华北克拉通北缘及邻区前燕山期主要地质事件

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提要:近年来,华北克拉通北缘及邻区的研究进展集中在前燕山期的主要地质构造格架的廓清,以及晚中生代以来的构造岩浆事件和克拉通岩石圈减薄研究的深化。本文对前者的研究进展作评述和展望。华北克拉通自 1.8~1.75 Ga 形成后,时有岩浆扰动。1.35 Ga 的基性岩床和岩墙群事件代表了华北克拉通与北美克拉通的裂解,说明华北克拉通曾经是哥伦比亚超大陆的组成部分。华北克拉通北缘大陆边缘的演化也应当从 1.35 Ga 以后开始。早古生代时期,在华北克拉通以北的兴蒙造山带南部发育了白乃庙岛弧岩带,但此时华北克拉通依然记录的是稳定沉积。该岛弧岩带在早古生代末期可能通过弧–陆碰撞形式增生到华北克拉通北部边缘。早中泥盆世期间,在华北克拉通北缘发育了年龄为 410~380 Ma 的碱性杂岩,可能与弧陆碰撞后的伸展有关。从晚石炭世(~320 Ma)开始,华北克拉通北缘发展为安第斯型活动大陆边缘,古亚洲洋向南俯冲在华北克拉通之下。在相邻的兴蒙造山带,古亚洲洋还存在向北的俯冲,形成了白音宝力道岛弧岩带。古亚洲洋沿索伦缝合带的最终闭合发生在二叠纪末—三叠纪初期。华北克拉通北缘大量~250 Ma 以来的后碰撞岩浆活动记录了这一拼合过程。晚三叠世—早侏罗世华北克拉通北缘发生大规模逆冲推覆。早侏罗世时期,华北克拉通北缘已经出现基底结晶岩系的广泛剥露。在燕山期构造岩浆作用之前,华北克拉通北缘的东西向构造格架基本奠定。

关 键 词:华北克拉通北缘;构造事件;前燕山期;大陆边缘;岩浆作用

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华北克拉通自形成以后至燕山期大规模的构造岩浆作用发生之前,许多地质构造事件轮廓不甚清晰,有些问题似是而非。近年来的研究进展将一些重要问题确定下来,使得华北克拉通北缘及邻区前燕山期的主要地质构造格架明确建立起来。本文对有关研究进展作简要评述和展望。

1 华北克拉通北缘大陆边缘的初始

长期以来,华北克拉通与全球其他克拉通的关系问题虽有探讨[1-4],但是没有明确的答案。华北克拉通的形成不是孤立事件,应当是全球大陆演化的组成部分。由此产生一个重要问题,华北克拉通与全球相关大陆是何时发生裂解的?这意味着裂解后华北克拉通开始了它的一个重要的大陆边缘演化。同时也意味着一个相联系的大洋历史的开始。

华北克拉通自古元古代碰撞拼合以来[5,6],经历了古元古代晚期的后造山构造岩浆过程[6,7]。从古元古代—中元古代之交开始,华北克拉通进入盖层沉积阶段。从最近的研究进展看,华北克拉通北部在中元古代期间并没有显示典型克拉通的稳定状态,间或有岩浆扰动事件发生[8-16](图 1)。通过对侵入燕山地区雾迷山组白云岩和下马岭组碎屑岩内的辉绿岩岩床的锆石及斜锆石 LA-ICP-MS Pb-Pb 定年,确定辉绿岩床的侵位时代为中元古代中期,Pb-Pb 年

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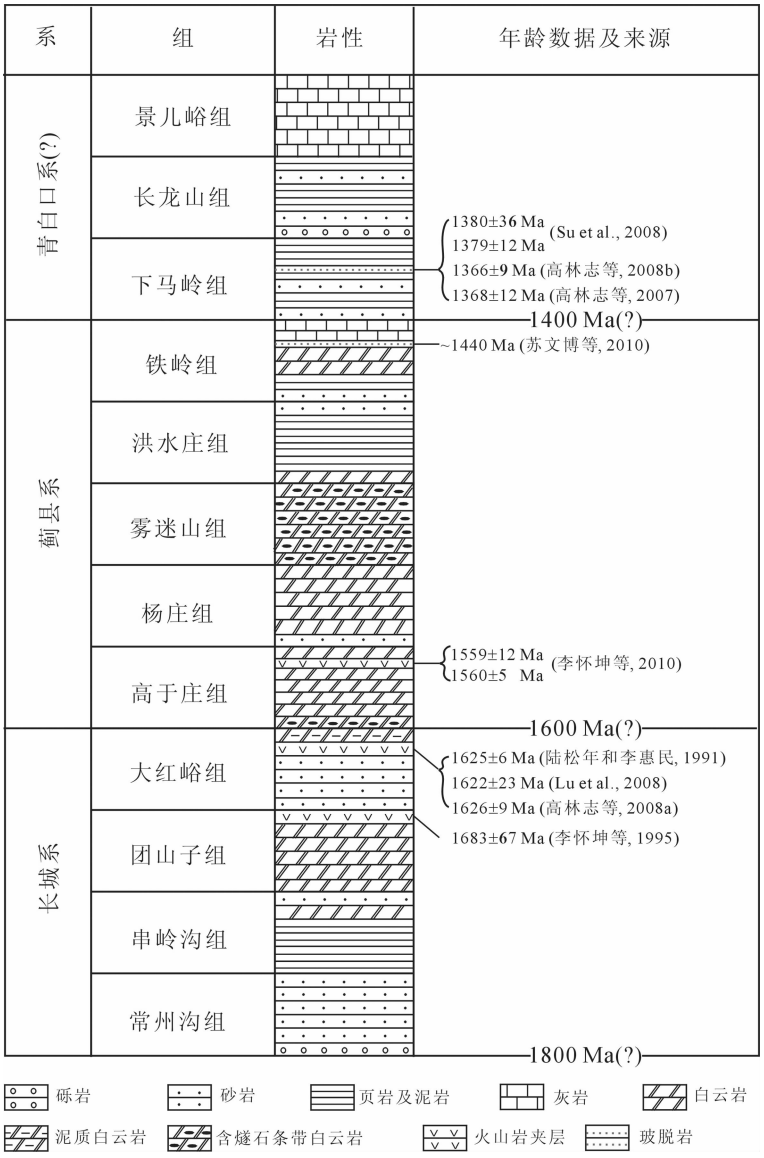

图 1　华北克拉通北部中元古代地层划分及年代学依据(据文献[17]修改)

