

ESF Exploratory Workshop on

**New Perspectives on Volcano
Behaviour, Volcanic Hazards and
Volcanism-Related Mineral Resources**

Scientific Report

Sovata, Romania, 4 - 7 September 2007

**Convened by:
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1. Executive summary

General information on workshop organisation

The Workshop was held in Sovata, Romania, between 4 and 7 September, 2007, in accordance with the proposed Workshop schedule. Activities associated with the workshop took place over two full days plus an additional 2 half days.

The workshop was funded by the European Science Foundation and logistically supported by the Sapientia Transylvanian Hungarian University, Cluj-Napoca, Romania

The local Organizing Committee included:

Alexandru Szakács, Sapientia Transylvanian Hungarian University, Cluj-Napoca, Romania
Ágnes Gál, Babeş-Bolyai University, Cluj-Napoca, Romania
Eugenia Niţoi, Geological Institute of Romania, Bucharest

ESF delegate to the workshop: Dr. Olgeir Sigmarsson, Clermond-Ferrand

Logistics

All the indoor workshop activities, accommodation and meals took place in the Danubius Hotels complex in Sovata, Mureş County, Romania, as follows:

- Accommodation of participants in the Brădet Hotel** (double rooms)
- All meals in the Sovata Hotel.

Oral and poster sessions, as well as discussions were held in a suitable conference room (Hall B) of the Sovata Hotel.

Participation

The workshop was attended by 21 scientists from 8 countries: Czech Republic (1 person), France (2), Hungary (3), Italy (6), Russia (2), Romania (5), Switzerland (1), UK (1).

Workshop package

All participants received a workshop package containing:

- Workshop bag and pencil (courtesy of the Sapientia Transylvanian Hungarian University)
- Badge (with name and country)
- Workshop volume (34 pages)
- ESF information materials
- Leaflet presenting the Sapientia Transylvanian Hungarian University
- Tourist leaflets about Sovata and surroundings (courtesy of Danubius Hotels)

Workshop Volume

A 34 page workshop volume was supplied to each participant. The content of the volume was as follows:

- Introduction, including 1) Welcome, 2) Information on venue, registration and logistics, 3) Useful phone numbers and addresses, 4) Workshop Project essentials (extracts from the

- submitted Workshop proposal to ESF)
- ESF Exploratory Workshop Philosophy
- Objectives of the Workshop
- Workshop programme
- Workshop participants (with affiliation and full addresses)
- Abstracts of oral and poster sessions
- Field trip description
- References
- Location maps and geological-volcanological sketch maps

Workshop objectives

The main objective of the workshop was to examine a so far unexplored interdisciplinary scientific issue: the influence of edifice instability-related processes, volcano-basement interaction and related tectonic features on the evolution of volcanic hydrothermal systems and, as a consequence, on the emplacement of hydrothermal mineral deposits.

The workshop, through discussions around the field relationships in the East Carpathians volcanic range (Romania), explored the potential of this new research avenue to highlight synergistic opportunities for future novel collaborative research amongst the workshop participants. The interdisciplinary approach of the workshop has been enhanced by the participation of scientists specialized in 1) physical volcanology of active volcanoes, 2) geology of eroded volcanic terrains, 3) petrology and geochemistry of volcanic rocks, 4) tectonics of volcanic edifices and their basement, 5) volcano topography and geomorphology, 6) hydrothermal systems and fluid-rock interactions related to volcanic environments, 7) volcanism-related mineral deposits, and 8) geochronology of volcanic areas.

Workshop program

The formal part of the program included:

- opening ceremony with
 - 1) welcome talks of the Mayor of town Sovata, Mr. Ferenc Péter, and Rector of the Sapientia Hungraian Tranylvanian University, Prof. Dr. László Dávid
 - 2) Talk by ESF Representative Olgeir Sigmarsson

The scientific program actually realised during the workshop followed closely the schedule planned in the submitted Wokshop proposal. It included the folowing events:

- plenary sessions presenting scientific contributions from participants:
 - 1) An overview of the local geology (1 talk)
 - 2) Invited talks on key topics of the workshop followed by discussions (6 talks)
 - 3) Poster presentations (each poster was briefly presented by its first author) followed by discussions (6 posters)
 - 4) Offered ad-hoc talks on subjects emerging from the invited talks, posters and discussions (3 talks)
- 2 field-trips: one in a well-exposed volcanic area of the East Carpathians, another in the Praid salt mine
- plenary discussion addressing workshop conclusions and plans for future cooperation and follow-up projects

