

# Protection of Lives from Sediment Disasters

About 1,000 sediment disasters occur every year in Japan causing heavy loss of human lives and damage to properties.

A SABO Supplementary Reader



## Protection of Lives from Sediment Disasters

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URL\_ <http://www.sabopc.or.jp>

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# 1 Japan is prone to sediment disasters

Japan is blessed with abundant nature. On the other hand, however, various natural disasters occur. One of them is the sediment disaster.



**Debris flow**  
(2014/Hiroshima sediment disaster, Hiroshima City, Hiroshima Prefecture)



**Landslide**  
(1995/Jitsukeyama landslide, Nagano City, Nagano Prefecture)



**Slope failure of Shirasu terrace (a mass of accumulated volcanic ash)**  
(1986/Kagoshima heavy rainfall disaster, Hirano Town, Kagoshima City, Kagoshima Prefecture)

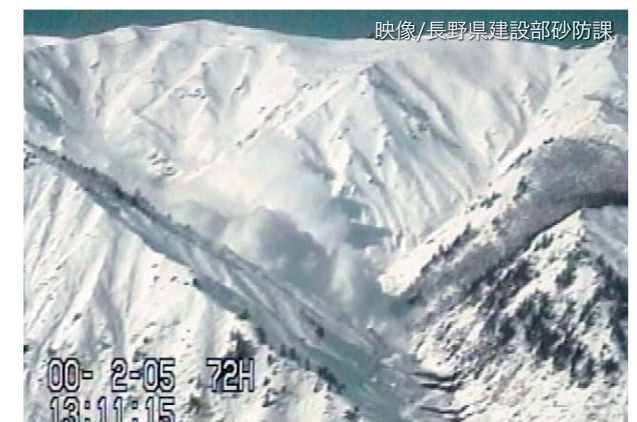


**Let us learn more**

◇“Sediment disaster” is defined as the disaster where houses, roads, agricultural lands etc. are buried and human lives are lost, by collapse of land mass of sediment (soil, sand, stone etc.) on slopes of mountains and hillsides, or by the flow of the mixture of such sediment with rain water and river water. Sediment disasters include debris flow, landslide, slope failure etc.



**Mud flow of volcanic ash occurred after eruption**  
(2000, Miyake Island, Tokyo)



**Snow avalanche in Hakuba Village**  
(2000, Hakuba Village, Nagano Prefecture. Photo by Nagano Prefecture with supervision by Public Works Research Institute of MLIT)



**River closure(natural dam)**  
(2011/Typhoon No.12, Totsukawa Village, Nara Prefecture)

# Why so many sediment disasters in Japan?

The causes are attributed mainly to the climate and the geology/topography of Japanese archipelago.



## <Heavy rains>

One of main causes for sediment disasters is heavy rains. Japan is a country where rainfall amount is particularly great in the world. Moreover, concentrated heavy rains occur by typhoons, Baiu-front (stationary front in the rainy season) etc.

## <Mountainous topography with fragile geology>

Around 70% of Japan is mountainous areas. Further, most mountains are steep and fragile in geology, and collapse easily.

## <Steep rivers>

Mountains in Japan are generally high and steep, therefore, rivers originating in such mountains are "rapids". The more rapid the current is, the stronger is the erosion in upstream mountain areas, resulting in much sediment discharge to downstream areas.

## <Frequent earthquakes and many volcanos>

Earthquakes occur frequently in Japan. They trigger slope failures, landslides etc. Further, there are as many as 110 active volcanoes in Japan.

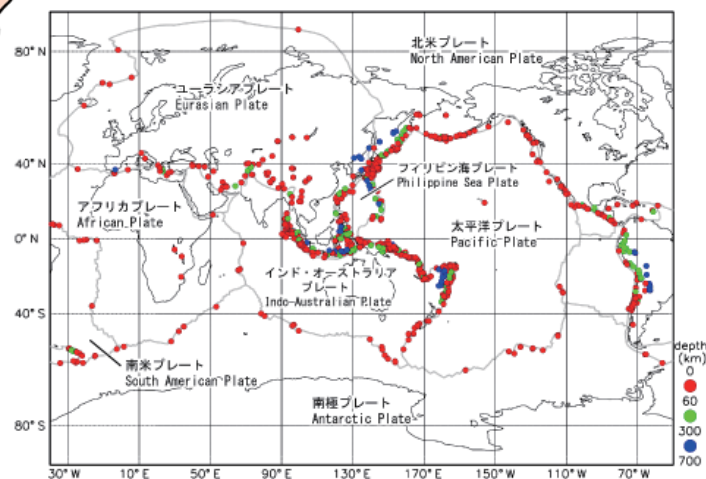


I now know that earthquakes occur along boundary of plates.



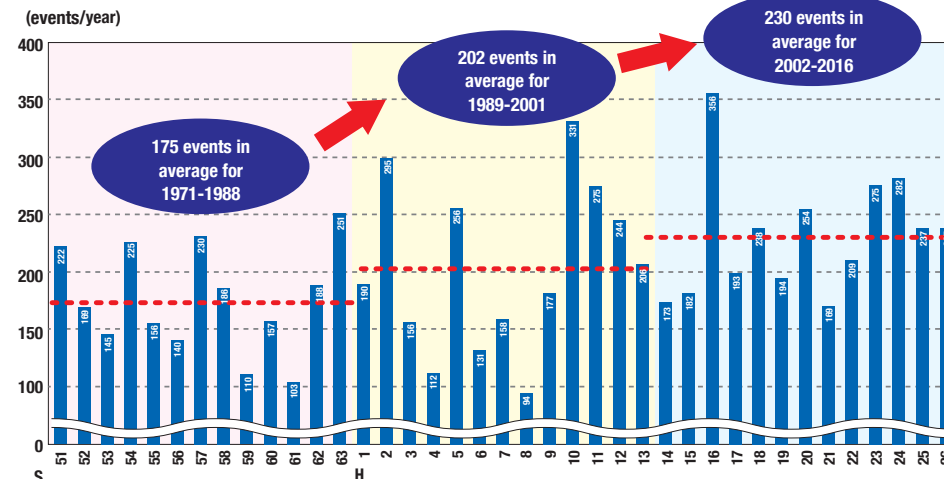
## Let us learn more

- ◇ "Active Volcano" means a volcano which erupted in recent 10,000 years. There are about 1,500 active volcanos in the world. Japan's land area is only 0.1% of the world, but the number of the active volcano is as many as 7%.
- ◇ It is thought that earthquakes occur by the movement of the plates. The plates are hard base rocks covering the earth by about ten blocks (There are several different opinions about the number of the plates). Four of them are located in the vicinity of the Japan archipelago.

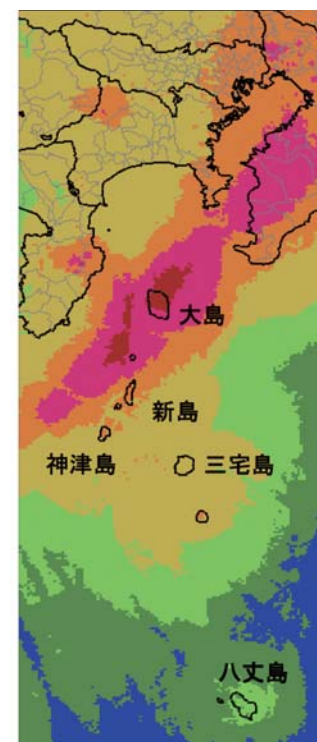


## <Hazardous heavy rainfall has been increasing.>

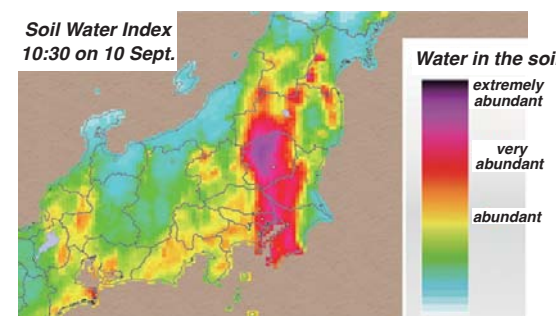
In recent years, very heavy rainfall concentrated over narrow areas in short period (localized heavy rainfall) has been increasing, and, as a result, sediment disasters are also increasing.



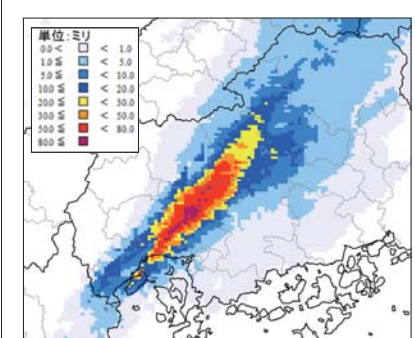
Rainfall distribution during Typhoon No.26 in October 2013 (27 hours rainfall during 6:00 on 15 October~9:00 on 16 October)



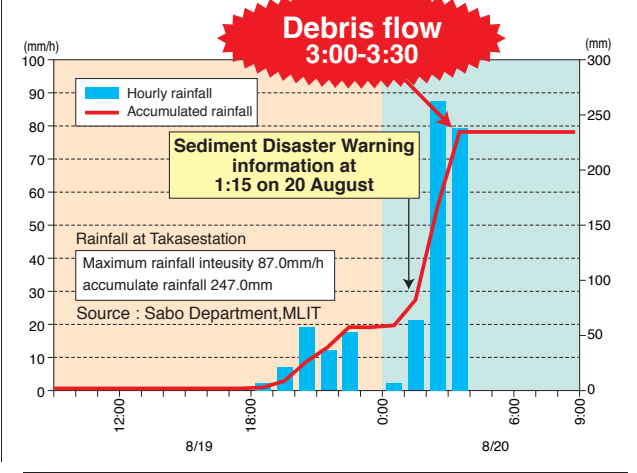
Soil Water Index at the time of Kanto-Tohoku Heavy Rainfall Disaster in September 2015 (The figure shows the rainfall amount infiltrated into the soil)



Rainfall distribution during Hiroshima sediment disaster in 2014 (One hour rainfall during 2:00~3:00 on 20 August)