Fig.1　Subdivision and zircon U−Pb age constraints on the Meso−Neoproterozoic strata in northern NCC

龄分别为(1345±12)Ma 及(1353±14) Ma[17]。这一年龄结果与近期报道的下马岭组辉绿岩床斜锆石 TIMS U−Pb 年龄(1320±6 Ma)[18]非常接近,说明华北克拉通北部中元古代沉积地层内的大量辉绿岩床群的侵位时代为中元古代中期(图 2)。华北克拉通北部中元古代中期基性岩床群的年代学研究结果及其与全球中元古代基性岩墙(床)群对比,以及古地磁数据的重新分析表明[19−29],华北克拉通在中元古代期间应为哥伦比亚超大陆中 Nena 陆块群的一员,并可能与北美(劳伦)及西伯利亚克拉通相连(图 3)。华北克拉通从哥伦比亚超大陆的裂解可能开始于中元古代中期 1.35 Ga 以后。这说明,华北克拉通北缘的大陆边缘发展从 1.35 Ga 开始, 古亚洲洋的前身——泛古洋的历史至少部分从 1.35 Ga 开始。同时,中国北方中—上元古界的长城系、蓟县系和青白口系的时代应当在古元古代末—中元古代期间,大约 1.75 ~1.35 Ga? 因为大规模的裂解伴随着地幔柱的上升和区域的抬升。青白口系的沉积结束应当在此之前。

2　早古生代大陆边缘

在经历了中元古代中期裂解之后, 华北地块北缘进入被动大陆边缘发展阶段。早古生代期间,在华

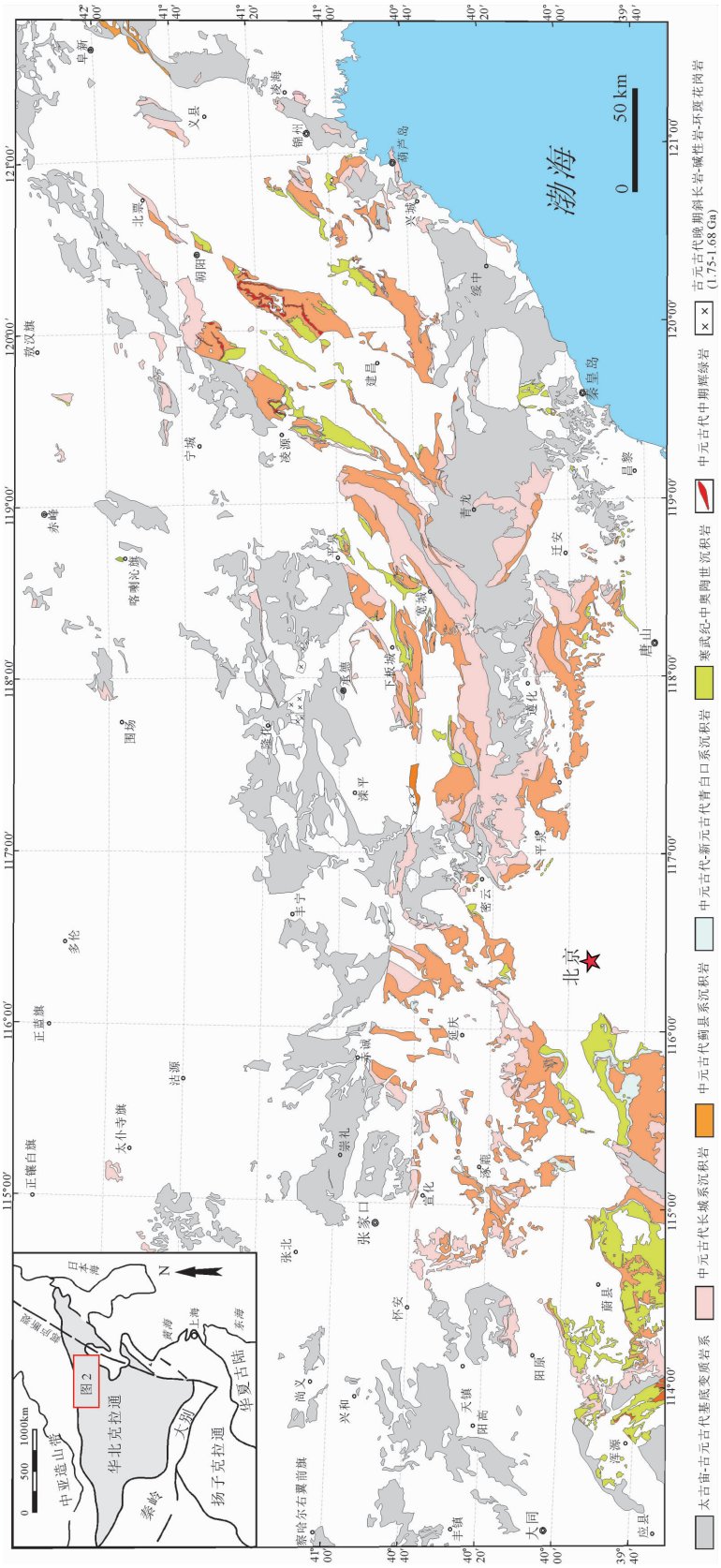

图 2 华北克拉通北部太古宙—古元古代基底岩石及中新元古代—早古生代盖层沉积分布图(据文献[17]修改)

Fig.2 Sketch geological map of northern NCC, showing the distribution of Archean–Paleoproterozoic basement rocks, late Paleoproterozoic intrusive rocks and Meso–Neoproterozoic and Early Paleozoic sedimentary rocks

