matheson, Cliff Haryett and a mine engineer) to discuss the results of the intensity and aftershock investigations. The meeting was covered by the local CBC television station and included an interview with Matheson, Gendzwill and Horner after it concluded. As the interview was shown that evening it left the (true) impression that the mine was doing everything it could to investigate the tremors.

## Future Studies

The meeting with PCS officials resulted in a verbal agreement for the funding of a proposal by Gendzwill to conduct further extensive monitoring studies over the mine. The concern being that the earthquakes might be related to the mining procedures. The reasons for this concern are:

1. The spatial correlation between the mined area and the epicentres (Fig.2).
2. The absence of previous seismicity in the area. Although the location capability for events of this size has existed only since the mid-1960's, interviews with long-time residents in the area suggested no other similar occurrences.
3. The shallow focal depths as evidenced by the felt areas and relatively high intensities, and the short S-P intervals of the small events recorded by the field stations. Other evidence is the Rg phase recorded by the seismograph operated by the University at a distance of about 40 km east of the epicentre (Fig.3). This phase is usually only seen from explosions (surface source).

It will be critical to determine hypocentres for the small shocks recorded at the field stations to see whether or not they are in the sedimentary sequence (above or below the mine cavity that lies at a depth of about 1 km) or in the precambrian basement. If Gendzwill does not have his seismograph operating in the mine before the EPB stations are returned (about April 11), hypocentre location will not be possible until the monitoring program funded by PCS is initiated.

## References

Horner, R.B., and Hasegawa, H.S. 1978. The seismotectonics of southern Saskatchewan.

Canadian Journal of Earth Sciences, 15, pp. 1341-1355.

## Appendix

This section contains copies of all newspaper articles received to date.



# U of S professor will not speculate on quake cause

The university professor looking into Monday's earthquake — the second in the Saskatoon area in three weeks — says he is not yet prepared to speculate on whether it was caused by natural events or connected to two potash mines in the area.

Dr. Don Gendzwill of the University of Saskatchewan's geology department said Monday's earthquake was similar to one Feb. 29 about eight kilometres west of the city, although it may have been centred a few kilometres south.

It registered between three and 3.5 on the Richter scale and occurred at 6:32 p.m.

Gendzwill said he will continue his investigation into the cause, hopefully aided with equipment from the federal government.

The university's geology department has been able to record earth tremors with a seismograph located east of the city.

However, Gendzwill said he hopes to be able to borrow another one which could be located over the spot where the earthquake was noticed.

He said he has received calls from area residents, who described it as a "thunk" or loud vibrations. No damage was reported.

He said he expects to spend the next few days talking to area residents.

An earthquake of similar magni-

tude was reported Feb. 29. There may have also been one in October or November, 1979, according to area residents' reports, but the university's equipment was not set up at that time.

Bob Horner, seismologist for the earth physics branch of the department of energy, mines and resources in Ottawa, said there have been 10 or 12 earthquakes in Saskatchewan within the past five years, but the recent ones are the only ones near Saskatoon.

