THE FORMATION AND THERMAL STABILITY OF WATER IN PLAGIOCLASE BY PROTON IMPLANTATION. H. Tang[1], X. D. Zeng[1,2], X. Y. Li[1], W. Yu[1], B. Mo[1], [1]Center for Lunar and Planetary Sciences, Institute of Geochemistry, Chinese Academy of Sciences, Guiyang 550081, China (e-mail for the first author: tanghong@vip.gyig.ac.cn), [2]University of Chinese Academy of Sciences, Beijing 10049, China.

Introduction: In the past decades, the moon was considered to be very dry. Until recent years, the evidence of water on the moon has been confirmed by remote detection and lunar sample analyses. Especially, remarkable absorption characters at about 3 μm and near 2.8 μm on the almost entire lunar surface have been detected by the onboard infrared spectrometers of Cassini, Deep Impact and Chandrayaan-1 missions[1-3], which indicated the presence of H_2O and OH, respectively. The widespread OH/H_2O on the lunar surface is thought to be the result from the interaction between the solar-wind proton and the oxygen in the regolith. Besides, Apollo 11 and 17 have been analysed by FTIR and SIMS. The results reveal the presence of significant amounts (~100-200ppm) of hydroxyl in agglutinitic glasses. And the hydrogen isotope compositions of some agglutinitic glasses (δD<-700‰) suggest that some of the observed hydroxyl is derived from solar wind sources (δD≈-1000‰)[4]. However, the formation mechanism, states, abundance and stability of solar wind induced water are still ambiguous. Here the formation and thermal stability of water in plagioclase by H^+ implantation will be presented.

Experiments: To simulate the process of solar wind implantation, an ion implanter (Fig.1) is used to accelerate H^+ to several keV and then implant into the samples. The experiments are performed in Center for Lunar and Planetary Sciences, Institute of Geochemistry, CAS. In the experiment, the sample is placed in a holder and implanted in the vacuum chamber. The sample chamber is evacuated and maintained under a pressure of 3×10^{-4} Pa at room temperature before implantation. Then, the plagioclase (An = 50-53) sample is irradiated with 5 keV H^+ at dose of 10^{17} ions/cm^2. For quantitative analysis of water content in the sample, doubly polished thin section has been prepared before the experiment. The thickness of the thin section is about 220 μm. The sample is baked at 120℃ for 24 hours to remove the absorbed water. We use micro-FTIR with Temperature Controlled Stages to analyse the change of water content with temperature.

Fig. 1. The ion implanter

Results: After H^+ implantation, the peak intensities of OH and H_2O in the plagioclase sample are obviously increased (Fig. 2). The absorption peak of OH and H_2O is 3621 and 3436 cm-1, respectively. The increase of water content is about 215±45 ppm.

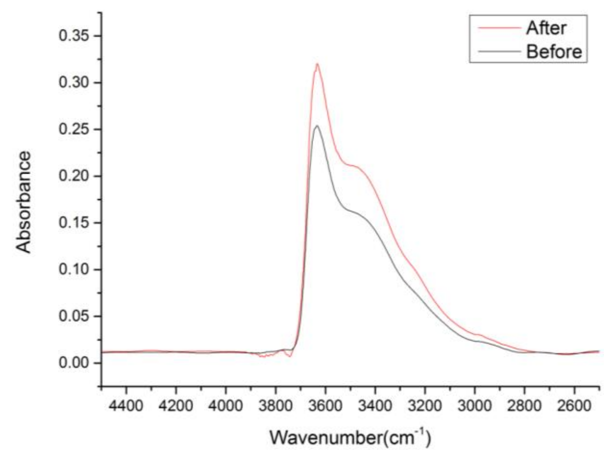

Fig.2. IR spectra of plagioclase before (black) and after (red) implanted by 10^{17} ions/cm^2 H^+.

We also analyse the thermal stability of the water with temperature in the sample after H^+ implantation. As the temperature increases, the water content decreases gradually (Fig. 3). H_2O content decreases obviously than OH content, and there is rarely H_2O content above 300℃.

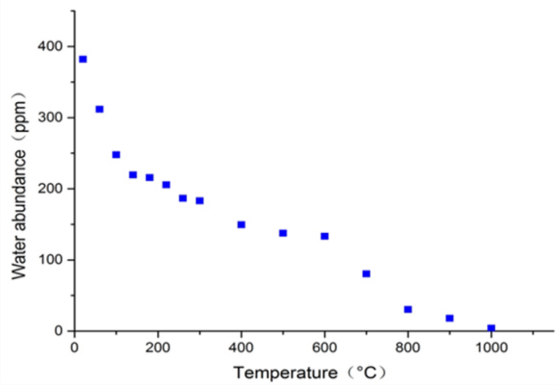

Fig. 3. water content of plagioclase after H^+ implanted in different temperatures

Conclusions: After H^+ implantation, the water content increases, which is associated with OH and H_2O, respectively. The change of water content in the plagiolcalse after H^+ implantation with temperature is obvious. The H_2O decreases fast than OH, which is consistent with the results from the recent IR exploration.

References: [1] Clark R. N. (2009) *Science*, *326*, 562-564. [2] Pieters C. M. et al. (2009) *Science*, *326*, 525-536. [3] Sunshine J. M. et al. (2009) *Science*, *326*, 565–568. [4] Liu Y. (2012) *Nature Geoscience, 5,* 779-782.