

“SOPOLIVITE KAMANI” (“RUNNY STONES”) GEOSITE IN SASHTINSKA SREDNA GORA MOUNTAIN

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ABSTRACT. The present article represents the results from the investigation of the geoconservation value of “Sopolivite Kamani” (“Runny Stones”) geosite (its nomination for a geosite is proposed here), located in the central part of Sashtinska Sredna Gora Mountain between the towns of Koprivshtitsa and Strelcha. It has not been described yet as geological phenomenon and it is not included in the “Register and cadastre of the geological phenomena in the Republic of Bulgaria” as well as in the State Register of Natural Sites. The geosite represents a complex of granite blocks of varied sizes and shapes formed mainly in the rocks of Late Carboniferous Smilovene pluton and partly in these of Early Permian Strelcha pluton, both of them referred to Srednogorie granitoids. The outcrops allow examination of the prototectonics of the two plutons as well as different stages of spheroidal weathering in the granites. According to the classification of the geological phenomena “Sopolivite Kamani” geotope is referred to the geosites of aesthetic value (geomorphologic class), and according to the original Bulgarian methodology for estimation of geological phenomena it is of local importance. The further popularization of the geosite will increase its total expert value by adding investigational and educational value to its present characteristics.

Keywords: geological heritage, geoconservation, “Sopolivite Kamani” (“Runny Stones”) geosite, Sashtinska Sredna Gora Mountain.

ГЕОТОП „СОПОЛИВИТЕ КАМЪНИ“ В СЪЩИНСКА СРЕДНА ГОРА

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РЕЗЮМЕ. Настоящата статия представя резултатите от изследването на геоконсервационното значение на геотопа „Сополивите камъни“ (номинарането му за геотоп се предлага тук), намиращ се в централната част на Същинска Средна гора между градовете Копривщица и Стрелча. Той не е описван като геоложки феномен и не фигурира в „Регистър и кадастър на геоложките феномени в Република България“, както и в Държавния регистър на природните забележителности. Представява комплекс от гранитни блокове с различна форма и размери, оформен главно в скалите на къснокарбонския Смиловенски плутон и отчасти в тези на раннопермския Стрелчански плутон, които се отнасят към Средногорските гранитоиди. Разкритията позволяват изучаването на прототектониката на двата плутона, както и различни етапи от сферичното изветряне на гранитите. Съгласно класификацията на геоложките феномени геотопът „Сополивите камъни“ попада в групата на обектите с естетическа стойност (клас геоморфоложки), а според оригиналната българска методика за оценяване на геоложки феномени, той е с локално значение. Популяризирането на геотопа ще повиши общата му експертна оценка, добавяйки към досегашната му характеристика изследователска и образователна стойност.

Ключови думи: геолошко наследство, геоконсервация, геотоп, Сополивите камъни, Същинска Средна гора.

Introduction

The central part of Sashtinska Sredna Gora Mountain, between the towns of Koprivshtitsa and Strelcha, reveals a great diversity of natural sites, as most of the mare included in the State Register of Natural Sites. Seven of these sites, representing geological phenomena (Zhelev, Petrov, 2017a, b), were nominated for natural sites in 1972 on the basis of an order of the Ministry of Forest and Environment Protection. They are exposed in the south slopes of the mountain, north and northeast of the town of Strelcha (Fig. 1): Arbushki Rocks, Goranitsa, Kiselitsata, Gabrovitsa, Gerekinski Gyol, Garvanov Kamak, Turchanov Kamak. Later on Petrov (in Zhelev, Sinyovski, 2003¹) compiled files for them within the project “Register and cadastre of the geological phenomena in the Republic of Bulgaria”(1999-2003) financed by the Ministry of Environment and Water in the Republic of Bulgaria. During the

compilation of the Register the experts did not describe and estimate the outcrops of granite blocks of varied size and shape in the highest central parts of Sashtinska Sredna Gora Mountain west of Koprivshtitsa-Strelcha road in the Sopolivite Kamani locality. Бакалова (2014) noted the presence of “bizarre rock forms on the crest of Sashtinska Sredna Gora Mountain”, but she did not give any data for their spatial distribution. The present article aims (i) to represent in brief the geological setting, (ii) to give a description of “Sopolivite Kamani” (“Runny Stones”) geosite, and (iii) to estimate its geoconservation value.

