50 years University of Mining and Geology "St. Ivan Rilski"
Annual, vol. 46, part I, Geology and Geophysics, Sofia, 2003, pp.327-329

SPECTROMETRIC MEASUREMENTS OF GRANITES AND STUDY SURFACE EFFECTS

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ABSTRACT
Spectrometric measurements are a part of remote sensing. They study reflected, emitted or scattered from real land cover light as a function of wavelength. According to main experimental problem obtained spectral reflectance characteristics of different land surfaces have been analyzed. The goal of present paper is the study of petrographic samples with natural roughness and with different mineral grain size and than to do analysis of study surface effects in spectrometric measurements. In this paper granites as a mixed class of their rock-forming minerals are measured. If more than one class is found within the studied surface it is called a mixed class. Laboratory spectral reflectance measurements in range (0.4 - 1.1 μm) of granites are performed. Spectral reflectance characteristics of samples with natural roughness and with different mineral grain size are compared. The study surface effects in spectrometric measurements of granites are discussed.

INTRODUCTION

Spectrometric measurements are a part of remote sensing. They study the light as a function of wavelength. If more than one class is found within the studied surface it is called a mixed class. In this case studied granites are two sub-classes of one and the same class (group) of granite and rhyolite (Маринов, 1989). In other words, the granites are mixed class of their rock-forming minerals.

The goal of present paper is the study of petrographic samples with natural roughness and with different mineral grain size and than to do analysis of study surface effects in spectrometric measurements.

MATERIALS AND METHODS

It is known that the specific reflectance, absorption and emission of solar radiation by land covers is the basis of remote sensing, of spectrometric measurements in particular (Мишев *и др.*, 1987).

At the root of spectrometric studies lies the fact that the reflected by the object radiation contains information about surface structure and roughness. This information is carried by the specific spectral distribution of the reflected solar radiation, i.e. by the reflectance coefficients $r(\lambda_i)$. These coefficients form the spectral reflectance characteristic $R\{r(\lambda_i)\}$ and are spectral informational features of the studied object. According to similarity of objects spectral reflectance characteristics different classes could be formed.

The parameters of studied object using measured spectral reflectance $R\{r(\lambda_i)\}$ are defined, i.e. inverse task is to be solved. A basis for the purpose provides the dependence of the reflectance features on the type and properties of the object. This dependence actually determines the informational content of spectral features.

The amount of light scattered and absorbed by a grain is dependent on grain size (Clark and Roush, 1984; Hapke, 1993). In Clark, *et al*., 1993 have been measured reflectance spectra of pyroxene as a function of grain size. As the grain size becomes larger, more light is absorbed and the reflectance drops. The reflectance decreases as the grain size increases.

Made literature review shows that previous investigations aim at analyzed mineral samples. In present paper a try to examined and analyzed obtained results from petrographic samples as mixed class of their rock-forming minerals is to be done.

The studied objects surface structure is of particular importance. It determines the distribution of reflected from surface radiation. Four type of surfaces could be group.

Orthtropic surfaces diffusely or evently reflect the incident flux in all directions. Specular surfaces reflect the incident radiation mainly in the incident beam plane at an angle equal to the angle if incidence. Dry stony surfaces and denudated rock soils have this type of reflectance within the visible range. Anti-specular surfaces reflect to a maximum of the direction of the emision source. Combined surfaces have two reflectance maxima of the incident radiation – specular and anti-specular.

Mentioned above group have to be include in results interpretation. If a priori information is not enough it could be bring a lot of omissions in interpretation. It is important to know technical parameters of used apparatuses and experimental conditions.

The studied petrographic samples are with natural roughness and with different mineral grain size. The aim is approximation of laboratory spectrometric measurements to natural one. As another confusing factor in spectrometric measurements is cut or polished sample. Polished and mirror surfaces could be make a change in spectral reflectance coefficients value.

Laboratory spectral reflectance measurements in range (0.4 - 1.1 μm) with $\Delta\lambda$=20 nm of granites (10 samples) were performed. It was used spectrometric system for remote sensing SPM-1, made in STIL-BAS (Илиев, 2000).

RESULTS AND DISCUSION

Figure 1 shows spectral reflectance characteristics of studied granites. Obtained values of spectral reflectance coefficient depend on mineral grain size, i.e. on petrographic structure. Reflectance feature of coarse-grained granites is almost horizontal or with a small angle (0-15), of medium-grained the angle is 15-30 and of fine-grained the slope is over 30 .

