Age distribution of detrital zircons from major rivers in North and South America: implication for the continental growth history

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In order to understand the continental growth history of the Earth, we must evaluate the recycled granitic materials to their protolith ages, because the Phanerozoic orogens occupy the continents more than 50% on the Earth and are composed of dominantly sedimentary rocks over 90%. To overcome this difficulty, the age population of detrital zircons from river sand is critical, because of (1) resistance of zircon against recrystallization, (2) common occurrence in granitic rocks, and (3)high blocking temperature of U-Pb isotope system. We initiated to analyze those zircons from Mississippi, Mackenzie, and Amazon Rivers.

To obtain large numbers of ages quickly, we have developed the laser ablation ICP-MS at Tokyo Institute of Technology.

As a first step, we investigated ages population of zircons (total 857 grains) from Mississippi River sand, North America. Th / U ratio was also analyzed to distinguish the origin of zircon, either metamorphic or igneous, simultaneously. The Mississippi River and its tributaries cover North American continent about 40%, and transport the sediment into the river mouth. Somewhat degree of discordance, we adapted Pb-Pb age to discussion. Age distribution of zircon is compared with spatial ratio of basement with different age (Hoffman, 1991). The results indicated that zircon age mainly different events occurring at about 0.3 Ga, 1.1~1.5 Ga, 1.8 Ga, and 2.7 Ga. The highest peak range from 1.7 to 1.8 Ga make up about a 12% of the total. This data indicate that large crustal growth was occurred at around 1.8 Ga relatively. Metamorphic source zircons (Th / U ratio is above 4) are less than 0.2% of all. These ages correspond to periods of major crustal formation of the (1) Ouachita orogen; late Proterozoic ~250 Ma, (2) Grenville; 1.0~1.3 Ga, (3) Yavapai-Mazatzal orogen; 1.6~1.8 Ga and (4) Wyoming provinces; 2.6~2.8 Ga. Areal dominations of each orogen are 11%, 20%, 33%, and 14%. The co-relationship between zircon distribution and areal population of orogenic belts match well to justify the method employed in this work. The number of zircon suggests correlating with the area of individual crust on the river. Thus, this method is available to better understand the history of continental growth.

At the same time, we attempted to dispute statistically about zircon age population.

Here are two important factors to assess the validity of zircon age distribution and to resolve the number of zircon analyses: (1) the error bar of each column and (2) the feature of distribution. The former is to make sure the occurrence of major peaks, or to determine the sufficient condition of age distribution with error bar in its case. The latter indicates that varieties of feature (bimodal or trimodal or more) dominate the class marks.

Accordingly, we applied this method to Mackenzie and Amazon Rivers, and discussed the continental growth rates of North and South America.