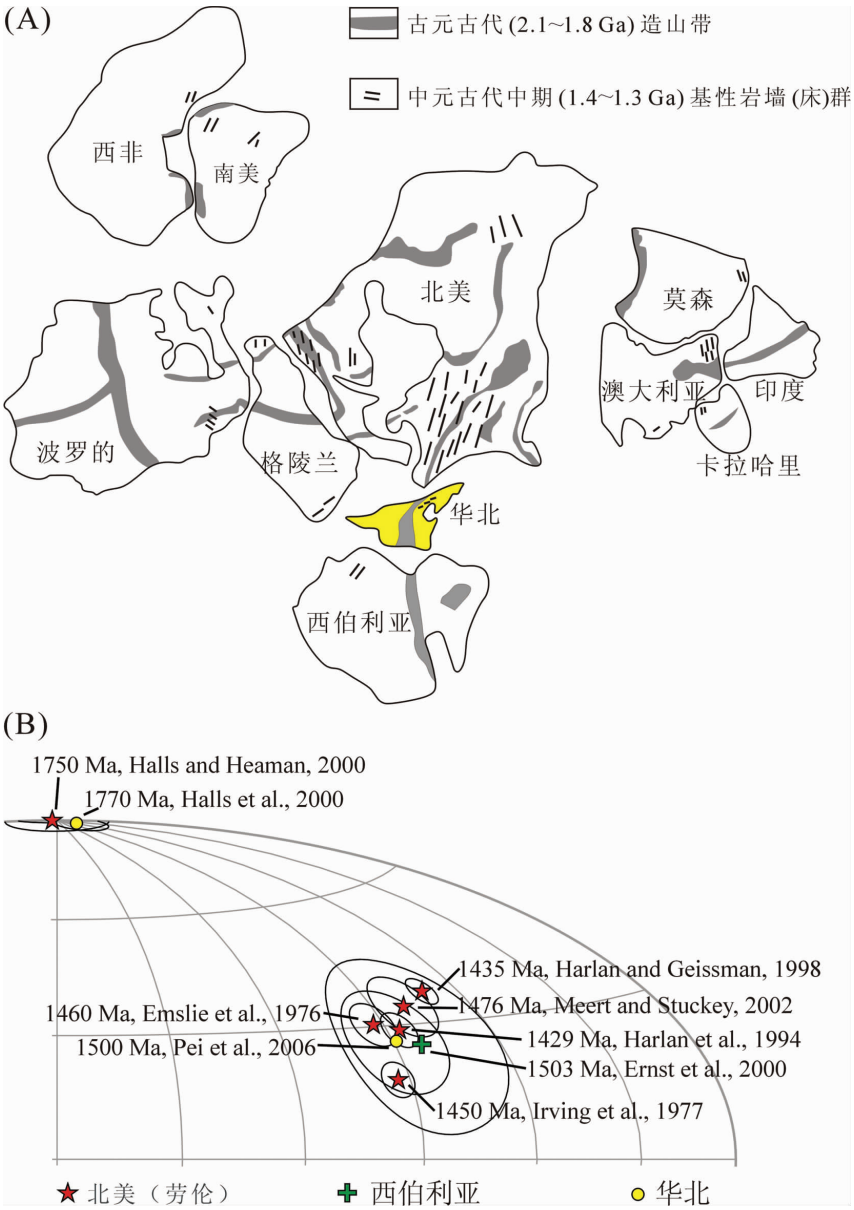

图 3　中元古代期间(1.70~1.35 Ga)华北克拉通在哥伦比亚超大陆中的位置示意图(A)及相关古地磁证据(据文献[17]修改)

Fig.3　Schematic diagram (A) showing the possible position of the NCC within the Columbia (Nuna) supercontinent during 1.70~1.35 Ga and the paleomagnetic evidence (B) for reconstruction

北克拉通北侧发育了白乃庙岛弧岩带[30-34]。该岛弧岩带从白云鄂博北部开始,经白乃庙、图林凯、解放营子,向东到达吉林南部地区。对岛弧火山岩及侵入岩的锆石 U-Pb 定年结果[31-34]及笔者未发表的测年数据表明,白乃庙岛弧岩带可能开始于早奥陶世(~475 Ma)或更早,结束于晚志留世(~420 Ma)。

虽然有学者认为华北克拉通北缘在早古生代时期为活动大陆边缘[35],白乃庙可能为发育在华北克拉通北缘的陆缘弧[36],但华北克拉通北部广泛发育的寒武纪—中奥陶世陆表海沉积似乎支持被动大陆边缘的认识[37]。最新的野外地质调查及年代学结果显示,以往所认为的华北克拉通北缘一些与活动大陆边缘有关的早古生代岩体(如合教岩体)侵位时代不是早古生代(笔者未发表资料)。早古生代岩浆活

动仅发育在白乃庙岛弧岩带上,华北克拉通北缘在早古生代时期依然保持稳定,未发现有这一时期的岩浆活动记录。因此早古生代期间在华北克拉通北缘与白乃庙岛弧之间,也存在有一个较为宽广的洋盆。白云鄂博北部乌德混杂岩带内洋壳物质可能是这一洋盆消减的记录[32]。

志留纪末期,白乃庙岛弧与华北克拉通北缘发生弧-陆碰撞[37],白乃庙岛弧增生拼贴在华北克拉通北缘之上。内蒙古中部西别河组地层与下伏奥陶纪—志留纪岛弧火山沉积岩系之间的不整合[31,38]可能与这一弧-陆碰撞过程有关。位于不整合面之上的西别河组为一套磨拉石或类磨拉石沉积[39],限定了这一弧-陆碰撞的时限。其沉积时代为晚志留世[38]或晚志留世末期—早泥盆世早期[39-41]。

3 泥盆纪碱性岩浆活动

泥盆纪岩浆岩的分布范围虽然不大,但在华北地块北缘自东向西均有分布,时代主要为早泥盆世末期—中泥盆世,少量为晚泥盆世。典型的泥盆纪岩体主要包括:冀西北张家口水泉沟碱性杂岩体,其侵位年龄在 390 Ma 左右[42];冀北承德大庙孤山二长闪长岩,侵位年龄为(390±5) Ma[43];内蒙古大青山北缘高家村角闪二长岩 (锆石 TIMS U-Pb 年龄为 390 Ma)❶;赤峰车户沟正长花岗斑岩((376±3) Ma)[44];赤峰红山公园钾长花岗岩((387±4) Ma)[45]等。沿大庙断裂带出露的一些基性-超基性杂岩(红石砬、二道沟及下哈叭沁等地)[46]❷及白云鄂博地区的一些碱性花岗岩❸也形成于这一时期。在赤峰东部莲花山、敖汉旗朝吐沟等地还存在有一些晚泥盆世流纹斑岩及流纹质熔结凝灰岩,其形成时代为(364±2) Ma[47]。以碱性岩为主的岩石组合特征显示泥盆纪岩浆活动可能形成于伸展构造背景。华北地块北缘泥盆纪岩浆活动的形成可能与这一时期弧-陆碰撞后的伸展背景有关。

