# Increased detectability of microearthquakes in the swarm area of Nový Kostel (Western Bohemia)


University of Stuttgart

**Martin Häge, Manfred Joswig**

Institute for Geophysics, University of Stuttgart, Azenbergstraße 16, 70174 Stuttgart, Germany
haege@geophys.uni-stuttgart.de, joswig@geophys.uni-stuttgart.de



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## 1. Introduction

The region in Western Bohemia is one of the seismically most interesting areas in Europe because of its swarm activity. It is assumed that the weak background activity, the microseismicity in inter-swarm periods, plays an important role in terms of stress accumulation. A microseismic study was carried out in the vicinity of the focal area Nový Kostel to address two main topics:

1) Does weak seismicity exist below the detection threshold of the local West Bohemian seismological network (WEBNET)?

2) Is it possible to map an active fault zone with a short-term measurement?

## 2. Measurement performance

The measurement was performed with three small arrays, each consisting of one central 3-c and three 1-c seismometers, arranged as an equilateral triangle with an aperture of 200 m. Figure 2.1 shows the station distribution of the small arrays (SNSx) and a part of the stations of WEBNET with the seismicity from 1994-2007.

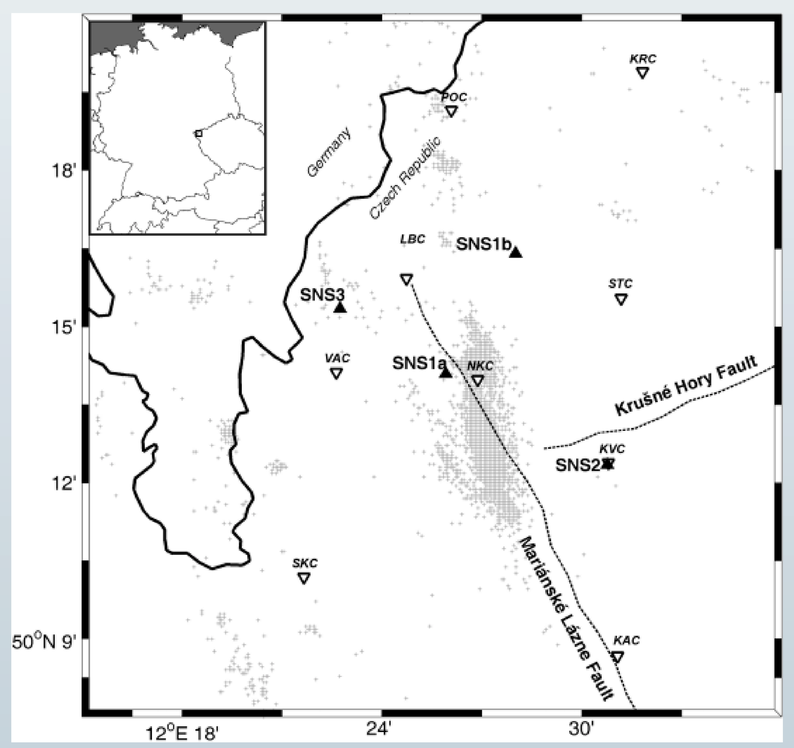


Fig. 2.1: Station distribution.