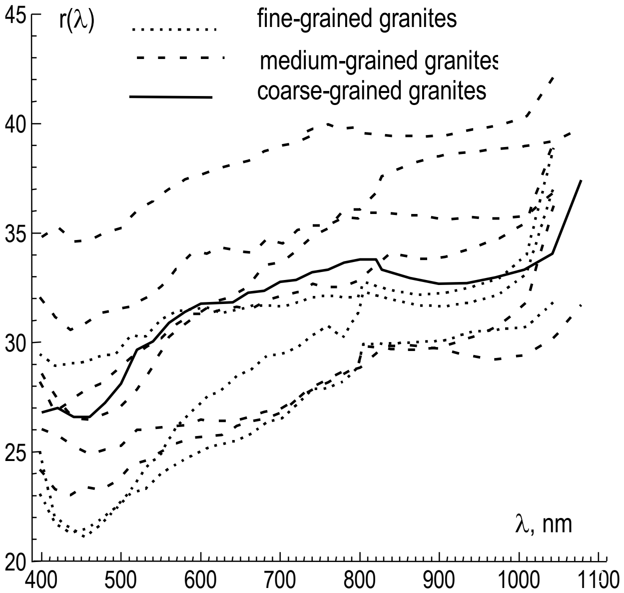

Figure 1. Spectral reflectance of granites with different structure.

Conventionally numerical symbols for three types structure are: 1 – for fine-grained granites; 2 – for medium-grained granites and 3 – for coarse-grained granites. The aim fo this substitution is possibility to analyzed grain size effects in spectrometric measurements.

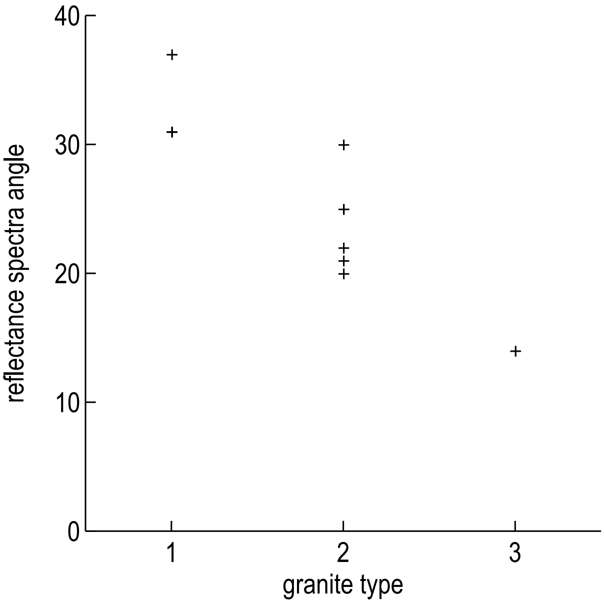

Figure 2. Relationships between granite type structure and reflectance spectra angle.

In advance it was done petrographic analysis on mineral composition, percentage mineral contents, structure and roughness of granites. Figure 2 shows relationships between granite type structure and reflectance spectra angle. It can be seen that the reflectance angle decreases as the grain size increases, i.e. the structure is changed from fine-grained to coarse-grained.

Table 1. Compare structural description.

N	Name	Structure in Figure 1	Structure in determination
1	Granite	Fine-grained	Medium-grained
2	Porphyry granite	Medium-grained	Medium-grained, K-felspar porphyries
3	Porphyry granite	Coarse-grained	Coarse-grained, Plagioclase porphyries
4	Two-mica granite	Medium-grained	Medium-grained
5	Porphyry granodiorite	Medium-grained	fine-grained, K-felspar porphyries
6	Granite	Medium- to Coarse-grained	Medium-grained
7	Granite	Medium-grained	Fine- to Medium-grained
8	Granite	Medium-grained	Fine- to Medium-grained
9	Granite	Fine-grained	Fine- to Medium-grained
10	Granite	Medium-grained	Fine- to Medium-grained

In Table 1 is present the structural description of studied granites in petrographic analysis and in spectral reflectance characteristics. The comparision shows good coincidence of structural description in two used way.

Roughness is another factor which spectral reflectance characteristics of granites depend on. It was registrated (Spiridonov, *et al.*,1980; Борисова, 1996) that polished and smooth rock surfaces increase spectral reflectance coefficients. In present experiment only two samples are with almost smooth surface. It can be seen (Figure 1) in higher spectral reflectance coefficient values.

CONCLUSIONS

An advantage of spectrometric investigations is a lot of information including in obtained results. This allowed their use as decodal indication for type classification of studied objects.

Analysed spectral relfectance characteristics content a complex information. Their type depend on set of factors (color, determined by proportion in mixed class granites of salic and mafic rock-forming minerals; structure and roughness of the samples). We can conclude that study surface effects in spectrometric measurements are:

- reflectance spectra angle of granites;
- higher spectral reflectance coefficients values obtained from more smooth granites.

The author would like to thanks to assistant Prof. B. Banoushev from Mineralogy and Petrography Department at Mining and Geology University "St. Ivan Rilski" for his help and consigned petrographic samples.

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