Publications of the Institute of Geophysics, Polish Academy of Sciences
Geophysical Data Bases, Processing and Instrumentation
vol. 423 (C-112), 2018, pp. 41-42
DOI: 10.25171/InstGeoph_PAS_Publs-2018-022
16th Castle Meeting New Trends on Paleo, Rock and Environmental Magnetism, Chęciny, Poland, 2018

Assessment of Topsoil Contamination Near the Stanisław Siedlecki Polish Polar Station in Hornsund, Svalbard, Using Magnetic Methods

Tomasz GONET[1,2,✉], Beata GÓRKA-KOSTRUBIEC[3],
and Beata ŁUCZAK-WILAMOWSKA[1]

[1]Faculty of Geology, University of Warsaw, Warsaw, Poland

[2]Currently: Centre for Environmental Magnetism and Palaeomagnetism, Lancaster Environmental Centre, Lancaster University, Lancaster, UK

[3]Institute of Geophysics, Polish Academy of Sciences, Warsaw, Poland

✉ t.gonet@lancaster.ac.uk

A b s t r a c t

The area of South Spitsbergen National Park is exceptionally vulnerable to degradation caused by human activity due to the pristine condition of the natural ecosystem. Therefore, both environmental assessment and its thorough monitoring is of vital importance.

The present research is concerned with the assessment of topsoil contamination near the Stanisław Siedlecki Polish Polar Station (PPS) in Hornsund, Svalbard. To achieve this, we employed magnetic methods supplemented by chemical analyses and microscopic observations. Laboratory experiments were used to evaluate the concentration, magnetic mineralogy and grain-size distribution of anthropogenic magnetic particles.

Fig. 1 presents the spatial distribution of topsoil magnetic susceptibility in the PPS area. It indicates that heavy-metal contamination near the PPS originates primarily from local sources – the station's main building and scrapyard (A1 in Fig. 1), as well as the fuel station (A2 in Fig. 1). The range of the soil contamination does not exceed 50 meters. The comparison between the results of this study and an earlier investigations of soil contamination in the PPS area (Luks and Głowacki 2007) shows that the areal extent of the PPS impact on the environment has not expanded significantly since 2004 (although a new contamination source, the scrapyard, is now present).

Further analyses showed that anthropogenic spherical, magnetite-like particles are present near the station, whereas uncontaminated topsoil is devoid of such particles. Magnetite and goethite are the primary magnetic phases, with magnetite levels being higher in the polluted area. Magnetic fraction of contaminated topsoil consists of a mixture of single-domain and multi-domain grains, while uncontaminated topsoil contains smaller grains.

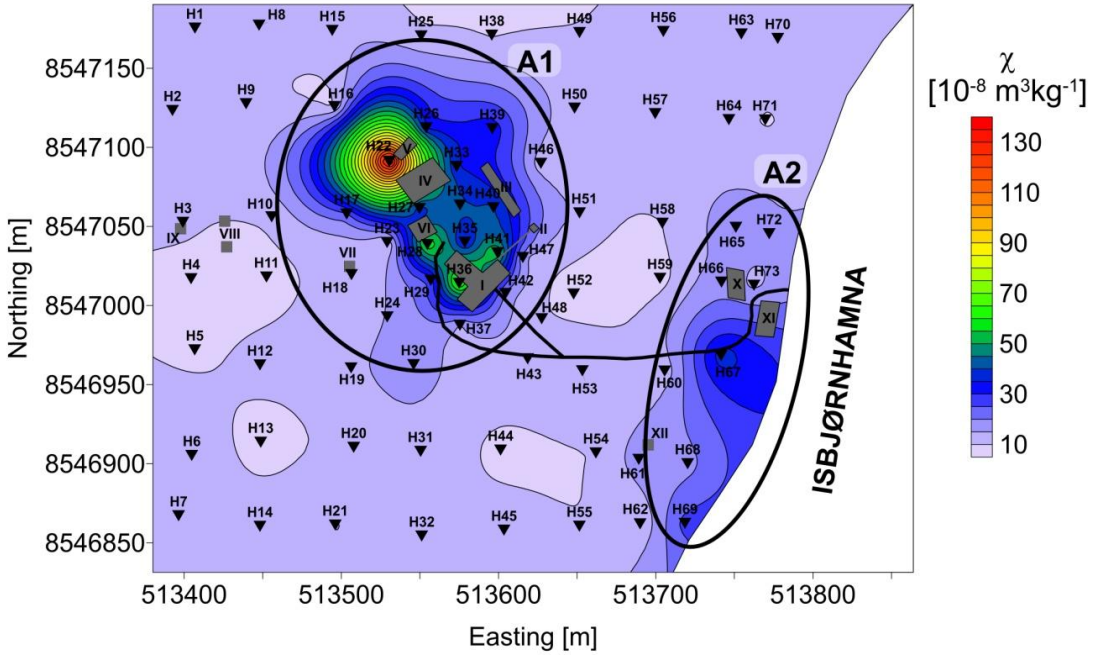

Fig. 1. Spatial distribution of the magnetic susceptibility (χ) of topsoil near the Stanisław Siedlecki Polish Polar Station in Hornsund, Svalbard (grey polygons represent various building of the station: I – the main building, II – sewage treatment plant, III – snowmobile parking, IV – storage hall with waste incinerator, V – scrap yard, VI – workshop, VII – meteorological station, VIII – magnetics stations, IX – seismological station, X – fuel station, XI – harbor warehouse, XII – fuel depot for helicopters; thick black line indicates the road between harbor warehouse and the main building; black triangles represent sampling sites with sample numbers: H1, H2, etc.).

Results show a clear correspondence between Pollution Load Index and magnetic susceptibility anomalies in the area. This study demonstrates that topsoil magnetic susceptibility in the PPS area reflects the heavy-metal contamination. Consequently, magnetic methods offer a relatively rapid, inexpensive, non-invasive and sensitive tool for the evaluation of topsoil contamination in environmental monitoring programs.

Keywords: topsoil contamination, magnetic susceptibility, heavy-metal content, Polish Polar Station, Arctic.

References

Luks, B., and P. Głowacki (2007), Zanieczyszczenia gleby metalami ciężkimi w rejonie Polskiej Stacji Polarnej Hornsund. **In:** R. Przybylak, M. Kejna, A. Araźny, and P. Głowacki (eds.), *Abiotyczne Środowisko Spitsbergenu w Latach 2005-2006 w Warunkach Globalnego Ocieplenia*, Uniwersytet Mikołaja Kopernika i Instytut Geofizyki PAN, Toruń, 267–279 (in Polish).