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Post Indian plate-Kohistan Island Arc collision tectonics of the northwest Himalaya at the Main Mantle Thrust, Lower Swat, Pakistan

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Detailed micro-meso to macroscopic structural investigations of the metasedimentary Alpurai Group exposed south of the Main Mantle Thrust (MMT) provides new constraints on a very complex tectonic history related to the ongoing Himalayan Orogeny. The Triassic protoliths of the metasediments represent the northern-most passive continental margin rocks of the Indian plate and record at least three distinct deformation and metamorphic events ranging in age from ca. 39.1 to 28.3 Ma. An S_1 foliation, preserved as inclusion trails in garnet is transposed by younger deformation in the matrix and at outcrop-scale. S_1 crenulated cleavages preserved in the S_2 microlithon and garnet porphyroblasts developed at ca. 39.1 Ma during initial N–S horizontal bulk shortening. Well defined regional S_2 foliations in the matrix and garnet rims, tight to close D_2 mesoscopic folds, L^2_2 mineral lineations, Dosara syncline and Loe Sar dome developed during E–W shortening at ca. 28.3 Ma. Monazite grains, which grew during D_2 are aligned parallel to the S_2 differential crenulation cleavage defined by well developed muscovite and biotite. Weakly developed E–W trending S_3 crenulation cleavage and east-plunging D_3 mesoscopic folds on the western limb of the Dosara syncline deflect S_2 foliations and L^2_2 mineral lineations both microscopically and mesoscopically. Micro to mesoscopical S_3 foliations are characterized by biotite and muscovite growth. Muscovite replacement by biotite in the S_3 foliations indicates a prograde metamorphism related with the ongoing N–S shortening between the Indian plate and Kohistan Island Arc. Soft mantle around the S_2 parallel feldspar and quartz porphyroclasts have been deformed into δ -type tails on both sides during D_3 . Asymmetric D_3 mesoscopic folds, δ -type tails at outcrop scale and sigmoidal mica fish at thin section scale show top-to-south shear sense and tectonic transport. The southwards migration of the tectonic front at the MMT led to the development of the E-W trending Khairabad-Panjtal thrust equivalent to Main Central Thrust, Main Boundary Thrust and Main Frontal Thrust.