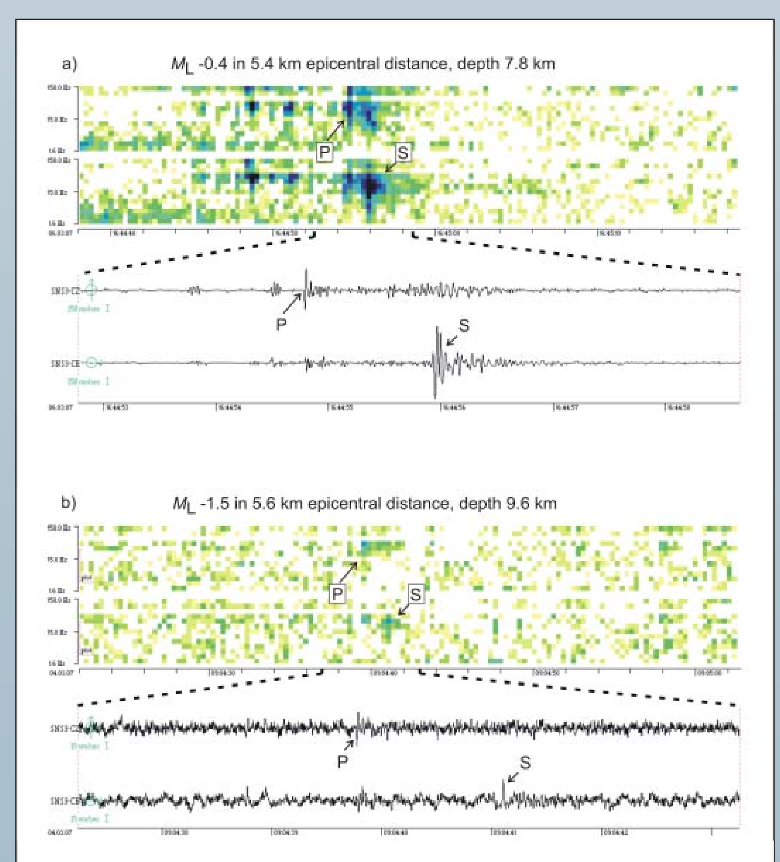

Fig. 2.2: Performance of sonograms vs. seismograms. Seismograms are filtered between 3 and 30 Hz.

In the measurement period of six days, 13 microearthquakes in the range $M_L$ -1.5 to -0.1 were detected and located using sonograms for event detection. In the same period, WEBNET recorded the four largest events down to magnitude $M_L$ -0.4.

Figure 2.2 clarifies the two detection thresholds. Example a) shows the weakest event recorded by WEBNET, b) the weakest event recorded by SNS. The upper two traces represent the sonograms of the vertical and transversal component of the central station of SNS3, the two traces below the zoomed seismograms.

## 3. Frequency-magnitude distribution

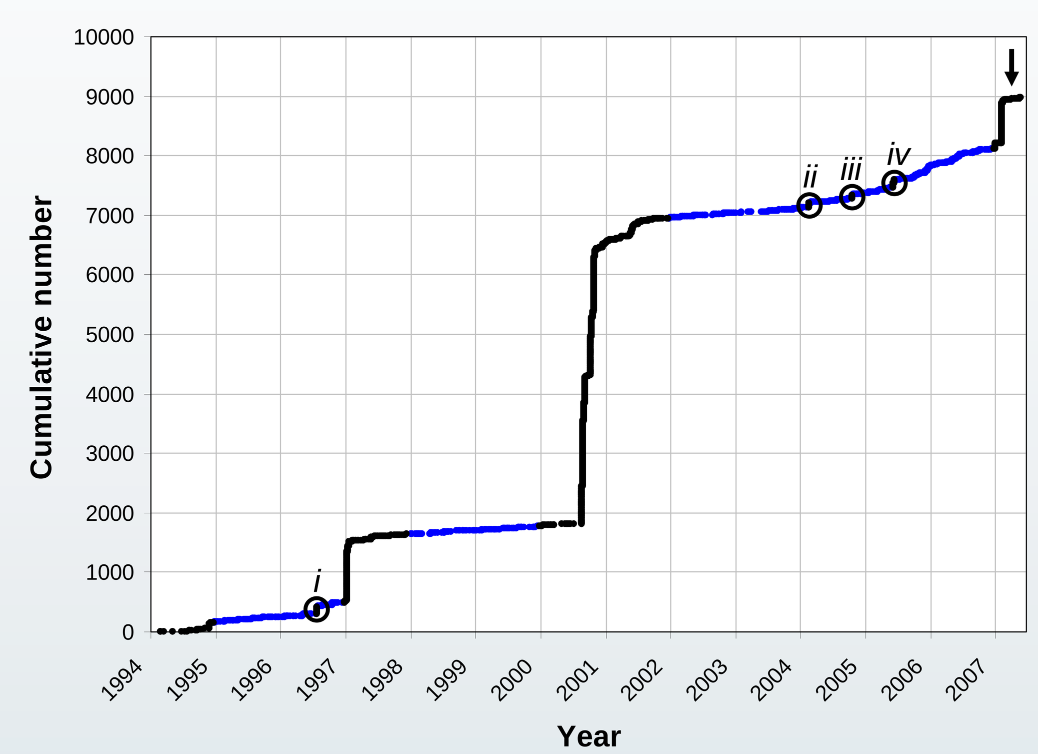


*Fig. 3.1: Cumulative number of events from January 1994 – May 2007. Arrow marks the time period of the microseismic study. Circles indicate micro-swarms.*

We compared the amount of our recorded events with the local background seismicity of the last years. Figure 3.1 shows the cumulative number of events that occurred within the area of our minimum detected magnitude of $M_L$ -1.5 in 10 km. Only the blue segments were taken for analysis, hereinafter called bulletin.

The frequency-magnitude distributions of the bulletin and some selected (micro-) swarms, normalized to the measurement period of six days, are displayed in Figure 3.2. Our recorded events are shown in red with error bars of ±1 event per 0.3 magnitude bin. The continuation to small magnitudes can be well approximated with the determined *b*-value of 1.11±0.04 and shows the increased detectability of about one magnitude compared to WEBNET.

