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NAJZNAČAJNIJI KARSTNI IZVORI BOSNE I HERCEGOVINE I NJIHOVO MESTO I PROMOCIJA U VELIKOM MEDJUNARODNOM PROJEKTU MIKAS (NAJZNAČAJNIJI KARSTNI IZVORI SVETA)

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Bruno Tomljenović

PREGLED STRUKTURNE GRAĐE I TEKTONSKOG RAZVOJA SREDIŠNJEG DIJELA DINARIDA I JUGOZAPADNOG DIJELA PANONSKOG BAZENA OD PERMO-TRIJASKOG RIFTINGA DO NEDAVNIH POTRESA U HRVATSKOJ I U BOSNI I HERCEGOVINI

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Alem Logo

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FROM VOLCANOLOGY TO PETROGENESIS: AN EXAMPLE FROM CENOZOIC VOLCANIC ROCKS OF SERBIA

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Key words: volcanic rock, pyroclastic deposit, dacite, andesite, quartz latite, lamproite, magma mixing, explosive activity

Abstrakt: It is generally thought that field observations and macro- and microscopic petrographic descriptions of magmatic rocks belong to, albeit unavoidable, routine methods that commonly do not provide valuable petrogenetic inferences. Such an attitude is wrong not only because it relies exclusively on up-to-date geochemical and isotope techniques but because in such away other information can be seriously neglected. In this review paper, we argue that volcanological and petrographic characteristics that are usually acquired solely by field- and optical investigations, may indeed serve as petrogenetic indicators. For elaborating this, we refer to examples provided by Serbian Cenozoic volcanic rocks.

The majority of acid/intermediate Cenozoic volcanic rocks in Serbia formed between Oligocene to earliest Miocene and can be grouped into: 1) Oligocene dacite-andesites thatemplaced as shallow intrusives, lava flows, extrusions and accompanied autoclastic facies (e.g., Slavkovica, Ibar Valley, part of the Rogozna Mts.) and 2) late Oligocene/earliest Miocene quartz latites that appear as extrusive, shallow intrusive facies and as widespread pyroclastic deposits (e.g. Rudnik, Ljig-Belanovica, Borač, Kotlenik, etc).

The existing petrogenetic interpretation proposes that Oligocene dacite-andesites originated by fractionation and crustal contamination of primary magmas formed by melting of the mafic lower crust. On the other side, the petrogenesis of late Oligocene/earliest Miocene quartz latites involved mixing between two types of magma – an acid calc-alkaline magma compositionally similar to those that had produced the older dacite-andesites and 2) a high-K/ultrapotassic lamproitic/lamprophyric melt that comes from the metasomatized lithospheric mantle. The processes of magma mixing were responsible, first, for elevated potassium contents in hybrid magmas (i.e., quartz latites) as well as for triggering highly explosive eruptions and for the formation of pyroclastic deposits.

Accordingly, for differentiating the products of these two Cenozoic volcanic episodes is very useful to make the accurate petrographic determination of the present volcanic rocks and to reveal whether the studied volcanic succession formed via explosive eruptions or not. This information can be acquired by common field observations and by studying thin- sections, however, this approach requires an advanced understanding of the link between volcanological facies, rock petrography and petrogenetic processes. For accurate petrographic classification of volcanic rocks, it is sometimes not sufficient to recognize the present phases, particularly if differences are subtle as those between dacite and quartz latite.

Both dacite and quartz latite may contain only plagioclase and quartz as phenocrysts and a similar fine-grained (or aphanitic) matrix, which makes their petrographic distinguishing difficult. The absence of sanidine in quartz latite is a common phenomenon, either because it did not crystallize or it appears in phenocrysts too large (and too rare) that may be not comprised by thin-sections (or even by hand-specimens).

In such cases, the researcher should try to find evidences of magma mixing processes. These textures record disequilibrium conditions caused by the interaction of two melts of different composition and temperature; they are mostly represented by: sieved plagioclase (tiny inclusions of glass inside plagioclase phenocrysts), strongly resorbed quartz crystals (rounded and/or embayed), pyroxene-bearing selvages around quartz, phlogopite rims over biotite and hornblende phenocrysts as well as by the presence of various xenocrysts and xenoliths. The recognition of any of such textural and mineralogical evidence is suggestive that the studied rock crystalized from a hybrid quartz latite magma rather than from a dacite one.

The recognition of true pyroclastic rocks among many types of volcaniclastic deposits is crucial for inferring the role of explosive eruptions. In our older geological literature, especially in the Explanatory Books of the Basic Geological Map of the Socialist Federative Republic of Yugoslavia (scale 1:100.000), volcanological considerations are either absent or very poorly present. As a consequence, the Explanatory Books contain quite a few examples of volcaniclastic rocks that have been classified as pyroclastic rocks without a proper argumentation. Even non-volcanologists must know that pyroclastic rocks originate exclusively by explosive eruptions either as pyroclastic fall- (agglomerates, lapilli-fall deposits and tuffs), pyroclastic flow- (block and ash flows, pumice and ash flows, etc) or pyroclastic surge deposits, depending on the mechanism of transportation and deposition of tephra (a collective term for all particles ejected during explosive volcanic events). Any other fragmentation mechanism (e.g., autoclastic and hyaloclastic brecciation, hydraulic fracturing or weathering) or transportation mode (e.g., pure gravitation, water currents or wind) of volcanogenic detritus produce non-pyroclastic deposits; such as, among many others, autoclastic breccia, lahars, debris flows or debris avalanches). Valuable insights into the true character of volcanic facies can be acquired yet in the field, although it requires some basic volcanological knowledge. The presence of fragments of highly vesicular lava, such as pumice or scoria, is solid evidence of explosive volcanic activity simply because the major driving force for volcanic explosions is expanded volcanic glass. There are many other criteria for recognizing primary pyroclastic facies and it is out of the scope of this paper to elaborate all them in detail, however, we must underline again that attributing any fragmented volcanogenic rock to pyroclastite may be a serious mistake.

Taking all this into account, we suggest that classic field and petrographic observations, often considered routine, can be of large significance even for complex and multidisciplinary petrological studies. However, if these investigations are applied too routinely, then not only that they are less useful but they can easily bring serious confusion.

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