ACTA MONTANA 1992
Series A, No. 2(88), 221-231

# REGISTRATION BY LOCAL SEISMIC NETWORK IN SOUTHERN PART OF THE OSTRAVA-KARVINÁ COAL BASIN (CZECHOSLOVAKIA)

[a] Zdeněk KALÁB

[a] *Mining Institute of Czechoslovak Academy of Sciences*
*708 00 Ostrava-Poruba, Studentská 1768, Czechoslovakia*

Abstract:

The seismic network called the Seismic Polygon Frenštát (SPF) was put into operation in 1992. It consists of five three-component seismic stations. The signal in digital form is transmitted by radio to the registration centre. The apparatuses of the network were developed by the Mining Institute of CSAS.

The task of the SPF can be divided into three basic fields. There are presented the first results of registration by the SPF in this paper.

Key words:

local seismic network, natural and induced seismicity, statistical distribution

## 1. INTRODUCTION

Investigation into seismic activity in the mining regions covers significant proportion of study of massif disturbance and subsequent strategy of the rockburst prevention. At the Ostrava-Karviná Coal Basin (OKR), belonging to the fields with the highest induced seismicity in Czechoslovakia, the seismicity is monitored by networks at several levels. Their activities are dealt with other publications /for example HOLUB et al., 1988, KNOTEK et al., 1991, KNEJZLÍK et al., 1990, KALÁB, 1991/. From the viewpoint of the basic research activity the monitoring of seismicity at Frenštát region of the southern part of the OKR seems to be rather interesting because start of coal mining is prepared here in this region, till now free of any mining activity.

The Frenštát region is being monitored by a local seismic network called the Seismic Polygon Frenštát (SPF). This network is dealt with as an autonomous system consisting of five three-component stations with digital data recording in the registration centre. The apparatus

outfit of network developed at the Mining Institute of CSAS and the network will be described in detail in the next paper /KNEJZLÍK et al., 1992/.

## 2. TARGETS OF THE SPF

The targets of the SPF can be split into three fundamental fields:

- The first task follows from distribution of the stations approximatelly in the potential mining field of the Frenštát Colliery. Registration of the seismic activity in the field in question will present reasonable insight into seismic activity of this region before the start of mining work. In line with the results of further monitoring systems the analysis of the primary state of stress of the massif will be carried out,
- The second task is focused into the field of analysing the strong rockbursts originating in the mined part of the Ostrava-Karviná Coal Field. These rockbursts are well-recorded by the SPF-stations and they can be interpreted here,
- The third task is given by the geological structure of the monitored field. The SPF is installed in the contact point of two significant geological units, i.e. the Bohemian Massif and the Carpathian Belt.

## 3. GEOLOGICAL SITUATION

The locality in question is lying in the region of the overlying flysh sheets of the West-Carpathian units not far from the contact with the Bohemian Massif /BOUČEK et al., 1963/ (Fig. 1.).

The basis, i.e. the oldest rocks are represented here by the igneous rocks of Brunovistulicum (the mica paragneiss). The nappes of the igneous rocks consist of the Devonian conglomerate, sandstone and limestone. Above these nappes there occurs the Culm sedimentation that is covered by a sedimentation of Payable Carboniferous. In this region the Payable Carboniferous can be found in a depth of -300 to -1500 m (Tab. I.).

The overlying flysh sheets are represented above all by sediments from Jurassic to Paleogene System, i.e. the Silesian and Subsilesian units. These units consist of claystone, sandstone and to a lesser extent of limestone. Occasionally the eruptive rocks from Cretaceous System are encountering here. The surface is covered by the Quaternary sediments in some sites almost 100 m thick. These sediments are of clay, sand, claystone and marl.

