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# Measurement Results and Conclusions on the Spectral Reflective Coefficients of Volcanites, Granitoides and Gneisses

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## 1. Definition of the Problem

The remote sensing of the Earth by air- and space-born high sensitive instruments provides for images (photographs and photoelectron pictures) of land and water surface in several ranges (channels) of the visible and near infrared portion of the electromagnetic spectrum. These images are of general application and the different formations are outlined within the respective channels. Based on this information, the geological and geomorphological studies specify the location, shape and sizes of various geological bodies; maps of lineament and circular structures are compiled. All this is an initial stage in applying remote techniques in geology. In future there have to be developed methodics of identifying geological objects, based on their spectral reflective characteristics. A necessary condition here is to provide for system and multiple laboratory and ground (field) studies on the main classes of geological object within their different behaviours and to prepare a catalogue of their spectral reflective characteristics (SRC). Referring to that, some work has been done in Bulgaria in cataloguing the SRC of the major genetic rock classes: magmatic, metamorphic and sedimentary. It is known that the SRC of a given object is the dependence of the spectral reflective coefficient on the wavelength within a given range of the electromagnetic spectrum. The spectral reflective coefficient (SRCO) is the ratio between the reflected radiation from the studied object ($B_\lambda$ obj.) and the maident radiation on the reference object (screen) ($B_\lambda$ref.), i. e. with known reflective coefficient and spectral characteristics within the studied range.

## 2. Instruments and Measurements Techniques

Our Laboratory has developed a portable spectrometer to measure the SRC of various earth formations and objects *in vitro* and *in situ*. The instrument, known as ISOCH-020, consists of twenty channels with channel width 10-12 nm and works within the range of 400-800 nm at aperture angle of view

--13°. The natural sunlight is used in field work and a xenon lamp with power of 100 W or other artificial source of light, and the non-uniformity of its spectral characteristic of irradiation within the range of 400-800nm does not exceed 30%. A specially designed screen 80 mm in diameter is used as reference object. The screen has a photometric characteristic close to the one of ideal diffusion reflective white surface. The average SRCO is over 95% and the non-uniformity of SRC within the range of 400-800 nm is $\pm$0.25%.

The rock samples to be studied have the shape of irregular polyhedron, with natural roughness and in certain cases one of the faces was additionally polished. Studies were perfomed under natural sunlight and the solar zenith angle varied between 46 and 65°. In order to reduce as much as possible the influence of the diffuse scattered light by the surrounding objects, the instrument and the samples were placed on black-mat tissue. In dependence on the sample sizes, the distance to the optic aperture of the instrument was selected so that the field of view would embrace as much as possible of the measurable surface. That was necessary because of the fact that the diffuse indicatrice of the actual object had to be considered, due to large solar zenith angles, microshades would appear and they reduce the SRCO.

## 3. Brief Petrographic Characteristics of the Rocks

Samples to measure the coefficient of spectral brightness are taken from various outcrops observed in different parts on the Bulgarian territory and are selected in such a way as to be representative of magmatic and metamorphic rocks.

### *a) Volcanites*

Samples from two big groups of volcanic rocks are selected — acid and medium acid. The samples are taken mainly from the Rhodopes and the Western part of Sredna Gora mountain, i. e. South and West of Bulgaria. The group of acid rocks comprises rhyolites (samples Nos. *1-6*), rhyodacite (No. *7*), delenites (Nos. *8-9*) and the medium acid rocks are presented by No. *10* -- latite and No. *11* — andesite.

The age of the volcanic rocks is Paleogene and they are related to the Alpine orogenic volcanism. They occur as flows, subvolcanic bodies and dikes, intruded in the crystalline complex and the granitoides of the Rhodope massif, as well as in depressions located between its major morphostructures.

Among the acid volcanic rocks the rhyolites are widespread. Their common feature is the presence of aphanitic ground mass, composed of potassium felspar, quartz and volcanic glass. In it phenocrysts of plagioclase, felspar, quartz and sometimes biotite, amphibole and pyroxene are observed. The groundmass versus porphyry individuals is from 85 to 30%. The rhyolites are mainly of felsitic (samples Nos. *1-4*), porphyry (No. *5*) and hyaline (No. *6*) texture. Accessory minerals in the rhyolites are zircon, tourmaline, titanium, magnetite. The rhyolite texture is fluidal banded.

Macroscopically the plagiorhyolite-rhyodacite (No. *7*) has fine porphyritic texture - holocrystalline for the ground mass. The main rock-forming minerals are: plagioclase, felspar, biotite, amphibole and rarely quartz.

The coarse porphyritic delenites are subvolocanic bodies. They have micro- to medium-grained alotriomorphic texture. Main intratelluric minerals are: pyroxene, amphibole, plagioclase, quartz and felspar (sanidine). Accessory: zircone, apatite, titanite, magnetite, orthite, some secondary minerals as epidote, chlorite, sericite also occur.

