RELATIONSHIP BETWEEN MIRE VEGETATION AND VOLCANIC ACTIVITY: A CASE STUDY FROM TADEWARA MIRE, SOUTH-WESTERN JAPAN

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Abstract: Most Japanese mires are affected by volcanic activities such as deposition by volcanic ash. Some mountainous mires experience frequent disturbance by volcanic activity. Relationship between volcanic activity and vegetational change with special reference to chemical deposition from volcano has been investigated in Tadewara mire. Three peat cores of 210 cm, 270 cm, and 420 cm were collected for plant macrofossil analysis and chemical analysis. Two distinct horizons consist of volcanic glasses were observed at 160 and 252 cm depths. Composition of plant macrofossil and exchangeable cation changed at the volcanic glass layers. A distinct peak of sulfur content in peat core was found at the depth of 110 cm. Elemental composition of peat core shows that content of carbon, nitrogen, and hydrogen decreased corresponding to the increase of sulfur. Dominant species of macrofossil community started to change from *Sphagnum spp*. to *Phragmites australis* just corresponding to the increase of sulfur at 110 cm. Increase in sulfur content in peat core started at 970±40yBP (14C dating) and it corresponded to the peak of volcanic activity of Mt. Kurotake nearby Tadewara mire. Thus we concluded that mire vegetation changed from ombrotrophic to minerotrophic community by sulfur deposition due to the volcanic activity.

Key Words: Volcanic activity, mire vegetation, disturbances

INTRODUCTION

Mire provides habitats for rare or endemic species, and mire form a unique ecosystem. Many factors e.g. climate, topography, geology, and water quality are determining mire vegetation and succession.

Volcanic ash, volcanic gases and aerosols form volcanic activity are the dominant determinant factors in mire vegetation and the effect is important for mires surrounded by volcanoes such as in Japan. Many reports on the effect of volcanic ash on mire succession clarified that mire vegetation dynamically changes after deposition of volcanic ash. Wolejko and Ito (1986) discussed the uniqueness of the Japanese mires as compared to mire of the world, and proposed the new term "tephratrophic mire" because tephra supplies nutrients to mire vegetation. Hotes.*et al*. (2006) discussed that vegetation responses are primarily caused by the physical effects of burial under a mineral layer. However, chemical effect by ash deposition on mire vegetation has not been fully clarified.

The objective of this study is to clarify the relationship between volcanic activity and vegetational change in mire with special reference to chemical deposition originated from volcano.

METHODS

Study Area

In this study, relationship between volcanic activity and vegetational change has been investigated in Tadewara mire, a minerotrohic mire in the mountains area in the south-western part of Japan (Figure 1).

Tadewara mire is located on Kujyu mountain area in the Oita prefecture (33.07°N, 131.14°E). Mire are formed on a slope of chain of volcanic peaks and water is supplied from springs at the foot of mountains at 1000 m a.s.l. Communities of *Phragmites australis - Epilobium palustre, Moliniopsis japonica-Sphagnum fimbriatum* dominated in mire. Eight times of volcanic eruption has been recorded since 5000 years before around this mire (Kamata et al. 1996). Thus, Tadewara mire has been frequently experienced the effect of volcanic activity.

