Distribution of highly saline groundwater in the areas with many landslides in the southern Niigata Prefecture

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Numerous numbers of landslides have occurred in the areas of Neogene sedimentary rocks in the southern Niigata Prefecture. They have been called Tertiary type landslides and their occurrence has been attributed to the weakness of those rocks, but recent studies have found highly saline groundwaters beneath some landslides and suggested those groundwaters may be related to landslide activity (Watanabe et al., 2009). However, distribution of highly saline groundwater in wide areas is not known and the actual relationship between highly saline groundwater and landslides has not been validated. We have conducted geological surveys and the CSAMT geophysical exploration in and around the Nagakurayama anticline, where many landslides and gravitational slope deformations are recognized.
The Nagakurayama anticline consists of Neogene massive tuff, mudstone, and alternation of tuff and mudstone beds, which are folded with an axis of NNE-SSW and plunging to the north and the south. The hinge line is along a ridge. There are many landslide units on both wings of the anticline, and there are linear depressions along the ridge. Other anticlines and synclines are aligned subparallel to the Nagakurayama anticline in the Higasi-kubiki hills, Niigata (Takeuchi and Kato, 1994).
Our CSAMT survey showed that the surveyed area is widely underlain by zones of low resistivities (<10 Ω m) generally deeper than about 100 m and that much higher resistivity areas are present shallower than the level. High resistivity zones extend much deeper just beneath the linear depression. Comparing with the results with geological cross sections, higher resistivity zones may correspond to tuff and the linear depression. The interstitial water of mudstone may be highly saline water in the depth and might be replaced by fresh water at shallower zones. The replacement could deteriorate rocks and likely be the basic causes of landslide occurrence.

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