Geological Setting

The area of “Sopolivite Kamani” (“Runny Stones”) geosite is composed of Neoproterozoic-Lower Paleozoic high-graded metamorphic rocks, Paleozoic intrusive bodies, Upper Cretaceous subvolcanic rocks, and Quaternary deposits (Fig. 2).

¹Jelev, V., D. Sinyovsky (Eds.). 2003. Register and cadastre of the geological phenomena of Republic of Bulgaria. 188 files in 5 volumes. – National Geofund, XV-1232 (In Bulgarian, Russian and English).

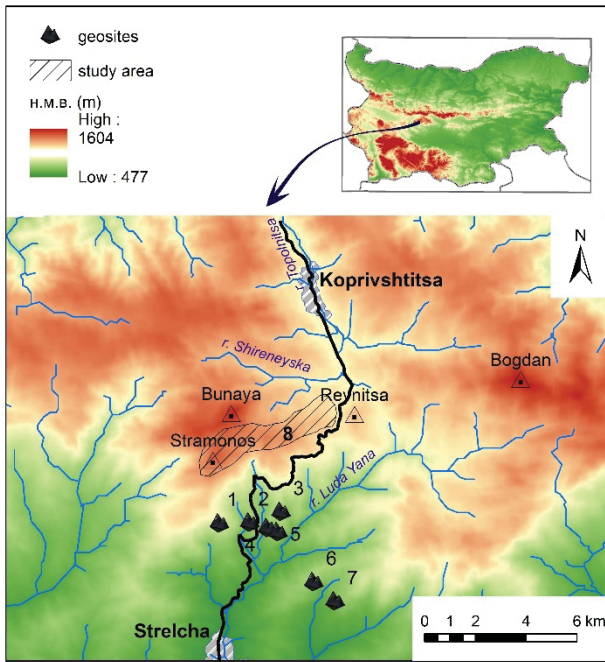


Fig. 1. Geological phenomena in the central part of Sashinska Sredna Gora Mountain
 1 – Arbushki Rocks, 2 - Goranitsa, 3- Kiselitsata, 4 - Gabrovitsa, 5 – Gerekinski Gyol, 6 – Garvanov Kamak, 7 – Turchanov Kamak, 8 – “Sopolivite Kamani” (“Runny Stones”) geosite

The oldest rocks are referred to *Koprivshitsa amphibolitic complex* and *Pirdop gneissic complex*. The first one forms a narrow strip in the southeastern outskirts of the town of Koprivshitsa, and the second one crops out as west-east oriented broad strip south, southeast and east of the town of Koprivshitsa, as well as in two isolated areas southwest of the same town. The two complexes were named respectively “lower amphibolitic formation” and “upper gneissic formation” (Dabovski et al., 1972), “Koprivshitsa Group” and “Pirdop Group” (Dabovski, 1988). Later on (Iliev, Katskov, 1990; Katskov, Iliev, 1993) they were characterized as “Unsubdivided Boturche Group” and “Unsubdivided Arda Group” of the “Prarhodopes Supergroup” (introduced in the Rhodopes by Kozuharov, 1987), and Zagorchev (2008) nominated them as “Koprivshitsa amphibolitic complex” and “Pirdop gneiss-migmatic complex” according to the recommendations of Hrishev et al. (2005) on the terminology of the non-layered lithostratigraphic units. The *Koprivshitsa amphibolitic complex* is composed of amphibolites and migmatized amphibole-biotitic gneisses, while the *Pirdop gneissic complex* comprises mainly migmatized two-mica gneisses and minor amount of muscovitic, biotitic and amphibole-biotitic gneisses. On the base of U-Pb analyses conducted by Arnaudov et al. (1989) and Peycheva et al. (2004), as well as these for the lateral relationships of the two complexes, Antonov (in Antonov et al., 2011) determined for them Neoproterozoic-Lower Paleozoic age.

