Geophysical Research Abstracts
Vol. 12, EGU2010-15483, 2010
EGU General Assembly 2010


# Structure and geotechnical characteristics of landslide of Geyser Valley (Kamchatka)

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Geyser Valley (the valley of the Geyser River) is one of the most unique nature objects in Russia. There are only four geyser zones in the world. In 2007 in the valley of the Geyser River a large landslide was formed; it destroyed influenced more than a half of all thermal objects.

Geyser Valley landslide

Formation and displacement of the landslide in Geyser Valley took place 3 June 2007 in the upper reaches of the Vodopadniy creek. According to the observers, the main displacement on the landslide body looked like viscoplastic flow of ground masses and lasted 2,5 minutes. As a result of slope deformations a landslide tongue formed (1,2 -1,5 km length and 0,2-0,4 km width). The landslide surface is uneven, the slope dips do not exceed 100. The whole rock volume involved in displacement is around 4,7 mln m3.

Presently the upper part of the landslide consists of different tuff blocks rough to porcelain-like fine-grained rocks. In the lower part of the landslide the type of landslide surface changes, as well as the deposits composing the landslide massif. The surface becomes more even due to the bigger quantity of small fragments and the larger extent of big blocks disintegration.

There may be at least two possible reasons for the loss of stability. The first reason is high level of fracturing of the basement rock. Another reason for loss of rock stability is a considerable hydrothermal activity in this region. As the fractured zones are the natural channels for the fluid migration, weakened zones appear along them due to hydrothermal conversion of original rock masses. Initially the slope rock masses represented by tuff-sedimentary rocks are subjected to substantial changes. Converted to the dispersed state, they have various chemical and mineral composition. The content of $SiO_2$ changes 57,4 to 72,8%; $Al_2O_3$ – 13,0 to 26,6%; $Fe_2O_3$ - 3,9 to 8,6%; CaO – 0,1 to 3,8%; MgO – 0,6 to 3,2%. Among minerals composing these rocks there is a group of clay rocks often forming pseudomorphic crystals of the original minerals, zeolites feldspars. Laboratory researches of strengthening characteristics of clayey landslide rocks in the samples showed that they have value of internal friction angle - 11-17 – and cohesion – 27-37 kPa. The sample destruction during the shear happens like a viscoplastic deformation.

We can also note that reduction of strength of rock due to the intensive hydrothermal conversion under conditions of relatively steep slopes (to 35°) and deep erosion valley will be the reason for future landslide processes in Geyser Valley.