4 早石炭世末—早二叠世安第斯型大陆边缘

早石炭世末—二叠纪是华北克拉通北缘构造演化的重要阶段[48]。近些年研究结果揭示,在华北克拉通北缘内蒙古隆起("内蒙地轴"),以往所认为的太古宙—古元古代结晶基底岩系内,存在大量的早石炭世末—二叠纪片麻状闪长岩-花岗闪长岩侵入体(图 4)[49-53]。其侵位时代主要开始于~320 Ma,结束于 270~260 Ma。这些岩体通常表现出不同程度的变形,部分岩体显示出典型的同构造岩体特征。早石炭世晚期—中二叠世侵入岩呈东西向带状分布,平行于华北地块北缘边界。在岩石组合、矿物组合、岩石地球化学、同位素组成及空间分布等方面均显示活动大陆边缘岩浆弧的特征,并且可以与世界典型大陆边缘岩浆弧(如北美内华达岩浆弧、南美秘鲁海岸岩基等)相对比[54,55]。因此早石炭世晚期—早二叠世岩浆活动发育的构造背景应为安第斯型活动大陆边缘。其形成与古亚洲洋板块向华北克拉通俯冲有关(图 5-A)。华北地块北缘内蒙古隆起大致代表了这一安第斯型活动大陆边缘弧的范围。

虽然石炭—二叠纪火山岩在华北克拉通北缘似乎不发育,但在华北克拉通北缘的内蒙古大青山、河北兴隆、山西大同、宁夏银川、辽宁等地的石炭—二叠系地层中发现有凝灰岩层的记录[56-58]。笔者有关华北克拉通北缘上石炭统 G 层铝土矿的待发表资料和王瑜等[59]对华北中部地区的上石炭统 G 层铝土矿的报道,说明其物源主要是同时期的火山岩。沉积学分析结果表明,凝灰岩的物源区在其北侧,但由于华北地块北缘同期火山岩出露非常有限,因此这些凝灰岩通常被认为是兴蒙造山带古火山活动的产物[57]。对北京西山上古生界地层凝灰岩夹层中的锆石 SHRIMP U-Pb 测年及微区 Lu-Hf 同位素分析表明, 凝灰岩锆石 Hf 同位素组成与内蒙古隆起内早石炭世末—早二叠世侵入岩非常相似,但与中亚造山带内同期岩浆岩明显不同,表明这些凝灰岩主要来源于华北北缘的内蒙古隆起,而不是其北侧的兴蒙造山带[60]。因此,晚古生代期间在内蒙古隆起上应该曾经存在与安第斯型活动大陆边缘有关的弧火山活动(图 6)。由于后期构造作用[60],内蒙古隆起在晚古生代—早中生代期间经历了强烈的抬升剥露。这一结论得到岩体侵位深度估算[61,62]和沉积学证据[63]的

❶天津地质矿产所区域地质调查队. 1:5 万石兰哈达幅区域地质图(K49E018011),2002.

❷倪志耀. 冀北退变榴辉岩、易剥钙榴岩和变质橄榄岩及其地质意义. 中国科学院地质与地球物理研究所博士后出站报告, 2002.

❸内蒙古自治区地质调查院. 1:25 万白云鄂博幅区域地质图(K49C003002), 2003.

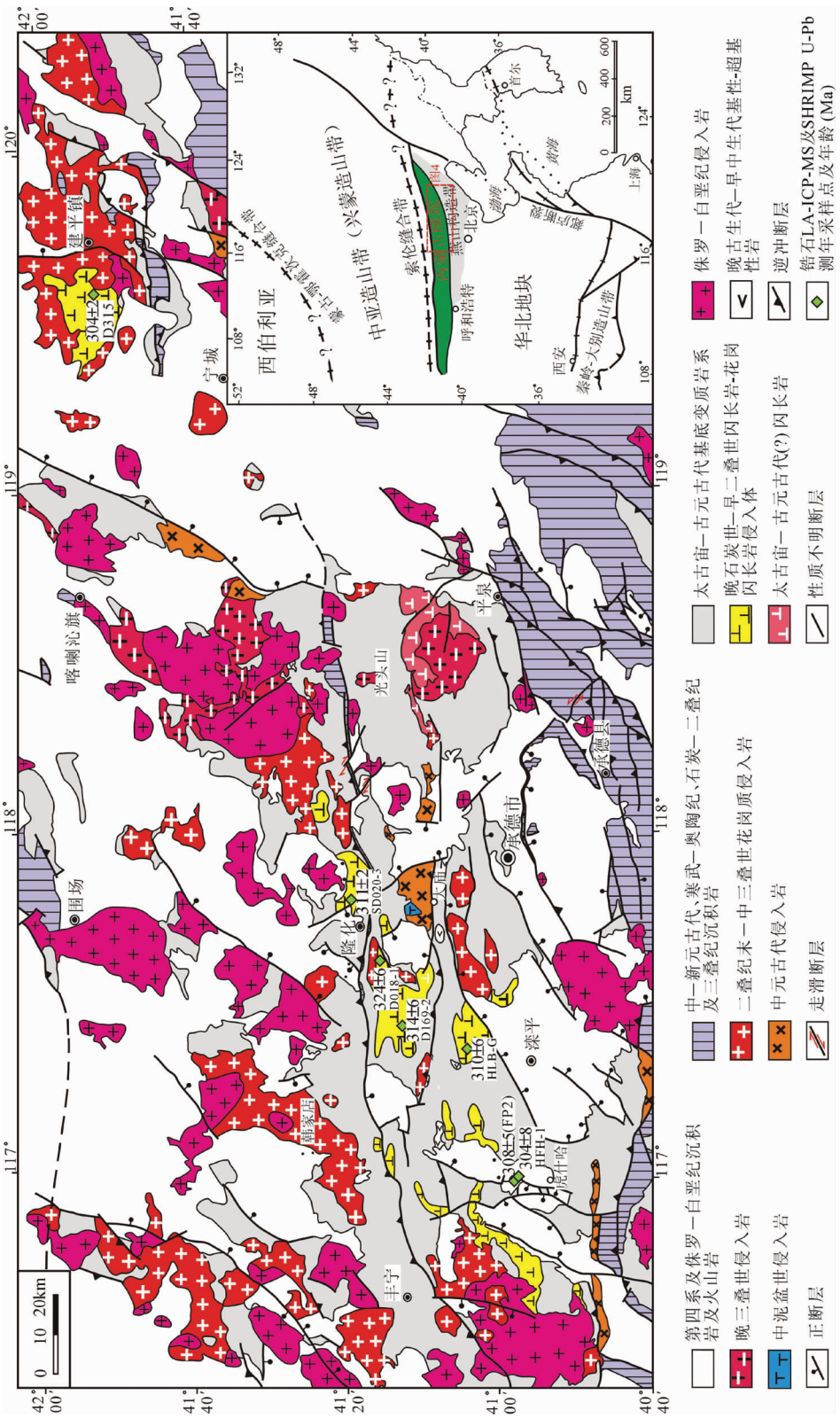

图 4　华北克拉通北缘东段晚古生代–早中生代侵入岩分布图(据文献[52]修改)

