

# 从郭扎错断裂构造特征探讨 阿尔金断裂带西延问题

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**摘要:**阿尔金断裂带在大陆动力学研究中具有十分重要的地位,但其西延过郭扎错后的走势存在争议。郭扎错断裂为北东东向的线性构造带,具多期活动性。笔者从宏观到微观详细论述了该断裂构造的几何学、运动学特征,并结合动力变质作用、沉积盆地、岩石地层分布及变形年代学等资料将其划分为韧性左行平移( $J_3-K_1$ )、脆性正-平移( $E_1-N_1$ )、脆性逆-平移( $N_2$ )和脆性左行滑落(Q)等 4 个阶段。综合分析地质调查资料、地球物理场资料及卫片影像特征,认为郭扎错断裂与阿尔金断裂带是在同一动力学系统中形成的具有相似运动学、动力学特征的相关线性构造,应属同一断裂系统。因此,阿尔金断裂带并非西止于拉竹龙,亦非由郭扎错北侧转向北西,而是经郭扎错继续向南西延伸,过龙木错、羌臣摩河后,由空喀山口进入克什米尔。

**关键词:**阿尔金断裂带;郭扎错断裂;变形;磁组构;年代学

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阿尔金断裂带位于青藏高原北部边缘,是中国西北地区呈北东东向展布的一条重要构造带,是青藏高原隆起并向北推挤的一条重要的应力释放线<sup>[1-4]</sup>。其两侧构造演化区别明显,西侧主体为克拉通,东侧则为沿该断裂带呈左行斜列的弧形活动构造带(褶皱带),带间散布着一系列中生代构造盆地,组成醒目的“盆山构造”格局。因此,阿尔金断裂带不仅是解决中国西部构造单元对比的突破口,而且在中国乃至全球新生代大陆动力学研究中具有十分重要的地位<sup>[5-6]</sup>。

对于阿尔金断裂带,前人的研究工作涉及区域地质调查、宏观格局与属性讨论<sup>[7-10]</sup>、宏观和微观的综合研究<sup>[2-4,11-12]</sup>、断裂带形成时代<sup>[6,13-14]</sup>以及断裂带的运动学属性及其活动性<sup>[15]</sup>等方面。目前,阿尔金断裂带成为青藏高原大陆动力学研究的热点,一批国内外学者云集该区,对其组成、展布范围、几何学运动学特征以及动力学机制等作了大量研究,取得了丰硕成果<sup>[16-20]</sup>。但迄今为止,阿尔金断裂带的延伸规模<sup>[21-23]</sup>、走滑历史<sup>[5-6,28-38]</sup>及其运动学特征<sup>[29-40]</sup>等问题仍存在争论。特别是断裂带西延过郭扎错后的走势,由于以往工作程度极低,仅有航、卫片和地球物理资料,缺乏直接的地质证据。本次工作通过对郭扎错断裂的野外地质调查,从宏观到微观进行综合分析,并结合卫片影像资料

和地球物理资料,探究该断裂与经典阿尔金断裂带的一致性,以此讨论阿尔金断裂带西延问题。

## 1 郭扎错断裂变形特征

郭扎错断裂为一北东东向的线性构造带,沿郭扎错—龙木错—舒木—空喀山口一线展布,西延进入印控克什米尔,出露长度约 300 km(图 1)。该断裂由数条断层分枝、复合组成,因活动强弱不同,沿构造线出现宽窄不一的负地形地貌。野外调查发现,其多期活动性特征明显,其中脆性变形强烈,破碎带宽度达千米,受其影响,早期变形形迹仅保留于构造带内脆性断裂不发育部位或脆性断层夹块中,且沿构造线时强时弱、断续展布,表现出韧性变形行为在空间上发育的不均一性。

沿郭扎错断裂断续出露宽 200~400 m 的韧性剪切带。卷入韧性变形的地质体有中二叠世空喀山口组(图 2-B)、晚石炭—早二叠世展金组以及早中白垩世(90~120 Ma)花岗岩体,带内发育条带状构造、石香肠构造、剪切褶皱及构造透镜体等韧性变形构造,相伴产生的强片理化带产状为  $335^\circ \angle 52^\circ$ 。构造透镜体三轴比值(X/Y/Z)为 16/13/3,反映出强挤压剪切特征。与断层相关的剪切褶皱,其枢纽及轴面优势

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产状分别为  $325^{\circ}\angle 67^{\circ}$  和  $205^{\circ}\angle 72^{\circ}$ , 指示主干断层韧性条件下的左行平移。此外, 保留于韧性剪切带中的旋转碎斑系和  $S_8-S_9$  组构等指向构造亦指示该断裂早期具有明显的北东东向韧性左行走滑。特别是发育于剪切面理之上的矿物拉伸线理、矿物集合体线理(黑云母、角闪石、石英)具有相近的产状:  $S: 328^{\circ}\angle 63^{\circ}, L: 50^{\circ}\sim 55^{\circ}\angle 7^{\circ}\sim 12^{\circ}$ , 从而进一步确定该断裂早期左行走滑伴有一定程度由北向南的逆冲。空喀山口一带, 平行于主干断裂发育多条逆(冲)断层, 断面产状  $10^{\circ}\sim 340^{\circ}\angle 35^{\circ}\sim 45^{\circ}$ , 阶步及擦痕线理产状  $50^{\circ}\sim 75^{\circ}\angle 12^{\circ}\sim 25^{\circ}$ 。断层带内拖曳褶皱轴面和枢纽产状分别为  $335^{\circ}\angle 66^{\circ}$  和  $60^{\circ}\angle 55^{\circ}$ , 指示主干断裂在中浅-浅构造层次发生左行-逆平移运动, 特别是局部保留的叠瓦状构造更说明了半塑性条件下挤压机制的存在。值得一提的是, 前述断面上亦发育指示具左行走滑分量正断裂性质的擦痕线理, 优势产状为  $355^{\circ}\angle 45^{\circ}$ , 被北东东向擦痕截切, 这表明在左行-逆平移运动之前, 应存在一期张扭性构造活动, 发育左行平移-正断层。

郭扎错-空喀山口一线, 断层三角面发育(图 2-A), 破

碎带宽 30~60 m, 空喀山口、羌臣摩河等地破碎带宽度可达 1 000 m 以上, 且结构完整, 角砾岩-碎粒岩-断层泥均有出露。断层破碎带中保留有早期韧性、脆韧性变形产物: 糜棱岩碎块、挤压劈理化带、构造透镜体和残留的逆冲推覆断面等。龙木错东巨厚的第四纪湖积物中发育多组多方向的张性断层, 构成露头尺度的堑、垄构造和滑覆构造, 这些张性断层走向北东东 ( $75^{\circ}\sim 80^{\circ}$ ), 断面产状  $345^{\circ}\sim 350^{\circ}\angle 70^{\circ}$  (优势)、 $175^{\circ}\angle 70^{\circ}$ , 滑距 20~50 cm。ETM 卫片影像也明显反映出该构造带穿切、改造了现代水系和第四纪沉积物。

郭扎错断裂显微变形构造发育(图 3), 其中眼球状构造、不对称压力影、书斜构造、S-C 组构、剪切褶皱、显微拖曳构造以及云母鱼等指向构造(图 4), 从微观尺度验证了该断裂早期韧性活动的左行走滑性质。羌臣摩河南侧长英质糜棱岩中, 石英表现为塑性变形, 而长石则表现为显微破裂等脆性变形, 这种同一矿物相中脆-韧性变形共存现象, 明显地反映了脆-韧性转换的显微构造特征。统计显示, 断层角砾岩中显微张裂隙走向为北东东向( $70^{\circ}$ 左右), 而张剪裂隙为北东向