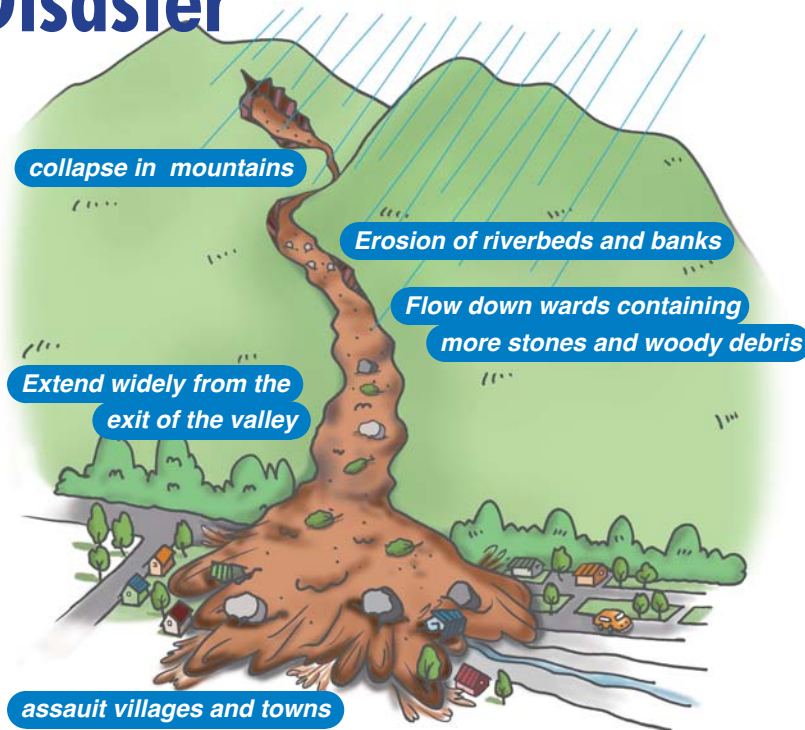
In the case of Hiroshima sediment disaster in August 2014, the rainfall ceased for some time and resumed intensively. The sediment disaster occurred in only two hours thereafter. The disaster caused extensive damage claiming 74 casualties.



As a result of the combined effect of the wind towards the depression originated in Typhoon No.18, and the wind from Typhoon No.17 in the Pacific off Japan, the cumulonimbus clouds were generated one after another in a long line, and brought about heavy rainfall. In the upstream areas of Kinu River, sediment disasters occurred at many places, while in the downstream areas, Joso City of Ibaraki Prefecture was affected severely by floods due to breach of river embankment.

## 2 Debris Flow Disaster

Debris flow is a phenomenon that sediment produced by heavy rainfalls in mountains and valleys becomes muddy with water and runs down rapidly towards downstream areas. It grows on the way by eroding valleys and taking in rocks and large woods, and extends widely from the exit of the valley to assault villages and towns.



**A town affected by debris flows**  
(2014/Nagiso Debris flow disaster, Nagiso Town, Nagano Prefecture)



**Debris flows (mud flows) by heavy rainfalls of a typhoon**  
(2013/Typhoon No.26, Oshima Town, Tokyo)



A rock as large as this size can be drifted.



It is as fast as cars running in the town.



**A large rock drifted down by debris flows**  
(2014/Hiroshima Debris flow disaster, Hiroshima City, Hiroshima Prefecture)

**20-40km/hour!**

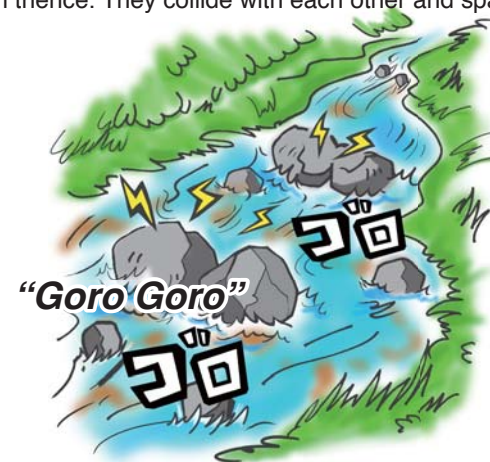


## Omens(presage)for debris flows

Most debris flows are caused by heavy rainfalls. If such phenomena as shown below are perceived in rivers or torrents, they may be omens of debris flows. Let us evacuate immediately.

**>>>Rumbling sounds like “Goro Goro” are heard and sparklings are seen in rivers and torrents.**

This suggests that slope collapses have occurred in upstream mountain areas and large stones are flowing down thence. They collide with each other and spark.



**>>>Mountain rumbling is heard and abnormal smell is perceived.**

This suggests that slope collapses have occurred in upstream mountain areas.

**>>>Ground rumbling is heard.**

This suggests that debris flows are already coming down.



**>>>Current of rivers and torrents becomes turbid and muddy, and trees drift with the current.**

This suggests that slope collapses have occurred in upstream mountain areas, and sediment and trees are flowing down thence.



**>>>River water decreases, while rains continue.**

This suggests that sediment from slope collapses in upstream mountain areas has blocked the current of the river. The sediment which blocks the current may collapse all at once, resulting in debris flows to affect downstream areas.

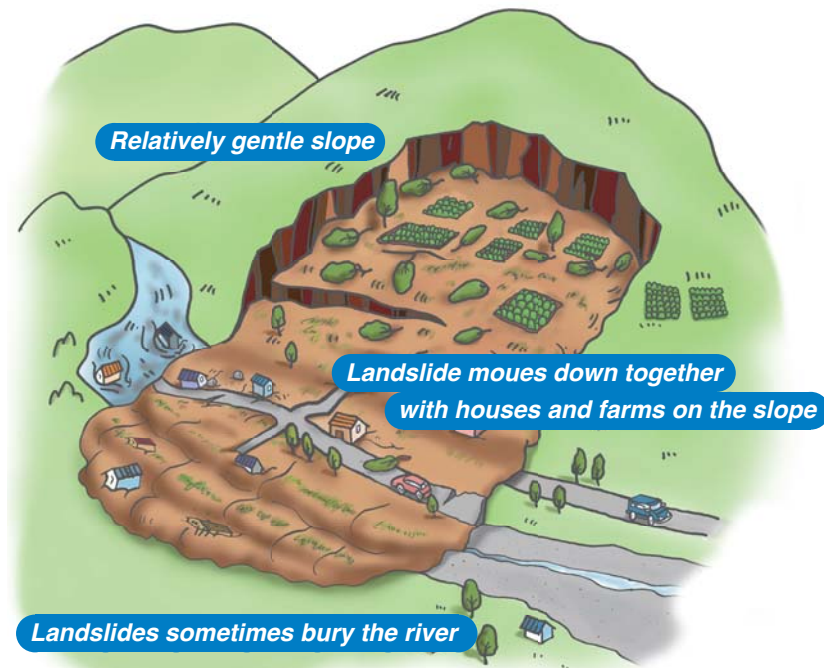


### Let us learn more

- ◇ Debris flows do not always have omens. However, once something unusual or strange is perceived, it is necessary to inform it to neighbors as well as to village/town office, and to evacuate to a safer place as soon as possible.
- ◇ In order to perceive such abnormal phenomena, it is necessary to observe the nature around us carefully from time to time at ordinary time and to know well the nature at ordinary time.
- ◇ “Abnormal smells” include burnt smell, smell of decay, smell of soil etc.
- ◇ It is possible that, while there is no rainfall where we are, heavy rainfalls in upstream areas may cause debris flows to hit us all of a sudden. When camping in river side, for example, it is necessary to move away from the river to a safer place as soon as possible, once black clouds are seen over mountains and /or rumblings of thunder are heard in the distance.

# 3 Landslide Disaster

Landslide is a phenomenon that a wide area of relatively gentle gradient slides down a slope. Some move slowly over time but others move quickly as fast as several meters all at once, causing serious damage to houses, agricultural lands, roads etc.



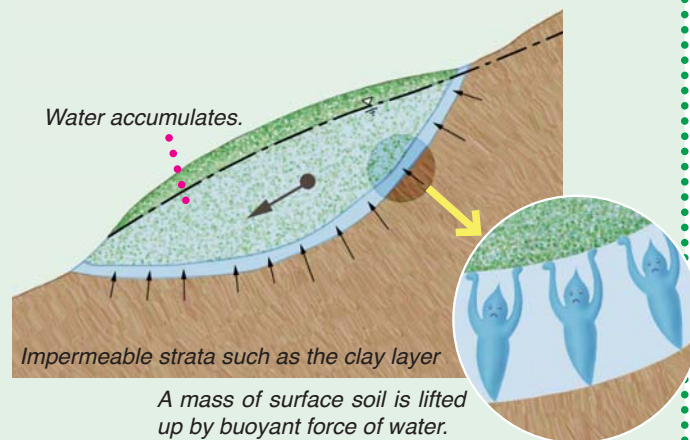
**Landslides caused by Chuetsu Earthquake in Niigata Prefecture**  
(2004, Nagaoka City, Niigata Prefecture (Former Higashi Takezawa area of Yamakoshi Village))  
Earthquake can cause landslides.



**Landslide buried a community and reached the highway.**  
(2010, Takigo Town, Kagoshima Prefecture)

## Mechanism of landslide

Landslides occur where there are strata which are impermeable, such as clay layer. Rain water, snow melted water, underground water etc. permeates the soil and accumulates above the impermeable strata. Then the mass of soil is lifted by the buoyant force and slides down the slope. Landslide may start moving detonated by earthquake.



## Let us learn more

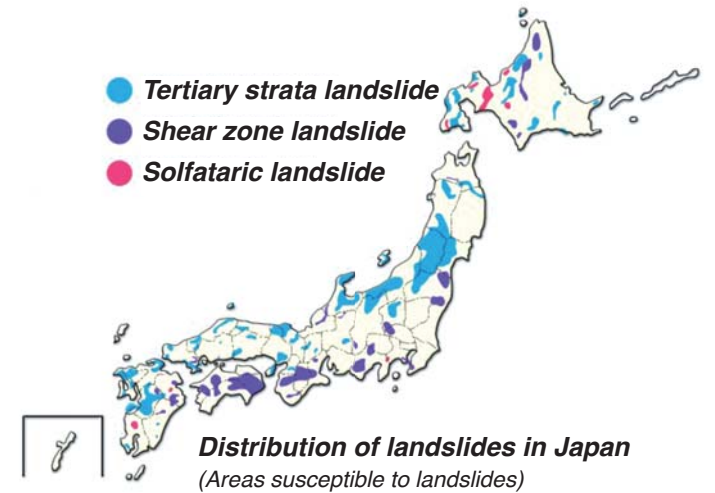
◇The conditions to provoke landslides are the existence of strata of much different water permeability, similar inclination between the surface slope and strata and so on, in addition to the existence of clay or other impermeable layer.