The informal part of the programme included:

- 1) informal presentation of workshop participants and their scientific interests during the initial gathering
- 2) informal discussions on the workshop topics during dinners and field-trips
- 3) a short individual leisure programme in Sovata tourist resort area before leaving

Workshop atmosphere

Because 1) the relatively small and manageable number of participants and 2) the fact that the majority of participants already knew each other and interacted during various previous gatherings as co-participants in earlier projects (e.g. IGCP 455), an intimate, friendly working atmosphere was created allowing a smooth and trouble-free development of workshop activities, as planned.

Additional informal interactions, other than between workshop participants, including the ESF delegate, were not realised because the location of the workshop in a small tourist resort area (but close to field-trip objectives) lacking any academic or other scientific community. The only exception to this was the informal discussions we had with salt-mine geologist István Horváth who kindly guided us in the Praid salt mine and offered a short introduction to the geologic and mining history of the diapiric salt body.

General conclusions

We are confident the workshop successfully met its major objectives, offering a valuable forum for discussing an emerging interdisciplinary scientific topic at the fringes of volcanology, tectonics and ore geology. Scientists from a wide range of backgrounds examined the relationships between volcanic evolution, edifice instability, volcanic and basement structure, and volcano hydrothermal systems and related ore genesis. The major links between these processes were identified and discussed. Finally, possible avenues for follow-up activities and cooperation between participants and other interested scientists were explored within the ESF and other international institutional frameworks (e.g. UNESCO-IGCP).

2. Scientific content of the event

The workshop started on September 4th, 7.30 PM with opening of the Workshop, welcome talks by local and institutional hosts, followed by a talk given by ESF delegate (Olgeir Sigmarsson) presenting the philosophy, goals and organization of ESF, and the opportunities it offers to European scientific research and interchange. The introductory evening session concluded with presentation (by the Local Organizers) of the participants, workshop logistics and activities.

A short morning session of September 5th consisted of a presentation entitled “**Overview of the geology of the Neogene/Quaternary East Carpathian volcanic arc within the framework of the Carpathian-Pannonian Region**” given by A. Szakács in order to familiarize participants with the regional and local geological framework, evolution of volcanism during Neogene time in the area and the main related issues relevant to the workshop topic. After outlining the time-space evolution pattern of volcanism on the whole Carpathian-Pannonian Region (CPR) and of its south-eastern segment (the Caliman-Gurghiu-Harghita volcanic range - CGH - in the East Carpathians), the talk focused on volcano instability-related processes displayed in the CGH, such as edifice failure and related debris avalanche deposits, and volcano-basement interaction and related unusual tectonic features. The speaker gave some further details by responding to questions posed by participants.

Between 10 AM -5 PM the party went out for a field-trip, during which debris avalanche deposits resulting from the edifice failure of the Rusca-Tihu volcano in the Calimani Mts., ca. 8 Ma ago, were examined in a number of roadside outcrops along a segment of the Mureş valley separating the Calimani Mts. from the Gurghiu Mts. Explanation at the exposures, given by A. Szakács, emphasized that each outcrop displays specific lithological features of the deposits (block facies, matrix facies, jig-saw-fit blocks, soft-sediment deformation, hydrothermal alteration, etc.). Features (e.g. strike-slip faulting) relevant for debris-avalanche emplacement mechanisms were also seen and examined by the participants. Lively discussions arose on the relevance of the hydrothermal alteration seen in the debris avalanche deposits at two exposures, and their significance from the viewpoint of edifice instability, hydrothermal mineralization and ore genesis, in particular whether they were generated via processes related to edifice collapse and debris avalanche formation or they predated those processes and even contributed to volcano instability leading to failure.

Upon returning from field-trip, an evening oral session, chaired by A. Szakács, was held between 7-8.30 PM. The invited talks were focused on general aspects of volcanic edifice evolution and instability, deformation and mutual influence between volcano and basement. Three invited talks reviewed key issues relevant to volcano instability and volcano-basement interaction.