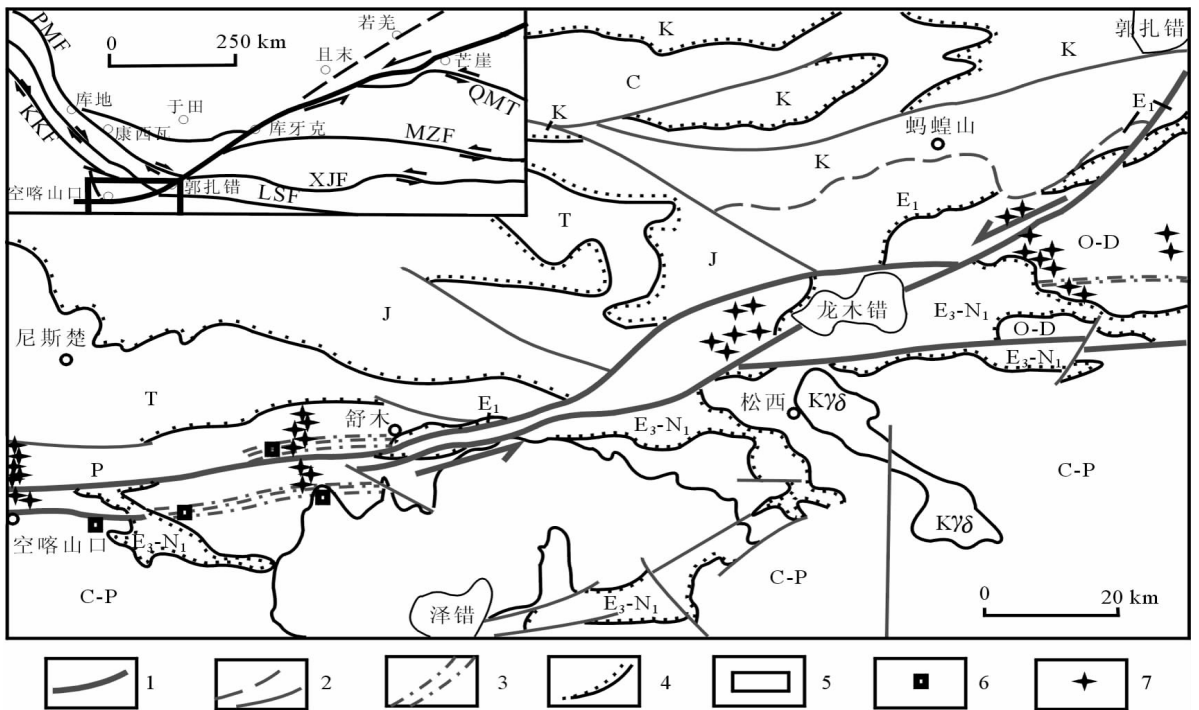


图 1 研究区的地质简图及样品位置

$E_3-N_1$ —渐—中新世地层;  $E_1$ —古新世地层; K—白垩系; J—侏罗系; T—三叠系; P—二叠系; C—P—石炭—二叠系; O—D—奥陶—泥盆系;  $K\gamma\delta$ —花岗岩闪长岩; PMF—帕米尔东缘断裂; KKF—喀喇昆仑东缘断裂; QMT—祁漫塔格冲断裂; MZF—木孜塔格断裂; XJF—西金乌兰—金沙江断裂; LSF—龙木错—双湖断裂; 1—主干断层; 2—一般断层/遥感解译断层; 3—韧性剪切断层; 4—角度不整合地质界线; 5—工作区; 6—同位素(Ar/Ar)采样位置; 7—磁组构采样位置

Fig.1 Geological sketch map of the study area and localities of samples

$E_3-N_1$ —Oligocene—Miocene;  $E_1$ —Paleogene; K—Cretaceous; J—Jurassic; T—Triassic; P—Permian; C—P—Carboniferous—Permian; O—D—Ordovician—Devonian;  $K\gamma\delta$ —granodiorite; PMF—Eastern Pamir marginal fault; KKF—Eastern Karakorum marginal fault; QMT—Qimantag thrust fault; MZF—Muztag fault; XJF—Xijir Ulan—Jinshajiang fault; LSF—LungmuCo—Shuanghu fault; 1—Main fault; 2—General fault/ fault interpreted by remote sensing; 3—Ductile shear zone; 4—Unconformity; 5—Study area; 6—Sampling location (Ar/Ar); 7—Sampling location (magnetic fabric)

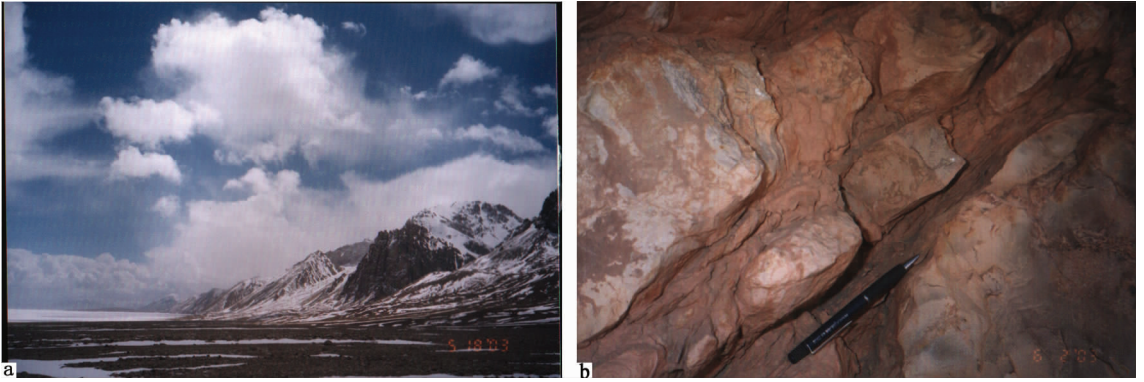


图 2 郭扎错断裂露头特征

a—郭扎错,断层三角面;b—空喀山口,石香肠构造

Fig.2 Characteristics of outcrops of the Gozha Co fault

a—Gozha Co, fault scarp;b—Kongka Pass, boudinage structure

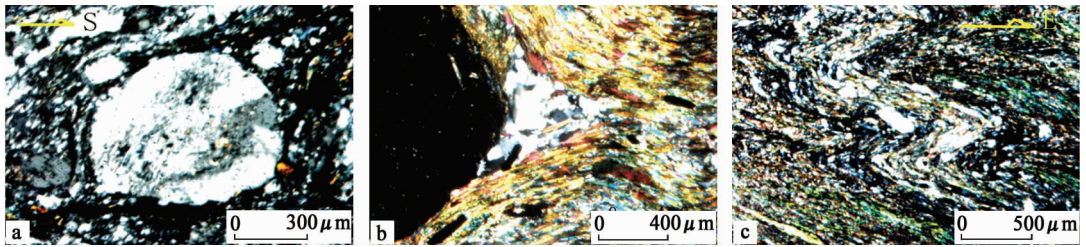


图 3 郭扎错断裂韧性变形显微构造

a—舒木,眼球构造;b—羌臣摩河,压力影构造;c—舒木,剪切褶皱

Fig.3 Ductile deformation microstructure in the Gozha Co fault

a—Shumu, augen structure;b—Qiangchenmo River, pressure shadow;c—Shumu, shear fold

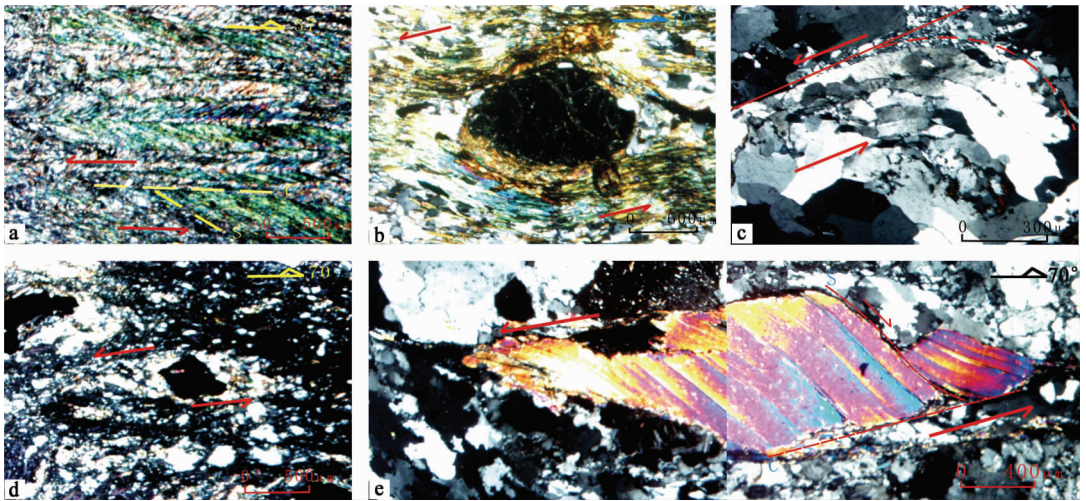


图 4 郭扎错构造学运动学显微特征

a—羌臣摩河,S-C—组构;b—龙木错,眼球构造;c—羌臣摩河,拖褶皱;d—舒木,压力影构造;e—舒木,云母鱼

Fig.4 Kinematic microstructure of the Gozha Co fault.