## Types of landslide

Landslides can be classified into three types as follows.

|   |
|---|
| <b>Tertiary strata landslide</b>  |
| Tertiary strata were formed about 65~1.7 million years ago through accumulation of volcanic ash, mud etc. They easily turn to clay.   |
| <b>Shear zone landslide</b>   |
| Shear zone is a stratum where the rock is fragile with a number of fissures and is easily turned into clay. This type of landslide prevails in the vicinity of major faults such as the median tectonic line. |
| <b>Solfataric landslide</b>   |
| This type of landslide occurs where the strata have been turned into clay by the effect of hot springs, volcanic activities etc.  |

- Tertiary strata landslide
- Shear zone landslide
- Solfataric landslide



## Omens (presage) for landslides

Following omens may be perceived before landslides occur. cracks in the ground may appear even several months before the mass movement.



>>>Changes in the ponds: water becomes turbulent, water level decreases etc.

>>>Cracks, deformation in the ground



>>>Sounds of trees like "Zawa Zawa", "Meki Meki"

>>>Sounds of trees being split

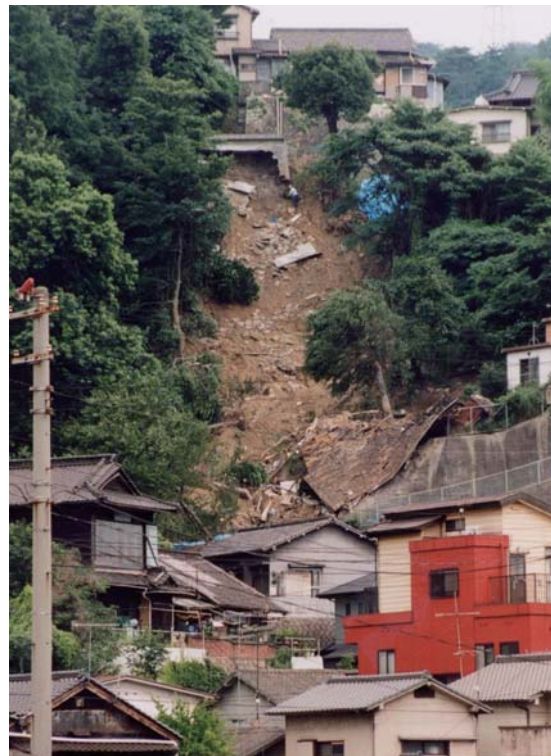
>>>Sounds of roots of trees being cut

>>>Sounds of rumbling mountain roaring

>>>Augmentation of spring water

# 4 Slope Failure Disaster

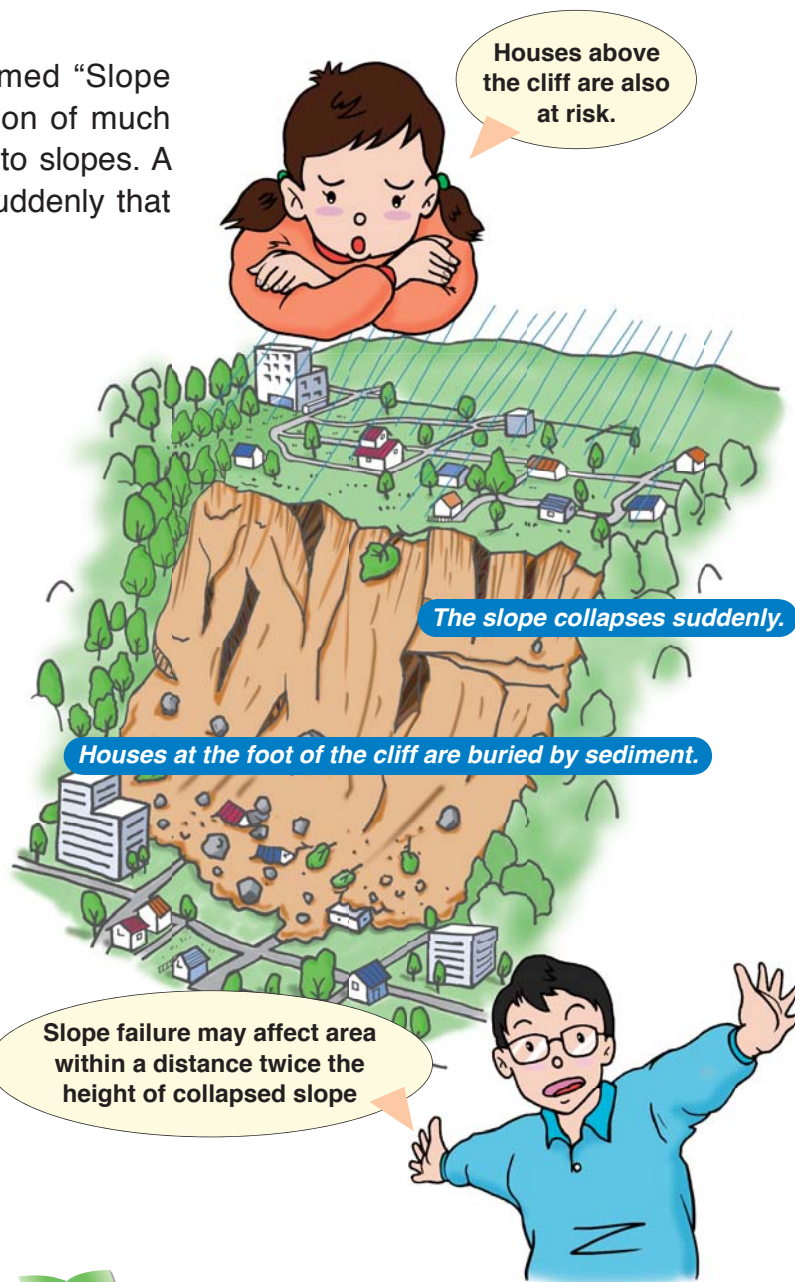
Collapse of steep slope (cliff) is termed "Slope failure". It is caused mainly by infiltration of much water from rainfall, snow melting etc. into slopes. A large mass of sediment collapses so suddenly that many people fail to escape and die.



**Houses collapsed by a slope failure**  
(1999/Baiu front heavy rains, Kure City, Hiroshima Prefecture)



**Slope failure in a housing area developed on a hillside slope**  
(1999/Baiu front heavy rains, Kure City, Hiroshima Prefecture)



### Let us learn more

- ◇ Slope having a gradient of 30 degrees or more is one of criteria as target area for countermeasures according to Sediment Disaster Prevention Act.
- ◇ It is said that the possibility of slope failure is generally high in the slopes where the height is more than 5 meters, big boulders are on the surface, much water springs out even at ordinary times, and so on. Precautions are particularly necessary when it is raining.
- ◇ Slope failures may be provoked by earthquake, strong winds and so on.
- ◇ Slope failures may occur even after the rain is over. Precautions should continue even after the rainfall has ceased.
- ◇ Slope failures occur rather frequently in populated areas such as housing areas developed in hillsides.

## Omens (presage) for slope failures

Various omens (presage) as mentioned below may be perceived before the occurrence of slope failures. Slope failures occur in a short time after the omens are perceived, Once any omen is perceived, let us communicate each other in the community and evacuate to a safer place as soon as possible.

>>>Cobbles roll down the slope clatteringly.



>>>Cracks appear on the slope.



>>>Muddy water springs out on the slope.



>>>Trees tremble and tilt.

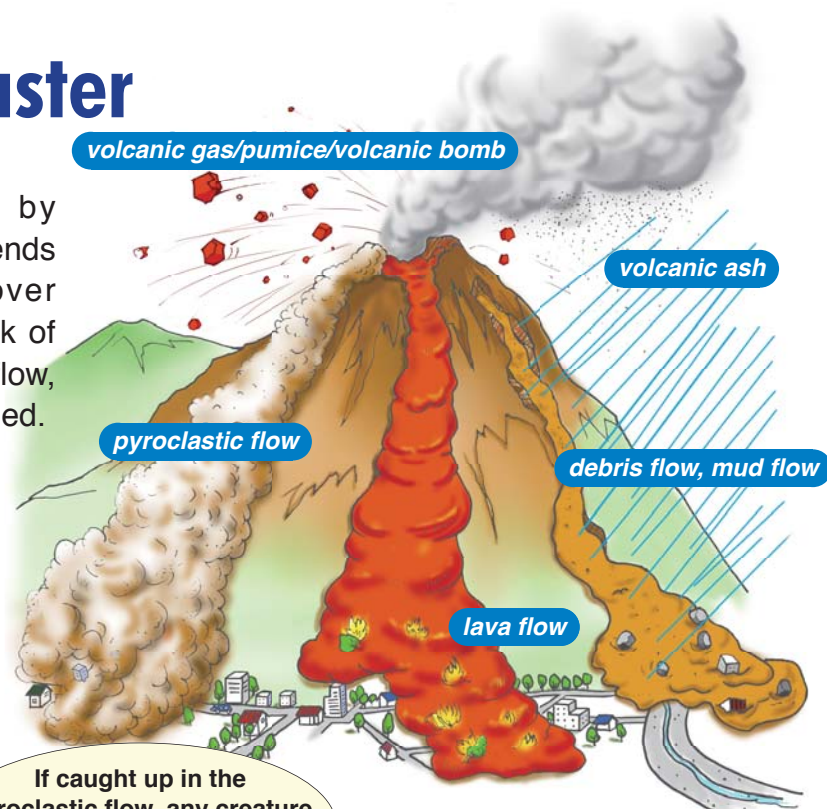


### Let us learn more

- ◇ In addition to these omens, following omens may also be perceived: change in the spring water (sudden increase or decrease, spurt out or stop), swelling of the slope surface, ground rumbling etc. However, slope failures may occur all of a sudden without omens, therefore residents living near the foot of steep slopes are recommended to evacuate without delay earlier than residents of other areas.
- ◇ If going out of the house for evacuation place is considered no more possible, it is recommended to evacuate to a room of the house of the second or higher floor and away from the hazardous slope.
- ◇ Deference between landslide and slope failure: Landslide has "sliding surface" and the mass above the sliding surface moves slowly. In many cases landslides occur on the slope of gradient gentler than those of slope failures.

