СПИСАНИЕ НА БЪЛГАРСКОТО ГЕОЛОГИЧЕСКО ДРУЖЕСТВО, год. 79, кн. 3, 2018, с. 65–66
REVIEW OF THE BULGARIAN GEOLOGICAL SOCIETY, vol. 79, part 3, 2018, p. 65–66
National Conference with international participation "GEOSCIENCES 2018"

X-ray diffraction analysis of tephra layers from Perunika Glacier, Livingston Island, Antarctica

Рентгенофазов анализ на тефроидни нива от ледник Перуника, о-в Ливингстън, Антарктика

Stefan Velev[1], Tsveta Stanimirova[2], Docho Dochev[2], Kamen Bonev[3]
Стефан Велев[1], Цвета Станимирова[2], Дочо Дочев[2], Камен Бонев[3]

[1] Sofia University "St. Kliment Ohridski", National Center for Polar Studies, 1504 Sofia; E-mail: velev.stefan83@gmail.com
[2] Sofia University "St. Kliment Ohridski", Faculty of Geology and Geography, 1504 Sofia;
E-mails: stanimirova@gea.uni-sofia.bg; dochev@gea.uni-sofia.bg
[3] Bulgarian Antarctic Institute, 1504 Sofia; E-mail: bonev.kamen@gmail.com

Keywords: tephra layers, X-ray diffraction analysis, Livingston Island, Antarctica.

Introduction

Tephra layers are interstratified in the ice caps of the South Shetland Islands, Antarctica. Livingston Island is largely encircled by 30–70 m high ice cliffs. Many of the cliffs contain dark layers of unconsolidated ash (tephra) (Fig. 1a). The ice and tephra stratigraphy seen in the ice cliffs is the result of deposition within the accumulation zone in the interior of the island. The distortion of tephra layers during glacial transport and ablation may result in different local tephra stratigraphies. The distinctive grouping and spacing of the multiple tephra layers is repeated at many localities. All of the tephras were sourced in Deception Island, a large active volcano in Bransfield Strait situated 30–55 km south of the tephra outcrops on Livingston Island (Pallas et al., 2001).

Results and discussion

In the cliff of Perunika Glacier there are 10 tephra layers. During the 26th Bulgarian Antarctic Expedition 7 of them were observed. The other were inaccessible