a—Qiangchenmo River,S-C fabrics;b—Lungmu Co, augen structure;c—Qiangchenmo River, drag fold;

d—Shumu, pressure shadow;e—Shumu, mica fish

(40~50°),前者产状与主干断裂基本一致,说明在浅构造层次,主干断裂表现为张性滑落,平移幅度较小,而后者则指示主干断裂发生了左行平移。另外,张性碎裂岩中常见有早期压性构造岩甚至是糜棱岩角砾,显微尺度复合(叠加)构造岩的发育进一步说明了郭扎错断裂多期活动特征。

## 2 郭扎错断裂磁组构特征

大多数岩石中都含有一定量的铁磁性矿物,构造应力作用会使这些矿物发生韧性变形和(或)动态重结晶并导致产生定向排列,从而使岩石呈现磁化率各向异性。这种由变形

岩石中矿物对应变所作磁性记录表现为磁组构<sup>[4]</sup>。研究表明,岩石磁化率椭球体与应变椭球体不仅对应各轴方位吻合,而且它们的大小也具有一定的比例关系<sup>[42-48]</sup>。因此,可用磁化率椭球体形态和空间定向来分析岩石所经历的构造历程、构造变形的性质及应力作用的方式、方向。本次工作研究了郭扎错断裂岩石磁组构特征(另文),从微观角度映证了其构造运动学性质。其中磁组构参数的弗林图解表明该断裂具有多期活动性,应力机制主要表现为剪切以及带有剪切性质的拉伸和压扁(图5-A);最小磁化率主轴(kmin)产状特征则表明主应力方向为 NNE-SSW 和近 SN 向(图5-C),且进一步说明

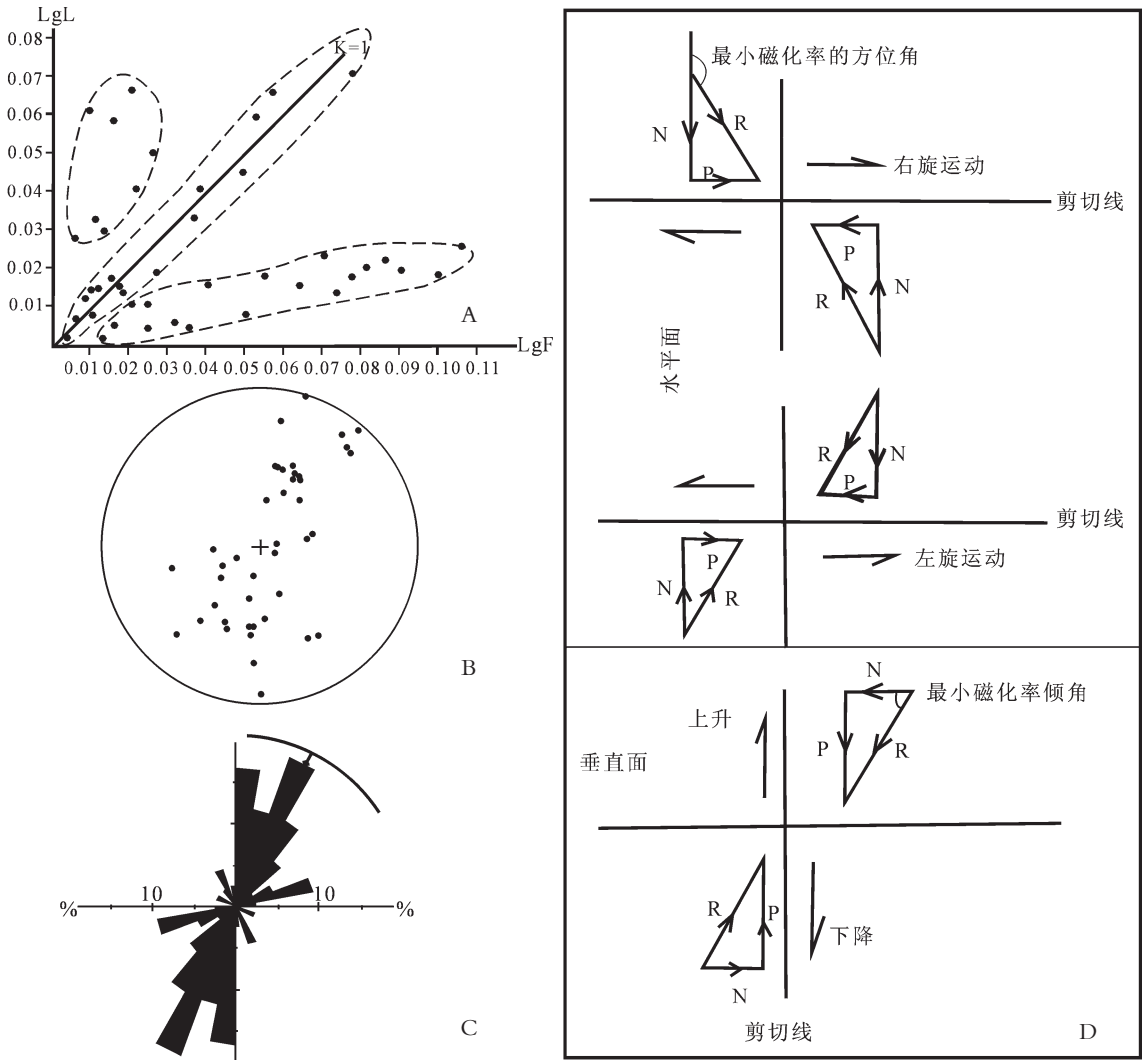


图5 郭扎错断裂构造岩磁组构特征

A—磁组构参数弗林图解; B—最小磁化率主轴(Kmin)赤平投影图; C—最小磁化率主轴反映的主压应力( $\sigma_1$ )玫瑰花图; D—磁化率椭球判断剪切带运动方向图<sup>[4]</sup>(R—用最小磁化率方位或倾角定义的单位合矢量, P—平行剪切带的分量, N—正交剪切带的分量)

Fig.5 Characteristics of magnetic fabrics of the Gozha Co fault

A—Flinn diagram of magnetic fabric parameters; B—Stereographic projection of the minimum magnetic susceptibility axis (Kmin); C—Rose diagram of the principal stress ( $\sigma_1$ ) reflected by the minimum magnetic susceptibility axis; D—Kinetic direction of the shear zone judged by the magnetic ellipsoid <sup>[4]</sup>(R—Resultant vector defined by the azimuth of the minimum magnetic susceptibility or dip angle; P—Component parallel to the shear zone; N—Component orthogonal to the shear zone)

左旋走滑是郭扎错断裂的主要运动形式(图 5-B、D)。

### 3 郭扎错断裂控盆控岩特征

韧性走滑运动之后,郭扎错断裂进入以伸展为主的构造活动期,分布于龙木错—郭扎错一带和泽普错北部的古新世蚂蝗山组( $E_1m$ )受其控制。该组由下往上具有 3 套岩性组合:底部为砾岩、细砾岩、石英砂岩、粉砂质泥岩,正粒序,发育平行层理;中部为厚层状的微晶灰岩;上部则由泥岩、砂岩、砂砾岩、白云质灰岩和巨砾岩等组成,具逆粒序,见平行层理、板状交错层理。上述沉积规律反映了盆地形成、发展到萎缩的过程,同时也表明郭扎错断裂在古新世的伸展活动由弱到强、最终停止的发展过程。该套沉积沿构造带出露,其一侧受限于断层,另一侧角度不整合于早—中志留世龙木错组( $S_{1-2}lm$ )之上,构成不对称的箕状断陷盆地。

野外调查还发现,北西向和北东东向断裂共同制约了渐新世—中新世松西组( $E_3-N_1s$ )的展布。而赋存于该地层中的渐新世—中新世火山岩呈串珠状沿郭扎错断裂产出(图 6),表明该构造带在渐新世—中新世有一次强烈的构造活动。

第四纪以来,沿郭扎错断裂形成规模巨大的堑、垄状构造,第四纪湖泊沿构造带串珠状分布,并接受了较厚的沉积物。龙木错东出露—高约 40 m 的湖积陡坎,其下部为砂砾石层,砾石含量大于 30%,成分复杂,分选性较差;上部为巨厚层粘土,成层性较好;砂砾石层与粘土层之间为厚约 30 cm 的互层状粉沙、粘土。该套岩性组合中发育露头尺度的堑、垒构造,其性质与控制第四纪盆地的边界断裂一致。湖积物沉积时代(ESR 测年)为 1.1、1.4、1.8 万年,表明边界断裂在全新世时期仍在活动,具有同沉积断裂的性质。