# 5 Volcanic Disaster

Volcanic disasters are caused by volcanic eruption and the damage extends over wide areas. Heavy rainfall over volcanic ash accumulated on the flank of mountain may trigger debris flow/mud flow, and the damage may be further extended.



### Pyroclastic flow

(June 1991, Unzen-Fugendake, Nagasaki Prefecture) Pyroclastic flow is a flow of the mixture of volcanic ash, lava, hot gas and air erupted from the crater. The maximum speed may exceed 100km/hour and the temperature at the center is nearly 1,000°C

If caught up in the pyroclastic flow, any creature will die instantly by the high temperature and gas.



Debris flow by volcanic eruption of Unzen-Fugendake (1991, Shimabara City, Nagasaki Prefecture)

### Let us learn more

◇ Debris flows are triggered by much rainfall over areas where volcanic ash is deposited. The volcanic mudflow triggered by snow melting due to heat of erupted materials when eruption occurred during snow season is called "Snow melting type volcanic mud flow". This type of volcanic mudflow resembles debris flow, but is faster in movement and greater in magnitude.

◇ Debris flows around volcanos last long as long as volcanic deposits remain and volcanic mud flow continue to occur as long as erupted materials remain on the mountain even after the volcanic activities end.

◇ Big earthquakes may trigger volcanic eruption. Besides the Great East Japan Earthquake of 2011, there were five huge earthquakes with the magnitude exceeding M9 since the middle of the 20th century (1952 Kamchaka M9, 1957 Andreanof (Aleutian Is.) M9.1, 1960 Chile M9.5, 1964 Alaska M9.2, 2004 Sumatra M9.2), each of which was followed by eruptions of nearby volcanos. In fact, as many as 20 volcanos across Japan from Hokkaido to Kyushu became active after the Great East Japan Earthquake.



### Ontake-san blowing off volcanic smoke

(September 2014, on the boundary between Gifu Prefecture and Nagano Prefecture)



### Snow melting type volcanic mud flow by eruption of Tokachidake

(1926, Tokachidake, Hokkaido) The heat of volcanic ash melted the snow on the mountain, resulting in the large scale mud flow. Villages at the foot of the mountain were buried and a number of persons were dead or missing.

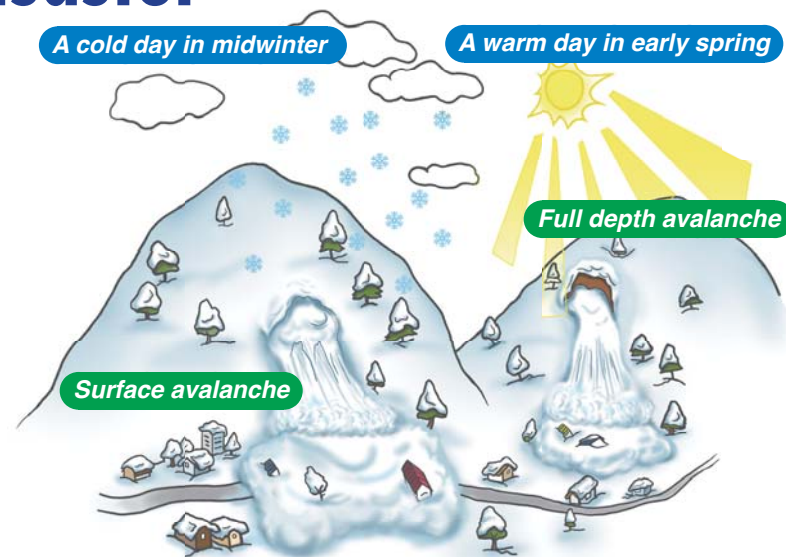
# 6 Avalanche Disaster

Avalanche is a phenomenon that the snow accumulated on the flank of mountains runs down the slope. There are two types: a surface avalanche and a full depth avalanche.



### Rescue operation for persons buried in an avalanche

(1986/Maseguchi avalanche disaster, Itoigawa City (former Nou Town), Niigata Prefecture) 13 persons died by the surface avalanche.

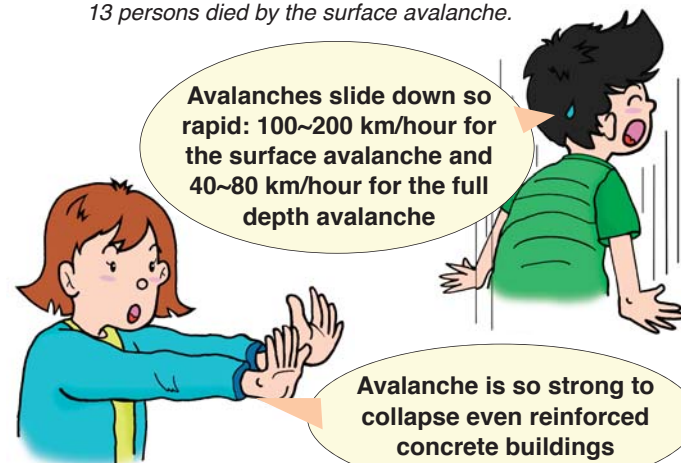


### Surface avalanche and Full depth avalanche

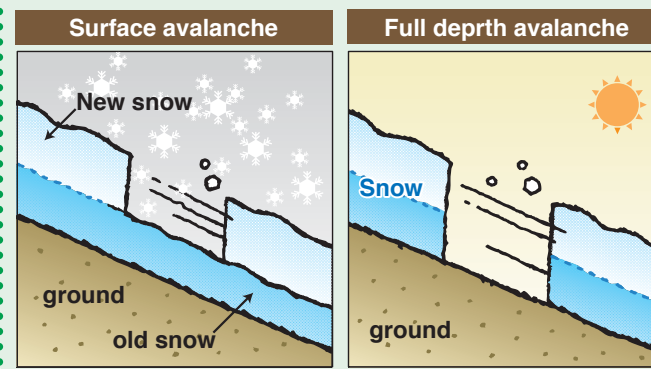
Surface avalanche: When much snow accumulates anew on the old snow, the new snow may slide down. This phenomenon is called surface avalanche. Surface avalanche occurs when temperature is low and snow is continuously falling.

Full depth avalanche: Full depth avalanche occurs when weather is fine and temperature is rising, or in rainy days. Both the old snow and new snow melt and slide down together.

Avalanches slide down so rapid: 100~200 km/hour for the surface avalanche and 40~80 km/hour for the full depth avalanche



Avalanche is so strong to collapse even reinforced concrete buildings



### Omens(presage) for avalanches

Photo taken and provided by National Research Institute for Earth Science and Disaster Prevention and Niigata Prefecture

Following phenomena suggest possible occurrence of avalanche. Please keep away from the slope.



### Cornice

Snow overhangs from the ridge.



### Snow ball

Lumps of snow like balls roll down over the slope.



### Crack

Cracks appear on the snow as if the slope is scratched.



### Snow wrinkle

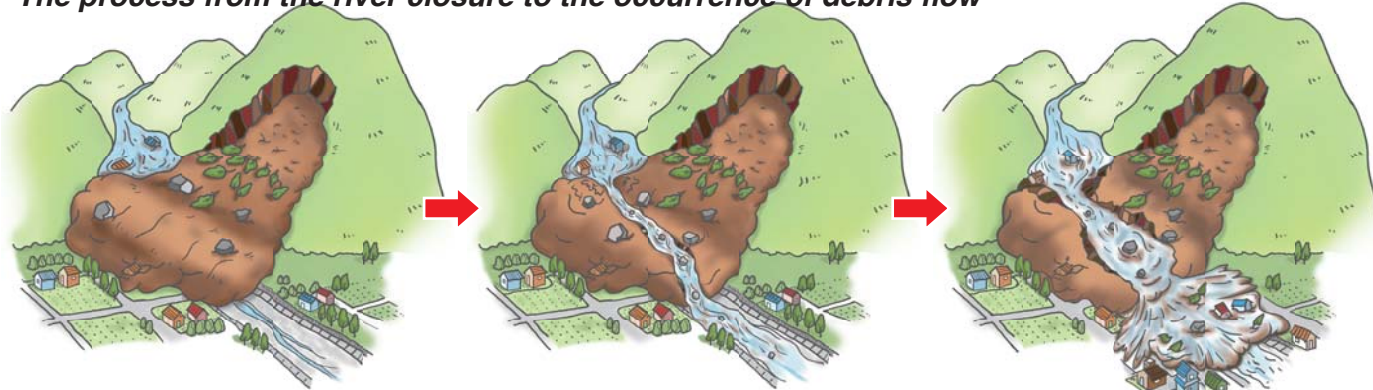
Snow surface becomes wrinkled, like a sodden finger.



# 7 River Closure (Natural Dam)

Huge amount of sediment due to earthquakes, landslides, heavy rains, volcanic eruption etc. is discharged to river and close the river channel, creating a water pool like a pond on the upstream side. This situation is called "river closure (natural dam)". In the upstream areas, houses, roads etc. are submerged, while, in the downstream areas, floods containing much sediment, debris flows etc. may cause damage, once the sediment which is closing the river collapses abruptly (breach).

## The process from the river closure to the occurrence of debris flow



Sediment discharged from mountains closes river channel (like a dam), resulting in the creation of a water pool (like a reservoir) on the upstream side.

The water level rises gradually and overflows the sediment mass which is closing the river. The sediment mass starts to collapse (breach).

The collapsed sediment mass is mixed with water and develops into debris flow and floods.

映像/国土交通省湯沢砂防事務所

I came to know that so many river closures occurred by earthquakes in the case of Niigata Chuetsu Earthquake and Iwate/Miyagi Inland Earthquake



### River Closure occurred by Iwate/Miyagi Inland Earthquake

(2008 Ichinoseki City, Iwate Prefecture)  
A natural dam has been created by river closure as a result of sediment discharge into the river.



