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Article

Edutainment with basalt and volcanoes – the Rockeskyller Kopf example in the Westeifel Volcanic Field/Vulkaneifel European Geopark, Germany

Peter Rene Bitschene*

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Abstract: The West Eifel Volcanic Field (WEVF), geotouristically better circumscribed as "Vulkaneifel European Geopark, VEG", is a roughly 60 x 30 km wide intracontinental volcanic field with monogenetic multiphase alkali basaltic volcanoes featuring maars, tuff rings, scoria and cinder cones, and lava flows. The setting of the WEVF is intraplate extensional; its origin is commonly attributed to the Eifel plume. A fine ambassador for the WEFV is the Rockeskyller Kopf Volcanic Complex (RVC), the Eifel's and Germany's most complete volcano. The volcanic rocks there comprise alkaline basalts, very rare evolved rocks, and upper mantle to crustal xenolith suites.

No doubt, there are enough basaltic and volcanic assets to educate and entertain the public in general. The problem to overcome here is: How to facilitate petrologic and volcanologic expert knowledge to the mildly interested visitor? One solution is a geopark with trails and panels, with guided walks and informative leaflets, and properly managed museums that exhibit and explain volcanic content. In particular, "volcanic" storytelling indoor and outdoor is essential to both educate and entertain people and thus bridge the gap between science and society.

Kurzfassung: Das Westeifel-Vulkanfeld (WEVF) ist ein ca. 30 x 60 km großes intrakontinentales Vulkangebiet mit monogenetischen, alkalibasaltischen Vulkanen, die in Form von Maaren, Tuffringen, Schlackenkegeln und Lavaströmen auftreten. Geotouristisch wird die WEVG besser als Vulkaneifel Geopark (VEG) bezeichnet. Das WEVF ist geotektonisch einem extensionalen Intraplatten-Regime zuzuordnen, seinen Ursprung verdankt es dem sog. „Eifel-Plume". Ein exemplarischer Vertreter des WEVF ist der Rockeskyller-Kopf-Vulkankomplex (RVC), er gilt als komplettester Vulkan der Eifel und Deutschlands. Die vulkanischen Gesteine dort umfassen alkaline Basalte, sehr selten höher differenzierte Gesteine, und Xenolithe aus dem oberen Erdmantel und der Erdkruste.

Kein Zweifel, hier gibt es genügend basaltische und vulkanische Aspekte, die der Öffentlichkeit zur Bildung und Unterhaltung dienen. Eine Schwierigkeit gilt es jedoch zu überwinden: Wie vermittelt man petrologisches und vulkanologisches Expertenwissen an nur halbherzig interessierte Besucher? Eine Möglichkeit ist ein Geopark mit Pfaden und Tafeln, mit geführten Wanderungen und informativen Faltblättern, und natürlich mit ordentlich geführten Museen, welche die vulkanischen Zeugnisse ausstellen und erklären. Ganz wichtig ist auch das „vulkanische" Geschichtenerzählen, drinnen und draußen, um die Menschen sowohl zu bilden wie auch zu unterhalten, und um somit die Brücke zu schlagen zwischen Wissenschaft und Gesellschaft.

Keywords: Rockeskyller Kopf Volcanic Complex (RVC), geotourism, monogenetic volcanism

Schlüsselwörter: Rockeskyller-Kopf-Vulkankomplex (RVC), Geotourismus, monogenetischer Vulkanismus

1. Introduction

Petrologists and volcanologists would rather write about the West Eifel Volcanic Field (WEVF; e.g. Lorenz 1973, Büchel & Lorenz 1982, Büchel & Mertes 1982, Mertes & Schmincke 1985, Büchel 1994, Lutz & Lorenz 2013) than about the Vulkaneifel European Geopark (VEG). As in this paper the topic is "education" and "entertainment" in a "volcanic geopark", it seems appropriate to use the geotouristic term "Vulkaneifel European Geopark, VEG", which is also synonymous with the official name "Vulkaneifel Nature- and Geo-Park". Either way, the VEG (Fig. 1, in light grey, with Gerolstein as its geotouristic epicentre) is set into the green heart of the Eifel, a low-rising mountain range in the west of Germany, comprises about 1200 km², and features the Quaternary intraplate monogenetic alkaline basalt volcanism of the WEVF, with the RVC as one of its most prolific show cases.

