岩石学报
ACTA PETROLOGICA SINICA

张建新,于胜尧,孟繁聪,李金平. 2009. 造山带中成对出现的高压麻粒岩与榴辉岩及其地球动力学意义. 岩石学报, 25(9): 2050-2066

造山带中成对出现的高压麻粒岩与榴辉岩及其地球动力学意义

作者	单位
张建新	中国地质科学院地质研究所, 北京 100037
于胜尧	
孟繁聪	
李金平	

基金项目：国家自然科学基金项目(40772138, 40472102)、中国地质科学院地质研究所所长基金(J0804)和中国地质调查局地质调查项目(1212010611811,1212010711816)资助

摘要：

在一些典型碰撞造山带中,高压麻粒岩与榴辉岩在空间和时间上密切相关,它们之间的关系对揭示碰撞造山带的造山过程和造山机制具有重要意义。本文以中国西部的南阿尔金、柴北缘及中部的北秦岭造山带为例,详细陈述了这3个地区榴辉岩和相关的高压麻粒岩的野外关系、变质演化和形成时代,目的是要建立大陆碰撞造山带中榴辉岩和相关高压麻粒岩形成的地球动力学背景模式。南阿尔金榴辉岩呈近东西向分布在江尕勒萨依-玉石矿沟一带,与含夕线石副片麻岩、花岗质片麻岩和少量大理岩构成榴辉岩-片麻岩单元,榴辉岩中含有柯石英假象,其峰期变质条件为P=2.8~3.0GPa, T=730~850℃,并在抬升过程中经历了角闪岩-麻粒岩相的叠加; 大量年代学研究显示其峰期变质时代为485~500Ma。南阿尔金高压麻粒岩分布在巴什瓦克地区,包括高压基性麻粒岩和高压长英质麻粒岩,它们与超基性岩构成了一个大约5km宽的构造岩石单元,与周围角闪岩相的片麻岩为韧性剪切带接触。长英质麻粒岩和基性麻粒岩的峰期组合均具有蓝晶石和三元长石(已变成条纹长石),形成的温压条件为T=930~1020℃,P=1.8~2.5GPa,并在退变质过程中经历了中压麻粒岩相变质作用叠加。锆石SHRIMP测定显示巴什瓦克高压麻粒岩的峰期变质时代为493~497Ma。都兰地区的榴辉岩分布柴北缘HP-UHP变质带的东端,在榴辉岩和围岩副片麻岩中均发现有柯石英保存,形成的峰期温压条件为T=670~730℃和P=2.7~3.25GPa,退变质阶段经过了角闪岩相的叠加; 榴辉岩相变质时代为420~450Ma。都兰地区的高压麻粒岩分布在阿尔茨托山西部,高压麻粒岩包括基性麻粒岩长英质麻粒岩,基性麻粒岩的峰期矿物组合为Grt+Cpx+Pl±Ky±Zo+Rt±Qtz,长英质麻粒岩的峰期矿物组合为: Grt+Kf+Ky+Pl+Qtz。峰期变质条件为T=800~925℃,P=1.4~1.85GPa,退变质阶段经历了角闪岩-绿片岩的改造,高压麻粒岩的变质时代为420~450Ma。北秦岭榴辉岩分布在官坡-双槐树一带,榴辉岩的峰期变质组合为Grt+Omp±Phe+Qtz+Rt,所计算的峰期温压条件为T=680~770℃和P=2.25~2.65GPa,年代学数据显示榴辉岩的变质时代为500Ma左右。北秦岭高压麻粒岩分布在含榴辉岩单元的南侧松树沟一带,包括高压基性麻粒岩和高压长英质麻粒岩,与超基性岩在空间上密切伴生,高压麻粒岩的峰期温压条件为T=850~925℃,P=1.45~1.80GPa,锆石U-Pb年代学研究显示其峰期变质时代为485~507Ma。以上三个实例显示,出现在同一造山带、在空间上伴生的高压麻粒岩和榴辉岩有各自不同的变质演化历史,但榴辉岩中的榴辉岩相变质时代和相邻的高压麻粒岩中的高压麻粒岩相变质作用时代相同或相近,这种成对出现的榴辉岩和高压麻粒岩代表了它们同时形成在造山带中不同的构造环境中,即榴辉岩的形成于大陆俯冲带中,而高压麻粒岩可能形成在俯冲带之上增厚的大陆地壳根部。