**A village inundated by the river closure**  
(2004, Niigata Chuetsu Earthquake, Nagaoka City, Niigata Prefecture (Former Yamakoshi Village)  
The river was closed by sediment discharged due to earthquake, and an upstream village Kogomo was inundated.

"River Closure (Natural Dam)" is sometimes called "Sediment Dam"



### Let us learn more

◇When a serious damage due to a river closure is presumed to riverine villages, countermeasures are undertaken such as: To cut off the sediment and lower the height of the natural dam before the water level reaches the top of the natural dam, so that the water may overflow safely without causing damage to the natural dam; To construct drainage channels and/or drainage tunnels to drain the water.

## Deep Seated Landslide

The phenomenon that mountain slopes collapse from the deep bed rock is called "Deep Seated Landslide". The deep seated landslide is greater than surface land slide in terms of the amount of the collapsed sediment, and accordingly the magnitude of debris flow and river closure, and the extent of the damage.

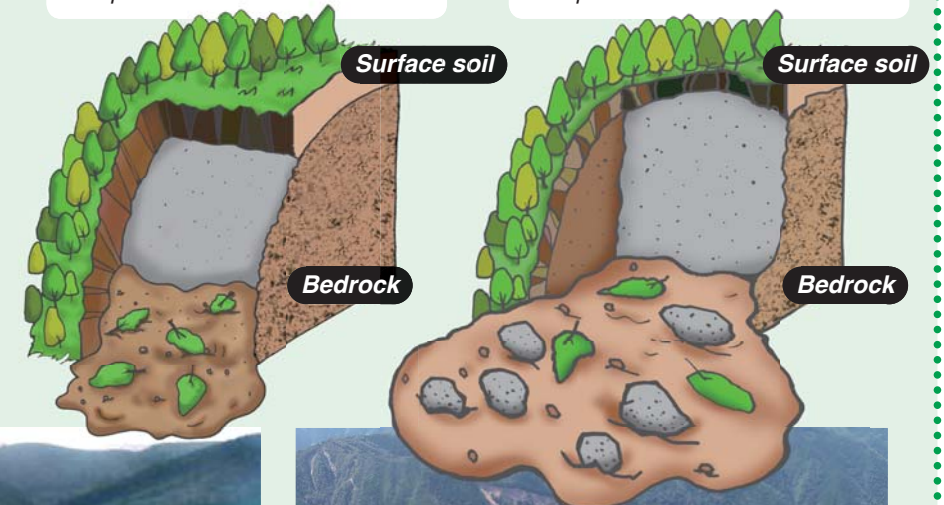
The mechanism of occurrence of the deep seated landslide is thought as follows: A large amount of rainwater or snow melt water infiltrates deeply into the crack of bed rock and lifts the surface soil together with bed rock by the force of water (buoyant force). Deep seated landslide may also be triggered by earthquakes.

### Deep seated landslide

Bed rock below surface soil also collapses.

### Surface landslide

Surface of the slope (surface layer) collapses and slides down



**Debris flow by deep seated landslide**  
(1997 Izumi City, Kagoshima Prefecture)  
21 persons were killed by the debris flows



**Deep seated landslides by heavy rainfall**  
(2011 Typhoon No.12, Totsuukawa Village, Wakayama Prefecture)  
River was closed by sediment produced by a landslide.

### Let us learn more

◇Mechanism of deep seated landslide has not been fully cleared yet. However, through analysis of deep seated landslides in the past, progress is being made to identify geological and topographical conditions in which such landslides occur. Based on the results of such analysis, MLIT published in 2010 "Estimated frequency map of deep seated landslide", and in 2012 "Deep seated landslides evaluation map at torrent level" which evaluates risk at torrent level for areas identified as the high frequency area in the 2010 publication.

[http://www.mlit.go.jp/mizukokudo/sabo/deep\\_landslide.html](http://www.mlit.go.jp/mizukokudo/sabo/deep_landslide.html)

Countermeasures against deep seated landslide is difficult. Therefore it is recommended to keep attention to heavy rainfall and long-lasting rainfall, and to evacuate without delay, in areas which have been identified as high risk areas in these maps.

◇Deep seated landslides sometimes occur fairly long time after rains ceased. The deep seated landslide which triggered large debris flows in 1997 in Izumi City, Kagoshima Prefecture occurred four hours after the rains ceased. This is because it takes time for the rain water to infiltrate deeply to the base rock. When it rained heavily or continued for days in areas where the risk of deep seated landslide is high, it is necessary to keep alert for days even after rains have ceased.

# 8 Preventive measures against sediment disasters

## Preventive measures against debris flows

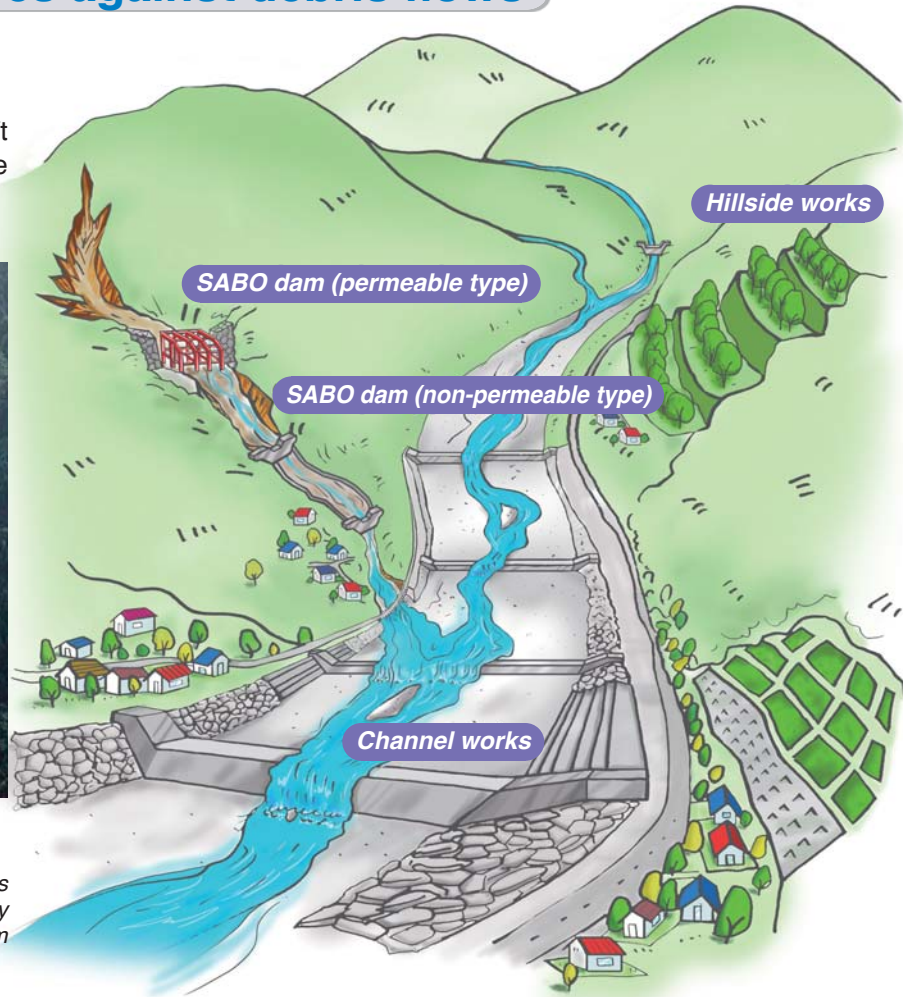
### SABO Dam

SABO dam captures debris flow, drift woods etc. and prevents damage in the downstream areas,



#### SABO dam which captured debris flow (non-permeable type)

The SABO dam captured sediment of debris flow triggered by "2007 Baiu front heavy rains" and protected towns in the downstream areas.



### Channel Works

In steep rivers, riverbed and river side are eroded by the force of the high velocity flow heavily and progressively. In order to weaken the force of the flow, and thus to mitigate erosion and to reduce the volume of the sediment transported to downstream areas, step works and low dams are constructed in the river in a series. Revetment is constructed to protect river side from erosion.



**Channel works**  
(Nomugi-Pass channel works, Matsumoto city, Nagano Prefecture)  
Parks constructed along the river.

### Hillside works

Trees and grasses are planted in naked mountains to prevent erosion and collapse of mountain slopes.



#### Kobe City and Rokko Mountains in early Meiji Era

The naked mountains seemed to be covered with snow from a distance.



#### Mitatabi-yama, Rokko Mountains when hillside works began

Hillside was cultivated in steps along contour line and seedlings were planted



**Rokko Mountains at present**  
"Green" has revived after 100 years of the hillside works.

## Various types of SABO dam



#### Cell type SABO dam (Kamisawagawa SABO dam, Nagaoka City, Niigata Prefecture)

The large steel cells are filled with the mixture of the soil produced in the course of construction works and cement.



#### Steel Slit Dam (Maetanigawa SABO dam, Echizen City, Fukui Prefecture)

One of permeable type SABO dam. It allows sediment to pass through during ordinary floods, and captures only large stones and drifting trees flown down by debris flows.

Sediment and drifting trees captured by dams are taken out later.



#### SABO dam with a fish way (Sakauchi SABO dam, Ibikawa Town, Gifu Prefecture)

"Fish way" is a passage for the fish to go upstream for spawning.



