Title	Volcanic Eruption of Twindaung : Environmental Aspect.
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Issue Date	2012

Volcanic Eruption of Twindaung: Environmental Aspect

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Abstract

The project area is situated in Sagaing Region. Volcanic craters in this area are aligned in nearly NE-SW. East Twindaung and Taungbyauk craters are phreatomagmatic cones (maars) and the others are cinder cones. During Pliocene, volcanic rocks of the area first erupted and continued up to Holocene. The type of eruption is Vulcanian type phreatomagmatic eruption. The volcanic eruption of the area can be known by studying the volcanic rocks, sedimentary rocks and rock structures in this area. Type, style, and explosivity of the eruption control its products i.e. volcanic rocks and landforms of the area. From the geological knowledge of the volcanic eruptions of the area combined with chemical and petrological knowledge of their products (in particular, volcanic rocks) it can be known that the effect of the rock and soils on the environments in connection with composition and properties of soils and rocks. The soils on the exposures of air-fall deposits are potassium rich. Therefore, vegetation grows well. Cultivation of millet, paddy rice and other crops is favorable. The soils occurring directly above the Irrawaddian sandstones are so porous and permeable that the trees are difficult to grow, as a result, scarcity of vegetation on them.

Keys: maars, Vulcanian type-phreatomagmatic eruption, potassium rich, millet

Introduction

The area investigated, lying in the Monywa District, Sagaing Region, is situated N Latitudes 22° 10′ and 22° 25′ and E Longitudes 94° 55′ and 96° 03′. It covers approximately 380 square kilometers. The area is mostly a flat plain except where the volcanic craters, volcanic hills and sedimentary ridges are present. The Chindwin River flows NNW to SSE in this area. This area and its neighboring areas fall in the central volcanic arc of the Central Cenozoic Belt of Myanmar. These areas are situated 50 km north of Mt. Popa.

The main objective of this study is to know the environmental aspect of the volcanic eruption in the area. The fairly detailed geological map of the area was drawn (Fig.1).

The rocks are Tertiary in age except the igneous and metamorphic rocks of Salingyi area. In the eastern parts, the rocks of Eocene age are exposed. These are followed to the east by Miocene clays and sandstones and these again by the

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sandstones of Irrawaddy Formation. To the south, in Salingyi area, the basement complex (Salingyi Uplift) is well exposed. Sabe Taung, Letpadaung Taung and Kyisin Taung approximately 10 km west of Monywa are composed of rhyolite, dacite, andesite and locally containing copper mineralization.

Volcanic craters (vent) occupied on either side of the Chindwin river. They are generally circular in shape and the crater rims are well defined on landsat image. East Twindaung crater which is situated on the eastern bank of Chindwin river about 3.2 km N-E from Shwezaye village, is deepest and most perfectly preserved. On the west bank of Chindwin River, there is a line of four distinct craters, from north to south, Taungbyauk, Middle Twindaung, West Twindaung and Le'she. All these craters are structurally volcanic cones. East Twindaung and Taungbyauk crater are phreatomagmatic cones (maars) and the others are cinder cones (pyroclastic cones). More than dozen of small ill-defined craters are found as subsidiary vents in this area. Above mentioned volcanic craters appear to pass obliquely the regional trend (N-S) of the region which can be marked by alignment of sedimentary hills of Irrawaddy Formation and low table lands (butte-shaped hills) of Silaung basalts (younger basalts). Unconformities are present. Tectonic folds and faults are not found in this area

