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张广才岭“新元古代”一面坡群的形成时代: 来自岩浆锆石和碎屑锆石U-Pb年龄的制约

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摘要:

本文报道了黑龙江省张广才岭“新元古代”一面坡群唐家屯组流纹岩和长石石英砂岩以及杨木岗组粉砂质泥岩中锆石的U-Pb定年结果, 结合上覆早侏罗世太安屯组流纹岩的定年结果, 讨论了一面坡群的形成时代及其构造属性。采自该群绝大多数锆石均呈自形-半自形晶, 显示出典型岩浆生长环带或条痕状吸收, 暗示其岩浆成因。定年结果表明, 采自一面坡群唐家屯组底部流纹岩的形成时代为 295 ± 2 Ma, 而上部长石石英砂岩产生了234Ma、260Ma、273Ma、291Ma、309Ma和327Ma多组谐和年龄; 杨木岗组粉砂质泥岩产生了226Ma、267Ma、362Ma、411Ma、485Ma和783Ma多组谐和年龄; 覆盖在杨木岗组之上的中生代太安屯组流纹岩的定年结果为 189 ± 1 Ma。从上述定年结果可以看出, 一面坡群唐家屯组流纹岩形成于早二叠世, 而其上部的长石石英砂岩与杨木岗组粉砂质泥岩的形成时代类似(226~234Ma)——即其形成于晚三叠世-早侏罗世之间(226~189Ma), 而非先前所确定的新元古代。基于杨木岗组中碎屑锆石的年龄频数, 杨木岗组的沉积物源主要来自于周边晚古生代地质体以及次要的早中生代、早古生代和新元古代地质体。此外, 早二叠世流纹岩与同时代玄武质岩石共同构成了双峰式火山岩组合, 可能暗示一种伸展环境。

英文摘要:

In this paper, we present the U-Pb age of detrital and magmatic zircons from the sedimentary and volcanic rocks within the "Neoproterozoic" Yimianpo Group in Heilongjiang Province, NE China, combined with the age of the overlying rhyolite from the Taiantun Formation, to constrain the formation time and tectonic nature of the Yimianpo Group. The Yimianpo Group, from bottom to top, is subdivided into the Tangjiatun and Yangmugang formations. The Tangjiatun Formation, outcropped in Shangzhi region, is composed mainly of the meta-intermediate-acidic volcanic rocks (including rhyolite, intermediate-acidic tuff, and minor andesite) in the lower part and feldspar quartz sandstone as well as minor phyllite in the upper part. The Yangmugang Formation consists mainly of sandstone, siltstone, and slate in the lower part and thin layer of sandstone, slate, carbonaceous slate, and silty mudstone in the upper part. The Taiantun Formation, unconformably covering the Yangmugang Formation, is composed mainly of rhyolite and intermediate-acidic tuff. The majorities of the zircons from three samples collected from the Yimianpo Group are euhedral-subhedral in shape and display oscillatory growth zoning or striped absorption in cathodoluminescence (CL) images. Combined with their Th/U ratios (0.30~2.57), it is suggested that these zircons crystallised from a magma. The dating results indicate: (1) that the $^{206}\text{Pb}/^{238}\text{U}$ ages of 16 analytical spots of zircons from a rhyolite (sample 11HSZ4-1) in the lower part of the Tangjiatun Formation range from 289Ma to 302Ma, yielding two groups of concordia ages: 295 ± 2 Ma (mean square weighted deviation (MSWD)=1.08, n=15) and 428 ± 4 Ma (n=1), the former represents the formation time of the rhyolite, the latter is the age of a captured zircon; (2) that the $^{206}\text{Pb}/^{238}\text{U}$ ages from 72 analytical spots on zircons from sample HSZ5-1 (a feldspar quartz sandstone) yield six groups of concordant ages: 234 ± 3 Ma (MSWD=1.2, n=12), 260 ± 2 Ma (MSWD=0.2, n=12), 273 ± 3 Ma (MSWD=0.03, n=6), 291 ± 1 Ma (MSWD=0.49, n=35), 309 ± 8 Ma (MSWD=0.01, n=2) and 327 ± 4 Ma (MSWD=0.37, n=5), suggesting that the deposition of its protolith began after ~234Ma; (3) that the $^{206}\text{Pb}/^{238}\text{U}$ ages from 23 analytical spots on zircons from sample 11HSZ2-1 (a silty mudstone) in the Yangmugang Formation yield age populations of 226 ± 4 Ma (n=1), 267 ± 3 Ma (MSWD=1.7, n=15), 362 ± 7 Ma (MSWD=1.05, n=3), 411 ± 6 Ma (n=1), 485 ± 12 Ma (MSWD=0.01, n=2), and 783Ma (n=1), implying that it was deposited after 226Ma; and (4) that the $^{206}\text{Pb}/^{238}\text{U}$ ages from 23 analytical spots on zircons from an overlying rhyolite (sample 11HSZ3-4) in the Taiantun Formation range from 185Ma to 193Ma, yielding a weighted mean $^{206}\text{Pb}/^{238}\text{U}$ age of 189 ± 1 Ma (MSWD=1.5, n=23), i.e., Early Jurassic, which is interpreted as the formation age of the rhyolite. Based on the dating results of magmatic zircon

s and detrital zircons and field covering relationship, we conclude that the rhyolites from the Tangjiatun Formation in the Yimianpo Group formed in the Early Permian, rather than Neoproterozoic as previously believed, while the feldspar quartz sandstone from the upper part of the Tangjiatun Formation should be classified to the Yangmugang Formation in age, and that the silty mudstone from the Yangmugang Formation, together with the feldspar quartz sandstone from the upper part of the Tangjiatun Formation, deposited between 226~232Ma and 189 ± 1 Ma, i.e., Late Triassic-Early Jurassic, rather than Neoproterozoic as previously believed. Based on the similarity of age populations of detrital zircons with ones of the outcropped terranes in the study area, it is suggested that the sediments of the Yangmugang Formation in the Yimianpo Group mainly sourced from the Late Paleozoic terranes and minor Early Mesozoic, Early Paleozoic and Neoproterozoic terranes in the adjacent regions. Additionally, the Early Permian rhyolites in the Tangjiatun Formation, together with the coeval basaltic rocks and gabbros in the adjacent regions, constitute a typical bimodal volcanic rock association, implying an extensional environment.

关键词: [锆石U-Pb年龄](#) [形成时代](#) [物源](#) [一面坡群](#) [张广才岭](#)

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