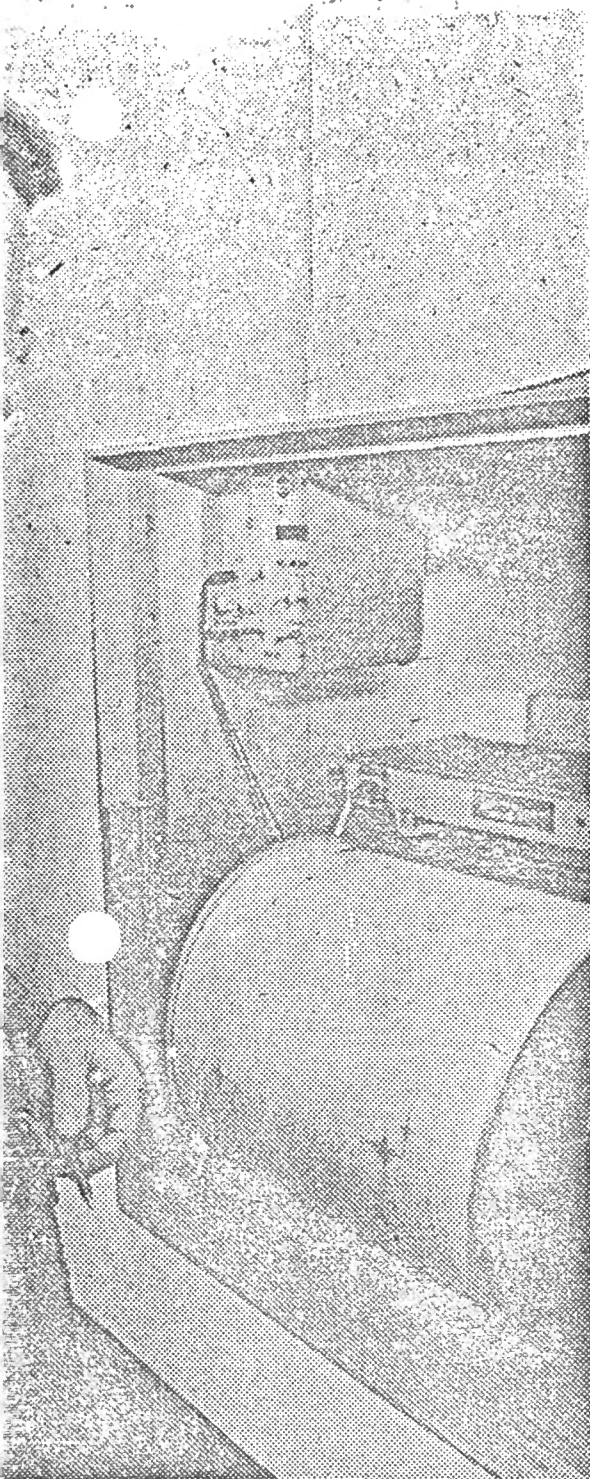
Horner said his department may provide Gendzwill with seismology equipment, and Gendzwill said he is also asking an equipment manufacturer to loan some equipment.

Horner said earthquakes near Esterhazy in recent years have raised speculation they may be linked to the potash mines. He said the release caused by removal of rocks can cause tension on the rock above, resulting in slight movement.

He said there seems to be no apparent reason for the Saskatoon earthquakes.

He said the Saskatchewan earthquakes have been most unexpected although there is historical evidence there was a large earthquake in southern Saskatchewan in the early 1900s which was felt throughout the west and as far east as Thunder Bay.

—JOHNSRUDE



—S-P Photo by Glen Berger

Gendzwill studies seismograph

Star Phoenix Mar. 18, 1980

# Earthquake rudely disrupts farmer's nap

By Larry Johnsrude  
of the Star-Phoenix



Stuart Gilmour

Stuart Gilmour says it felt like something hit his house. It was an earthquake measuring 3.5 on the Richter scale.

Gilmour, who farms about 13 kilometres west of Saskatoon, said he was half asleep in his armchair Friday afternoon when it struck.

"It actually felt like something ran into the house," he said. It rattled dishes in the china cabinet but lasted only a few seconds.

His daughter Lorena, who was downstairs at the time, said at first she thought her father had dropped a heavy chair on the floor.

Dr. Don Gendzwill, an associate professor of geology at the University of Saskatchewan, said although there have been other recent earthquakes in Saskatchewan, Friday's was the closest to Saskatoon.

Although it caused no damage to his home, Gilmour said it left cracks

in the plaster wall and knocked a clock over at a neighbor's about a kilometre north. He said he has talked to four other neighbors who also felt the earthquake.

Gilmour said at first he thought the shaking could have come from the Duval potash mine, about five kilometres away, but mine officials assured him they were not blasting that day. He also telephoned a radio station and was told it was likely a sonic boom.

He called Gendzwill Tuesday, who confirmed that it was an earthquake.

Gilmour's wife, Joyce, said she had a similar experience last fall, at the end of October or beginning of November.