The medium acid volcanic rocks are presented by latite (No. *10*) and andesite (No. *11*). These are melanocratic rocks with typical hialopilitic (andesite) texture and massive structure. Microscopically the ground mass is aphanitic composed of plagioclase, pyroxene, volcanic glass. Porhyries of plagioclase, pyroxene and amphibole may be observed here and very rarely — olivine.

*b) Granitoides*

They are from Rilo-Rhodopean batholites. Samples of granodiorites, biotite granites and two-mica granites are collected. Here are samples of numbers: *4584, 4732, 3011, 7107, 2086, 5368, 2193, 8653, 3735, 2224, I and II.*

The granitoides are mainly coarse- to medium-grained granular rocks. Their structure is mostly hipidiomorphic granular, sometimes porphyritic and in certain cases — cataclastic. Their texture is massive, sometimes parallel. Main rock forming minerals are: felspar, quartz, plagioclase, biotite and two-mica muscovite. Secondary and accessory minerals are: orthite, titanite, zircon, apatite and ore minerals.

*c) Gneisses*

Two types are considered: biotite and two-mica (samples Nos. *340, 1907* and *5005*).

Gneisses are fine- to medium-grained rocks with lepidogranoblastic structure and parallel texture. The main minerals are: plagioclase, quartz, biotite and muscovite. Accessories are: zircon, rutile, apatite and ore minerals.

## 4. Discussion of Results

Both within the period of measurements and when discussing the results, the factors with greatest influence on the rock SRCO may be defined separately in two principal groups: internal and external.

Among the external factors the main role is played by the source of light, which may be of natural or artificial origin, but its influence is known as a rule and could be considered in data interpretation.

Among internal factors significant is the influence of the structural-textural feature, the mineral and chemical composition, the surface of the measured samples, etc.

When measuring the spectral brightness of the different genetic classes of rocks, sun was used as a source of light. The strength of solar irradiation for the geographic latitude of Sofia (eastern longitude — 23°20'45"; northern latitude — 42°41'02") depends on solar location over horizon, i. e. on the zenith angle. Measurements were performed during the autumn of 1978, Sept. 30 and Oct. 3-4, within the interval 11:23-15:51. During these days the zenith angle changed from 46 to 65°. When comparing the measured values of the SRCO for the three days and for the interval of noon-hours of the autumn season, it was determined that the solar zenith angle is of weak importance (Tables 1 and 2).