英文摘要：

In some typical collision orogens, high-pressure granulites are spatially and temporally associated with eclogites. Understanding the relationship between eclogites and high-pressure granulites can provide crucial constraints on the orogenic process and mechanism in the continental collision orogens. This contribution presents the field relationships, metamorphic conditions and chronological data from three areas (South Altyn, North Qaidam and North Qinling) to establish a tectonic model for the formation of high-pressure granulites and associated eclogites in continental collision orogens. South Altyn Tagh (SAT) eclogites occur in the Yushikuanggou-Jianggeleshiyi area near Qiemo. These eclogites and associated sillimanite-bearing gneisses, granitic gneisses and small amount of marbles form an eclogite-gneiss unit. Quartz pseudomorphs after coesite have been recognized in the SAT eclogites. Peak *P-T* conditions have been estimated at 2.8~3.0GPa and 730~850℃. Subsequent retrogression overprint developed under amphibolite-granulite facies conditions. Geochronology interpreted to reflect eclogite-facies metamorphism yields ages between 485 and 500Ma. SAT high-pressure granulites, located at the Bashiwake area, consist of mafic granulites and felsic granulite. The granulites and enclosed ultramafic rocks compose a HP/HT metamorphic unit about 5 km wide, bounded by sinistral strike-slip shear zones against amphibolite-facies gneisses that lack evidence for high-pressure metamorphism. Peak metamorphic assemblages of high-pressure granulites contain ternary feldspar (now mesoperthite) and kyanite. Thermobarometry indicates that they experienced peak *P-T* conditions of 930~1020℃ and 1.8~2.5GPa, and postdated by a medium- high-pressure granulite facies overprint. Zircon SHRIMP geochronology dated the high-pressure facies metamorphic events at 493Ma to 497Ma. Dulan eclogite unit is located at eastern end of North Qaidam HP/UHP metamorphic belt. Coesite inclusions have been recognized in both eclogites and paragneisses, and are also supported by *P-T* estimates of peak conditions of eclogites (2.7~3.25GPa, 670~730℃). Subsequent retrogression overprints were suggested to occur under amphibolite facies conditions. Geochronology interpreted to reflect eclogite-facies metamorphism yi

elds ages between 420Ma and 450Ma. Dulan HP granulite unit, located at the western part of Aercituoshan, mainly consists of mafic granulites and felsic granulite. Mineral assemblages in equilibrium in mafic granulites contain mainly garnet, clinopyroxene, kyanite, plagioclase, zoisite/clinozosite, rutile and quartz, whereas felsic granulites contain garnet, kyanite, K-feldspar, plagioclase and quartz. Thermobarometry of the peak mineral assemblages yields *P-T* conditions of 1.4~1.85GPa and 800~925℃, postdated by subsequent retrogression under amphibolite facies-greenschist facies conditions. High-pressure granulite facies metamorphism was estimated to have occurred at ca. 450Ma. North Qinling eclogites occur along Guanpo-Shuanghuaishu with near east-west trend in the North Qinling orogens. North Qlinling eclogites contains peak assemblages of Grt+Omp±Phe+Qtz+Rt, yielding peak metamorphic conditions at 2.25~2.65 GPa and 680~770℃. Geochronological data suggest eclogite facies metamorphism took place ca. 500Ma. North Qinling high-pressure granulite is situated in the Songshugou, southern side of eclogite-bearing unit. Mafic granulites and felsic granulites are spatially associated ultramafic rocks. Peak *P-T* conditions were estimated at 1.45~1.80GPa and 850~925 ℃. Zircon U-Pb datings indicate peak high-pressure granulite facies event occurred between 485Ma and 507Ma. The three examples above indicate that high-pressure granulite and spatially close eclogite experienced contrasting metamorphic histories but granulite-facies conditions in high-pressure granulite and eclogite facies onditions in eclogites developed at the same time. This possibly implies that high-pressure granulites and eclogites formed in different thermal environments, i.e. eclogites in continental subduction slabs, whereas high-pressure granulites at the base of the overriding continent crust thickened as a result of continental subduction.

关键词：高压麻粒岩 榴辉岩 碰撞造山带 南阿尔金 柴北缘 北秦岭 大陆俯冲

投稿时间： 2008-12-12 最后修改时间： 2009-03-01