"It just felt like we were moving," she said. "That sure was a funny feeling."

She said she called her sister in Saskatoon, who also felt the rumbling.

"It's kind of scary. It makes you wonder what's to come."

Gendzwill has no explanation for the earthquake, or at least not yet.

He said it could have been caused by a fault in the earth two kilometres below the surface or activities in the two nearby potash mines.

According to the geology department's seismic equipment in CFQC-TV's transmission building east of Saskatoon, the quake hit at 1:42 p.m. Friday. The greatest impact lasted for about two minutes, although it would not have been felt that long.

Gendzwill said it was also recorded at seismic stations at Flin Flon, Edmonton, Suffield and Minton, near Regina.

He said the 3.5 reading came from the other stations because Saskatoon's was set to record smaller earth tremors and Friday's ran off the scale.

He expected to talk to other farmers in the area who might have felt

the quake and is hoping anyone with any knowledge of it will contact him.

He referred to it as a shallow quake, affecting only a radius of seven or eight kilometres.

"It was a small earthquake but it was noticeable by the people living right over it," he said.

Earthquakes measuring over four on the Richter scale are noticeable while those measuring between three and four are only sometimes noticeable, he added.

He said a 1972 earthquake at Bengough, in southern Saskatchewan, has been the largest Saskatchewan quake to date. It was believed caused by a fault more than three kilometres below the Earth's surface.

There also was an earthquake at Dana in 1976 but its cause has not been determined.

Seismic equipment will be used in an attempt to determine the cause of Friday's earthquake, he said.

# Quake analysis may take month

An associate geology professor at the University of Saskatchewan investigating a small earthquake a week ago says it will likely be a month before all information on it will be analysed.

Don Gendzwill said he talked to about 30 to 35 people living west of Saskatoon Thursday, between 10 and 15 of whom noticed the Feb. 29 earthquake.

He said they described it as a "thump" or heavy vibration, shaking their homes and rattling dishes, as if their house had been run into by heavy equipment. One person

said his dog began to bark, sensitive to the after-shocks.

A cause has not been determined. He said information from the university's seismic equipment will have to be analysed before a judgment can be made on its cause, likely to take a month.

The earthquake's impact was concentrated to an area with a radius of about eight kilometres, located about 10 kilometres west of Saskatoon. It measured 3.5 in the Richter scale.

Gendzwill said it was not noticed

at the nearby Duval and Cory potash mines.

The university's seismic equipment located east of Saskatoon recorded the quake, and Gendzwill said it will remain there to record any other unusual earth tremors. He said he would also like to locate seismic equipment over the earthquake site but does not know whether he will be able to get another piece of equipment.

He said the earthquake caused no damage although one area resident reported cracks in a plaster wall.

# U of S expands

By Larry Johnsrude  
of the Star-Phoenix

The geophysicist investigating three recent earthquakes west of Saskatoon is hoping more seismic equipment will answer some of his questions about what is causing the unusual activity beneath the Earth's surface.

Don Gendzwill of the University of Saskatchewan said two seismographs — received from the federal department of energy, mines and resources — have been situated within two kilometres of each other

where the quakes occurred eight kilometres west of the city. The university is purchasing more sensitive computerized equipment.

Gendzwill has not yet determined whether the earthquakes were caused naturally — by shifting in the Earth's crust — or by the nearby Potash Corporation of Saskatchewan Cory mine.

"The mine is a suspect cause of the action but it is possible the earthquakes were caused by Mother Nature herself," he said.

He said mines have been known to cause earthquakes because remov-

## equipment to investigate quakes

ing the rock can strain the remaining rock, causing it to shift.

He met with mine management last week, who he said are concerned about knowing whether they are faced with an engineering problem.

"If the mine is at fault, they want to know it and maybe they can do something about it. If the mine is not at fault, it would be pointless for them to undertake an expensive program."

The earthquakes, noticed by area residents, occurred Nov. 18, Feb. 29

and March 17. Although all have been in the vicinity of the mine, none have been directly over mine shafts.