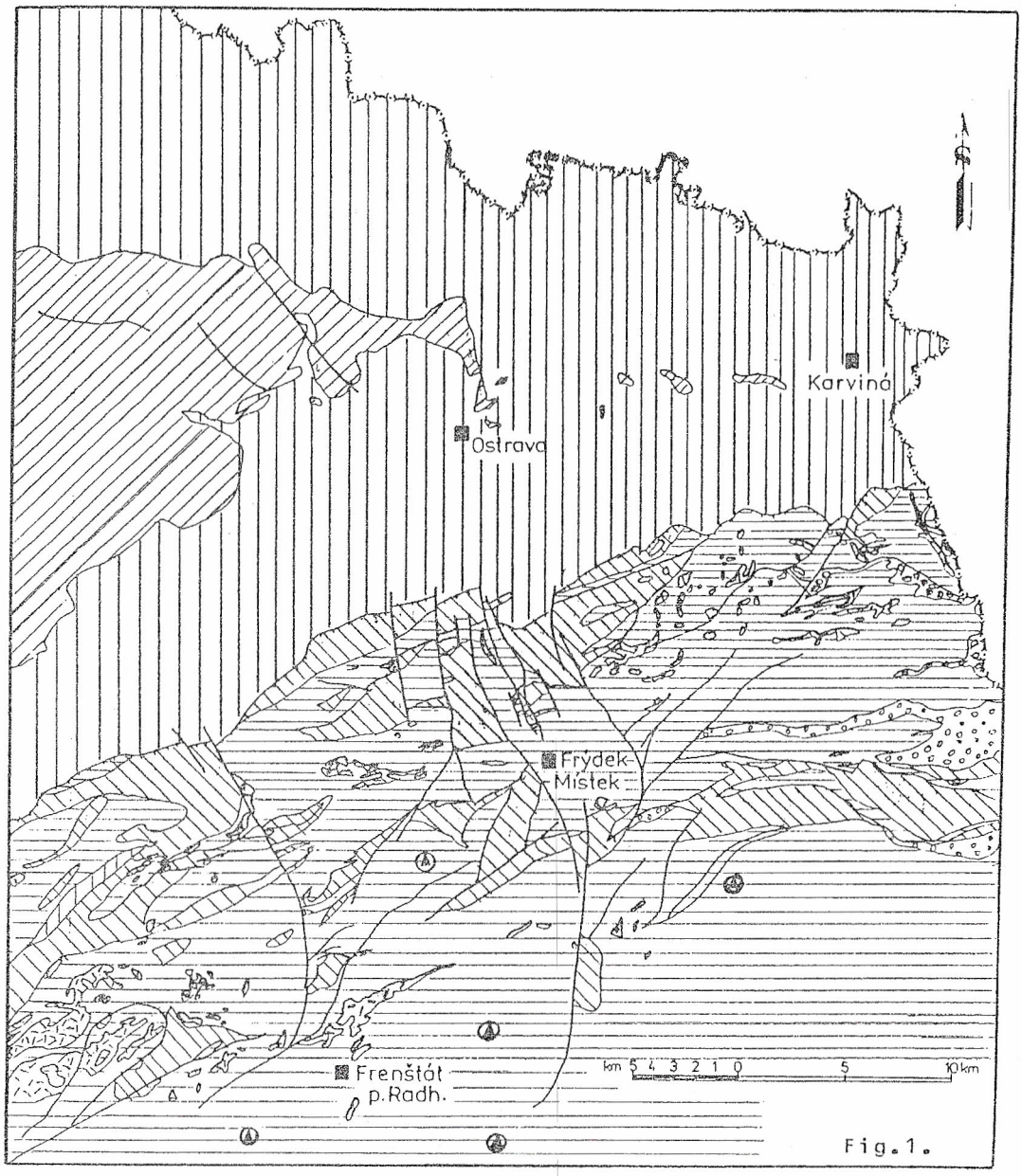



Fig.1.

Neogene
Paleogene
Cretaceous
Jurassic
Culm
Eruptive rocks
Seismic stations

Tab. I. Generalized section of SPT stations (one letter is 100 m)

| Palkovické Hůrky | Vyšné Lhoty | Petruží | Trojanovice | Čeladná |
|---|---|---|---|---|
| Q | | | | |
| S | S | | | |
| S | S | Q | Q | Q |
| S | S | S | S | S |
| S | S | S | S | S |
| S | S | S | S | S |
| | | | | ±0 |
| S | S | S | S | S |
| S | S | S | T | S |
| M | S | S | T | S |
| P | S | S | T | S |
| P | S | M | P | S |
| P | S | P | P | S |
| P | P | P | P | P |
| C | P | P | P | P |
| | P | P | P | P |
| | P | P | P | P |
| | P | P | P | P |
| | P | P | P | P |
| | P | P | P | P |
| | C | P | P | P |
| | | P | P | P |
| | | C | C | C |