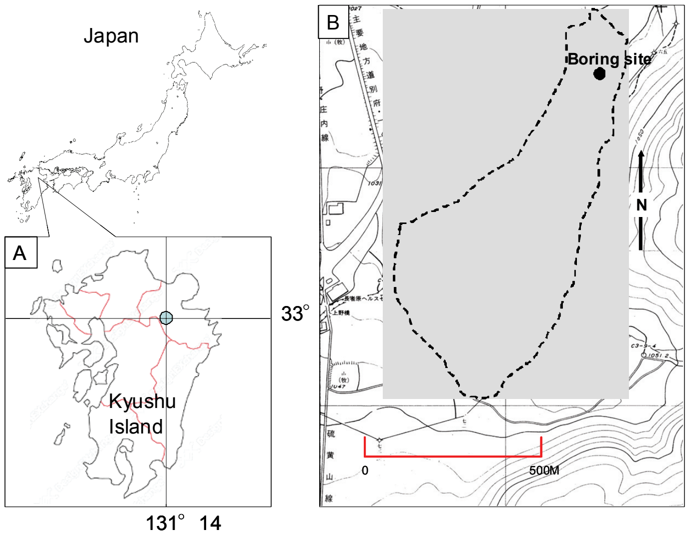

Figure 1. Location of the Tadewara mire in South-Western Japan.

Peat Core Sampling

Peat core samplings were made at the center of the Sphagnum dominated mire community and cores were collected by Tomas type peat sampler. Three cores were sampled within the area of 1 m diameter in May 2006. Core 1 was taken up to 210 cm, core 2 was taken up to 270 cm and core 3 was taken up to 420 cm. Each core was divided into segments according to soil color and texture. And these were stored at 5 ℃ until used for plant macrofossil analysis.

Macrofossil analysis

Plant macrofossils in peat core show environmental condition such as temperature or water condition at the time of deposition. Visual observation investigated to check plant macrofossil composition. When identification of species was difficult, observation of plant macrofossil was made by SEM.

Chemical Analysis and ^{14}C Dating

Segments of each collected core that was classified by soil color and texture were weighed, then oven dried at 105℃ for more than 24h and weighed again to determine moisture contents. Dried samples were used for elemental composition analysis — Carbon, Hydrogen, Nitrogen, and Sulfur in peat, and acetate extractable K, Ca, Mg, and Na concentrations were analyzed.

Two distinct horizons with volcanic glasses were observed at 160 and 252 cm depths and 14C dating by Accelertor Mass Spectrimeter (AMS) was made on these horizons (Geo-science laboratory).

RESULTS AND DISCUSSION

Vegetation Change

Dominant plant macrofossil data and 14C dating were shown in Figure 2. By 14C dating, conventional radiocarbon age of 74 cm and 158 cm depth were 108.2 ± 0.5 yBP, 970 ± 40yBP, respectively, and hence the peat accumulation rate was 1.0 mm/yr.

Typical progressive succession in mire is from nutrient rich Phagmites community to ombrogenous Sphagnum dominated vegetation (Sakaguchi 1980). Change in macrofossil composition in Tadewara mire over the past 1000 years showed that retrogressive succession from Sphagnum community to Moliniopsis community started at 970 ± 40yBP.

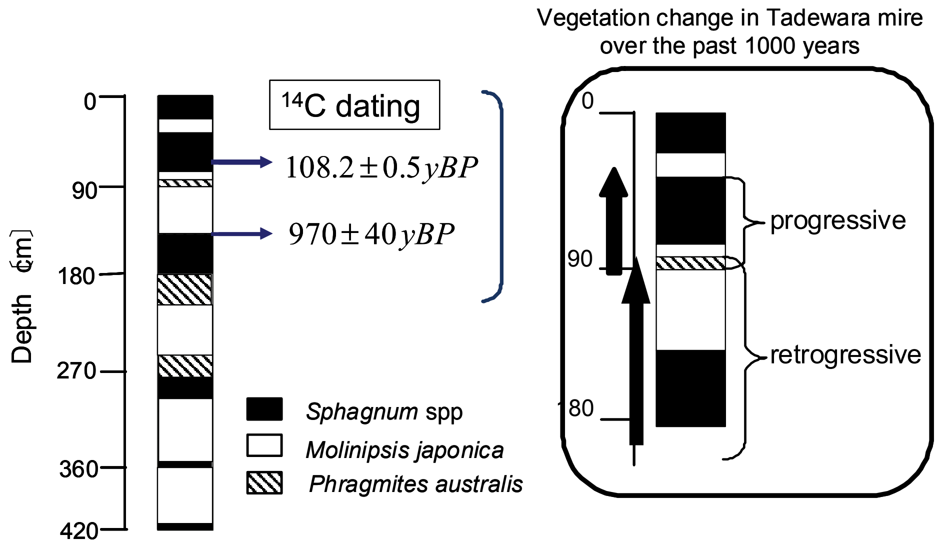

Figure 2. Vegetation change in Tadewara mire.