1. **D. Rust**, in the name of a larger group of scientists, summarized what is currently known on how and to what extent substrate influences volcanic edifices with relevant worldwide examples: “**Edifice substrate influences on volcanoes**”. The three major substrate characteristics - structure, lithology and topography - were first listed and briefly discussed, then the main results of their influence were shown – orientation and style of lateral collapse, changes of the magma delivery system, shifting erosion paths. The speaker emphasized the inherent difficulties of assessing substrate influence mainly due to changing conditions with time and due to further volcanic activity obscuring the resultant features. Processes and features connected with substrate influences were exemplified in the second part of the talk: faulting of the volcanic edifice (Kizimen, Ollague, Reventador), substrate faulting with a

special emphasis on strike-slip faulting (Mayon, analogue models) and substrate tilting (analogue models), reorganization of stress regime (Stromboli, Reventador, Ollague), reorganization of magma feeding system (Stromboli, Ollague, Reventador), land-sliding and erosional paths (Pinatubo, Etna), rheological contrasts in the substrate (Etna, analogue models), effects of buried topography (Etna). A possible future research direction was suggested by the ending question of the talk: which of these is likely to be illuminated by studying the exposures provided by deeply eroded volcanoes?

2. The talk by B. van Wyck de Vries entitled “**Growth, deformation and shape of volcanic-magmatic systems**” started from the premise that volcanic systems are not well known at depth, or poorly integrated with the surface, hence the need of searching for field evidence and of modelling the inferred processes. Experience gain by such an approach at Laboratoire Magmas et Volcans (LMV), UBP Clermont Ferrand, France, addressing deformation induced by intrusion below volcanoes was summarized. Deformational and topographic features expected to be generated by intrusion in volcano substrates were pointed out through analogue modeling (grabens, en echelon fractures, topographical bulging), then natural examples actually showing those surface features were sought and found (Maderas, Nicaragua and Tata Sabaya, Chile). Deep structural features induced in substrate and lower part of volcanic edifice - fold belts, thrust and strike-slip faults - by a cup-shaped shallow intrusion have been pointed out at Mull, UK. Analogue modeling of this example allowed surficial deformation features to be inferred (edifice uplift, brecciation and gravity sliding) of the currently deeply eroded structure. Further research planned or ongoing at LMV on links between intrusion and volcano deformation was shown finally.

3. In his talk entitled “**Volcano mapping as tools for understanding volcanic constructs and evolution**” G. Groppelli presented an overview of the modern methodology of mapping in volcanic terrains, based on a stratigraphic approach, which allows unraveling volcanic structure and inferring long-term volcano evolution. Identifying, mapping and interpreting three types of units – lithostratigraphic, lithosomatic and syntehmic – results in a complete and complex picture of volcano evolution and structure. The relevant examples given include Etna and Nevado de Toluca (Mexico). It is extremely interesting how tectonic features such as fault systems can be integrated in such a systemic stratigraphic approach, as exemplified by Nevado de Toluca volcano. Finally it was pointed out how such a cartographic approach, which is at the very base of any volcanological research, could help understanding processes and structures related to volcanic edifice instability.

The evening session ended with poster displays (8.30-9 PM) and informal discussions around them.

The scientific program of September 6th started with a morning visit to the Praid Salt mine. The history of the mine and of the salt mining along with a short introduction to the geology of Miocene salt formation in the Transylvanian Basin and post-formation salt diapirism was given on-site by salt-mine geologist István Horváth. The current use of part of the mine for curative purposes was also explained. Then participants examined the floor, walls and ceiling of the huge mine halls where deformation structures of the diapiric salt body are well exposed. As was explained by A. Szakács during his introductory overview of regional and local geology, the salt diapirs developed at the eastern margin of the Transylvanian Basin are order-of-magnitude larger than those occurring along its western margin due to interaction between the huge composite volcanic edifices of CGH range to the east and their basement

including the rheologically weak salt layer. Salt rheology was supposedly also influenced by thermal effects of the neighboring magmatic systems enhancing the diapiric uprise of salt. The salt layers in the mine walls are tightly folded with structures suggesting sequential salt deformation peaks. No systematic asymmetry of folds, due to impingement from the east (where the volcanic edifices are located), has been identified so far. Discussions among participants mainly focused on the extent to which volcano loading and thermal effects contributed to salt diapirism, and how salt deformation beneath the volcanoes fed back eventually to edifice deformation. Due to erosion and heavy vegetation, no obvious deformational structures have been revealed so far on the neighboring Seaca-Tatarca volcano. However, purpose-oriented studies could result in identification of such structures in the future.