GEOLOGICAL MAP OF THE TWINDAUNG-SILAUNG AREA, MONYWA DISTRICT

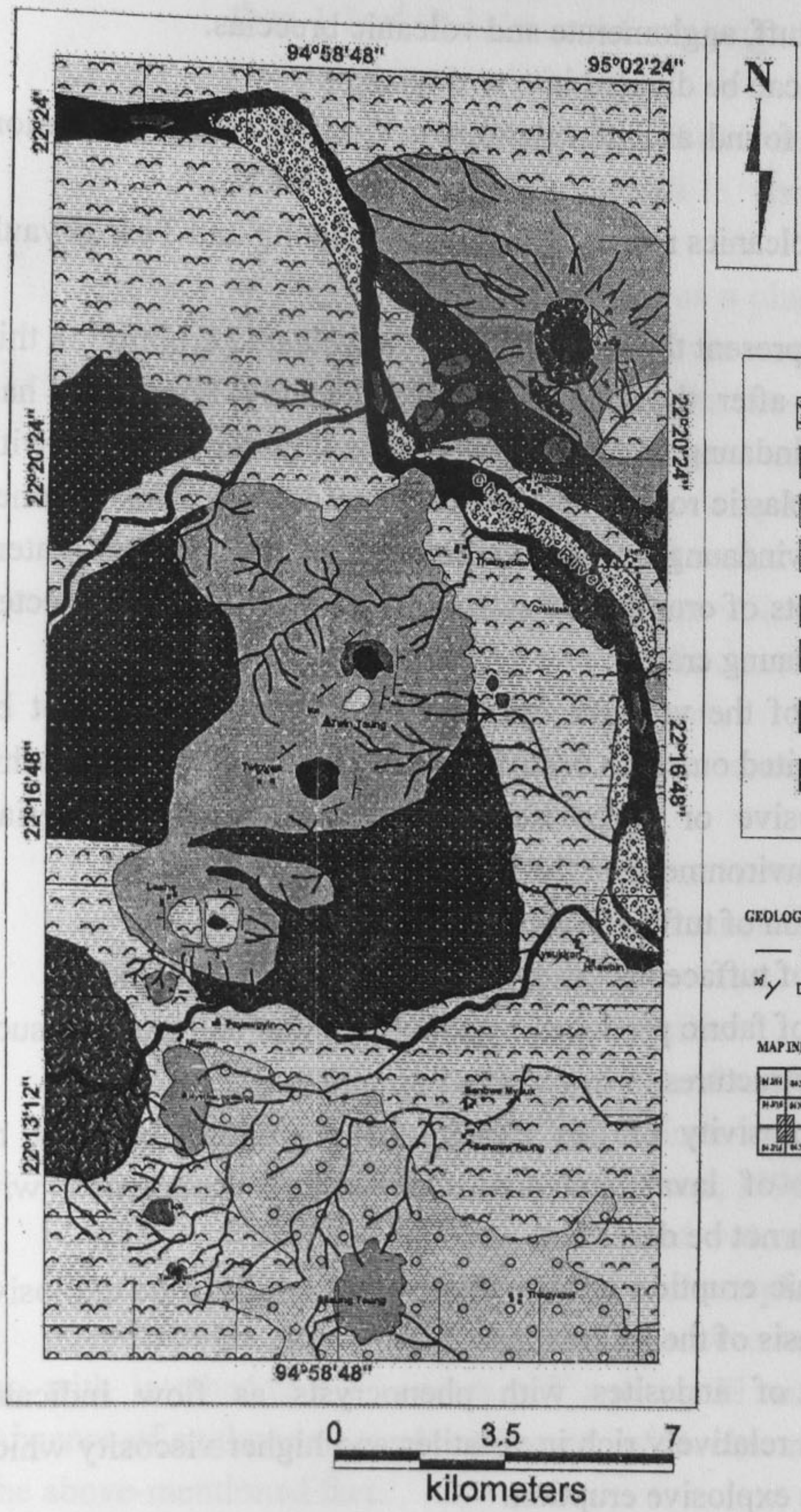

Figure (1) Geological map of the study area.

Volcanic Eruption

The area investigated lies in the Central Volcanic Arc. The volcanic of this arc are post- Paleocene to Recent in age.

The volcanics of this area are andesites, basalts and volcaniclastic rocks. Most volcaniclastic rocks are pyroclastic air – fall deposits in nature. The volcaniclastic rocks in this area are tuff, lapilli tuff, agglomerate and volcanic breccias.

The volcanics in the area can be divided into two types:

(1) the older tuff found as intercalations in the Irrawaddy Formation and

(2) the younger volcanics mainly found at Twindaung and Taungbyauk craters.

