

Paleozoic tectonic evolution of the Yili Block, western Chinese Tianshan

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Key-words. – Tectonics, Paleozoic geodynamics, Central Asia, Tianshan, Yili block.

Abstract. – The Yili block is a triangular area bordered by sutures and fault zones in the western Chinese Tianshan belt. It is often considered as a part of the Central Tianshan micro-continent with Proterozoic basement extending westward into Kazakhstan and Kirgizstan, but this interpretation is questionable. This paper aims to synthesize the available data, discusses the meaning of the tectonic boundaries and proposes a model for the Paleozoic evolution of the Yili block. Alike the entire Tianshan belt, the Yili block underwent a polyphase evolution including subduction of oceanic crust and collision with micro-continent and volcanic arcs. The southern boundary of the Yili block is formed of Proterozoic basement and Early Paleozoic platform sediments, tectonically overlain by oceanic high-pressure metamorphic rocks and ophiolite. It has been involved in a south-dipping subduction associated with the closure of the Tianshan Ocean and the subsequent collision with a micro-continent correlated with Central Tianshan. This tectonic event resulted in top-to-the-north ductile thrusting observed in oceanic HP metamorphic rocks and Proterozoic basement as well. During the Late Paleozoic, the northern boundary of the Yili block was an active continental margin related to the southward subduction of the North Tianshan oceanic basin, this boundary is represented by Late Carboniferous turbidite and ophiolitic mélange. The southern and northern boundaries have been both reworked by Permian strike-slip faults.

L'évolution tectonique du bloc de Yili (Tianshan chinois occidental) au Paléozoïque

Mots-clés. – Tectonique, Géodynamique Paléozoïque, Asie centrale, Tianshan, Bloc de Yili.

Résumé. – Le bloc de Yili est un domaine triangulaire du Tianshan chinois occidental limité au sud et au nord par des sutures ophiolitiques ou des failles. Le bloc de Yili qui est habituellement considéré comme une partie du micro-continent du Tianshan central avec un substratum précambrien se prolonge vers l'Ouest au Kazakhstan et au Kirgizstan. Cette vue est ici remise en question et cet article propose une nouvelle interprétation des limites tectoniques et de l'évolution Paléozoïque de ce bloc. Comme tout le Tianshan Paléozoïque, le bloc de Yili résulte d'une évolution polyphasée impliquant des subductions de lithosphères océaniques et des collisions entre micro-continent et/ou arcs volcaniques. La bordure sud du bloc de Yili est constituée d'un socle Protérozoïque et de sa couverture sédimentaire de plate-forme d'âge Paléozoïque inférieur. Cet ensemble est affecté par une déformation ductile polyphasée. Des schistes bleus et éclogites à protolithes océaniques ainsi que des mélanges ophiolitiques surmontent tectoniquement le socle par un chevauchement ductile vers le nord, visible dans les roches haute pression ainsi que dans le socle lui-même. Cette tectonique résulte de la fermeture de l'océan du Tianshan par une subduction à pendage sud suivie de la collision avec le micro-continent du Tianshan central. Au Paléozoïque supérieur, la bordure nord du bloc de Yili est une marge active résultant de la subduction vers le sud du bassin océanique du Tianshan Nord, elle se caractérise par une zone de mélange formée de turbidites du Carbonifère supérieur et d'éléments ophiolitiques. Les deux sutures limitant le microcontinent de Yili ont été reprises par des décrochements ductiles dextres d'âge permien.

INTRODUCTION

The Tianshan belt, which stretches E-W for more than 3000 km is an important part of the Central Asia orogenic belt (fig. 1a) [Burtman, 1975; Coleman, 1989; Zonenshain *et al.*, 1990; Dobretsov *et al.*, 1995; Sengör and Natal'in, 1996; Jahn *et al.*, 2000; Brookfield, 2000]. In China, the Tianshan belt separates the Tarim and Junggar basins to the south and north, respectively (fig. 1). According to previous works [e.g. Windley *et al.*, 1990; Allen *et al.*, 1993; Gao *et*

al., 1998; Chen C.M. *et al.*, 1999], several ophiolitic belts have been used to define an Early Paleozoic South Tianshan Suture (STSS, corresponding to faults 3 and 4) and a Late Paleozoic North Tianshan suture (NTSS, corresponding to faults 1 and 2), dividing the Chinese Tianshan belt into North Tianshan, Central Tianshan and South Tianshan zones. Both sutures were reactivated by large-scale strike-slip faults during Permian (fig. 1b).

