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Late Paleozoic tectonic evolution of the northern West Chinese Tianshan Belt

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Abstract

The northern West Chinese Tianshan is divided into three subunits: Carboniferous turbidite, ophiolitic mélange and Yili magmatic arc. Stratigraphical and petrological studies suggest that the turbidite and ophiolitic mélange form a subduction complex. The ophiolitic mélange that forms the North Tianshan suture was a result of intra-oceanic tectonism and subsequent redeposition and deformation during the subduction of the North Tianshan oceanic basin. The Yili arc-type granitoids are constained by single zircon U-Pb radiochronology between 361 and 309 Ma. The first-hand kinematic results on the deformed turbidite suggest that this suture zone was reworked by a Permian ductile dextral strike-slip fault. An evolutionary model of the study area allows three events to be distinguished: 1) Late Devonian to Carboniferous subduction of the oceanic basin below the Yili Block producing Yili magmatic rocks and subduction complex, 2) Late Carboniferous complete closure of this basin, 3) Permian right-lateral strike-slip faulting generating pull-apart basins and alkaline magmatism. A prominent reactivation during the Indo-Eurasia collision provoked the northward thrusting of the Paleozoic units upon the Cenozoic sediments of the Junggar Basin, consequently, hiding the bulk of this Late Paleozoic suture.

Keywords: Paleozoic subduction; strike-slip shearing; mélange; zircon U-Pb dating; Tianshan

1. Introduction

The Tianshan range, extending E-W over 3000 km from NW China to Kazakhstan and Kyrgyzstan, separates the Tarim Basin to the South from the Junggar Basin to the North. It is a key region for understanding the Late Paleozoic geodynamic evolution of Central Asia. The Paleozoic Tianshan orogenic belt is considered to result from the accretion and/or collision of continental blocks, magmatic arcs and subduction complexes [1-6]. The Tianshan orogenic belt can be subdivided in several ways. Geographically, the West Chinese Tianshan (WTS) develops from Urumqi to the Chinese border (Fig. 1). Topographically, it consists of two E-W elongated ranges surrounding the Yining basin, which is also called "Yili Block". From a tectonic point of view, the Chinese Tianshan orogen is generally divided into North, Central and South domains. The Yili Block, located between the North and Central Tianshan domains, played an important role on the

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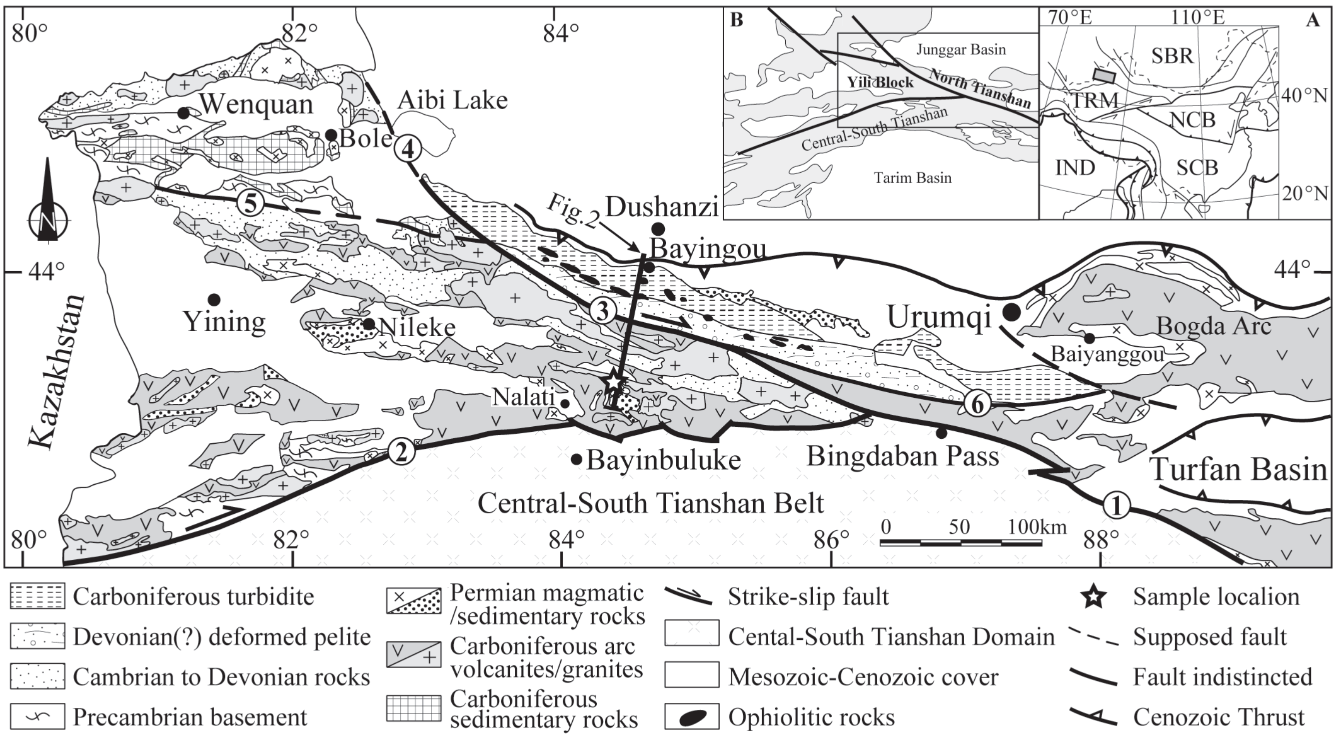

Fig. 1: Structural map of northern West Chinese Tianshan belt (modified from XBGMR [11]). Insert A shows the location of the study area in Central Asia, inset B defines the North Tianshan and the Yili Block. 1, Main Tianshan Shear Zone (MTSZ); 2, the Northern Central Tianshan Fault after Gao et al. [18]; 3, North Tianshan Fault; 4, Aibi Lake Fault; 5, Sailimu- Jinghe Fault; 6, Houxia Fault.

