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胶西北新城金矿床二长花岗岩岩石地球化学、锆石U-Pb年龄及Lu-Hf同位素组成

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摘要:

胶东是我国最重要的金矿集区,也是环太平洋中、新生代金成矿系统的重要组成部分,其内花岗质岩石分布广泛,95%以上的金资源储量赋存在晚侏罗世玲珑型花岗岩和早白垩世早期郭家岭型花岗质岩中。关于花岗岩类的成因,尤其是早白垩世花岗质岩的岩石类型及其源区仍存在争议。新城金矿床位于胶东西北部焦家断裂带北段,是迄今为止在胶东矿集区内发现的赋存在早白垩世花岗质岩中最大的金矿床,其内已探明金资源储量大于200t。该金矿床的赋矿围岩为新城花岗岩体,由中细粒石英二长岩和中粗粒似斑状二长花岗岩组成,形成于127~132Ma。进一步的地质观察表明中粗粒似斑状二长花岗岩两侧的岩石粒度逐渐变细,斑晶逐渐变小,长英质矿物增多,明显不同于中粗粒似斑状二长花岗岩,应为中细粒似斑状二长花岗岩。论文对该中细粒似斑状二长花岗岩进行了系统的岩石地球化学、锆石LA-ICP-MS定年和Lu-Hf同位素组成研究,并进一步探讨了该类岩石的地球化学类型、形成时代、岩浆源区性质及其与新城花岗岩体的关系。岩石地球化学研究表明中细粒似斑状二长花岗岩具有高的SiO₂(71.18%~73.72%)、全碱(K₂O+Na₂O=7.07%~8.64%)、Ba(>793×10⁻⁶)、Sr(>729×10⁻⁶)和轻稀土含量(>71.14×10⁻⁶),低的Al₂O₃(13.57%~15.73%)、MgO(0.22%~0.39%)、Rb(<91.7×10⁻⁶)、Th(<7.4×10⁻⁶)、U(<4.51×10⁻⁶)、Nb(<4.49×10⁻⁶)、Ta(<0.26×10⁻⁶)、Y(<3.67×10⁻⁶)和重稀土含量(<7.47×10⁻⁶),明显的铷异常,明显亏损Nb、Ta、P、Ti等高场强元素,显示出典型的高Ba-Sr花岗岩所具有的地球化学特征,属高Ba-Sr花岗岩。锆石LA-ICP-MS定年结果表明中细粒似斑状二长花岗岩形成于123±1Ma,而石英二长岩和中粗粒似斑状二长花岗岩的锆石LA-ICP-MS年龄为127±2Ma~132±1Ma,3种类型岩石具有相似的主量元素组成及稀土和微量元素分布模式,表明新城花岗岩体的形成时代应为123±1Ma~132±1Ma。Lu-Hf同位素测试结果显示中细粒似斑状二长花岗岩岩浆锆石的ε_{Hf}(t)为-20.76~-18.66,二阶段模式年龄t_{DM2}为2351~2479Ma;在ε_{Hf}(t)-锆石U-Pb年龄图解中,所有数据点均落在球粒陨石演化线之下的壳源区域。金矿床已有石英二长岩、中粗粒似斑状二长花岗岩和区域玲珑型花岗岩Hf同位素组成及该中细粒似斑状二长花岗岩中2个太古代(2629±14Ma、2402±18Ma)和3个中生代(150±7Ma、151±1Ma、147±1Ma)的继承锆石年龄,表明新城金矿床内中细粒似斑状二长花岗岩应来源于前寒武纪变质基底岩石,岩浆上升过程中遭受了上地壳(主要是玲珑黑云母花岗岩)的混染。

英文摘要:

The Jiaodong Peninsula, the most important gold province in China, is an important part of the Pacific Rim Mesozoic-Cenozoic gold mineralization area, where the Mesozoic granitoids are widespread. The majority of gold resources (>95%) in Jiaodong Peninsula are hosted by the Late Jurassic Linglong and Early Cretaceous Guojialing granitoids. However, there is still controversy over the petrogenesis and sources of the granitic rocks, especially the Early Cretaceous granitoids. The Xincheng gold deposit, located in the northern part of the Jiaojia fault in northwestern Jiaodong Peninsula, is the only large gold deposit with a proven reserve of >200t Au hosted by the Early Cretaceous granitoids until now. As the host rocks of the Xincheng gold deposit, the Xincheng granitoids comprise an inner medium-to fine-grained quartz monzonite and an outer medium-to coarse-grained porphyritic-like monzogranite, which emplaced at 127~132Ma. A new phase with smaller granular size, minor phenocrysts, but more felsic composition was found based on further geological observations, which is completely different from medium-to coarse-grained porphyritic-like monzogranite. In this paper, it was defined as medium-to fine-grained porphyritic-like monzogranite. This paper systematically investigated the medium-to fine-grained porphyritic-like monzogranite, and conducted LA-ICP-MS zircon U-Pb dating, major and trace elements geochemical, and Lu-Hf isotopic constitution. These data enable us to discuss the petrologic classification, for ming age, source region of medium-to fine-grained porphyritic-like monzogranite, and the relationship between it and the Xincheng granitoids. The medium-to fine-grained porphyritic-like monzogranites, possess high SiO₂(71.18%~73.72%), total alkalis (K₂O+Na₂O=7.07%~8.64%), Ba(>793×10⁻⁶), Sr(>729×10⁻⁶) and LREE (>71.14×10⁻⁶), with low Al₂O₃(13.57%~15.73%), MgO(0.22%~0.385%), Rb(<91.7×10⁻⁶), Th(<7.41×10⁻⁶), U(<4.51×10⁻⁶), Nb(<4.49×10⁻⁶), Ta(<0.263×10⁻⁶), Y(<3.67×10⁻⁶) and HREE

(3.928×10^{-6}). The rocks are characterized by no significant Eu anomalies and prominent depletion of Nb, Ta, P, Ti. All these results indicate that the rocks belong to the high Ba-Sr granites. LA-ICP-MS zircon dating yields U-Pb age of 123 ± 1 Ma for the medium-to fine-grained porphyritic-like monzogranites. Regarding to the previous geochronological data (127 ± 2 Ma~ 132 ± 1 Ma) for medium-to fine-grained quartz monzonite and medium-to coarse-grained monzogranites, and similar major elements composition, REE and trace element distribution patterns among these three kinds of rocks, it is suggested that the Xincheng granitoids were emplaced at 123 ± 1 Ma~ 132 ± 1 Ma. The medium-to fine-grained porphyritic-like monzogranites have zircon $\epsilon_{\text{Hf}}(t)$ values of -20.76 to -18.66, and two-stage Hf model ages (t_{DM2}) vary in range of 2351~2479 Ma. In the $\epsilon_{\text{Hf}}(t)$ vs. Age diagram, all the data points lie below the chondritic Hf evolution line, indicating that the ancient crust was an important source for the Xincheng granitoids. Previous zircon Hf isotope data obtained from quartz monzonite, medium-to coarse-grained monzogranites and the Linglong granite, along with presence of two Archean (2629 ± 14 Ma, 2402 ± 18 Ma) and three Mesozoic (150 ± 7 Ma, 151 ± 1 Ma, 147 ± 1 Ma) inherited zircons, indicate that the monzogranites might be generated by partial melting of Precambrian metamorphic basement rocks of coupled with assimilation of the wall rocks of the upper crust, especially the Late Jurassic Linglong granites.

关键词 : [二长花岗岩](#) [锆石U-Pb年龄](#) [Lu-Hf同位素](#) [新城金矿床](#) [胶西北](#)

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