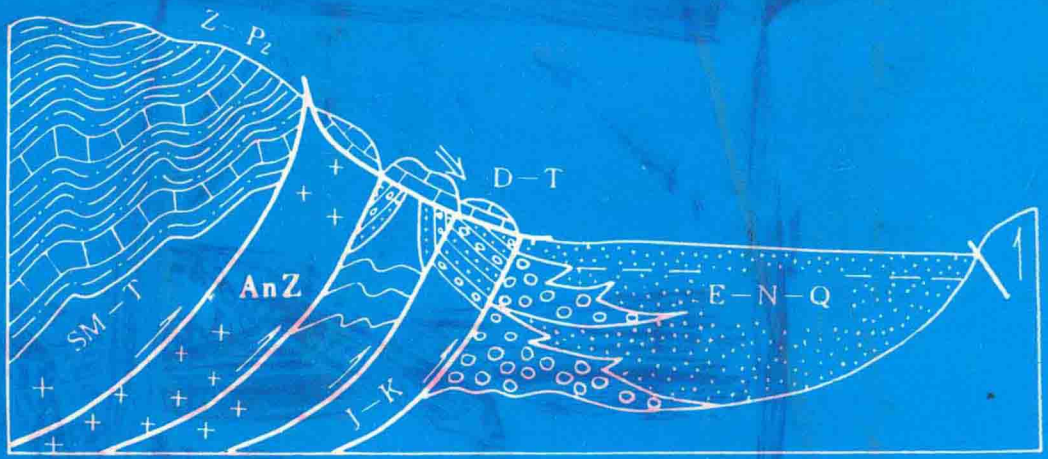
龙门山基础地质研究（Ⅰ）

龙门山中段地质

Longmenshan Zhongduan Dizhi

林茂炳 苟宗海 等著



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龙门山中段地质

林茂炯　苟宗海　王国芝　邓江红
李　勇　马永旺　王道永　石绍清　著
石　和　李永昭　胡新伟

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内容简介

本书是一本有关四川龙门山中段(彭州市、都江堰市、什邡、绵竹、汶川、大邑等县市)地区的基础地质调查及研究性论著。内容包括龙门山中段地区的地层、古生物、沉积特征、岩浆作用、变质作用、地质构造以及地质发展历史等方面的系统论述。本书是作者在 1∶5 万区域地质调查的基础上结合相关专题研究成果和八五、七五科研项目的成果,并吸收了有关石油、天然气等生产单位的成果编著而成。全书以板块构造、推覆构造为纲,以构造演化为主线,详细论述了龙门山的地质发展过程,提出了龙门山的造山模式具三段式特征。

本书是研究龙门山中段地质的一本资料丰富、理论性强、适用性广的专著。书末还附有有关旅游资源等的专门附录。全书图文并茂,资料、数据多,共约 35 万字。

本书可供地质专业科技人员参考,也可供相关地区采矿、水利、旅游开发、地震等单位参考。

龙门山中段地质

林茂炳　荀宗海　等著

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Geology in the Middle Sector of Longmen Mountains

Lin Maobing, Gou Zonghai, Wang Guozhi, Deng Jianghong,
Li Yong, Ma Yongwang, Wang Daoyong, Shi Shaoqing
Shi He, Li Yongzhao, Hu Xinwei

Press of Chengdu University of Science and Technology

前　言

这是一项以区域地质测量成果为依托、结合外围路线地质调查和点上解析为重点，整理并编辑以前科研成果为主所进行的一项综合性研究成果。林茂炳任题目负责人，主持全面工作。本书比较详细地论述了龙门山中段地区，尤其是彭灌地区的地层、构造、岩石、矿产、变质作用、岩浆作用和沉积作用的专门论著。全书共约35万字，由林茂炳、苟宗海、王国芝、李勇、邓江红、石绍清、王道永、马永旺、石和、胡新伟、李永昭等人参与工作。后期主要由林茂炳、苟宗海、王国芝、马永旺、胡新伟、李勇等人最终整理完成。

