

Effect of Space Weather observed in the Czech oil pipeline network

Pavel Hejda, Josef Pek

Buried pipelines are equipped with a cathodic protection system which keeps the pipeline at a negative potential of about 1 to 2 volts in relation to the ground, in order to prevent corrosion. The pipe to soil voltage is monitored at cathodic protection stations. As the pipelines are long electric conductors they respond to geomagnetically induced currents (GIC). The impact of geomagnetic disturbances on the pipe to soil (PtoS) voltage was studied, based on the data from 20 stations on the Czech pipelines recorded in the period 2005 – 2017. Whereas the signal of strong magnetic storms is quite pronounced in some stations, it was often overprinted by technical disturbances, like strange currents by DC supplied railways.

The strong effect of Halloween geomagnetic storms on the GIC in the Czech oil pipelines was demonstrated by Hejda & Bochníček (2005). In the present work we report a systematic study based on the data recorded in 20 stations on the Czech pipelines in the period 2005 – 2017.

The primary test was based on comparison of the PtoS voltage with the plane wave model of the geoelectric field. We assumed that large range of geoelectric field E should bear large range of PtoS voltage. Relation between daily maxima of hourly ranges of E and PtoS voltage was thus tested. However, the results showed significant relation only on 3 of 20 stations.

The test thus indicated that

- either the most parts of pipelines are insensitive to the changes of geomagnetic field
- or there are other stronger sources of disturbances of PtoS voltage.

To understand better this phenomenon, E and PtoS variation for the most disturbed days was inspected. The case of 17th March 2015 is presented below.

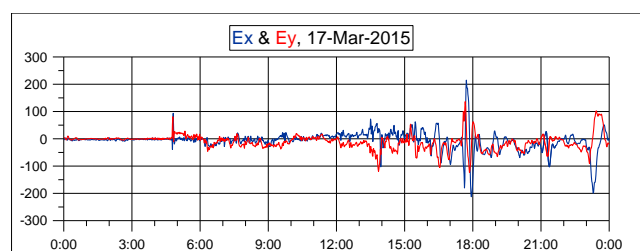


Figure 1: Plane wave model of horizontal components of geoelectric field based on the observations of geomagnetic field at Budkov Observatory on 17th March 2015

It showed out that the geomagnetic signal was mixed with technical disturbances. They include strange current generated by DC powered railways, industrial and urban noise, crossing with other pipelines, etc. The recorded

Authors:
P. Hejda, J. Pek
Institute of Geophysics, Czech Academy of Sciences, Prague, Czech Republic

PtoS voltage can be also influenced by the quality of pipeline coating. One must further take into account that the cathodic protection system works for recovering the original state (especially in case of changes towards positive PtoS voltage).

Two examples are shown. Station MLV29 is situated in a magnetically quiet place close to German boundary. Station M1604 is close to the DC supplied railway east of Prague. In this case the PtoS voltage monitors the traffic on the railway.

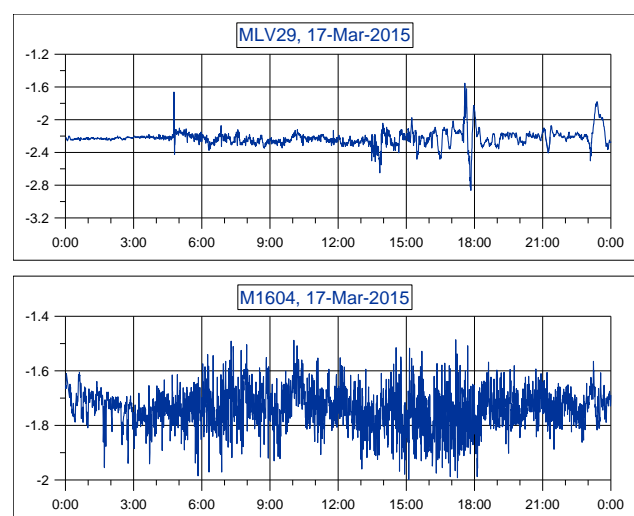


Figure 2: PtoS voltage recorded at stations MLV29 and M1604 on 17th March 2015

Acknowledgements:

The data of the PtoS voltage were released by courtesy of the join-stock company **MERO ČR a.s., the data owner**. This research was supported by the grant 17-19875S of the National Science Foundation of the Czech Republic.

References:

P.Hejda, J. Bochníček, 2005. Geomagnetically induced pipe-to-soil voltages in the Czech oil pipelines during October-November 2003. *Annales Geophys.*, 23, 3089-3093.

Corresponding author:
Pavel Hejda
Institute of Geophysics, Czech Academy of Sciences
Bocni II/1401, Prague, 14100 Czech Republic
Tel.: +420 267103339
e-mail: ph@ig.cas.cz