Fig.4　Geological map of the central–eastern segment of the northern margin of the NCC, showing the distribution of Late Paleozoic–Early Mesozoic intrusions

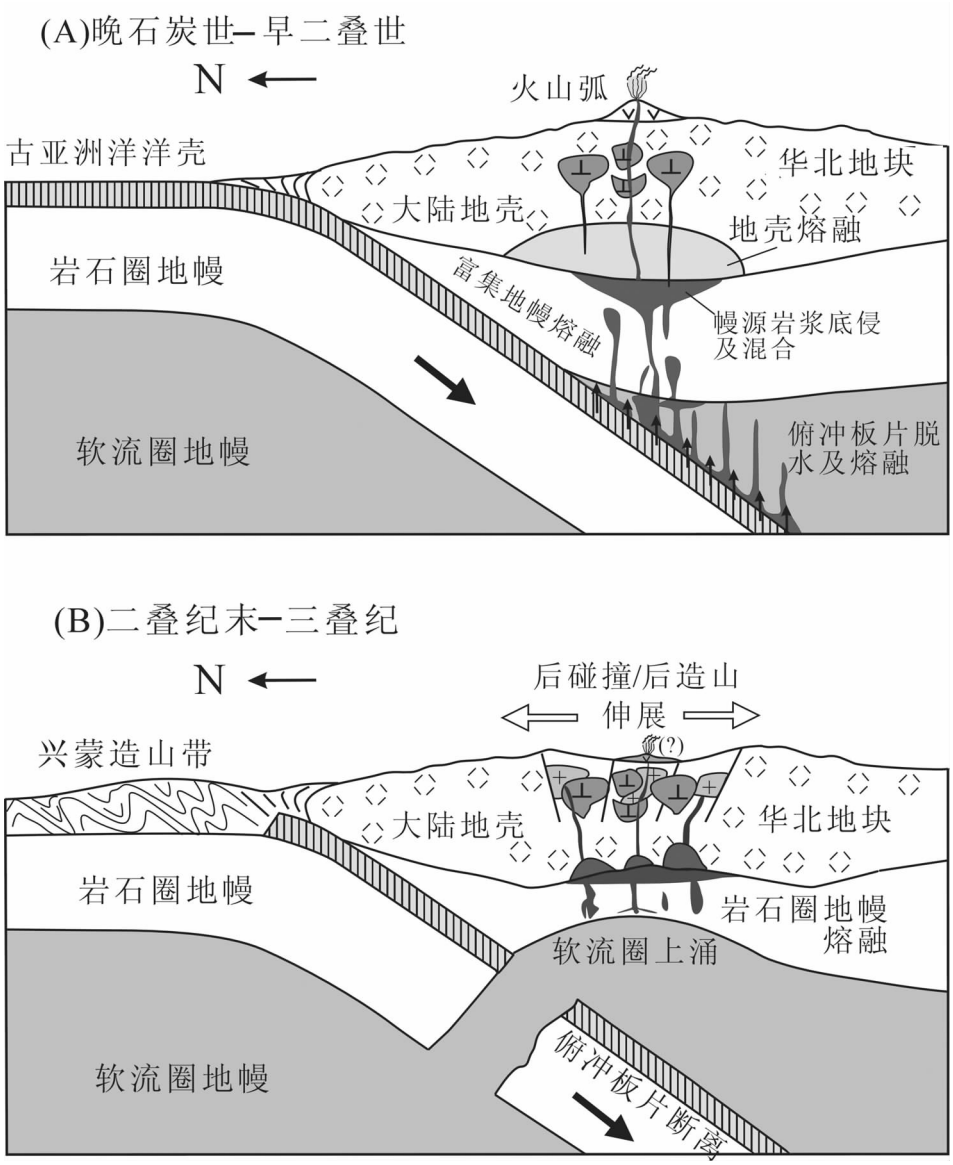

图 5 华北克拉通北缘晚古生代—早中生代岩浆岩形成模式图(据文献[52]修改)

Fig.5 Schematic diagram showing petrogenetic model of Late Paleozoic to Early Mesozoic magmatic rocks in the northern margin of the NCC

支持。

对华北晚古生代沉积盆地的研究结果表明,石炭纪末—二叠纪期间,华北地块北部沉积盆地已经由克拉通盆地转变为具有弧后性质的前陆盆地[64]。华北北部晚古生代沉积盆地碎屑锆石研究结果显示,在晚古生代沉积地层内,除来自太古—古元古代结晶基底岩系的锆石外,还存在大量的早石炭世末—二叠纪岩浆锆石[65-67],这些岩浆锆石的时代及 Hf 同位素特征等均与华北地块北缘内蒙古隆起上同时期的岩浆锆石相似[66,67],表明晚古生代期间内蒙古隆起上有大量的物质被剥露到南侧的盆地中沉积。

在华北克拉通北侧的兴蒙造山带,晚石炭世—早二叠世也存在古亚洲洋向北的俯冲,形成了位于索伦缝合带北侧的白音宝力道岛弧岩带[68-69]。说明晚石炭世—早二叠世古亚洲洋板块的俯冲消减可能是南北双向的。

