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西秦岭新生代高钾质玄武岩流体组成及其地幔动力学意义

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摘要：

西秦岭新生代高钾质玄武岩是认识大陆碰撞俯冲体制下地幔流体组成及深部动力学的岩石探针。本文采用分步加热质谱法测定了西秦岭高钾质玄武岩中斑晶及基质的流体化学组成和碳同位素组成,结果表明流体组分在200~400℃、400~800℃和800~1200℃阶段性释出,以H_2O为主,其次为CO_2和SO_2,并含有相对较高的He含量。从橄榄石斑晶到斜长石斑晶和基质H_2O和CO_2逐步升高。橄榄石斑晶流体挥发份主要释气峰温度(900~1200℃)明显高于中国东部地幔捕虏体及其它地区超镁铁质岩体中的橄榄石,流体组份以SO_2和CO_2等氧化性组份为主,其CO_2的$\delta^{13}C$值(-26.21‰~-20.85‰,平均-23.32‰)和CH_4的$\delta^{13}C$值(-42.35‰~-38.17‰,平均-40.03‰)低于基质的$\delta^{13}C_{CO_2}$值(-16.43‰~-11.67‰,平均-13.22‰)和$\delta^{13}C_{CH_4}$值(-44.22‰~-34.03‰,平均-39.70‰)。基质中CO_2和CH_4碳同位素组成具有机质热裂解特征。原始岩浆的流体挥发份主要为SO_2、N_2和CO_2,可能起源于较深的混杂地幔源区、演化于高f_{O_2}的环境。流体挥发份化学和同位素组成表明高钾质玄武岩浆挥发份中存在地幔和地壳来源组分,幔源岩浆上升演化过程中可能加入了大量的H_2O和CO_2等,可能存在碳酸岩岩浆的混合或岩浆穿透区域碳酸盐地层的混染;其中的再循环壳源组分可能为古特提斯洋闭合俯冲或其后华北克拉通与扬子克拉通碰撞相关的再循环壳源沉积物脱出的流体组分。

英文摘要：

India-Asia continental plate subduction and collision lead to widespread Cenozoic potassic-ultrapotassic magmatism in the Tibet which provides a valuable indicator of the composition and nature of the deep mantle beneath the Tibet. The Cenozoic mantle xenolith bearing high-potassic basalts (7.1~23Ma) distributed in western Qinling,western China are a window to probe the mantle composition and geodynamics beneath north-eastern margin of Tibet Plateau. The chemical and carbon isotopic compositions of volatiles in olivine(Olv)and plagioclase(Pl)phenocrysts and matrix(Mtx)of Cenozoic high-potassic basalts in western Qinling have been determined by stepwise heating mass spectrometer to reveal volatile sources and geodynamic implications under the system of continental plate subduction and collision. The results showed that the volatiles in high-potassic basalts were released by stage at temperature intervals of 200~400℃,400~800℃ and 800~1200℃,and are characterized by dominant H_2O with minor CO_2 and SO_2, as well as detectable He. The olivine phenocrysts show higher release temperature interval(900~1200℃)of main volatiles than those in mantle xenoliths in eastern China and ultramafic intrusion (400~800℃) in other regions,and are mainly composed of SO_2(68.72mm^3/g)and CO_2(59.46mm^3/g)etc. oxidized volatiles. The contents of H_2O and CO_2 increased gradually from olivine phenocrysts to plagioclase phenocryst and matrix. Olivine phenocrysts display relatively lighter $\delta^{13}C_{CO_2}$ (-26.21‰~-20.85‰,av. -23.32‰)and $\delta^{13}C_{CH_4}$(-42.35‰~-38.17‰,av. -40.03‰)than matrix(-16.43‰~-11.67‰,av. -13.22‰ for CO_2,-44.22‰~-34.03‰,av. -39.70‰ for CH_4),which show the $\delta^{13}C$ features of crust with thermal cracking component of organic matters. The volatiles in primary magma are mainly composed of SO_2, N_2 and CO_2, and could be derived from a deep mixes mantle reservoir and developed in high f_{O_2} environment. They could be mixed by coexisting carbonatite magma or assimilated by the local Carboniferous carbonate which magma penetrated, and had been added by a large quantity of H_2O and CO_2 during magma ascent and evolution. The chemical and carbon isotopic compositions of volatiles suggested that a recycled crustal component derived from the devolatilization of subducted oceanic plate or sedimentary rocks, which could be related to paleo-Tethyan oceanic plate or Northern China plate with Yangtze plate subduction and collision under the system of India-Asia collision.

关键词：地幔动力学 碳同位素 化学组成 流体挥发份 高钾质玄武岩 西秦岭

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