Vertical Profile of Chemical Properties in Peat Core

Relationship between vegetation change and elemental composition in peat core were shown in Figure 3. Elemental composition of peat core showed that content of carbon, nitrogen, and hydrogen decreased corresponding to the increase of sulfur. Dominant species of macrofossil community started to change from *Sphagnum spp.* to *Phragmites australis* just corresponding to the increase of sulfur at 110 cm.

Origin of sulfur could be the eruption of Mt. Kurotake. Eruption of Mt. Kurotake was recorded at 980 ± 30yBP (Itoh et al. 1997), and then sulfur enrichment in mire soil would be due to volcanic deposition originated from eruption of the Mt. Kurotake. Enrichment of sulfur in peat soil caused eutrophication on mire resulting in retrogressive succession from Sphagnum community to nutrient rich vegetation.

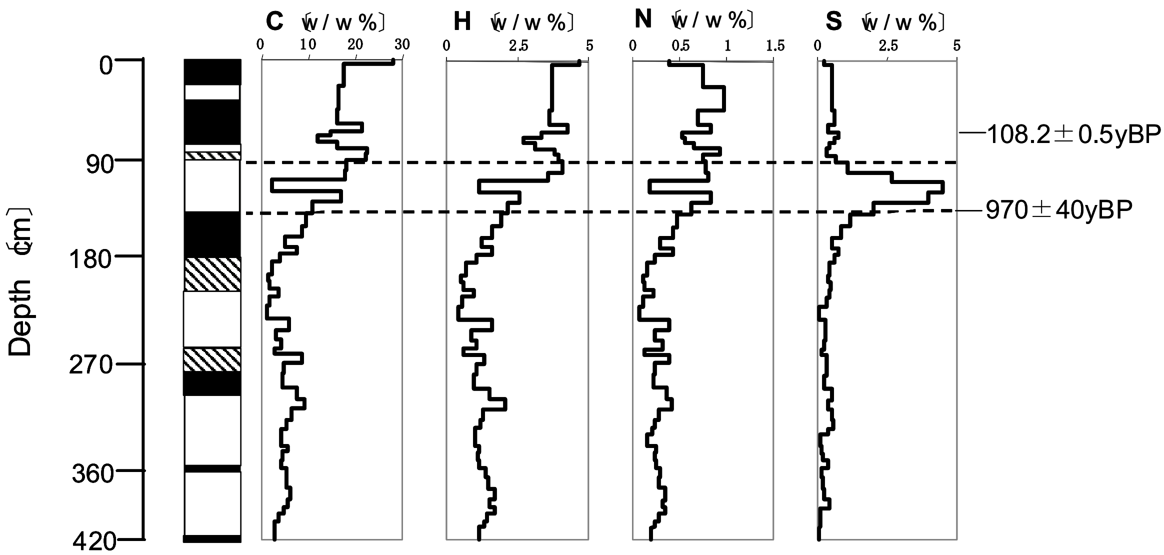

Figure 3. Relationship between vegetation change and elemental composition in sediment core.

Exchangeable cation concentrations showed higher values at the volcanic glass layers. Data not presented deposition of volcanic glasses would accelerate decomposition of nutrients by increasing aeration in wetland soil.

CONCLUSION

In this study, the relationship between volcanic activity and vegetational change with special reference to chemical deposition originated from volcano is clarified. Sulfur deposition by volcanic activity triggered retrogressive succession in mire community. However, mire vegetation changes from nutrient rich vegetation to ombrogenous vegetation within ca.100 years without volcanic activity.

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