

Trenching and radar survey of lateral fault at the western Toyako Spa on the northern foot of Usu Volcano, Hokkaido, Japan

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During the 1910 and 1977-1982 activity that occurred on the northern foot of Usu Volcano, notable crustal movement caused by intrusion of the dacite magma continued before and after the explosions. Due to north-facing (lakefront) movement of Toyako and Sobetsu Spa area on the northern foot, lateral faults were produced on east-and-west sides. Re-activation of some of the 1977-1982 faults (Katsui et al.1985) was observed during the present activity. In particular, the fault movement in western Toyako Spa area caused severe damage to buildings, e.g., Toyako Kyokai Hospital, roads and other constructions. However, timing, displacement and internal structure of faults remains unknown. If the imaging of fault is clarified, there is possible that magma intrusive process is inferred from fault activity. The relationship between magma intrusion and fault activity will be examined by ground-penetrating radar (GPR) survey and trenching.

Step Continuous Wave GPR survey was performed on road at the Ritsusenji temple site in western Toyako Spa and we decided to dig a trench nearby radar line. The trench was 15 m long, 5 m deep, 10 m wide at the bottom, and elongated in a WNW direction, across the fault strike.

The trench walls display the historical eruptions records from AD1663. The formations are divided into 14 beds of brown loam (Unit1), AD1663 cinders (Unit2), AD1663 surges and it's reworked (Unit3), AD 1663- AD 1769 tephra (Unit4), humus (Unit5), AD 1769 tephra (Unit6), humus (Unit7), AD 1822 tephra (Unit8-9), AD 1853 tephra and it's reworked (Unit10), Edo to Showa Era soil (Unit11), artificial soil in 1960s (Unit12), AD 1977-1978 tephra (Unit13), AD2000 tephra (Unit14) in ascending order.

The faults, divided into 6 faults of F1, F1-2, F2, F2-2, F3 and F3-2, cut these formations. These faults on N and S side are reverse faults in an appearance, but imbricate stacking of left lateral faults observed E side. Therefore, the fault system is indicated by positive flower structure, transpressional deformation as a lateral fault. The timing of each faulting events are estimated F1 event: AD1910, F2 event: AD1910 and AD1977, F3 event: AD1977 and AD2000. Activity of theses faults has gradually migrated from F1 to F3, as well as piggy-back thrust. Besides the evidence of fault activity in the Edo era was not found.

Fault displacement during the 1910 activity is extremely larger than during the 1977-1982 and 2000 by trench log. There is probable that the growth of cryptodome in the vicinity of the fault caused notable crustal movement. Yokoyama et al. (1973) suggested possibility that the growth of Kompira-yama (old cryptodome) progressed at the time of the 1910 eruption formed the new cryptodome and faults (Omori, 1911).

The GPR data shows fault traces characterized by a sudden change and west facing of reflection pattern. The image of reflection patterns correlates with positive flower structure formed by lateral fault.