Q Quaternary
S Silesian and Subsilesian units (Jurassic to Paleogene)
M Miocene
T Tertiary
P Payable Carboniferous
C Culm

## 4. THE SEISMIC POLYGON FRENŠTÁT

Verification and pilot-plant service of the seismic network were started in the Frenštát region on January 9th, 1992, namely in four stations. The last station was commissioned on April 30th, 1992. The distribution of stations is obvious from figure (Fig. 2.).

The parameters for set-up of recording are controlled from the registration centre in which the emitted data are permanently received. Start of recording is made on the principle of examination of the STA/LTA-ratio and the coincidence of symptoms. The weight of the individual channels for the relevant stations can be set-up within 1-100, the required sum of weights from the individual channels for starting a record makes some 100. The parameter values are not fixed yet, however, more suitable variants were tested. The record takes place On-line on a recording computer for the sake of its profound examination. The proper interpretation takes place on the interpreting computer; the processing software is ever developed and programs finished till now will be presented.

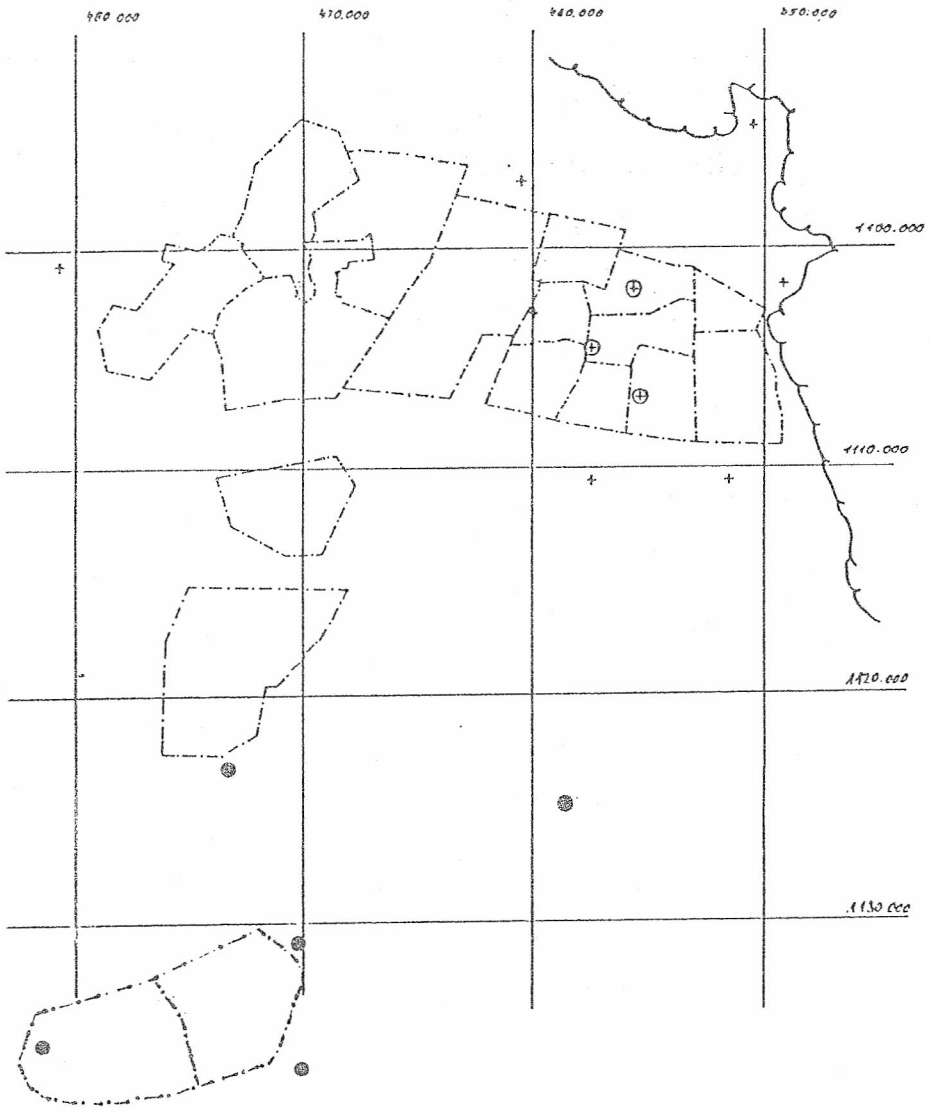



Fig. 2.
Distribution of the stations of Seismic Polygon OKR
/+ surface stations, ⊕ underground stations/ and
of Seismic Polygon Frenštát / ● surface stations/

## 5. DISTRIBUTION OF REGISTRATION

Nowadays, processing of recorded data takes place in two stages. Because of seeking for the optimum parameters, for start, when playing back to the interpretation computer, the data are split into useful and useless records. The first group consists of disturbances of instruments, disturbances of the telemetric transition, records of sound wave, records of noise and the non-identified records (substantial parts of the phenomenon are missing and so it is difficult to arrange it properly). These records are erased after confrontation of registration with the seismic station Ostrava - Krásné Pole and the seismic stations of the mining local network. Records of this group represent about one half of registered records.

The other recorded data are interpreted and then split into the following categories : the local seismic phenomena /1/, the rockbursts from the mined part of Ostrava-Karviná Coal Field /2/, the rockbursts coming from Poland /3/, the earthquakes /4/ and other noise /5/. The statistic distribution of registered records (from second group) is presented in table (Tab. II.).

Tab. II. Distribution of registered records

| | /1/ | /2/ | /3/ | /4/ | /5/ | Sum |
|---|---|---|---|---|---|---|
| January | 0 | 28 | 33 | 6 | 67 | 134 |
