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VERSITA

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New advances of understanding physical volcanology processes in the Carpathian-Balkan Region from a global perspective

Editorial

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The current issue of the Central European Journal of Geosciences (CEJG) contains several papers devoted to physical volcanology processes. This is the second topical issue published in the CEJG.

The Carpathian-Balkan Region (CBR) including the Carpathian-Pannonian Region (CPR) is a perfect site in Central and Southeastern Europe where young and active volcanism co-exists with older volcanic terrains that were formed in a strikingly similar way to their active, younger counterparts. This scenario makes the CBR - CPR a perfect playground to study, compare, and advance our knowledge of the volcanic processes that generated a broad range of volcanic landforms, volcano-sedimentary environments and associated ore mineralizations. This unique nature of the CBR - CPR manifested in the past decade through increased research activity, focused on understanding the physical volcanology of various volcanic systems from intra-continental to subduction related tectonic settings. The proximity in both age and space of various volcanoes, their erosional remnants, as well as volcanogenic sediment-filled basins in such diverse environments, ranging from submarine to lacustrine to continental realms, provide an exceptional location to understand physical volcanology processes in general.

This geological aspect of the volcanism in the CBR–CPR provided vivid and active research programs in the past decades to contribute to our understanding to volcanic processes both in a regional and global scale. Based on this natural progress, various research programs were developed on volcanic areas in Central and Southeastern Europe. Many of these provided far-reaching outcomes that the global volcanic community has just started to discover. While these research projects made significant contributions to our understanding of the geodynamics [1–10] and related petrogenesis of magmatic processes [8, 11–21] and their time and space distribution pattern [22–26] in the CBR–CPR , the physical volcanology aspects of such models were commonly overlooked or have not been well connected to other studies. Physical volcanology research was commonly individually focused on specific problems or volcanic reconstruction of a specific region [27–46]. In addition, physical volcanology as an independent research field has not been practised in accordance of its most recent global developments and therefore such studies were

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fragmented, rather than cohesively incorporated to the geological research of Central and Southeastern Europe. This knowledge gap and didactical problems generated a natural move to initiate a focused approach, calling for research outputs relevant to the CBR – CPR that would be collected to form a single Journal volume. The Central European Journal of Geosciences as a new regional Journal (http://versita.com/science/geosciences/cejg/) with a global aspects and publication goals was the ideal media to arrange a thematic issue on physical volcanology based on research from the region and subjects directly or indirectly relevant to the CBR–CPR volcanology.

Physical volcanology research has a great tradition in Central and Southeastern Europe. This region has provided fundamental contribution to our understanding on basic petrological, sedimentological and stratigraphical knowledge on Miocene to Recent volcanic rocks. In addition, the long-lasting mining history of the region associated with volcanic-hosted mineralization was a driving mechanism to pursue volcanic researches for a significant period. While many of the outcomes of those early volcanic researches are still valid or in use, the dramatic developments in physical volcanology in the past three decades, many of them manifested in key textbooks [47–50] and review articles [51–62], generated a need to revisit, revise, and initiate new research directions to understand the volcanic framework of the volcanic regions of the CBR–CPR. The past years' physical volcanology research activity in Central Europe resulted in a large number of recent publications, including new, locally published, text books and lecture/workshop notes [63]. Several formal (e.g. 2nd International Maar Conference, 2004; PANCARDI meetings; Society of Economic Geologists meetings) and informal international workshops have been organized in the region in the past decades. These events gradually defined core physical volcanology research subjects and provided a means for researchers and research institutes to coordinate and facilitate volcanic research in the region. These workshops were the core scientific meetings to identify new developments in physical volcanology and provide measures to adopt new results to the region's physical volcanology research. In this process numerous scientific and technical obstacles were encountered. Most importantly, the fragmented nature of Central Europe, with its numerous countries and their political divisions, has produced a very diverse range of research across the region. Some countries put significant effort into supporting volcanic research while others acted differently, with the studied volcanic regions located between them. As a result, especially in volcanic geology, geological mapping projects were commonly poorly coordinated, causing confusion among researchers trying to understand volcanic stratigraphy units, lithologies and their interpreted volcanic processes. In addition, due to the shortage of national research funds in many of the region's countries, an increasingly uneven scientific knowledge has been developed, especially in research fields represented by newly developed interdisciplinary subjects such as physical volcanology.