The younger volcanics represent the later phase of the volcanic eruption in this area. This eruption took place after the deposition of Irrawaddy Formation had completed. As a result, East Twindaung crater and Taungbyauk crater made up with andesites and/or basalt and pyroclastic rocks were formed. Besides, pyroclastic cones such as Le′ She′ crater, West Twindaung crater, and the other small indistinct craters were formed. Some were products of eruption of subsidiary vent probably connected with the main feeder, East Twindaung crater.

In this area, the nature of the volcanic eruption of earlier phase cannot be known clearly because of the limited outcrops of tuff. However, it can be said that this volcanic eruption is an explosive or pyroclastic eruption, originally subaerial, deposited into the sub aqueous environment on the basis of the following:

(1) Intercalation of tuff in Irrawaddy Formation.

(2) Presence of tuffaceous sandstones in Irrawaddy Formation.

(3) Presence of fabric produced by soft- sediment deformation such as slump structures in Irrawaddy Formation.

The type and intensity of explosivity of this earlier phase eruption can not be described because of absence of lavas and the other criteria concerned with explosivity. Similarly, stages can not be described.

The nature of the volcanic eruption of later phase can be said to be explosive or pyroclastic eruption on the basis of the followings:

(1) Presence of andesites with phenocrysts as flow indicates magma is relatively rich in volatiles and higher viscosity which can cause explosive eruption.

(2) Occurrence of andesite probably as a plug which formed by filling of lavas in the older vent in the East Twindaung crater.

(3) Presence of generally well-bedded pyroclastic beds including agglomerate at and around the East Twindaung crater.

(4) Presence of bombs and blocks at the East Twindaung crater and its neighbouring areas.

(5) Presence of vent breccia closely associated with andesite and basalt.

(6) Bursting of the East Twindaung crater at the eastern side of it where there is no andesite wall.

Type of volcanic eruptions in this area can be said to be Vulcanian type of phreatomgmatic eruption on the basis of the following.

(1) The volcanic eruptions of the area are volumetrically small, i.e. less than 1 km^3. It is known from height and aerial extent of the volcanic rocks in this area.

(2) Most of the lavas are crystal rich andesites indicating that magma is relatively fairly high enough in viscosity and volatile content to be explosive.

(3) Andesites and basalts occur as a plug of solidified lava which allows pressure to build up. Explosions result, when gas confined beneath it, is suddenly released. The gas pressure results from exsolution of volatiles from rising fresh magma and accumulating beneath the plug. Besides, pressure was produced by steam as a result of interaction of magma and ground water that mixed with optimal ratio.

(4) Ejection of shattered fragments of lava, as a result, andesite and basalt bombs and blocks formed in this area.

(5) The eruptions are fairly frequent.

(6) Evidences (e.g. welded tuff) of nuee ardente type of eruption are not found.

(7) Presence of basalt outcrops with volcanic breccia (e.g. Taungbyauk crater and the small indistinct crater).

(8) Rarity of unsorted pyroclastic rocks.

(9) Absence of scoriaceous materials.

(10) Presence of a large proportion of non-juvenile lithic clasts in lapilli tuff but not more than 50% indicate dry phreatomagmatic eruptions and vulcanian explosion (G. J. Orton, 1996).

(11) Formation of maar structured volcanic cones (e.g, East Twindaung crater, Taungbyauk crater) indicate phreatomagmatic eruption.

Although, most eruptions in this area were vulcanian type, cinder cones made up with interbedding of coarse tuff and lapilli tuff indicate strombolian activity. Absence of agglomerate beds and scanty of blocks and bombs in cinder cones support the above-mentioned fact.

Environmental Aspect

The volcanic eruption of the area can be known by studying the volcanic rocks, sedimentary rocks and rock structures in this area. Type, style and esplosivity of the eruption control its product i.e. volcanic rocks and landforms of the area. From the geological knowledge combined with chemical and petrological analysis of the volcanic rocks of soils of the area, it can be known that the effect of rocks and soils on the environment in connection with composition and properties of soil and vegetation.