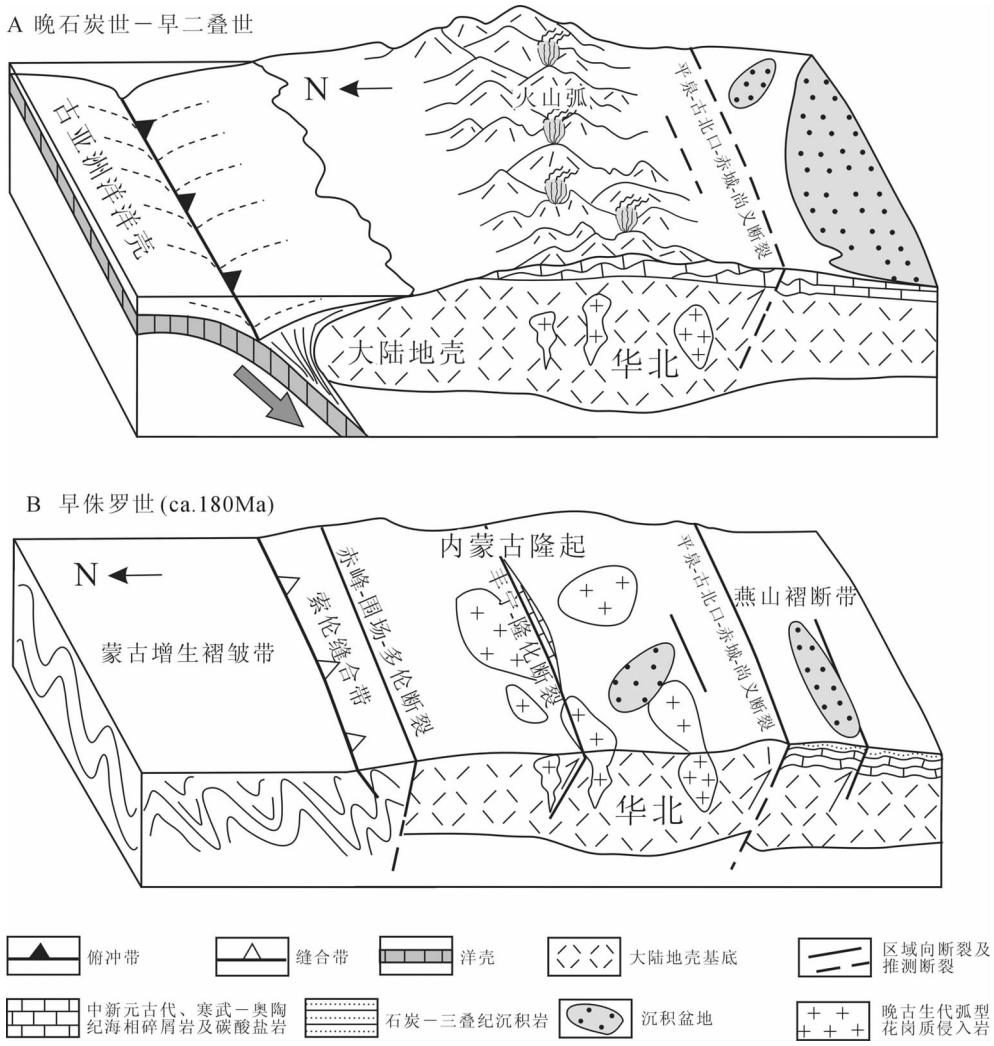

图 6　华北地块北缘晚石炭世–早侏罗世构造演化示意图(据文献[50]修改)

(A) 晚石炭世—早二叠世,古亚洲洋板块向华北地块俯冲,在华北边缘发育了安第斯型活动大陆边缘及火山弧。火山物质经风力及水力搬运,沉积于其南部沉积盆地中,形成了华北石炭—二叠纪地层中广泛发育的凝灰岩层。弧型花岗质侵入岩于15~18 km 深度侵位。在内蒙古隆起上可能发育了大量的中新元古界、下古生界地层。(B) 早侏罗世(ca. 180 Ma),大量的弧型花岗质侵入岩剥露到地表并被早侏罗世火山岩及煤系地层所覆盖。内蒙古隆起上的中新元古代、早古生代地层及晚古生代—早中生代火山岩被大量剥蚀,仅在丰宁—隆化断裂上残留了少量中元古代长城系沉积岩。早侏罗世火山岩年龄来源于文献[88]。FL: 丰宁—隆化断裂;PGCS: 平泉—古北口—赤城—尚义断裂;CWD:赤峰—围场—多伦断裂

Fig.6　Three−dimensional schematic diagram showing tectonic reconstruction of the northern margin of the NCB during Late Carboniferous and Early Jurassic (ca. 180 Ma)

(A) In the Late Carboniferous to Early Permian period, the Paleo−Asian oceanic plate subducted beneath the northern margin of NCB; an Andean−style continental arc developed and probably some volcanic ash was transported by wind and streams and redeposited in southern basins; arc granite plutons were emplaced at a depth of ca. 15−18 km; Meso−Neoproterozoic marine clastic and carbonate, and probably Cambrian−Ordovician marine clastic and carbonate and late Carboniferous volcanic rocks once existed in the Inner Mongolia Paleo−uplift (IMPU). (B) In the early Jurassic period (ca. 180 Ma), arc granite plutons were exposed at the surface and were unconformably overlain by early Jurassic volcanic and sedimentary rocks; Meso−Neoproterozoic, Cambrian−Ordovician marine clastic rocks and carbonate and late Carboniferous volcanic rocks within the IMPU were entirely eroded except for some Mesoproterozoic quartzite along the Fengning−Longhua fault. Age of early Jurassic rock from Davis et al. (2001)[88]. FL: Fengning−Longhua fault; PGCS: Pingquan−Gubeikou−Chicheng−Shangyi fault; CWD: Chifeng−Weichang−Duolun fault

5 二叠纪末—三叠纪初碰撞拼合及岩浆活动

古亚洲洋最终闭合的时间一直是国内外地质学家关注的热点之一。尽管目前对华北地块与蒙古增生褶皱带最终碰撞拼合时代还存在争议，但大量的多学科研究结果均支持华北地块与西伯利亚南缘蒙古增生褶皱带最终碰撞拼合时间为二叠纪末—三叠纪初期[35,36,48,68,70-79]，且最终缝合带位于索伦—林西(或西拉木伦)—长春—延吉一线，而不是一些学者所认为的索伦—贺根山一线[70,71]。但从空间上来看，华北地块与西伯利亚南缘蒙古增生褶皱带沿索伦—林西(或西拉木伦)—长春—延吉拼合的时间自西向东可能存在一定差异，西侧可能稍早于东侧。

华北克拉通北缘二叠纪末—三叠纪岩浆岩的分布范围也很广泛，岩性主要为钾长花岗岩、二长花岗岩及碱性杂岩，其次为基性-超基性岩及少量中-酸性火山岩，岩浆活动主要开始于~250 Ma。二叠纪末—三叠纪岩浆岩的岩石组合及地球化学特征均显示出后碰撞/后造山岩浆作用特征。岩石组成上有由二叠纪末—中三叠世以高钾钙碱性为主，向晚三叠世大量出现碱性岩及相伴的碱性超镁铁岩的演变的趋势。与该期岩浆作用相对应还有较多的多金属矿床形成[44,80-83]。与主要出露在内蒙古隆起上的石炭纪—二叠纪东西向侵入岩带明显不同，华北地块北缘二叠纪末—三叠纪岩浆岩带的分布范围更宽，其南界可达燕山构造带最南端的蓟县盘山、太行山北段的河北涿鹿及内蒙古中南部的凉城地区，表明三叠纪岩浆活动的影响范围更广。这套岩石的形成与华北地块与西伯利亚南缘蒙古增生褶皱带最终碰撞拼合后的后碰撞/后造山伸展作用有关(图 5-B)。