Paleozoic evolution of WTS, but its tectonic feature and the relationship with the North Tianshan are still poorly constrained. This study aims at clarifying the Late Paleozoic tectonic evolution of the northern WTS Belt, and we focused on the ophiolitic mélange, turbidite, the Yili magmatic arc as well as shear zone crossing the highway from Dushanzi to Nalati (Fig. 1 and 2). The tectonic significance of ophiolitic rocks is discussed and a geodynamic evolutionary model of the North Chinese Tianshan is proposed.

2. Structure of the northern WTS

The WTS consists of several units bounded by strike-slip faults (Fig. 1). The north side of the Central-South Tianshan Belt is bordered by the Main Tianshan Shear Zone (MTSZ, fault 1 in Fig. 1) [4, 5, 7], which separates the Central-South Tianshan Belt from the "Bogda Arc" [4]. To the West it merges with fault 2 separating the Yili Block to the Northwest from the Central-South Tianshan Belt to the south. To the North, the North Tianshan Fault (NTF, fault 3 in Fig. 1) [8], which is also named Junggar Fault [9] or Borohoro Fault [10], divides longitudinally the northern range of WTS along the Borohoro Range into the Yili Block and the North Tianshan Domain. Aibi Lake Fault (fault 4 in Fig. 1) is the northwest extension of the NTF. Sailimu-Jinghe Fault (fault 5 in Fig. 1) separates the Yili Block from the "Bole Block". Although a detailed discussion of the Bole Block is beyond the scope of this paper, it is worth noting that it strongly differs from the Yili Block and therefore is a very peculiar domain in the tectonic framework of WTS. Lastly, the "Houxia Fault" (fault 6 in Fig. 1) separates Carboniferous arc-related rocks that are exposed around the Turfan Basin from the North Tianshan terrigenous rocks (Fig. 1). In the following sections, we present northern WTS located to the east of the Sailimu-Jinghe Fault, and up to Urumqi. This area can be subdivided into three lithotectonic units: 1) Carboniferous turbidite, 2) ophiolitic mélange and 3) Yili magmatic arc (I, II and III, respectively in Fig. 2). The units I and II constitute one single subduction complex, i.e. the North Tianshan subduction complex, but the contrasted lithology allows the distinction of two different units.

2.1. Carboniferous turbidite

The northern slope of the Borohoro Range consists of a turbiditic formation developing WNW-ESE for 300 km long and about 20 km wide. On the basis of plant fossils, these terrigenous rocks are assigned to the Bayingou Formation of Late Carboniferous age [11]. This unit is estimated to be between 5,000 and 10,000 m thick although it is difficult to establish because of possible tectonic duplication. Sandstone beds present variable thickness ranging from a few centimeters to 1 m (Fig. 3a, b). Typical Bouma sequences can be observed. Some deep-water ichnofossils (*Chondrites sp.* and *Helminthoidda Labyrinthica*) were found in sandstone [11] indicating deep sea fan deposition. Sandstone grains and conglomerates pebbles consist of terrigenous, volcanic, plutonic and siliceous clasts with only minor carbonate

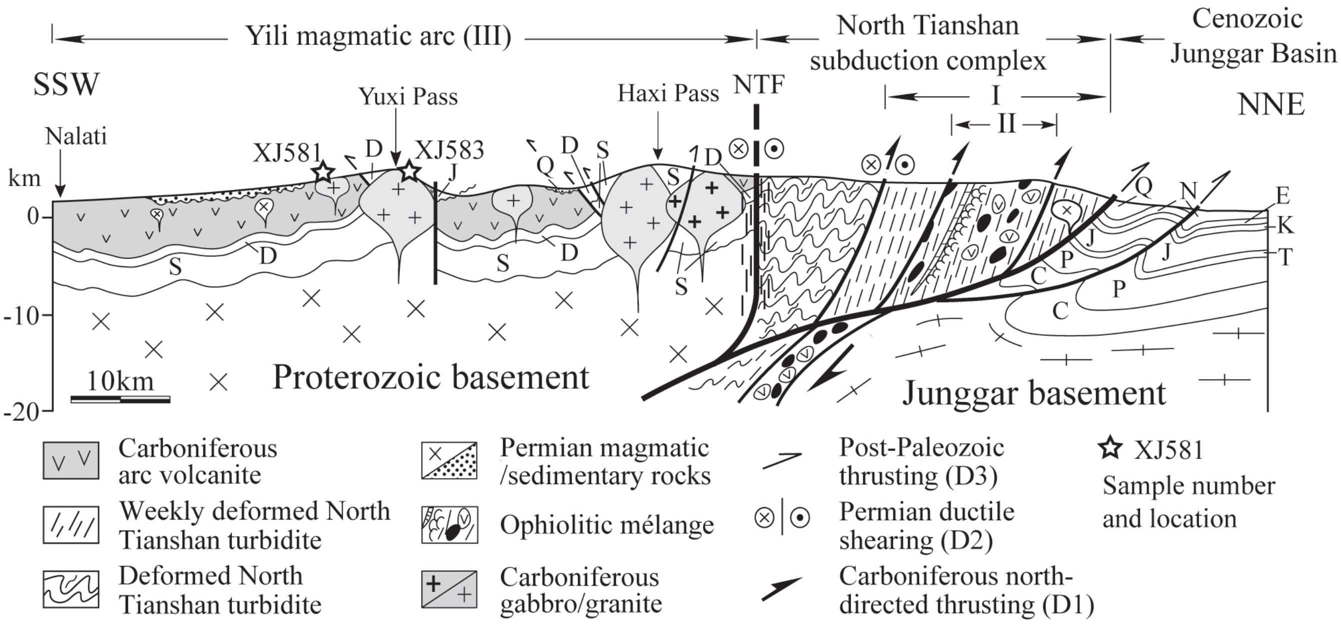

Fig. 2: Crustal scale cross section from Dushanzi to Nalati showing the polyphase deformation: Carboniferous D1 thrusting, Permian D2 shearing, and Cenozoic D3 thrusting. The dextral strike-slip fault partly reworks the Carboniferous suture (thickness of strata are after Liu and Li [24]). S, D, C, P, T, J, K, E, N and Q represent Silurian, Devonian, Carboniferous, Permian, Triassic, Jurassic, Cretaceous, Paleogene, Neogene and Quaternary, respectively.

clasts. Petrographic study indicates that the plutonic clasts are dominantly composed of granodiorite, diorite and gabbro. The volcanic clasts have calc-alkaline geochemical features [12]. Although detailed mapping is not available, load casts, graded bedding and cross laminations allow us to recognize both normal and upside down sequences that infer isoclinal folding or thrust stacking. Up-to-the-North thrust faults are also observed. Therefore, the turbidite series was likely involved in north verging recumbent fold and thrust sheets.