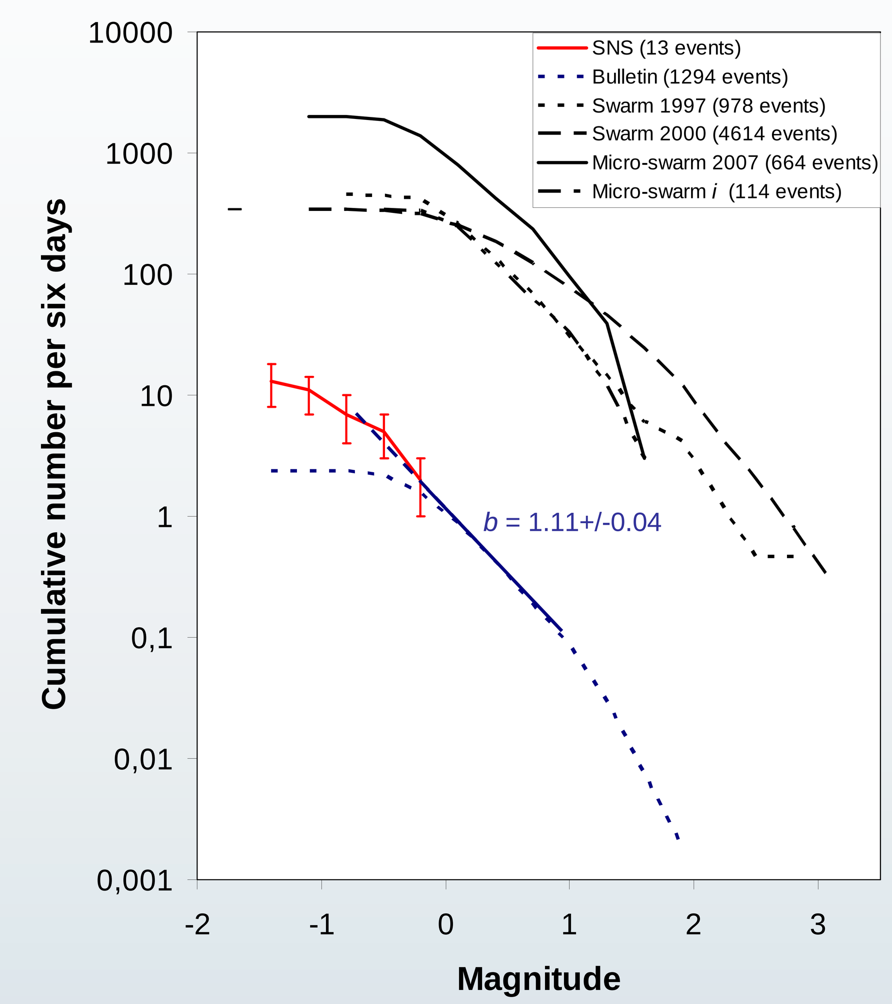


*Fig. 3.2: Frequency-magnitude distributions. Graphs are normalized to measurement period of six days.*

## 4. Event location

Figure 4.1 shows the result of the absolute location in blue asterisks. Black dots indicate seismometers of each small array and triangles pointing down display two stations of WEBNET. The mean location difference between WEBNET and our location, determined by the four events recorded in common, is 0.8 km in horizontal and 0.5 km in vertical direction.

A relative location was performed to achieve a higher location resolution. Figure 4.2 shows the similarity matrix of the 13 events sorted by time with a cross correlation coefficient ranging from 0 to 1 and the corresponding seismograms in front. Events with a cross correlation coefficient ≥ 0.6 (events no. 4 - 13) were used for relocation. Event no. 4 was taken as master event (underlined asterisk in Figure 4.1). The result of the relocation is given with blue dots in the inset of Figure 4.1 indicating a NW-SE direction which fits well with the orientation of the Mariánské Lázně Fault (MLF).

