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Unroofing of the Gangdese arc as documented in the Cretaceous succession of the Xigaze forearc basin (South Tibet)

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The Xigaze forearc basin formed in the Cretaceous, between the Yalung-Zangbo suture zone to the south and the Gangdese arc to the north, during subduction of Neo-Tethyan oceanic lithosphere under the Lhasa terrane (Einsele et al., 1994; Durr, 1996; Wang et al., 1999, 2012; Wu et al., 2010). Well-preserved and superbly exposed strata provide an excellent opportunity to study the evolution of a forearc basin. The succession includes the Sangzugang, Chongdui, Ngmaring and Padana Formations (from bottom to top). The Sangzugang Fm. accumulated as a carbonate platform on the southern Lhasa margin in the Aptian- Early Albian (∼120-107 Ma), while cherts of the lower Chongdui Fm. were deposited on the continental rise. In the Late Albian- Cenomanian (∼107-98 Ma), turbiditic sandstones were deposited in distal-fan (lower-middle Chongdui sandstones) to slope settings (lower Ngmaring Fm.). The upper Ngmaring and Padana Fms. (Late Cenomanian- Early Campanian, 98-77 Ma) document a shallowing-upward succession deposited in submarine-fan, shelfal and finally deltaic environments, recording the transition from the underfilled stage (Aptian-Coniacian; ∼120-86 Ma), to the filled stage (Santonian-Campanian; 86-77 Ma).

Sandstone composition evolves from feldspatho-lithic arenite to litho-feldspatho-quartzose and finally litho-quartzose, indicating a change from undissected to dissected arc and finally mixed provenance. Detrital zircons from the upper Chongdui and lower-middle Ngmaring Fms. yielded dominantly Mesozoic ages, passing upward from unimodal (peak age at 110 Ma) to bimodal distribution (peak ages at ∼110 and ∼158 Ma). Age patterns are more complex in the upper Ngmaring and Padana Formations, with many pre-Mesozoic ages and more clusters of Mesozoic ages. Our dataset indicates volcanic and next plutonic rocks of the Gangdese arc as the main source of sediments in the early forearc-basin stage. Erosion of the Lhasa block later on attested to the final unroofing stage of the Gandese arc.