2.2. Ophiolitic mélange

Ophiolitic rocks are present within the turbiditic formation. According to the available geological maps [11, 13], these rocks crop out discontinuously for about 250 km long and 5~15 km wide (Fig. 1). In the regional geology, they are referred to as the Shadawang Formation [11]. Several areas are already well acknowledged to investigate the ophiolites [14-19]. In the Bayingou section, 30 km to the south of Dushanzi (Fig. 1), the dominant rocks are serpentinized peridotite (Fig. 3c), gabbro, diabase, basalt, chert, plagiogranite and rare limestone. Black or red scaly mudstone and light yellow-green greywacke often surround the other rock types. Mafic greywacke that might be easily confused with gabbro corresponds actually to gabbroic sandstone.

In the field, the ophiolitic rocks crop out in two ways: either as continuous sequences of massive basalt, pillow lava and overlying red chert (Fig. 3d) that develop for a few tens meters, or as centimetre to kilometre size isolated bodies of mafic-ultramafic or sedimentary rocks included in a schistose mudstone matrix. In the latter occurrence, the blocks exhibit without any regular organization but distribute rather randomly in the matrix. Sandstone phacoids are included in the scaly mudstone (Fig. 3e). Mafic and ultramafic blocks occur as olistoliths within the turbidite. Pebbly mudstone bearing angular blocks of gabbro, basalt, sandstone, chert and limestone are described in Gurt and Motoshalagou sections [8, 17], northwest of Bayingou.

On the basis of geochemistry, three types of mafic rocks are distinguished: N-MORB, OIB and IAT [14, 15, 17], indicating the genesis of oceanic basin. These lithological and geochemical features are compliant with the interpretation of the rocks as an ophiolitic suite. However, the absence of coherent ophiolitic bodies larger than one kilometre or so, the widespread blocky habitus of the rocks and the importance of sedimentary facies opposite to the magmatic ones suggest that this whole suite represent a mélange unit formed during the closure of an oceanic basin. The cherts associated with the mafic rocks yield Late Devonian to Early Carboniferous radiolarians and conodonts [15, 17], and one plagiogranite block yields a zircon U-Pb SHRIMP age of 325±7 Ma [20]. Both suggest a Late Paleozoic age for ophiolite formation. The tectonic significance of the ophiolitic mélange and its geodynamic setting will be discussed in the forthcoming sections.

2.3. Yili magmatic arc

The Yili Block contains voluminous volcanic rocks of Carboniferous age [11, 21] (Fig. 1). The volcanic rocks consist of basaltic andesite, andesite, rhyodacite, dacitic andesite, tuff and volcano-sedimentary rocks. They are closely associated with limestone and shallow water clastic deposits. The evolution of sedimentary facies of the Yili Block infers a progressive change from a gently subsiding platform during