可见,郭扎错断裂对古新世和更—全新世沉积盆地具有显著的控制作用,同时也是渐新世—中新世盆地控制因素之一。对前两者的作用,在走向上具有明显的非一致性,盆地规模不一,反映出控盆断裂张性活动的强弱。

### 4 郭扎错断裂构造年代学特征

本次工作对郭扎错断裂内同构造变形矿物以及与断裂相关地质体进行了多方法同位素测年,试图通过对该断裂活动和演化过程的年代学制约来探讨其与阿尔金断裂带的一致性。其中韧性变形岩石中同构造变形矿物(黑云母) $^{40}Ar/^{39}Ar$ 同位素年龄分别为(105.9±0.5) Ma; (121.5±0.6) Ma; (121.1±1.4) Ma; (150.4±0.9) Ma(另文)。发育在松西组( $E_3-N_1s$ )中的安山熔岩 $^{40}Ar/^{39}Ar$ 同位素年龄及潜火山岩(花岗斑岩)锆石 U—Pb 同位素年龄分别为(36.72±0.19) Ma 和(32.7±0.2) Ma。此外,断层泥的电子自旋共振(ESR)测年,结果为 3.634 Ma。除上述种种,在严格受控于该断裂的蚂蝗山组( $E_1m$ )中所获得的裂变径迹年龄还提供了关于该断裂多次构造活动(热演化史)的时间依据(表 1)。

上述年龄数据表明郭扎错断裂具有明显的多期活动性,特别是在晚侏罗世—早白垩世及古—渐新世两阶段发生了强烈的构造运动。结合构造变形、动力变质作用、沉积盆地及岩石地层分布等特征,将郭扎错断裂构造演化分为 4 个阶段:①韧性左行平移阶段( $J_3-K_1$ ):发育韧性变形带、韧性剪切带;②初脆性正—平移阶段( $E_1-N_1$ ):控制了区内古新世沉积盆地(蚂蝗山组),并为渐新世—中新世盆地(松西组)的形成、演化提供了空间;③初脆性逆—平移阶段( $N_2$ ):发育大量的压扭性构造面、挤压片理、破劈理及拖曳褶皱,特别是局部保留的呈叠瓦状构造的逆冲断层;④脆性左行滑落阶段(Q):走滑分量较少,形成规模较大的堑垒构造,控制了更—全新世盆地的发育,至今仍在活动。

### 5 阿尔金断裂带西延问题探讨

关于阿尔金断裂带西延问题,由于以往工作程度较低而存在很大争议。国家地震局“阿尔金活动断裂带”课题组认为“阿尔金断裂西起西藏的拉竹龙附近”<sup>[30]</sup>;任纪舜等<sup>[49]</sup>援引“于

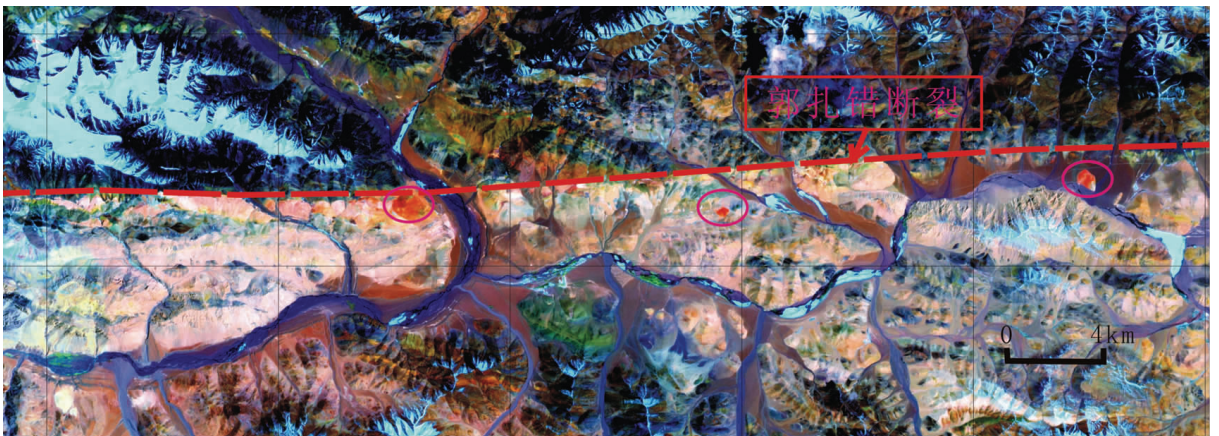


图 6 沿郭扎错断裂带串珠状分布的火山岩(ETM 卫片)

Fig.6 Beads-shaped volcanic rocks along the Gozha Co fault (ETM)

表1 磷灰石裂变径迹分析结果  
Table 1 Measurements of the apatite fission track

实验号	原样号	颗粒数	$\rho_s$ ( $10^5/cm$ ) (Ns)	$\rho_i$ ( $10^5/cm$ ) (Ni)	$\rho_d$ ( $10^5/cm$ ) (Nd)	P(x) (%)	Central T $\pm 1\sigma$ (Ma)	Pooled T $\pm 1\sigma$ (Ma)	L( $\mu m$ ) (N)
Tong14	2115FT	16	2.644 (667)	17.364 (4380)	15.840 (3058)	0	39 $\pm$ 5	39 $\pm$ 2	11.4 $\pm$ 3.0 (100)
Tong15	6081FT1	18	1.954 (297)	25.919 (4152)	15.840 (3058)	0	19 $\pm$ 2	18 $\pm$ 1	13.2 $\pm$ 2.5 (103)
Tong16	6081FT2	16	0.724 (151)	15.458 (3222)	15.840 (3058)	0	14 $\pm$ 3	12 $\pm$ 1	11.4 $\pm$ 3.3 (96)
Tong17	7105FT	16	1.189 (132)	12.327 (1368)	15.840 (3058)	0	25 $\pm$ 7	25 $\pm$ 2	12.1 $\pm$ 2.6 (95)

注:本次测试采用外探测器法,在中国地震局地质研究所新年代学开放实验室完成。裂变径迹年龄采用 Zeta 常数法计算,其公式为:  $T=1/\lambda_d \ln(1+\lambda_d \zeta g \rho_d / \rho_s)$ 。对于单颗粒年龄:  $\rho_{\text{theo}}=\rho_i/\rho_s$ ;  $\lambda_d=1.55125 \times 10^{-10} \text{a}^{-1}$  是  $^{238}\text{U}$  的衰变常数;  $\zeta=321.1 \pm 8.5$  是本次实验磷灰石定年的 Zeta 常数;  $\zeta=179.7 \pm 8.0$  是本次实验锆石定年的 Zeta 常数;  $\rho_s$  为矿物中自发裂变径迹密度,  $N_s$  为所测径迹数;  $\rho_i$  为云母外探测器记录的矿物中诱发裂变径迹密度;  $\rho_d$  为中子注量监测器标准轴玻璃组件的诱发裂变径迹密度; 本次实验的  $N_d=6269$ ,  $\rho_d=10.15 \times 10^5$ ;  $g=0.5$ , 为几何因子。

田县和伯力克幅 1:25 万地质填图”资料认为“阿尔金断裂从库牙克向西南延伸,进入伯力克幅后,并未继续向西南行进,而是呈弧形沿苏巴什蛇绿混杂岩带转为近东西走向,进而转成北西走向,与著名的康西瓦断裂相连”,并进一步认为阿尔金断裂是一条转换断层。根据“在同一动力学系统中形成的具有相似运动学、动力学特征的相关线性构造形迹应作为一个断裂系统”<sup>[4]</sup>,笔者认为郭扎错断裂与阿尔金南缘断裂带处于同一构造线,应为阿尔金断裂带组成部分。