The afternoon programme of the day started with a short talk by I. Pinteá on glass-foam/bubbly melt inclusions in phenoclasts of the Miocene Dej Tuff (Transylvanian Basin, Romania) as recording pre-eruptive magma chamber and conduit processes. Animated discussions took place among fluid-inclusion experts present at the workshop on the significance of the displayed examples of glass-foam inclusions in volcanic rocks. The talk was followed by poster presentations. Each poster author briefly (<10') presented his/her (plus co-authors) poster. Posters covered a variety of subjects, according to the author's expertise, touching the workshop's interdisciplinary approach, including 1) evolution and stability of edifices at active (Stromboli, Corazzato et al.) and old, dissected (Duproske hory, Czech Republic, Rapprich) volcanic structures, 2) geomorphological aspects of volcano flank stability at modern (Sancy, Massif Central, France) and old dissected (Calimani, Romania) volcanoes (Pop), 3) fluid and melt inclusion studies at subduction-related volcanoes in the Carpathians (Pinteá), 4) links between volcanism/volcanic system evolution and hydrothermal processes/ore genesis in general (Márton) and in the Tokaj Mts., Hungary (Kiss et al.). Discussions were held after each poster presentation.

The afternoon program continued with an oral session chaired by D. Rust including three invited talks, all of them addressing the relationships between volcanic evolution, edifice instability and hydrothermal ore genesis.

1. A. Szakács reviewed current knowledge on the broader subject of edifice instability and the consequences of instability-related processes on a wide range of magmatic, tectonic and hydrothermal processes. The talk entitled **"Volcano instability, re-equilibration processes and their possible influences on the volcano-hydrothermal system"** first addressed the causes and types of edifice instability (intrinsic and extrinsic instability factors), then emphasized that the actual stability status of a volcano is the net result of a balance between instability factors, and features/processes counteracting instability ("stability factors") arriving to the suggestion that both volcanoes and their evolutionary stages could be subdivided into "unstable" and "stable" types. Unstable volcanoes naturally tend to restore their lost stability through a number of re-equilibration processes, among which edifice/flank failure and volcano-basement interaction are the two most important. The consequences of edifice/flank failure were then examined. The types and extent of those processes primarily depend on the size of the event: major failure events should have deep and long-lasting effects, being turning points in the further evolution of the volcano itself and its environment, including the volcano-hydrothermal system. Depressurization, edifice unloading and the instant nature of the process are listed as the key factors governing the influence of edifice/flank failure. Effects on the volcano plumbing system are related to magma chamber processes influenced in opposite ways by pressure drop (shifting the system towards the liquidus) and volatile loss (promoting crystallization); the relative importance of those processes are variable depending

on volatile content, hence chemical composition of the magma involved. Further effects of edifice failure on the short-term and long-term volcano behavior, topography, erosion and sedimentation, as well as on basement were briefly discussed. The major influence of edifice failure on the volcano hydrothermal system and ore genesis was then addressed in some more detail. Both short-term (boiling, destruction of the shallow system and precipitation of pressure-sensitive ore minerals) and long-term processes (dramatic change in the hydrologic regime of the hydrothermal system and shift towards low-T and dilute conditions) were considered, as well as their consequences in ore genesis (with a recently reported example at Lihir, Papua-New Guinea). The effects of volcano-basement interaction on the volcano hydrothermal system and ore genesis are more elusive due to the gradual nature of the processes involved and yet to be addressed by research, the speaker emphasized. At a speculative level, one may assume that the focus of both volcanic activity and hydrothermal fluxes are strongly influenced (e.g. shift from center to periphery) by the changing stress regime in both edifice and basement due to volcano spreading and other processes related to volcano-basement interaction. The talk concluded that volcano instability-related issues represent promising avenues of future investigation in volcanological, tectonic and ore-genetic studies. A number of possible subjects of future research pursuits were pointed out during this presentation.