Despite these problems, the coordinated and collaborative research methods, especially in the past two decades, culminated in numerous high level publications, many of them in leading research journals from scientists who have worked on physical volcanology subjects for a long time and have great expertise gained from similar researches on active volcanic regions elsewhere. This collaborative work resulted in the production of many joint volcanology maps of the region, joint international research projects specifically involving top researchers with expertise on active volcanic processes, hosting of international field workshops attended by leading experts, and ultimately, numerous publications where regional experts worked together with leading volcanologists. This topical issue on physical volcanology of the Central European Journal of Geosciences is one of the most recent attempts to provide a venue for thematic research outputs on physical volcanology that connect, facilitate and encourage others to explore the physical volcanology potential of the region.

This topical issue is primarily based on a special technical session offered for the XIXth Congress of the Carpath-Balkan Geological Association (http://www.cbga2010.org/CBGA.htm) held in Thessaloniki, Greece between 23rd and 26th of September, 2010. In this technical session presentations were invited on physical volcanology studies primarily based on examples located in the Carpathian-Balkan Region, as well as research that has relevance, similarity, or recent or ancient analogy from elsewhere in the world that could be applied directly to volcanic systems in the Carpathian-Balkan Region. This session, and as a subsequent output, this topical journal issue, collected works on theoretical approaches for understanding the physics of explosive volcanism, volcanic mass flow processes and their natural hazard implications, quantifying sedimentary budgets in volcano-dominated sedimentary basins and geochronological methods developed, trialed in, or compared with volcanic systems of the Carpathian-Balkan Region. The CBGA session was officially supported by the International Association of Volcanology and Chemistry of the Earth Interior's (www.iavcei.org) Commission on Volcanogenic Sediments and Commission on Monogenetic Volcanism.

Contributions that were submitted to the CEJG as full length manuscripts went through vigorous peer review.

The accepted papers form a logical set of works dealing with both regional and global aspects of associated volcanism of the CBR–CPR.

The issue starts with a detailed review on the volcanic forms described, reconstructed or compared with modern analogies from the Carpathian – Pannonian Region (CPR) [64]. The CPR is a geodynamically significant volcanic region where volcanism started as a direct result of a subduction process, forming arc volcanic chains along the Carpathian front. The Miocene subduction-related, commonly calk-alkaline, volcanic processes gradually gave place to a post-subduction/post-collisional back-arc volcanism, that manifested in the formation of intraplate volcanic field formations across the Pannonian Basin. This review is among the first works intending to summarize our current knowledge on the volcanic history of a region that is very complex, but well-constrained in time and space. The real value of this work is the up-to-date nature of current studies in the region, their link to global volcanic studies, and an un-precedented cooperative nature of presentation involving authors across the region. The CPR is among those few relatively well-exposed and well-studied regions where the older volcanism provides a deeper exposure of cores of arc-related as well as intra-plate volcanoes. The CPR is also unique from a geotectonic and geo-environmental point of view. It provides a good basis for comparison to areas where island arc volcanism takes place in a diverse sedimentary environment where volcanic islands are located in shallow marine to near-sea level island-confined regions, such as the present day Vanuatu arc (Figure 1), Solomon Islands, or Papua New Guinea.

The volume also presents a paper from the Aegian arc [65] as another nearby potential modern analogue to the CPR arc volcanism, providing good evidence for the future potential on volcanic research in SE Europe. This petrological paper documents the stages and main steps of rhyolite petrogenesis on the basis of the Kos Plateau rhyolitic explosive volcanism in Greece. The paper primarily concentrates on the petrologic aspects of the rhyolite formation in arc settings, which can be connected well to the older rhyolitic volcanism once associated with Miocene arc volcanism in the CBR–CPR.