首先,从地质特征看,郭扎错构造带内不仅发育早期的韧性变形带,而且还分布有大量的韧脆性、脆性构造岩,由它们所反映出来的构造几何学、运动学特征及变质特征与阿尔金断裂带完全一致<sup>[2,4,26,28,50]</sup>。此外,该断裂对古新世和更—全新世沉积盆地具有显著的控制作用,同时也影响了渐—中新世盆地的沉积。特别是赋存于松西组( $E_3-N_1s$ )中的火山岩呈串珠状沿断裂带分布,表明始—渐新世火山岩与断裂有明显的成因关系。而发育于若羌、茫崖的阿尔金断裂带的控岩控盆特征与其相似<sup>[31,51-53]</sup>,表明它们在始—渐新世均发生过强烈的构造活动。

其次,构造年代学资料也印证了两者的一性。迄今为止,很多学者对阿尔金断裂带进行了多方法的年代学研究,获得了大量的数据<sup>[13-14,40,50,54-56]</sup>,并分别结合区域地质背景进行了解释。尽管在阿尔金断裂带的起始时间等问题上分歧较大,但大量年代学证据表明:(1)阿尔金断裂带是一条以左行平移为主的、具多期活动性的走滑断层;(2)该断裂在中晚侏罗世—早白垩世和始—渐新世曾发生过强烈的构造活动;(3)该断裂在第四纪直至目前仍具有较强的活动性。前文所述关于郭扎错断裂的构造年代学资料不仅表明了该断裂具有多期活动性,而且其时间界定与阿尔金断裂带<sup>[24,55-58]</sup>具有较强的一致性,这预示着两者可能具有相同的动力学背景。它的每一次活动都与印度—欧亚板块会聚这一大的构造背景息息相关,正如阿尔金断裂带的多次脉冲式活动可能是印度—欧亚板块碰

撞事件在青藏高原北部地区的构造响应<sup>[14]</sup>一样。

再者,在 ETM 卫星照片中,阿尔金断裂带向 SW 延伸到北纬 36°时,仍有经郭扎错向 SW 方向继续延伸的影像,该线性影像沿郭扎错南侧—龙木错—舒木野营地—羌臣摩河—空喀山口展布。沿构造线分布的古新世蚂蟥山组( $E_{1m}$ ) (浅砂红色、浅黄白色色调)、渐—中新世松西组( $E_3-N_1s$ ) (黄绿色色调)以及赋存于该地层中始—渐新世火山岩影像清晰。此外,ETM 卫片影像还反映出该构造带明显穿切了现代水系和第四纪沉积物,表明郭扎错断裂与阿尔金断裂带同样是一条至今仍在活动的走滑断层<sup>[54,59-62]</sup>。此外,青藏高原中西部地温梯度图和磁性层底界深度图<sup>[63]</sup> (图 7~8)也清楚显示出 NEE 走向的阿尔金断裂带一直向西南延展,并经空喀山口进入克什米尔。

综上所述,郭扎错断裂与阿尔金断裂带无疑是在同一动力学系统中形成的具有相似运动学、动力学特征的相关线性构造形迹,理应作为一个断裂系统。因此,阿尔金断裂带并非西止于拉竹龙,亦非由郭扎错北侧转向北西,而是经郭扎错继续向南西延伸,过龙木错、羌臣摩河、空喀山口后西延出国。

## 6 结论

(1)郭扎错断裂内发育的韧性变形带和大量的韧脆性、脆性构造岩以及由它们所反映出来的构造几何学、运动学特征与郭扎错以东的阿尔金断裂带完全一致。

(2)该断裂对古新世和更—全新世沉积盆地的控制作用和对渐—中新世盆地沉积的影响,特别是对赋存于渐—中新世松西组( $E_3-N_1s$ )中始—渐新世火山岩的控制特征与发育于若羌、茫崖的阿尔金断裂带的控岩控盆特征极其相似。

(3)构造年代学资料表明郭扎错断裂具有多期活动性,总体可归为 4 期,即发生在中生代晚期( $J_3-K_1$ )的韧性左行平移、古—中新世( $E_1-N_1$ )的韧脆性左行正—平移、上新世( $N_2$ )的韧脆性左行逆—平移和第四纪以来的脆性左行滑落。左行平

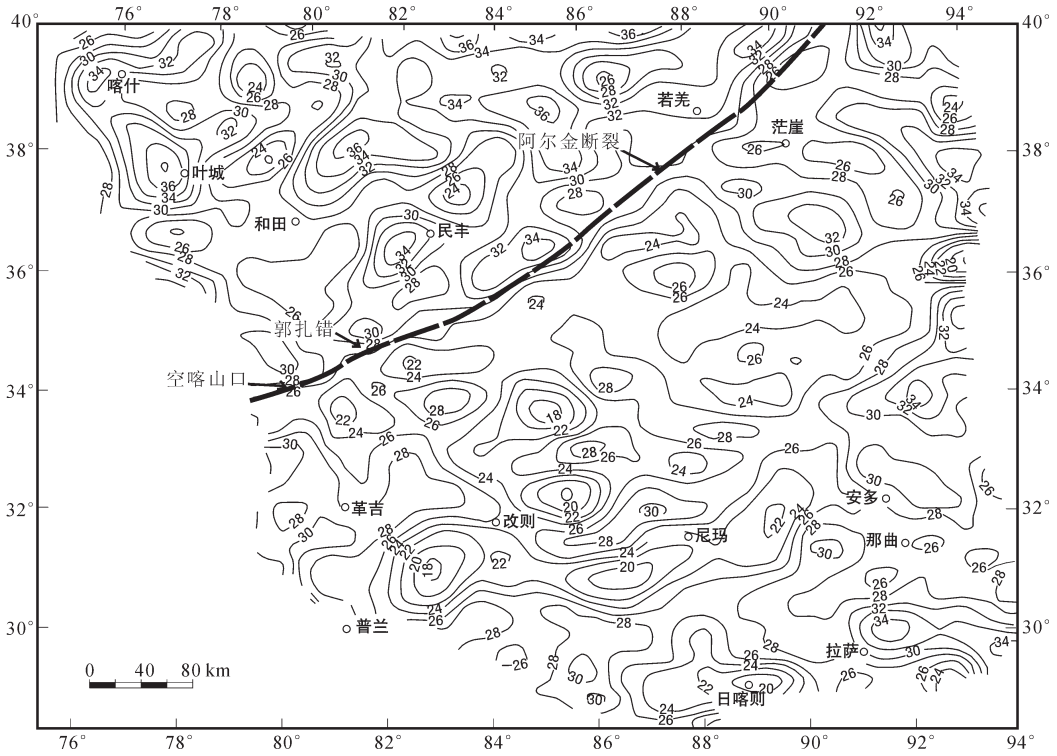


图 7 青藏高原中西部及邻区地温梯度图(单位:°C/km)(据[63]修改)

Fig.7 Geothermal gradient map of the west-central Qinghai-Tibet Plateau and its adjacent areas (unit:°C/km) (modified from [63])

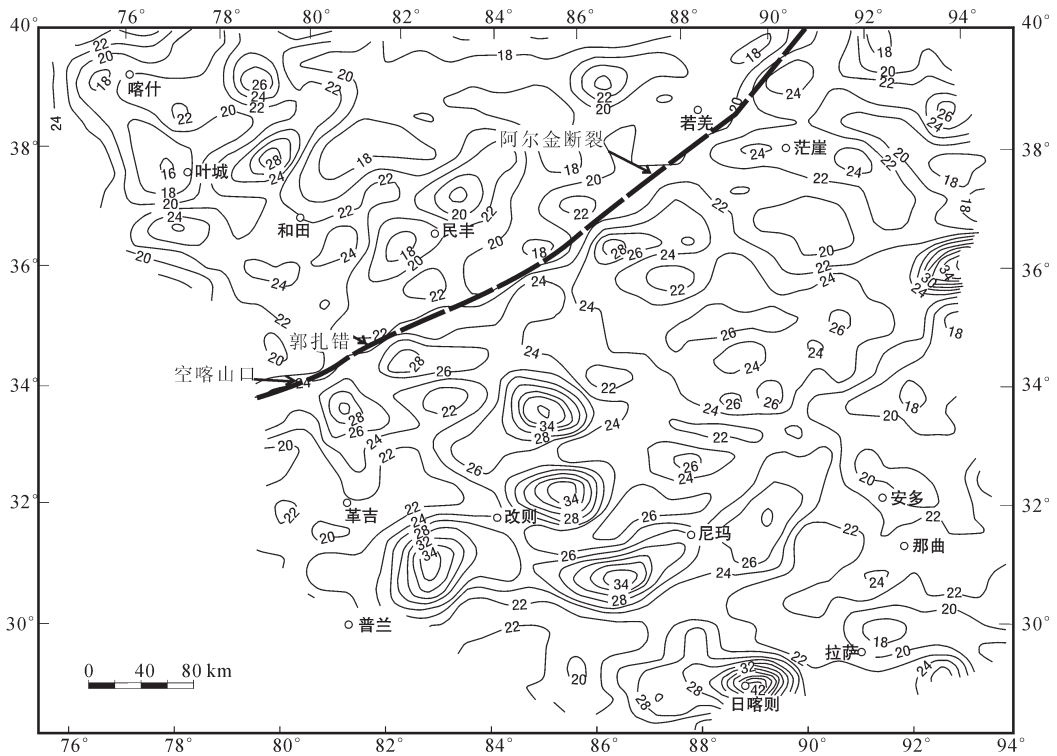


图 8 青藏高原中西部及邻区磁性层底界深度图(等深线单位:km)(据[63]修改)