#### SABO dam registered as national tangible cultural property (Dodo River No.6 sunadome work, Fukuyama City, Hiroshima Prefecture)

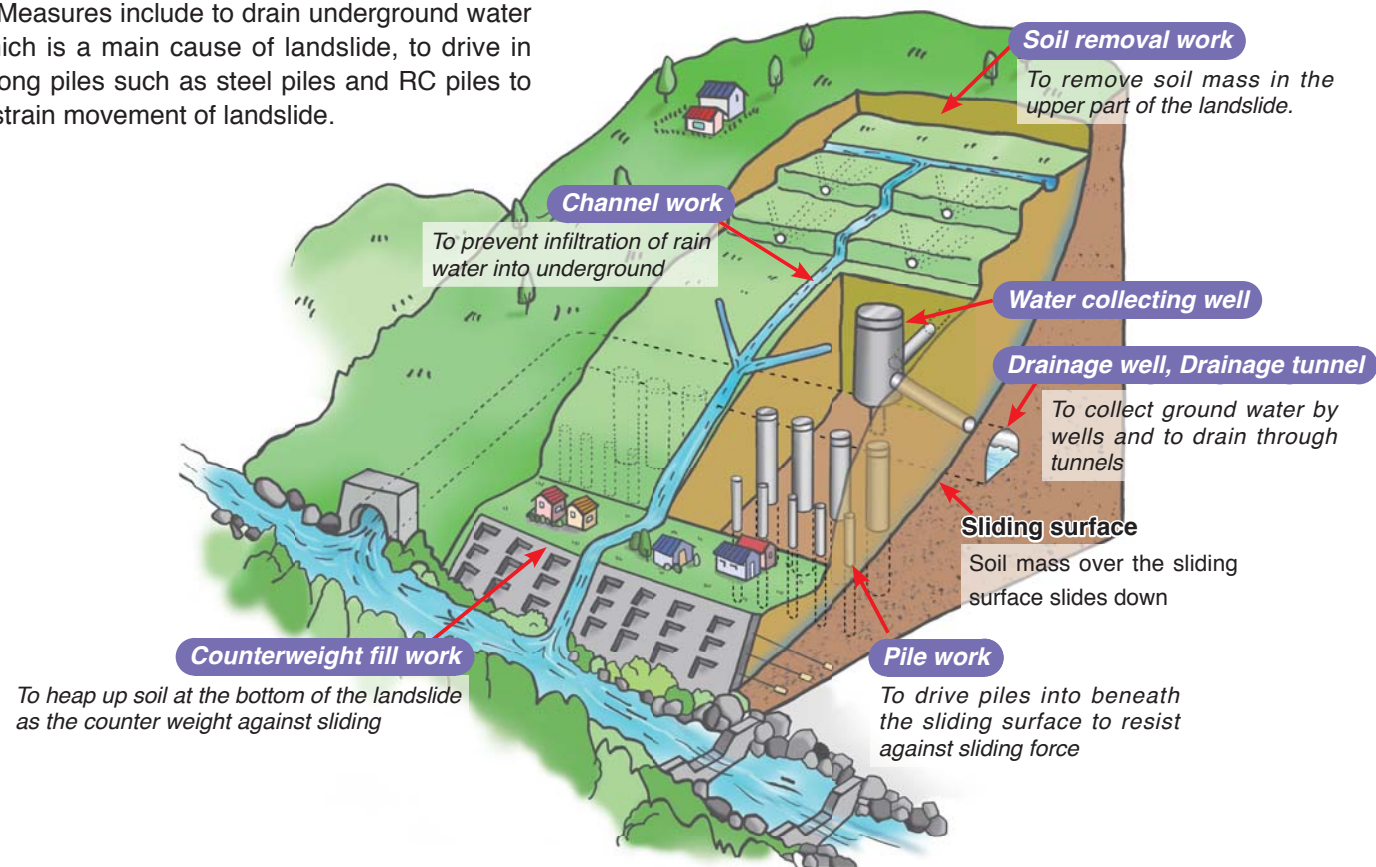
A stone masonry SABO dam called "Osunadome" which was constructed in 1835 in Edo era according to an old document. Sunadome means sand capturing.

### Let us learn more

◇SABO means a variety of works to protect our lives and livelihood from sediment disasters. SABO works include construction of SABO facilities (SABO dams etc.)/reconstruction works after disaster, routine works for inspection/monitoring/observation, awareness activities about knowledge on sediment disasters as well as evacuation and other actions at the time of emergency. SABO works are carried out by central government (MLIT) and local governments.

## Preventive measures against landslide

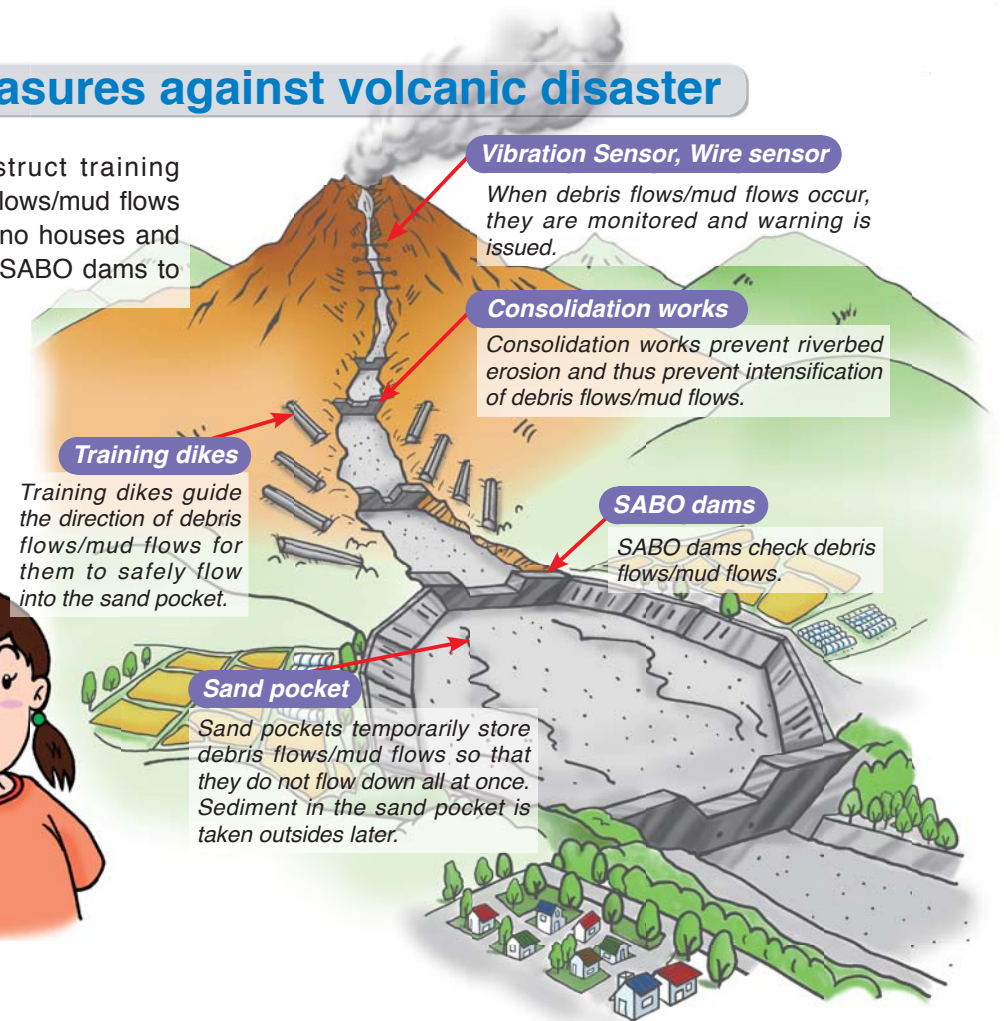
Measures include to drain underground water which is a main cause of landslide, to drive in strong piles such as steel piles and RC piles to restrain movement of landslide.



## Preventive measures against volcanic disaster

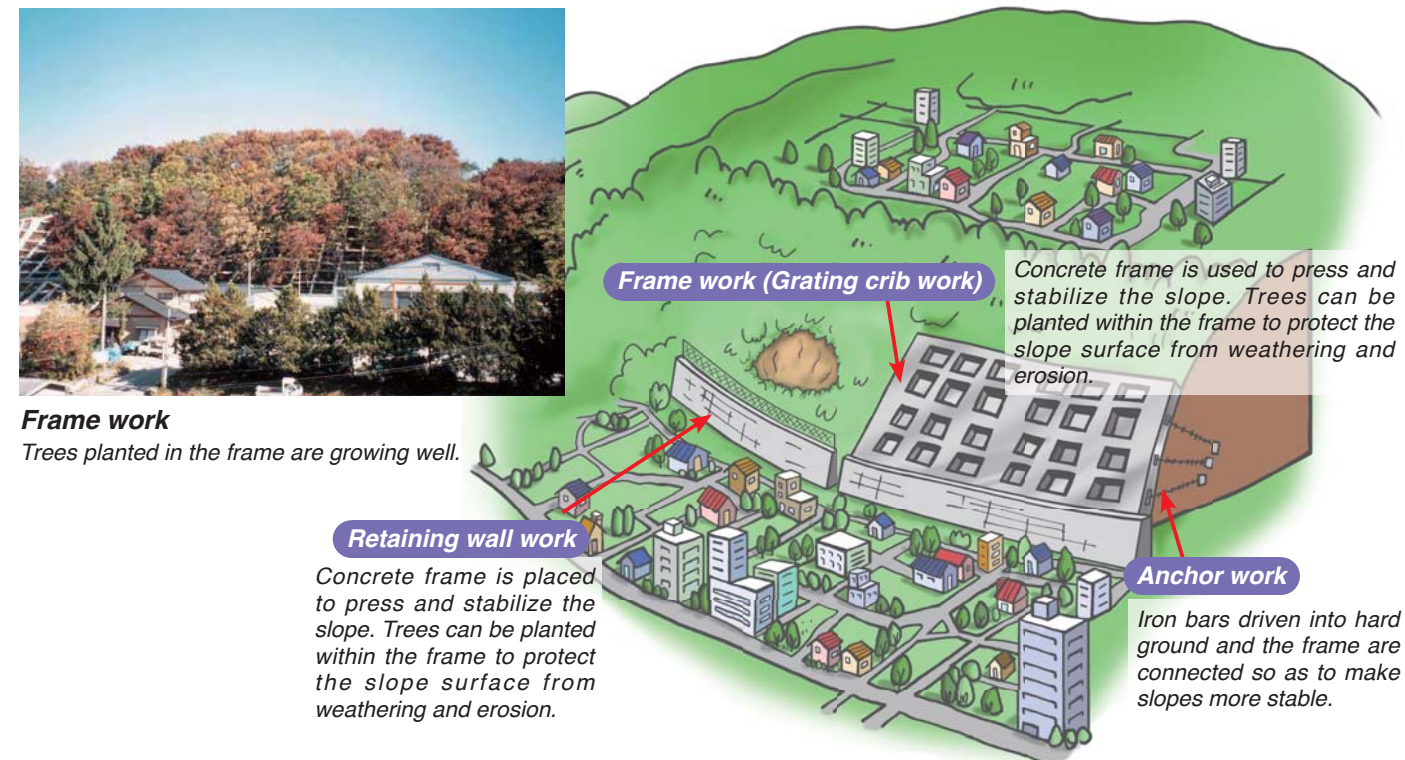
Measures include to construct training dikes to divert volcanic debris flows/mud flows towards area where there are no houses and agricultural lands; to construct SABO dams to check such volcanic flows.