2. A second talk of the session entitled "**Relationships between volcanic spreading and geothermal systems at Mount Amiata volcano**" was given by A. Borgia presenting a detailed and relevant case study of a relatively small-sized felsic volcanic system in central Italy and its related geothermal system. Monte Amiata volcano is strongly interacting with its substrate mostly by volcano spreading processes inducing deformational structures within both the edifice and its ductile basement. By using a multidisciplinary approach, including numerical modeling, it was suggestively demonstrated how volcano/basement deformation is reflected by the geothermal features of the area.

3. The final invited talk of the session entitled "**Styles of hydrothermal systems and ore deposits in terrestrial intermediate-acidic volcanic systems**" given by F. Molnár introduced key issues of volcanism-related hydrothermal phenomenology. To set the scene, the spatial locations of hydrothermal ore deposition were shown in relation to volcanic edifices at both volcanic (0-1 km depth) and subvolcanic (1-3 km depth) levels where epithermal Au-Ag-Cu -Pb-Zn deposits and porphyry Cu (-Au, -Mo) deposits form, respectively. After presentation of the general mineralogical and geochemical features of low-sulphidation epithermal ore deposits, their particular volcanological setting (low relief volcanic area) and hydrothermal facies were described. Their recent analogies are found as geothermal fields at and around active/recent volcanoes, such as in Japan. They were exemplified with the Miocene Tokaj Mts. volcanic-hydrothermal complex in Hungary where the position and the role of the paleo-water-table in ore deposition has been pointed out. In contrast, high-sulphidation epithermal ores characterize high-relief volcanic areas with their surface expressions found in craters. Both active (Naka-dake) and extinct (Iwato) Japanese volcanoes are given as examples of volcanoes hosting high-sulphidation epithermal systems. Porphyry-type ores occur in subvolcanic-plutonic environments as exemplified by the Paleogene Reck deposits in Hungary. The speaker then explained the genetic connections between the subvolcanic porphyry and the volcanic high sulphidation hydrothermal environments at stratovolcanoes. Finally, he estimated the influence of collapse phenomena on the hydrothermal system by breaching the shallow magmatic fluid system and destroying their related ore deposits.

During the evening of September 6th (7.30-8.30 PM), informal discussion took place commenting the subjects of the talks given before and other issues addressed during the workshop. Responding to an earlier “provocation” of A. Szakács, A. Belousov gave a short but relevant explanation, using examples and pictures of Kamchatkan volcanoes, of why large volcanoes are sometimes more stable than small ones: smaller volcanoes built up by eruptions of more felsic magma are destabilized by intrusions within the edifice, while large volcanoes made of more basaltic compositions erupt their less viscous magmas without generating intrusions inside the edifice. B. van Wyck de Vries presented a series of slides illustrating analogue modeling of debris avalanche processes and resulting deposits generated by edifice failure, in which tectonic and lithologic features seen in field studies at Tetivicha and Socompa volcanoes (Central Andes), such as thrusting, strike-slip faulting, normal faults, hummocks, substrate incorporation, levees, striae and reverse grading (some of them actually also seen during the field-trip along the Mures valley) have been reproduced and the mechanisms of their formation explained.

Profiting from his presence among the workshop participants, ESF delegate O. Sigmarsson was asked to express his opinion and advice on the possible follow-up paths of this workshop within ESF framework. He suggested the ESF Networking program as the most suitable follow-up opportunity for the group, which includes scientists from a relevant number of strong European researchers centers, including East European ones. He stressed that any further project to be successful should be well-focused and have leaders with the strongest possible track record.

The morning of the last workshop day (September 7th) was dedicated to the conclusions of the main results of the workshop and to discussion on the opportunities of future follow-up activities. A. Szakács evaluated the workshop as a fruitful meeting and its results as positive. All participants agreed and a consensus arose that the workshop results really deserved efforts at projecting future cooperation among participants in order to pursue the scientific issues addressed during the workshop. Then he briefly presented the outline of the discussion concerning follow-up of the Workshop results. Discussion led to the following conclusions.