The VEG is famous for its Devonian rocks and fossils, and for its monogenetic intraplate volcanism, both providing scientific and touristic thrills! The first Devonian trilobites of

*Address of the author: Gerolstein Museum of Natural History, Hauptstraße 72, 54568 Gerolstein, Germany / info@naturkundemuseum-gerolstein.de

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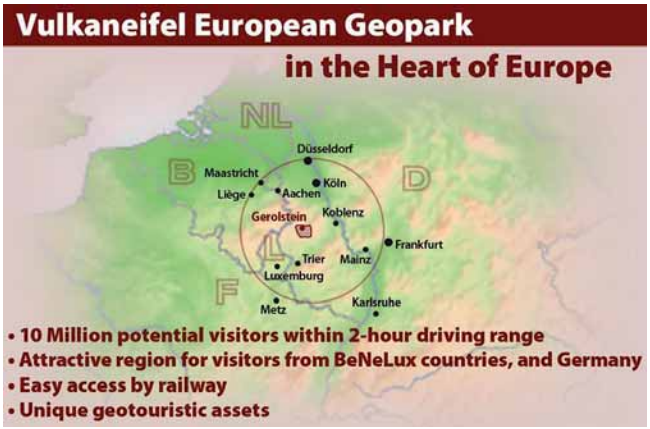

Fig. 1: The Vulkaneifel European Geopark (VEG, in light grey) in the middle of NW-Europe with Gerolstein as its geotouristic epicentre.

Germany were described here, the term "maar" was coined in today's VEG, and Germany's most recent – in geological time scales – volcanic eruption ca. 11000 years ago, the Ulmen Maar, also lies in the VEG.

A historical look reveals that the first geotrails in the VEG were set up in the late eighties in the District of Hillesheim (Eschghi et al. 1990, Kasig 1989). However, it was the District of Gerolstein, where in 1989 the "Gerolstein District Geopark" was initiated in order to fulfill three requirements: Protect geosites in general and especially famous fossil bearing sites, attract visitors to geologically outstanding sites fostering geotourism, and provide additional economic stimulus to the public. In 2000, the Gerolstein District Geopark was enlarged to become the Vulkaneifel European Geopark (VEG), one of the four founding members of the European Geopark Network. In 2004, the VEG was awarded UNESCO supported Global Geopark Network membership, and finally in 2005 the VEG merged with the Volcano Park in the East Eifel to form the "National Geopark Vulkanland Eifel". In 2010, the VEG was extended with the label "Nature Park", today's complete name thus is "Vulkaneifel Nature- and Geopark". For the sake of simplicity, we adhere to the above-introduced term VEG.

The aim of this contribution is to show that monogenetic volcanism in the Vulkaneifel European Geopark is well suited for education and entertainment – commonly put together to form the modernistic word "edutainment" – of the public in general, thus bridging the gap between science and society. A fine example to show and explain the scientific, educational and entertaining qualities of the VEG is the RVC.

2. Philosophy and concept

It is quite clear that this contribution will neither focus on the origin of maars or the petrogenesis of basaltic rocks nor discuss monogenetic intraplate volcanism in detail. However, a basic concept of the Vulkaneifel monogenetic volcanism, represented by the RVC, must be developed that is both scientifically sound and easily to be communicated. This concept involves the early and latest "news" on maar formation (e.g. Lorenz 1973, Valentine & White 2012, Kurzlaukis & Fulop 2013), on the petrogenesis of the WEVF's alkaline basalts (Mertes & Schmincke 1985, Shaw & Woodland 2012), on basaltic intraplate volcanism in general (e.g. Kereszturi & Nemeth 2011), and on geoparks with basaltic volcanism (e.g. Moufti & Nemeth 2013).