Volcanic eruption can not be prevented but damage can be reduced.



## Preventive measures against slope failures

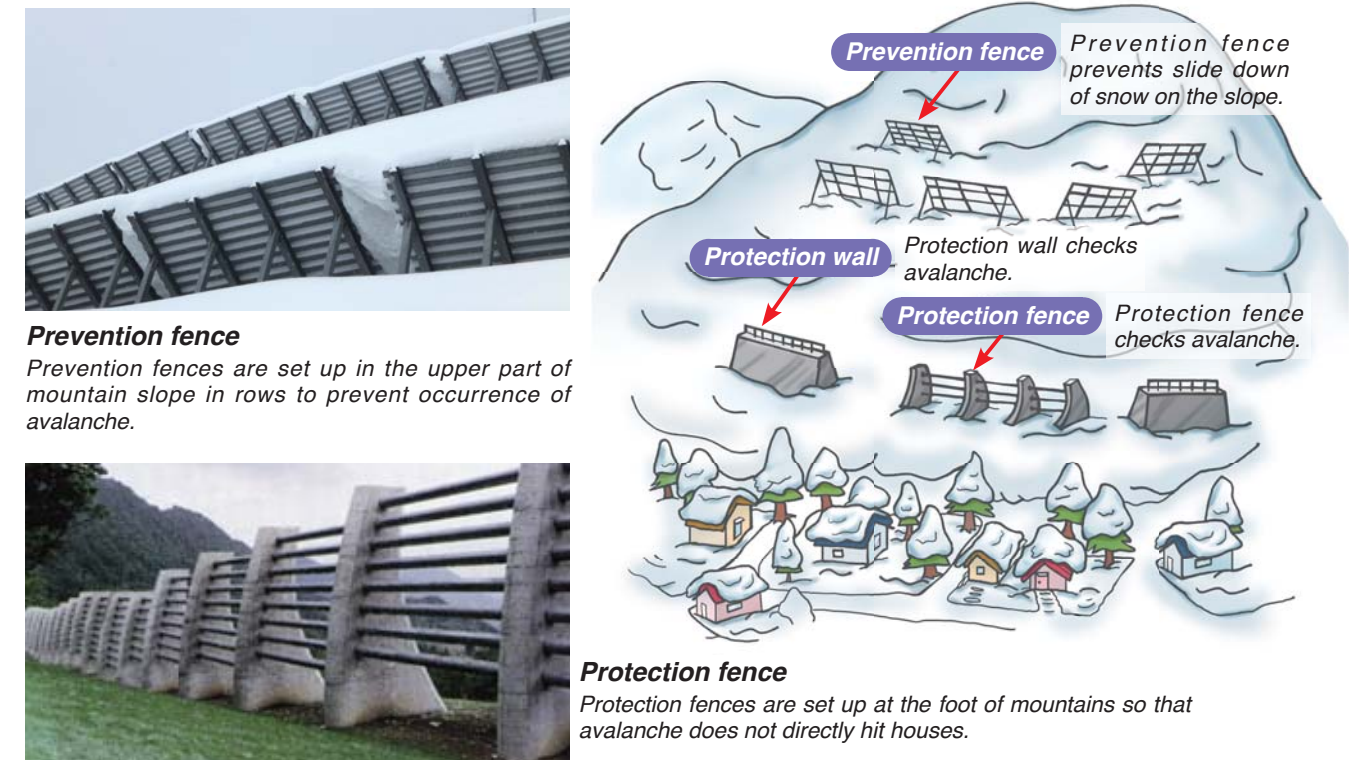
Concrete frames are placed over slopes at risk of slope failure to press and stabilize such slopes, and walls and fences are built to check collapsed soil from the cliff and protect houses.



**Frame work**  
Trees planted in the frame are growing well.

## Facilities to prevent avalanche disaster

There are two types: Facilities to prevent avalanche to occur, and those to prevent avalanche to run down to the foot of mountains.



# 9 Disaster Information

In order to protect ourselves from sediment disasters, each of us should have correct knowledge on sediment disasters, and should be ready to evacuate quickly once faced with emergency.

## Let us make best use of hazard maps

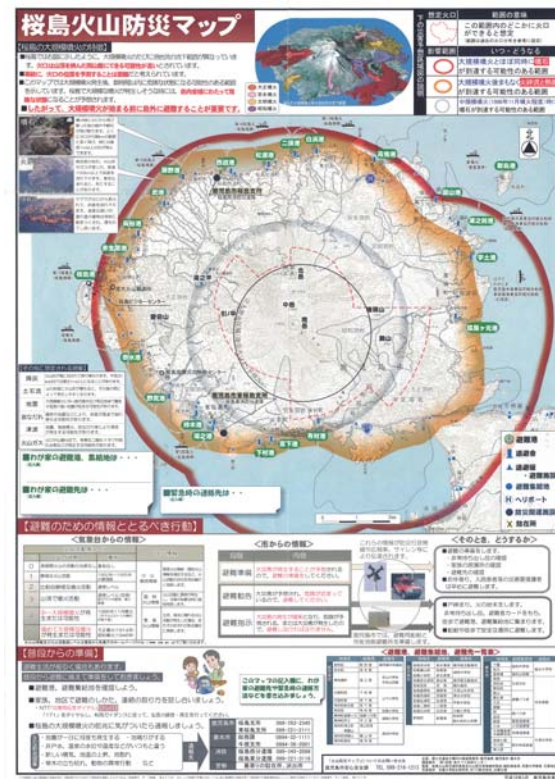
There are as many as 530,000 places at risk of sediment disasters (debris flows, landslides, slope failures) in Japan. There are 47 active volcanos which are under constant observation by JMA (as of 2015). "Hazard Maps" are available which show the hazardous places of sediment disasters and the areas possibly affected when volcanos erupt. Hazard maps are distributed to each family and are available at municipal offices. Please be sure to get and see them carefully.

Maps showing the location of dangerous spots and hazard areas in each prefecture are available also at the home page of MLIT.

Home page of SABO Department, MLIT  
<http://www.mlit.go.jp/mizukokudo/sabo/index.html>



An example of Hazard Map (Sediment Disaster Hazard Area Map) (Nagano City, Nagano Prefecture)



An example of Volcanic Hazard Map (Sakurajima, Kagoshima Prefecture)

### Let us learn more

◇ In 2000, "Sediment Disaster Prevention Law" was enacted with the aim of protecting human lives from sediment disasters through soft approaches such as promotion of warning and evacuation system. According to the Law, prefecture governors are responsible to designate areas prone to sediment disasters (Sediment Disaster Hazard Area: Yellow Zone), and, within the yellow zone, to designate areas where particularly heavy damage will occur once a sediment disaster occurs (Special Sediment Disaster Hazard Area: Red Zone). The governors should inform the residents of the designation and restrict development activities in the red zone.

◇ After the heavy rain alert is issued, if the risk of sediment disaster becomes further high, "Sediment Disaster Alert Information" is issued jointly by prefecture and JMA. In the HP of JMA and prefectures are given supplementary information on risks in detail for each small area. It is recommended to take early action for evacuation even before such information is provided.

## Let us obtain disaster information through internet

The latest information on dangerous spots is available through internet.



An example of HP of prefecture for sediment disaster information "Sediment Disaster Portal Hiroshima", Hiroshima Prefecture

Disaster Information Dissemination Center, MLIT  
<http://www.mlit.go.jp/saigai/bosaijoho/>

Sediment Disaster Alert, JMA  
<http://www.jma.go.jp/jp/dosha/>

XRAIN: Rainfall Information Dissemination Site, MLIT  
<http://www.river.go.jp/xbandradar/>

In addition to these information sources, detailed weather information and disaster information are available at HP of Sabo Division of each prefecture.

Disaster Prevention Application is available which automatically provides information to the smart phone when disaster risk becomes high so that such information is made available to any person whereas be is. In addition applications are also made available by local governments.

Yahoo Disaster quick information >>> <http://emg.yahoo.co.jp/>

Goo Disaster Application >>> <https://play.google.com/store/apps/details?id=jp.ne.goo.bousai.bousaiapp>

## Let us know the meaning of "Alert" and "Warning"

JMA issues alert and warning when disaster is anticipated judging from information on heavy rainfall and other weather conditions. These information is communicated to residents through local governments and information media. Alert and Warning are as follows:

| Alert/Warning and meaning  | What we should do   |
|--|---|
| <b>Heavy Rainfall Alert</b><br>Sediment disaster may occur by heavy rains.   | Keep watch on weather information, and confirm evacuation sites and articles/goods to carry   |
| <b>Heavy Rainfall Warning (sediment disaster)</b><br>Serious disaster may occur.   | Evacuate voluntarily in hazardous areas. In other areas, prepare for evacuation.  |
| <b>Special Heavy Rainfall Warning (sediment disaster)</b><br>Extremely serious disaster of the probability of once in several decades is most likely to occur. | Take action immediately to protect life (Evacuate to evacuation place, or move to safe place in the house if evacuation outside is not possible). |



If danger of sediment disaster becomes further high while the heavy rainfall alert continues, Sediment Disaster Warning Information is issued.

As for active volcanos, "Eruption Warning Level" is announced by JMA.