Fig.8 Depth map of the bottom of the magnetic layers of the west-central Qinghai-Tibet Plateau and its adjacent areas (depth contour unit: km) (modified from [63])

移贯穿始终。这些特点与阿尔金断裂带具有较强的一致性,预示着两者具有相同的动力学背景,即同为印度—欧亚板块汇聚、碰撞过程中,青藏高原北部地区的构造响应。

(4)郭扎错断裂与阿尔金断裂带是在同一动力学系统中形成的具有相似运动学、动力学特征的相关线性构造形迹,同属一个断裂系统。北东东走向的阿尔金断裂带并非西止于拉竹龙,亦非由郭扎错北侧转向北西,而是经郭扎错继续向南西延伸,经龙木错、舒木野营地、羌臣摩河,由空喀山口进入克什米尔。

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#### 参考文献(References):

- [1] Tapponnier P, Peltzer G, Armijo R. On the mechanics of the collision between India and Asia [C]//Coward M P, Ries A C (eds.). *Collision Tectonics*. London: Geol. Soc. Spec. Publ., 1986.19:115-157.
- [2] 郑剑东. 阿尔金断裂带的几何学研究 [J]. 中国区域地质, 1991, (1):54-59.  
Zheng Jiandong. Geometry of the Altun fracture zone [J]. *Regional Geology of China*, 1991, (1):54-59(in Chinese with English abstract).
- [3] 郑剑东. 阿尔金山大地构造及其演化 [J]. 现代地质, 1991, 5(4): 347-354.  
Zheng Jiandong. Tectonics and evolution of the Altun Tagh mountain [J]. *Geoscience*, 1991b, 5(4):347-354 (in Chinese with English abstract).
- [4] 崔军文, 唐哲民, 邓晋福, 等. 阿尔金断裂系[M]. 北京:地质出版社, 1999.  
Cui Junwen, Tang Zhenmin, Deng Jinfu, et al. *Altun Fault System* [M]. Beijing:Geological Publishing House, 1999(in Chinese).
- [5] 张治涛. 阿尔金断裂带的地质特征 [J]. 中国地质科学院西安地质矿产研究所所刊, 1985, (9):20-32.  
Zhang Zhitao. On the geological characters of the Altun fault [J]. *Bulletin of Xi'an Institute of Geology and Mineral Resource, Chinese Academy of Geological Sciences*, 1985, (9):20-32 (in Chinese with English abstract).
- [6] 葛肖虹, 张梅生, 刘永江, 等. 阿尔金断裂研究的科学问题与研究思路 [J]. 现代地质, 1998,12(3):295-301.  
Ge Xiaohong, Zhang Meisheng, Liu Yongjiang, et al. Scientific problems and thought for research of the Altun fault [J]. *Geoscience*, 1998,12(3):295-301(in Chinese with English abstract).
- [7] Molnar P, Tapponnier P. Cenozoic tectonics of Asia: effects of a continental collision [J]. *Science*, 1975, 189(4201):419-425.
- [8] 李春昱. 中国板块构造轮廓 [J]. 中国地质科学院院报, 1980, 2(1): 11-22.  
Li Chunyu. An outline of the plate tectonics in China [J]. *Bulletin of the Chinese Academy of Geological Sciences*, 1980, 2 (1):11-22 (in Chinese with English abstract).
- [9] 黄汲清, 任纪舜, 姜春发, 等. 中国大地构造及其演化 [M]. 北京:地质出版社, 1980.  
Huang Jiqing, Ren Jishun, Jiang Chunfa, et al. *Geotectonic Evolution of China* [M]. Beijing:Geological Publishing House, 1980 (in Chinese).
- [10] 黄汉纯, 王长利. 阿尔金构造带特征及其对塔里木和柴达木盆地的影响 [J]. 地球学报, 1987, 17:17-32  
Huang Hanchun, Wang Changli. Characteristic features of the Altyn Tagh belt and its relation to the Qaidam and Tarim basins [J]. *Acta Geoscientia Sinica*, 1987, 17:17-32(in Chinese).
- [11] Wang Zejiu, Wu Congjian, Xiao Xuchang, et al. Global Geoscience Transect Colmud-Ejin Transect China [M]. Beijing: China Geological Map Printing House, 1997.
- [12] Sobel E R, Arnaud N. A possible middle Paleozoic suture in the Altyn Tagh, NW China [J]. *Tectonics*, 1999, 18(1):64-74.
- [13] 李海兵, 杨经绥, 许志琴, 等. 阿尔金断裂带印支期走滑活动的地质及年代学证据 [J]. 科学通报, 2001, 46(16):1333-1338.  
Li Haibing, Yang Jingsui, Xu Zhiqin. Geological and chronological evidence of Indo-Chinese strike-slip movement in the Altyn Tagn fault zone [J]. *Chinese Science Bulletin*, 2001, 46(16):1333-1338(in Chinese).
- [14] Liu Yongjiang, Geuser J, Ge Xiaohong, et al. <sup>40</sup>Ar/<sup>39</sup>Ar age evidence for Altyn fault tectonic activities in western China [J]. *Chinese Science Bulletin*, 2003, 48(18):2024-2030.
- [15] 杨藩, 叶素娟, 曹春潮, 等. 新生代阿尔金断层中、东段右行走滑特征 [J]. 地质科学, 1994, 29(4):346-354.  
Yang Fan, Ye Sujuan, Cao Chunchao, et al. Right lateral Strike-slip characteristics of the middle eastern segment of Altun fault in Cenozoic era [J]. *Scientia Geologica Sinica*, 1994, 29 (4):346-354 (in Chinese with English abstract).
- [16] 张建新, 许志琴, 崔军文, 等. 一个韧性转换挤压带的变形分解作用——以阿尔金断裂带东段为例 [J]. 地质论评, 1998, 44(4): 348-356.  
Zhang Jianxin, Xu Zhiqin, Cui Junwen, et al. Deformation partitioning of ductile transpressional zones: an example from the eastern segment of the Altun fault zone [J]. *Geological Review*, 1998, 44(4):348-356(in Chinese with English abstract).
- [17] 张建新, 张泽民, 许志琴, 等. 阿尔金构造带西段榴辉岩的 Sm-Nd 及 U-Pb 年龄 [J]. 科学通报, 1999, 44(10):1109-1112.  
Zhang Jianxin, Zhang Zemin, Xu Zhiqin, et al. The ages of Sm-Nd and U-Pb of eclogite from the west Altyn tectonic belt [J]. *Chinese Science Bulletin*, 1999, 44(10):1109-1112(in Chinese).
- [18] Matte Ph, Tapponnier P, Arnaud N, et al. Tectonics of western Tibet between the Tarim and Indus [J]. *Earth and Planet. Sci. Lett.*, 1996, 142:311-330.
- [19] Courtillot V, Jaupart C, Manighetti L, et al. On causal links between flood basalts and continental breakup [J]. *Earth Planet. Sci. Lett.*, 1999, 166(3/4):177-195.
- [20] Rumelhart P E, Yin A, Coughill E, et al. Cenozoic vertical-axis rotation of the Altyn Tagh fault system [J]. *Geology*, 1999, 27(9):