To the west, a triangular area that continues westward into Kazakhstan and Kirgizstan, and bounded by the Borohoro

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Manuscrit déposé le 15 février 2007; accepté après révision le 30 septembre 2007

range to the north and Haerkeshan range to the south, respectively, is called “Yili block” (fig. 1). Meso-Cenozoic sediments of the Yining basin cover most of the Yili block, Paleozoic and Proterozoic rocks crop out along its northern and southern edges (fig. 1b). However, an ambiguity exists regarding the definition of the “Yili block”. Generally, it corresponds to the area located between the Qingbulak-Nalati fault (QNF) and the North Tianshan fault (NTF) (faults 1 and 3 in fig. 1b). This structural definition relies mainly on late tectonic features since the QNF and NTF are Permian dextral wrench faults, and the QNF is considered as the eastern extension of the Nikolaiev tectonic line [Wang *et al.*, 1990]. The Bole area, to the north of the Jinghe fault (No.5 in fig. 1b) does not belong to the Yili block since 1) the Paleozoic series of this area are platform carbonate and clastic rocks different from volcano-sedimentary series in Yili area [Wang *et al.*, 2006], and 2) according to our recent study, the paleomagnetic pole calculated from Carboniferous rocks of Bole area is different from that from coeval rocks of Yili area. Thus, in the Chinese Tianshan belt, the Yili block refers to a triangular area bordered by the QNF fault, NTF and Jinghe fault (fig. 1b).

Furthermore, the Yili block is also regarded as a micro-continent corresponding to the westward extension of Central Tianshan [Xiao *et al.*, 1990; Allen *et al.*, 1993; Coleman, 1994; Gao *et al.*, 1998; Chen C.M. *et al.*, 1999; Zhou *et al.*, 2001], but the pre-Carboniferous paleogeographic and tectonic significance of the Yili block and its

relationships with the North, Central and South Tianshan zones remain controversial. In this paper, we present a synthetic cross-section based on our own field surveys across the Yili block, discuss its correlation with the Central Tianshan, and propose an evolutionary model for the Yili block during the Paleozoic.

THE SOUTHERN EDGE OF THE YILI BLOCK

In the southern part of the Yili block, or northern Haerkeshan Range, different Paleozoic lithotectonic units are distinguished (figs. 1b and 2). From north to south, the first unit consists of Carboniferous limestone and sandstone associated with andesite, rhyolite, trachyte, tuff and minor basalt (figs. 1b and 2) [XBGMR, 1992, 1993]. Synchronous plutons of gabbro, granodiorite, tonalite, K-granite, pegmatite and aplite dykes are well developed. The Carboniferous rocks are lithologically similar throughout the Yili area (fig. 1b). Recent trace elements geochemistry and isotopic studies indicate that the magmatic rocks are calc-alkaline and were generated in an active continental margin [Zhu *et al.*, 2005, 2006; Wang *et al.*, 2007]. Zircon U-Pb dating of the magmatic rocks (SHRIMP/ICPMS) yield 390-300 Ma ages indicating that these arc-type rocks formed during Mid-Devonian to latest Carboniferous [Zhu *et al.*, 2005; Wang *et al.*, 2006; Zhai *et al.*, 2006]. Early Paleozoic series is absent in this area, and the Carboniferous magmatic arc overlies directly a continental basement composed of