Table 1

*Spectral Reflective Coefficient of Volcanites*

| Rock | rhyolite | | rhyolite | | rhyolite | | rhyolite | | rhyolite | perlite | | rhyodacite | | delenite | | latite | | andesite |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | *1* | | *2* | | *3* | | *4* | | *5* | *6* | | *7* | | *8* | *9* | *10* | | *11* |
| hm/surface | rough | polished | rough | polished | rough | polished | rough | polished | rough | rough | polished | rough | polished | rough | rough | rough | polished | rough |
| 402 | 22.0 | 34.0 | 18.0 | 22.5 | 22.0 | 33.0 | 15.0 | 18.5 | 24.0 | 30.0 | 41.0 | 22.0 | 42.0 | 21.0 | 11.0 | 14.0 | 22.0 | 10.0 |
| 411 | 22.0 | 33.0 | 18.0 | 22.5 | 22.0 | 33.0 | 15.5 | 18.5 | 23.0 | 30.0 | 41.0 | 22.0 | 41.5 | 20.5 | 10.5 | 14.0 | 22.5 | 11.0 |
| 425 | 22.0 | 33.0 | 17.0 | 23.0 | 22.5 | 33.0 | 16.0 | 18.5 | 23.0 | 29.5 | 40.0 | 21.0 | 41.0 | 20.5 | 10.5 | 14.5 | 22.5 | 11.0 |
| 440 | 23.0 | 34.0 | 18.0 | 23.0 | 23.0 | 33.0 | 16.5 | 19.0 | 23.0 | 29.5 | 41.0 | 22.0 | 43.0 | 20.5 | 10.5 | 15.5 | 23.5 | 10.5 |
| 464 | 24.0 | 35.0 | 18.0 | 23.0 | 24.0 | 33.0 | 17.5 | 19.0 | 23.0 | 30.0 | 41.0 | 23.5 | 43.0 | 20.5 | 11.0 | 15.5 | 23.5 | 11.0 |
| 483 | 25.0 | 35.5 | 18.5 | 24.0 | 24.5 | 33.0 | 18.0 | 19.0 | 24.0 | 31.0 | 41.0 | 24.5 | 44.0 | 21.0 | 11.5 | 16.0 | 23.5 | 11.5 |
| 501 | 26.0 | 36.0 | 19.5 | 24.5 | 25.0 | 33.5 | 19.0 | 19.5 | 24.0 | 31.5 | 41.0 | 25.5 | 44.5 | 21.0 | 11.5 | 16.5 | 23.5 | 12.0 |
| 546 | 31.0 | 39.0 | 22.0 | 27.0 | 26.0 | 34.5 | 22.0 | 21.5 | 27.0 | 33.5 | 42.0 | 30.0 | 48.0 | 22.5 | 14.0 | 17.5 | 23.5 | 13.0 |
| 557 | 32.5 | 40.0 | 23.0 | 27.5 | 27.0 | 34.5 | 23.0 | 21.5 | 28.5 | 34.0 | 45.0 | 31.5 | 49.0 | 23.0 | 15.0 | 18.5 | 23.5 | 14.0 |
| 597 | 37.0 | 41.5 | 25.0 | 29.0 | 28.0 | 35.5 | 25.5 | 23.0 | 31.0 | 37.0 | 46.5 | 33.5 | 50.0 | 24.0 | 16.0 | 17.5 | 23.0 | 14.0 |
| 618 | 39.0 | 42.5 | 25.5 | 30.0 | 29.5 | 36.0 | 27.0 | 24.0 | 33.0 | 38.5 | 48.0 | 36.0 | 51.0 | 25.5 | 17.0 | 18.0 | 23.0 | 15.5 |
| 662 | 41.0 | 43.0 | 26.5 | 30.0 | 30.0 | 36.0 | 28.0 | 24.0 | 34.0 | 40.0 | 49.0 | 37.5 | 51.0 | 27.0 | 17.5 | 17.5 | 23.0 | 15.5 |
| 689 | 43.0 | 44.0 | 27.5 | 30.5 | 30.5 | 36.5 | 29.0 | 24.5 | 36.0 | 42.5 | 51.0 | 39.0 | 51.0 | 28.0 | 18.0 | 17.5 | 22.0 | 16.5 |
| 701 | 43.0 | 44.5 | 27.0 | 30.5 | 31.0 | 37.0 | 29.0 | 24.5 | 36.0 | 42.5 | 50.0 | 39.0 | 51.0 | 28.0 | 19.0 | 17.5 | 22.5 | 16.5 |
| 713 | 43.0 | 44.0 | 27.0 | 30.5 | 30.0 | 36.0 | 29.0 | 26.5 | 36.0 | 43.0 | 50.0 | 39.0 | 51.0 | 28.5 | 19.0 | 17.5 | 22.0 | 16.0 |
| 725 | 44.0 | 45.0 | 28.0 | 30.5 | 30.0 | 36.0 | 29.0 | 24.5 | 38.0 | 44.0 | 52.0 | 40.5 | 51.5 | 30.0 | 20.0 | 18.0 | 22.0 | 17.0 |
| 740 | 45.0 | 45.0 | 28.0 | 30.5 | 30.0 | 36.0 | 29.5 | 25.0 | 37.0 | 45.0 | 52.0 | 40.5 | 51.0 | 30.0 | 20.5 | 17.5 | 22.0 | 17.5 |
| 753 | 45.5 | 45.5 | 28.0 | 31.0 | 30.0 | 36.0 | 30.0 | 24.5 | 37.0 | 45.0 | 52.0 | 41.0 | 51.0 | 30.0 | 20.5 | 17.0 | 21.5 | 17.0 |
| 775 | 46.0 | 45.0 | 28.0 | 30.5 | 30.0 | 36.0 | 30.0 | 24.5 | 37.0 | 45.0 | 52.0 | 41.0 | 51.0 | 30.0 | 21.0 | 18.0 | 22.0 | 15.5 |
| 802 | 46.0 | 44.0 | 27.0 | 29.5 | 30.0 | 35.0 | 30.0 | 23.5 | 37.5 | 45.0 | 52.0 | 41.0 | 51.0 | 30.0 | 24.0 | 18.0 | 21.5 | 15.0 |

