Sedimentary architecture of submarine mid slope deposits with relics of gas hydrate fractures revealed by X-ray CT scanning: new insights from the Tuaheni Landslide Complex, North-East of New Zealand

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Résumé

The Hikurangi subduction margin in northern New Zealand is a seismically active zone that triggered a great number of submarine mass-transport deposits. It is also well-known for free gas and gas hydrates occurrences in near-seafloor sediments, including close to the Tuaheni Landslide Complex (TLC). Among the multiple submarine deposits associated to the TLC, the T2 deposit was interpreted as a creeping submarine landslide considering its uncommon morphology and chaotic signature on seismic data. In 2017, IODP 372 Expedition collected c.200 m-deep drilled cores through the entire T2 deposit. X-CT and high-resolution line scans on these cores allow to precise the composition and internal architecture of the T2 deposit in terms of lithology, deformation and sedimentary structures. X-CT data reveal a composite architecture with two units: a lower unit made of channel-levee fined-grained turbidites with several intercalated mud-flow deposits, and an upper unit composed of hemipelagic sediments, sandy turbidites and a surficial seismically-induced mud-flow deposit (MF4). Shear zones, sediment loading and fluid escape structures largely occur through the T2 deposit while a great number of soft-sediment deformation structures (SSDS) particularly affecting sandy turbidites and yet are interpreted as earthquakes-related. In addition, X-CT reveal low-CT-density, near-vertical structures into fine-grained sediments. They are located at the SMT (Sulphate Methane Transition; 17 mbsf) and interpreted as relics of gas hydrate filled-fractures. Thus, we propose to re-assess the nature and depositional model of the T2 Deposit as a marine composite sedimentary complex formed by sea level variations since the Late Pleistocene, with a basal and multiple internal weak-layers. A surficial mud-flow deposit (MF4 $<$ 11 ka) potentially emplaced after a seismic event, buried hydrate-bearing sediments below the BSR, driving gas hydrate dissociation and weak layers formation. These results bring new evidence for gas hydrates implication into slope instability processes and marine geohazards.

Mots-Clés: Submarine landslide, gas hydrates, IODP cores, X, CT scans, weak layers, deformation structures

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