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Petrographic study of the Miocene-Pleistocene sandstones in the Western Foothills, southern Taiwan: implication for the unroofing history of Taiwan orogenic belt

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Petrographic study of foreland basin deposits provides a record of unroofing history for the orogenic belt in Taiwan since late Miocene. In this study, we analyze sandstone petrography and quartz grain shape to discuss the source provenance and orogenic exhumation history of the southern Taiwan.

Results of sandstone composition indicate that Miocene sandstones contain abundant monocrystalline quartz with minor feldspar, most probably supplied from Eurasian continent. The late Pliocene-early Pleistocene (3.6-2.5 Ma) sandstone contains lithic fragments which consist dominantly of sandstone fragments (12%). It suggests that the sediments were derived from sedimentary provenance of the orogenic belt (Miocene strata). The early Pleistocene (2.5-1.2 Ma) sandstone consists of sandstone (8%), metasandstone (8%), and argillite (14%) fragments (Oligocene strata), which were derived mainly from low-grade metamorphic provenance (Hsuehshan Range). Since the middle Pleistocene (<1.2 Ma), sandstone is composed of large amount lithic fragments of sandstone (2%), metasandstone (5%), argillite (7%), quartzite (20%), and slate (20%) fragments, which were derived from the Central Range (Hsuehshan and Backbone Ranges).

The shape of particle indicates the useful information of their transport distance and degree of erosion. Therefore, we use monocrystalline quartz to analyze their sphericity. Results of morphological analysis show the best circularity in the late Pliocene strata with the emergence of sedimentary lithic (sandstone) fragments. In contrast, the Pleistocene strata had become less circularity and enriched in metamorphic lithic fragments. We can realize that circularity became much better is related to reworked undiagenesis sediments from top of orogenic belt.

The sequential change of petrography indicates the unroofing of Taiwan orogenic belt, whereas the exhumation history is revealed significant changes from undiagenesis sediments to metamorphic provenance since Pliocene.