Study on fluid inclusions of volcanic rocks in Songliao basin: The significance for natural gases

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Introduction

The Songliao basin is the largest sedimentary basin in China with most significance in producing oil and natural gases. In recent years, Chinese geologists found and explored the natural gases genetically linked to Mesozoic volcanic rocks in this basin (Qin *et al*., 2001). Three types of volcanic rocks have been identified in the basin, which are basaltic igneous flows, andesite and rhyolite. All those volcanic rocks are richness in fluid inclusions (Fig.1). The widely spreading of Mesozoic-Cenozoic volcanic rocks along Tan-Lu fault belt in east China and the gas-liquid compositions from fluid inclusions are drawn great attention to geochemists. This study focus on the compositions of fluid inclusions bearing in these different volcanic rocks series.

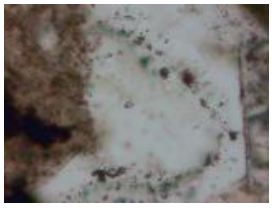

Fig. 1 Typical fluid inclusions bearing in quartz of an andesite in the Songliao basin

Experiment and Results

The chemical compositions of fluid inclusions are determined with RM-1000 laser Raman spectroscopy produced by Renishaw Company at Institute of Geology & Mineral Resources, Xi'an. The results show that most of the fluid inclusions are mainly composed of CO_2, CH_4, CO, H_2, N_2, H_2S and SO_2. The relative high concentrations of CO_2 in fluid inclusions are correspondent to funding of CO_2 reservoir with inorganic genesis widely distributed in different sub-sags of the basin in the past decade. In contrast, the other components in fluid inclusions among the combustible CH_4, CO and H_2 consist of main components of the natural gases explored in the basin. The compositions of fluid inclusions of volcanic rocks are also good proxies to trace the mantle degassing since Mesozoic in east China.

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Different accumulation of Pb, Zn, and Cd in river sediments and in lake sediments originated from ancient zinc smelting activities in northwestern Guizhou, southwestern China

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Zinc smelting in northwestern Guizhou, southwestern China resulted in significant heavy metal accumulation in sediments. In this study, river sediments were collected in a river in the smelting region, and lake sediments were collected in a lake ca. 10km downwind from zinc smelters. Concentrations of Pb, Zn, and Cd in the river sediments varied greatly in the range of 4,375-21,850, 7,275-30,425, and 42.0-95.0 mg kg^{-1}, averaging in 14,022, 24,441, and 72.9 mg kg^{-1}, respectively. Ratios of Pb/Cd and Zn/Cd in river sediments were in the range of 104-266 and 173-390, respectively. However, Concentrations of Pb, Zn, and Cd in lake sediments were in the range of 66.0-160, 130-1200, and 2.60-71.0 mg kg^{-1}, averaging in 99.7, 536, and 26.0 mg kg^{-1}, respectively. Ratios of Pb/Cd and Zn/Cd in lake sediments varied narrowly in 2.14-25.4 and 16.9-50.0, respectively. Normally, Pb, Zn and Cd accumulated vertically in the lake sediments in the depth of 0-15cm, and then their concentrations dramatically decreased to sediment baselines. In river sediments, Pb was mainly in carbonate bound fraction (35-51%) and iron and manganese bound fraction (26-47%); Zn was in carbonate bound fraction (32-39%) and iron and manganese bound fraction (38-48%); whereas Cd in residue fraction (16-59%) and carbonate bound fraction (15-45%).However, in surface lake sediments, organic bound fraction was the dominating chemical forms of Pb (34-82%), Zn (3.8-46%), and Cd (31-84%); while residue bound fraction accounted for 14-39% for Pb, 17-69% for Zn, and 4.0-55% for Cd, respectively. High organic matter content (14-45%) may reasonably explain high concentrations of organic bound metals in lake sediments. In river sediments, $^{206}Pb/^{207}Pb$, $^{206}Pb/^{208}Pb$ ratios varied in 1.182-1.185, 0.399-0.403, respectively; however, in lake sediments, these ratios were in the range of 1.178-1.2202, 0.477-0.486, respectively. These results suggested that Pb, Zn, and Cd in river sediments were from release of zinc smelting slags, however, in lake sediments, they were originated from dust deposition of zinc smelting emits. Elemental fractionation during smelting may cause big differences in Pb/Cd and Zn/Cd between river sediments and lake sediments.

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