Dr Joanna Szafraniec's postdoctoral training stay at the Institute of Earth Sciences, the University of Iceland in Reykjavik combined with a field study trip

During the period of 1–14.09.2015 r. Dr Joanna Szafraniec participated in a study trip to Iceland. Its main objective was to renew and expand scientific contacts together with having consultations on a planned research project at the Institute of Earth Sciences (Jarðvísindastofnun Háskólans; Fig. 1), the University of Iceland in Reykjavik. Another important objective was to gather cartographic materials and data. The academic supervision was provided by Prof. Helgi Björnsson.

Fig. 1. The building of the Institute of Earth Sciences, the University of Iceland in Reykjavik, so called, Askja (photo: J. Szafraniec).

The scientific research of the Institute of Earth Sciences is focused on three main subjects: comprehension of volcanoes, environmental and climate research, and recognition and comprehension of the processes occurring in the Earth's crust, on the borders of lithospheric plates. The objects of the research are also ice caps of the island (Fig. 2), the largest glaciers in Europe, along with their marginal zones.

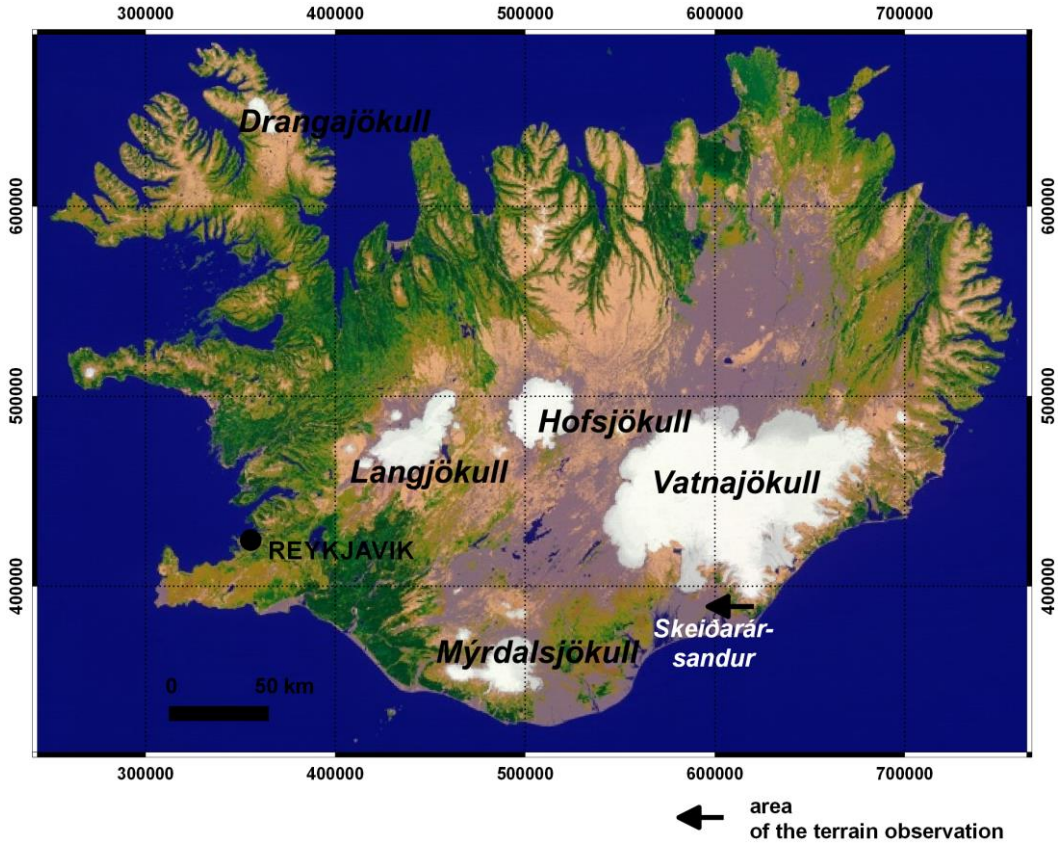

Fig. 2. The largest ice caps in Iceland (base source of the map: National Land Survey of Iceland).

