The Chimei submarine canyon and fan: A record of Taiwan arc-continent collision

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The Chimei submarine canyon, which is located on the deforming Philippine Sea plate just east of the Luzon arc, delivers sediments from the Taiwan orogen into the deep sea, forming the Chimei submarine fan complex. We present new constraints on the history of Taiwan arc-continent collision as recorded by the Chimei submarine canyon and fan. We used a combination of multichannel seismic reflection profiles and high-resolution bathymetry to study the morphology and stratigraphic sequences of the Chimei submarine canyon and fan, as well as the underlying pre-fan deep-sea strata. The Chimei submarine canyon is fed largely by the Hsiukuluan River, which is the only river to cut across and incise the uplifting Taiwan Coastal Range, and merges tributaries that drain both the eastern Central Range (accretionary wedge) and the Coastal Range (deformed Luzon arc and forearc basin). The 500 m deep Chimei submarine canyon cuts through an uplifting east-vergent submarine thrust belt as it descends to nearly 5000 m water depth, where it crosses the frontal active thrust to empty into the Chimei fan complex deposited on the stable Huatung Basin to the east. Huge sediment fluxes are fed through the Chimei submarine canyon during typhoons, which results in a 10 km wide and planar canyon bottom shaped by strong submarine erosion and empties into the largest submarine fan-valley system at the foot of the canyon in the Huatung Basin, with a present area of ~2087 km2 and a maximum thickness of ~2 km. The currently active channel system eventually empties into the Ryukyu trench to the northeast where the distal Chimei fan is impinging on the Ryukyu accretionary wedge.

The Chimei fan was deposited above a seismic sequence boundary that separates more transparent and chaotic middle and upper sequences (fan sequences) from the underlying continuous and concordant lower (pre-fan) sequence. The seismic facies in lower sequence shows continuous and parallel seismic reflections that onlap upon the Huatung Basin oceanic crust, which we interpreted it to be original deep sea sediments of the Huatung Basin. Most lower-fan seismic characteristics are shown in the middle sequence and upper-fan characteristics are shown in upper sequence. Based on their seismic facies characteristics, we interpret the middle and upper sequences to be composed of orogenic sediments from Taiwan arc-continent collision. The different seismic facies within each sequence of the Chimei fan record a progression of Taiwan orogeny: (1) During initial arc-continent collision, sediments were delivered from the Central Range to the Huatung Basin and initial Chimei submarine fan was formed. (2) After the Luzon arc has uplifted above sea-level, the Chimei submarine canyon and deep-sea valley was formed along the topographic low of the Luzon arc, northern part of the Chimei fan has been eroded away, and only southern part of fan behind topographic high of arc has been preserved. It is anticipated that future sampling of the uplifted strata of the Chimei submarine canyon, Chimei fan complex and pre-fan sequences through a variety of means, including coring and ocean drilling will provide much insight into the dynamics of collisional mountain belts.

Keywords: sedimentary record of tectonics, submarine canyon, submarine fan, Taiwan arc-continent collision , seismic reflection profile