HF-W AND U-PB DATING AND REE AND TI ANAYLYSIS OF ZIRCONS EXTRACTED FROM MESOSIDERITES.

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Introduction: Mesosiderites are a group of stony-iron meteorites, consisting of about equal parts of metallic iron-nickel and silicates. Their silicates are similar to howardite-eucrite-diogenite (HED) meteorites in mineralogy, chemistry and oxygen isotopes [1]. One of the models for mesosiderite parent body is proposed by [2]. In this model, the earlier stratified parent body was possibly destroyed by a catastrophic impact and reaccreted with a core, mantle, crust materials mixture [2]. To study the history of mesosiderite parent body, we have conducted Hf-W and U-Pb dating, rare earth elements and titanium concentration analyses of zircons. Their crystallization temperatures were estimated according to Ti-thermometer [3]. The accurate Hf-W dating of zircons in a mesosiderite was firstly reported by an ion microprobe study [4]. However, there is no natural zircon standard with abundant tungsten because of its incompatibility in zircon crystal. To overcome this difficulty, we created the new standard zircons with known amount of Hf and W, and applied them to Hf-W dating of three mesosiderites [5]. We also report the U-Pb ages, REE and Ti concentrations of the same mesosiderites zircons in order to discuss their origins and evolutions.

Experiment: Fourteen zircon grains in total were extracted from 3 mesosiderites (Asuka 882023, Northwest Africa 1242, Vaca Muerta) [6] and embedded on epoxy resin disk. They are all anhedral with grain sizes of 40–60 μm. No growth bands or heterogeneous bright pattern was observed by a cathodoluminescence. All isotopic and leelmental analyses were conducted using NanoSIMS 50 at AORI, UTokyo. A 2 nA O^- primary beam was used to sputter a 7–8 μm diameter crater on the zircon surface. A high mass resolving power of 9,400 at 10 % peak height was attained to separate the heavy REEs from the oxide of light REEs with adequate flat top. A multi-collector system combined with peak-jumping by magnetic field was adjusted to detect REEs and matrix ions (^{30}Si). All REEs and Ti intensities relative to ^{30}Si (i.e. REE/^{30}Si and $^{49}Ti/^{30}Si$ ratios) were calibrated against those of NIST SRM610 glass standard, under the assumption that the matrix effects are insignificant at the high mass resolving power mode [7]. Titanium concentration analysis and Pb-Pb dating of the zircons were conducted separately, where the latter experiment followed the previous study [8].

Results & Discussion: The concentrations of REEs and Ti of the zircons were calculated to acquire their crystallization temperature. Lead-Pb ages of the individual zircon grains were calculated under the assumption that the isotopic compositions of initial Pb are identical to those of Canyon Diablo Troilite [9]. NanoSIMS relative sensitivity factor of Hf/W ratio was determined with our new standard zircons [5]. Absolute ages of individual zircon grains were calculated with their $^{182}Hf/^{180}Hf$ values and the anchor age of 4565.3 Ma for Ste. Marguerite [10]. Hf-W ages vary from 4532 Ma to 4548 Ma with the average of 4540 Ma, younger than 4563 Ma of smaller and euhedral zircon in Vaca Muerta measured by SHRIMP [11]. The titanium thermometer suggests the formation temperature of zircon between 791 °C and 952 °C. It may be possible to calculate the cooling rate by the combination of Hf-W age and the temperature. Enrichment of heavy REE with increasing mass number, positive Ce anomaly and negative Eu anomaly in normalized patterns are common features of terrestrial zircon samples [12]. REE contents of mesosiderite zircons are generally lower than terrestrial ones similar to the previous report [13], while the graph rising to the right in REE patterns is similar to that of terrestrial ones. In some samples, the enrichment from La to Gd is smaller than that from Tb to Lu, suggesting metamorphic signature [14].

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