Table 2

*Spectal Reflective Coefficient of Granitoides and Gneisses*

| Rock | Biotite | | Granites | | | | Two-mica granites | | | Biotite granodiorite | | | Gneisses | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | 2086 | 5368 | 2193 | 3735 | 8653 | 2221 | I | II | 4584 | 4732 | 3011 | 7107 | 1907 | 5005 | 340 |
| nm/surf. | rough | rough | rough | rough | rough | rough | rough | rough | rough | rough | rough | rough | rough | rough | rough |
| 402 | 42.5 | 40.0 | 35.0 | 39.0 | 49.0 | 27.0 | 51.5 | 48.0 | 44.0 | 22.0 | 23.0 | 22.0 | 13.0 | 20.0 | 7.5 |
| 411 | 41.5 | 41.5 | 35.0 | 36.0 | 47.0 | 26.5 | 49.5 | 47.0 | 44.0 | 22.5 | 23.0 | 22.0 | 13.5 | 20.0 | 9.5 |
| 425 | 41.0 | 41.0 | 35.0 | 38.0 | 48.0 | 26.0 | 49.5 | 47.0 | 45.0 | 22.0 | 23.5 | 22.5 | 13.0 | 20.0 | 9.0 |
| 440 | 42.0 | 41.5 | 35.0 | 39.5 | 47.0 | 27.0 | 50.5 | 48.5 | 45.5 | 23.0 | 23.5 | 22.5 | 13.5 | 20.5 | 9.0 |
| 464 | 44.5 | 41.5 | 36.0 | 40.0 | 44.0 | 28.0 | 53.0 | 50.0 | 44.5 | 24.0 | 25.0 | 22.5 | 15.0 | 21.0 | 10.0 |
| 483 | 44.5 | 42.5 | 37.5 | 39.0 | 45.0 | 30.0 | 54.0 | 49.5 | 46.5 | 25.0 | 24.0 | 24.0 | 16.0 | 22.0 | 10.0 |
| 501 | 45.5 | 43.5 | 38.0 | 37.5 | 44.0 | 30.0 | 55.0 | 49.5 | 48.0 | 26.0 | 25.0 | 24.5 | 17.0 | 22.5 | 11.5 |
| 546 | 49.5 | 46.0 | 43.0 | 41.0 | 46.5 | 34.0 | 58.5 | 53.0 | 49.0 | 29.0 | 26.0 | 27.0 | 24.0 | 26.0 | 17.0 |
| 557 | 51.0 | 48.5 | 43.5 | 42.0 | 46.0 | 35.0 | 59.0 | 53.5 | 50.0 | 29.5 | 27.0 | 27.5 | 25.0 | 27.0 | 17.5 |
| 597 | 52.0 | 48.0 | 45.0 | 43.0 | 46.0 | 36.0 | 60.0 | 53.5 | 51.0 | 30.0 | 27.0 | 28.0 | 27.0 | 28.0 | 20.0 |
| 618 | 53.0 | 49.5 | 45.5 | 44.0 | 47.0 | 37.5 | 61.0 | 55.0 | 52.5 | 31.0 | 27.5 | 29.0 | 29.0 | 29.0 | 21.0 |
| 662 | 55.5 | 49.0 | 47.0 | 44.5 | 46.5 | 37.5 | 62.0 | 58.0 | 52.0 | 32.0 | 27.0 | 30.5 | 29.0 | 30.0 | 23.0 |
| 689 | 54.5 | 51.0 | 46.5 | 44.5 | 46.0 | 40.5 | 63.5 | 57.0 | 52.0 | 32.5 | 27.0 | 31.0 | 30.0 | 30.0 | 23.5 |
| 711 | 55.0 | 50.5 | 48.0 | 45.0 | 45.0 | 39.0 | 62.5 | 55.5 | 51.0 | 32.5 | 28.0 | 31.0 | 29.5 | 30.5 | 24.0 |
| 713 | 54.5 | 51.0 | 46.5 | 45.0 | 47.0 | 38.5 | 62.5 | 58.5 | 52.0 | 33.0 | 28.0 | 32.0 | 30.0 | 30.0 | 24.5 |
| 725 | 56.0 | 48.0 | 47.5 | 45.5 | 46.0 | 39.5 | 64.0 | 58.5 | 53.0 | 33.0 | 27.5 | 31.5 | 31.0 | 30.0 | 25.0 |
| 740 | 56.5 | 52.0 | 46.5 | 45.5 | 46.0 | 40.0 | 63.0 | 59.0 | 52.5 | 33.0 | 27.5 | 31.5 | 31.5 | 30.5 | 26.5 |
| 753 | 56.0 | 52.0 | 48.0 | 46.0 | 47.0 | 40.5 | 63.5 | 58.0 | 53.5 | 33.5 | 27.0 | 31.5 | 31.5 | 30.5 | 27.0 |
| 775 | 55.5 | 52.0 | 48.0 | 46.0 | 48.0 | 41.0 | 64.5 | 60.0 | 54.0 | 34.0 | 27.0 | 32.0 | 32.0 | 31.0 | 26.5 |
| 802 | 57.0 | 52.0 | 47.0 | 46.0 | 46.0 | 40.5 | 64.0 | 59.0 | 53.5 | 34.0 | 27.0 | 32.0 | 31.5 | 30.5 | 27.0 |