6 三叠纪—早侏罗世的构造变形

华北北缘三叠纪—早侏罗世的构造变形以京东盘山地区、辽西牛营子地区和冀北下板城地区的构造变形和盆地演化为例来说明。

盘山地区位于燕山褶断带的南部。盘山岩体是以花岗岩为主的复式岩体[84]，侵位时代 203~207 Ma[85]。岩体西侧为庄果峪向斜，蓟县系铁岭组组成核部，蓟县系雾迷山组组成两翼。东侧为府君山向斜，下寒武统府君山组和青白口系井儿峪组组成核部，雾迷山组和杨庄组组成两翼；庄果峪向斜和府君山向斜轴迹走向北北西，它们的中南部被走向北东东的蓟县断裂冲断，而盘山岩体穿刺侵入了蓟县断裂。但是，盘山岩体侵入的围岩呈同心环状围绕盘山岩体分布，被研究者称为同侵入的褶皱，或同褶皱的侵入[86]。在盘山岩体北部的红石坎村，可以观察到一个小背斜的两翼高于庄组和杨庄组层间有花岗斑岩岩床侵入。据此判断，这一岩床的侵位时代应当早于区域的褶皱变形。

为了准确限定盘山岩体侵位和区域褶皱与蓟县断裂逆冲时代，笔者选择盘山岩体郎家峪单元和红石坎花岗斑岩岩床测定其侵位时代。红石坎花岗斑岩的锆石 SHRIMP U-Pb 年龄为(214±3) Ma，郎家峪单元的侵入年龄为(210±4) Ma。由此确定区域重要的褶皱-逆冲断裂变形发生在(214~210) Ma。

晚三叠世的构造变形在燕山地区是强烈的。在辽西牛营子地区，三叠纪晚期—早侏罗世的逆冲推覆构造被中侏罗世的郭家店组角度不整合覆盖。笔者认为牛营子逆冲推覆构造控制了邓杖子组碳酸盐角砾和砾石的沉积。邓杖子组是一套崩滑流沉积。长度超过 4000 m 巨大的寒武系—奥陶系岩片崩落滑入盆地。滑覆在中元古代地层上的寒武系—奥陶系岩片长度达 7000 m，宽度近 2000 m(图 7)[87]。

在冀北下板城盆地，三叠纪时期的河流自东向西流经盆地。沉积相分析显示为一个较开阔的河谷。在造山带或褶断带，水系干流平行构造带方向发育。沉积环境和构造的剧变发生在早侏罗世早期。东西向的河流谷地被自北而南的冲积扇快速充填，物源分析说明盆地北侧“内蒙地轴”的华北克拉通基底结晶岩系快速剥露出来[63]。晚三叠世—早侏罗世的巨量剥蚀暗示着承德—古北口断裂的推覆和区域上这一时期的快速抬升。

7 结 语

华北克拉通北缘大陆边缘的发展从 1.35 Ga 开始，同时相邻大洋开始演化。早古生代时期，在华北克拉通北部的兴蒙造山带南部发育白乃庙岛弧岩带，但此期华北克拉通北部依然比较稳定。该岛弧岩带在早古生代末期可能通过弧-陆碰撞而增生到华北克拉通北部边缘。早中泥盆世期间，在华北克拉通北缘发育 410~380 Ma 的碱性杂岩，可能与弧陆碰撞后伸展有关。从晚石炭世(大约 320 Ma)开始，华北克拉通北缘发育成安第斯型活动大陆边缘，古亚洲