1. Where to apply with follow-up projects? ESF and UNESCO-IGCP were both suggested as possible institutional framework possibilities. A. Szakács informed of ongoing attempts to obtain IGCP support for further cooperation in a subject with similar emphasis: a project submitted in 2006, involving some people attending the ESF Workshop, has not been approved for minor flaws and it was encouraged to be re-submitted this year. G. Groppelli stressed that IGCP projects are suitable only for organizing periodic gatherings of scientists of the group, but not for actual research activities. B. van Wyck de Vries opined that the ESF Networking Program should be followed as it was suggested by O. Sigmarsson last evening, because it allows stronger longer-term interactions between research groups, including periodic meetings, and also allows for using complementary infrastructural facilities existing at research centers where the groups belong. The network could be realized by groups active in at least 8 European countries (Italy, France, UK, Hungary, Romania, Germany, Russia and Czech Republic). D. Rust proposed that other European institutional opportunities, such as the Marie Curie Program, should also be taken into account.
2. Who should take the initiative organizing networking activities before submitting an ESF Networking Project? A. Szakács proposed that because of institutional and infrastructural weakness, the Romanian research group should pass the initiative to a Western European research centre with a stronger background for an ESF Networking Project. B. van Wyck de Vries offered Clermont-Ferrand University, France as a

suitable base for initiating the networking program. However, IGCP project resubmission should be in the further responsibility of its Romanian initiator. Participants agree.

3. When to apply? It was consensually agreed that the October 30, 2007 term of application for the ESF Networking Program application is unrealistic. The October 30, 2008 term should therefore be targeted. Resubmission of IGCP project is in charge of A. Szakács, F. Molnar, A. Tibaldi, deadline October 15, 2007.
4. Scientific target of the ESF Networking Project? A single, well-focused subject: volcano (G. Gropelli) or volcanic environment (A. Borgia) or volcanic system (B. van Wyck de Vries, A. Szakács). A multidisciplinary approach: all agree. Novelty of the networking target: the exploratory workshop's approach should be maintained. Impact: volcanic hazard, mineral resources, environmental issues (e.g. carbon cycle).
5. Title? "Volcanic systems: multidisciplinary approaches to understanding their behavior, environmental and social impacts/hazards"?
6. Steps to be followed:
 - a. Resubmit IGCP project: Szakács, Molnar, Tibaldi, more – October, 2007
 - b. Initiate virtual networking: van Wyck de Vries – end 2007
 - c. Check Marie Curie: Rust – March 2008?
 - d. Application for ESF Network program, 2008, October 30
7. Keeping contact via e-mail and, possibly, via video conference/Skype.

3. Assessment of the results, contribution to the future direction of the field

The EW-06-030 ESF Workshop assembled scientists from the volcanological and tectonic communities with a strong background of prior cooperation on modern volcano-tectonics subjects, together with scientists from the mineral deposits/ore genesis community to discuss and initiate common avenues of interdisciplinary research and cooperation in an emerging field of research at the fringes of physical volcanology, volcanic petrology and geochemistry, volcano-tectonics and ore genesis studies in volcanic environments. The strong interdisciplinary focus of the workshop – influence of edifice instability-related processes on volcano hydrothermal systems and related ore genesis – allowed the subject to be addressed from a variety of viewpoints by researchers with diverse backgrounds and expertise. This initial goal of the workshop has been fulfilled. Through state-of-the-art presentations of the various interacting subfields of research represented in the workshop, participants became aware of the most recent leading results of other groups and research subfields. In particular, ore genesis experts learnt about volcano instability and related processes, while physical volcanologists and experts in volcano tectonics were initiated in novel results of ore-genetic studies. These presentations helped workshop participants to identify and pinpoint the major issues of common interest at the intersection of the research fields considered, from which the ideas of further follow-up research and activities eventually emerged. From this perspective the workshop also met its planned goals.

From the European scientific cooperation perspective, and the future direction of the field, the workshop can be viewed as a first step in a longer-term project of interaction between expert groups focused on a novel interdisciplinary subject addressing the causal links between volcanism, tectonics and ore genesis at unstable volcanoes. This project builds on the background of prior and on-going institutional international cooperation and results obtained by researchers belonging to the physical volcanology, igneous petrology/geochemistry and volcano-tectonic/structural geology community. Enlargement of this informally constituted

cooperation network with experts of the ore genesis/mineral deposits community around a common-interest novel research field was effectively obtained during the workshop and highlights a promising direction for further research collaboration. Future directions of common research and interaction within the existing European institutional framework were thus outlined; while the ESF Networking Programme was considered to be the most suitable opportunity for follow-up research and scientific cooperation.