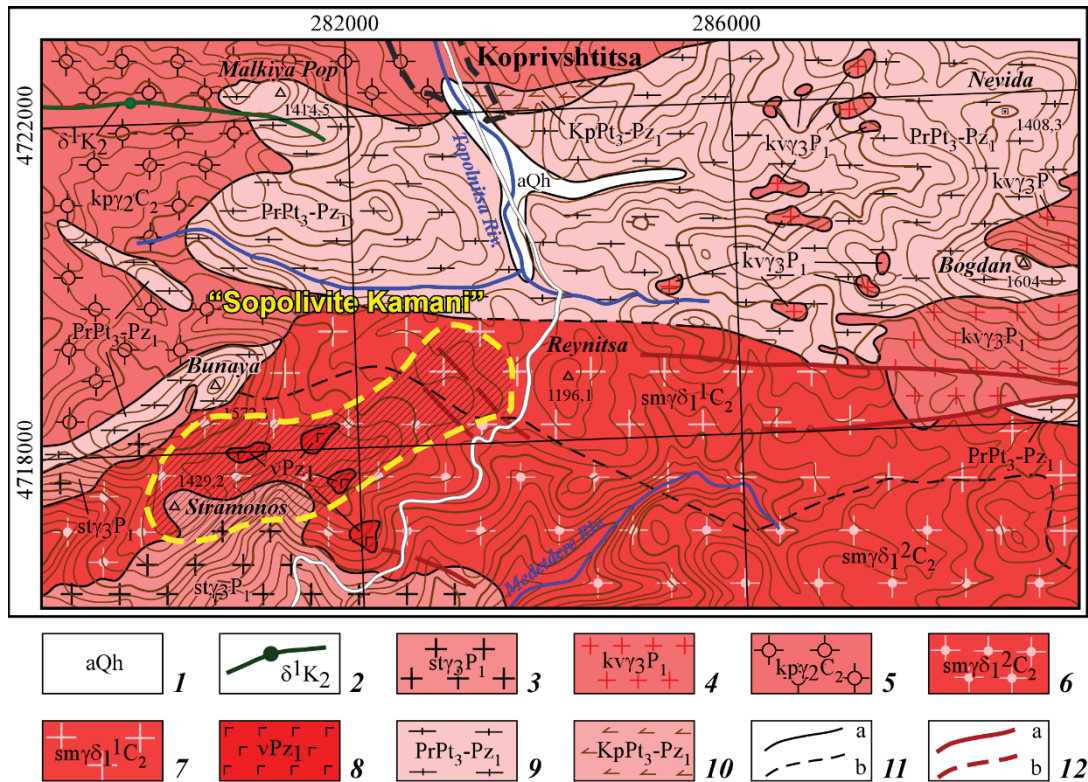


Fig. 2. Geological map of the area of “Sopolivite Kamani” (“Runny Stones”) geosite (amended after Iliev, Katskov, 1990)
 1, Quaternary: alluvium (Holocene gravels and sands); 2, Upper Cretaceous: quartz-diorite porphyritic dykes; 3-7, Upper Paleozoic (Srednogorie granitoids): 3, Sirelcha pluton (coarse-grained felsic wo-micagranites; Lower Permian), 4, Karavelovo pluton (even-grained felsic biotite granites; Lower Permian), 5, Koprivshitsa pluton (porphyroid biotite to two-micagranites; Upper Carboniferous), 6, 7, Smilovene pluton (6, porphyroid granites and granodiorites, 7, granodiorites – contaminated facies; Upper Carboniferous); 8-10, Neoproterozoic and Lower Paleozoic: 8, gabbrodiorites and peridotites (Lower Paleozoic), 9, Pirdop gneiss complex (Neoproterozoic-Lower Paleozoic), 10, Koprivshitsa amphibolitic complex (Neoproterozoic-Lower Paleozoic); 11, geological boundary (a, proven, b, supposed); 12, fault (a, proven, b, supposed).

