BLASTING WORKS FOR CLEARING OF STREAM BED KNĚŽMOSTKA BROOK

TRHACÍ PRÁCE PRO UVOLNĚNÍ KORYTA NA ŘÍČCE KNĚŽMOSTKA

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Abstract

On the base of request of the Labe Water Authority, state owned enterprise, was executed a prefeasibility study for performance of blasting works for a clearing of clogged stream bed of the Kněžmostka brook in the protected area Natura 2000-Drhleny. The Water Authority took a step to fruitful execution of the blasting works in the brook after approval of the prefeasibility study. The sludge in the stream bed was released and flowed away from a site where produced a problems with flowing. The seismic methods and resistivity tomography proved successful for realization of the project.

Abstrakt

Na žádost Povodí Labe, statní podnik byla provedena studie proveditelnosti realizovat trhací práce za účelem uvolnění zabahněného koryta říčky Kněžmostka v chráněném území Natura 2000 - Drhleny. Po schválení závěrů studie proveditelnosti bylo přikročeno k úspěšnému provedení trhacích prací v místě říčky. V korytě říčky došlo k uvolnění bahna a jeho odtoku z místa, kde neúměrně zatěžovalo průtok vody. Při realizaci projektu se výrazně uplatnily seismické metody a odporová tomografie.

Keywords

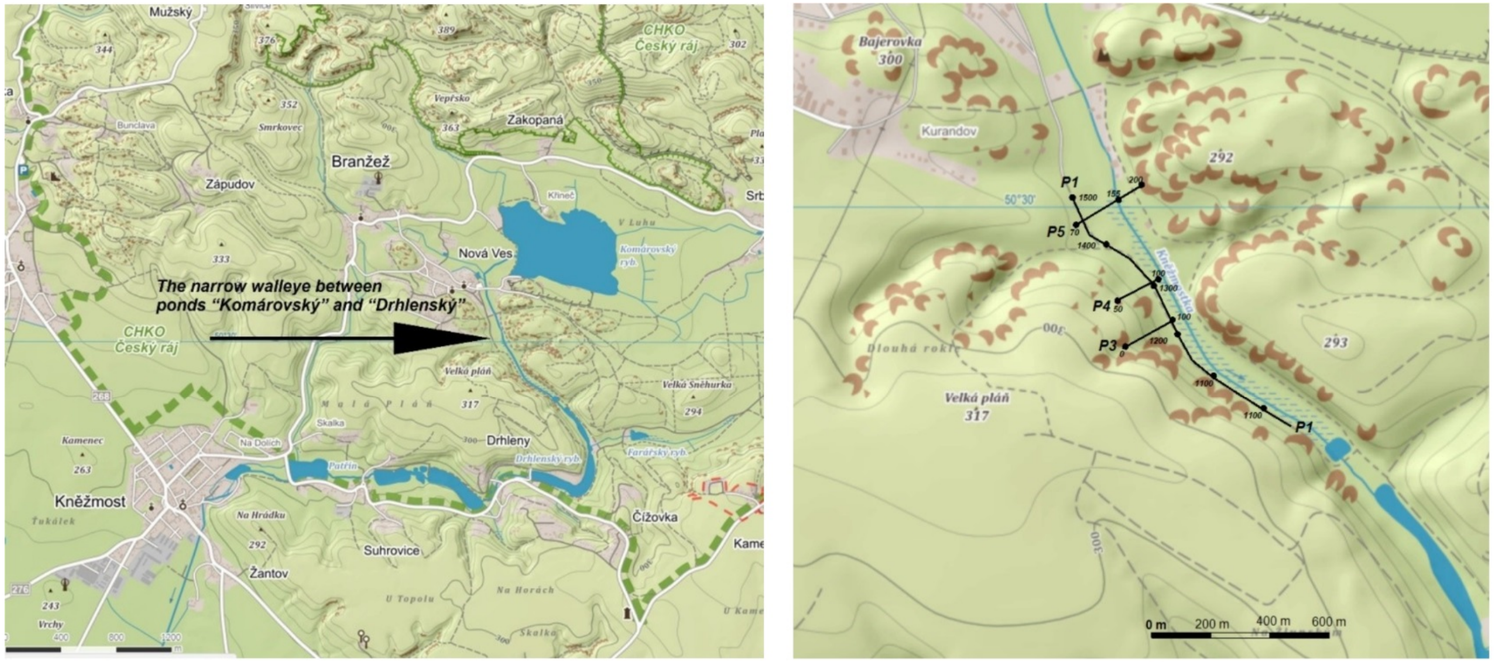
blasting works, seismic, resistivity tomography, explosive, protection of environmental, sludge, brook