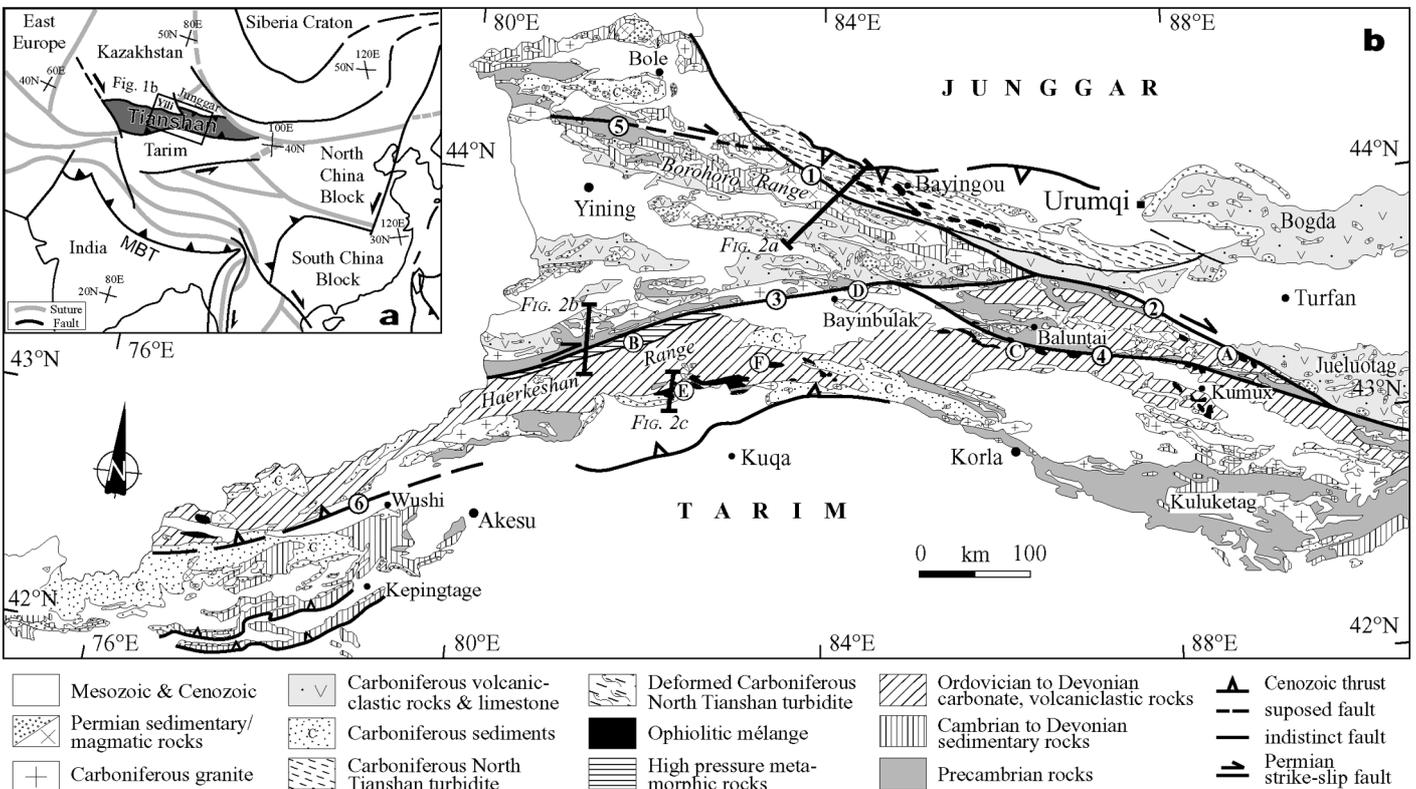


FIG. 1. – (a) Location of the Yili block in Central Asia; (b) Geological map of the Chinese western Tianshan belt (modified from XBGMR [1992]). Numbers in circles refer to the main faults: 1, North Tianshan fault (NTF); 2, Main Tianshan shear zone (MTSZ); 3, Qingbulak-Nalati fault (QNF); 4, Baluntai fault; 5, Jinghe fault; 6, South Tianshan fault (STF). Capital letters correspond to localities cited in text: A, Gangou-Mishigou; B, Kekesu; C, Guluogou-Wuwamen; D, Nalati; E, Heiyingshan; F, Kulehu.

FIG. 1. – (a) Localisation du bloc de Yili en Asie Centrale; (b) Carte géologique de la partie ouest du Tianshan chinois (modifiée d'après XBGMR [1992]). Les numéros correspondent aux failles majeures, et les lettres capitales correspondent aux localités citées dans le texte.

Neoproterozoic (Sinian) dolomite and Meso- to Paleo-proterozoic gneiss [XBGMR, 1993; Chen Y.B. *et al.*, 1999, 2000; Hu *et al.*, 1999]. As a whole, the magmatic arc is undeformed except locally along the Qingbulak-Nalati fault where gabbroic and granodioritic plutons and the Precambrian basement are mylonitized [Gao *et al.*, 1995]. The dextral ductile shearing occurred around 270-250 Ma [Zhou *et al.*, 2001].

To the south, the second unit is formed by highly sheared gneiss and quartzite corresponding to the Proterozoic basement of the Yili block (figs. 1b and 2). This unit is overthrust to the north by a metamorphic complex composed of micaschists, muscovite-quartzites, and mafic rocks including relics of blueschists and eclogites. The HP [Klemd *et al.*, 2002; Klemd, 2003; Gao and Klemd, 2003] or UHP [Wei *et al.*, 2003; Zhang *et al.*, 2003a, 2003b] metamorphic conditions are related to a subduction/collision event. Protoliths are MORB and OIB basalts, mafic volcaniclastic rocks, and deep-sea sediments representing an oceanic crust [Gao *et al.*, 1995; Gao and Klemd, 2003]. This metamorphic complex extends southwestward to Kyrgyzstan and Tajikistan [Dobretsov *et al.*, 1987; Tagiri *et al.*, 1995; Volkova and Budanov, 1999]. Kinematic analyses of the HP metamorphic rocks and the underlying gneiss indicate a top-to-the-north shearing [Gao *et al.*, 1995]. This northward shearing was interpreted as due to the exhumation of HP metamorphic rocks [Gao *et al.*, 1995]. However the south dipping foliation, and the good kinematic consistency from HP metamorphic rocks, Proterozoic Yili basement rocks better fits the interpretation of a northward thrusting of the oceanic rocks upon the Yili continental basement. Radiometric ages of greenschists and blueschists reveal an important retrogression that occurred at 330~310 Ma [Gao and Klemd, 2003; Klemd *et al.*, 2005]. Despite the formation of an Ordovician-Silurian magmatic arc due to subduction of oceanic lithosphere [Laurent-Charvet, 2001; Ma *et al.*, 2006], isotopic ages for blueschists and eclogites from the HP metamorphic complex cluster closely around 350 Ma [Xiao *et al.*, 1992; Gao *et al.*, 1995; Gao and Klemd, 2003; Wang, unpublished].