The didactic concept for the VEG's monogenetic intraplate volcanism presented here is derived from physical volcanology, implying that distinct volcanic activity forms distinct volcano-morphological features with distinct resulting volcanic deposits. The result is a "4 phases" model, which is basically applicable for a single volcano as well as for the entire volcanic field. This "4 phases model" helps to understand a single outcrop as well as the whole WEVF. By no way it implies that all volcanoes in the WEVF have seen all four phases. Some have only seen Phase I, others only Phases II and III, and Phase IV is ubiquitous throughout.

Phase I describes the initial maar-forming, hydroclastic phase of an Eifel volcano. A maar crater is formed that successively deepens itself into the crust as long as groundwater and volcanic gas and heat (magma) interact; as a consequence, characteristic maar tephra, rich in Devonian and Bunter country rock clasts, is deposited around the crater. Phase I may also be named "Maar Phase".
Phase II describes the volcanic edifice building, pyroclastic phase of an Eifel volcano. Basaltic ash/cinder and scoria cones develop with characteristic dark, basaltic ash, lapilli and bomb/block deposits. Due to the prevailing type of volcanism, Phase II may also be named "Strombolian Phase".
Phase III comprises all the effusive basaltic lava lakes, flows, ponds and dikes that fill valleys, craters and fissures with solid basalt. Due to the prevailing type of volcanism, Phase III may also be named "Effusive Phase".
Phase IV is the actual state for the dormant Eifel volcanism, as it encompasses the CO_2 emanations, which are manifested in mofettes and carbonated mineral waters. Phase IV may thus also be named "Mofette Phase".

The philosophy beyond is that educating and entertaining stories about basalts and volcanoes can be told in the field and in the museum once this basic concept is understood.

3. Geotouristic assets

The "4 phases concept" for the Vulkaneifel volcanoes is visualised and explained by intriguing outcrops for which the term "geotouristic asset" is coined. A "geotouristic asset" is a geological outcrop – also the term "geosite" or "geotope" applies – that fulfils the following requirements: It is an accessible, well-maintained outcrop that exposes a geological issue or product, there are proper explanations/panels on site, and/or leaflets/publications and/or guided walks/excursions are offered that bring in revenue! Thus, a geotouristic asset is a geotope that has an accountable value attached (Fig. 2).

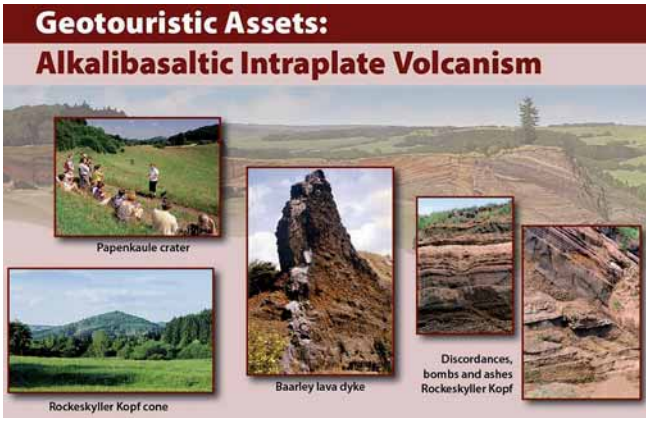

Fig. 2: Geotouristic assets in the VEG related to the monogenetic WEVF.

4. Edutainment with basalt and volcanoes

Of course, people visiting the VEG want to be entertained and educated. They want to walk along well-designed trails with unique geological/volcanological outcrops, and hear or read entertaining and educating stories.