*a) Volcanites*

Data obtained by sample measurements of acid volcanic rocks show that highest is the SRCO of sample No. *1*-rhyolite taken from the Eastern Rhodopes. Sample No. *2* — rhyolite from the same volcanic region is defined by lowest indices of spectral brightness. Both samples do not differ in such structural indices as shape, size of porphyries, but there is considerable difference in the quantity of ground mass. Referring to this index, the acid volcanic rocks may be divided into two groups: (1) with great amount of ground mass (over 80% for samples Nos. *1, 6, 7*), and (2) with increased porphyry content (30-40% — samples Nos. *2, 3, 4*) (Fig. 1, Table 1). The rock samples of the first group are characterized by high values of SRCO within the range of 600-800 nm. The rhyolite (Sample No. *5*) under equal content of porphyry and ground mass has average indices of reflective capacity with respect to the upper two groups (Fig. 1, Table 1). Sample No. *7* — plagiorhyolite has the followng specifics: within the range of 400-500 nm the spectral brightness, equals the rhyolitic one, but within the range of 600-800 nm it augments, which may be interpreted with structural features of the rock. It is of dense almost aphiric structure for the porphyry and holocrystalline — for the ground mass. This structural index of the sample brings it closer to the rhyolites with higher amount of ground masses. In the case, the small sizes of the minerals definitely influence the increase of the SRCO within the range of 600-800 nm. The reverse is the effect on the spectral brightness in augmenting the porphyric sizes. Typical example is the coarse-grained porphyric delenite (sample No. *9*). Here the lowest values of spectral brightness are observed — 10% within the short-wave interval of the electromagnetic spectrum, up to 24% in the IR range. The other sample (No. *8*) of coarse-grained porphyric delenite does not differ from No. *9* in structural indices (sizes and shape of minerals) but its indices are with 10% higher on the average. In macroscopic comparison of the two samples a difference between the surfaces under which the measurements are taken, appeared. For sample No. *9* it is rough and uneven, with difference between roughnesses up to 5 nm. At equal other conditions one more index is introduced, namely the surface of the measured samples. Under natural conditions, this index woule probably be of lesser importance because of physico-chemical rock weathering, dust, development of microorganisms, etc.

The dominant colour of the acid volcanic rocks is rose-violet and pale rose. The perlite (sample No. *6*) represents an exception — it is almost white and the rhyolite (sample No. *4*) is of intensive red colour. And in fact, only these rock samples have shown SRCO indices which differ from the others and this influence is especially remarkable within the short-wave interval of the electromagnetic spectrum, between 400-500 nm. In this range the perlite shows values of spectral brightness of 10% higher and the difference with reference to the rhyolite of intensive red colour attains 15%. This difference is the smallest within the range of 546-557 nm.

The latite (sample No. *10*) and the andesite (sample No. *11*) refer to the medium-acid rocks. Here a steep decrease of the reflective capacity is observed. A slow increase of the SRCO is found for the latite — from 14 to 18%. The lowest values of spectral brightness (from 10.5 to 17.5%) are measured also for the andesite, and in the near-infra-red region a certain decrease is detected between 753 and 802 nm. The latite demonstrates another peculiarity — from 557 to 802 nm the values of SRCO are almost the same. Obviously, within the increase of the dark-coloured minerals, the reflective capacity of the volcanic rocks considerably decreases and this is to be traced within the whole measurement range of the electromagnetic spectrum.

The colour of the medium acid rocks is: grey-greenish for the latite and dark grey for the andesite. The following peculiarity has been determined:

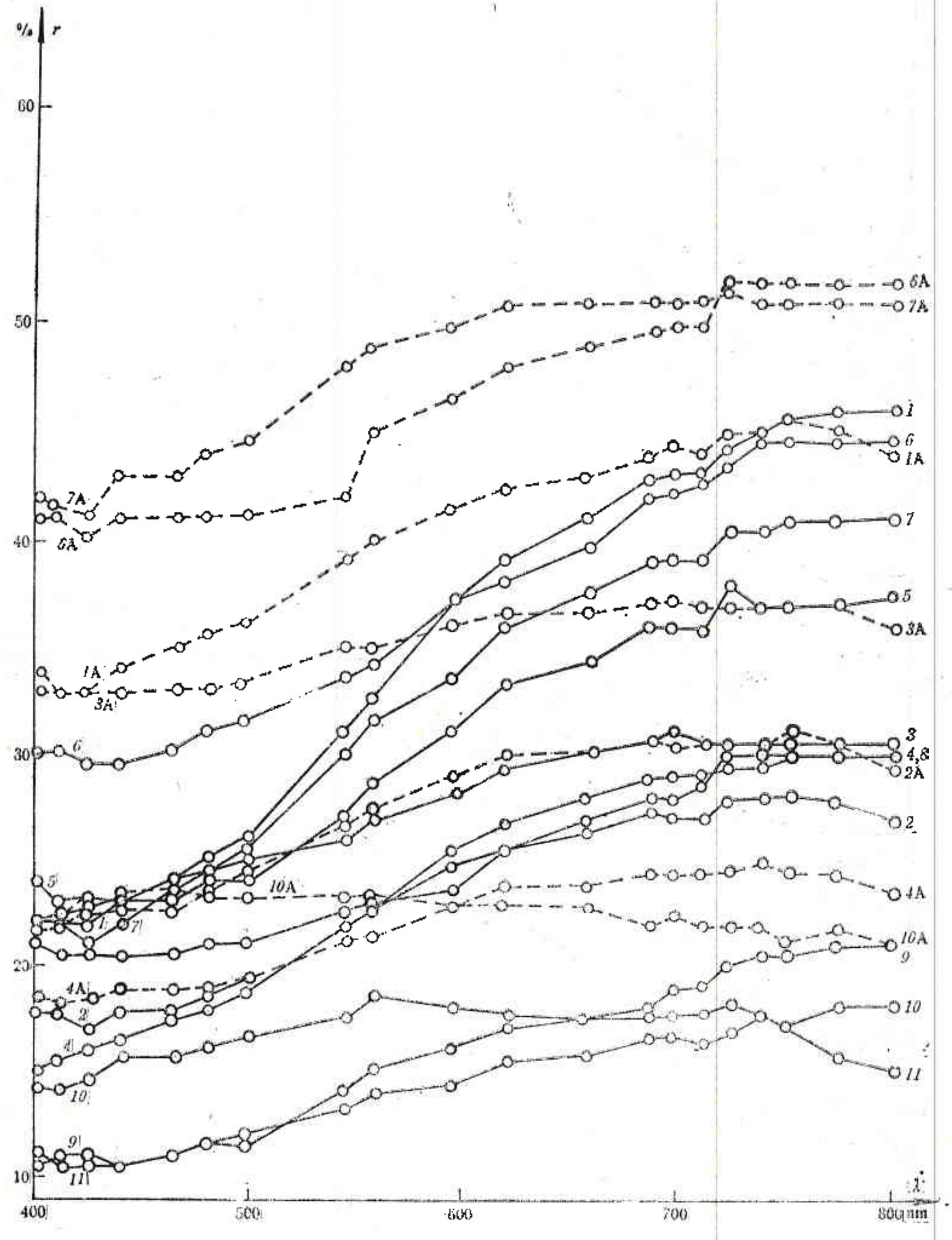


Fig. 1. SRCO curves of volcanites

Samples: *1, 2, 3, 4, 5* — rhyolites; *6* — perlite; *7* — plagiorhyolite-rhyodacite; *8, 9* — delenites; *10* — latite; *11* — andesite; Broken curves refer to polished samples

