Hf-W dating of zircons from mesosiderites with high-pressure sintered sample

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Hf-W dating is a chronometer based on the decay of ^{182}Hf to stable ^{182}W with a half-life of 8.9 Myr (Vockenhuber et al., 2004). This radiometric dating method is important for discussing the timing of core formation in protoplanets and meteorites' parent bodies because hafnium is a lithophile element while tungsten is a siderophile one. In-situ analysis of Hf/W ratio on zircon ($ZrSiO_4$) mineral shows several difficulties, whereas meteoritic zircons have been often used to acquire the information of the early solar system due to their high resistance to thermal metamorphism and great aptitude for U-Th-Pb chronology. Generally, in-situ analysis needs standard materials which have well documented concentrations of target elements and the same matrix as the sample in order to avoid the change of sensitivity depending on major components (matrix effects) during an analysis using a secondary ion mass spectrometer (SIMS). There are no available standard zircons which include abundant and homogeneous tungsten because of its incompatibility with zircon crystal. Therefore, the previous studies determining the relative sensitivity factor (RSF) of Hf and W (Hf/W) for Hf-W dating of zircons using SIMS have been based on several assumptions (e.g., Ireland & Bukovanská,2003; Koike et al., 2017). These methods for measuring Hf/W ratios are indirect ways in terms of lacking standard zircons with known amount of W. In this study, we created new standard zircons which have abundant Hf and W concentrations. High purity zircon powder was mixed with hafnium and tungsten oxide. They were well crushed and mixed by a high energy ball mill and solidified by high-pressure sintering method with multi-anvil apparatus (ORANGE-3000, Geodynamics Research Center, Ehime University) in order to establish the direct way to determine the RSF of Hf/W ratio on zircons for in-situ analyses. Moreover, we applied these standards to Hf-W dating of zircons from a couple of mesosiderites with NanoSIMS (Atmosphere and Ocean Research Institute, the University of Tokyo) at approximately 30 μm scale. As a result of these analyses, we obtained the Hf-W age consistent with Koike et al. (2017) for the mesosiderite Asuka 882023.

Keywords: Hf-W dating, zircon, mesosiderite, sintering, NanoSIMS, RSF

