IN-SITU ION MICROPROBE U-PB DATING OF PHOSPHATES IN H-CHONDRITES Kentaro Terada[1] and Yuji Sano[1, 2], [1]Department of Earth and Planetary Sciences, Hiroshima University (1-3-1 Kagamiyama, Higashi-Hiroshima 739-8526, JAPAN, terada@letitbe.geol.sci.hiroshima-u.ac.jp), [2]Ocean Research Institute, the University of Tokyo (1-15-1 Minami-dai, Nakano-ku 164-8639, JAPAN).

Introduction: The U-Pb system is a useful chronometer for understanding the formation history of chondritic materials. Since the pioneering work of Patterson [1], an enormous amount of work on Pb-Pb dating of meteorites has been reported. Recently, Göpel et al. [2] have undertaken U-Pb isotopic studies of phosphates separated from equilibrated ordinary chondrites, which are the major host phase for U and are enriched by an order of magnitude or more relative to the bulk rock (typical concentrations of 0.1 - 3 ppm for phosphates). The observed Pb-Pb model ages for these phosphates range from 4.563-4.502 Ga, with an analytical precision of 1 Ma and the U-Pb system is apparently concordant. They also argued that the Pb-Pb ages of the phosphates from several H chondrites show a negative correlation versus their metamorphic grade, and concluded that the thermal processing of the equilibrated chondrites took place over a 100 Ma interval and grain size of the phosphates increases with the degree of metamorphism from 10 - 50 µm up to 200 µm in type 6 chondrites. For a better understanding of the thermal history of their parent bodies, it is important to increase the number of U-Pb ages of phosphates in various chondrites. In this study, we present results from in-situ analyses of U-Pb dating of the phosphates from three H chondrites; Y-7301 (H6), ALH-77294 (H5) and Y-74371 (H4), using SHRIMP (Sensitive High Resolution Ion MicroProbe) installed at Hiroshima University.

Analytical Method (SHRIMP): We have been working on techniques for in-situ analyses of U and Pb isotopes for apatites in terrestrial rocks, various fossils and phosphates in Martian meteorite [3, 4, 5]. These techniques take advantage of the high sensitivity of the SHRIMP at high mass resolution and are superior to the conventional TIMS analyses in the following ways: (1) a much smaller amount of sample is required, (2) the mineralogy of the phosphates and textural relationships with other minerals can be investigated, (3) after the U-Pb analysis, other elements can be measured in the same grain, and (4) assumptions about the initial lead composition are not required, because a "mineral isochron" can be provided.

About 5 nA O_2^- primary beam was focused to sputter a 20 µm diameter area on the phosphates and the positive secondary ions were extracted at 10 kV. The mass resolution is ~5800 at ^{208}Pb. The magnet was cyclically peak-stepped from mass 159 ($^{40}Ca_2{}^{31}P^{16}O_3^+$) to mass 254 ($^{238}U^{16}O^+$), including the background and all Pb isotopes, and 238 and 248 for ^{238}U and $^{232}Th^{16}O$. For phosphate analyses, significant isobaric interference were not recognized in the mass range. The $^{238}U/^{206}Pb$ ratios and elemental abundance are obtained from the observed $^{238}U^+/^{206}Pb^+$ ratios by calibration using the PRAP apatite standard, an empirical quadratic relationship between $^{206}Pb^{*+}/^{238}U^+$ and $^{238}U^{16}O^+/^{238}U^+$ ratios, and a radiometric age of 1156 Ma.

Results: The observed Tera-Wasserburg concordia-constrained linear three-dimensional isochron ages (Total Pb/U isochron age) in the $^{238}U/^{206}Pb$ - $^{207}Pb/^{206}Pb$ - $^{204}Pb/^{206}Pb$ diagram are 4554 ± 39 Ma (2 sigma) for Y-7301, 4084 ± 350Ma for ALH-77294, and 4535 ± 120 Ma for Y-74371. These are almost consistent with previous work using TIMS, although the errors of the ion microprobe analyses are larger than those done by TIMS. An important point to note is the observed isotopic composition of common lead of the three chondrites, which are obtained from the intersection of the regression line with the y-z plane in the 3-D correlation diagram. The observed common lead compositions for Y-74371 ($^{206}Pb/^{204}Pb$ = 9.4 ± 2.9 and $^{207}Pb/^{204}Pb$ = 8.8 ± 2.5) are consistent with those of Canyon Diablo Pb ratios of $^{206}Pb/^{204}Pb$ = 9.30 and $^{207}Pb/^{204}Pb$ = 10.294 (Tatsumoto et al., 1973). On the other hand, the Pb compositions for Y-7301 ($^{206}Pb/^{204}Pb$ = 18.0 ± 3.0 and $^{207}Pb/^{204}Pb$ = 14.9 ± 2.4) and ALH-77294 ($^{206}Pb/^{204}Pb$ = 17.5 ± 1.2 and $^{207}Pb/^{204}Pb$ = 16.0 ± 1.3) are obviously different from the Canyon Diablo Pb ratios, suggesting that these two chondrites have been affected by modern Pb contamination such as Antarctic ice/snow ($^{206}Pb/^{204}Pb$ = 17.0-18.3 and $^{207}Pb/^{204}Pb$ = 15.3-15.6 [7, 8]). Thus, our result implies that model ages using the Pb composition of Canyon Diablo as an initial lead might not be valid for some Antarctic meteorites. In these kinds of studies, more careful treatments are required.

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