最后的资料整理及书稿编写工作安排如下：前言，绪论，地质发展史，结语由林茂炳编写；地层由苟宗海、李勇、石和、王国芝、邓江红、李永昭编写，苟宗海统稿；岩浆岩由邓江红编写；变质岩由王国芝编写；构造由林茂炳、马永旺、王道永、石绍清编写；沉积特征由李勇编写；附录Ⅰ、Ⅱ由苟宗海编写，附录Ⅲ由林茂炳编写。全书由林茂炳统稿。胡新伟参加了全部野外工作，负责组构及部分显微构造研究。

早期参加部分工作的尚有刘登忠、马玉孝、夏竹、卫管一、茅燕石、陆卫江、俞广等。本书在编写和形成过程中先后得到我院金景福、王成善、曾允孚、蔡学林、陈源仁、蔡元庄等六位教授和四川省地矿局姚冬生总工与方飞龙、王大可、路步英等三位高工的指导、帮助，作者在此一并致以真诚的谢意。

著　者

1996年1月

目　录

Contents

Geology in Middle Section of Longmen Mountains

Abstract

This book is devided into 7 parts. The introduction, stratigraphy, metamorphism, magmatism, structures, sediments and geological history of evolution. They are written by Lin Maobing, Gou Zonghai, Wang Guozhi, Deng Jianghong, Li Youg, Ma Yongwang, Shi Shaoqing, Shi He, Wang Daoyong, Li Yongzhao, Hu Xinwei and edited by Lin Maobing. It is mainly based on the data and the results of 1:50,000 scale regional geological mapping in the middle sector of Longmen Mountains and the associated researches in the adjacent regions which were finished before 1995.

I. **Chapter one**

Middle sector of Longmen Mountains is located on the west margin of Sichuan Basin. It is a mountainous region. The highest peak is more than 4000M. It can be devided into rear Mountain belt, Central Mountain belt and front Mountain belt. It is a complex region in geology, geography and climate, nationality and batany.

This is an important region for the geology, because its tectonic location is in a key locality rounded by East-West Qinling-Kunlun belt, Ganzi-Songpan fold belt, Kongdian North-South belt and Yangzi platform. Many geologists have paid more attention to this region. In 1920s～1930s people began to do geological research in this region. Coal measurges and klippen structures had been found at that time. Huang Jiqing, Zhu Sen, Ye Lianjun, Li Chunyu, et al are the earliest contributors.

Ⅱ. **Chapter two**

Stratigraphy of this region may be sepereted into two stratigraphic subdistricts. The strata in Sichuan Basin and Longmen Mts. Stratigraphic subdistrict includs metasedimentary rocks of Huangshuehe group in proteozoic era, sedimentary rocks (limestones, shales, mudstones and sandstones etc.) of palaeozoic to mesozoic era and a few uncemented deposits in quantennary. Strata in Markang substratigraphic region are mainly with low metamorphic rocks of sandstones, shales, mudstones and a few limestones and basult of S-T periods. We will discuss them as lithostraligraphy, bio-stratigraphy chronostratigraphy individully.

Ⅲ. **Chapter three**

Metamorphic rocks are distributed in two regions. One is in the central region of Mountains in Masongling district. It was mainly metamophored from the volcanic-sedimentary rocks of island arc origin at the age of early proteozoic time. It has been refolded later. It is mainly in green schist and now existed as an inclusion within the Pen-Guan Complex (igneous rocks) belonging to the Sibao-Chengjiang stage of metamorphism. It has been mixed with the serpentinite into a kind of tectonic melange. This is mainly metamorphosed by regional dynamical-geothermal metamorphism and overlying by late dynamic metamorphism. The next one is closed related to the formation of the ore deposits of copper within this region.