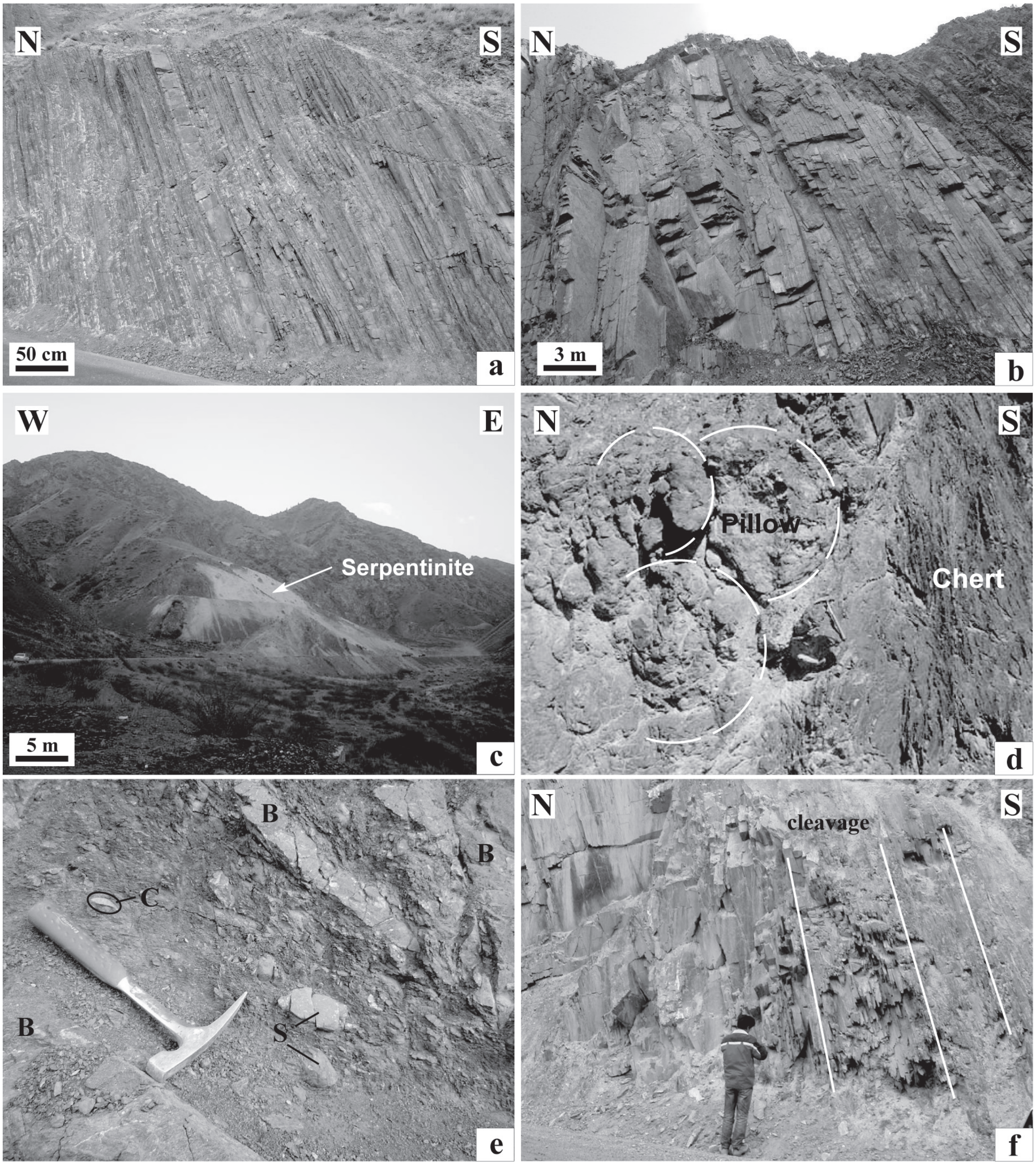

Fig. 3: Field photographies of the North Chinese Tianshan subduction complex. **(a, b)** Carboniferous turbidite dipping at high angle to the south; **(c)** decameter-size serpentinite block in Bayingou ophiolitic mélange; **(d)** pillow lavas and overlying red chert and pelite in mélange; **(e)** green sandstone (S), Late Devonian-Early Carboniferous red chert (C), tholeiitic basalt (B) included in red pelitic matrix of the mélange; **(f)** Slate at the south of the mélange, the subvertical cleavage contains a sub-horizontal mineral-stretching lineation.

the Early Carboniferous towards a Late Carboniferous filling up environment [22]. Geochemical analyses of the volcanic rocks show that they belong to calc-alkaline series and formed in a continental active margin setting [22, 23].

Arc-type granodiorite, diorite and tonalite are widespread within the Yili Block (Fig. 4a). The granodiorite is mainly composed of plagioclase, hornblende and minor

Table 1: Zircon U-Pb data of granitoids from the Yili Block

Plots	Ratios						Ages						Disc.(%)
	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	
XJ581													
MA23C2	0.1044	0.0108	0.0167	0.0003	0.0480	0.0054	107	2.1	99	264	101	10	2.1
MA23C5	0.1541	0.0098	0.0245	0.0003	0.0449	0.0029	156	1.9	-61	159	145	9	1.9
MA23C11	0.1794	0.0094	0.0247	0.0004	0.0520	0.0029	157	2.4	284	126	168	8	2.4
MA23C7	0.3593	0.0103	0.0482	0.0004	0.0531	0.0016	303	2.4	332	69	312	8	2.4
MA23C8	0.3708	0.0182	0.0482	0.0009	0.0533	0.0027	303	5.4	342	115	320	14	5.4
MA23C12	0.3861	0.0109	0.0489	0.0005	0.0565	0.0016	306	3.4	471	61	332	8	3.4
MA23C9	0.3592	0.0123	0.0490	0.0004	0.0526	0.0019	309	2.6	311	83	312	9	2.6
MA23C3	0.3647	0.0085	0.0494	0.0003	0.0523	0.0013	311	2.1	300	57	316	6	2.1
MA23C6	0.3685	0.0101	0.0502	0.0004	0.0528	0.0014	316	2.4	320	62	319	8	2.4
MA23C10	0.3646	0.0095	0.0510	0.0004	0.0515	0.0014	321	2.4	263	61	316	7	2.4
MA23C4	0.3707	0.0153	0.0515	0.0005	0.0514	0.0021	324	3.2	261	93	320	11	3.2
MA23C1	0.3907	0.0150	0.0532	0.0006	0.0520	0.0021	334	3.5	285	93	335	11	3.5
XJ583													
MA23M11	0.3494	0.0216	0.0483	0.0008	0.0537	0.0033	304	5.3	357	138	304	16	5.3
MA23M9	0.3560	0.0214	0.0486	0.0007	0.0540	0.0033	306	4.7	373	138	309	16	4.7
MA23M7	0.3673	0.0261	0.0488	0.0008	0.0558	0.0040	306	5.4	445	157	318	20	5.4
MA23M8	0.3342	0.0239	0.0487	0.0010	0.0530	0.0039	306	6.6	329	168	293	18	6.6
MA23M12	0.3612	0.0289	0.0490	0.0010	0.0551	0.0044	307	6.2	417	179	313	22	6.2
MA23M3	0.3588	0.0226	0.0492	0.0009	0.0565	0.0035	308	5.5	473	136	311	17	5.5
MA23M4	0.3832	0.0247	0.0495	0.0008	0.0578	0.0038	309	5.0	521	144	329	18	5.0
MA23M10	0.3306	0.0245	0.0491	0.0008	0.0513	0.0039	310	5.4	256	174	290	19	5.4
MA23M6	0.3662	0.0256	0.0495	0.0008	0.0560	0.0040	310	5.3	453	160	317	19	5.3
MA23M2	0.3953	0.0227	0.0500	0.0009	0.0594	0.0034	312	5.7	583	123	338	17	5.7
MA23M5	0.3250	0.0246	0.0504	0.0010	0.0502	0.0040	318	6.2	202	187	286	19	6.2
MA23M1	0.3705	0.0280	0.0511	0.0010	0.0574	0.0045	319	6.6	508	173	320	21	6.6

Disc. (%) denotes percentage of discordance

quartz as well as biotite (Fig. 4b). Single zircon grains of one granodiorite and one microdiorite samples collected along the highway from Dushanzi to Nalati (Fig. 1 and 2) are dated using a Hewlett Packard HP 4500 ICP-MS fitted with a Nd-YAG Laser operating at 213 nm at the University of Tasmania (Australia). The U-Pb isotopic results are presented in Table 1 and in Fig. 5. The granodiorite XJ583 yields an age of 309±3Ma (MSWD=0.63) with an isolated peak in the histogram. The microdiorite XJ581 presents a main peak age of 315±3Ma (MSWD=4.6) with 4 out of 120 analyses scattering from the main peak in histogram, their relatively high U/Pb ratio is interpreted as due to a Pb loss. Geochronology of the calc-alkaline granites from other places in the Yili Block (Work in progress) indicates that the oldest age for arc-related magmatism is 361 Ma. This plutonic event that lasted for about 50 millions years was contemporaneous with congenetic volcanic activity, i.e. basalt and dacitic andesite from the same area yielding SHRIMP U-Pb zircon ages ranging from 354 Ma to 313 Ma [23].