Geotrails and accompanying flyers

Dozens of geotrails do exist all over the VEG. In the beginning, already at the end of the 1980s (Eschghi et al. 1990, Kasig 1989), these geotrails were rather long, up to 64 km as for example Route III in the Gerolstein District (Frey & Schneider 1995). After a thorough evaluation, a second generation of geotrails was then set up from 2004 on with shorter, circular trails and a well-constrained thematic envelope (Bitschene & Schueller 2006). A fine example for a geotrail with definite volcanic content is the circular trail "Rockeskyller Kopf – at the heart of the volcano".

This geotrail (Fig. 3) starts right in the middle of the village Rockeskyll, where parking lots are available and a panel provides an overview of the tour. The circular trail is 3.2 km long, overcomes 135 m of height and has three explanatory panels explaining the outstanding outcrops in three abandoned quarries. A flyer (Fig. 3 is part of it) exists, guided walks are regularly offered, and hundreds of school and university classes have already visited this great volcanic complex. The "Rockeskyller Kopf" is one of the most outstanding geotouristic features of the VEG and truly merits the distinction to be "Germany's most complete volcano" (Bitschene et al. 2012). Of course, geotrails should be accompanied by explanatory flyers, which not only show the way but

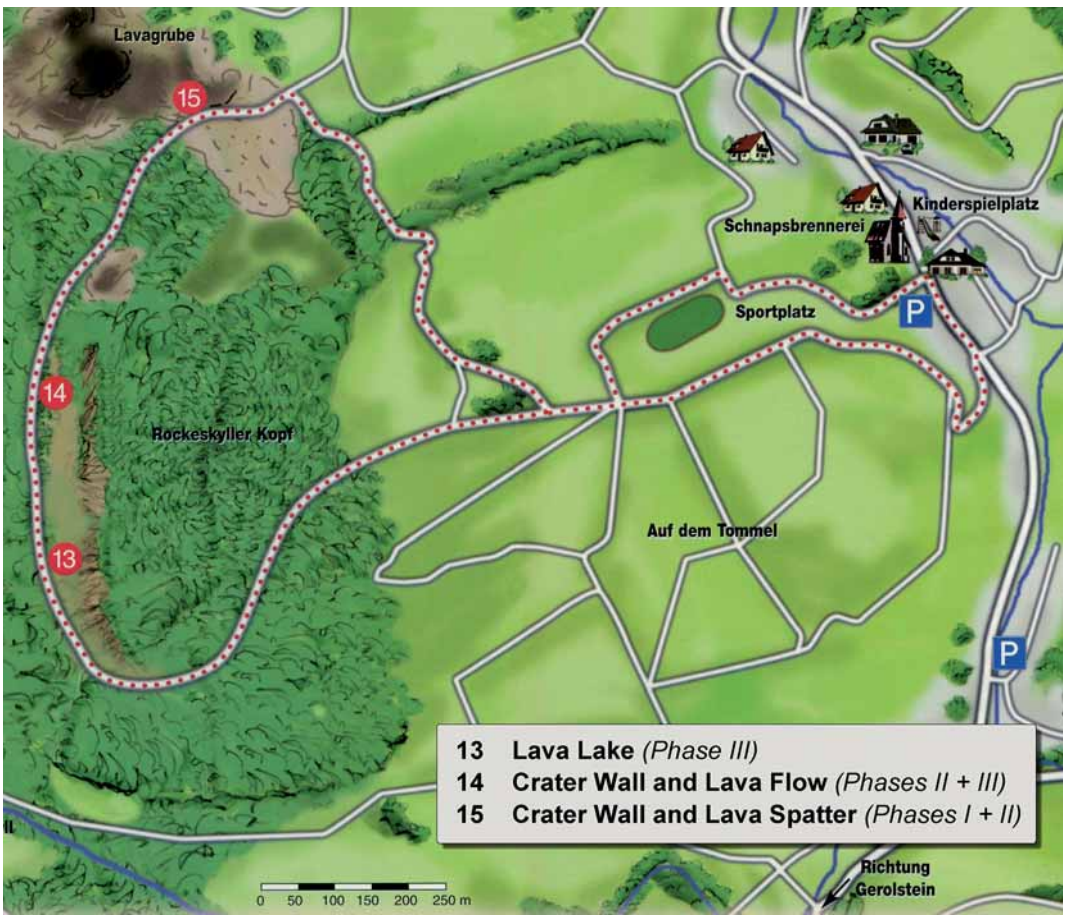

Fig. 3: Circular geotrail "Rockeskyller Kopf Volcanic Complex" with geosites 13–15.

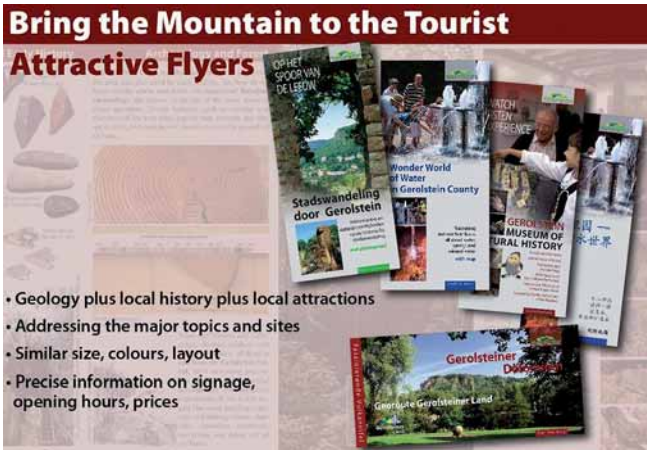

Fig. 4: Multi-lingual flyers for geotrails covering different themes in the VEG.

also deliver in a few words what can be observed at the geosites. In addition, within an internationally acknowledged geopark these leaflets should also be published in different languages (Fig. 4).

Panels

Proper panels are essential in providing needed information for the tourist as well as for the eager lay and professional volcanologist. There are four essential requirements for a good panel with geological content: It must correctly explain with proper words what you see in front; it should contain colourful pictures that visualise the written text and the outcrop in front; the explanatory text should be as short as possible, but as long as needed to explain the geologic features. Last but not least, the panels and their placements should be kept clean and accessible, and must thus be checked on a regular basis. The preparation of a geopanel is an art that requires a deep understanding, of course, of the Eifel volcanism, but also a good eye for pictures and skills for the text. Texts in foreign languages are helpful, but not recommended when they otherwise restrict the proper explanation of an outcrop. Here, tags or QR-codes are advised.

Within the last 25 years, the VEG has seen three different generations of panels, the first one with extensive wording (>1000 words), the second ones with colourful pictures and ca. 400–500 words, and the last ones with only ca. 200 words, but in three languages.

Story Telling and how maars are related with "Marxism"

No doubt, what participants in a guided tour want to hear is a good, exciting and unique story. In addition, strong wording such as "youngest German volcano", "deepest Eifel maar", and "Germany's most complete volcano" also help when delivering Eifel volcanology to the audience. But let us consider here a good story that has a proven historic background and a stunning interpretation.

