A mixing model for crustal growth in Northeastern China as revealed by U-Pb age and Hf isotopes of detrital zircons from modern rivers

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Northeastern (NE) China consists of the eastern part of the Central Asian Orogenic Belt (CAOB), which is the most important site of juvenile crustal formation in the Phanerozoic. Detrital zircons from young sediments, or in modern river sediments, may record crustal material that has not been preserved or is no longer exposed. Here, we report U-Pb ages and Hf isotopes of 1381 detrital zircons in 13 sand samples from 5 modern rivers, which drain the most part of NE China, in order to characterize the crustal growth and evolution. These zircons give three magmatic age groups of 100-600 Ma, 1600-2000 Ma and 2300-2700 Ma. The third group from the Songhua river characterizes the North China craton. The first and second group zircons were derived from rivers that drain within CAOB, and display a large spread in Hf isotope two-stage model ages (T_{DM2}) between 400 and 3000 Ma but with a significant peak at 600-1600 Ma. They suggest that 98% of the crust for much of NE China formed 500 Ma ago. However, NE China has significant production of juvenile crust in the Paleozoic [1]. Clearly, the obtained Hf model ages are a mixing product. To estimate the true crust formation age, we simply assume the mixing source consists of the depleted mantle (juvenile crustal addition) and the regionally known oldest crust components, whose proportions can thus be calculated for each zircon from its U-Pb age and Hf isotope. The mixing model shows that proportions of the juvenile crustal component are about 50-90% in the 100-400 Ma age group, 40-70% in the ~500 Ma age group and below 50% in the 1600-2000 Ma age group. The corresponding crustal growth rates suggest that 20%, 47% and 98% of the present crustal volume were formed by 2700 Ma, 200 Ma and 100 Ma ago, respectively (Figure 1).

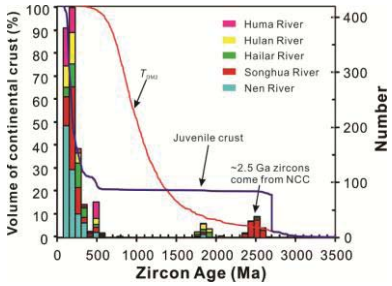

Figure 1: Histogram of concordant U-Pb ages and crust growth curves based on two-stage Hf crust formation ages and our mixing model for detrital zircons from rivers in NE China.

[1] Wu *et al.* (2000) *Tectonophysics* **328**, 89-113.

Geochronology and geochemistry of the Mesozoic volcanic rocks from the Hailar basin, NE China

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Mesozoic volcanic rocks and granitoids are widespread in northeastern China, which are interpreted as a large igneous province in eastern Asia and are distinguished by extensive Phanerozoic crustal growth as a part of the Central Asian Orogenic Belt. These Mesozoic volcanic and pyroclastic rocks are important reservoir rocks of petroleum in the basins distributed in NE China, e.g. the Songliao basin that has been a major oil and gas field in China. This study focuses on a successive volcanic rock series that are exposed along the northwestern bank of the Hulun Lake of the Hailar basin.

Two rock formations, the Shangkuli Formation and the Tamulangou Formation, contain volcanic rocks in the Hailar basin. Zircon U-Pb dating of six rhyolitic samples successively collected from the Shangkuli Formation in a profile along the western bank of the Hulun Lake yields ages of 137 Ma to 147 Ma, possibly implicating a long term of volcanic activities in this area. This magmatism is likely related to the closure of the Mongolia-Okhotsk Oceans in late Mesozoic. The volcanic rocks are characterized by low contents of MgO and compatible elements in spite of the variations in major element contents. Both the basic and acid volcanic rocks of the Tamulangou and the Shangkuli Formations are characterized by slightly depleted Nd isotopic composition with initial ε_{Nd} values of 0.63 to 2.67 and relatively low initial $^{87}Sr/^{86}Sr$ values of 0.7033 to 0.70548. Homogeneous Sr-Nd isotopic composition of different volcanic rocks in context of the spatial and temporal relationship indicate that they were derived from a similar mantle source and formed through different degrees of fractional crystallization of the primary melt(s). This study is supported by the Ministry of Science and Technology of China (grant No. 2009CB219305).