Farther south, the next lithotectonic unit is represented by Silurian limestone that have been thrust northward upon the metamorphic complex. Ordovician-Silurian arc-type volcanic and volcaniclastic rocks are observed in Bayinbulak and south of Gangou-Mishigou areas (locations D and A in fig. 1b) [XBGMR, 1993; Laurent-Charvet, 2001; Ma *et al.*, 2006]. Furthermore, subduction-related granitoids dated at 446~395 Ma by zircon U-Pb method crop out south of Gangou-Mishigou (location A in fig. 1b) [Xu *et al.*, 2006b], north of Kumux [Hopson *et al.*, 1989] and north of Baluntai [Yang *et al.*, 2006] areas. Devonian carbonate, sandstone and chert are also widely developed all along the Haerkeshan Range from north of Wushi, south of Bayinbulak, south of Baluntai to north of Kumux areas (fig. 1b). These rocks record the Early-Middle Paleozoic evolution of a tectonic unit distinct from the Yili block.

The Paleozoic series that forms the backbone of the Haerkeshan Range is tectonically overlain by an ophiolitic mélange composed of serpentinized ultramafic rocks, gabbros, basalts, mafic volcaniclastic rocks, Late Devonian-Early Carboniferous radiolarian-bearing cherts [Liu, 2001] and Devonian limestone blocks included in a colored schistose matrix. Gabbroic block from Heiyingshan and pillow

lava from Kulehu (locations E and F in fig. 1b) yield zircon U-Pb LA-ICPMS age of 392 ± 5 Ma and SHRIMP age of 425 ± 8 Ma [Long *et al.*, 2006], respectively. The mélange matrix is undated yet, but as weakly deformed Carboniferous rocks unconformably cover the ophiolitic mélange, an Early Carboniferous age is likely. Our structural study that agrees with previous ones [e.g. Laurent-Charvet, 2001] indicate a top-to-the-north ductile shearing. Therefore, the ophiolitic mélange should be rooted along the STF (fault 6, fig. 1) that separates the Tianshan belt from the northern margin of Tarim. The flat-lying foliation and thrust contact are also deformed by south verging folds and high angle thrust faults (fig. 2). Although the age of this event is not dated, a Meso-Cenozoic age is likely since Permian sandstone is affected by the folding.

THE NORTHERN EDGE OF THE YILI BLOCK

The Borohoro range forms the northern edge of the Yili block. South of the Cenozoic thrust, two lithotectonic units are identified, namely a Carboniferous turbidite and an ophiolitic mélange [Wang *et al.*, 2006; figs. 1, 2]. The turbidites are developed in an area of 300 km long and 20 km wide and consists of sandstone and black argillite alternations. Sandstone presents typical Bouma sequences and the thickness of sandstone beds varies from a few centimeters to 1 meter [XBGMR, 1993; Wang *et al.*, 2006]. Terrigenous, siliceous and calc-alkaline magmatic clasts are observed in sandstone and conglomerates, deep-water ichnofossils indicate that the turbidites were deposited in a forearc deep-sea environment [Wang *et al.*, 2006]. The southern part of the turbidite, along the NTF, exhibits a subvertical slaty cleavage with a subhorizontal mineral-stretching lineation. Kinematic observations indicate a dextral ductile shearing related to the NTF [Wang *et al.*, 2006]. Ar-Ar dating on biotite-rich slate indicates that the dextral shearing occurred at 275~245 Ma. This timing is consistent with that of the Main Tianshan shear zone (MTSZ, No. 2 in fig. 1b) [Laurent-Charvet *et al.*, 2002, 2003].