The research project being planned together with a team of scientists from the Nicolaus Copernicus University in Toruń and in collaboration with the University of Iceland is aimed at identification of the scope and parameters of the hydrological catastrophic outflows of glacial water during the vistulian glaciation and determination of their significance in shaping the environment of the young glacial area of North Poland in a response to the climate change and in the light of the research of analogous processes in Iceland. The complexes of landforms of Icelandic marginal zones such as terminal moraines, developing and transforming outwash surfaces (Fig. 3)and a depression forming on the back of the moraines, which accumulates proglacial water, are important indicators of the dynamic condition of the glacier. Thus, today's marginal zones constitute natural laboratories for observing phenomena and processes in the conditions of the glacier ongoing recession. The observed here effects of the global warming, in combination with endogenous processes are the source of such spectacular phenomena as catastrophic glacial floods (Fig. 4), an Icelandic term – jökulhlaup. Icelandic marginal zones are a perfect analogy (the principle of uniformitarianism) for the conditions in the Polish Lowland at the end of the Pleistocene, i.e. at the end of the last Ice Age. The vast outwash plains of Pomerania, making up 25% of its area, testify to the great masses of water flowing out of the Scandinavian ice sheet. Little is still known about the character of this drainage, however a number of geological and geomorphological evidence and the results of numerical modelling indicate that locally the outflow might have been extreme in intensity.

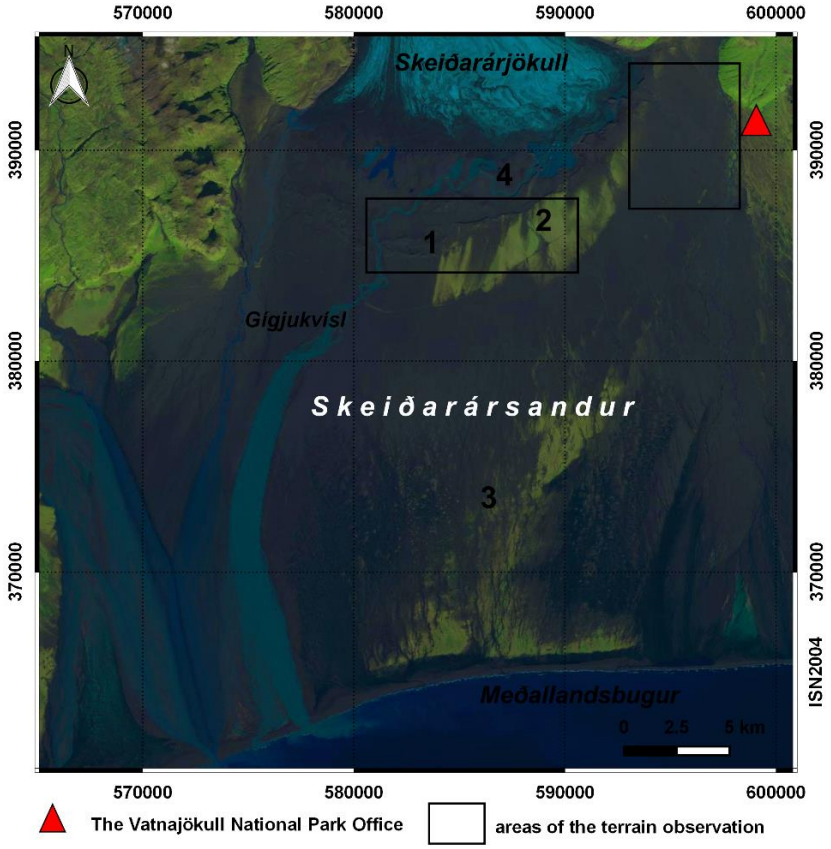

Fig. 3. The marginal zone of Skeiðarárjökull: 1 – the arch of terminal moraines, 2 – the proximal zone of a sandur, 3 – the distal zone of a sandur, 4 – a depression on the back of the moraines (base of the map: the satellite scene LANDSAT8, LC82170152015268LGN00 of 09/25/2015, courtesy of US Geological Survey).