They measured about three to 3.5 on the Richter scale, a level barely noticeable, and the latest one appears to be centred about two kilometres south of the Feb. 29 one, with the earliest one centred in between.

Gendzwill said his conclusions on where they were centred came from talking to residents, whose descriptions ranged from a heavy thump to a lesser vibration of the ground. None caused any damage.

He said they were centred in different areas likely because the first caused a shifting which had to be compensated by subsequent shifts.

"Since we've received three earthquakes within the past couple of months, I wouldn't be surprised if we get another one," he said, adding it would likely be of the same magnitude as the others.

The latest earthquake was noticed by miners underground at Cory, who felt the earth vibrate and reported a rush of wind.

No rock was disturbed, although

an abandoned shaft collapsed about half an hour afterward.

Gendzwill said it is difficult to say whether the ceiling of rock in the shaft fell because of the earthquake. He said abandoned shafts are designed to collapse on their own, so this collapse may have happened anyway.

He said the moving air could have been caused by compression of rock caused by the earthquake.

He expects to be putting some seismic equipment into the mine in hopes to determine what effect, if any, it has had on any of the events.

Star Phoenix March 25 1980

March 22, 1980

# Early Saskatoon resident recalls 1909 earthquake

By Donna Sherman  
of the Star-Phoenix

The two earthquakes experienced by residents living near Saskatoon recently were not, as had been thought, the first recorded in this area.

In 1909, Saskatoon residents experienced a quake which was felt throughout Western Canada.

At 9:15 p.m. on May 15, 1909, an earthquake occurred which lasted between 30 seconds and one minute. It was felt from Winnipeg to Lethbridge and from St. Paul, Minn., to Prince Albert.

Although there was no Richter scale to record it, a report in the Daily Phoenix of the time said, "In scores of homes, windows rattled, doors shook, pictures swayed on walls and dishes and glassware raked and clattered restlessly, as though the houses were being shaken by some giant unseen hand."

Eleanor Wrigley, of 611 Eighth St. East, recalls the quake.

She said in an interview her family was then living near what now is the exhibition grounds and were the only people in the area.

A few other families lived across the railway tracks, she said, and they used to gather together and go downtown on Saturday nights.

The only way for her family to get downtown was by using the original railway bridge — which has since collapsed — to cross the river, by walking the ties.

She and her sister were walking along the bridge and had got about halfway across when "all of a sudden it started to sway."

They rushed to the side of the bridge and stood on the uprights, as they would have done when trains came.

However, fountains of water came up over the side of the bridge, splashing them, and they thought the bridge was collapsing, she said.

The quake also caused two or three railway cars to come down the bridge of their own volition.



Glen Berger

## Eleanor Wrigley tells of being on swaying bridge in quake

Wrigley, now 87, said that as the pair got close to town they could see horses acting strangely and could hear people screeching and running.

She said there was a general uproar caused by the quake and dishes and windows were broken, while groceries were knocked off shelves in some of the stores.

When the pair returned home, furniture was moved from one side of rooms to the other side, she said.

Not everyone in the city felt the quake, according to the newspaper report.

It said that few people who were standing on their feet felt the tremor but most of those sitting down or working over anything firm, such as tables and desks, felt the roll.

In Caswell Hill and Mayfair, the

shock was distinctly felt, the newspaper said, as pictures on walls shook and door rattled.

On the east side of the city, articles in kitchens rattled while furniture doors opened.

In Watrous, plaster cracked and was shaken from the walls of some buildings and in Wolseley, a well caved in, but that was the most extensive damage from the first quake ever recorded in Western Canada.

In Langham, the quake lasted two minutes, while in Winnipeg it lasted 40 seconds, and a CPR conductor on his way to Wolseley said no one on the train noticed anything but in every town he stopped at, people were talking of the quake.

He said he thought it was more severe east of Saskatoon than it was in the city itself.