The ophiolitic mélange is developed discontinuously in a 250 km long and 5~15 km wide area and crops out within the turbiditic formation. It consists of serpentinized peridotite, gabbro, diabase, basalt, chert, plagiogranite and rare limestone blocks enclosed in a sheared matrix made of black or red mudstone and light-yellow-green greywacke. Famennian-Visean microfossils have been found in cherts [Xiao *et al.*, 1992; Li *et al.*, 1994], and zircon U-Pb ICPMS/SHRIMP ages of 344 ± 3 ~ 325 ± 7 Ma are obtained from Bayingou gabbro and plagiogranite [Xu *et al.*, 2005, 2006a], both indicate Late Devonian to late Early-Carboniferous ages for the ophiolitic rocks. Petrological and geochemical studies show that the mafic rocks were formed in an oceanic basin [Wu *et al.*, 1989; Xiao *et al.*, 1992; Li *et al.*, 1994]. Structural analysis indicates that both blocks and matrix were deformed by north-directed shearing [Wang *et al.*, 2006].

To the south of the NTF, the Paleozoic series consists of Cambrian to Silurian clastic rocks overlain by Devonian-Carboniferous volcanic and sedimentary series and Permian volcanic-clastic rocks. Petrological and geochemical analyses demonstrate that the Carboniferous magmatic

rocks have calc-alkaline affinities and formed in a continent-based magmatic arc [Wang *et al.*, 2007].

DISCUSSION

Our study shows that the structure of the northern edge of the Yili block is a Carboniferous active continental margin characterized by a subduction-accretion complex, including ophiolitic blocks, and a magmatic arc. The polarity indicates that subduction was south-dipping. The subducting plate corresponds to the Junggar block, which crustal structure remains controversial. It is proposed that Permian to Cenozoic sedimentary series of 8-10 km thick are underlain by an oceanic crust [e.g. Carroll *et al.*, 1990]. Other authors consider that the Junggar basin is underlain by a thinned continental crust [Sengör *et al.*, 1996; Li, 2004]. Although a discussion of this problem is beyond the scope of this paper, a continental crust seems more realistic. In our interpretation, during Late Paleozoic, the Junggar area formed a micro-continent with a Proterozoic basement and an Early Paleozoic cover. Since the Carboniferous suture between the Borohoro Range and Junggar is presently hidden below the post-Permian sedimentary pile, it can be considered as a “cryptic” suture.

Carboniferous magmatic arc rocks are widespread in the whole Yili block (fig. 1). The question of the number of arcs is also disputed. It is generally considered that active margins occurred on the northern and southern margins of the Yili block [e.g. Zhou *et al.*, 2001]. As discussed below, this interpretation is not in agreement with our observations in the Haerkeshan Range that suggest a south-directed subduction before Carboniferous. In our model, one single arc is preferred. The abnormal width of the Yili arc can be also explained as a result of Permian and Mesozoic wrenching and rifting [e.g. Shu *et al.*, 2005].

It is widely acknowledged that south of the QNF, an ophiolitic suture forms the relic of the closed “South Tianshan Ocean”. The sense of subduction and subsequent collision are disputed. Several lines of evidence suggest that the closure of the South Tianshan Ocean occurred by southward subduction, since the Ordovician-Silurian magmatic arc is located south of the HP metamorphic unit, and the ductile deformation related to the thrusting of the tectonic-metamorphic units is directed from south to north. Our tectonic model considers that the Yili block is a microcontinent, which collided in Late Silurian-Middle Devonian times with a southern continent represented by the Haerkeshan Range after a southward subduction during the Late Ordovician-Silurian. Since the ophiolitic mélangé developed in the southern slope of the Haerkeshan Range is a nappe thrust northward, it must be rooted in the northern margin of the Tarim block. However, the present-day boundary is represented by the South Tianshan fault (No. 6 in fig. 1b), which is reworked by the Cenozoic tectonics (fig. 2).

In previous works, the Paleozoic limestone series south of the HP metamorphic rocks was called “South Tianshan” zone and was interpreted as the passive northern margin of the Tarim plate [e.g. Windley *et al.*, 1990; Allen *et al.*, 1993; Gao *et al.*, 1998], upon which the ophiolitic mélangé was emplaced from south to north. However, the Paleozoic series of the Haerkeshan Range displays significant differences in rock facies and deformation with respect to those observed to the south, in Akesu and Kuluketag areas where the typical Tarim-type formations develop (fig. 1b) [XBGMR, 1993; Jia *et al.*, 2006]. Thus, here we include the Paleozoic unit of the Haerkeshan Range in the central Tianshan (fig. 2) that is separated from Tarim by the South Tianshan fault (figs. 1b, 2).