| February | 0 | 7 | 19 | 8 | 18 | 52 |
| March | 0 | 9 | 24 | 14 | 9 | 56 |
| April | 0 | 9 | 37 | 11 | 10 | 67 |
| May | 0 | 13 | 25 | 16 | 16 | 70 |
| June | 0 | 16 | 24 | 21 | 2 | 63 |
| July | 0 | 14 | 21 | 26 | 12 | 73 |

The first category refers to the local seismic phenomena localized into the field of registration basis. No record has been supplied to this group yet. This fact, however, is not surprising as the field occurs in a seismic free environment. Also the induced rockbursts are not assumed to be frequent as the mining process has not still started. The two facts have to be evidenced, as they are of utmost significance for determination of stress and deformation, originating in massif during the mining process. In similar manner the effect of simultaneous tectonic forces has to be presented here. We must add to this fact: Assessment of the state of stress - existing in the mining locality befor the beginning of the mining work - is one of the fundamental preconditions for calculation of stability of the mining activities.

The stress and deformation arising during mining vary directly with the primary stresses. While the physics-mechanical properties of a massif, being the secondary source of backgrounds for calculation of stability, can be determined even in room already exploited, this work cannot be made to determine the primary stress in the massif /RAKOWSKI, 1992/. For this reason, from the viewpoint of basic research, we consider the monitoring of seismic activity of the region in question for unseparated part of complex assessment of the properties of a massif before the beginning of the mining activity. The acquired knowledge will be used even for modelling of stress fields in the mined part of the Ostrava-Karviná Coal Field.

The SPF is recording the strong rockbursts coming from the mined part of Ostrava-Karviná Coal Field with an energy of $5x10^4$ units and greater /according to the energy classification of the OKR, i.e. rockbursts with a local magnitude higher than 1.4/. In the period of reduced perturbation there are recorded also rockbursts having a lesser energy. Interpretation of such rockbursts cannot be made separately from other data of the OKR, as the stations are installed at distances of 20 to 40 km. These data enlarge the set of digitally registered data on the rockbursts for the sake of their interpretation. In case of a rockburst of anomalous intensity this registration would be of paramount significance, as the records from the near stations would not be interpretable. At present the processing routines are being completed to enable compatibility of the data interpreted with those coming from the network of the Seismic Polygon of the OKR.