The tectonic setting and age of the Yili magmatic rocks are consistent with those of the Middle Devonian to Carboniferous Bogda calc-alkaline volcanic rocks [4, 24], and sharply contrast with those of the Permian intra-plate granites, alkaline basalts or continental tholeiites and associated felsic rocks that crop out in Nileke and Baiyanggou areas (Fig. 1) [11, 25].

3. Polyphase deformation in the northern WTS

Three principal phases of deformation, called D1 to D3, are recognized in the northern WTS Belt. They are presented here in the retro-tectonic order (from younger to older) in order to remove the effects of younger deformations on the older ones.

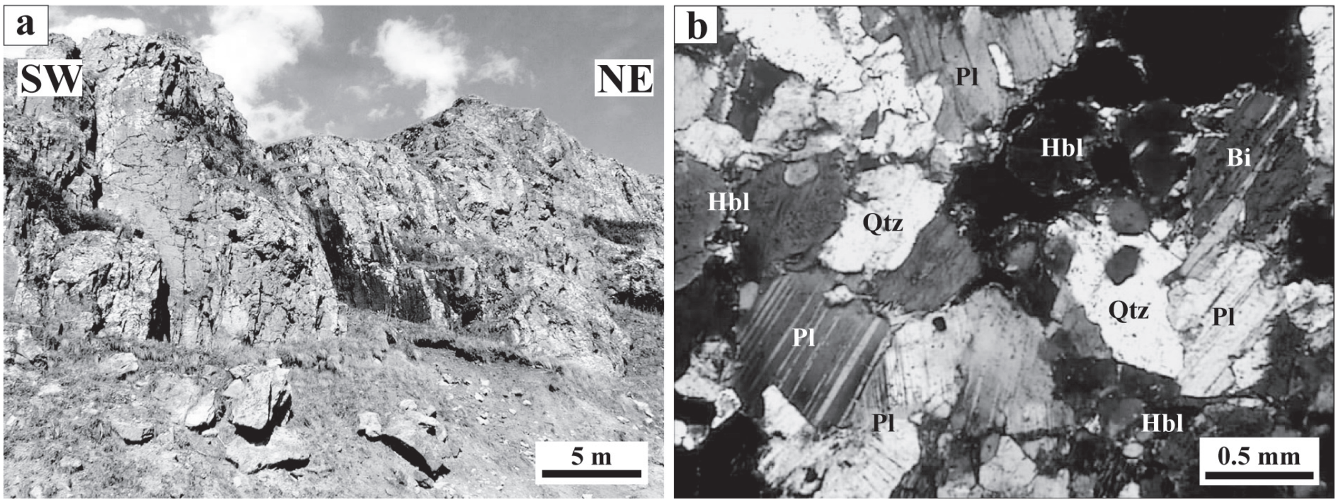

Fig. 4: (a) Field photography of arc-type granitoids in the Yili Block; **(b)** Micro-photography of a granodiorite showing the plagioclase (Pl), hornblende (Hbl), quartz (Qtz) and biotite (Bi).

3.1. Cenozoic intracontinental thrusting (D3)

The northern piedmont of the Tianshan Belt, at the contact with the Junggar Basin, consists of a thick succession (nearly 10 km) of Triassic-Neogene terrigenous deposits formed by fluvial erosion of the range (Fig. 2) [26]. Kilometre scale north verging folds and high to intermediate angle brittle thrusts accommodate a N-S shortening of the south margin of the Junggar Basin. According to detailed structural, geomorphological and magneto-stratigraphic results, the Paleozoic rocks (either turbidites or volcanic rocks) are thrusted over the Mesozoic to Neogene continental sediments with a throw of several tens kilometres [27-30]. As a consequence, prominent tectonic features, such as the Late Paleozoic suture between the Yili and Junggar blocks, have been concealed and cannot be recognized in the field (Fig. 2).

3.2. Permian dextral strike-slip faulting (D2)

As observed along the Dushanzi-Nalati highway and other parallel routes, the southern part of the turbidite unit is lithologically dominated by black mudstone, sandstone, minor chert and volcani-clastic rocks. Although attributed to the Devonian [11], these rocks remain undated since they are mainly clastic. They underwent a ductile deformation characterized by a steeply dipping slaty cleavage (Fig. 3f) with a subhorizontal mineral-stretching lineation. In the field, kinematic criteria are rare, but sigmoidal cleavage, lensoids and asymmetrically sheared clasts suggest a dextral sense of shear, which is confirmed by microscopic observations (Fig. 6). Quartz and feldspar clasts exhibiting asymmetric pressure shadows (Fig. 6a), shear bands (Fig. 6b), sigmoidal biotite (Fig. 5c), sheared andalusite or elongated quartz ribbons with oblique sub-grain fabrics (Fig. 5d) are common microstructures. Therefore, the present boundary between the turbidite, ophiolitic mélange and the Yili Block is a ductile right-lateral strike-slip fault, i.e. the NTF (fault 3 in Fig. 1, Fig. 2) [8]. The age of the shearing is not settled yet, on the basis of paleomagnetic data in the West Tianshan Belt in Kyrgyzstan, Bazhenov et al. [31] proposed that a dextral strike-slip event occurred during the Late Permian to Early Jurassic. However, in the study area, Jurassic coal bearing sandstone that covers the volcanic rocks are not deformed by the ductile shearing, that should therefore be older than Jurassic. Moreover, in East Chinese Tianshan, the MTSZ (fault 1 in Fig. 1) is dated at 280-250 Ma from syn-kinematic biotites by Ar-Ar method [4, 7]. Since the NTF and MTSZ appear to be cartographically continuous, a Permian age can be tentatively inferred for the NTF.

