Chemical composition of the Triassic mudstones in the Thakkola area, central Nepal Himalaya.

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A thick sedimentary sequence ranging from Cambro-Ordovician to Cretaceous, which was deposited in the southern margin of the Tethys Sea, is widely distributed in the Thakkola area, central Nepal Himalaya. This study aims at clarifying the precise environmental change during the Triassic period along the southern part of the Tethys Sea on the basis of geochemistry using X-ray fluorescence (XRF).

The Triassic stratigraphic sequence in this area comprises Tamba Kurkur Formation (Lower Triassic; Scythian-Anisian), Mukut Limestone (Middle Triassic; Anisian-Carnian), Tarap Shale (Upper Triassic; Carnian-Norian), and Quartzite Formation (Most upper Triassic; Norian-Rhaetian?) in the ascending order. The Tamba Kurkur Formation comprises lower limestone yielding abundant ammonoids and upper shale. The Permian-Triassic boundary is confirmed to be at the base of this formation. The Mukut Limestone comprises alternate beds of limestone and mudstone with ammonoid and brachiopod fossils. The Trap Shale is rich in mudstone with a minor amount of limestone. The upper part of this formation yields abundant fossils such as ammonoid, bivalve, and brachiopod, whereas the lower part is deficient in fossils. The mudstones in the most Triassic strata show abundant bioturbation with Skolithos and Cruziana Ichnofacies; however, in the lower part of the Tamba Kurkur Formation and the central part of the Trap Shale, the development of planar laminated mudstone is observed due to the lack of bioturbation.

The concentration of the major elements in the Triassic mudstones is discussed based on the comparison with PAAS (Post-Archean Australian Shale; Taylor and McLennan, 1985). These mudstones are characterized by a higher concentration of Al2O3 and lower concentrations of MnO, MgO, and Na2O. The concentration of trace elements, particularly V, Ni, and Zn, is high in the upper part of the Tamba Kurkur Formation and central part of the Trap Shale. The CIA value (Nesbitt and Young, 1984) of the Triassic mudstones is 70-82, which suggests an intense weathering in the hinterland. Provenance indexes such as SiO2/Al2O3, K2O/Na2O, and Cr/Zr suggest a transition from moderately basaltic to felsic hinterland during the early Triassic.

The trace element concentration and lack of intense bioturbation in the lower and upper Triassic strata suggest the existence of noxious environments with fine-grained carbonaceous sediments. Such characteristic environments are considered to have corresponded to the rapid transgression in that duration. Meanwhile, though a precise analysis of the provenance transition is necessary, strong weathering conditions with high temperatures are suggested along the southern part of the Tethys Sea.