

The Hadean environment inferred from mineral inclusions within the oldest terrestrial zircons

The Hadean environment inferred from mineral inclusions within the oldest terrestrial zircons

*山本 伸次¹、田中 大貴²、坂田 周平³、大林 秀行⁴、平田 岳史⁴、磯崎 行雄⁵、小宮 剛⁵

*Shinji Yamamoto¹, Daiki Tanaka², Shuhei Sakata³, Hideyuki Obayashi⁴, Takafumi Hirata⁴, Yukio Isozaki⁵, Tsuyoshi Komiya⁵

1. 横浜国立大学大学院環境情報研究院、2. 横浜国立大学大学院工学部、3. 学習院大学理学部、4. 東京大学理学部、5. 東京大学総合文化研究科

1. Graduate School of Environment and Information Sciences, Yokohama National University, 2. College of Engineering Science, Yokohama National University, 3. Department of Chemistry, Gakushuin University, 4. Graduate School of Science, The University of Tokyo, 5. Graduate School of Arts and Sciences, The University of Tokyo

Terrestrial rock records during Hadean era (> 4.0 Ga) are scarcely preserved due to surface erosion, subduction, and intense meteorite bombardment. Clues about conditions during this time can be deduced from detrital zircon and its mineral inclusions as old as 4.4 Ga recovered from metasedimentary rocks at Jack Hills in the Narryer Gneiss Complex, Western Australia [1-2]. Hadean zircons from Jack Hills contain various mineral inclusions such as muscovite, quartz, plagioclase, biotite, hornblende, apatite, magnetite, and biogenic carbon (graphite). Investigations of these mineral inclusions have suggested the emergence of a hydrosphere, granitic continental crust, sedimentary cycling, geo-magnetic field, and biosphere in Hadean earth [3-6]. Especially, chemistry of apatite inclusions in zircon reflects the compositions of whole rocks, thus can characterize the host magma [7]. However, the percentage of Hadean zircons to detrital zircons in Jack Hills was as small as 5% [8]. Moreover, skepticism about the preservation of such inclusions have recently raised because of secondary metamorphic overprint [9]. Owing to these reasons, large number of age analysis for zircon grains and precise identification of primary mineral inclusions must be operated to derive reliable information for Hadean earth environment. To overcome this, we have developed rapid and precise dating technique using laser ablation ICP-mass spectrometer (LA-ICP-MS). Mineral inclusions in the zircons were investigated using laser Raman microspectroscopy, equipped with high-speed Raman mapping system. Our preliminary results show that primary apatite and melt inclusions are successfully recovered from zircons of over 4.0 Ga out of 3000 checked grains. The chemistry of apatite and melt inclusions are commonly utilized to characterize host rock, missing Hadean crust. Combination of rapid U-Pb dating with LA-ICP-MS and mineral identification with laser Raman leads us to trace a missing Hadean environment from the oldest zircon of the Earth.

References

- [1] Compston, W. and Pidgeon, R.T., 1986, *Nature*, 321, 766-769. [2] Wild, S.A., Valley, J.W., Peck, W.H., and Graham, C.M., 2001, *Nature*, 409, 176-178. [3] Hopkins, M., Harrison, T.M., and Manning, C.E., 2009, *Nature*, 456, 493-49. [4] Harrison, T.M., 2009, *Annu. Rev. Earth Planet. Sci.*, 37, 479-505. [5] Bell, E.A., Boehnke, P., Harrison, T.M., and Mao W.L., 2015, *PNAS*, 112, 144158-14521. [6] Tarduno, J.A., Cottrell, R.D., Davis, W.J., Nimmo, F., and Bono, R.K., 2015, *Science*, 349, 521-524. [7] Jennings E.S., Marshcall, H.R., Hawkesworth, C.J., and Storey, C.D., 2011, *Geology*, 39, 863-866. [8] Holden, P., Lanc, P., Ireland, T.R., Harrison, T.M., Foster, J.J., and Bruce, Z., 2009, *Int. Jour. Mass Spectrometry*, 286, 53-63. [9] Rasmussen B., Fletcher, I.R., Muhling, J.R., Gregory, C.J., and Wild, S.A., 2011, *Geology*, 39, 1143-1146.

キーワード : Hadean、 zircon、 mineral inclusion

Keywords: Hadean, zircon, mineral inclusion