3.3. Carboniferous north-directed thrusting (D1)

In the turbidite unit, a series of tight isoclinal folds marked by siliceous layers are locally well developed. Due to the intense D2 dextral shearing, it is difficult to state whether these folds were formed during the D2 event or ealier. If the latter is the case, the fold asymmetry indicates a northward vergence. Bedding-parallel shear zones, sometimes marked by chlorite or illite coatings and N-S trending slicken-lines indicate a north-directed shearing. Similar low temperature shear zones can be observed around the ophiolite blocks in the mélange. These thrust faults are difficult to date, indeed, some of them might have been formed during the Cenozoic D3 event. However, on some surfaces, shearing related horizontal slicken-lines overprint steeply dipping striaes. This structural succession allows us to infer that the Carboniferous turbidite and ophiolitic mélange units experienced a top-to-the-north shearing before the D2 right-lateral shearing. Thus a Late Carboniferous age appears likely for this D1 event.

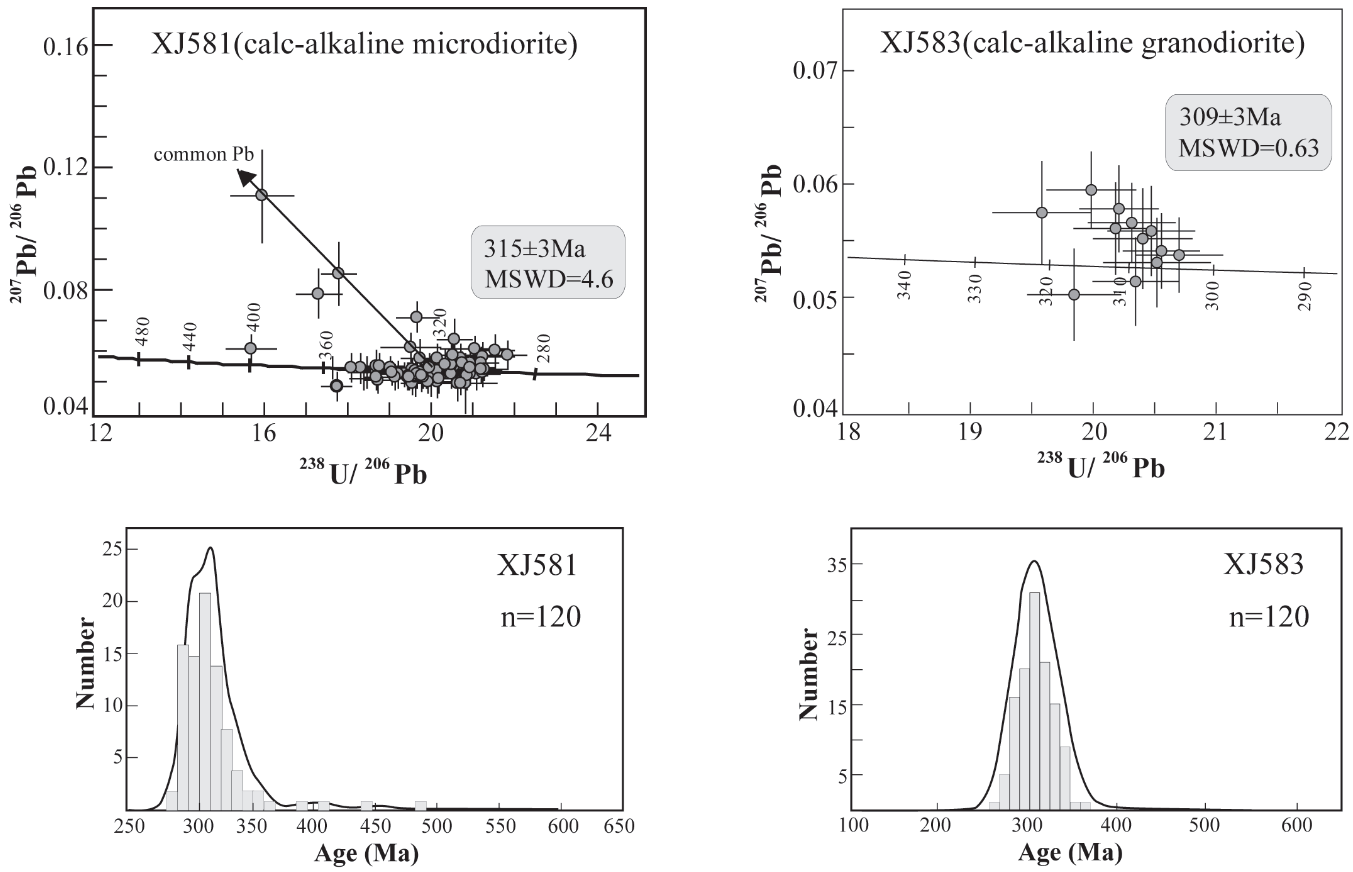

Fig. 5: Concordia diagrams of ICP-MS U-Pb zircon analytical results and histograms showing the age distribution for the arc-related calc-alkaline granitoids from the Yili Block (see Fig. 1 and 2 for samples localities).

4. Discussion

4.1. Implication of the ophiolitic rocks

The formation of the North Tianshan ophiolitic mélange is still controversial, and it was interpreted either as in situ disrupted ophiolites [15] or as klippes [18]. Since all the typical lithologies are represented in the field, previous researchers regarded these rocks as an ophiolitic nappe that was thrusted upon the turbidite [15-17]. However, a complete continuous ophiolitic sequence is lacking, and the oceanic rocks are always disrupted and mixed with sediments. In addition, the ophiolitic blocks and the surrounding sedimentary rocks often display sheared boundaries.

Sedimentary as well as tectonic processes may form a mélange [32]. In most outcrops, mafic and ultramafic rocks are mixed together with gabbroic sandstone, greywacke and pelite. This suggests that the oceanic rocks underwent an intra-oceanic tectonic event that was responsible for unroofing of peridotite and gabbro, shearing and subsequent re-deposition on the ocean floor. Finally, the already mixed magmatic and sedimentary rocks are included in the turbidite, as trench fill deposits during subduction. The sheared block-in-matrix structure supports a tectonic process active during accretion. According to the mélange classification proposed by Raymond [32] we interpret this ophiolitic mélange as a sheared olistostrome with exotic blocks.