The next question to solve is the correlation of the structure of the Yili block with the classical zones of the Tianshan belt developed eastward. The important network

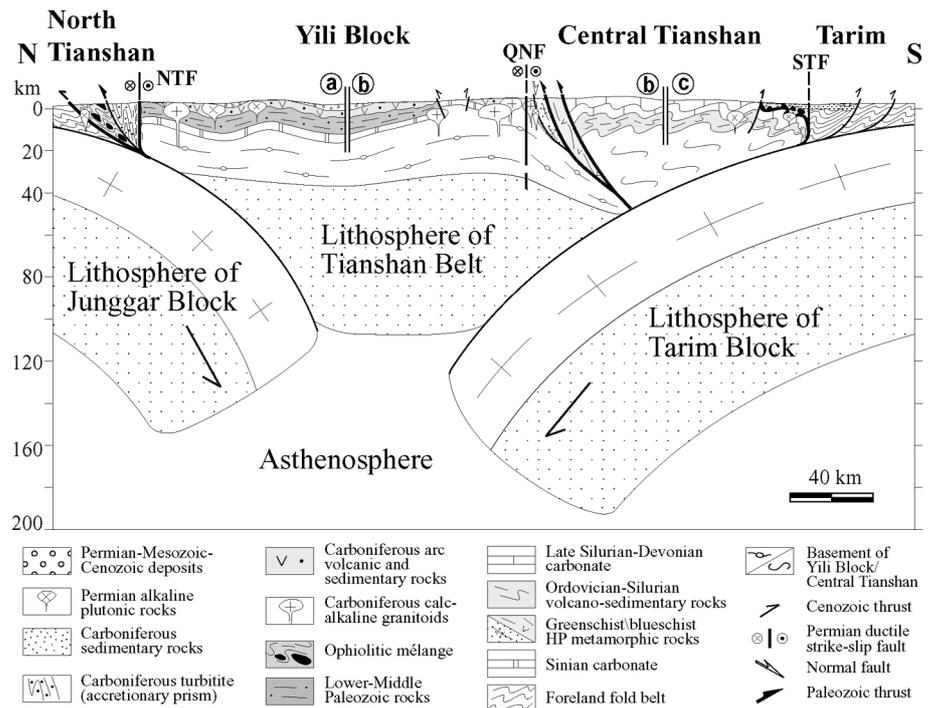


FIG. 2. – Interpretative cross section of the Yili Block and its boundaries.
 FIG. 2. – Coupe interprétative à travers le bloc de Yili et ses limites.

of dextral wrench faults that superimposes upon the paleogeographic and tectonic boundaries developed during the pre-Permian tectonics hampers such a correlation. The Bayingou ophiolite observed in the Borohoro Range is often correlated with the Gangou-Mishigou ophiolitic mélangé (A in fig. 1) [Windley *et al.*, 1990; Allen *et al.*, 1993; Gao *et al.*, 1998]. However, these ophiolites could not belong to the same suture as they are different in age.

The Gangou-Mishigou ophiolite is presently strongly reworked by ductile dextral shearing along the MTSZ. This Permian wrench fault appears as the eastward extension of the NTF [Shu *et al.*, 1999; Laurent-Charvet, 2001; Wang *et al.*, 2006]. However, as the MTSZ lies south of the North

Tianshan arc, it cannot correspond to a suture that would be the result of a south-directed subduction. Another possibility is to correlate the Gangou-Mishigou ophiolite with the HP metamorphic rocks that crop out in the north slope of the Haerkeshan Range.

The Gangou-Mishigou mélangé is an important tectonic boundary separating the Carboniferous Bogda-Jueluotag arc [Charvet *et al.*, 2001; Laurent-Charvet, 2001; Li *et al.*, 2006; Wu *et al.*, 2006] from the Central Tianshan [Wang *et al.*, 1990; Li, 2004; Li *et al.*, 2006], which is composed of Proterozoic crystalline basement, Ordovician-Silurian volcanoclastic rocks, Carboniferous shallow water terrigenous and limestone deposits and well-developed intrusions of