A large part of records registered by the SPF refer to records of rockbursts coming from Poland. Records are cumulated from rockbursts coming of the whole Polish part of the Upper-Silesian Basin and even of rockbursts coming from the copper mines at Lubin. These records are not interpreted yet.

From the records of the SPF there can be separated even the category of earthquake. For near earthquakes the entire wave picture is recorded such as the earthquakes of south Poland from the last decade of June 1992. For remote and far remote earthquaking activities only some non-identifying stage is recorded and thus, no registration of earthquake is to be spoken about.

The last category consists of the so-called other noises. This term covers registration of industrial interferences, quarry blasting and some other records interpreted additionally as manifestation of elevated perturbation and distress (cross-country flight of an aeroplane, passing of cars etc).

Examples of wave patterns are given in Appendix.

## 6. CONCLUSION

Because of relatively a short time of service of the Seismic Polygon Frenštát its contribution to the specified targets can hardly be evaluated at present time. Eventually, we want to remark here. Monitoring of seismicity at the Frenštát region and interpretation of monitoring provide knowledge to be used both for the basic research and for the applied research or directly for the full-scale practice.

## REFERENCES

Bouček, B. and Kodym, O. (1963). Geology II, Publishing of CSAS, Prague, Czechoslovakia. /in Czech/

Holub, K., Kalenda, P., Sglunda, R. and Slavík, J. (1988). The Present Status and Outlook of Construction the Local Seismological Network in the Ostrava-Karviná Coal Field, in Procházková. Induced Seismicity and Associated Phenomena, Processing of conference, Liblice, Czechoslovakia.

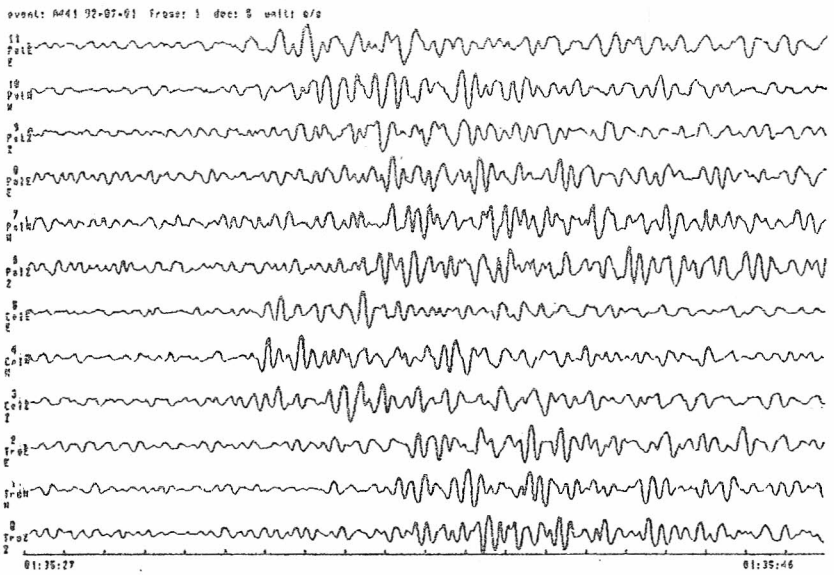
Kaláb, Z. (1991). Regional Diagnostic Polygon in the Ostrava -Karviná Coal Field (OKR), Publs. Inst. Geophys. Pol. Acad. Sc., M-15(235).

Knejzlík, J., Gruntorád, B. and Zamazal, R. (1990). Experimental Local Seismic Network in A. Zápotocký Mine of Ostrava-Karviná Coalfield, Acta Montana, Czechoslovakia. /in print/