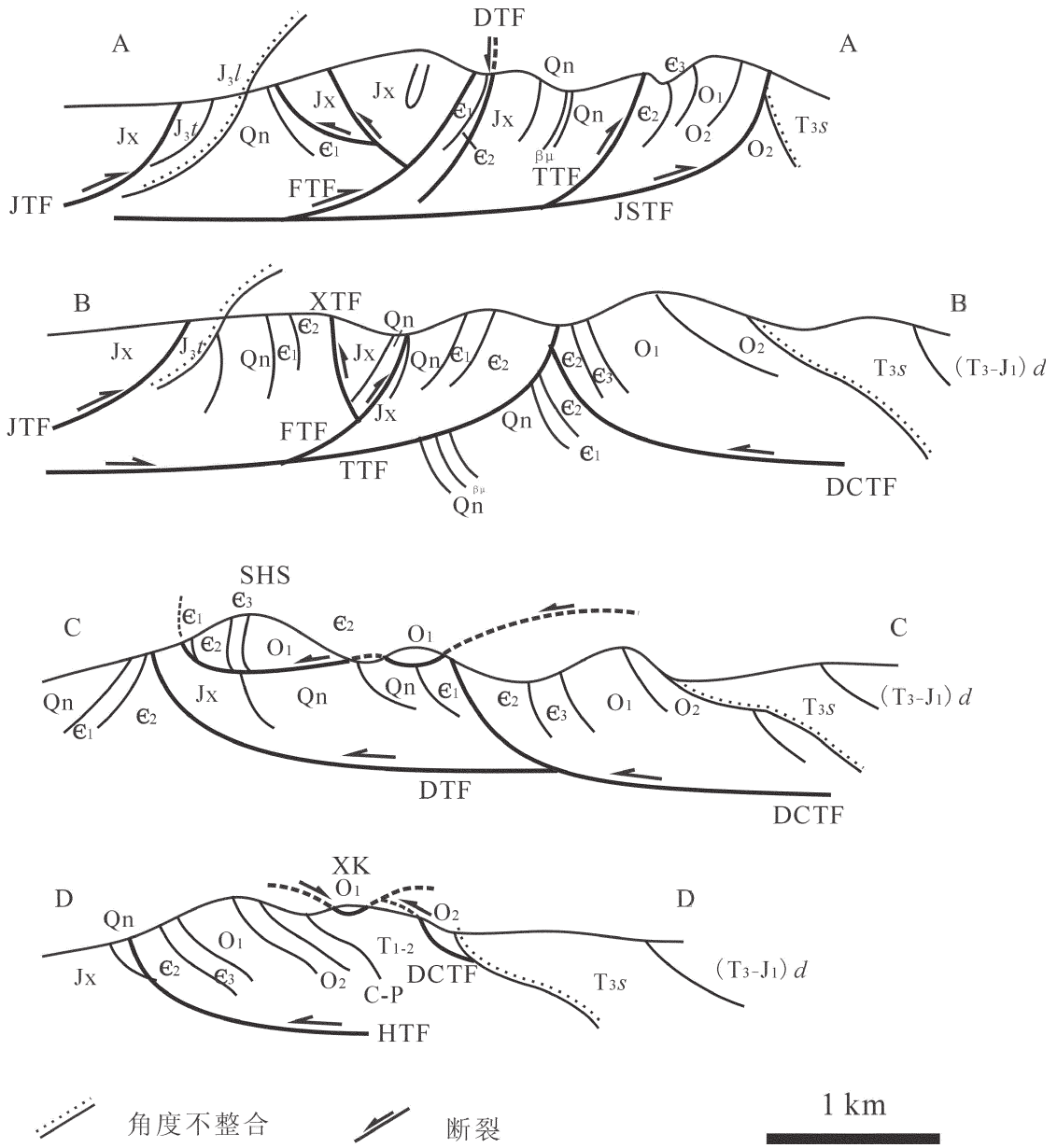

图 7　辽西凌源邓杖子—郭家店地区地质构造剖面图(据文献[87])

J_3t—晚侏罗世土城子组;J_3l—晚侏罗世蓝旗组;$(T_3-J_1)d$—晚三叠世—早侏罗世邓杖子组; T_3s—晚三叠世水泉沟组; T_{1-2}—中-上三叠统;C-P—石炭系-二叠系;O_2—中奥陶统; O_1—早奥陶统; ϵ_3—上寒武统;ϵ_2—中寒武统; ϵ_1—下寒武统; Qn—青白口系; Jx—蓟县系;DTF—东庄逆冲断层;HTF—侯杖子逆冲断层;DCTF—大崔洼逆冲断层;JSTF—金黄岭—三皇庙逆冲断层;TTF—太阳沟逆冲断层;FTF—范家沟逆冲断层;XTF—杏树沟逆冲断层;JTF—姜家沟逆冲断层;XF—西沟飞来峰; SHS—石灰窑子沟崩塌滑覆岩片

Fig.7　Geological section through Dengzhangzi-Guojiadian area, Lingyuan County, western Liaoning

J_3t-Late Jurassic Tuchengzi Formation; J_3l-Late Jurassic Lanqi Formation; (T_3-J_1)d-Late Triassic to Early Jurassic Dengzhangzi Formation; T_3s-Late Triassic Shuiquangou Formation; $T_{2-3}l$-Middle-Late Triassic Laohugou Formation; C-P-Carboniferous-Permian strata; O_1-Early Ordovician strata; O_2-Middle Ordovician strata; ϵ_1, ϵ_2, and ϵ_3-Early, Middle, and Late Cambrian strata; Qn-Qingbaikou System; Jx-Jixian System. DTF-Dongzhuang thrust fault; HTF-Houzhangzi thrust fault; DCTF-Dacuiwa thrust fault; JSTF-Jinhuangling thrust fault; TTF-Taiyanggou thrust fault; FTF-Fanjiagou thrust fault; XTF-Xingshugou thrust fault; JTF-Jiangjiagou thrust sheet; XK-Xigou Klippe; SHS-Shihuiyaozi Sliding Block

洋向南俯冲在华北克拉通之下。在相邻的兴蒙造山带古亚洲洋洋壳还存在向北的俯冲，形成了白音宝力道岛弧岩带。古亚洲洋沿索伦缝合带的最终闭合发生在二叠纪末—三叠纪初期。大约 250 Ma，华北克拉通北缘进入后碰撞的构造岩浆演化阶段，并形成重要的 Mo 矿床。晚三叠世—早侏罗世的区域褶皱和逆冲构造发育。盘山地区 214~210 Ma 的构造变形和岩浆侵入确切证明了这一点。由于三叠纪—早侏罗世华北克拉通北缘的大规模抬升，晚石炭世—二叠纪时期安第斯型大陆边缘形成的矿产几乎剥露殆尽。使得中侏罗世开始的成矿作用呈现前所未有的爆发之势，即所谓的“燕山期成矿大爆发”。华北克拉通北缘何时和如何从早古生代的被动大陆边缘转变为石炭纪中期开始的活动大陆边缘还需要今后进一步深入研究。

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Pre-Yanshanian geological events in the northern margin of the North China Craton and its adjacent areas

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Abstract: Recent researches on the northern margin of the North China Craton (NCC) and its adjacent areas have been mainly focused on the main pre-Yanshanian tectonic framework and the late Mesozoic tectonomagmatic evolution and lithosphere destruction. This paper gives a brief review on the previous research progress and future prospect in this aspect. The northern NCC has undergone multiple magmatic processes after its cratonization during ~1.8 Ga. Large volumes of 1.35-1.30 Ga mafic sill (dyke) swarms in northern NCC are related to the breakup of the NCC from the Columbia supercontinent and might indicate that the NCC was probably a member of Nena including the Laurentia (North America and Greenland), Siberia and Baltica cratons in the supercontinent. The evolution of the northern continental margin of the NCC was probably initiated at 1.35 Ga. During the Early Paleozoic, the Bainaimiao island arc belt was located to the south of the NCC. At the end of Early Paleozoic, the island arc was accreted to the NCC probably by arc-continental collision. Early-Middle alkaline complexes with emplacement ages ranging from 410-380 Ma in northern NCC are probably related to the extension after arc-continental collision between the NCC and the Bainaimiao arc terrane. From the Late Carboniferous (~320 Ma), the northern margin of the NCC became an Andean-style continental arc due to the southward subduction of the Paleo-Asian oceanic plate beneath the NCC. The southward subduction of the Paleo-Asian oceanic plate also occurred in the Xing-Meng orogenic belt during this period, which resulted in the formation of the Baolidao island arc. Final closure of the Paleo-Asian Ocean and collision between the Mongolian arc terrane and the NCC occurred during the latest Permian~earliest Triassic period with post-collison magmatism from ~250 Ma. During the Late Triassic~Early Jurassic period, the northern NCC is characterized by strong thrusting. In the early Jurassic, the Archean-Paleoproterozoic basement metamorphic rocks were widely exposed. The tectonic framework of the northern margin of the NCC and its adjacent areas was preliminarily established prior to the Yanshanian tectonism and magmatism.

Key words: northern margin of the North China Craton; geological event; Pre-Yanshanian; continental margin; magmatism

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