The second region is in the rear zone of Mountains west of Maowen fault. It is mamly in S-D and Triassic periods. They belong to the metamorphism of Indo-China orogeny. They are in low grade of green schist. The major rocks are phyllite. The main metamorphism is also the regional dynamic-geothermal metamorphism. That is part of the huge metamorphic zone which is developed as a metamorphic geothermal upheaval (bulge) named shanchanling metamorphic zone.

Ⅳ. Chapter four

Igneous rocks are formed all in proteozoic time except for some viens, named as Pen-Guan Complex. According to the pedigree relations, it can be devided into four super-units. Zhongtanbao super-unit, Xinwenpin super-unit, Taipinyi super-unit and Dahongbao super-unit And every super-unit also can be subdevided into several units. Such as Sangpin unit, Zhaojiaowan unit, masangpin unit, etc. Among them the Zhongtanbao super-unit is a complete series of rocks from basic to acid in Lithology. It is an evolutionary system of composition representing an origin of primary continental crust and island arc environment. Xinwenpin super-unit is a textural evolution system from gabbro to quartz diorite which indicate the same origin and environment as the one above. Taipinyi super-unit is mainly consisted of monzonitic granite and represents a series of textural evolution. It is formed in the origin of matural continental crust. Dahongbao super-unit is mainly formed by feldspar granit from acid to alkaline property. It represnts a forming environment of orogenic rift with a relatively extensional origin, Accompanied with the volcanic rocks of sinian system of the origin of continental rift in front of the Mountains the whole igneous rocks of proteozoic era are represented a complete orogenic process of this region and with a distinctive evolutionary law from South west to Northeast from old to young in age, from basic to acid in lithology.

Ⅴ. Chapter five

Structures in middle sector of Longmen Mountains are very typical. It can be called a huge thrust-nappe tectonic belt. It may be devided into nappe tectonic belt and sliding blocks according to the mechanism of formation. From northwest to southeast they are named Zhenghe folded nappe tectonic belt, Maowen-Genda ductile folded nappe tectonic belt, Yinxiu-baishuihe brittle-ductile thrust nappe belt, Pen-Guan brittle thrust nappe belt etc. and sliding blocks zone overlying the Pen-Guan brittle thrust nappe belt. The first one is not belonging to the Longmen Mountains itself. The others are formed from northwest to southeast from earlier to younger with an expanding manner of piggy-back type and the Tethys' component (Zhenghe nappe) is thrusted and napped above the components of Longmen Mountains later. So they are contacted with a tectonic relations. A typical important thing of this region is the co-existance of nappes and sliding blocks at the same location and form a special overlying Model between nappes and sliding blocks in the region of frontal mountain belt. That means the sliding blocks superposed on the Pen-Guan thrust-nappe belt. In this way to form a dauble layered allochthous structures. Sliding blocks Changed into lots of klippen later. The overlying manner of throse

sliding blocks are variety so it also can be subdevided into different types. It formed from Indo-China movement to Himalayian movement.

Ⅵ. **Chapter six**

Foreland Basin of Longmen Mountains is close related to the Mountain biulding itself and form a whole system. The fillings of basin are the results of the uplifting of the mountain. The composition, texture and the contact relations of different basin are the respondses or records of the Mountain buildings, especially for the thrusting and napping processes. From late triassic system to cenozoic group 5-6 structural stratigraphic sequences have been established that give an outlines of the episoids of thrusting or napping and four kinds of basins have been distingished. In this way we seperated the thrusting and napping into four times or stages.

Ⅶ. **Chapter seven**

Based on the foregoing study of different aspects, the evolutionary history of Longmen Mountains have been changed gradually.

At the time of proteozoic era Longmen Mts. is in a subducted or collision stage between an oceanic plate and a continental plate. At that time there developed island arc volcanic eruption and tectonic melange, the Pen-Guan Complex, serpentinite and metavolcanic rocks of Huangshihe group.

