

Rock toppling depending on slope structures of Mt.Kan'nondake, Kumamoto, Japan, and the retreating process of the cliff

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Characteristics of slopes in mountainous area generally express the types and frequency of slope failures which are repeatedly occurred during geologic time. To understand such relations on steep slopes of the Mt. Kan'nondake, a typical monadnock peak, Kumamoto, Japan, slope structures and slope failures recently occurred in there have been studied. The slope is mainly composed of the Paleogene sandstones and mudstone with thin coal beds. The monadnock peak rises above the surface of the Quaternary pyroclastic flow deposits of the Aso volcano origin.

NW-SE trending synclinal and anticlinal structures were recognized in the Paleogene strata, and the former is almost coincide with the ridge elongating in NW-SE trend. A results of detail measurement of strata shows that most of steep slope dips gently mountain side, and consequently they form a small basin-like structure. Therefore, the cliff is mostly inward slope in the monadnock peak.

Rock toppling along vertical joint planes, which are normal to bedding planes, and wedge sliding along joint planes steeply dipped are dominant, and these movements depend on the characteristic slope structure mentioned above. This means that the mountain slopes have retreated with steep cliff through repeatedly occurrence of toppling.

In the foot of the cliff, the paleogene strata is covered by the Quaternary pyroclastic deposits of welded tuff, and both are also covered by thin fluvial gravel beds. Upper surface of the Paleogene strata is also gentle, and is continuous with the basal surface of the pyroclastic flow deposits. This means that there was an erosional basal level around this level even before the stage of the pyroclastic flow deposits, and therefore only upper portion above the gentle surface has been dissected with retreating of the cliff during geologic time.

Amount of debris with large blocks of sandstone, some of which attains more than several meters in diameter, are distributed on the gentle slope around the monadnock covering the gravel deposits. Considering the topographical environments around the monadnock, most of debris and blocks are estimated to have fallen from the cliff and have deposited on the gravel beds at least after the stage of the pyroclastic flow deposits. Based on this, annual dissecting volume and annual retreating rate are estimated to be 10 to 100m³/year and 0.001 to 0.01m/year. Comparing with the slope failures appeared on the slope, this means that frequency of the occurrence of slope failure is too small during tens to sixty thousand years.