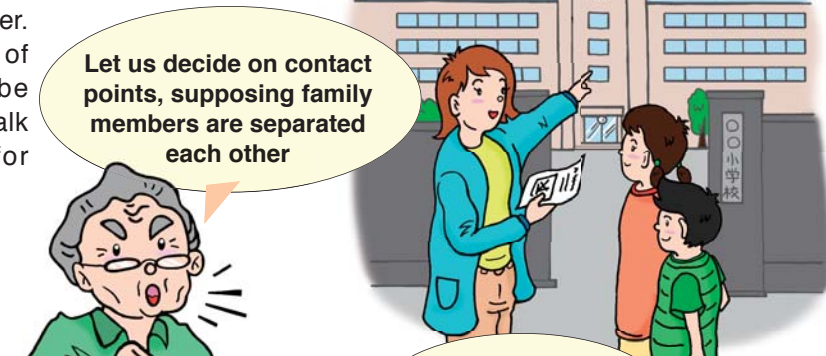
| Forecast/Warning              | Eruption warning level   | Volcanic activities   | Actions of residents   |
|-------------------------------|--|---|--|
| Eruption Forecast             | <b>Level 1</b><br>Keep in mind that the volcano is an active volcano | Volcanic activities are calm. Eruption of ashes are sometimes seen in the crater (Entering into such area may be fatal)                           | Normal life  |
| Warning for areas near crater | <b>Level 2</b><br>Restriction in areas near crater                   | Areas in the vicinity of the crater will be affected (Entering into such area may be fatal). Eruption will occur or will be anticipated to occur. |  |
|                               | <b>Level 3</b><br>Restriction of entry                               | Residential areas will be seriously affected. (Entering into such area may be fatal). Eruption will occur or will be anticipated to occur.        | Normal life. According to the situation, evacuation preparations for persons in need of help |
| Eruption Warning              | <b>Level 4</b><br>Preparation for evacuation                         | Eruption to seriously affect residential areas is anticipated (Such possibility is increasing)  | Preparation for evacuation in areas order warning Evacuation of persons in need of help.     |
|                               | <b>Level 5</b><br>Evacuation   | Eruption to seriously affect residential areas has been occurring or is imminent.   | Evacuation from endangered areas   |

# 10 Learn how to evacuate

## /// What should be kept in mind for disaster in daily life

### Evacuation place should be decided in advance in the family

All family members are not always together. In order to avoid confusion in the face of emergency, evacuation place should be decided in advance in the family, and walk along the evacuation route together for confirmation.



Let us decide on contact points, supposing family members are separated each other



It's a good idea to walk on a rainy day and at night.

### Pay attention to weather information

Let us keep watch on weather information of TV and radio. Once sediment disaster information and/or weather related warning are issued, it is advised to be ready for evacuation any time. Let us pay attention to information of local disaster radio.

### Preparation of articles to be carried at the time of emergency

Articles to be carried should be decided by the family, as necessities are different from family to family. It is also necessary to decide who will carry what.



### What is the difference between Evacuation

#### Recommendation and Evacuation Order

Let us know the meaning of words on evacuation issued by municipal offices

| Degree of danger | Words on evacuation                         | What we should do  |
|------------------|---|--|
| ↓                | <b>Voluntary Evacuation</b>                 | Evacuate voluntarily, If judged dangerous by ourselves                             |
|                  | <b>1_Evacuation Preparation Information</b> | Those who take time for evacuation should evacuate. Others prepare for evacuation. |
|                  | <b>2_Evacuation Recommendation</b>          | Start evacuation, because damage is likely to occur                                |
|                  | <b>3_Evacuation Order</b>                   | Evacuate immediately, because damage is highly likely or already taking place      |

Never say "I am safe here without evacuation"!

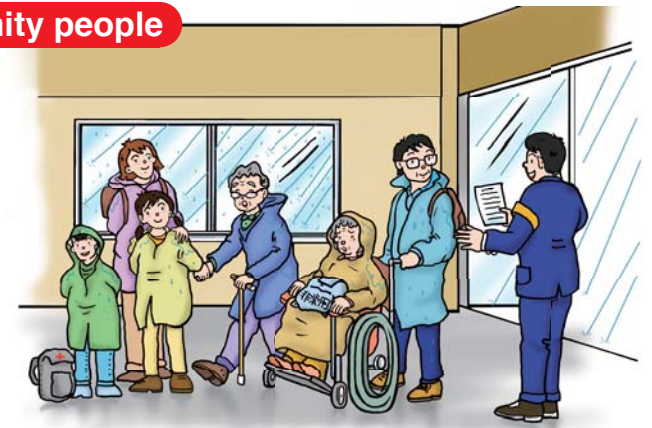


## /// Protect lives by early evacuation

If any danger or fear is perceived, it is important to evacuate as early as possible even without evacuation alert and warning. Judgement when disaster is already imminent may not be correct due to evacuate confusion. Evacuation at night time in the dark is dangerous. Let us take actions while it is still light.

### Evacuate in cooperation among community people

Please call neighbors and evacuate together. Aged persons and others who may take time for evacuation should be assisted by community people for early evacuation.

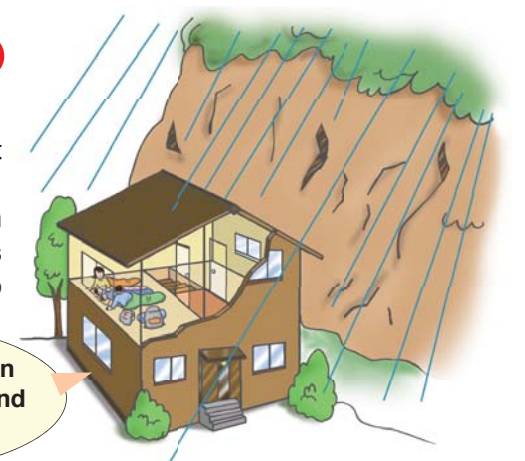


### You should be the first to evacuate

There are persons who are reluctant to evacuate even danger is imminent. In such a case, please evacuate by yourself. Then they will follow.

### "Protect life" is the first priority in any occasion

In case that the road is already under water or it is dark outside, movement to evacuation place is no more possible. In such cases it is recommended to evacuate to RC building if available in the vicinity. If that is also impossible, the last option will be to evacuate to a room in the house which is located in the 2nd floor or above and away as much as possible from the dangerous slope. Do not get closer to widow glasses.



Evacuation to a room on the 2nd floor or above, and away from the slope

## Let us measure the rainfall

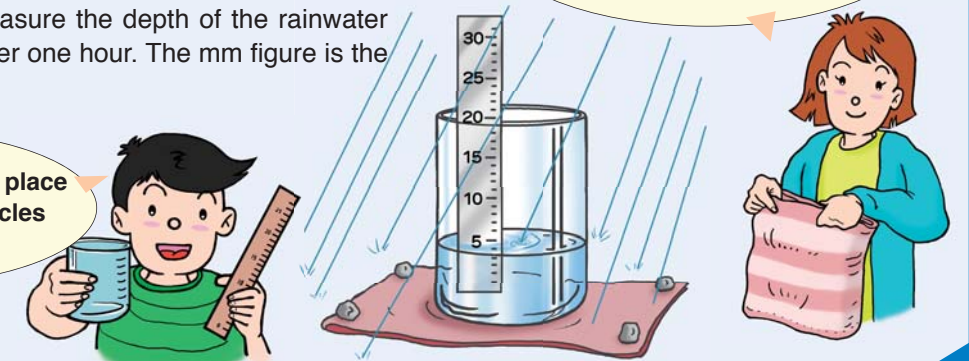
Most sediment disasters are triggered by rains. Generally, small scale slope failures will start to occur when the rainfall exceeds 20mm /hour. However please keep in mind that rainfall of less intensity may cause disaster if it lasts for days.

### «Simple method of rainfall measurement»

To place a small vessel (an empty tin can etc.) which has the same diameter at the top and the bottom at a flat place outside the house. To measure the depth of the rainwater in the vessel by a ruler after one hour. The mm figure is the rainfall amount per hour.

Splashing of rains into the vessel can be prevented by putting a piece of cloth under the vessel.

Please put the vessel at a place where there is no obstacles against rainfall.



## Check List to protect lives from sediment disaster



A check list has been prepared which lists up what should be done to prepare for emergencies in ordinary time in the family and the neighborhood.

How about your family? Please check how you are prepared using the check list with family members and neighbors.

### Check the dangerous places around the house!

- 1. The hazard map (Sediment Disaster Hazard Area Map) is at an easily accessible place.
- 2. Whether there are "Sediment Disaster Hazard Area (Yellow Zone)" / "Special Sediment Disaster Hazard Area (Red Zone)", and sediment disaster hazardous places (places which are prone to debris flow, slope failure, landslide etc.) or not near the house has been checked on the hazard map.
- 3. Hazardous places identified on the hazard map have been visited and confirmed.
- 4. Whether major sediment disasters occurred or not in old times was inquired to aged persons, or was investigated at a library, the municipal office etc.

### Check the evacuation place and contact points!

- 5. Location of a near-by evacuation place has been confirmed on the hazard map.
- 6. Whether there are dangerous places (such as cliffs, ditches without cover, and channels without fence) or not on the way to the evacuation place at the time of raining was checked by walking to the evacuation place by family members.
- 7. Decision has been made on the building in which to evacuate when movement to the evacuation place is no more possible (such as a nearby RC building).
- 8. Decision has been made on the room in the house in which to evacuate when going out of the house is no more possible (such a room as is located on the 2nd floor or above, and away from the dangerous slope).
- 9. Decision has been made on the contact points in case when family members are separated each other (preferably two places: friend or relative in a nearby area, and those in an area a bit away)
- 10. Evacuation place and contact points are well known by all the family members. Each member has a memo on telephone numbers. Telephone numbers have been registered in each mobile phone.

### Check the articles to be carried with at the time of emergency!

- 11. Decision has been made, through discussion in the family, on emergency articles which should be carried with when moving to the evacuation place.
- 12. The emergency articles have been collected and put at an easily accessible place.
- 13. Decision has been made on the distribution of responsibility: who will carry what.

### Check the disaster information properly!

- 14. Addresses of internet sites which provide rainfall information and disaster information have been registered in PCs and mobile phones in the house.
- 15. The meaning of Heavy Rainfall Alert□Heavy Rainfall Warning□Special Heavy Rainfall Warning, and Sediment Disaster Warning Information are well known in the family.
- 16. The difference between Evacuation Preparation Information, Evacuation Recommendation and Evacuation Order are well known in the family.
- 17. Various omens for each sediment disaster are known in the family.