The area investigated is mostly a flat plain except volcanic craters, volcanic hills and sedimentary ridges. Volcanic craters are aligned in nearly NE-SW. Structurally, these are maars and cinder cones which are the products of vent-type volcanic eruption. Volcanic hills are butte shape hills which are the products of fissure-type eruption. Sedimentary ridges and hillocks are the remnants of denudation.

It is known that the volcanic rocks (lavas) and pyroclastic rock (tuff) are magnesium and iron rich type. They can be said to be alkaline due to the considerable amounts of potassium and sodium. These elements transferred to soil by means of mainly mechanically break down of rocks in residual soil formation in this dry zone. The transported soils seem to be lesser in amount. So, the soils are rich in these elements which yield favorable condition for vegetation and cultivation. Besides, the running water of the area left the salt on the bedrock of the stream as white powder indicate that the water is salty due to the presence of potassium and sodium obtained from soils and rocks. Thus, the soils on the exposures of air-fall deposits in this area are potassium rich. They are, therefore fertile. The soil occurring directly above the Irrawaddy sandstones are so porous and permeable that the trees and plants are difficult to grow on them, as result, scarcity of vegetation on them. This type of soils is known as Primitive Crushed Stone Soils. These soils are not suitable for agriculture.

In this area, there are extensive stretches of black soils of these the most important is in the nearly level plain between the Yamas. Another important area of black soils lies east of the Chindwin and extends from Nyaunggan in the north to below Monywa in the south. But the bulk of the soils are red in color consisting of red sands and gravels sometimes interspersed with ferrrugiuous conglomerate and to this kind of soils are to be assigned most of the areas in the neighborhood of the Chindwin on either bank including bottoms of explosive craters.

This area falls in the Dry Zone. According to Bender (1983) the following soil properties are known. Cinnamen soils are restricted to relatively narrow belt, Red brown Savanna Soils found in this area are typical of the dry zone. The colours of this soil complex vary between dark chestnut-red, brown-red and orange. They are frequent enrichments of carbonate within the soil profile; iron calcareous concretions are found in the lower portions. The humus content are below 2 %, nitrogen and available phosphorous compounds are low. The available potassium content is fairly high. The base exchange capacity varies between 10 and 30 meg / 100 g, and the pH > 7.0 (in extreme cases it may reach 9.0). Red-brown Savanna soils are well suited for dry forming. They are endangered by soil erosion. Dark Compact Savanna Soils are found chiefly on flat, even terrain and above aluvia in this area. They are also known as "Black Cotton Soil".

Despite the black to dark-grey brown colour the humus content is barely 1%. The heavy clayey soils are calcareous and show horizons with carbonate enrichment. They posses high base exchange capacity. When they dry out, these soils become very hard and exhibit deep mudcracks; rain turns them into mud. They are not very

suited for farming; giving suitable irrigation they can be used to grow paddy rice, cotton, chilly and even millet and related crops. The Dark compact Savanna Soils also contain small areas with Solonetz (alkaline) and Solon chalk (saline soils). In areas where the groundwater is near the surface in this area rice, cotton, sesames, millet, tobacco and groundnuts are the main crops grown.

Conclusion

The area investigated is situated in the Monywa District, Sagaing Region. This area falls in the Dry Zone of Myanmar. From the analysis of rocks and soils in the area, it can be known that the soils occurred on the volcanic rocks are magnesium and iron rich. They can be said to the potassic due to the considerable amounts of potassium. Frequent enrichment of carbonate is also noted. Red-brown Savanna soil are well suited for dry forming. Giving suitable irrigation, dark compact Savanna soils can be used to grow paddy rice, cotton, chilli and even millet and related crops. The soil occurring directly above the Irrawaddy sandstones are so porous and permeable that the trees and plants are difficult to grow on them.

Acknowledgements

I like to tender my sincere thanks to Dr Khin Swe Myint, Prorector, Mandalay University and Dr Than Than Nu (Professor/ Head of Geology of Mandalay University) for their encouragement. I also thank to Dr Zaw Win (Assistant Lecture, Department of Geology, Defense Services Academy) for help in preparing this manuscript.

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