The secondary stage was the formation of the broad Yangzi platform in the palaeozoic era. This stage lasted a long time from Sinian period to early Triassic period of early Mesozoic era in a huge region. Its west edge may reach to the present Jinsha River at least. The composition is mainly in the marine facies. For instance the carbonate rocks and clastic rocks as well as some mudstones and shales. Contacted relations are normally. It indicate the palaeocondition was warmer in climate and relatively stable of continental margin. At the western part some continental rifts or Alacgens occured in S-D to P period, in which the sediments of semigeosynclinal facies deposited as a kind of semiflych.

The third stage was in Indo-China orogeny. The whole broad Yangzi platform has been uplifted and folded into a continent to form folded Longmen Mountain belt in a direction of North-East. At the same time the Tethys ocean enlarged towards the east partly overlying on the components of Yangzi platform.

The fourth stage is in Yanshanian. That is a fast uplifting for the whole Longmen Mountains and its northwestern plateau. The foreland basin formed and mainly filled with red contiental deposits. Also some mesozoic granite bodies intruded in the North west plateau. Thrusting and napping started with the folding of Indo-China movement and Yanshan movement.

The last stage is in Himalayian orogeny. It was the strongest mountain building period. Accompanied with the uplifting of the Qingzang plateau (plate) the compressional force translated to the Longmen Mountains and let the mountain system into the strongest stage of thrusting and napping towards the South East. That is the last

strongest mountain building process (nappe orogeny). This process give a great distroy for the folded Longmen Mountatin system of Indo-China orogeny. That is why the present structures are mainly full of faults (thrusts and nappes). At the last time of this stage some gravitational sliding occured. Rock blocks (sliding blocks) distributed on the frontal thrust nappe belt forming an overlying Model between nappes and sliding blocks. Those process shorttened the crust of this region and the Mountain system getting more uplifting. This is called nappe orogeny.

In summary, the Longmen Mountain system were built by three stages' orogeny. The collision orogeny of interplate, fold orogeny and nappe orogeny of intraplate.

第一章　绪　论

一、目的及任务

龙门山中段是我国重要造山带的一部分，又紧邻大城市和四川省经济发达地区，是今后从事地质研究和矿产资源及环境工程建设的重要地区。过去的工作已有相当成绩，但结合国家新一轮的区调工作要求进行全面研究尚属首次。作者有幸在七五期间在此区域及中北段和南段部分地区从事了以找油气为中心的科学研究和1∶5万区调工作。八五期间又在本区中段进行了1∶5万的区域地质调查和配合扬子地台西缘地区的矿产资源评价工作，并取得了外围的路线地质调查资料，从而积累了较为丰富的研究成果和最新的测试数据。运用板块构造观点，以构造为纲，从地层、岩浆活动、变质作用和沉积作用、构造运动等诸方面综合分析，系统阐述本区地质和构造发展历史，追溯龙门山隆升崛起过程和造山作用特征已有一定可能。为了完成此项任务，组成了由构造、地层、岩石、沉积学等方面的人员参加的研究队伍，结合我院承担的映秀、大宝山、海窝子和都江堰等幅1∶5万区调任务及扬子西缘龙门山地区铜及多金属资源评价等工作，从野外填图、路线地质考察和重点地区剖析的基础上，进行了全面总结归纳，构成本书文稿的基本内容。

二、工作区范围、位置及自然地理状况

工作区位于龙门山中段，涉及绵竹、什邡、彭州市、都江堰市、崇州市、大邑县、汶川、理县等县市。总面积达9000km²，地跨平原、丘陵、低山、中山及高山区，其中白水河地区及映秀地区多为无人区，地形切割强烈，交通不便，森林茂密，最高处达4141m，工作条件十分艰苦。尤其是岩浆岩及变质岩区多半位于2000m 以上地区，露头极差(图1-1)。

