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The North Nuratau Fault Zone, Uzbekistan—Structure and evolution of a Palaeozoic Suture Zone

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ABSTRACT

The Nuratau Fault Zone in eastern Uzbekistan forms part of the western prolongation of the Tien Shan, an extensive orogenic zone located along the margin of the Central Asian Orogenic Belt. The Nuratau region is geologically complex, forming part of the suture zone between the Kazakh-Kyrgyz continent and the Alai microcontinent. A model is proposed suggesting modified N-directed subduction model, where an extensive fold-and-thrust belt developed in the Nuratau region. This, coupled with significant transform activity would have resulted in major segmentation of the existing stratigraphy in the region, as well as the development of a foredeep basin to the north of the fold-and-thrust belt. Regional suturing and collision was variable. Indeed, the collisional history probably involved multi-phase subduction/accretion of various microcontinents, ancient island arcs, and fragments of oceanic islands. Final collision would have produced an eroding basinal high in the region of the Nuratau mountains, which issued sediment both northwards into the remnant basin of the Turkestan Ocean, but also to the south into the newly forming Amu Darya Basin.

1. Introduction

Central Asia is a mosaic block of various basement fragments derived from the subduction and collision of various microcontinents, terranes and island arc complexes assembled over the Phanerozoic (e.g. Zonenshain et al., 1990; Berzin et al., 1994; Sengor and Natal'in, 1996; Buslov et al., 2001), many of which remain poorly defined. The region is crossed by the Tien Shan, a fold-and-thrust belt (Bazhenov et al., 1999; Burtman, 1980, 1997), resulting from Cenozoic intraplate deformation, including the progressive collision of India with Eurasia (Molnar and Tapponnier, 1975; Tapponnier and Molnar, 1979). The Tien Shan extends along an E–W axis for c. 2500 km from Xinjiang in NW China through to its termination in central Uzbekistan. The southern Tien Shan is situated along the SW margin of the Central Asian Orogenic Belt (CAOB, =Altaids), a key region for our understanding both of the amalgamation of Eurasia and the Phanerozoic growth of the CAOB itself (Windley et al., 1990; Bazhenov et al., 1999; Gao et al., 2009; Fig. 1).

The western part of the Tien Shan (i.e. Kyrgyzstan and Uzbekistan) is composed of three major structural units/terranes, the Northern, Middle, and Southern Tien Shan. The Northern Tien Shan comprises several Precambrian-age blocks, as well as Cambrian-Lower Ordovician ophiolites and marine sediments (Biske and Seltmann, 2010) overlain by Ordovician-age sediments and volcanic rocks, and cut by I-type granites. The region includes the deformed margin of the Kazakh-Kyrgyz continent. The Middle Tien Shan (=Syrdarya, Naryn or Ishim-Middle Tien Shan microcontinent) comprises a range of Neoproterozoic units which include tillites and acid volcanic rocks (Alekseev et al., 2009). From Middle Devonian–Late Carboniferous times, it probably formed part of the passive margin of the Kazakh-Kyrgyz continent, and was characterized by shallow-marine carbonate and siliciclastic sediments (Biske and Seltmann, 2010). The Southern Tien Shan, which is separated from the Middle Tien Shan by the Southern Tien Shan Suture (which includes Early Ordovician–Early Carboniferous ophiolites (Kurenkov and Aristov, 1995; Gao et al., 1998; Chen et al., 1999)), is a Late Palaeozoic-age, fold-and-thrust belt formed during the closure of the Turkestan Ocean (a precursor of Palaeo-Tethys; Zonenshain et al., 1990; Kheraskova et al., 2010; Seltmann et al., 2011; Fig. 2). Lithologies present include Silurian-Lower Permian sediments and volcanics. Seltmann et al. (2011) note that the Southern Tien Shan region contains deformed forearc accretionary complexes as well as passive margin sediments. A major strike-slip structure – the Taras-Ferghana Fault – separates the eastern and western terranes of the Southern Tien Shan. The latter region can be subdivided into three units – (from W to E), the Kyzylkum, Alai (=Alay) and Kokshaal segments, with the former two located to the west of the Taras-Ferghana Fault (Konopelko et al., 2007). Lithologically, the three are similar, comprising Ordovician–mid Carboniferous

