Gas hydrate

Mass transport-dominated sedimentation in a foreland basin, the Hidaka Trough, northern Japan

Atsushi Noda1*

Introduction

Mass transport is an important process of sediment redistribution that poses threats to coastal societies and to deep sea basins. It is vital to understand this process for disaster prevention and protection of economic interests offshore areas. We carried out mass transport-dominated sedimentation in an active foreland basin, the Hidaka Trough, which developed from collision between the northwest Pacific Ocean and the eastern margin of the Okhotsk Plate (Noda et al., 2012). The Trough is associated with large, frequent earthquakes. The Trough is filled with thick (>5 km) sediments ranging from younger Central European to modern distal modern hemipelagic mud and volcanic ash. Bottom-set facies reflections and the distribution of mud volcanoes, pull-apart basins, and acoustic-void zones on the seafloor indicate the presence of subsurface gas fields in the basin (MTDs; Higashiura et al., 2010b, 2010a). Basin-scale MTDs are found in the basin margin. The origin of MTDs is closely related to strong power and high frequency activity. The MTDs appear associated with large, frequent earthquakes. The Trough is filled with thick (>5 km) sediments ranging from younger Central European to modern distal modern hemipelagic mud and volcanic ash.

Mass transport is an important process of sediment redistribution: (A) Index map of the study area. (B) Topography and bathymetry around the study area. (A3-Coal Marker in Figure 1).

Methods

A suite of studies has been focused on mass-transport-dominated sedimentary basins of active margins. Studies have been focused on mass-transport-dominated sedimentary basins of active margins. Models of mass transport are important in understanding mass wasting and the three-dimensional processes for disaster prevention and protecting economic interests in coastal and marine environments.

Results

Mass transport deposits

The MTDs are widely distributed in the trough (Figure 3a). The seafloor profiles commonly show a typical tripartite anomaly consisting of a headwall domain, a translational domain, and a toe domain (Figure 3b). The headwall domain is characterized by topographically smooth surface, and a marked change in reflection facies. It contains variably elongate features with upward-facing surface reflections suggesting no escape of the deposits. The toe domain is represented by a compressional pressure ridge that forms a rounded-dome-like elongate mound (Figure 4a). The MTDs were sourced from three sides of the marginal slope, but predominantly from the northeastern margin where aseismic failures are active near the toe of the slope. The thickness range from 10 to 30 m, and most are less than 20 m thick. The deposits are cut by water depths of 700–800 m, and the average gradient of the slope is 20°. The transverse and longitudinal slopes of the MTDs exhibit headwall, translational, and toe segments (Figure 5c).

The translational domain has transparent internal reflections, and subsurface gases. These factors individually or collectively contributed to the development of gas hydrate on the seafloor (Figure 6). The toe domain is mound-like, with its highest point located near the acoustic wipe-out zones where headwall scarps are located closest to the slope margin. The toe domain is mound-like, with its highest point located near the acoustic wipe-out zones where headwall scarps are located closest to the slope margin. The translational domain has transparent internal and lateral reflections. It contains variably elongate features with upward-facing surface reflections suggesting no escape of the deposits.

The headwall domain is characterized by topographically smooth surface, and a marked change in reflection facies. It contains variably elongate features with upward-facing surface reflections suggesting no escape of the deposits. The toe domain is represented by a compressional pressure ridge that forms a rounded-dome-like elongate mound.

Discussion

Earthquake

Gas hydrate

Summary

The MTDs in this area are generally high (15–18°) in the Hidaka Trough, northern Japan. We found that the MTDs are widely distributed in the trough (Figure 3a). The seafloor profiles commonly show a typical tripartite anomaly consisting of a headwall domain, a translational domain, and a toe domain (Figure 3b). The headwall domain is characterized by topographically smooth surface, and a marked change in reflection facies. It contains variably elongate features with upward-facing surface reflections suggesting no escape of the deposits. The toe domain is represented by a compressional pressure ridge that forms a rounded-dome-like elongate mound.

The MTDs were sourced from three sides of the marginal slope, but predominantly from the northeastern margin where aseismic failures are active near the toe of the slope. The thickness range from 10 to 30 m, and most are less than 20 m thick. The deposits are cut by water depths of 700–800 m, and the average gradient of the slope is 20°. The transverse and longitudinal slopes of the MTDs exhibit headwall, translational, and toe segments (Figure 5c).

The translational domain has transparent internal reflections, and subsurface gases. These factors individually or collectively contributed to the development of gas hydrate on the seafloor (Figure 6). The toe domain is mound-like, with its highest point located near the acoustic wipe-out zones where headwall scarps are located closest to the slope margin. The toe domain is mound-like, with its highest point located near the acoustic wipe-out zones where headwall scarps are located closest to the slope margin. The translational domain has transparent internal and lateral reflections. It contains variably elongate features with upward-facing surface reflections suggesting no escape of the deposits.

The headwall domain is characterized by topographically smooth surface, and a marked change in reflection facies. It contains variably elongate features with upward-facing surface reflections suggesting no escape of the deposits. The toe domain is represented by a compressional pressure ridge that forms a rounded-dome-like elongate mound. The MTDs were sourced from three sides of the marginal slope, but predominantly from the northeastern margin where aseismic failures are active near the toe of the slope. The thickness range from 10 to 30 m, and most are less than 20 m thick. The deposits are cut by water depths of 700–800 m, and the average gradient of the slope is 20°. The transverse and longitudinal slopes of the MTDs exhibit headwall, translational, and toe segments (Figure 5c).