全区气候复杂，地形多变。东部夏季多雨，最高气温31℃左右，冬季气温达－2～－3℃。西部普遍较为干燥，气温偏低，夏季在20～25℃间，冬季可达－5～－8℃。因此本区低中山区及丘陵区仍属亚热带－温带气候区。而中高山区则已属寒温带－亚寒带气候类型。3000～3500m 以上地区植被类型以针叶林为主，并逐渐过渡到高山草甸带。

经济发展不平衡，东南部地理条件较好，人烟稠密，耕地较好，普遍为农耕区，以稻谷、小麦、玉米为主。最东南边缘地区离城镇较近，有比较发达的蔬菜种植业，是全国蔬菜种植基地和蔬菜集散地之一。中部地区以彭州市及都江堰市所辖的中低山及丘陵地区为主，除仍以农业为主外，兼有较为发达的小矿山小乡镇企业，主要从事煤炭、石灰石(水泥原料)等矿山开采和水泥生产。东北部白水河地区有小规模的蛇纹石、石棉及铜矿采矿事业，但由于储量不大，除蛇纹矿外多已转入乡镇企业及个体私营无计划采伐或手工采掘。西部映秀等地主要为中高山区，除公路沿线局部有农业种植外，几乎没有其他产业。森林砍伐均属无计划的乱伐，倒是河谷流急，水电建设发达，水力资源丰富。此外近年来旅游事业逐渐发达。已有银厂沟旅游区，丹景山旅游点，灌县龙池森林公园(亚高山植物园)和耿达一卧

龙大熊猫自然保护区和繁殖基地，灌县都江堰水利工程及二王庙公园等也是著名旅游区和科学研究中心。

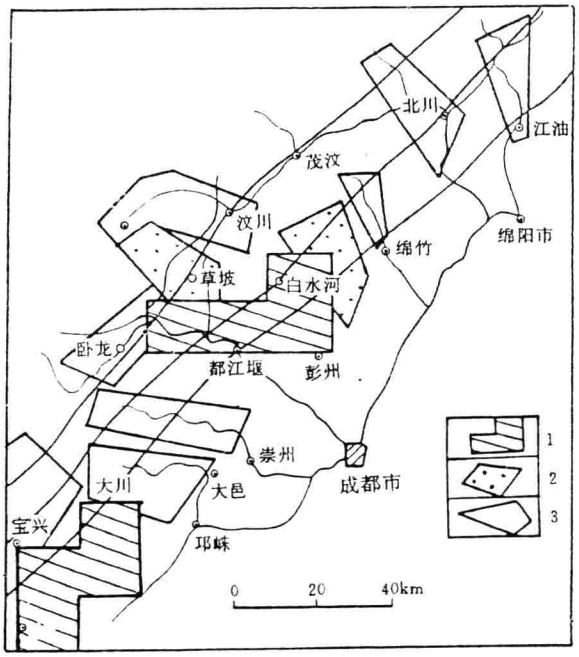

图1-1　研究工作区位置简图

1.1∶5万填图区域；2.重点研究区域；3.路线地质研究区

三、地质研究历史

龙门山区的地质研究早在三十年代即已开始(表1-1)，黄汲清、李春昱、朱森、叶连俊等首先在龙门山的前山带从事以找煤为中心的区域地质考查工作，对于前山带煤矿资源的开发和地层划分进行了开创性的工作，并首先在彭灌地区发现了众多的飞来峰构造。新中国成立后先后有中国科学院、大渡河地质队、温江队、阿坝队、地质矿产部、冶金部、建材部、石油部、成都地质学院、中国地质大学、南京大学等单位在区内开展了不同比例尺的科学研究工作和矿产普查工作，对于区内的基础地质研究提出了较多新认识。最具系统性的调查研究工作是由四川省地矿局区域地质调查队于60～70年代完成的包括本测区在内的1∶20万的茂汶幅和灌县幅的工作，较系统地建立了本区的地层系统和构造轮廓，这是新中国成立后迄今为止在本区所进行的最具建树性的基础地质工作，至今仍有重要参考价值。文革以后祖国进入了改革开放的大发展时期，随着矿产资源、油气地质、环境工程和旅游事业的发展，四川省地质矿产局、成都地质学院、中科院地质所、地科院、南京大学、中国地质大学、地矿部西南石油局、建材部、冶金勘探公司等都投入了大量勘查和研究工作，引进了先进的理论和方法。近年来先后有赵友年、罗志立、刘肇昌、刘和甫、林茂炳、许志琴、刘树根、陶晓风、侯建勇等在本区运用板块构造观点、推覆构造观点、韧性剪切带及地体等学说在本区从事了大量研究工作，大大深化了对区内基础地质的研究程度，为在本区开展1∶