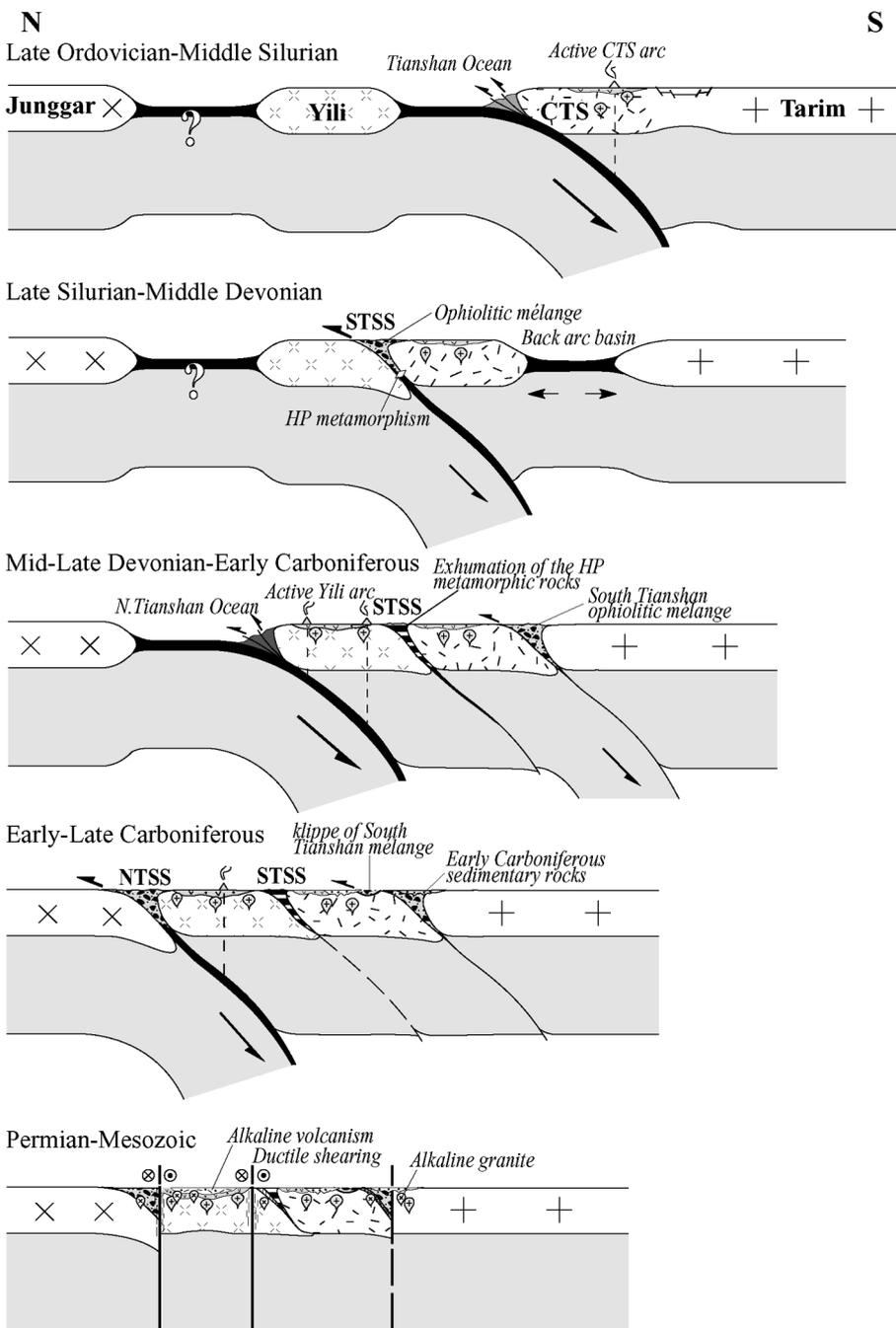


FIG. 3. – Simplified model showing the Paleozoic evolution of the Yili and adjacent blocks.
 FIG. 3. – Modèle simplifié montrant l'évolution du bloc de Yili et des blocs voisins au Paléozoïque.

different ages (fig. 1b). On the basis of similar Proterozoic rocks in Central Tianshan to those around the Yining basin, the two areas were considered as the same domain, i.e. Yili-Central Tianshan plate [Xiao *et al.*, 1992; Gao *et al.*, 1998]. However, the Paleozoic series observed in the Yili area is clearly distinct from that of the Central Tianshan. The Carboniferous magmatic arc rocks widespread in the Yili area, are never found in the Central Tianshan. Contrarily, Ordovician-Silurian arc-type volcanic rocks developing in Central Tianshan are absent in the Yili area. These lithological differences suggest a different Paleozoic evolution for the Yili and central Tianshan areas.

Thus the Central Tianshan should be separated from the Yili block. The ophiolitic mélangé and HP metamorphic rocks recognized south of the Qingbulak-Nalati fault and in the Gangou-Mishigou area form the same pre-Permian suture between the Yili block and a southern continental domain corresponding to the Haerkeshan Range and Central Tianshan.

The Baluntai fault (No. 4 in fig. 1b) was considered as the suture zone separating the central Tianshan and the South Tianshan, and from which ophiolitic nappes emplaced to the south during the closure of the South Tianshan Ocean [Windley *et al.*, 1990; Allen *et al.*, 1993]. In our view, this fault is just a Permian dextral strike-slip fault developed within the Central Tianshan continental block.