It is common knowledge that the term "maar" and its explanation as a volcanic edifice come from the Eifel/Germany. The merits go to the eminent naturalist and geologist Johann Steininger, who in 1820 in his book "Die erloschenen Vulkane in der Eifel und am Niederrheine" coined the term "maar". Steininger was a thorough observer and vivid scientific writer. For decades he traveled the Eifel, observed the volcanic edifices, collected fossils and rocks, and then thoroughly wrote down his observations with proper interpretations. But Steininger's main profession was a teacher at the High School in Trier. As a teacher, he also followed his meticulous scientific approach of observation-documentation-interpretation when teaching his pupils. No wonder that one of his most prominent pupils became an eager lay geologist, who also engaged into Steininger's methods of scientific thinking. This famous pupil was Karl Marx! A publication by "The International Marx Engels Foundation/Amsterdam" (2011) underpins the astonishing interest Karl Marx throughout his lifetime had in palaeontological and geological issues. In addition, the use of the word "formation" in his critique of the social formations is directly derived from the descriptive and already existing term "geological formation"! Of course, Karl Marx is globally known as a critic of capitalism, who laid down the foundations of "Marxism". Clearly underestimated, however, is that in his way of thinking and his love for palaeontological and geological descriptions he consequently followed his schoolteacher Johann Steininger. It is a bold hypothesis, but nevertheless seems fair to say that Marx acquired Steininger's method of observing, describing and interpreting nature, and applied it to social issues.

The full story therefore is that the maars of the Eifel (and other geological/volcanological issues there) taught Steininger firstly to observe, and then describe and finally interpret nature; it was this scientific way of thinking Steininger delivered to his pupil Karl Marx and so influenced Marx's way of observing, describing and interpreting capitalism and the working class. Therefore, "maar" and "Marxism" are directly related! Maybe the term "Ma(a)rxism" would also apply – twinkle, twinkle!

The observation, documentation and interpretation of geological, especially volcanological issues is, to the author's opinion, therefore not only a necessary exercise to understand geological concepts, but is also a highly recommended training for logic thinking in general.

5. Edutainment at the Rockeskyller Kopf Volcanic Complex

We now approach the volcano, where the logic thinking through observation, description and interpretation can be trained, and where eventually the 4-phases concept for Eifel volcanism can be learned.

The Quaternary Rockeskyller Kopf Volcanic Complex (RVC), situated about 3 km NE of the town of Gerolstein (Fig. 1), belongs to the WEVF, and VEG, respectively. The RVC emitted melilithites and leucitites (Shaw & Woodland 2012), rare carbonatite has been described (Riley et al. 1986), and is famous for its diversity of upper mantle and crustal xenoliths (Haardt 1914), especially for "glazed" sandstones (Shaw 2009). Several maars, craters and volcanic edifices

Fig. 5: "Ship nose" (stop 15 in the map of Fig. 3) at Rockeskyller Kopf with basal tephra layers from the initial maar phase I ("M", dip from the right to the left, note the white Devonian limestone clasts!), discordantly ("D" is the discordance) overlain by tephra layers from the subsequent Strombolian Phase II ("S", dip from the left to the right) and recurring phase-I-eruptions ("M", maar tephra layers); listric crater rim gravity faults ("F").

(Shaw et al. 2010) comprise the RVC, and because of the excellent outcrops the RVC is named "Mother of all Eifel Volcanoes" and even "Germany's most complete volcano" (Bitschene & Schüller 2011); and, of course, it is a prime location for both volcanological research and geotouristic valorisation (Bitschene et al. 2012).

There is one outcrop (Fig. 5) that is especially well suited for training one's skills in the observation, description and interpretation of volcanological issues. This outcrop – called "ship nose" because its shape resembles the stern of a sinking tanker – is the leftover of the volcanic edifice that was exploited during the last 120 years or so. The prominent "ship nose" is geosite No. 15 of the circular geotrail "Rockeskyll Volcanic Complex" (Fig. 3).

Observation and description

The first step is to describe the morphological and geological inventory, i.e. colour, thickness and dip of the tephra layers, and length, direction and dip of linear elements such as faults and discordances. From the bottom to the top, two main tephra units ("M" and "S") can be observed. Tephra unit "M" comprises several concordant tephra layers with brownish to reddish colours dipping from the right (south) to the left (north), and is composed of about 70 % Devonian country rock clasts and 30 % basaltic clasts. Tephra unit "S" comprises several concordant dark-grey tephra layers dipping from the left to the right, and is composed of >95 % juvenile basaltic pyroclasts. The two tephra units are separated by a sharp unconformity (D). The lower tephra unit "M" also shows steeply dipping antithetic faults (F) with an offset of about 50 cm.

