1 Introduction

The formation process and alumina source of the bauxite deposits that have developed in Southeast Yunnan have been debated for a long time. The bauxite deposits in the area can be divided into two types. The first type is found within the Permian carbonate rocks, overlying the paleokarst landform upon the Middle Permian Maokou formation or Upper Carbonic Weining formation and covered by the Upper Permian Longtan formation or wujiaping formation. The second type is lateritic bauxite, which lying on alumosilicate rocks.

The lateritic bauxites can be directly related to the underlying source rocks through their textures and compositions. And most researchers suggest that the underlying carbonates are the major source rocks for the bauxites, based on comparisons of the ratios of inertelements. Nevertheless, some studies show comparisons of element ratios that ruled out carbonates as the source and suggest that Permian mafic rocks can provide ore-forming materials (Chen and Lan, 1991).

The effects of lateritic weathering, post-bauxitisation diagenesis, and contamination by water and air-laid sediments to the element concentration, that be largely avoided by studying zircon, that are resistant to physical and chemical weathering (Deng et al., 2010). U-Pb ages in bauxites provides direct evidence for the age of the potential parent rock and thus indicates the precursor rocks of the bauxite ores. LA-ICP-MS zircon U-Pb dates of the detrital zircon from bauxite ores in this area, provided new constraints on the genesis of the late Permian bauxites in Southeast Yunnan.

2 Geological Settings and Sampling

The southeastern part of Yunnan Province in Southwestern China is geologically a part of the Upper Yangtze Block and nearby to the outer zone of the Emeishan large igneous province (LIP) (He et al., 2006). The bauxite deposits in the southeast Yunnan are mainly clustered within the Wenshan, Qiubei and Guangnan counties. The contact between the bauxite horizon and the underlying Middle Permian or Upper Carbonic carbonate bedrock is sharp.

Three bauxite ore samples (TC001-1, TC003-1 and TC004-1) were collected from bauxite deposits in Southeastern Yunnan for U-Pb dating.

3 U-Pb Dating of the Zircons

The U-Pb analyses were performed using the LA-ICP-MS at the State Key Laboratory of Geological Processes and Mineral Resource, China University of Geoscience, Wuhan, following the analytical procedures described by Liu et al. (2010). Most of the zircons from both samples have clearly oscillatory zoning and little erosion on the surface, while only a few have core-rim structures and an intensely eroded shape. In this study, Th/U values in all of the zircons range from 0.19 to 1.6, and are therefore believed to be of igneous origin.

For sample TC001-2, 29 out of 35 analyses show clusters in concordant Pb$^{206}$/U$^{238}$ ages ranging from 234 to 257 Ma, with a weighted mean of 253 ± 7 Ma. And for sample TC003-1, 36 out of 53 analyses show clusters in concordant Pb$^{206}$/U$^{238}$ ages ranging from 233 to 258 Ma, with a weighted mean of 255 ± 1.9 Ma. Similar ages were obtained for the sample TC004-1, and 21 out of 34 analyses show clusters in concordant Pb$^{206}$/U$^{238}$ ages ranging from 235 to 261 Ma, with a weighted mean of 257.3 ± 2.6 Ma. Less than one-quarter of the analyses give significantly older ages that range from about 300 to 2550 Ma, and most of these are discordant ages.

It shows that the LA-ICP-MS zircon U-Pb ages of the bauxite and underlying basalt from Yunnan and Guangxi are 259.7±8.1Ma, 253.6±7.0Ma, 255±1.9Ma and
257.3±2.6 Ma. And these zircon U-Pb ages (253 Ma, 255 Ma, 257 Ma for the four samples) from bauxite ores, which are consistent with the emplacement of the Emeishan LIP and different from the reported ages of the other magmatic rocks occurring in the study area.

4 Discussion

The zircon U-Pb ages (253 Ma, 255 Ma and 257 Ma for the three samples) from bauxite ores in Southeast Yunnan, which is formed upon the unconformity induced by the activation of Emeishan plume, are consistent with the emplacement of the Emeishan LIP. These ages may indicate that the zircons in the bauxite ores come from magmatic rocks related to the Emeishan plume.

The little erosion of the detrital zircons around 253 Ma, 255 Ma or 257 Ma reveal that the parent rocks are not far from the bauxite deposits, indicating that the magmatic rocks related to the Emeishan plume developed in the Southeastern Yunnan. This opinion is consistent with that of Deng et al. (2010). Deng et al. studied Permian bauxite in Western Guangxi, and determined that these bauxites are spatially and temporally associated with the Emeishan LIP. They also suggested that plume-lithosphere interaction happens at the periphery of the plume.

It is difficult to determine the source rocks from which the bauxite is derived in the Western Guangxi via geochemical analysis. From the U-Pb ages of the detrital zircons in bauxite ores, we can ascertain that the magmatic rocks related to the Emeishan plume provide material for the bauxite ores in Southeast Yunnan. It can be weathered and transformed into bauxite ores. Therefore, the magmatic rocks generated by the Emeishan plume may contribute more Al for the bauxite ores than the other rocks, such as carbonates and so on.

5 Conclusions

This paper provides a study of U-Pb dating of the detrital zircons in bauxite ores.

Detrital zircons in the Permian bauxite ores in Southeast Yunnan, China, yields U-Pb ages clustering mainly around 253 Ma, 255 Ma and 257 Ma, which is consistent with the emplacement age of the Emeishan plume. It reveals a genetic relationship between the Emeishan plume and the formation of bauxites in Southeast Yunnan, China. And the Emeishan plume may have significant control on the formation of bauxites in Southeast Yunnan.

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