Amongst the high-graded metamorphic *Paleozoic intrusive bodies* of ultramafics and granitoides are intruded. The first ones are small-sized bodies of gabbrodiorites to peridotites of Early Paleozoic age (Katskov, Iliev, 1993), cropping out as 4 small areas east of Stramonos Peak. The granitoid intrusions, referred by Dabovski (1968) to Srednogorie granitoids, were divided into four intrusive complexes (Dabovski et al., 1972), represented of totally 9 plutons. Four of them crop out in the studied area: *Smilovene pluton* (first intrusive complex; Upper Carboniferous), *Koprivshitsa pluton* (second intrusive complex; Upper Carboniferous), *Karavelovo and Strelcha plutons* (third intrusive complex; Lower Permian). The first three are intruded entirely amongst the high-graded metamorphic complexes, while the last one crosses the rocks of Smilovene pluton. The plutons are composed of porphyroid granites and granodiorites (Smilovene pluton), porphyroid biotitic and two-micagranites (Koprivshitsa pluton), even-grained biotitic (Karavelovo pluton) and coarse-grained two-micafelsic granites (Strelcha pluton).

Upper Cretaceous dykes were established (Iliev, Katskov, 1990) amongst the high-graded metamorphics and the granites of Koprivshitsa pluton. They are composed of quartz-diorite porphyrite and crop out west of the town of Koprivshitsa.

The Quaternary deposits are developed on a small area in Topolnitsa River valley south of the town of Koprivshitsa. They include alluvial gravels and sands of Holocene age.

The area of "Sopolivite Kamani" geosite is formed in the frames of a tectonic unit named Srednogorie anticlinorium (Bonchev, Karagyuleva, 1961), Topolnitsa-Tundzha unit (Ivanov, 1998), or Central Srednogorie unit (Dabovski, Zagorchev, 2009), which is a part of the Srednogorie tectonic zone (Cvijić, 1904; Bonchev, 1946, 1971).

Characteristics of the geosite

The complex of rock outcrops, nominated here for a geosite after Sopolivite Kamani locality, forms a southwest-northeast oriented strip, 6 km long and 1-1.5 km wide, including separate groups of granite blocks with a great variety of shapes and sizes. It is located between the massive of Stramonos Peak and Koprivshitsa-Strelcha road, as its northeastern end is located 3.5 km south of the town Koprivshitsa (Figs. 1, 3). The formation of the geosite is a result of a spheroidal weathering characteristic for jointed intrusive rocks, under the combined impact of temperature, surface water and wind, as well as the further removal by surface waters of the disintegrated debris. The weathering is also predetermined by the prototectonics of the intrusives – three systems of joints are observed in granites (two subvertical and one subhorizontal - Platel, 1, 2). The influence of the exogenic processes could be investigated clearly along the subvertical joints (Plate I, 3, 4), as the geosite gives an opportunity for observation of different stages of the spheroidal weathering.

The area of "Sopolivite Kamani" geosite is characterized by middle-mountain relief and as a whole it has low values of horizontal relief disintegration, mainly to 0.5 km/km² (Fig. 3). These values and small slopes angles determine a reminder of flat (denudation) surface, which is laid down in the range of 1200 to 1400 m above sea level. According to Kanev (1989)

and Bakalova (2014) this surface is of Early Miocene age. Our field observations confirmed the relationship between the weathering stage and the horizontal relief disintegration. The areas with lowest values (eastern part of the geosite and the area around Stramonos Peak – Fig. 3) reveal groups consisting of well-rounded and clearly separated granite blocks (Plate I, 5-8), i.e. these are the areas with advanced stage of spheroidal weathering and the disintegrated debris has been removed by surface streams. The highest values of horizontal relief disintegration are characteristic for the central area of the geosite, where the prototectonics of Strelcha pluton, as well as the initial stages of spheroidal weathering could be observed (Plate II, 1-4).

