Interaction between the Himalayan and India-Afghan Collision Tectonics at the NW margin of the Indian Plate in the Kurram Region, NW Pakistan

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The NW Himalayas in Pakistan, with a minor component extending into the NE Afghanistan present a number of tectonic flexures, which yield orographic trends markedly different from the NW-SE trending Kashmir-Zanskar Himalayas in the east. West of the Western Himalayan Syntaxis, the ~200 km wide Himalayan orogen, bounded by the Indus Suture in the north and the Salt-Range Frontal Thrust in the south is oriented WSW-ENE (Coward et al., 1988). The Kurram-Waziristan Ranges at the western margin of the Kohat Plateau in the NW Himalayan foreland trend NNE-SSW, almost at right angle to the Himalayan trend in the north (Meisner et al., 1975; Beck et al., 1996), forming a local syntactical bend referred to as the Kurram Reentrant. This change in the orographic trends owes to two separate but coeval collisional tectonic regimes; India-Kohistan-Karakoram collision in the north (Coward et al., 1988) and India-Afghan collision in the west (Beck et al., 1995; 1996). The Kurram region NW of the Kohat Plateau, the focus of this study, represents the junction point between the collisional orogens resulting from these two collision events.

Three tectonic blocks are in contact with each other in the Kurram-North Waziristan region; 1) Spinghar block in the north, 2) Western Samana block in the middle and the 3) Kurram-Waziristan block in the south. The northern two blocks are characterized by WNW-ESE trends, in continuation with the orographic trend of NW Himalayas, while the southern block has NNE-SSE structural trend, contrasting with the Himalayan trend but parallel to the western ophiolite belt, contiguous with the Chaman transform fault. The Spinghar Block (stranding the border area between the Kurram Agency, Pakistan and Nangarhar Province, Afghanistan) is westerly extension of the Inner Lesser Himalayas in NW Pakistan (i.e., Lower Hazara-Peshawar Basin Zone) comprising low-grade metamorphic rocks (Precambrian Landikotal-Manki-Hazara slates) overlain by a Palaeozoic sequence. The Spinghar Thrust separates the Spinghar and Samana blocks and is western equivalent of the Nathiagali-Histartang Thrust that marks the boundary fault between the Inner and Outer Lesser Himalayas and separates the Internal Himalayas from the Outer Himalayas as defined by Coward et al. (1988). The Samana Block is part of the Outer Lesser Himalayas, and comprises carbonate-dominated Jurassic-Upper Palaeocene lithologies. The Samana Block, instead of being bounded by the Main Boundary Thrust (MBT) at its southern margin, as is the case in the Kohat-Potwar Plateau, is abutted against the Kurram-Waziristan Block along the Kurram Fault. The Sub-Himalayas are therefore missing in the Kurram Agency. The Waziristan-Kurram Block consists of a tectonic collage of thrust sheets derived from the shelf-oceanic basin transition zone in the Neotethys at the western margin of the Indian Plate and includes 1) Tani Formation, 2) dismembered ophiolite, 3) Triassic-Palaeocene Kurram-Khaisora Group and 4) Cretaceous Kahi Group (Satara-Zakha, Shinkai Post and Khajori Post formations), with Indian Plate passive-margin inner shelf autochthonous sequence exposed in window structures beneath these thrust sheets.

The typical passive margin shelf-sequence of the Hill Ranges in Outer Lesser Himalayas (i.e., Samana-Kotal Pass-Kalachitta-Margala Ranges) is characterized by a major Early Palaeocene unconformity marked by Hangu Formation (Pivnik and Sercombe, 1993). Subsequent sequence from Middle Palaeocene Lokhart Limestone to Middle Eocene Kohat Formation lacks any distinct unconformity (Izatt, 1990). In Samna Hill Ranges, west of Hangu, Beck et al. (1995; 1996) recognized that the Late Palaeocene Patala Formation is unconformably deposited on top of the Kurram Group, a succession of allochthonous oceanic foredeep sequence originally deposited in the Neotethys and displaced onto the Samana Hill Ranges prior to the deposition of the Patala Formation. This serves earliest signature of India-Afghan collision (Beck et al., 1995), which is restricted to the Samana Ranges of the Kurram region and is characteristically absent in the rest of the Outer Lesser Himalayas in Pakistan.

Our studies in the Kurram region concur with earlier findings (Meisner et al., 1975; Beck et al., 1995; 1996) that the thrust sheets derived from the Neotethys shelf-oceanic basin transition zone including
ophiolites (Khost-Waziristan), Kahi Group (deep-marine foredeep), Kurram-Khaisora Group (outer passive-margin shelf) over-thrust the inner Indian-Plate passive margin shelf in the Late Paleocene, which is now exposed only in thrust-fault bounded anticlines as window structures. However, some new findings further highlight these India-Afghan collision related structures. In the northern part of the Samana Ranges we have mapped a south-verging anticline (Chamkani Anticline) cored by the Kurram-Khaisora Group, with inner Indian-plate shelf sequence ranging from Jurassic Samana Suk Formation to Late Paleocene Patala Formation occupying the limbs of this anticline (Fig. 1). This contrasts with better known anticlines in the southern Samana Range (e.g.,Darsamnad, Khadimak; Beck et al., 1995, 1996) where the core is occupied by Hill Range sequence and Kurram-Khaisora thrust sheet occupies the intervening synclonoriae (as klippe). This structural relation suggests that the Western Samana Ranges in the Kurram Region show interaction between three thrust sheets 1) a basal allochthon of the Hill Range sequence, 2) a middle allochthon of the Kurram Group, and 3) an upper allochthon of the Hill Range Sequence. The upper thrust sheet of the Hill Range sequence is preserved only in the northern part of the Samana Ranges, whereas in the southern parts of the Hill Ranges only the two basal thrust sheets are preserved.

This work shows that the Kurram region in NW Pakistan is unique in NW Himalayas where thrust sheets derived from the Himalayan collision involving the northern passive margin shelf sequence were being emplaced southwards into the Hill Ranges simultaneously with thrust sheets derived from Indian Plate western shelf resulting from the India-Afghan collision.

Figure 1. A) Geological sketch map of Kurram Tribal Agency, NW Pakistan, B) Cross-Section across the Samana Ranges, Kurram Agency.

References