Interpretation

Tephra "M" is the result of the initial Phase I in the volcano's life, when the magma and its gases explosively interacted with the country rock and its groundwater. This initial Phase I deepened a crater into the surface – a maar – and deposited the ejecta as surge-and-fall-deposits around the crater to form a tephra ring. Tephra "M" therefore is synonymous with the maar building Phase I in the lifetime of the volcano.

After the formation of the maar crater and its surrounding tephra ring small-scale gravitational crater rim faulting occurred. Tephra blocks readjusted when antithetic faults, steeply dipping towards the crater, displaced the blocks slightly towards the crater due to slope instability around the crater. The crater wall of the maar orifice itself is indicated by the discordance (D), thus it is correctly termed crater wall discordance.

Explosive volcanic activity continued now erupting basaltic tephra layers that coated the inner crater wall and formed tephra unit "S". The basal dark ash and lapilli layer of unit "S" now has the same dip as the crater wall discordance because it had been deposited as an air-fall/spatter tephra layer onto the wall. The volcanic activity has now turned into Strombolian-type explosive eruptions (Phase II in the lifetime of an Eifel volcano) leading to the intra-crater basaltic air-fall ash and lapilli layers; of course, fallout ash and lapilli layers outside the crater also exist! Light coloured fallout layers were concordantly deposited, when pulverised country rock, soil and eventually crater-lake sediments were explosively emitted due to resumed maar-type (Phase I) volcanic activity. Eventually volcanic bombs were emitted, when final gas bursts cleared the clogged vent.

The educational and entertaining purpose of this paper, however, is not only the in-detail description and interpretation of this marvelous outcrop, but its use to train logical thinking through earth observation.

6. The meta-interpretation for educating logic thinking

The audience in general will be able to observe the tephra units "M" and "S", the discordance "D", the faults "F", and the volcanic bombs and its impact sags. But they are not able to use the proper nomenclature nor will they be able to deduce the volcanologic story behind. But by simple observation and description with their own words and thoughts they

will come to correct conclusions, and eventually train their logical thinking. Therefore, the geologic terms must be transferred into common words, and the genetic interpretation must be transferred into simple time-sequence interpretations. The resulting meta-interpretation now is: Unit "M" (Phase I) was deposited firstly by a cycle of repeated material deposition; then plane "D" and planes "F" developed, before unit "S" (Phase II) was deposited! So the logic time-sequence is M – D – F – S!

This kind of meta-interpretation is a complete training unit for logic thinking! It is a good example for how geology not only helps understand nature but also helps to observe, describe, think and interpret logically correct.

7. Conclusions

Scientifically, the Westeifel Volcanic Field (WEVF) is known for its monogenetic volcanism with alkaline basalts, lithospheric xenoliths, and as the region where the term "maar" has been coined. The WEVF and its volcanic rocks and morphologies can be both scientifically and geotouristically described in a 4 phases model with initial, hydroclastic maar phase (Phase I), subsequent pyroclastic Strombolian phase (Phase II), culminating effusive phase (Phase III), and final, ubiquitous Mofette phase (Phase IV).

The WEVF is well suited for geotourism, which is implicated by the synonymous term Vulkaneifel European Geopark (VEG). For education and entertainment with basalt and volcanoes in the VEG, an appropriate geotope – in this case the RVC – must be transformed into a geotouristic asset by adding a revenue. The best way to use basalt and volcanoes for edutainment thus is: geotrails, guided excursions, panels, leaflets and exciting story telling. The latter is exemplified by the fact that the Eifel maars and volcanoes, through the description and interpretation of J. Steininger, have directly influenced the thinking and writing of no other than the eminent philosopher and sociologist Karl Marx.

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