Klíčová slova

trhací práce, odporová tomografie, výbušnina, ochrana životního prostředí, bahno, potok

1 Introduction

The area of interest is located north - east of the city Mladá Boleslav (distance cirka10 km), on the east of the highway D10 (circa 5 km). The territory is protected as the area Natura 2000-Drhleny (CHKO Český ráj). See Fig 1 a, b. The Kněžmostka is a small river which goes mostly thorough sandstone layers of Cretaceous period. The narrow walleye, which sometimes make a problems with sludge in the stream bed, is located between ponds "Komárovský" and "Drhlenský". The clogged flowing is in the principle caused by intensive fishing farming on the pond "Komárovský".



a) b)

Fig. 1 Area of interest, a) well-arranged map, b) detail map with geophysical profiles

Fig. 2 Small tunnel in the sandstone makes only transport for a hand – operated cart

Fig. 3 Steep slopes with sandstone blocks

Fig. 4 Clogged meadows

Forest paths are very narrow and bad quality. A transport for excavators and the similar machinery is practically impossible. See Fig. 2. The slope round the brook is steep. See Fig. 3. The stream bed was clogged. See Fig. 4. The difficult field conditions were the case of an idea that for a clearing of clogged stream bed will be used blasting works.

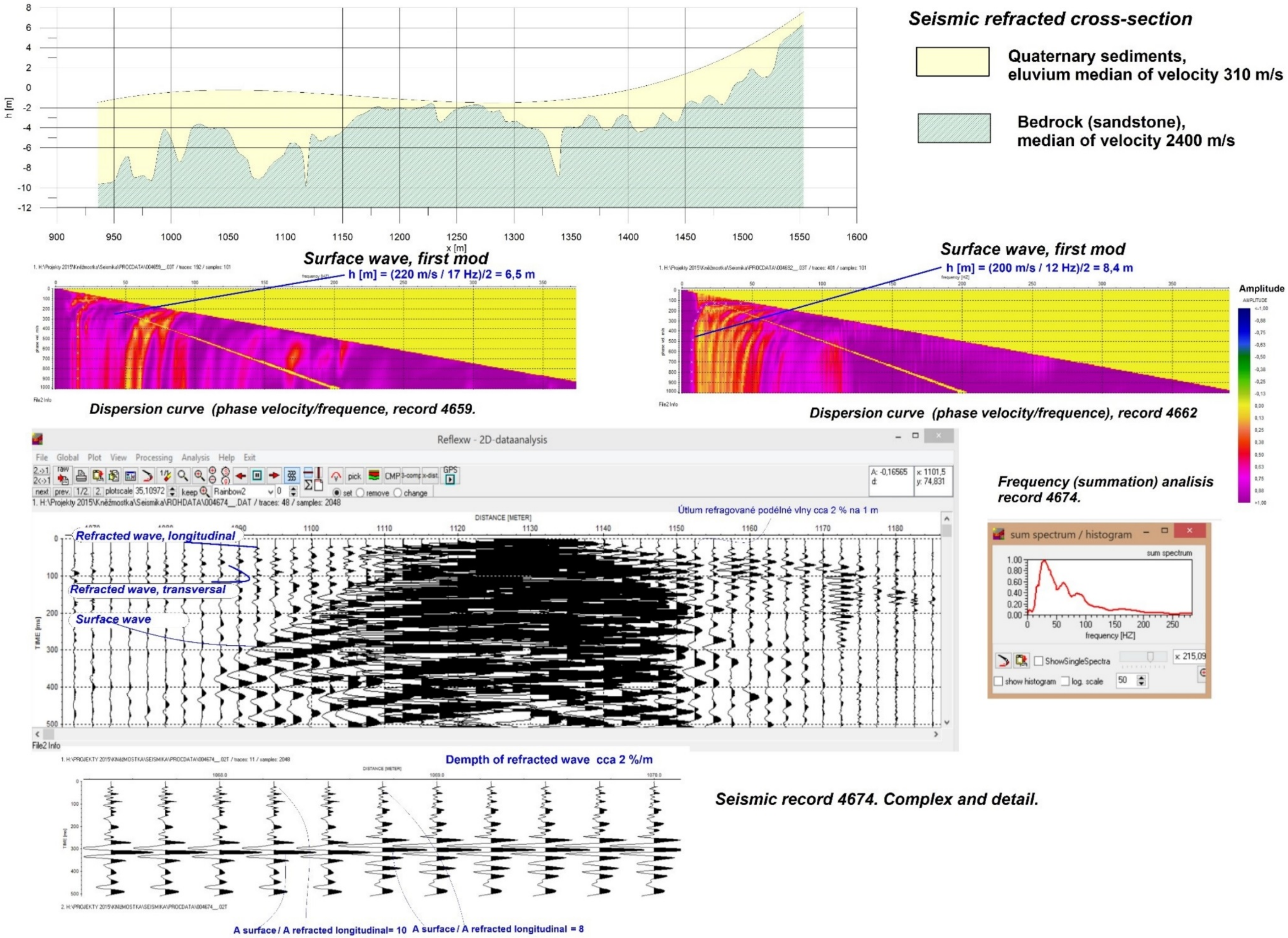


Fig. 5 Complex analysis of seismic waves from profile P1

2 The prefeasibility study

The prefeasibility study was based on a geophysical measurement which was target on a knowledge of geological and geotechnical condition of the exploratory area. We used complex geophysical method as follows:

- Seismic refraction measurement,
- MASW (multichannel analyze surface waves),
- ERT (resistivity tomography).

In the area of interest was situated one long profile (profile P1) which is parallel to the valley floor (right bank). Three profiles were set out perpendicular to the stream. The principal results from seismic measurements on the profile P1are presented on Fig. 5.

The typical results from resistivity tomography are presented on Fig. 6. The resistivity cross section from profile P5 is perpendicular to stream and is located on the north site of the area of interest.

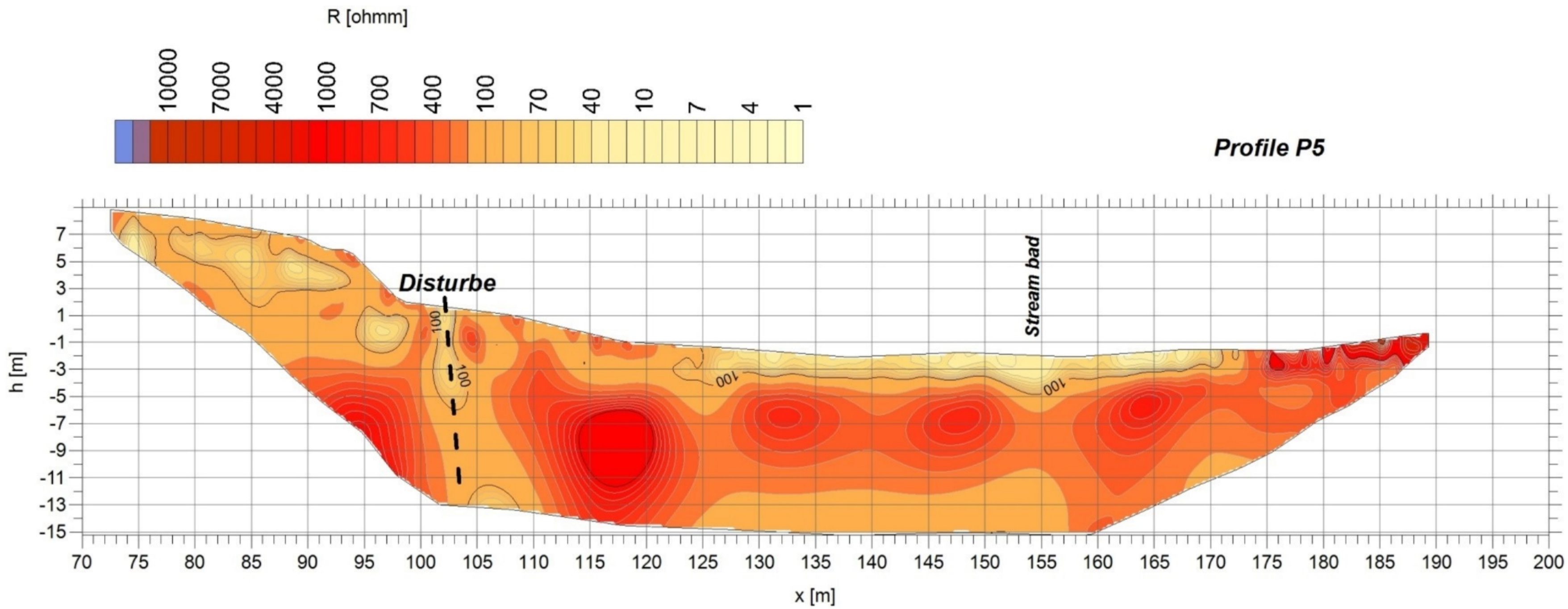


Fig. 6 Resistivity tomography, Profile P5

The principal conclusions from geophysical measurements are as follow:

<u>Seismic measurement:</u>

The interface between the Quaternary sediments and the bedrock is in the depth from 8 to 0 m.