4. Final programme

September 4th

- before 6 PM: venue and gathering of participants in Sovata, lobby of Hotel Brădet
- 6-7.30 PM: Hotel check-in activities and Registration
- 7.30-7.45 PM: Opening of the Workshop, welcome talks by local and institutional hosts:
 - Mr. Ferenc Péter, Mayor of the town Sovata,
 - Prof. Dr. László Dávid, Rector of the Sapientia Transylvanian Hungarian University
- 7.45-8.15: Talk by ESF Representative Olgeir Sigmarsson and related discussions
- 8.15- 8.45 PM: Presentation of participants, workshop logistics and activities by the Local Organizers
- 8.45-10.30 PM: Welcome dinner

September 5th

- 8-8.30 AM: Breakfast
- 8.30-9.15 AM: „**Overview of the geology of the Neogene/Quaternary East Carpathian volcanic arc within the framework of the Carpathian-Pannonian Region**” by Alexandru Szakács
- 9.15-9.30AM Discussions
- 10 AM -5 PM : field-trip – visiting debris avalanche deposits and other medial to distal andesitic volcanoclastic deposits along the Mureş valley – packed lunch during field-trip
- 6-7 PM: poster sessions
- 7-8.30 PM: oral session - talks:
 - „**Edifice substrate influences on volcanoes**” by Derek Rust et al.
 - „**Growth, deformation and shape of volcanic-magmatic systems**” by Benjamin van Wyck de Vries et al.
 - „**Volcano mapping as tools for understanding volcanic constructs and evolution**”– by Gianluca Groppelli
- 8.30-9 PM: Posters and discussions
- 9-10 PM Dinner

September 6th

- 8-8.30 AM: Breakfast
- 9 AM-2 PM: visiting in the Praid Salt mine, salt outcrops at surface („Salt Muntain” in Praid) showing volcano-enhanced salt-deformation structures in a diapiric body
- 2.30-4 PM: Lunch in Sovata
- 4-6 PM Posters and discussions
- 5.45-6 PM
 - "**Microthermometry of the glass foam (bubbly melt)**

- **inclusions : Dej tuff phenoclasts, as an example"** – by Ioan Pinte
- 6-7.30 PM oral session – talks:
 - „**Volcano instability, re-equilibration processes and their possible influences on the volcano-hydrothermal system**” by Alexandru Szakács
 - "**Relationships between volcanic spreading and geothermal systems at Mount Amiata volcano**" – by Andrea Borgia
 - „**Styles of hydrothermal systems and ore deposits in terrestrial intermediate-acidic volcanic systems**” – by Ferenc Molnár
- 7.30-8.30 PM: informal discussions on „Interaction between volcanism, tectonic and hydrothermal processes and their influence on volcano behavior and volcanic hazard” with the aim of devising the outlines of a larger cooperation Project
- 8.30-10 PM: Dinner

September 7th

- 8-8.30 AM: Breakfast
- 9 – 10.30 AM: Plenary session - conclusions of the workshop, planning of follow-up research activities and/or collaborative actions
- 10.30 AM – 1 PM: individual leisure program in Sovata Spa and check-out from Hotel
- 1 – 2 PM: Lunch (packet lunch for those departing earlier)
- 2 PM: General departure from Sovata

5. Statistical information on participants

Countries of origin. The participation was well balanced between Western European (10) and Eastern European countries (11), as follows: Czech Republic (1 person), France (2), Hungary (3), Italy (6), Russia (2), Romania (5), Switzerland (1), UK (1). The organizing country (Romania) was represented by 5 scientists, the maximum allowed by ESF Exploratory Workshop rules.

Age structure. Of the 21 participants 8 are young scientists (< 40 years old, PhD students or scientists at the beginning of their carriers), 13 are senior scientists (>40 years old).

Gender repartition: 6 female, 15 male

Institutional background. 13 participants belong to academic institutions (universities), to 6 research institutions, and 2 to governmental scientific agencies.

Expertise. The participants expertise cover a wide range of research fields allowing the strong interdisciplinary approach of the workshop: physical volcanology and field studies of active volcanoes, geology of eroded volcanic terrains, petrology and geochemistry of volcanic rocks, tectonics of volcanic edifices and their basement, volcano topography and geomorphology, hydrothermal systems and fluid-rock interactions related to volcanic environments, volcanism-related mineral deposits, and geochronology of volcanic areas.

There was a late cancellation of participation from 3 scientists (two of them woman).

6. Final list of participants

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