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Temporal variations on sedimentary environments of the late Miocene-Pleistocene foreland basin, NW Taiwan

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The overriding of Luzon volcanic arc on top of the subducting Chinese rifted-continental margin has resulted in the Taiwan mountain belts and a peripheral foreland basin west of the orogen since late Miocene. The sedimentary environments for NW Taiwan foreland basin exhibit a deepening, then shallowing-upward trend. From the oldest to the youngest, the foreland lithostratigraphic units in NW Taiwan are: Kueichulin Formation, Chinshui Shale, Cholan Formation, and Yangmei Formation. We studied the lithofacies along the Dahan River outcrop section of 2400 m in stratigraphic thickness that covers the oldest to youngest foreland succession in NW Taiwan.
We recognized 4 major depositional systems for the studied foreland succession represented by 10 facies associations and 16 lithofacies. The sequential development of major depositional systems is interpreted as follows. (1) mainland-attached shoreface environments (Kueichulin Formation, incipient foreland stage): Shoreface environments were attached to the mainland in the west and situated at the distal foreland with continent-derived sediment sources; (2) offshore marine (Chinshui Shale and lowermost Cholan Formation, underfilled, early foreland stage): Enhanced tectonic subsidence due to orogenic loading resulted in the foreland to become offshore marine. Sub-environment include offshore below storm wave base (Chinshui Shale, about 150 m thick) and offshore transition with paleo-water depth lying in between storm and fair-weather wave base (lower Cholan Formation, about 50 m thick). Lithofacies for offshore marine comprise laminated and bioturbated mudstones with in situ crab fossils; Lithofacies for offshore transition consist of laminated mudstones and biotubated sandstone interbeds; (3) tide-and-wave influenced, semi-enclosed marine bay systems (middle and upper Cholan Formation, overfilled, middle foreland stage): The amount of basin subsidence was matched by amount of sediment supply, resulting in aggradational coastal sediment package of around 450 m thick. The marine bays comprise biotubated mudstones, strongly bioturbated muddy to medium-grained sandstones, and planar and trough cross-bedded sandstones. Dominant trace fossil suite is proximal Cruziana ichnofacies, including Ophiomorpha, Thalassinoides, Palaeophycus, Planolite, and Rosselia. Marine bay margins comprise tidal flats of sand/mud inter-laminations showing wavy and lenticular structures, and marshes of mudstones with grass roots and paleosols; (4) meandering river systems (Yangmei Formation, overfilled, late foreland stage): Sediment supply outpaced basin subsidence, resulting in the foreland to become fluvial environments accumulating sediments up to about 1200 m. Sub-environments for the meandering river system include high energy point bars of sandstones with trough cross bedding and mud clasts, crevasse splays of sandstone and mudstone interbeds showing coarsening upward trend, channel levees with sandstone showing climbing ripples, and flood plains of mudstones with roots and paleosols.