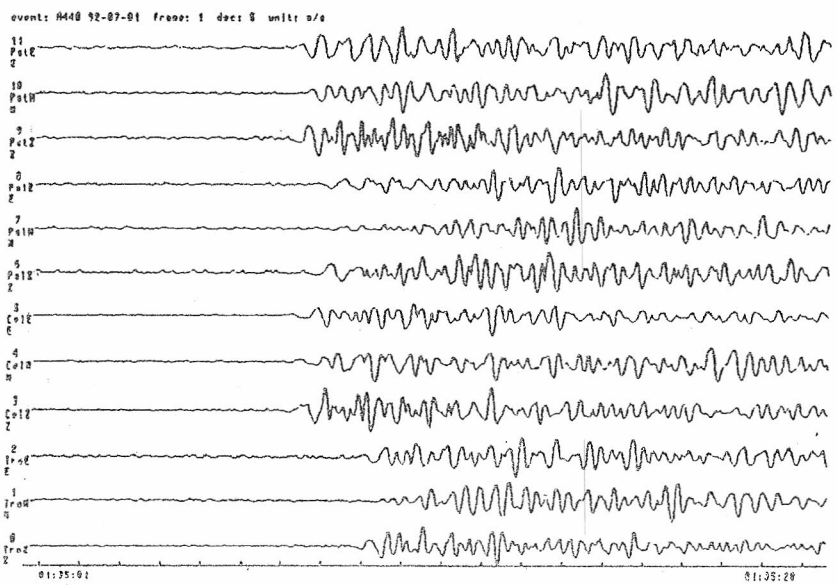
Knejzlík, J. and Zamazal R. (1992). Local Seismic Network in Southern Part of the Ostrava-Karviná Coalfield, International Symposium on Mining Induced Seismicity, in this Proceedings.

Knotek, S. et al. (1991). Interpretation of rock bursts at RDP, Report of OKD-BVZ, Ostrava, Czechoslovakia. /in Czech/

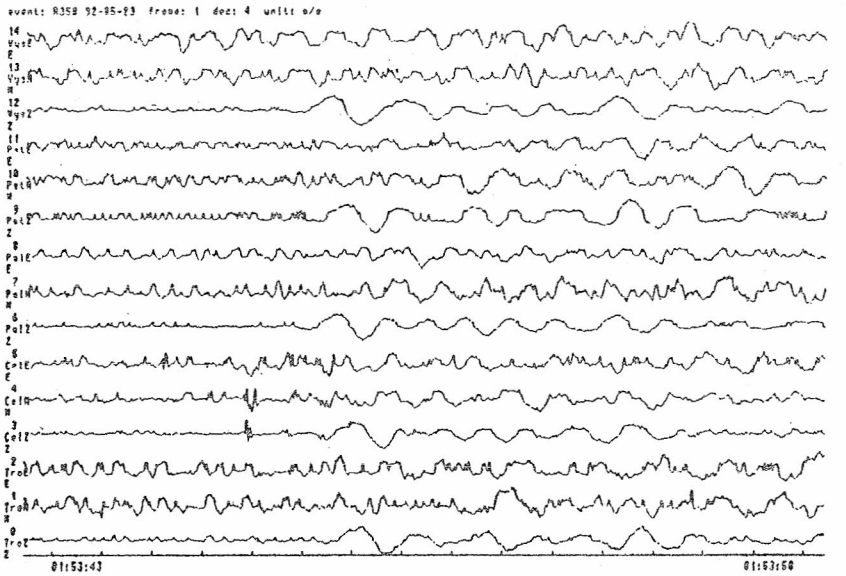
ed. Rakowski, Z. (1992). Geomechanics 91, Proceedings of International Conference. Mining Institute of CSAS, Balkema/ Rotterdam/Brookfield.