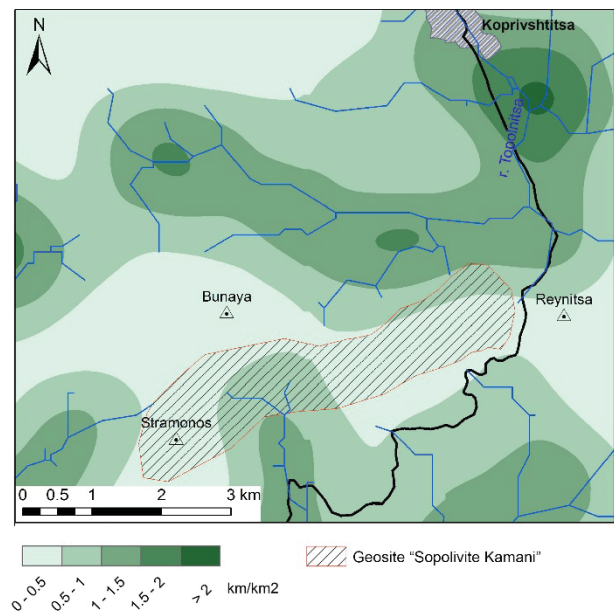


Fig. 3. Horizontal relief disintegration in the area of "Sopolivite Kamani" ("Runny Stones") geosite

Sopolivite Kamani locality is included by Koprivshitsa Municipality in tourist's routes (Map of Koprivshitsa). For this purpose at several places sign boards with general information were placed (Plate II, 5), and at 600 m west of Koprivshitsa-Strelcha road, next to the pathway to Stramonos Peak, a bower was built (Plate II, 6). It gives a good opportunity to view a panorama to north (Plate II, 7) and east, revealing the highest peak of Sredna Gora Mountain - Bogdan Peak (Plate II, 8).

The geosite, described in the present article, is referred to the geosites of aesthetic value (geomorphological class). After the conducted expert estimation, according to the original Bulgarian methodology for estimation of geological phenomena (Sinyovski et al., 2002), we concluded that it is of local importance, and it could be estimated as a geosite of high degree of preservation, exposure, resistance and accessibility.

Conclusion

The central part of Sashtinska Sredna Gora Mountain reveals a great diversity of natural sites, as considerable group of them are geological phenomena. The intrusive rocks, forming "Sopolivite Kamani" ("Runny Stones") geosite, on one hand are resistant to the influence of exogenic processes, and

on the other hand, they are located away from regions with well developed road infrastructure and intensive antropogenic influence, which suggests a long period of existing for the geosite. Its further popularization requires placing of signboards with geological information (data concerning the mineral composition, genesis, and age of the rocks), which will increase its total expert value by adding investigational and educational value to its present characteristics.