5万的区域地质调查工作，奠定了坚实基础，也使新一轮1:5万区调工作的起点大大提高了一步(表1-1)。

表1-1 研究程度表

工作日期	作者或单位	工作内容或资料名称
1931	谭锡畴、李春昱	路线调查。(西康地质志)
1955	四川地质局温江队	灌县懒板凳地区铁矿初勘
1955	昆明地质勘探公司304队	彭县白水河大宝山铜矿详查
1956	昆明勘探公司403队	彭县宝兴乡牛家山一带镍矿初查
1956	昆明地质勘探公司304队	彭县宝兴乡牛家山一带镍矿初查
1959	西南煤田勘探局地质三队	四川西部煤矿初勘
1959	四川省地质局温江队	懒板凳铁矿区铁矿初勘，彭县煤田煤矿初查
1959	四川省地质局石油普查大队	四川盆地龙门山及前山带石油普查
1960	四川省地质局402队	茂汶草坡乡山葱林白云母矿初勘
1960	四川省地质局阿坝队	四川茂汶漩口煤矿详查
1960	四川省地质局201队	彭县煤田普查及勘探设计
1960	四川省地质局温江队	灌县麻溪九甸坪铝土矿详查
1961	四川省地质局温江队	彭县灌县广汉后山地区综合普查
1961	四川省地质局205队	彭县白水河煤矿初查
1961	四川省地质局201队	彭县老君山煤田煤矿初查
1962	四川省地质局201队	灌县煤田赵公山区煤矿初查
1962	四川省地质局205队	彭县煤田利民，白鹿井田煤矿初查
1963	四川省地质局温江队	广汉什邡煤田外围初查(1:5万)
1963	四川省地质局201队	广汉什邡煤田外围初查(1:5万)
1965～1977	成都地质学院实习站	彭县关口一银厂沟地区地质地貌特征综合考查
1975	彭铜科研组	白水河马松岭矿区铜矿勘查及矿区区域地质调查
1976	成都地质学院	四川省内生金矿、铜镍矿成矿预测
1978	四川区测队	《四川省构造体系图及说明书》
1966～1975	四川省地质局第二区测队	1:20万灌县幅茂汶幅区域地质调查
1983	王振荣等	四川彭县地区推覆构造及其成因
1984	刘肇昌、代真勇	四川彭县推覆构造的特征与形成
1984	林茂炳	龙门山中南断逆冲断裂带及飞来峰构造
1984	周济元	论龙门山地区构造体系的演变及其形成机制
1984	王振荣	龙门山褶皱带的构造演化
1985	赵龙年等	龙门山推覆构造之初步研究
1985	詹行礼等	川西龙门山彭灌杂岩花岗岩成因类型及其构造环境初步探讨
1988	李远图	龙门山南西段飞来峰构造的基本特征
1988	侯建勇	四川彭灌地区推覆构造形成特征
1988	陶晓风	四川彭灌地区映秀断裂带构造分析
1986～1989	罗志立、龙学明等	《龙门山中北段(灌县一广元)晚古生代以来地史发展和变形特征研究报告》
1986～1989	林茂炳、吴山	龙门山中北段推覆构造研究报告
1986～1989	丁伟明等	龙门山中北段遥感图像地质解译及分析
1986～1989	罗志立	龙门山中北段重点剖面的地质和地球物理解释
1991	罗志立	《龙门山造山带岩石圈演化的动力学模式》
1991	龙学明	《龙门山中北段地史发展的若干问题》
1991	杨季楷	《彭县海窝子须家河组第四段的研究》
1991	崔炳荃等	《川西坳陷的沉降与龙门山的崛起》
1991	林茂炳、吴山	《龙门山推覆构造变形特征》
1991	张金熔、丁伟明	《龙门山中北段遥感图像解译的新发现》
1991	宁鸿度、刘树根	《龙门山中北段重磁场特征与深部构造的关系》

