Effect of mudflow on sediment characteristics and vegetation

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Introduction:

Disturbances and physical stress brought by volcanic eruption strongly control the degree of vegetation on harsh environments (del Moral and Bliss 1993). The violent eruption of Mount Tokachi in 1926 at central Hokkaido, Japan, triggered the Taisho Mudflow which devastated the Furano and Biei River basins scouring and depositing of sediment in the valley floor altering the chemical and physical properties (Murai, 1960). However, there are only a few studies which particularly dealt with the disturbances and their consequences on the sediment chemical and physical properties and vegetation. This study focused on the mudflow zones and their roles in affecting the sediment physical and chemical characteristics, and finally, clarify the vegetational status in different mudflow zones.

Study area and Method:

The study site is at southern slope of Mount Tokachi (2077 m) in Central Hokkaido Japan; with an altitude of about 540 to about 710 m along the Furano River. We identified the scoured and deposited zones according to the surface horizons and the distribution of substrates and categorized them into three zones namely *scoured* (SZ), *upstream deposited* (UDZ), and *downstream deposited zones* (DDZ) (Yajima et al, 1998). 16 holes of 50x50cm^2 were dug and their horizons were identified. Soil samples weighing about a Kg were collected from the depth of 0 to 20 cm for further analysis. Standard laboratory procedures were carried out to analyze soil bulk and particle densities, soil texture, water content and chemical parameters such as organic matter content, soil reaction, cations and CEC. Besides, all the tree species were identified, height and the diameter at breast height for overstory (height ≥2m) and height and the diameter at the stem base for understory (height ≤ 2m) were measured. Overstory vegetation quadrates ranging from 10 to 20m^2 were placed and a 2x2 m^2 quadrate was set inside the overstory vegetation quadrate for measuring the understory vegetation.

Results and discussion:

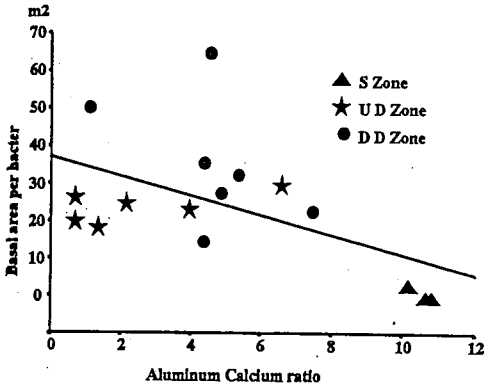
A fragipan layer, brittle, mostly comprised of sandy loam, with almost no fine roots, was found within 20 cm depth in SZ but not found in other zones. This property might be one of the factors controling the vegetation growth. The SZ and UDZ had significantly greater percentage of gravel in the mudflow sediment (2mm ~ 5cm) whereas the DDZ had significantly high amount of sand. The high proportion of gravel coinsides with the high vegetation density which indicates the importance of coarse fragments. The bulk density was highest at the SZ and lowest at the UDZ where as water content was the

lowest in the SZ than in the other two zones.

The study area had high amount of exchangeable aluminum, consequently low soil pH and CEC particularly in the SZ. The ratio between aluminum and calcium was high throughout the study area and particularly in the SZ. The organic matter content was significantly higher in the UDZ and DDZ than in SZ. All the cations present in the mudflow were considerably low in proportion. Al/Ca ratio retarded root growth which in turn affected the growth of the shoot system. This explains why the basal area was inversely proportional to Al/Ca ratio.

Abies sachalanensis, Picea gleahnii, Picea jejonensis and *Betula* spp. dominated the overstory of SZ and UDZ. But the DDZ was mostly covered by broadleaved species. The basal area in SZ was significantly low as compared to UDZ and DDZ. The overstory vegetation density was significantly different in every zone at 5% level. On the other hand, the understory had significantly greater number of species in the SZ than the other two deposited zones. The tree density was greater at the SZ and UDZ as compared to the DDZ but the basal area was lowest in SZ and highest in UDZ as shown in the figure below. The vegetation pattern shows that *Picea gleahnii* seems tolorant to high Al/Ca ratio.

This study emphasizes the importance of the different mudflow regimes to understand the differences in sediment chemical and physical properties in the devastated basin. Besides, broad range of the total basal area, average height and difference in understory species of vegetation in different zones were the significant contribution of the mudflow. It was suggested that a structural variability was controlled by Al/Ca ratio, the soil coarse fragments, water holding capacity and bulk density of the substrate.



The relation between the basal area of the overstory vegetation and aluminum calcium ratio.

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