4.2. Geodynamic evolution of the northern West Tianshan

The bulk architecture of the northern WTS Belt is due to a poly-orogenic evolution. As recognized by many authors on the basis of geological and geophysical studies [27-30], the Paleozoic rocks are thrusted to the north upon the Junggar Basin. Consequently, the primary Paleozoic structures are partly erased or concealed by the Cenozoic ones. Moreover, the D2 shearing might also hide initial relationships between the tectonic elements that formed the North Tianshan domain.

On the basis of high pressure metamorphic rocks with Sm-Nd and Ar-Ar ages around 350-315 Ma, some previous researchers proposed that the Yili magmatic arc resulted from the closure of a "South Tianshan Ocean" situated to the south of the Yili Block [18, 33-35]. However, older K-Ar ages ranging from 482 Ma to 415 Ma on these metamorphic rocks both in NW China and in Kyrgyzstan [31, 36] suggest that the high pressure event might be older than Yili arc magmatism. Moreover, there is no detailed structural analysis nor kinematic evidence supporting a northward subduction of "South Tianshan Ocean" below the Yili Block. Thus, on the basis of the previous studies and our own results, we propose a geodynamic model accounting for the evolution of the North Tianshan domain and the Yili Block (Fig. 7). In

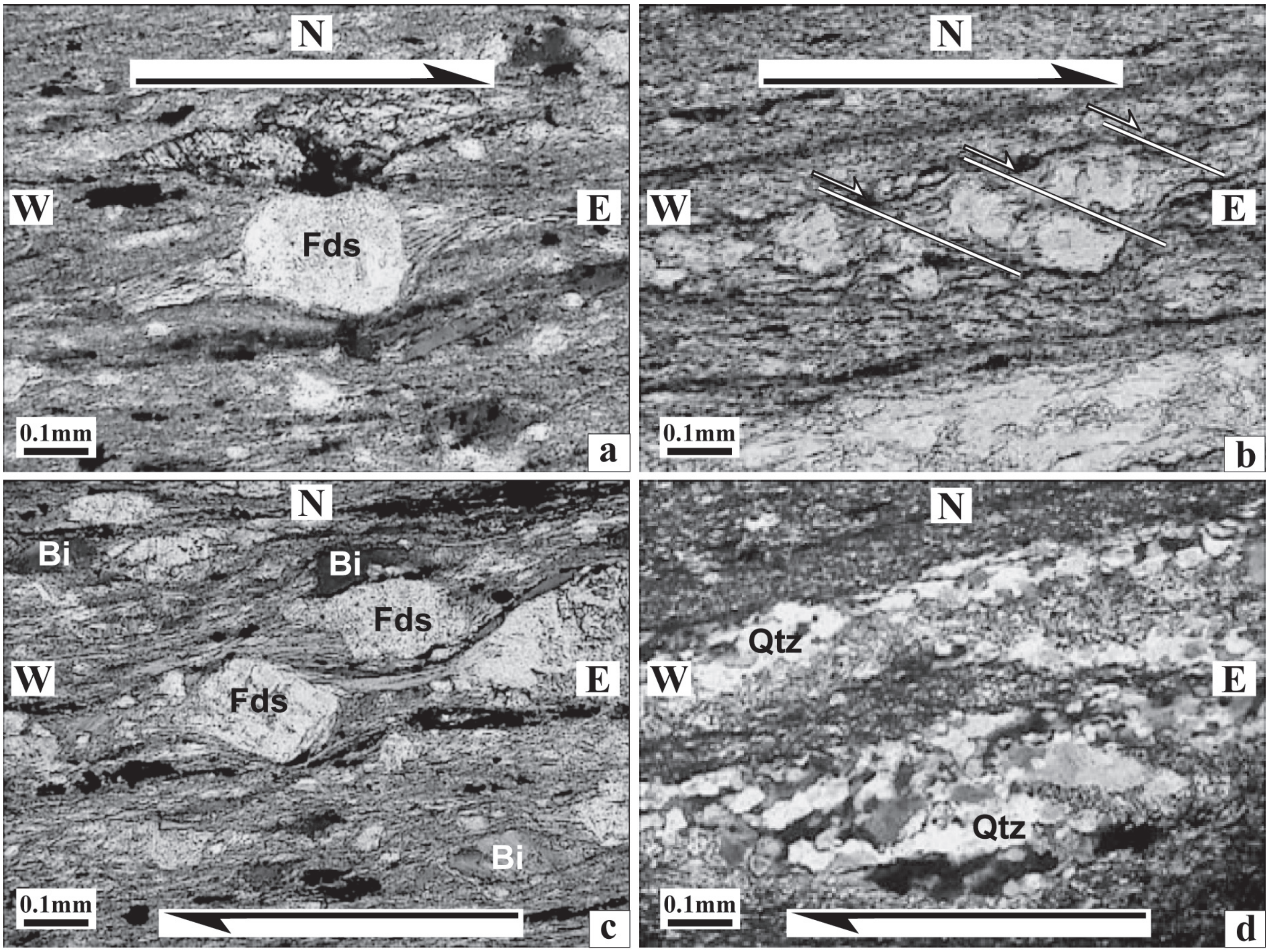

Fig. 6: Microscopic-scale shear criteria in slate along the North Tianshan Fault showing dextral ductile deformation. **(a)** feldspar clasts with asymmetric quartz and biotite pressure shadows; **(b)** shear-bands; **(c)** sigmoidal biotites and asymmetrically sheared feldspar clasts; **(d)** elongated quartz ribbons with an oblique shape fabric of recrystallized grains. In the field, the subvertical foliation contains a subhorizontal E-W trending mineral-stretching lineation (Fig. 3f). Mineral abbreviations: Fds, feldspar; Bio, biotite; Qtz, quartz.

our geodynamic model, the Yili magmatic arc is considered as the result of the south-directed subduction of an oceanic lithosphere located to the north of the Yili Block, remnants of this oceanic lithosphere are found in the ophiolitic mélange. Thus we assume that in Late Devonian to Carboniferous times, the subduction of an oceanic basin (i.e. "North Tianshan oceanic" [15]) below the Yili Block produced the magmatic arc and accretionary complex composed of turbidite and ophiolitic mélange.