第二章　地　层

本区出露的地层在地层分区上分属于龙门山及四川盆地分区(大宝山幅、海窝子幅、都江堰市幅)、马尔康地层分区(映秀幅)。前者出露的地层有元古界的黄水河群和震旦系、古生界的泥盆系、石炭系、二叠系、中生界三叠系、侏罗系、白垩系和新生界第四系。其中元古界和中、新生界主要分布于大宝山幅和海窝子幅，古生界主要出露于都江堰市幅。而古生界和三叠系早期地层又以飞来峰形式展布于本区内。马尔康地层分区的地层主要为上古生界(D－P)变质岩系及少量中、新生界(T、Q)非变质岩系，分布于映秀幅的西南部。

岩石地层单元的建立，是在1:20万区测所建立的地层单位基础上，进一步根据全国大区地层清理原则方案和结合本测区的实际情况而最后确定的，全区岩石地层单元系统见表2-1，2-2。

一、龙门山及四川盆地地层分区*

(一)岩石地层

1. 下元古界黄水河群(PtH)

分布于本区白水河幅西北角，呈捕虏体形式存在于晋宁－震旦期花岗岩中，与岩体呈侵入接触关系。按其岩石组合特征将其分为黄铜尖子组和关防山组。

(1)黄铜尖子组(PtHh)

黄铜尖子组系张洪刚、李承炎(1983)命名于芦山县快乐乡黄铜尖子。后经四川省地层清理委员会(1990)重新清理后，重新定义为原始定义的上段，岩性以灰、灰绿、褐灰等色的各种片岩为主，绿帘角闪岩为次的变质地层，与下伏干河坝组的接触关系为整合或断层。

本区黄铜尖子组主要分布于白水河镇北西侧的大坪、回龙沟、红岩、马松岭一带，厚度＞2446.4m。与层型剖面相比，本区部分变质岩系遭受过强烈塑性变形，使其变为不同变形程度的糜棱岩、初糜棱岩和变晶糜棱岩。对这类岩系在剖面描述中将按其变形前的母岩的岩性予以描述。现以三岔河－回龙沟剖面为例，从新到老描述如下(图2-1)：

上覆地层　关防山组　(PtHg)

灰色、灰白色大理岩、含石墨大理岩夹少量石墨片岩　77.3m

═══断　层═══

黄铜尖子组(PtHh)

第四段(Hh⁴)

21. 上部为灰、绿灰色角闪斜长片岩夹深灰色、灰绿色斜长角闪片岩、斜长石英片岩；下部为灰绿色、深灰色斜长角闪片岩、斜长阳起片岩夹角闪斜长片岩　314.1m

20. 灰色、褐灰色黑云绿泥钠长变粒岩夹钠长阳起片岩、偶尔夹黑云变粒岩　64.7m

19. 绿灰色绿泥钠长变粒岩和灰色含石榴黑云石英片岩、白云石英片岩及钠长石英片岩呈不等厚互层状　286.8m

18. 灰色黑云变粒岩与墨绿色黑云钠长片岩不等厚互层，常夹绿灰色钠长阳起片岩和阳起钠长片岩、灰白色浅粒岩　131.4m

17. 灰绿色绿泥阳起钠长片岩、绿泥钠长片岩夹深灰色钠长阳起片岩　91.3m

═══断　层═══

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* 表2-1