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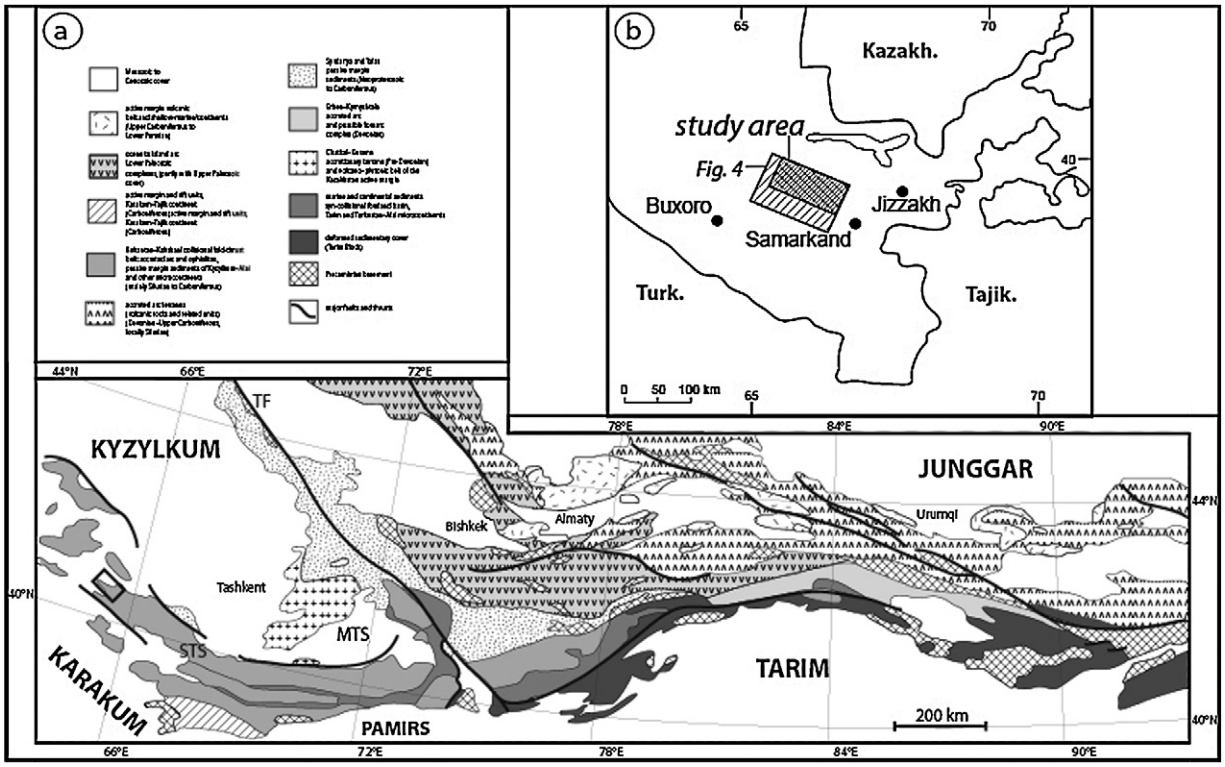

Fig. 1. (a) Geological overview of the Palaeozoic Tien Shan (after Biske and Seltmann, 2010), also showing the (b) regional map of Uzbekistan and adjacent countries showing the location of the study area (to the NW of Samarkand) in Uzbekistan, as well as of Fig. 4. (Kazakh = Kazakhstan; Tajik = Tajikistan; Turk = Turkmenistan). The study area is also indicated in (a). Key: MTS – Middle Tien Shan, STS – Southern Tien Shan, TF – Taras-Ferghana Fault.

pelagic sediments, partly associated with intraplate volcanics, and thick carbonate platforms (mainly Late Devonian–Early Carboniferous in age) which are best developed in the latter two segments (Biske and Seltmann, 2010; Seltmann et al., 2011).

Models of the tectono-sedimentary evolution of the Southern Tien Shan region are complex, and often incomplete with significant correlations problems between the various geological subdivisions along its length (see also Xiao et al., 2010). Previous work in the Soviet Union (e.g. Burtman, 1975; Khain, 1985) described several magmatic arcs, ophiolite belts and intramontane belts in the region; additionally, the location of important mineral deposits can be linked to accretionary processes to the north along the Tien Shan-Solonker suture zone (Seltmann and Porter, 2005).

The aim of the current study is to describe the North Nuratau Fault Zone in terms of its geology and structure, with fieldwork focussing on a 100 km × 25 km area to the west of the town of Jizzakh (Fig. 1). The zone is a complex one involving tectonic, sedimentary, magmatic and metamorphic features. Additionally, the region is one of not-insignificant mineralization, with recorded anomalies of gold, silver and several other elements (e.g. Jenchuaeva, 2001; Seltmann and Porter, 2005; Wilde et al., 2001; Yakubchuk et al., 2002; Yakubchuk, 2004). A secondary aim was to obtain an overview of the Ordovician–Permian stratigraphy in the region, combining this with new interpretations of a seismic profile trending N–S across the North Nuratau Fault Zone. Together, these data were used to present a new model for the evolution of the region as well as examining the relationship between the Palaeozoic basement and the overlying Mesozoic basins (i.e. Amu Darya Basin).

2. Geological setting

The regional history commenced with the break-up of the late Precambrian-age supercontinent Rodinia (which included Kazakhstan, =North Tien Shan) during the Late Proterozoic (see Kheraskova et al., 2010; Golonka, 2007, 2009, for details); most of the regional microcontinents thus have Precambrian-age basement (Akmejanov et al., 1982). The Kazakh-Kyrgyz continent formed mainly in Ordovician–Silurian times (Buslov et al., 2004; Zonenshain et al., 1990; Windley et al., 2007) as a result of island arc-microcontinent/terrane collisions (including the Tarim-Qaidim microcontinent), followed by a subsequent accretionary

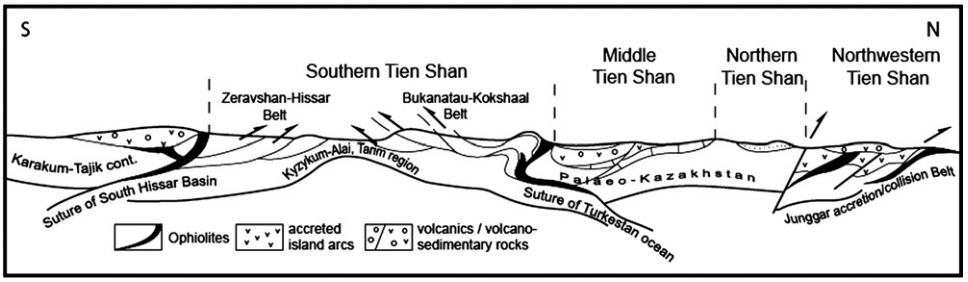

Fig. 2. Idealized profile of the Palaeozoic Tien Shan: a geodynamic model of collision in the Karakum-Tien Shan-Junggar system in Permian times (after Biske and Seltmann, 2010).