Sedimentary structures caused by submarine landslide southern Satsuma Peninsula

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Most of submarine landslides occur on the slopes of ocean basins and continental margins, and have been the subject of detailed studies. However, these landslides have a complex structure due to the complex seafloor topography such as submarine valleys and multiple landslides, and their deep-water depths have prevented us from obtaining high-resolution topography. In addition, the interrelationship between the internal structure of landslides and seafloor topography has not been discussed much. In this study, the water depth is 200-300m. Precise seafloor topography data was got were obtained by multi-narrow beam echo sounder using high frequencies. The horizontal resolution is about 10m. Seismic data was got by Multi-channel seismic reflection survey(MCS) data were also obtained. The vertical resolution is 5-10m, and horizontal resolution is around 50m. Our surveys were conducted 3 times from 2017 to 2019 by the T/S “Fukae Maru”, Kobe University. The MCS surveys carried out on the 6 lines and acquired data successfully. The obtained reflection data was processed by general denoising analysis, after that, stacked with 12.5m common midpoint bins. The tomography was processed to enhance the microtopography after denoising analysis. In addition, the topography before the landslide was obtained by interpolating the landslide area using the area not affected by the landslide.
The landslide has a maximum width of about 8km and length of about 26km, and the total area including the area affected by the landslide reaches 174km^2. At the eastern side, there is a headwall scarp with a maximum specific height of 140m known as the “Kaimon submarine cliff”. Block-like features and ridge-like rises that are higher than the surrounding terrain are collectively called "ridge" and classified into six areas according to the regularity and scale of the ridge. Furthermore,we compared pre-landslide topography with the current topography (post-landslide) to estimate the volume and distance of moved masses. As a result, we observed irregular ridges with different strikes in the relatively subsider area and regular ridges with aligned strikes in the uplift area, and estimated that the moved mass have 1.7 km^3 area with a maximum travel distance of 3 km.
In seismic sections, the changes in seismic facies generally correspond to changes in topographical features. Regions of transparent facies are identified only in the regions irregular ridges are developed, while area with prominent faults correspond to the region with regular ridges. The whole picture was observed that the acted as fluid near the source and the plastic deformation was predominant toward the end. By making these associations in more detail and analyzing the fine reflection section structure, the physical states such as the stress state at the time of formation were examined. In addition, stratified structures were widely observed outside the submarine landslide area, and the topography was almost uneven. It was found that the reflective layer found from the center to the end of the landslide area was the same as the stratified sediment found outside the area. The stratified sediments are also widespread on the slopes south of the headwall scarp and north of the landslide, and are deposited on the slopes in the form of onlap with the lower sediments. This suggests that the stratified structure was widely observed in the landslide area before the landslide, and that the stratified sediments caused the landslide.
In summary, the originally stratified sediments began to collapse from the eastern slope. Near the source, there was no sediment structure left at all, and it was crushed and mixed. In the vicinity of the source, gravels, sands and so on originating from the landslide were deposited over 10 m, and it is estimated that they were violently crushed and mixed at high speed. In the central part of the site, where the topography

changes from lower to higher due to the landslide, the uppermost harder sediments are seen in the shallow part of the transparent reflection, suggesting that the degree of crushing and mixing is decreasing while continuing. Towards the end, the stratigraphy is clearer, and it is widely compressed from faulting and deformation. It is presumable that this is an area where past-sea sediments were moved and deformed by landslides flowing from the source. It was revealed that the landslide occurred with severe fracturing and mixing, and progressed with gradual loss of energy, and that the rapid movement of sediments over a wide area, forming the current landslide topography.

Keywords: submarine landslide, MCS, Mass Transport Complexes