

ing the Middle and Late Jurassic. The uplift rate in the Middle Jurassic,  $77-88 \text{ m/Ma}$ , is correspondingly faster than that in the Late Jurassic, less than  $37 \text{ m/Ma}$ . This slowing down tendency reflects the gradual decay of the intensive uplift at the boundary time of the Early and Middle Jurassic. The zircon and apatite fission-track age pairs show the exhumation rate is normally less than  $55 \text{ m/Ma}$  since the Middle Jurassic. Meanwhile, the rock exhumation rate is basically at the same quantity grade as that of its uplift rate, implying that its exhumation and uplifting were in equilibrium on the whole.

**Key words:** east segment of the eastern Kunlun; Mesozoic; uplift and exhumation; zircon and apatite fission-track chronology.

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## 喜马拉雅造山带中段深成相和超浅成相超镁铁岩的发现及意义

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青藏高原众多的蛇绿岩带中出露大量的超镁铁岩, 这与特提斯的形成和演化密切相关. 然而在长达 2 000 km 的喜马拉雅造山带内部没有超镁铁岩的报道, 也没有找到新生代的火山岩. 最近我们通过 1:25 万定结幅、陈塘区幅(国内部分)区域地质调查, 首次在喜马拉雅造山带中段定结一定日一带发现晚新生代不同类型的超镁铁岩, 主要是深成相的尖晶石橄榄方辉岩、尖晶石橄榄二辉岩和超浅成相的苦橄玄武岩、玻基辉橄岩, 常与高压基性麻粒岩伴生. 它们是喜马拉雅和青藏高原软流圈及岩石圈的结构和热状态、壳幔相互作用的一个窗口.

深成相和超浅成相的超镁铁岩主要产于喜马拉雅造山带核部的变质杂岩中, 区域上超镁铁岩沿着伸展性和走滑式的剪切带或断层带分布, 围岩以片麻岩、石英片岩、石英岩、大理岩为主, 在特提斯喜马拉雅沉积岩系中也见到超浅成相超镁铁岩.

尖晶石橄榄方辉岩、尖晶石橄榄二辉岩以大小不等的透镜体或脉状体的形式产出, 具有不同程度的角闪石化和应变局部化. 在强应变带, 橄榄石定向排列; 颗粒细粒化, 出现亚颗粒和新生颗粒; 扭折带发育. 在弱变形岩石中, 斜方辉石呈粗大的柱状自形

晶, 颗粒之间充填细粒的橄榄石和被角闪石交代的单斜辉石, 显示变余堆晶结构, 原岩可能为超镁铁质堆晶岩. 通过 SHRIMP 测得尖晶石橄榄方辉岩中锆石  $^{206}\text{Pb}/^{238}\text{U}$  年龄平均值为  $(16.71 \pm 0.54)\text{Ma}$ , 这个年龄与其伴生的高压基性麻粒岩中的一组为  $(17.6 \pm 0.3)\text{Ma}$  的锆石  $^{206}\text{Pb}/^{238}\text{U}$  年龄值接近, 表明超镁铁岩岩体的形成与喜马拉雅造山带的构造隆升及其相关的伸展拆离作用、淡色花岗岩侵入同时, 并与该区晚新生代壳幔反应和圈层耦合密切相关.

苦橄玄武岩和玻基辉橄岩沿着活动断层带呈岩筒状产出. 灰黑色的苦橄玄武岩具有特殊的岩相学特征, 在光学显微镜下可见其典型的鬃刺结构, 橄榄石斑晶局部集中, 其间为玻璃质充填, 发育气孔构造, 是地幔高度部分熔融的结果. 深灰色、暗紫色玻基辉橄岩具斑状结构, 橄榄石和辉石斑晶含量为 15%~20%, 基质为玻璃质或玻基交织, 含有辉石和斜长石微晶. 许多玻基辉橄岩呈角砾状, 角砾大小不等, 呈棱角状和次棱角状, 可拼性较好, 可能是隐爆角砾岩. 苦橄玄武岩和玻基辉橄岩与尖晶石橄榄方

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化是拉轨岗日带构造隆升及拉轨岗日变质核杂岩形成的反映.

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### Characteristics and Geological Meaning of Metamorphic Zonation of Top Laguigangri Metamorphic Core Complex, Tibet

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**Abstract:** Laguigangri Mountains are composed of a series of chain-like swellings trending west and east. They all are vaults where there are a lot of metamorphic rocks and detachment faults, and so they are naturally related to each other. The research of chemical composition and metamorphic zonation and estimation of *p-T* of characteristic metamorphic minerals from metamorphic zone in Laguigangri has revealed the regularity of composition, temperature and pressure and metamorphic depth. This will evidence the activities of the metamorphic core and the detachment fault.

**Key words:** metamorphic zonation; chemical composition; metamorphic core complex; Laguigangri; Tibet.

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辉岩和尖晶石橄榄二辉岩产于相同的地质背景, 而且没有发生变质, 说明超浅成相超镁铁岩与深成相超镁铁岩同时或比后者更新, 它们是同源岩浆活动的产物.

在高喜马拉雅变质杂岩中发现青藏高原隆升过程中形成的与高压基性麻粒岩伴生的深成相超镁铁岩和超浅成相超镁铁岩, 这对于认识喜马拉雅和藏

南软流圈上隆和岩石圈减薄、幔源岩浆的组成和性质、壳幔物质交换过程和壳幔过渡带的形成与演化、异常热结构和热状态以及相关的热隆伸展作用和淡色花岗岩的壳内熔融成因等一系列重大基础地质问题具有重要的理论意义, 同时对于研究造山带地幔成矿作用和寻找金刚石、铂等稀有矿产也具有一定的意义.