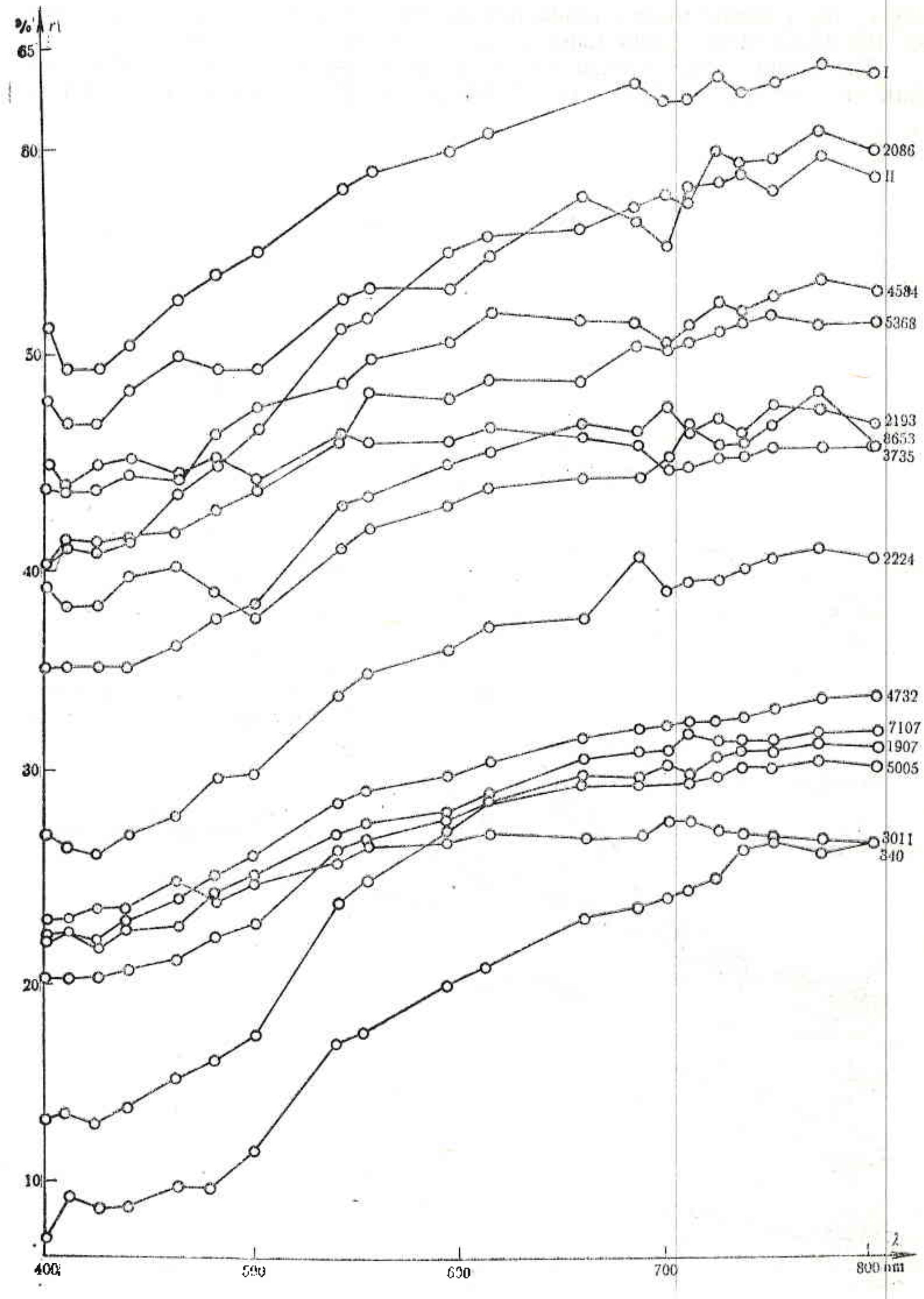


Fig. 2. SRCO curves of granitoides and gneisses

Samples: biotite granites — Nos. 2086, 5368, 2193, 3735, 8653, 2224; two-mica granites — I, II; biotite granodiorites — Nos. 4584, 4732, 3011, 7107; gneisses — Nos. 1907, 5005, 304 ;

under all measurements the SRCO of the lathite is higher than the andesite SRCO by 4-5% on the average.

Measurements have shown that the rock surface influences significantly the SRCO, that is why one of the sample faces was additionally polished (Fig. 2, Table 1). It was found that within the interval of 400 to 550 nm, the coefficient of light brightness increases by 10% on the average and to the near infra-red range gradually decreases and is about 5%.

*b) Granitoides*

When measuring the coefficient of light brightness of granitoides, it was determined that its highest values are attained with the two-mica granites and gradually decreases to the biotite granites and the granodiorites.

The two-mica granites perform SRCO changes from 48-51% at 408 nm to 59-64% at the near infra-red region. The lower values of sample II compared to sample I are due to the greater size of the mineral grains.

The biotite granites have SRCO from 28 to 60%. Their average values are between 35 and 50% (Fig. 2, Table 2). Lowest are the values of sample No. *2224* (from 28 to 40.5%). We assume that this is due to the weathered sample surface and the greater quantities of the biotite. Highest spectral brightness values has sample No. *2086* at 775 nm — 62%. The reflective capacity increase results from the augmented content of salic minerals as the percentage of the potassium felspar is particularly high. The surface of the rock is smooth. For the cataclastic biotite granite (Sample No. *8653*) SRCO has almost identical values, which is due to the uniform distribution of the mafic and salic minerals.

Results from SRCO measurements of biotite granodiorites show that they have lowest value compared with other granitoides. Sample No. *4584* is a certain exception, where SRCO changes from 44 to 54%, while for the other samples this varies between 22 and 35%. There is no difference in structural features and mineral composition between the samples. The difference is to be traced in the gravity ratio between the mafic and salic minerals. Sample No. *4584* contains about 65% light minerals (quartz, felspar, plagioclase). Furthermore it is cut by a small aplite vein. The surface is very fresh. Lowest values of SRCO has sample No. *3011*, here the mafites are predominant. Sample No. *7107* — biotite adamellite — refers to this group. Its graph does not differ from the other granodiorites.

*c) Gneisses*

Gneisses exhibit the lowest values of SRCO. For the biotite gneisses (samples Nos *1907, 5005*) the SRCO varies between 13-20% at 402 nm to 30-31.5% at 802 nm. Surprisingly, the lowest SRCO was determined for the two-mica gneiss — 340, i. e, from 7.5 to 27%. We assume that the reflective capacity decreases due to the highly expressed banded texture.

Typical peculiarity for the volcanites and gneisses, referring to the values of the spectral brightness coefficient, is the presence of two plateaux. The first is determined in the short-wave interval of the electromagnetic spectrum, between 400-500 nm with very poor decrease within the interval 411-425 nm. The second plateau is within the range of 700-802 nm also with weak decrease after 775 nm. In fact the two plateaux represent ranges within the optic spectrum with width up to 100 nm, where the reflective capacity is constant. This refers to the group of acid and medium acid rocks.