PALEOZOIC EVOLUTION OF THE YILI BLOCK

Figure 3 presents a simplified tectonic evolutionary model of the Yili block during the Paleozoic. In our interpretation, the Yili block was separated to the south from Central Tianshan by the “Tianshan Ocean” that corresponds to the previous “South Tianshan Ocean” [e. g. Gao *et al.*, 1998]. The subduction of the oceanic crust began as early as Late Ordovician, forming arc-type Ordovician-Silurian volcanic and intrusive rocks [Hopson *et al.*, 1989; XBGMR, 1993; Laurent-Charvet *et al.*, 2001; Ma *et al.*, 2006; Xu *et al.*, 2006b; Yang *et al.*, 2006]. The collision between the Yili block and central Tianshan took place in Late Devonian producing a HP metamorphism around 350 Ma [Xiao *et al.*, 1992; Gao *et al.*, 1995; 2000; Gao and Klemd, 2003]. Since the Early Paleozoic arc is exclusively developed in Central Tianshan, i.e. to the south of the Yili block (fig. 1b), and taking into account the top-to-the-north kinematics of the HP metamorphic rocks and the underlying gneiss, the polarity of the subduction should have been southward. Although some authors argue that the collision between the Yili, Central Tianshan and Tarim lasted until Late Carboniferous (~300 Ma) [Gao *et al.*, 2006] or even Triassic (~230 Ma) [Zhang *et al.*, 2007] in the westernmost of Chinese Tianshan, on the basis of Ar-Ar dating on phengites, the retrogression and exhumation of HP metamorphic rocks might have occurred since 330 Ma [Klemd *et al.*, 2005; Wang, unpublished].

From Cambrian to Silurian, the northern margin of the Yili block underwent a terrigenous and carbonate platform sedimentation. The occurrence of arc-type magmatic rocks of 390-300 Ma [Zhu *et al.*, 2005, 2006; Zhai *et al.*, 2006; Wang *et al.*, 2006, 2007] in the Yili area shows that the

tectonic environment of the Yili block changed from platform to active continental margin in the Mid Devonian. Some authors consider that the magmatic arc in southern Yili was generated by northward subduction of the Tianshan Ocean [Gao *et al.*, 1998, 2006; Chen C.M. *et al.*, 1999; Zhu *et al.*, 2005], but this interpretation is not in agreement with the above discussed evidence of 1) top-to-the-north thrusting of HP metamorphic rocks and 2) an active magmatic arc younger than the exhumation of the HP metamorphic rocks. Therefore, the formation of the Carboniferous Yili magmatic arc is more likely due to a southward subduction of the North Tianshan Ocean (fig. 3) [Xiao *et al.*, 1992; Allen *et al.*, 1993; Wang *et al.*, 2006] located between Yili and Junggar blocks. The final closure of the North Tianshan Ocean resulted in the formation of the North Tianshan ophiolitic mélangé in Late Carboniferous time.

South of Central Tianshan, in Silurian-Middle Devonian time, back-arc extension induced the opening of a marginal oceanic basin that closed in Late Devonian to Early Carboniferous. The relics of this oceanic basin are represented by the South Tianshan ophiolitic mélangé (figs. 1b, 2). The regional Early Carboniferous unconformity covering all pre-Carboniferous tectono-stratigraphic units can be observed in many places of the Chinese Tianshan belt [Chen CM *et al.*, 1999; Zhou *et al.*, 2001].

During the Permian, dextral wrenching along several faults reactivated the northern and southern boundaries of the Yili microcontinent (fig. 1b). It is worth to note that these faults, often close to the pre-Permian sutures zones, are nevertheless distinct structures. The presentation of the Permian alkaline magmatism [XBGMR, 1992, 1993; Allen *et al.*, 1995] is beyond the scope of this paper.

CONCLUSIONS

The Yili block, as a microcontinent underlain by a Precambrian basement, was never clearly defined by previous researchers. The structure of the southern and northern edges of the Yili block presented here allow us to go further in the distinction of tectonic zones and to address several pending questions on the correlation of the Yili block with the Chinese Tianshan belt. Taking into account the previous results, we propose a scenario for the Paleozoic tectonic evolution of the Yili block. This microcontinent that corresponded to an Early Paleozoic platform, subducted to the South and collided with Central Tianshan in Devonian times. During Late Paleozoic time, the Yili block represented the overriding plate below which the southward subduction of the North Tianshan Ocean gave rise to the development of an active continental margin. Nevertheless, further geochronological studies are still needed to better constrain the age of the magmatic, tectonic and metamorphic events.

Acknowledgements. – This study was co-sponsored by the National Basic Research Program of China (973 Programs) (Nos. 2007CB411301, 2001CB409804), China geological survey project (1212010611806). Funding of a part of research of the first author in France by the French Embassy in Beijing is gratefully acknowledged. Colleagues of the Bureau of National project 305, Xinjiang Uyghur Autonomous Region are thanked for their help for facility during fieldwork.

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