The seismic velocity of the longitudinal wave for superficial sediments is round 310 m/s.
The seismic velocity of the longitudinal wave for the bedrock (sandstones) is round 2400 m/s.
Surface waves have several modes and are very intensive. The typical velocity is 210 m/s. The thickness of the surface layer for theses waves are approx. 7 m.
The dominant frequency is 25 Hz. The damping for amplitude of longitudinal waves is circa 2% / m. The intensity of the surface waves are approximately 9 times more than intensity of the longitudinal waves.

<u>Resistivity tomography:</u>
Sandstones (high resistivity) are followed by clays (low resistivity).
The river muds were detected in the vicinity of the brook. The thickness of the sludge in the center of stream bad is round 3 m (maximum).

The conclusion from prefeasibility study was, that blasting works can be executed, bud only with concurrent seismic monitoring, which will control blasting works in relation to actual seismicity.

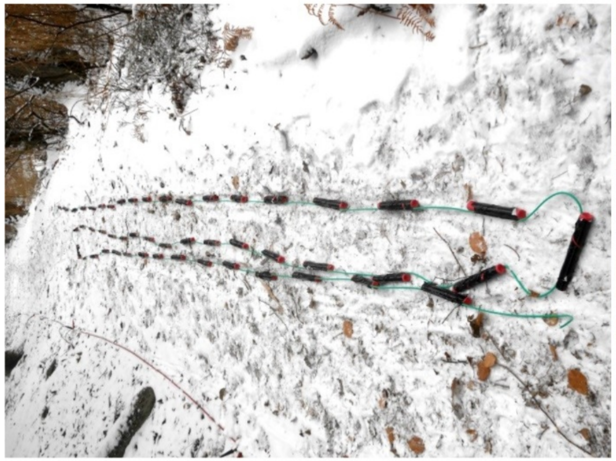


Fig. 7 The column charge with detonating fuse Startline 12

a) ***b)***

Fig. 8a, b Shooting works

3 Blasting works

The blasting works were executed in the Decembre 2015. The base building box for the demolition was a column explosive charge, which was compounded from cartridges of the explosive Perunit E 28/200. The cartridges have a weight 200 g and were long 220 mm. That's mean; the specific weight for chain contact was 1 kg explosive /m. The cartridges were taken up detonating fuse Startline 12 with circa 200 g explosive / linear meter. The maximum length of the column charge was designed 10m. The column charges were push to the thickened sludge to the depth circa 75 cm. The detonating fuse was started by a detonator Dem-S (feed line to blasting machine mostly 20 m). On the column charge was installed also loop of a trigger of the Terraloc seismic equipment.

The column charge is showed on the Fig. 7. The shooting work is showed on the Fig. 8 a, b and 9. The works were in motion of the winter, when the temperature was round – 2ºC and the valley was frozen.

The shooting works were observed by three seismic apparatus. First equipment (GIA, product Arenal comp., http:// www.arenal.cz) operated on the north part of the area of interest, that mean in the cottage area Nová Ves (the end of the profile P1). Second equipment (GIB, product Arenal comp., http:// www.arenal.cz) was mostly placed on the south end of the area of interest where the small dam is located. The third apparatus (Terraloc Mk-6, product ABEM comp., http://www.abem.se) followed the shooting work step by step along stream. The apparatus GIA is showed on the fig. 10. The equipment is outfitted by three geophones (three components x, y, z). The Terraloc Mk-6 is showed on Fig. 11. The equipment works with 48 channels (vertical geophones). The lay out with 48 geophones permits for long seismic profiles which can monitoring actual seismicity not only in the vicinity of the shooting, but also on the slope of the valley.

The equipment was activated by electrical impulse of the loop which was joined with column charges. The GIA and GIB were active for all work shifts.

Fig. 9 Shot

4 Seismic monitoring

The Terraloc equipment, which worked in the vicinity of the shoot master, detected vibrations of longitudinal waves with velocity from 1.5 to 9.5 mm/s and of transversal velocity between 0.5 to 9.5 mm/s. The tracks for these waves were changed from 15 to 30 m. The shooting was executed at the valley where are not practically buildings and slopes are consist out of compact sandstones or clays. The fixed equipment GIA and GIB had the oscillations mostly round 1 mm/s (maximum for GIA 3.5 mm/s and for GIB 4.6 mm/s. These equipment was far away from shooting mostly 100 – 1000 m. We can state that the buildings and cottages in the Nová Ves village and Drhleny village were safe, but natural oscillation (swing of trees, traffic) was surprisingly intensive. The scrutiny examination prevents for all buildings in the area of interest and we can state, that we had not any accident or damage on the end of our works.