- 819-822.
- [21] Sobel E R, Arnaud N. A possible middle Paleozoic suture in the Altyn Tagh, NW China[J]. *Tectonics*, 1999, 18(1):64-74.
- [22] Xu Zhiqin, Yang Jingsui, Li Haibing. Geological evolution and orogeny of east Kunlun terrain on the northern Qinghai-Tibet plateau[J]. *Earth Science Frontiers*, 2000, 7(suppl.):234-235.
- [23] Sobel E R, Arnaud N, Jolivet M, et al. Jurassic to Cenozoic exhumation history of the Altyn Tagh range, NW China constrained by  $^{40}\text{Ar}/^{39}\text{Ar}$  and apatite fission track thermochronology [C]//Hendrix M S, Davis G A (eds). *Paleozoic and Mesozoic Tectonics of Central Asia-From Continent Assembly to Intra-continental Deformation*. Geological Society of America Memoir, 2001, 194:293-316.
- [24] 陈正乐, 张岳桥, 王小凤, 等. 新生代阿尔金山脉隆升历史的裂变径迹证据[J]. *地球学报*, 2001, 22(5):414-418.  
Chen Zhengle, Zhang Yueqiao, Wang Xiaofeng, et al. Fission track dating of apatite constrains on the Cenozoic uplift of the Altyn Tagh mountain [J]. *Acta Geoscientia Sinica*, 2001, 22(5):414-418(in Chinese with English abstract).
- [25] 尹安. 喜马拉雅—青藏高原造山带地质演化——显生宙亚洲大陆生长[J]. *地球学报*, 2001, 22(3):193-230.  
Yin An. Geologic evolution of the Himalayan Tibetan orogen in the context of Phanerozoic continental growth of Asia [J]. *Acta Geoscientia Sinica*, 2001, 22(3):193-230(in Chinese with English abstract).
- [26] 张岳桥, 陈正乐, 杨农. 阿尔金断裂晚新生代左旋走滑位错的地质新证据[J]. *现代地质*, 2001, 15(1):8-12.  
Zhang Yueqiao, Chen Zhengle, Yang Nong. New geological evidence for late Cenozoic left-lateral displacement along the Altyn Tagh fault [J]. *Geoscience*, 2001, 15(1):8-12 (in Chinese with English abstract).
- [27] Ge Xiaohong. A new recognition of the Altun fault zone and geotectonic pattern of north-west China [C]//Ren Jishun, Xie Guanglian (eds). *IGCP-321 Proceedings of First International Symposium*. Beijing:China University of Geosciences Press, 1991:125-128.
- [28] 朱允铸, 钟坚华, 吴必豪, 等. 阿尔金山上升史与塔里木、柴达木成盐关系初探[J]. *石油与天然气地质*, 1990, 11(2):136-142.  
Zhu Yunzhu, Zhong Jianhua, Wu Bihao, et al. Preliminary approach to relationship between uplifting history of Altun mountains and salt-forming condition in Tarim and Qaidam basins [J]. *Oil and Gas Geology*, 1990, 11(2):136-142 (in Chinese with English abstract).
- [29] Yue Yongjun, Liou J G. Two-stage evolution model for the Altyn Tagh Fault, China[J]. *Geology*, 1999, 27(3):227-230.
- [30] 国家地震局“阿尔金活动断裂带”课题组. 阿尔金活动构造带[M]. 北京:地震出版社, 1992:75-165.  
Research Group on the Active Altyn Tagh Fault Zone. *The Active Altyn Tagh Fault Zone*[M]. Beijing:Seismological Press, 1992:75-165(in Chinese with English abstract).
- [31] 车自成, 刘良, 刘洪福, 等. 阿尔金断裂系的组成及相关新生代含油气盆地的成因特征[J]. *中国区域地质*, 1998, 17(4):377-384.  
Che Zicheng, Liu Liang, Liu Hongfu, et al. The constituents of the Altun Fault system and genetic characteristics of related Meso-Cenozoic petroleum-bearing basin [J]. *Regional Geology of China*, 1998, 17(4):377-384(in Chinese with English abstract).
- [32] 周勇, 潘裕生. 芒崖—肃北段阿尔金断裂右旋走滑运动的确定[J]. *地质科学*, 1998, 33(1):9-15.  
Zhou Yong, Pan Yusheng. Determination of a dextral strike-slip along the Altun fault zone at Mangai-Subei [J]. *Scientia Geologica Sinica*, 1998, 33(1):9-15 (in Chinese with English abstract).
- [33] 许志琴, 杨经绥, 张建新, 等. 阿尔金断裂两侧构造单元的对比及岩石圈剪切机制[J]. *地质学报*, 1999, 73(3):193-205.  
Xu Zhiqin, Yang Jingsui, Zhang Jianxin, et al. A comparison between the tectonic units on the two sides of the Altun sinistral strike-slip fault and the mechanism of lithospheric shearing [J]. *Acta Geologica Sinica*, 1999, 73(3):193-205(in Chinese with English abstract).
- [34] 葛肖虹, 刘俊来. 北祁连造山带的形成与背景 [J]. *地学前缘*, 1999, 6(4):223-229.  
Ge Xiaohong, Liu Junlai. The formation and background of the North Qilian orogenic belt [J]. *Geoscience Frontiers*, 1999, 6(4):223-230(in Chinese with English abstract).
- [35] 葛肖虹, 刘俊来. 被肢解的西域克拉通 [J]. *岩石学报*, 2000, 16(1):59-66.  
Ge Xiaohong, Liu Junlai. Broken "Western China Craton" [J]. *Acta Petrologica Sinica*, 2000, 16(1):59-66 (in Chinese with English abstract).
- [36] Tapponnier P, Mattauer M, Proust F, et al. Mesozoic ophiolites, suture and large-scale movement in Afghanistan. *Earth Planet Sci. Lett.*, 1981, 52:355-371.
- [37] Peter R, An Y, Rick B, et al. Oligocene initiation of deformation of northern Tibet, evidence from the Tarim basin, NW China [J]. *Abstract for GSA*, 1997, 29:A-143.
- [38] Metivier F, Gaudemer Y, Tapponnier P, et al. Northeastward growth of the Tibet plateau deduced from balanced reconstruction of two depositional areas: The Qaidam and Hexi Corridor basins [J]. *China Tectonics*, 1998, 17(6):823-842.
- [39] 许志琴, 崔军文. 大陆山链变形构造动力学[M]. 北京:冶金工业出版社, 1996:166-184.  
Xu Zhiqin, Cui Junwen. *Deformation Tectonics and Dynamics of Continental Mountain Chains* [M]. Beijing:Metallurgical Industry Press, 1996:166-184(in Chinese).
- [40] 周勇, 潘裕生. 阿尔金断裂早期走滑运动方向及其活动时间探讨[J]. *地质论评*, 1999, 45(1):1-9.  
Zhou Yong, Pan Yusheng. The initial shear sense of the Altun fault and its timing [J]. *Geological Review*, 1999, 45(1):1-9(in Chinese with English abstract).
- [41] Kneen S. The relationship between the magnetic and strain fabrics of some haematite-bearing Welsh slates [J]. *Earth Planet. Sci. Lett.*, 1976, 31:413-416.