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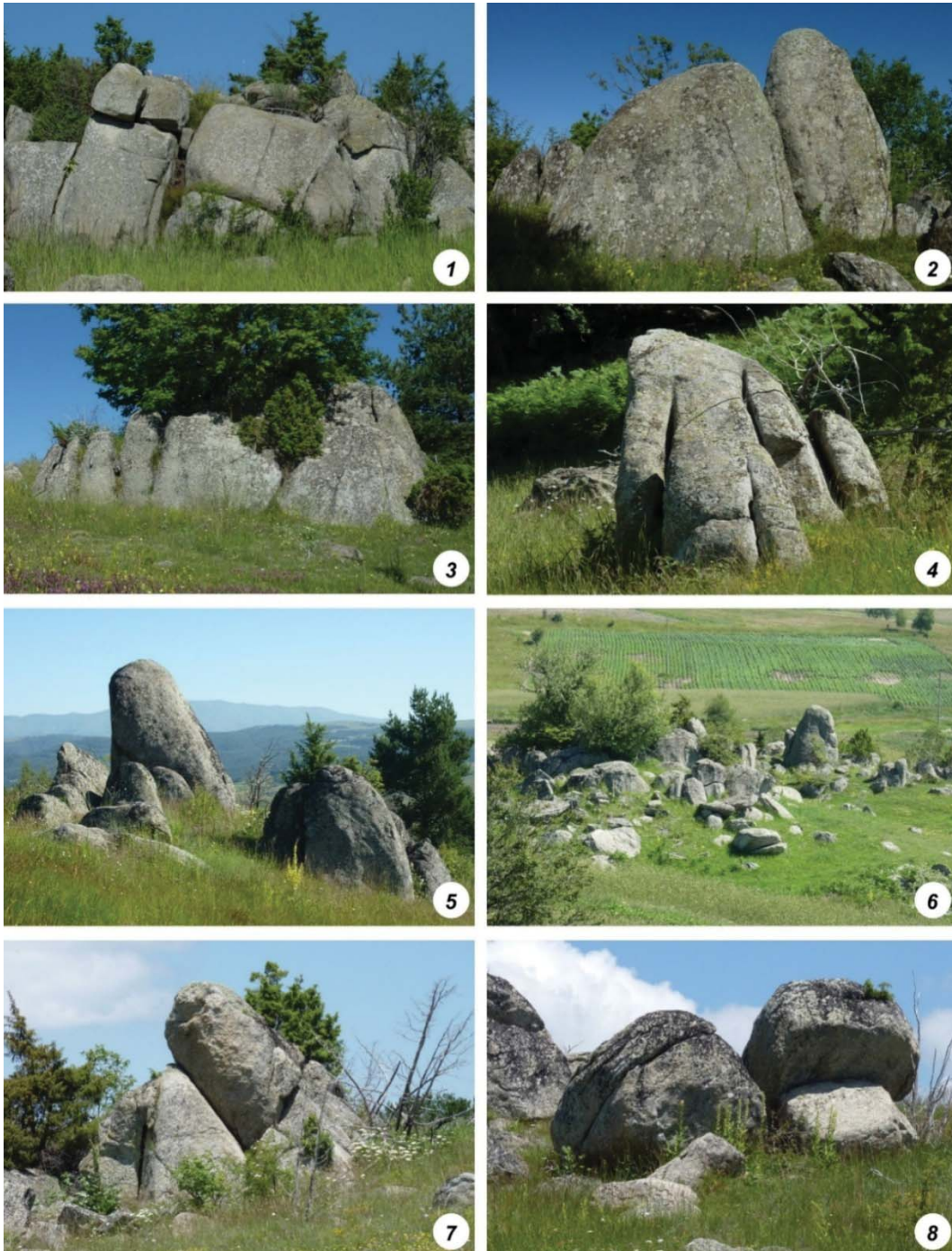
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PLATE I



1, 2, clear formed subvertical fractures in the eastern part of “Sopolivite Kamani” (“Runny Stones”) geosite; 3, 4, examples for gradual broadening of the subvertical fractures (3,advancedstage, 4,initial stage); 5-8, clearly separated well rounded granite blocks (5, 6,eastern part of the geosite, 7, 8,western part of the geosite between Stramonos and Boev Shamak Peaks).

PLATE II



1, 2, primary fractures of Strelcha pluton in the initial stage of spherical weathering southwest of Boev Shamak Peak; 3, 4, granite blocks with tapered edges southwest of Boev Shamak Peak; 5, signboard, placed by Koprivshitsa Municipality at the eastern part of the geosite; 6, a bower built by Koprivshitsa Municipality next to the pathway to Stramonos Peak 600 m west of Koprivshitsa-Strelcha road; 7, view north of the bower; 8, Bogdan Peak(at the background) seen from the bower.