U-Pb & Hf-W DATING OF YOUNG ZIRCON IN MESOSIDERITE ASUKA 882023.

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Introduction: Mesosiderites are unique stony-iron meteorites, which composed of eucritic silicate clasts and Fe-Ni metal. A number of mineralogical and chronological studies have previously proposed the complicated metamorphic history for mesosiderites [1, and references therein]. Zircon, an accessory phase in mesosiderites, is robust to the secondary processes and keeps geochemical records, including U-Pb and Hf-W chronologies. Due to the limited grain sizes and low abundances, only a few studies have reported the chronologies of mesosiderites zircon [2][3]. In order to determine the timing of the zircon formation and the thermal metamorphism in mesosiderites, we focus on the combined U-Pb and Hf-W dating of the zircon, using NanoSIMS. Here, we report our dating results of zircon in a mesosiderite, Asuka 882023.

Samples & Analytical Methods: Asuka 882023 (A88) is a mesosiderite with brecciated basaltic silicates and Fe-Ni metal. Sugiura and Kimura [4] suggested metamorphic type 2A for this meteorite indicating a severe re-heating and slow cooling features. A polished thin section of A88, #53-1 was allocated from National Institute of Polar Research, Japan. A large anhedral zircon grain with size of > 50 µm was identified adjoining to the metal (Fig. 1) by SEM-EDS observation.

U-Pb and Hf-W dating were carried out using NanoSIMS 50 at AORI, Univ. of Tokyo. A 2nA O^- primary beam with spot size of ~10µm was utilized for each dating sessions. The established analytical protocols and calibration methods for U-Pb [5] were applied. After U-Pb dating, the section was re-polished to obtain a new surface for Hf-W dating. Secondary ions of $^{182}W^+$, $^{183}W^+$ and $^{186}W^+$ were cyclically collected. Following the previous protocols with Cameca IMS 1270 [6], secondary ions of $^{30}Si^+$, $^{96}Zr^{16}O^+$, $^{178}Hf^+$ and $^{186}W^{16}O^+$ were counted simultaneously with $^{186}W^+$. Potential REE-O isobaric to W isotopes (e.g. $^{166}Er^{16}O^+$ to $^{182}W^+$) can be reduced to negligible level with adequately high mass resolution power. Zircon in Agoult eucrite with the known Pb-Pb age of 4554.5 ± 2.0 Ma [7] was also analyzed, to determine the relative sensitivity factor (RSF) of Hf/W.

Results & Discussion: Nine spots analyses provide the concordant ^{238}U-^{206}Pb and ^{207}Pb-^{206}Pb ages at 4375 ± 300 Ma (2-sigma) and 4502 ± 75 Ma, respectively. The total Pb-U age was also calculated from these data as 4492 ± 80 Ma, suggesting the U-Pb system in A88 zircon has been closed since ~4500 Ma. For Hf-W dating, the absolute Hf-W age of A88 zircon becomes 4532.8 +5.7/-10.4 Ma (1-sigma; Fig. 2) with the estimated RSF, which is determined from the analyzed data of Agoult zircon and its literature age [7].

The U-Pb and Hf-W ages of A88 zircon are consistent at ca. 4530 Ma within experimental errors. This age is younger than the previous Pb-Pb age of Vaca Muerta zircon at 4563±15 Ma [2], while consistent with the Pb-Pb age of Estherville zircon at 4520±27 Ma [3]. The younger zircons in A88 and Estherville also have textual similarities, such as large anhedral shapes and contiguous appearance with metal, while the older zircons in Vaca Muerta are small euhedral grains [2]. It is likely that the zircons in A88 and Estherville formed during the late metamorphic event, perhaps there was a major thermal event at ~4530 Ma on the mesosiderite parent body.

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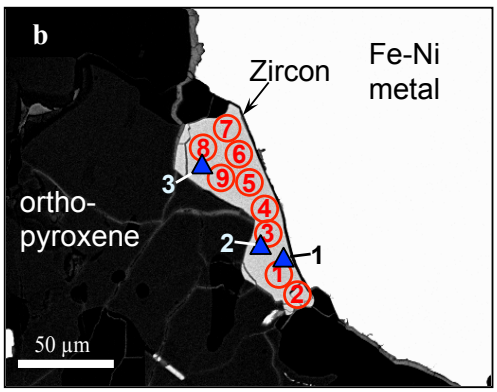

Fig. 1. BSE image of zircon in Asuka 882023, with NanoSIMS U-Pb spots# (circles) and Hf-W spots# (triangles)

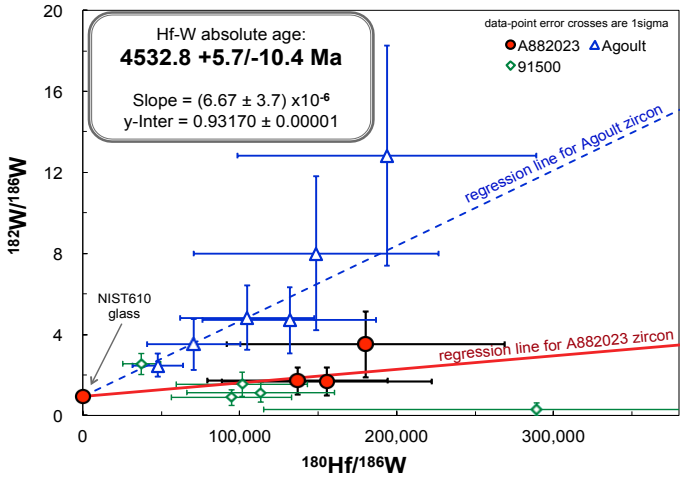

Fig. 2. Hf-W results of zircon in Agoult (opened triangle), Asuka 882023 (filled circles), and terrestrial standard 91500.