The closure of the North Tianshan oceanic basin in Late Carboniferous resulted in the northward obduction and re-deformation of the ophiolitic mélange. Then a prominent change led to the end of N-S convergence and the beginning of intra-continental transcurrent tectonics. This event was due to either: 1) collision between the continental blocks with Precambrian basements (the Yili Block and the Junggar block, which is alternatively considered as a trapped Paleozoic ocean [37]), or 2) the progressive change from N-S convergence during the earlier stages to NE-SW convergence in the final stages.

The intra-continental transcurrent tectonism is represented by the Permian dextral strike-slip faulting. By comparison with eastern Chinese Tianshan, this event is assumed to take place between 280 and 250 Ma [5, 7]. This lateral transcurrent faulting was likely responsible for local crustal thinning and opening of pull-apart basins (e.g. the Turfan Basin in Fig. 1) [38, 39] in which marine deep-water sediments and alkaline pillow lavas accumulated, e.g. in Baiyanggou area [25]. The pull-apart basins are also associated with intra-plate magmatic rocks, such as alkaline granite, basalt, continental tholeiite and felsic volcanic rocks [11, 38].

On the basis of magmatic, sedimentologic and tectonic evidence, the Permian intra-continental large-scale strike-slip tectonics appears to be geodynamically distinct from the Late Devonian to Carboniferous oceanic convergence that built up the West Chinese Tianshan Belt. Therefore, any reconstruction of the Late Paleozoic Central Asia should take into account these lateral displacements. For instance, the Permian transcurrent faulting was geometrically likely to trigger the

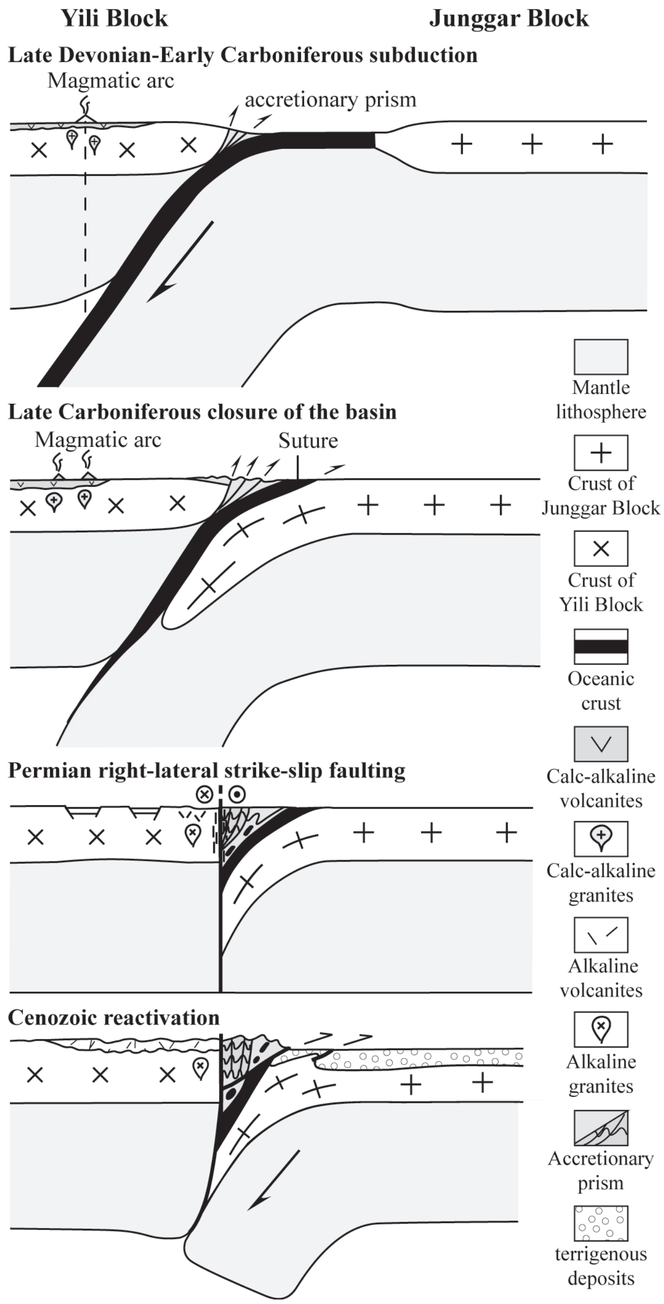

Fig. 7: Simplified geodynamic evolution of the northern West Chinese Tianshan Belt. In Late Devonian-Early Carboniferous, south directed subduction of an oceanic basin below the Yili Block led to the formation of a magmatic arc and an accretionary complex. In Late Carboniferous, the oceanic basin was closed, and the ophiolitic mélange was re-deformed. In Permian, the suture zone was reworked by dextral strike-slip fault. During Cenozoic, the intracontinental reactivation induced the thrusting of the North Tianshan Domain upon the Junggar sedimentary basin, the Paleozoic suture became "cryptic", i.e. hidden below the Paleozoic rocks.

lateral displacement of the Bogda Arc from its original place. Such displacement that was suggested to provoke strike-slip imbrication at the scale of the whole Central Asia Orogen [40] is still need to be documented quantitatively. A Paleomagnetic study that might provide such a constraint on the amount of E-W displacement is presently in progress.

5. Conclusion

Poly-orogenic events and multiple tectonic overprints arise some difficulties for reconstructing the geodynamic evolution of the Tianshan Belt. Taking into account the Cenozoic events, our study provides some new evidence to better understand the Paleozoic evolution of the northern WTS Belt. The polyphase evolutionary model proposed in this paper is comparable with the tectonic framework of the adjacent areas, and might be used to interpret the geodynamics of Central Asia Orogen. Regionally, Late Paleozoic subduction, accretion and collision of the Junggar Block play an important role on the building of the Central Asia, and the Permian post-collisional transcurrent event is widely recorded, but remains to be fully understood.

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