A short note devoted to further debate on evolved explosive volcanism in arc settings provides a caution regarding reconstructing eruptive environments when arc volcanism takes place in a near sea-level environment. This report documents field observations that are inconsistent with previous documentation of subaqueous emplacement mechanisms in one of the most voluminous silicic eruptive products in a modern arc setting in the Vanuatu volcanic arc [66]. This paper also connects well to the problem faced in many volcanic areas of the CBR - CPR, namely how, and to what extent, can we reconstruct eruptive environment in older settings.

The volume further propagates this problem from a different angle reporting field observation based data with chemical data on coherent magmatic bodies exposed in core zones of a Miocene composite arc volcano along the Carpathian volcanic arc, suggesting the total magmatic output occurred via intrusive processes along the entire volcanic arc [67]. This report sheds light on the need for future comparative studies between modern and older, more deeply exposed, volcanic arcs, to quantify the relative role of intrusive processes that can significantly contribute to the total eruptive volume. Failing to take into account their value in magma output estimates can cause significant total magma output underestimation. In addition, their chemical characterization also needs to be included in complex studies of arc volcanism to obtain a more refined picture of the melt evolution along any arc segments.

A further report provides a brief summary of andesite petrogenesis, based on chemical data collected in the last three decades from well-known andesite-dominated composite volcanoes of the North Island of New Zealand [68]. This review covers basic petrographic to isotope chemical data and provide a good summary that has direct relevance to volcanic petrogenesis of the very common rock type of andesites located along the erosion remnants of composite volcanoes of the Mioocene Carpathian volcanic arc.

The modern analogy approach to link the CPR volcanism to the modern, active global "picture" culminated in a work that intended to link monogenetic volcanic fields across the globe with those eroded fields that represent the post-subduction, intra-plate volcanic phase evolution of the western Pannonian Basin [69]. In this paper a step-by-step link and argument is given to demonstrate the small-volume, commonly atypical, monogenetic nature of the western Pannonian Basin monogenetic volcanic field evolution, pinpointing the need for further studies to find a global link among volcanic fields that are controlled by internal versus external parameters.

To demonstrate the above mentioned link a case study is given from a recently intensively studied small volume Plio-Pleistocene basaltic volcano of the Bakony-Balaton Highland Volcanic Field from western Hungary [70]. The nature of this volcano is atypical from the monogenetic volcanism perspective, displaying clear volcano-sedimentary evidence of its multiphase eruption style that built up a complex monogenetic volcano.

A paper closely related to the previous work demonstrates some problems with radiometric dating (K-Ar) of alkali basaltic rocks that contain leucite, nepheline or anal-

Figure 1. Lopevi volcano in the modern Vanuatu volcanic arc represents a conical shape andesitic composite volcano emerges from the Pacific ocean up to 1413 m above sea level. The perfect cone provides regular sub-Plinian explosive eruptions, Strombolian style summit and rift aligned fissure eruptions accompanied with various volume of lava effusion. The volcano provides substantial volcanic debris ready to be transported to the surrounding marine basins to build subaqueous volcaniclastic aprons. A volcano like Lopevi, and other similar volcanic archipelago-forming modern arcs are the perfect analogies for the eruptive environments of the Miocene arc volcanism along the Carpathian volcanic arc.

cym [71]. This work clearly demonstrates the potential variations in age data that can be obtained by various sample preparation conditions from rocks that are potentially rich in leucite. The obtained age variation is far greater than can be acceptable for determining true geological ages. The authors also provide a method to overcome this problem, and for the first time report similar old ages for the volcanic eruption of a volcano, preserved only as a plug today, that coincide well with the 8 Ma onset of basaltic volcanism in the Bakony- Balaton Highland Volcanic Field in Hungary.

The volume closes with an analytical paper addressing the deep textural features of volcanic glass shards formed due to magma and water explosive interaction associated with the evolution of a largely externally controlled monogenetic volcanic field in western Hungary [72]. This paper applies new a method to characterize volcanic ash particle morphology and connect those data with potential fragmentation history of the mafic melt involved in explosive eruptions.

This volume is among the first thematic volumes prepared specifically on volcanology aspects of the Miocene to Recent volcanism in Central to South-eastern Europe with a strong intention to highlight the potential to link ancient to recent volcanism. We hope the reader finds this volume useful and informative in both a regional and global perspective.

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