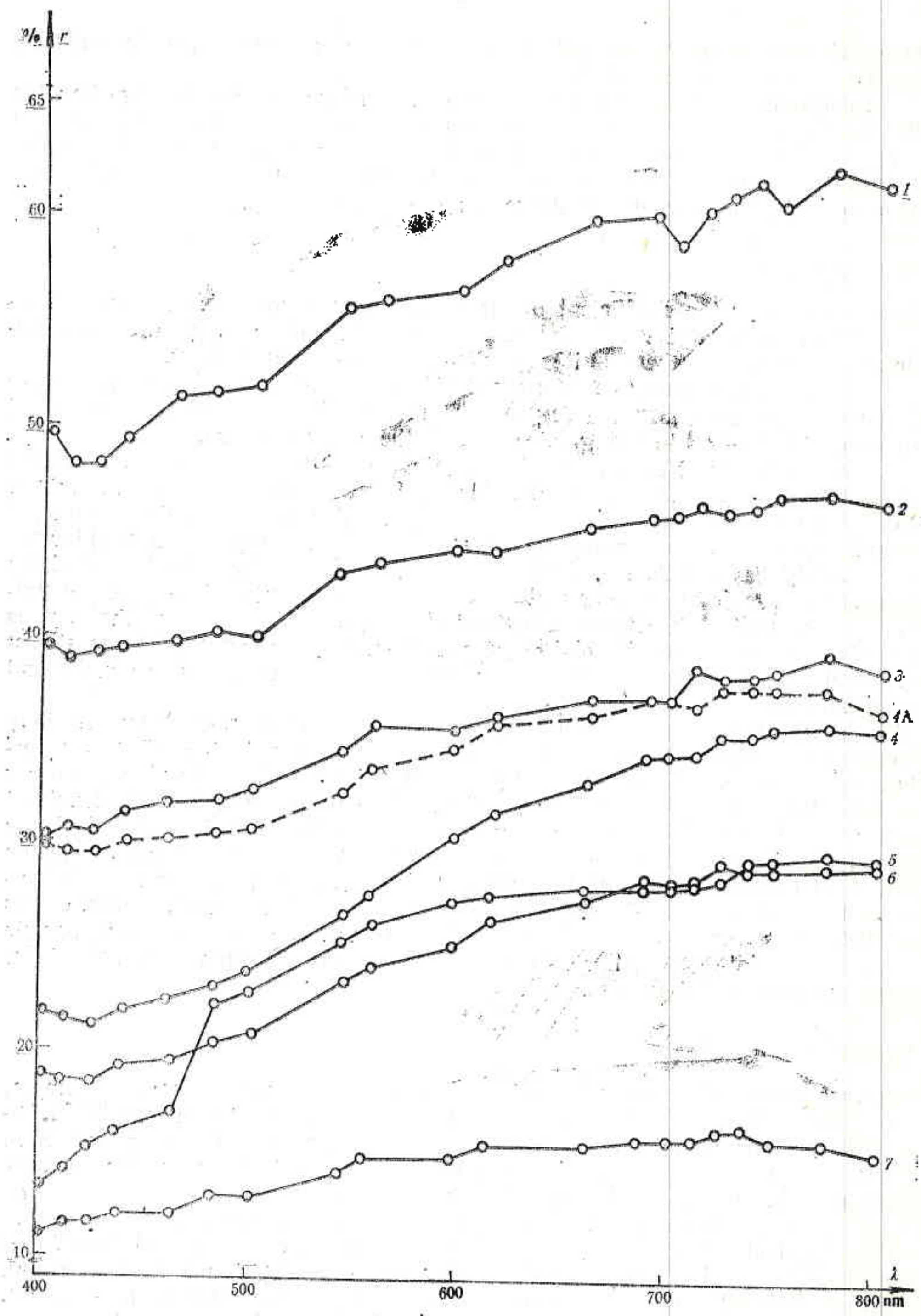


Fig. 3. SRCO averaged curves of volcanites, granitoids and gneisses

1 — two-mica granites; 2 — biotite granites; 3 — granodiorites; 4 — rhyolites; 5 — gneisses; 6 — delenites; 7 — andesite-latite

Another clearly exspressed peculiarity of the studied samples is the rapid increase of the spectral brightness within the interval of 500-700 nm. This feature gradually decreases with the increase of the dark-coloured silicates.

## 5. Conclusions

The measurements and the interpretations of the results obtained give grounds for the following conclusions:

1. Direct proportional dependence exists between the ground mass quantity and the SRCO for the acid volcanic rocks.
2. Acid rocks have higher SRCO values than the medium-acid and the basic rocks.
3. The predominant quantity of salic minerals augments the SRCO and vice versa.
4. The influence of the rock structure is manifested through the size of the minerals: at greater sizes of the porphyries the SRCO decreases and vice versa.
5. Smooth and polished rock surfaces increase the SRCO.
6. Samples of weathered surface have lower SRCO than the fresh ones.
7. Rock of massive texture have higher SRCO than the ones of parallel (banded) structure.
8. The lighter colour of rocks increases the SRCO and vice versa.

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## Результаты и интерпретация измерений спектральных отражательных характеристик вулканитов, гранатоидов и гнейсов


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(Резюме)

В данной работе приводятся результаты измерений спектральных отражательных характеристик скальных образцов вулканита, гранатоида и гнейса в лабораторных условиях с помощью разработанного болгарскими специалистами полевого спектромера ИСОХ-020 при естественном освещении Солнца. На основе полученных данных сделана интерпретация о влиянии геологического типа, структуры, окраски и состояния поверхности исследуемых образцов на их спектральные отражательные характеристики.