Fig. 4. A fragment of a twisted span of the old bridge that used to cross the Skeidará river as an evidence of the destructive power of jökulhlaup of 1996, Skeiðarársandur (photo: J. Szafraniec).

The project partner is Prof. Helgi Björnsson (Fig. 5), a prominent expert in the field of extreme glacial and hydrological processes and phenomena in Iceland and their conditioning, a consultant in the field of geomorphological consequences of these types of events. Consultations with Professor allowed discussing important aspects of the prospective project, especially drawing attention to the role of kettle holes at different outwash levels and their relationship with jökulhlaup. They also provided the opportunity to meet a wider circle of scientists studying these and related issues in Iceland, and the latest trends in activities, methods, research tools and databases.

Fig. 5. Prof. Helgi Björnsson (photo: J. Szafraniec).

An important part of the trip was also a short study expedition to the forefield of Skeiðarárjökull (cf. Fig. 2), a large, dynamic outlet glacier discharging from the southern part of the Vatnajökull ice cap. A wide section of the forefield is occupied by the area of Skeiðarársandur built from glaciofluvial deposits (Fig. 6). It is the largest sandur functioning contemporarily on Earth, also formed by jökulhlaup, including a major one which took place in November 1996. Participation in the field study, preceded by earlier detailed reading of the state of the research in this area, the topographic and glaciological situation on maps, aerial photographs and satellite scenes allowed the photographic documentation of the landforms of the sandur proximal zone, as well as the selection of the sites for future activities within the framework of the project. One of the objectives will be detailed mapping of the kettle holes

(Fig. 7) after the episodes of jökulhlaups, tracking changes in their morphometry along with the passing of time, and comparing the results with the data obtained in Pomerania. In Northern Poland, the zones of the occurrence of kettle holes have been also located, the genesis of which has not been still fully explained.

Fig. 6. A view of the edge of the proximal zone of Skeiðarársandur, the gorge of Háöldukvísl and the depression formed as the result of the glacier recession (photo: J. Szafraniec).

Fig. 7. An example of a kettle hole remaining after the jökulhlaup; in the course of the jökulhlaup, large ice blocks fell off the glacier front, then they were floated to the forefield and buried by outwash sediments. After having melted, the ice left a „print" within the outwash (photo: J. Szafraniec).

Taking part in the field study also allowed getting acquainted with the deposits forming Skeiðarársandur (Fig. 8). These observations and the insights on petrographic diversity, roundness and size of the debris will be valuable information when planning an experiment within the project on bedload transport.

Fig. 8. Diversification of glaciofluvial deposits on Skeiðarársandur; an example of the so-called obstacle mark – a boulder dragged during high-energy flows. After having been deposited, the boulder disorders paths of the current thus contributing to the formation of vortices. Behind the obstacle, a characteristic shade of sediments has been created (photo: J. Szafraniec).

The visit in Iceland enabled:

– renewing and strengthening cooperation in science, meeting new researchers;
– acquiring field experience in the forefield of the great glaciers of Iceland, and making observations and comparative documentation;
– collecting additional cartographic and geodetic data;
– consulting selected tasks of the planned project, and confronting the plans with the terrain and logistics realities.

I would like to express grateful thanks to the staff of the Institute of Earth Sciences of the University of Iceland in Reykjavik for the time, valuable comments, information and data provided. Special thanks go to Prof. Helgi Björnsson, Eng. Finnur Pálsson, Áugúst Þór Gunnlaugsson, Dr. Eyjólfur Magnusson, Joaquin Muñoz-Cobo Belart.

I would also like to thank Prof. Þhor Ellen Þórhallsdóttir from the Faculty of Life and Environmental Sciences, the University of Iceland for showing me around the kettle holes on the outwash plain, providing me with information on episodes of jökulhlaup and the results of the latest research related to the succession of the plants of the outwash plain.

I also want to thanks Tómas Jóhannesson from the Icelandic Met Office for providing me with LIDAR data for Skeiðarársandur.

The trip was funded by the Centre for Polar Studies, the University of Silesia from the pro-quality funds of the National Leading Research Centre (KNOW) in the field of Earth Sciences, 2014–2018.