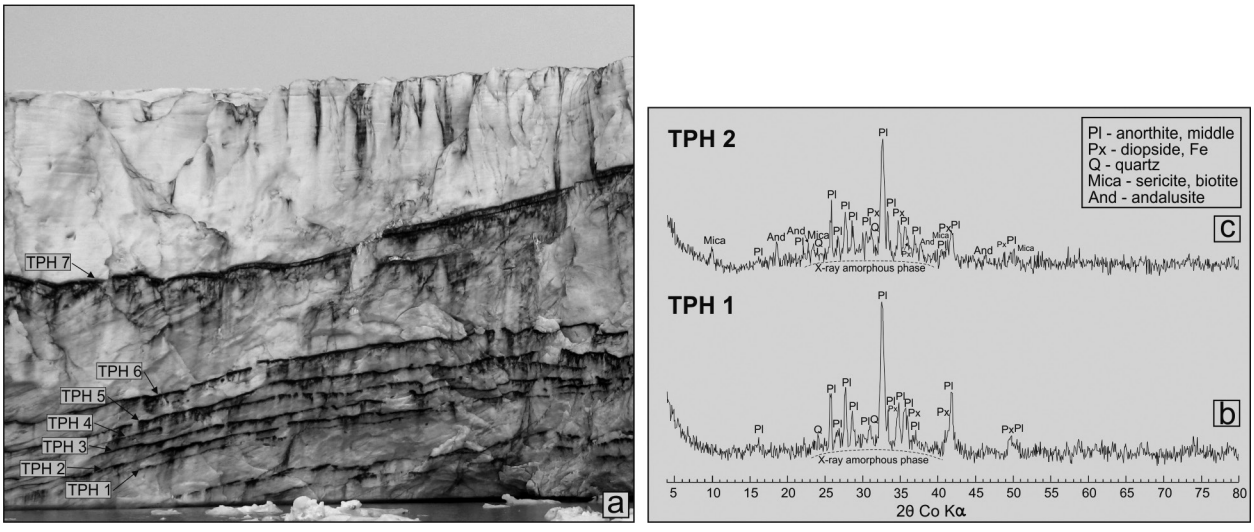

Fig. 1. *a*, tephra layers cropping out in the Perunika Glacier; the ice cliff is approximately 50 m high; *b*, powder XRD pattern of TPH 1, representative of samples built only by plagioclase and pyroxene; *c*, powder XRD pattern of TPH 2, representative of samples with additional phases

Table 1. Phase content of seven samples from tephra layers, analyzed by powder XRD

	Phase content, %	Anorthite, middle	Diopside, ferrian	Quartz	Andalu-site	Mica	X-ray amorphous phase
Sample	*TPH 1*	33.8	6.8	1.5	5.6	6.2	46.2
	TPH 2	45.0	8.7	1.4			45.0
	TPH 3	47.2	8.6	1.2			43.0
	TPH 4	44.9	9.6	0.8			44.5
	TPH 5	39.4	7.7	0.9	2.2	5.1	45.5
	TPH 6	41.2	7.7	1.8			49.3
	TPH 7	37.5	8.8	1.4	3.7	6.7	47.5

due to glacier conditions. The lower six levels (TPH1-6) are located at relatively equal intervals and have thicknesses between 3 cm and 5 cm. The layer TPH7 is situated about 10 m above TPH6 and is 10–12 cm thick (Fig. 1a). All tephra layers consist predominantly of black and subordinately of red components.

In this research for the first time is shown data for phase composition of the tephra layers from Livingston Island. Powder X-ray diffractometric assay shows uniform phase composition of the crystal component from samples at 7 assayed levels – plagioclase (34–47%) and pyroxene (7–10%) (Fig.1b, c; Table 1). Diffraction lines analysis defines two types of plagioclase – anorthite and sodian anorthite. Comparison between registered diffraction lines and different pyroxene types from the reference database (PDF-2 of ICDD) identifies pyroxene from all samples as ferrian diopside. A small amount of quartz (1–2%) was also present in all samples. This phase composition corresponds with basalt and basaltic andesite from the published data on chemical content of the tephroid levels by Pallas et al. (2001).

In three of the levels was discovered andalusite (2–6%) and mica (5–7%) (Fig. 1c; Table 1). Due to low mica content in the samples, it is difficult to define its type by powder analysis. However, in samples from levels THP 1, 2, 3, 5, and 7 the mica is probably sericite type and in levels TPH 4 and 6 – biotite type.

Xenocrystals of andalusite and micas (biotite and sericite) are an interesting discovery. Considering their metamorphic genesis, the most reasonable source is the metamorphic fundament of this Antarctic area. The lithotypes it is built are represented by phyllites, schists, Ca-silicate rock types, marbles, rare amphibolites and fine layers of volcanic metaconglomerates (Marsh, Thompson, 1985).

Future works include: sampling tephra materials from other locations, more XRD analysis and different geochemical analysis.

References

Marsh, P. D., J. W. Thompson. 1985. The Scotia metamorphic complex on Elephant Island and Clarence Island, South Shetland Islands. – *British Antarctic Survey Bull.*, *69*, 71–75.

Pallas, R., J. L. Smellie, J. M. Casas, J. Calvet. 2001. Using tephrochronology to date temperate ice: correlation between ice tephras on Livingston Island and eruptive units on Deception Island volcano (South Shetland Islands, Antarctica). – *Holocene*, *11*, 2, 149–160.