Fig. 10 Seismic equipment GIA (Arenal)

Fig. 11 Seismic equipment GIA Terraloc Mk-6 (ABEM)

The monitoring of the blasting works walks in ČSN 730040 for building object, but the principal problem was not with relative distant cottage settlements however with stability of the hillsides of the valley. We have not any standards for this problems and we must procced from our prefeasibility study (see chap. 2) and consistent seismic and geological monitoring.

The example of seismic record from seismic equipment GIA and GIB are showed on Fig. 12. The typical objects which could be potentially in danger are imaged on Fig. 13.

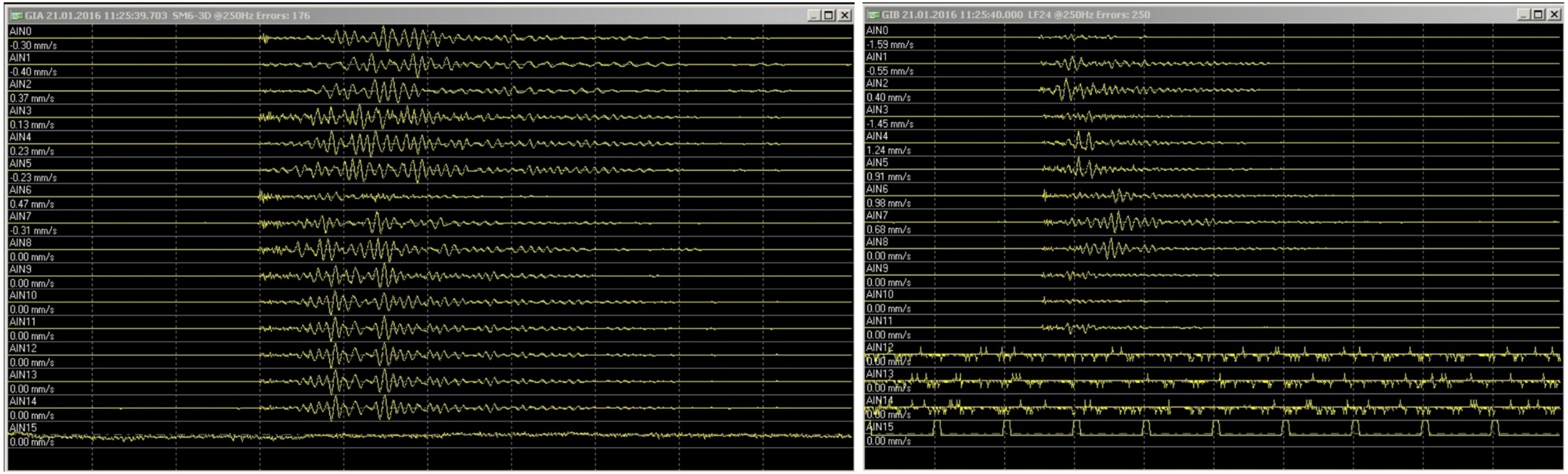


Fig. 12 Sections of primary seismic records of the equipment GIA(left) and GIB (right). The seismic record (left), part with maximum velocity 0.5 mm/s (5 kg explosive, distance 200 m). The seismic record (left), part with maximum velocity 1.6 mm/s (5 kg explosive, distance 150 m)

a) ***b)***

Fig.13 The typical cottage from Nová Ves village (a) and the small dam on the south end of the shutting trace (b)

5 Conclusion

The blasting works were useful and opened flow rate of the clogged stream bed of Kněžmostka brook between Nová Ves village and the small barrage (dam) near Drhleny village. The works were possible on the base good knowledge of geological and geotechnical conditions. This knowledge was down to precise seismic and geoelectrical measurement. The project was started by prefeasibility study and the blasting works were controled by carefully seismic monitoring. The blasting works were underway without any accidents and were more gentle to the nature than earthworks with machinery. The seismic measurement detected standard conditions, but with the warning, that blasting works form very intensive surface wave which run far from narrow valley. The geophysical data was put to a database and are ready alternatively to father detailed study. The Fig. 14 illustrates the open stream of the Kněžmostka brook.

Fig. 14 The open stream bed of the Kněžmostka brook

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6 Acknowledgements

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