



Supercritical turbidity-current bedforms in the northeastern continental slope, South China Sea

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Large-scale Supercritical flow bedforms in the northeastern continental slope of the South China Sea were investigated by integrating high-resolution multibeam bathymetric data and multichannel seismic profiles. In the area, many canyons are developed, including the Penghu, West Penghu, Jiulong, South Taiwan Shoal and Dongsha canyons. Most of the canyons downslope join the South Taiwan Shoal canyon, and finally merge into the Penghu canyon. Numerous step-like features were recognized within the South Taiwan Shoal and the West Penghu canyons. The features, ranging from 1.2 to 10.0 km in wave length and 5.4 to 80.9 m in wave height, are mostly interpreted as cyclic steps formed by turbidity currents flowing through the canyons based on their morphological and seismic characteristics. The steps align in trains along the canyon thalwegs or scatter in the canyon terraces. Each thalweg train consists of up to 19 continuous cyclic steps and extends up to 100 km in length, and is separated by a slope break into an upper steeper and a lower gentler segments. Steps in the upper segments are characterized by smaller wavelength and chaotic internal reflections, which contrast to those in the lower segments with a larger wavelength and typical upstream-dipping backset reflections. Aided by a simple numerical modeling exercise, we interpreted the features in the upper segments as net-erosional cyclic steps or transitional bedforms between antidunes and cyclic steps, and those in the lower segments as net-depositional cyclic steps. Nine short trains of scours were identified on a terrace of the South Taiwan Shoal canyon. They are oriented parallel to the tributaries draining over the terrace and roughly perpendicular to the main canyon thalweg, and are presumed as resulting from the tributary flows, indicating a complicated flow pattern within the canyon valley. In addition, four large fields of sediment waves were delineated. They are located on the western and southern flanks of the South Taiwan Shoal canyon, the southwestern flank of the Dongsha canyon, and outside of the mouth of the West Penghu canyon, respectively. The sediment waves are 2.8–7.2 km in wavelength and 30–60 m in wave height, and migrate upslope, and align parallel to local isobaths and orthogonal or oblique to the canyon trends. All these lines of evidence point to an overspilling or off-stripping turbidity current origin of the sediment waves. Further research suggests that the sediment waves are composed of various types of supercritical flow bedforms, including antidunes, chutes-and-pools, and possibly cyclic steps. Discoveries of the supercritical flow bedforms provide crucial evidence for turbidity current activities in the canyons. This work was funded by the National Natural Science Foundation of China (grants 91028003 and 41076020).