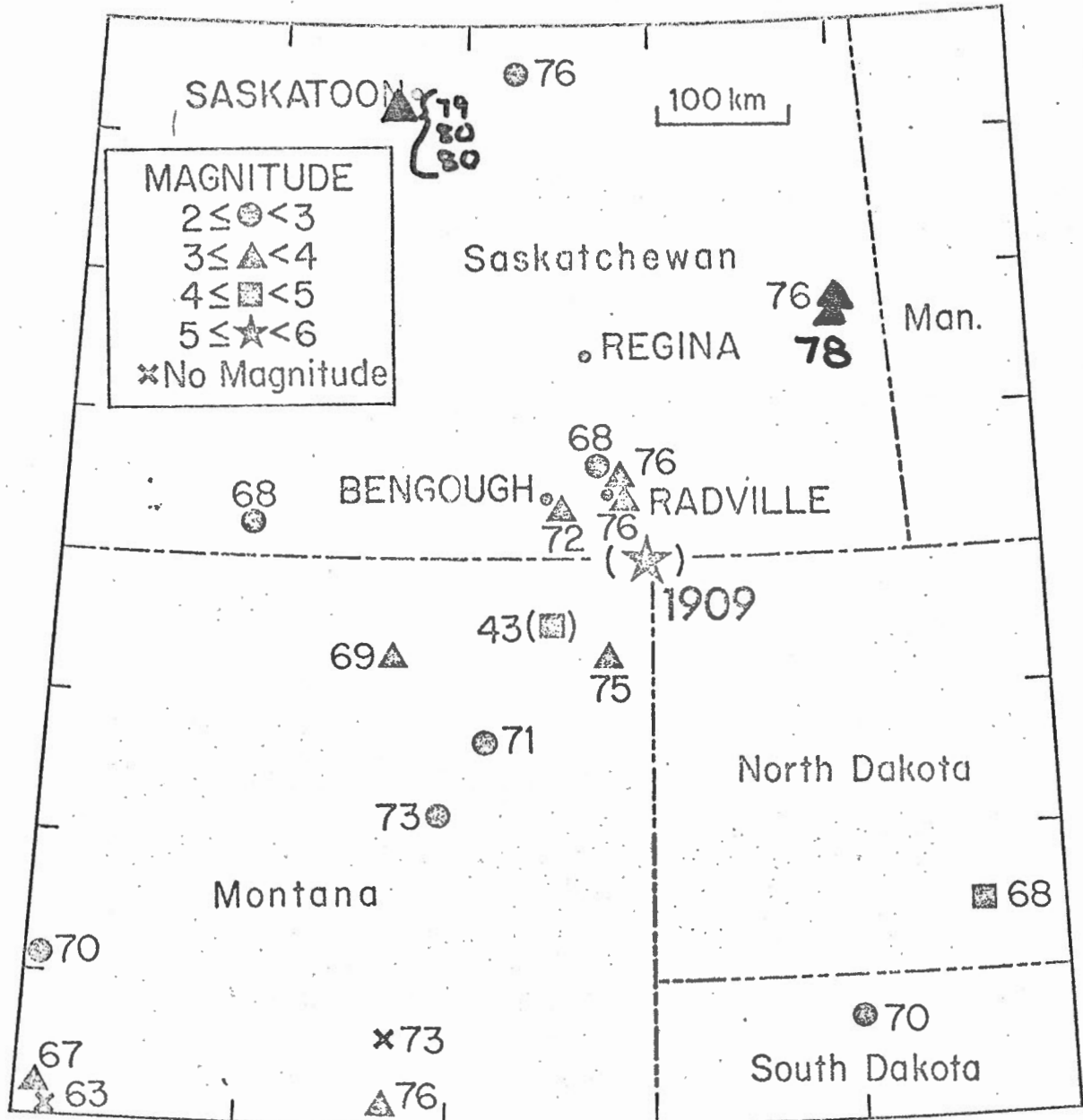


FIGURE 1. Earthquakes in Saskatchewan and adjacent areas of the north-central United States