- [42] Rathore J S, Henry B. Comparison of strain and magnetic fabrics in Dalradian rocks from the southwest Highlands of Scotland [J]. *J. Strat. Geol.*, 1982, 4: 373-384.
- [43] Hrouda F, Jezek J. The tectonic models for the relationship between magnetic anisotropy and strain: effect of triaxial magnetic grains [J]. *Tectonophysics*, 1999, 301: 183-190.
- [44] Hrouda F, Janak F. The changes in shape of the magnetic susceptibility ellipsoid during progressive metamorphism and deformation [J]. *Tectonophysics*, 1976, 34: 135-148.
- [45] Rathore J S. Evidence for sinistral movements along the Judicarian Line drawn from a study of magnetic fabrics in the region of Mt. Croce and Asten (South Tyrol) [J]. *Geol. Rundsch*, 1980, 69(3): 678-694.
- [46] Borradaile G J, Puumala M. Magnetic fabric as a kinematic indicator of faults: a test case [J]. *Ann. Tectonica*, 1989, 3: 3-11.
- [47] 丁道桂, 王道轩, 刘伟新, 等. 西昆仑造山带与盆地 [M]. 北京: 地质出版社, 1996: 1-223.  
Ding Daogui, Wang Daoxuan, Liu Weixin, et al. *Orogenic Belt and Basins in West Kunlun* [M]. Beijing: Geological Publishing House, 1996: 1-223 (in Chinese).
- [48] Taponnier P, Peltzer G, Armijo R. On the mechanics of the collision between India and Asia [C] // *Collision Tectonics*, edited by Coward M P and Ries A C, Geol. Soc. Spec. Publ. London, 1986, 19: 115-157.
- [49] 任纪舜, 肖黎薇. 1:25 万地质填图进一步揭开了青藏高原大地构造的神秘面纱 [J]. *地质通报*, 2004, 23(1): 1-11  
Ren Jishun, Xiao Liwei. Lifting the mysterious veil of the tectonics of the Qinghai-Tibet plateau by 1:250000 geological mapping [J]. *Geological Bulletin of China*, 2004, 23 (1): 1-11 (in Chinese with English abstract).
- [50] 刘俊来, 潘宏勋, 葛肖虹, 等. 阿尔金断裂中段 (阿克塞—芒崖段) 的早期断层作用 [J]. *地质学报*, 2001, 75(4): 477-483.  
Liu Junlai, Pan Hongxun, Ge Xiaohong, et al. Early faulting along the middle part (from Akesai to Mang'ai) of the Altun fault zone [J]. *Acta Geologica Sinica*, 2001, 75 (4): 477-483 (in Chinese with English abstract).
- [51] 郑剑东. 阿尔金断裂与大陆走滑断裂 [J]. *内陆地震*, 1988, 2(2): 123-130.  
Zheng Jiandong. The Aejin Fault and the continental strike-slip fault [J]. *Inland Earthquake*, 1988, 2(2): 123-130 (in Chinese).
- [52] 魏顺民, 向宏发. 阿尔金构造系渐新世—中新世以来断裂左旋位错时空分布规律研究 [J]. *地震地质*, 1998, 20(1): 10-18.  
Guo Shunmin, Xiang Hongfa. A study on spatial-temporal distribution of the fault sinistral displacement in the Altun structure system since Oligocene-Miocene [J]. *Seismology and Geology*, 1998, 20(1): 10-18 (in Chinese with English abstract).
- [53] 李海兵. 阿尔金断裂带的形成时代及其走滑作用对青藏高原北部隆升的贡献 [D]. 北京: 中国地质科学院, 2001.  
Li Haibing. Formation Age of Altyn Tagh Fault Zone and Contribution of its Strike-Slip to the Uplift of North Tibetan Plateau [D]. Institute of Geology, CAGS, Beijing, 2001 (in Chinese).
- [54] 王峰, 徐锡伟, 郑荣章, 等. 阿尔金断裂带西段车尔臣河以西晚第四纪以来的滑动速率研究 [J]. *地震地质*, 2004, 26(2): 200-208.  
Wang Feng, Xu Xiwei, Zheng Rongzhang, et al. Late Quaternary slip rate on the Altun Fault west to the Qarqan River [J]. *Seismology and Geology*, 2004, 26 (2): 200-208 (in Chinese with English abstract).
- [55] 陈正乐, 万景林, 王小凤, 等. 阿尔金断裂带 8 Ma 左右的快速走滑及其地质意义 [J]. *地球学报*, 2002, 23(4): 295-300.  
Chen Zhengle, Wan Jinglin, Wang Xiaofeng, et al. Rapid strike-slip of the Altyn Tagh fault at 8 Ma and its geological implications [J]. *Acta Geoscientia Sinica*, 2002, 23(4): 295-300 (in Chinese with English abstract).
- [56] 王瑜, 万景林, 李齐, 等. 阿尔金山北段阿克塞—当今山口一带新生代山体抬升和剥蚀的裂变痕迹证据 [J]. *地质学报*, 2002, 76(2): 191-198.  
Wang Yu, Wan Jingling, Li Qi, et al. Fission-track evidence for the Cenozoic uplift and erosion of the northern segment of the Altyn Tagh fault zone at the Aksay-Dangjin pass [J]. *Acta Geologica Sinica*, 2002, 76 (2): 191-198 (in Chinese with English abstract).
- [57] 陈文, 葛肖虹, 叶慧文, 等. 用激光微区  $^{40}\text{Ar}/^{39}\text{Ar}$  定年技术测定阿尔金断裂系多期活动的时代 [J]. *质谱学报*, 2000, 21(3/4): 189-190.  
Chen Wen, Ge Xiaohong, Ye Huiwen, et al. Laser probe  $^{40}\text{Ar}/^{39}\text{Ar}$  dating of micas on the deformed rocks from Altyn Fault and its tectonic Implication [J]. *Journal of Chinese Mass Spectrometry Society*, 2000, 21(3/4): 189-190 (in Chinese with English abstract).
- [58] 任收麦, 葛肖虹, 刘永江, 等. 晚白垩世以来沿阿尔金断裂带的阶段性走滑隆升 [J]. *地质通报*, 2004, 23(9/10): 927-932.  
Ren Shoumai, Ge Xiaohong, Liu Yongjiang, et al. Multi-stage strike-slip motion and uplift along the Altyn Tagh fault since the Late Cretaceous [J]. *Geological Bulletin of China*, 2004, 23(9/10): 927-932 (in Chinese with English abstract).
- [59] 向宏发, 魏顺民, 张晚霞, 等. 阿尔金断裂带东段第四纪以来的水系位错与滑动速率 [J]. *地震地质*, 2000, 22(2): 130-138.  
Xiang Hongfa, Guo Shunmin, Zhang Wanxia, et al. River offset and slip rate of the east segment of Altun Tagh fault zone since Quaternary [J]. *Seismology and Geology*, 2000, 22(2): 130-138 (in Chinese with English abstract).
- [60] 王峰, 徐锡伟, 郑荣章. 阿尔金断裂带东段距今 20ka 以来的滑动速率 [J]. *地震地质*, 2003, 25(3): 350-358.  
Wang Feng, Xu Xiwei, Zheng Rongzhang. Slip rate on the eastern Altyn Tagh fault since 20ka Bp [J]. *Seismology and Geology*, 2003, 25(3): 350-358 (in Chinese with English abstract).
- [61] 葛肖虹, 刘永江, 任收麦. 青藏高原隆升动力学与阿尔金断裂 [J]. *中国地质*, 2002, 29(4): 346-350.  
Ge Xiaohong, Liu Yongjiang, Ren Shoumai. Uplift dynamics of the Qinghai-Tibet Plateau and Altun fault [J]. *Geology in China*, 2002, 29(4): 346-350 (in Chinese with English abstract).
- [62] 崔军文, 张晓卫, 唐哲民. 青藏高原的构造分区及其边界的变形

构造特征[J]. 中国地质, 2006, 33(2):256-267.

Cui Junwen, Zhang Xiaowei, Tang Zheming. Tectonic divisions of the Qinghai-Tibet Plateau and structural characteristics of deformation on their boundaries [J]. Geology in China, 2006, 33(2):256-267(in Chinese with English abstract).

[63] 熊盛青, 周伏洪, 姚正煦, 等. 青藏高原中西部航磁调查 [M]. 北

京:地质出版社, 2001.

Xiong Shengqing, Zhou Fuhong, Yao Zhengxi, et al. The Aeromagnetic Survey in the Central and Western Qinghai-Tibet Plateau[M]. Beijing: Geological Publishing House, 2001(in Chinese with English abstract).

## Problem of westward extension of the Altyn Tagh fault belt discussed from the structural characteristics of the Gozha Co fault

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**Abstract:** The Altyn Tagh fault belt has a very important position in the study of continental geodynamics, but there is still a dispute over the trend of its westward extension after it passes Gozha Co. The Gozha Co fault is an ENE-trending linear structural zone and has undergone multi-stage activities. In the macrostructural to microstructural contexts, this article discusses in details its geometry and kinematics, and on that basis, combined with the data of the dynamic metamorphism, sedimentary basin, rock and stratigraphic distribution and deformation chronology, the Gozha Co fault is divided into four phases: the ductile left-lateral strike-slip fault ( $J_3-K_1$ ), ductile-brittle normal-strike-slip fault ( $E_1-N_1$ ), ductile-brittle reverse-strike-slip fault ( $N_2$ ) and brittle left-lateral slip fault (Q). Integrated analysis of the data of geological survey and geophysical field as well as features of satellite images shows that the Gozha Co fault and Altyn Tagh fault belt are correlative linear structures which have similar kinematic and dynamic characteristics and formed in the same dynamic system, thus belonging to the same fault system. Therefore, the Altyn Tagh fault belt neither stops at Lazhulong in the west, nor turns from north of Gozha Co to the northwest but continues to extend to the southwest via Gozha Co and enters into Kashmir from the Kongka Pass after passing Lungmu Co and the Qiangchengmo River.

**Key words:** Altyn Tagh fault belt; Gozha Co fault; deformation; magnetic fabric; chronology

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