Origin of the ~1.74 Ga, Anorthosite-hosted Damiao Fe-Ti-P Ore Deposit, North China

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The Damiao deposit is hosted in the ~1.74 Ga Damiao anorthosite complex, the only known massif-type anorthosite in China. It has been mined for several decades at an annual production of 2 million tons ore, and has long been an important source of Fe, Ti, P and V in China.[1] The deposit contains hundreds of ore bodies occurring as irregular lenses, veins or pods intruding hosting anorthosite. These discordant oxide ores contain abundant but variable apatite, and are classfied into Fe-Ti ore, nelsonitic ore and oxide-apatite gabbronorite on the basis of apatite contents and ore structures.

Combined with detailed field investigations, bulk ore major and mineral EPMA major and LA-ICPMS trace elemental analyses were conducted to understand the origin of the Damiao deposit. Intrusive feature of nelsonitic ores and contrast densities between Fe-Ti oxides and apatite suggest that the nelsonitic ores have crystallized from an immiscible nelsonitic melt. Fe-Ti ores displaying similar compositional range of Fe-Ti oxides and silicate minerals are interpreted to have also crystallized from the immiscible nelsonitic melt, which is further supported by the spatially close association of Fe-Ti and nelsonitic ore bodies and their comparable mineral assemblages of plagioclase, pyroxene, Fe-Ti oxides and apatite. This interpretation that fractional crystallization of the immiscible nelsonitic melt forming both Fe-Ti and nelsonitic ores is well consistent with linear variations of Sr, Y, Th, U and REE contents of apatite and the parallel chondrite-normalized REE patterns.

Oxide-apatite gabbronorite display relatively larger variable but more evolved compositions of silicate minerals than nelsonitic ores (and Fe-Ti ores), pointing to a separate origin in each case. Apatite of oxide-apatite gabbronorite contains lower Sr and MgO but higher REE contents and Y than those of nelsonitic ores, further indicating that nelsonitic ores are relatively more primitive [2], excluding the possibility that they have formed by immiscible segaration from oxide-apatite gabbronorite, as previously proposed. Based on their dissminated texture and continuous chemical variation, we considered that oxide-apatite gabbronorite may have formed by normal fraction crystallization process through a trend of iron enrichment in residual liquids, different from the immiscible origin for nelsonitic ores. Oxygen fagacity (fO_2) might be one of the important factors resulting in different forming processes for nelsonitic ores and oxide-apatite gabbronorite, because liquid immiscibility field expands generally with increasing fO_2. Higher fO_2 for nelsonitic ores is well indicated by their smaller negative Eu anomalies of apatite, because apatite readily accepts the Eu^{3+} into its structure but excludes the larger Eu^{2+}.

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Geochemistry and tectonic settings of Carboniferous volcanic rocks in the Junggar basin of China

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Intruduction

The Junggar basin, an important part of central Asia orogenic belt, is a Mesozoic and Cenozoic sedimentary basin developing upon Precambrian crystalline basement and Palaeozoic fold basement. The basement of the Junggar basin is a part of Kazakhstan plate, and interspersed in the Tarim plate and the Siberia plate. The Carboniferous volcanic rocks in the Junggar basin consisting of volcanic lava and volcaniclastic rock are most widely developed. Furthermore, oil and gas reservoirs have found in it. The geochemistry and tectonic settings of Carboniferous volcanic rocks in the Junggar basin are studied in this article. And the research about the tectonic setting of volcanic rocks of the basin has important significance on volcanic rock oil and gas exploration[1].

Method and Resolut

The volcanic lava in this area has characteristics of low K_2O, high Na_2O, high TiO_2 and high ΣREE. The REE distribution plots show the volcanic rocks are enriched in LREE and LILE, and depleted in Nb and Ta. In addition, the plots also reveal the characteristic of LREE and HREE differentiation. The ratios of Th/Nb and Nb/Zr as well as the tectonic setting discrimination diagrams show that the volcanic rock main body is characterized by intraplata volcanic rock, and formed under the tectonic setting of intraplata extension. The lava of this area with low Th/Nb, low La/Nb, slightly elevated LREE, as well as Nb/La-Th/Nb and La/Ba-La/Nb discrimination diagrams, show that depleting of Nb and Ta relative to Th is the result of subtractive component adding to volcanic source[2].

Conclusion

According to geochemical analyses, the lava with charcaterisctics is similar with "post collision arc volcanic rock"[3]. It is generated in an extensional setting of the late stage of orogenesis, and the magma source may be influenced by earlier oceanic plate subduction. Combining with the regional geologic characteristic, Carboniferous volcanic rocks in the Junggar basin were formed in an extensional rifting setting of the late stage of orogenesis, which is consistent with the region rifting function of large scale. The conclusions of this research make a significant improvement for the study of volcanic reservior distribution.

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