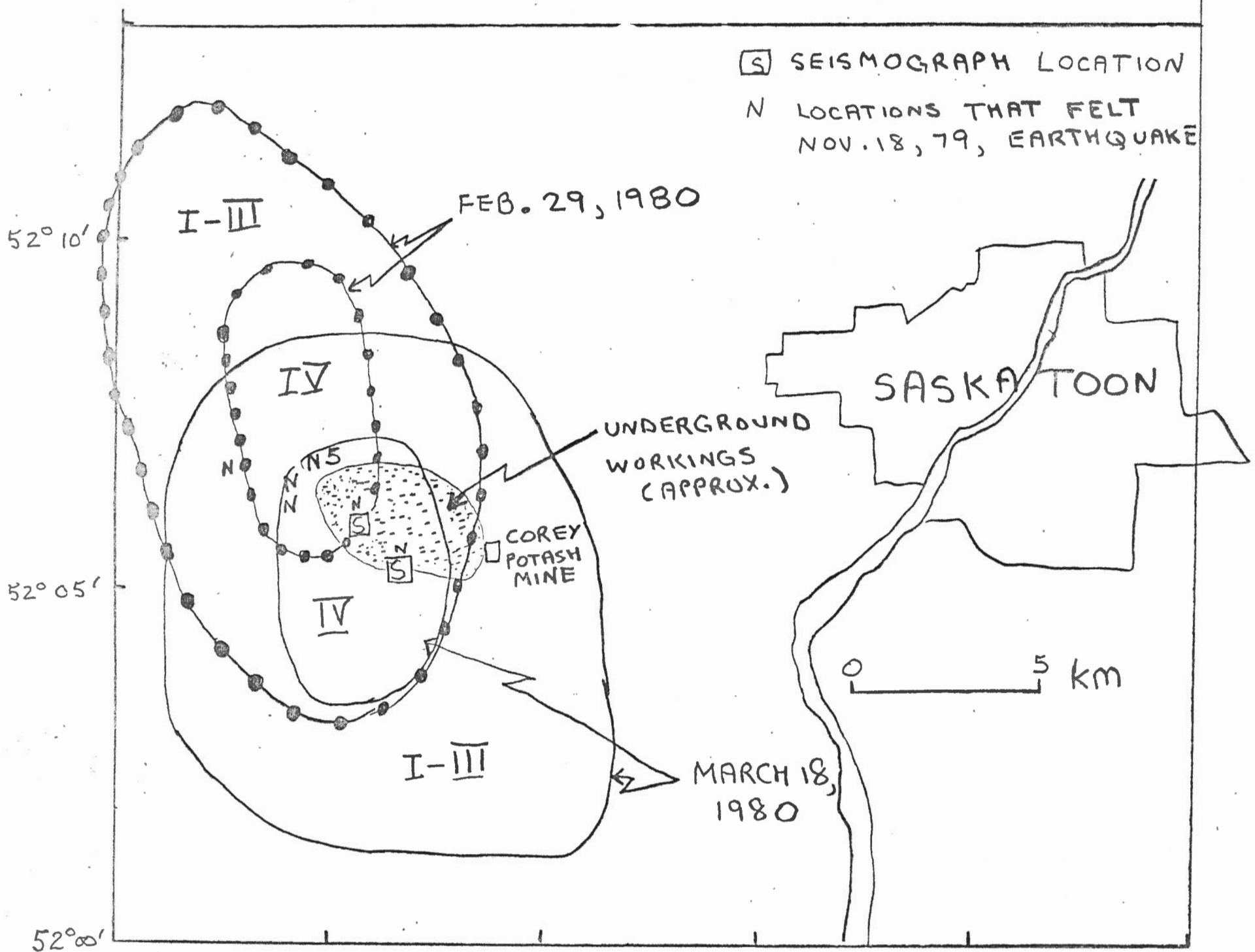


Figure 2.

18 MAR 1980

U. of S. SEISMOGRAPH

00<sup>h</sup> U.T.

SPZ

March 17  
6<sup>32</sup> PM

$\Delta \approx 40$  km

↑↑  
PS

R<sub>g</sub>

Figure 3.