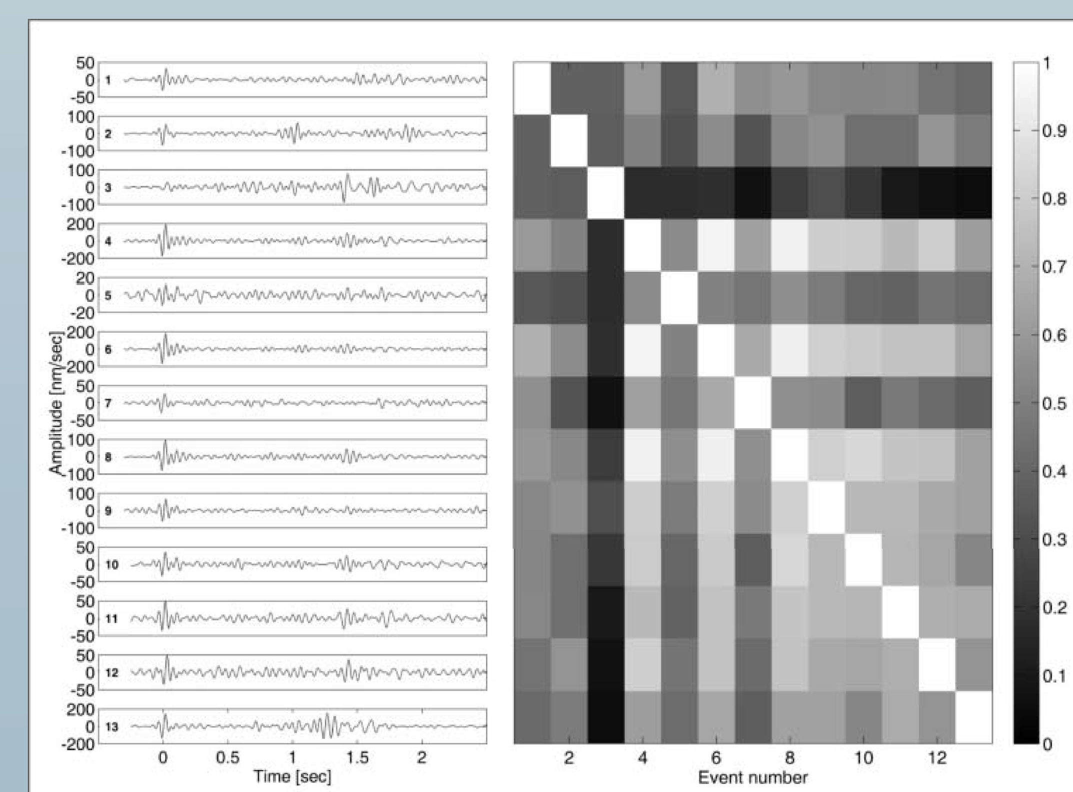


*Fig. 4.2: Waveforms and similarity matrix, sorted by time. Waveforms are taken from the central station of SNS3 (vertical component, filtered 5 to 25 Hz) with P onsets at 0 sec.*

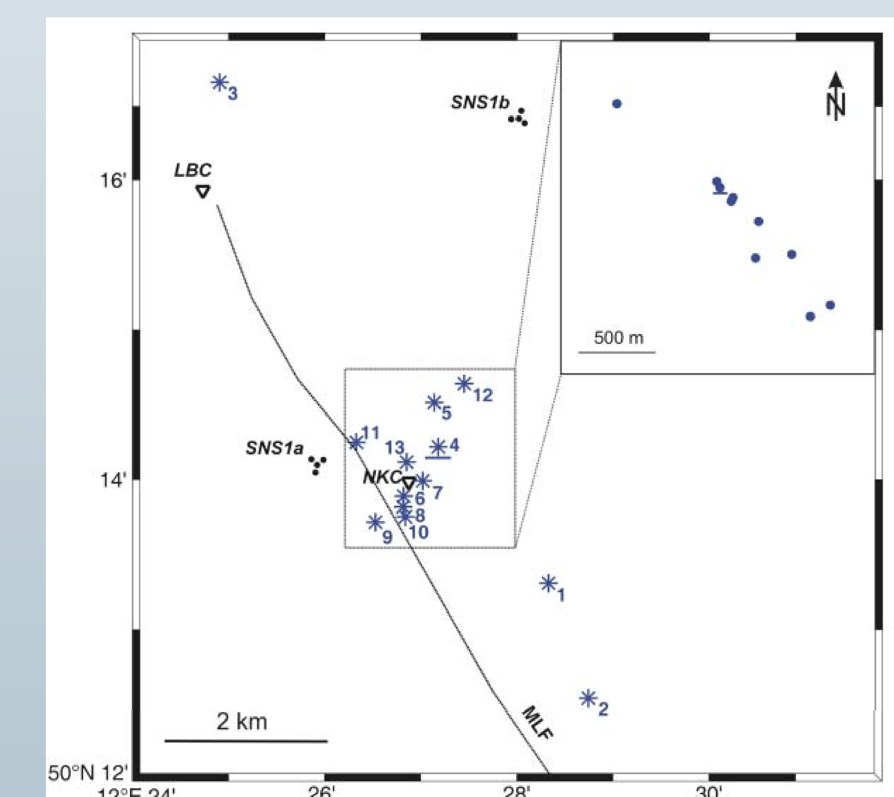


*Fig. 4.1: Absolute location of the recorded events in asterisks. The inset shows the result of the relative location.*

## 5. Conclusion

This microseismic study, performed with three small aperture arrays in the focal area Nový Kostel shows:

1) The existence of weak background seismicity below the detection threshold of WEBNET with a conformity between the amount of our recorded seismicity with the long-term observation.

2) The possibility to map active faults successfully with a short-term measurement.