Hydrogen isotopic compositions of Archean mantle estimated from a 3.2 Ga gabbro

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Hydrogen isotopic evolution of mantle may tell us water-cycling through the Earth history, though δD value of ancient mantle and its evolution are still largely unknown. The δD value of present mantle (-80‰) has been estimated from MORB glasses [1], however, the basalt glass rarely occurs in Archean seaquence. In this study, hydrogen isotopic compositions of a 3.2 Ga gabbro from the Regal Formation, Western Australia were analysed by ion microprobe in order to estimate the δD value of the 3.2 Ga mantle. The Regal Formation is considered as one of the best preserved records of Archean oceanic crust based on petrological and geochemical analyses [2, 3]. Based on bulk hydrogen isotope analysis of more than 40 samples, we selected the most D-depleted gabbro sample (δD_{VSMOW} = −104‰) for the ion microprobe analysis. We found that the gabbro sample contains igneous amphibole with high-Ti content and several amphiboles occur as exsolution lamellae in diopside that seem to reflect water in Archean source mantle. The measured amphiboles show wide range of δD values from −119‰ to +37‰. Based on textural observation, the δD values of the amphiboles occured as alteration rim of pyroxene at grain boundary are relatively high (δD= −31 ~ +37 ‰). These amphiboles were likely affected by secondary fluid. On the other hand, small but a number of lamellae amphiboles show low δD values (−119 ± 20 ‰), likely reflecting δD value of original magma. Consequently, our study suggest that the 3.2 Ga mantle were depleted in deuterium in comparison to modern mantle (δD = −80‰). This may provide an important insight into hydrogen cycling in Archean mantle and its evolution.

[1] Kyser & O'Neil (1984) *GCA* **48**, 2123-2133. [2] Shibuya *et al.* (2007) *JMG* **25**, 751-767. [3] Shibuya *et al.* (2012) *EPSL* **321**, 64-73.