Geology and tectonics of Northern Kyrgyz Tien Shan

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The Central Asian Orogenic Belt (CAOB) is the world largest accretionary orogens on Earth, that had a long accretionary history of up to 800 million years, beginning in the Tonian by the opening and widening of the Paleo-Asian Ocean (Zonenshain et al., 1990) and ending in the collision of the Siberian, Tarim and North China cratons and the younger Kazakhstan continent in late Permian to early Triassic time. The orogen consists of several distinct branches of which the Tien Shan is one of the major belts, and covers a vast terrain in Uzbekistan, Kyrgyzstan, Kazakhstan and China. The Tien Shan orogen is a perfect laboratory for understanding the geodynamic evolution of the western CAOB.

The Kyrgyz North Tien Shan (NTS) is located in the southwestern CAOB. It represents an early Paleozoic accretionary collage built upon a Precambrian basement. That collage has a complex fold-and-thrust structure and includes fragments of Precambrian microcontinents and Early Paleozoic oceanic and island-arc ophiolites. The basement of the NTS consists of Meso- to Neoproterozoic gneisses and supracrustal rocks assigned to the North Tien Shan microcontinent. The metasedimentary strata and granite–gneisses crop out in the Makbal and Burkhan anticlinoria in the western part of the Kyrgyz Range, south of Issyk-Kul Lake. All those units were amalgamated during several accretionary events during the Cambrian and Ordovician and underwent further reworking in island-arc and collisional settings during the Middle and Late Paleozoic. The whole structure of the collage was strongly folded and uplifted during the Cenozoic as a result of the India-Eurasia collision. The NTS is separated from the Middle Tien Shan by the Nikolaev Line. The NTS microcontinent, as well as other microcontinents in the western CAOB, was probably rifted off the Rodinia supercontinent in late Neoproterozoic early Cambrian time, which breakup formed an oceanic basin surrounded by ensimatic active margins with back-arc basins (Cambrian-early Ordovician?), ensialic active margins (middle-late Ordovician), and passive margins.

The NTS microcontinent is bounded by the Djalair-Naiman and Kyrgyz-Terskey ophiolite suture zones in the north and south, respectively. The ophiolites, oceanic and supra-subduction, were originated in the Terskey Ocean and at its Pacific-type active margins. Fragments of a Cambrian-Ordovician magmatic arc have been found and identified on a distance of more than 1000 km within a relatively narrow zone extending from the western Kyrgyz Range to the Chinese Central Tien Shan. The arc magmatism ceased in the Late Ordovician after the closure of the Terskey Ocean and collision of the North Tien Shan microcontinent with the Aktau-Junggar microcontinent. The Kyrgyz-Terskey ophiolite suture zone consists of Cambrian ophiolites, early Ordovician magmatic and sedimentary rocks of oceanic origin and middle Ordovician flysch and volcanogenic-sedimentary formations at the southern flank of the NTS. Previously, these rocks were interpreted either as an independent oceanic arc that docked to the southern margin of the NTS microcontinent in the late Cambrian or Early Ordovician, or as the southern parts of the NTS continental arc, locally extending into the back-arc basin. The oldest arc volcanic sequences occur in the central and eastern parts of the KT zone in the Kapkatas and Terskey ranges. In the Sultansary area of the Kapkatas Range, the lower part of the section consists of tholeiitic arc-related massive and amygdaloidal pillow basalts of the Beltepshi Fm. Upward the section they change to weakly differentiated calc-alkaline volcanic rocks of the Sultansary Fm., represented by agglomerate and lapilli tuffs, andesites, and dacites, intercalated with tuff breccias, tuffaceous sandstones, and limestone horizons in the upper part of the section. The geochemical characteristics indicate that the volcanic rocks of the Beltephsi and Sultansary fms. formed in a supra-subduction setting whereas positive whole-rock εNd values of +5.3 and +3.7 for basalts and andesites, respectively, indicate a juvenile magmatic source (Alexeiev et al., 2023).

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Zonenshain, L.P., Kuzmin, M.I., Natapov, L.M., 1990. Geology of the USSR: a plate tectonic synthesis. Geodynamic Monograph. American Geophysical Union, Washington, Geodynamics Series 21, 242 p.