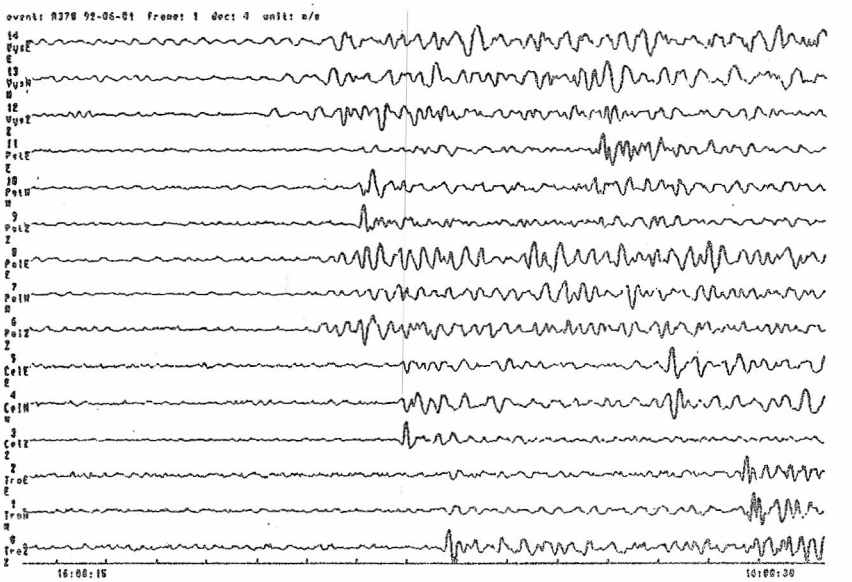

Records of earthquake from southern Poland
/S-wave, Mag = 3.6/



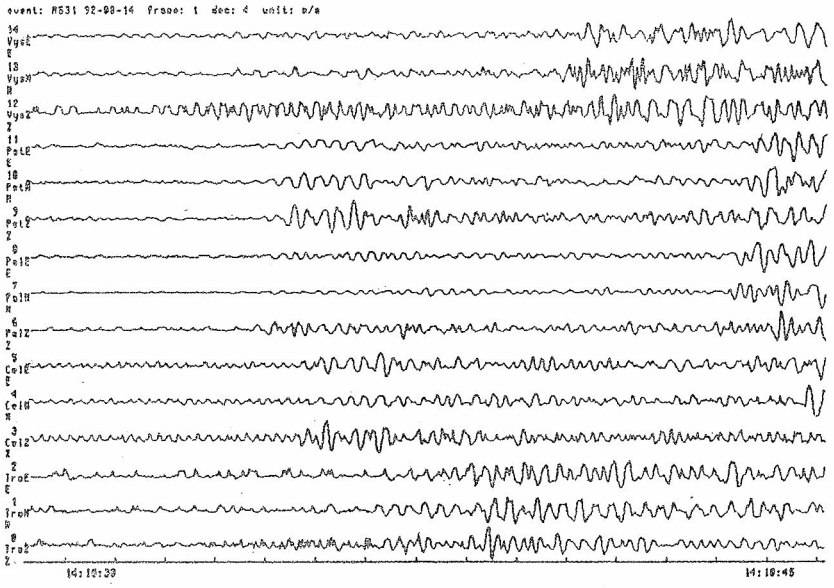

Records of earthquake from southern Poland
/P-wave, Mag = 3.6/



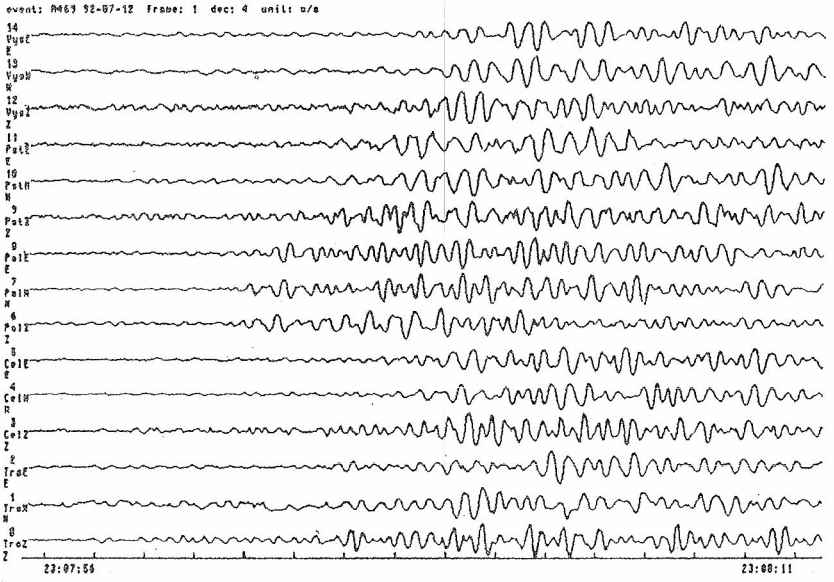

Records of non-identifying stage of far remote earthquake /Samoa/




Records of rockburst from CSA Colliery /OKR/




Records of rockburst coming from Polish part of the Upper-Silesian Basin




Records of rockburst coming from copper mines at Lubin /Poland/